BANKING CRISES, COMPETITION, AND FINANCIAL STABILITY: EVIDENCE FROM THE MIDDLE EAST AND NORTH AFRICA (MENA)

A thesis submitted for the Degree of Doctor of Philosophy

By

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ABSTRACT

Over the last three decades, both academic researchers and regulators have extensively studied the impact of financial reforms, deregulation, and innovation in relation to financial stability and banking systems' challenges. In the Middle East and North Africa (MENA), which is one of the important economic regions in the world due to its geographic location and human and natural resources, these forces particularly come at interplay, which merits research.

Against this backdrop, this thesis examines the banking crises, competition, and financial stability throughout the MENA region. We investigate the systemic banking crises over the period 1980 to 2018 throughout the MENA region and builds a suitable Early Warning System (EWS), given its centrality for policymakers, especially after the Global Financial Crisis (GFC) of 2007-2009. This thesis proceeds to survey the MENA region's macro and financial sector, which lays bare the importance of this empirical analysis. Concertedly, it provides a coherent analysis of systemic risk and identifies the causes of banking crises which, when understood, could lead to the design of an appropriate EWS. We consider the inclusion of liquidity and unweighted capital adequacy ratios, in addition to macroeconomic variables, as crucial for regulators to strengthen their macroprudential regulatory framework and build consistent procedures in accordance with the international standards (i.e., Basel III requirements). In order to use these two explanatory variables, we construct a full dataset. The thesis manifests itself in the analysis of 732 MENA banks whose multi-sourced data led to the construction of the two main regressors for the examined period- the liquidity and the unweighted capital adequacy ratios.

Moving forward, we resort to structural and non-structural approaches to investigate banking competition in each country in the MENA region over the extended period of 1995-2018, which covers significant economic and political events in the region. Furthermore, we adopt the portmanteau approach of De-Ramon and Straughan (2016) to estimate banking competition measures, as previously used in the literature. Subsequently, the analysis compares the results in different countries over the period and assesses the trends of competition intensity. We examine convergence in bank competition across MENA countries.

Moreover, we study the relationship between concentration, competition and bank stability by using several bank competition measures, including 5-bank concentration ratio, the Herfindahl-Hirschman Index (HHI) and the Lerner index and bank risk measures such as insolvency risk (Z-score), credit risk, liquidity risk, portfolio risk, and leverage risk. Given the region's political instability and socio-economic turmoil for almost a century, we incorporate an indicator of political risk in order to assess its effect on bank stability. Investigating this effect is crucial for policymakers in this region who set monetary policies specifically to enhance financial stability and ensure macroeconomic stability. This thesis provides insights into the relationship between competition and stability in the MENA region and offers results that will help policymakers set new policies and comply with international standards.

Keywords: Systemic and non-systemic Banking crises, Early Warning Systems, Bank Competition, Convergence, Financial Stability.

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Many colleagues from the Brunel family have helped me stay sane throughout the past years. Thank you for making this journey a memorable one.

DEDICATION

To

my parents,

husband, Omar

&

children, Abdul-Rahman and Ritta

for making everything possible

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ABBREVIATIONS

AMF	Arab Monetary Fund
BIS	Bank for International Settlements
EU	European Union
EWS	Early Warning System
FinTech	Financial Technology
GCC	The Cooperation Council for the Arab States of the Gulf
GFC	Global Financial Crisis
GMM	Generalized Method of Moments
HHI	Herfindahl Hirschman Index
HI	High-income countries
IMF	International Monetary Fund
IO	Industrial Organization
LMI	Lower middle-income countries
MENA	Middle East and North Africa
NEIO	New Empirical Industrial Organization
NOP	non-oil-producing countries
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OP	Oil-producing countries
UK	United Kingdom
UMI	Upper middle-income countries
US	United States
WB	The World Bank
WTO	World Trade Organization

Chapter 1

1.1 Introduction

The impact of financial reforms, deregulation, and innovation has been a focus for academic researchers and regulators over the last three decades. These forces substantially affect the financial stability of any economy and constitute challenges for the banking systems, particularly in the Middle East and North Africa (MENA) region, which is considered one of the important economic regions in the world because of its geographic location and human and natural resources (El-Erian et al., 1996). This thesis considers banking crises, competition, and financial stability in the MENA region. Most studies in these fields have only focused on examining developed and developing economies, with limited emphasis on the MENA region. The importance and originality of this thesis rest on transcending the current literature and being the first to apply several techniques and data to investigate previously mentioned concepts of the banking sector in the MENA region.

The thesis has been organised in the following way. First, we present the research motivation and an overview of the region's macroeconomic and financial sector, which justifies the choice of the MENA region for our empirical analysis (See **Chapter 1**). Second, we present a general literature review and common theoretical concepts for all three topics (See **Chapter 2**). Third, we investigate the systemic banking crises that occurred in the Middle East and North Africa (MENA) over the period 1980-2018 (Caprio and Klingebiel, 2002; Laeven and Valencia, 2008, 2013 and 2018) in order to build a suitable Early Warning System (EWS) (See **Chapter 3**). Here the thesis aims to provide a coherent analysis of systemic risk. It identifies the causes of banking crises which, when understood, could lead to the design of an appropriate EWS.

In the new global economy, designing an EWS appears to be a central issue for policymakers, especially after the Global Financial Crisis (GFC) 2007-2009. Several studies have revealed the importance of EWS to regulators. Notably, we consider the inclusion of liquidity and capital adequacy ratios in addition to macroeconomic variables as a crucial step by which regulators can strengthen their macro-prudential regulatory framework and build consistent procedures following the international standards (i.e., Basel III requirements). In order to use these two explanatory variables, we had to construct a full dataset. Therefore, we analysed 732 banks operating in the region and gathered data from different sources to construct the two main regressors for the examined period. We conclude that the most critical banking crisis determinants for the MENA region were GDP growth, GDP per capita and the liquidity and capital adequacy ratios, which all have an inverse relationship with the probability of a systemic banking crisis, while the government budget balance to GDP and inflation was positively correlated with the likelihood. Various robustness checks were used to ensure sound justification for the relationship that we found between the variables. We ran the model with different definitions of the systemic banking crisis and checked whether they would yield consistent results. Moreover, we tested the out-of-sample performance of the binomial logit model. We also engaged these results in building the EWS, which may play an essential role in the structural financial reforms pursued by financial regulators and central banks in the region.

In **Chapter 4**, we applied structural and non-structural approaches to investigate the banking competition in each country in the MENA region, as well as the region as a whole, over the extended period of 1995-2018. Our broad dataset covers a period of significant economic and political events in the region. Furthermore, we adopted the portmanteau approach of De-Ramon and Straughan (2016) in estimating all the banking competition measures previously used in the literature. We compared the results in different countries over the period and assessed the trends of competition intensity. Furthermore, we examine the convergence in bank competition across MENA countries. Our study has provided sufficient evidence that there are variations in bank competition intensity across countries. In general, the banking sectors in the MENA region are highly concentrated according to the 5-bank concentration ratio, moderately concentrated marketplace following the classification of the HHI, neither perfectly competitive nor monopolistic according to the mean and median Lerner index results. The region has monopolistic competition, as the Panzar-Rosse H-statistic calls it; the Boone indicator shows a slightly negative value, but this does not betoken a perfectly competitive condition.

In **Chapter 5**, we focused on studying the relationship between concentration, competition and bank stability by using several competition measures (a 5-bank concentration ratio, the Herfindahl-Hirschman Index (HHI) and the Lerner index) of the MENA region and bank risk measures (Insolvency risk (Z-score), credit risk, liquidity risk, portfolio risk and leverage risk). Furthermore, because the region has suffered from political instability and socio-economic turmoil for almost a century, we included in the model an indicator of political risk in order to assess its effect on bank stability. Investigating this effect is crucial for the policymakers in this region who set monetary policies specifically to enhance financial stability and ensure macroeconomic stability. Thus, we hope to provide insights into the relationship between competition and stability in the MENA region and offer results that will help policymakers set new policies and comply with international standards.

The results show that the concentration ratio and Lerner index are significantly negative, which suggests that, except for the credit risk results, bank risk, including the different risk exposures with various risk measures, reduces with greater concentration and market power. Regarding the control variables, the capital adequacy ratio and deposit insurance are negatively correlated with the banks risk measures, indicating that an increased capital adequacy ratio and the existence of deposit insurance play an essential role in mitigating bank risk-taking, which is consistent with the empirical literature and complies with international regulatory actions. The size of a bank and the ratio of net loans to total assets are only positively significant for the liquidity risk. These findings are consistent with those of Beck (2008) and Laeven et al. (2016). Cornett et al. (2011) claim that banks may tend to hold more liquid assets to overcome any monetary shocks that could affect their loan portfolio. The supervisory power is positively correlated with insolvency and leverage risk. In contrast to the findings of Al-Shboul et al. (2020) that large banks in the MENA have lower levels of risk, the political risk indicator is significant at the 10 percent level, indicating that the higher the value of the International Country Risk Guide (ICRG) political risk indicator (meaning the lower the degree of political risk) the lower the liquidity risk. Overall, our findings indicate that banks are more stable in a more concentrated and less competitive environment. Lastly, we summarise the thesis's main empirical findings and discuss the policy implications of the research (See **Chapter 6**).

1.2 Research motivation – Choice of Sample

1.2.1 Overview

In the global economy, financial stability is a central issue for regulators and many researchers. It is vital for economic growth because most transactions in the real economy are made through the financial system. A key role of any central bank worldwide is to ensure financial stability through conducting monetary policy. It is necessary here to clarify exactly what is meant by financial stability because it has numerous definitions. The most common definition involves the absence of system-wide episodes in which the financial system fails to operate (crises) and the resilience of financial systems to avert potential stress (World Bank, 2012). Traditionally, financial stability has been assessed by measuring its absence on the occasions of financial instability. Davis (2002, p.2.) defined financial instability as "*a major collapse of the financial system, entailing inability to provide payments services or allocate credit to productive investment opportunities". During instability periods, financial institutions are reluctant to provide credit facilities, asset prices drop excessively, and instalments (payments) may not be covered when due. Hence, it heightens the probability of bank runs, hyperinflation, or collapse of the stock market and severely affects confidence in the financial system.

The existing literature on financial stability is extensive and focuses mainly on measuring it by using real episodes of a banking crisis or Z-scores as a proxy. The relevant empirical literature has been devoted to developed countries, particularly after the Global Financial Crisis 2007-2009, and too little attention has been paid to investigating the situation in the MENA region.

This thesis aims to contribute to this growing area of research by exploring the MENA region from different perspectives. First, we investigate the systemic banking crises that have occurred in the Middle East and North Africa (MENA), since the region experienced costly banking crises during the 1980s and 2000s (Caprio and Klingebiel, 2002; Laeven and Valencia, 2008, 2013 and 2018) in order to build a suitable Early Warning System (EWS). This is an element of financial stability that has been used in several economies to monitor the financial system and provide warnings of a potential banking crisis. We have managed to design an EWS and determine the leading indicators of systemic banking crises that have occurred in the MENA region (see **Chapter 3**).

Second, we further our analysis to improve our understanding of the market structure in the region. Coccorese (2017) points out that a competitive environment in the banking industry may have several advantages[1] that boost savings and investments and enhance the financial system's stability. Therefore, we assess and measure the competition and/or market power of the banking industry. Our analysis complements and extends previous empirical studies on this issue by being the first to apply structural and non-structural approaches to banking competition in each country in the MENA region as well as the whole region over the extended period of 1995-2018. Our broad dataset covers a period of significant economic and political events in the region. Furthermore, we adopt the portmanteau approach of De-Ramon and Straughan (2016) in estimating all the banking competition measures previously used in the literature. Subsequently, we compare the results in different countries over the period and assess the trends of competition intensity. We classify our results by country and then by region. Next, we adopt the World Bank's country classification by income: lower middle income (Egypt, Iraq, and Morocco), upper-middle (Algeria, Iran, Jordan, Lebanon, Tunisia, and Turkey), and high (Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates). We also divide the region into oil-producing countries (Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, and Oman) and others (Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, and Israel). To further our analysis, we have investigated the region's convergence with regard to bank competition (see **Chapter 4**).

Third, we used several bank concentration and competition measures, as calculated in **Chapter 4,** to investigate the relationship between competition and financial stability. **Chapter 5** presents novel evidence by exclusively focusing on the MENA region by employing the bank risk measures (Insolvency risk (Z-score), credit risk, liquidity risk, portfolio risk, and leverage risk). Furthermore, because the region has suffered from political instability and socio-economic turmoil for almost a century, we include an indicator of political risk in the model to assess its effect on bank stability.

[1] More pressure on prices; decreased lending rates for borrowers (deficit units), increased deposit rates for lenders (surplus unites), easy access to finance leading to private sector development, capital accumulation, households' welfare, and economic growth (Coccorese, 2017).

Investigating this effect is crucial for policymakers in this region who set monetary policies specifically to enhance financial stability and ensure macroeconomic stability.

Before proceeding to investigate the systemic banking crises, competition and financial stability, it is important to present an overview of the MENA region's macroeconomic and financial sector, which justifies the choice of the MENA region for our empirical analysis. Many of the variables presented in the following sections are used in our regression models.

1.2.2 Background

The MENA region is considered one of the world's important economic regions because of its geographic location and human and natural resources (El-Erian et al., 1996)[2]. It has the most substantial proportion of world petroleum production and exports and contains about 70 percent of the world's oil reserves and 50 percent of its gas reserves (AMF, 2015). Since the 1990s, MENA's exports to GDP ratio have exceeded the world average because of its petroleum exports (Behar and Freund, 2011). In 2018, the leading oil exporters in the MENA region were Saudi Arabia (the world's largest producer) with 8.8 percent, Iraq 3.6 percent, United Arab Emirates 3.5 percent, Iran 3.36 percent, Qatar 2.8 percent and Kuwait 2.5 percent of global exports (AMF, 2019). Thus, the MENA region has historically produced about a third of the world's oil (Forbes, 2020). Moreover, according to OPEC (2019), most of OPEC's oil reserves are in the Middle East, 64.5 percent of the OPEC total.

Their vast natural resources constitute a high proportion of some countries' GDP. For instance, hydrocarbon production accounts for 37 percent of the GDP in Algeria. Cotton, iron, ore, and phosphate are MENA's significant exports. Morocco has most of the world's phosphate reserves, approximately 70 percent, and alone provides 30 percent of the global demand. The service sector and tourism play vital roles in the economic growth of the MENA. On average, the MENA region has a reasonable standard of living compared to other regions; its GDP per capita in 2018 was 8,043 USD. However, the standard of living within the region varies widely: GDP per capita in 2018 ranged from around 69,027 USD for Qatar to 944 USD for Yemen. The oil-producing countries generally have the highest GDP per capita in the region. MENA holds around 7.7 percent of the world's population but shows rapid population growth. Each country in the region is economically, socially, and politically highly diverse.

However, intraregional interaction is fragile, and this affects labour flows and trade in goods and services. Behar and Freund (2011) mention that the MENA region fails to take advantage of global

[2] IMF Publication.

trade integration because of the restrictiveness[3] of the trade regimes in most of the countries in the region.

In the next few years, the economy of MENA will be inclined to grow dramatically (Gurria, 2016)[4] due to the projects of investment in renewable energies, which inevitably will be funded by the banking sector and have the potential to be an essential economic activity. Moreover, some MENA countries[5] are setting new environmental policies[6] to promote green growth. According to OECD (2013), solar and wind energy in the MENA region is considered among the world's greatest. Therefore, supporting investments in this area will contribute to economic growth and create more jobs; the financial intermediaries involved will be dominant players in funding these projects (OECD, 2016). It should straightaway be clarified, in view of what has been said so far, that financial stability in the MENA region needs to be improved because many countries around the world are economically dependent on it, and it is a dominant provider of natural resources.

1.2.2.a MENA – definition, sample and importance

The selection of the MENA region as our sample was made according to the World Bank (WB) and International Monetary Fund (IMF) classifications. It is the area from the Atlantic coast of Africa to the frontiers of Pakistan and Afghanistan in Central Asia and from the Mediterranean coast to the southern borders of the Sahara Desert. It includes members of the Arab League, the Islamic Republic of Iran, Turkey[7] and Israel, and has a population of 381 million, representing 7.7 percent of the world's total. The MENA region is economically significant due to its geographic location, size, population and the richness of its natural resources. Studies on the MENA region may be of interest to other developed and developing countries for a range of purposes, such as investments, cross-sectional comparison of economic activities and trade interrelationships.

MENA's geographic location in the middle of the world's greatest landmass and vast natural resources has attracted other economies to implement investment projects there. Most of its countries are working to identify new sources of non-oil revenue. Moreover, they have dual banking systems, Islamic and conventional banks, to satisfy the needs of all their customers. Abed and Davoodi (2003) list several reasons for the MENA's weak economic performance: the trade-off between the increase of population

[2] High and complex tariffs, barriers to intra-Arab trade, high logistical costs, and insufficient skills.
[4] Angel Gurria, OECD Secretary-General.
[5] Morocco, Tunisia, Jordan, Egypt and the United Arab Emirates.
[6] For instance, the Jordan Clean Energy Investment Policy Review.
[7] Due to its solid socio-political connections with the Middle East, Turkey was included in the sample. Moreover, Turkey was within the samples of several studies concerning the MENA. For instance, "The Length and Cost of Banking Crises" by Frydl (1999) includes Turkey within the MENA sample.

growth and low productivity, limited implementation of institutional and political reforms, the control of most of the vital industries by the public sector, inefficiency of the educational system, the absence of well-developed financial markets, and high trade restrictiveness. Moreover, the Dutch disease[8] - natural resources crowd out other sectors (Nabil and Arezki, 2012). In 2015, the International Finance Corporation (IFC) and the Arab Monetary Fund (AMF)[9] pointed out the significant challenges to the financial systems in the MENA region. Notably, these challenges are the increased unemployment rate, high restrictions on access to finance, the postponement of policy reforms, and weak regulatory systems, especially regarding corporate governance.

1.2.2.b MENA- macro context

Evidence attests that macroeconomic variables are associated with an increased probability of systemic banking crises in a number of economies. MENA is not an exception; we found that GDP growth, inflation, GDP per capita and government budget balance to GDP, in addition to banking sector indicators, are leading indicators for the systemic banking crises in the region. Therefore, in this section, we take a closer look at the economic performance of the MENA region and present an overview of the macroeconomic variables over the last four decades.

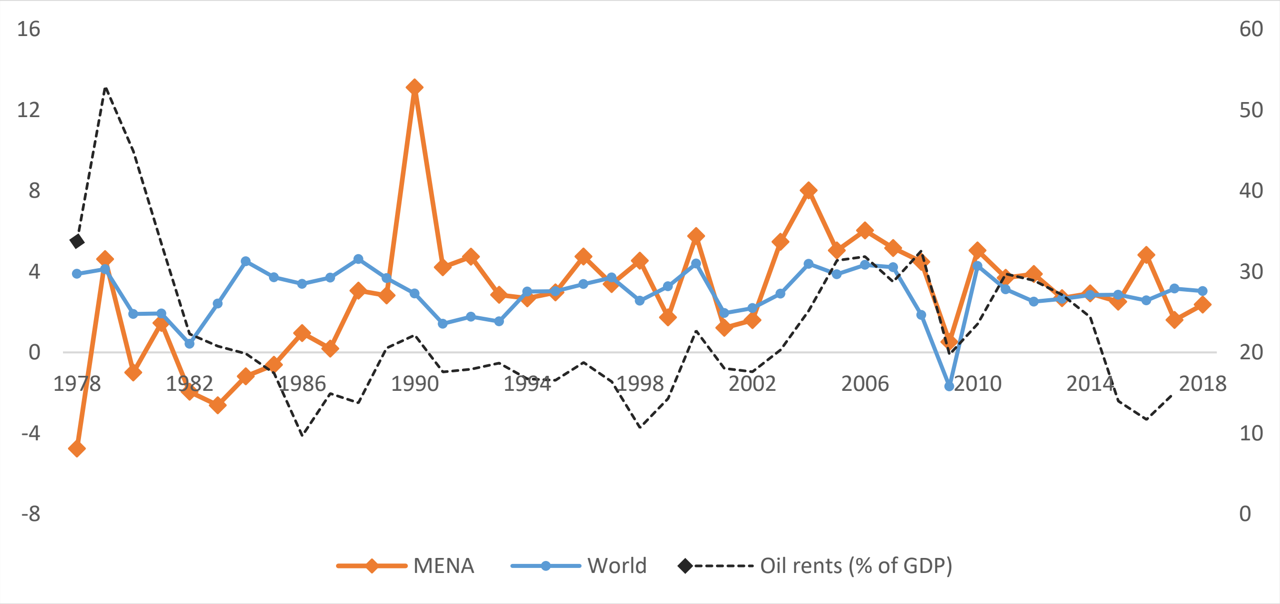
Historically, global economic growth has varied due to the volatility of oil prices, financial crises, political events, trade factors, fiscal concerns and industrial production. For the MENA region, the prospects of economic growth in the coming years are among the most significant challenges. One way to overcome any economic obstacle is by implementing structural financial reforms. In this matter, the existence of the Arab Monetary Fund (AMF) can play a significant role in spreading the appropriate rules and regulations around the region.

According to recent data, the International Monetary Fund (IMF) and the World Bank (WB) have done extensive research to assess the economic situation in the MENA region. They reached the consensus that, despite the civil wars in several countries, economic growth in 2018 was expected to be 2 percent on average and was forecast to rise modestly. This growth was due to the slight effect of financial reforms, the stabilisation policies applied in many countries and the effect of oil price volatility. Unfortunately, the projections of macroeconomic variables presented in the IMF regional economic outlook of 2019 have put the region in a very critical situation unless it takes immediate steps.

[8] The Dutch disease refers to an economic phenomenon where the rapid development/discovery (particularly natural resources)/ changes in the strcutre of production of one sector negatively affect other sectors in the economy (See Brahmbhatt et al., 2010; Nabil and Arezki, 2012).
[9] See AMF (2015).

The countries in the MENA show a significant disparity in, for instance, economic and population size, natural resources, trade transactions, public/private sector balances, political transformations, and financial systems. All these factors affect the economic development of the region and contribute to economic growth.

Figure 1.1: GDP growth rate (%) for the world and the MENA region from 1978 to 2018



Source: World Development Indicators, World Bank

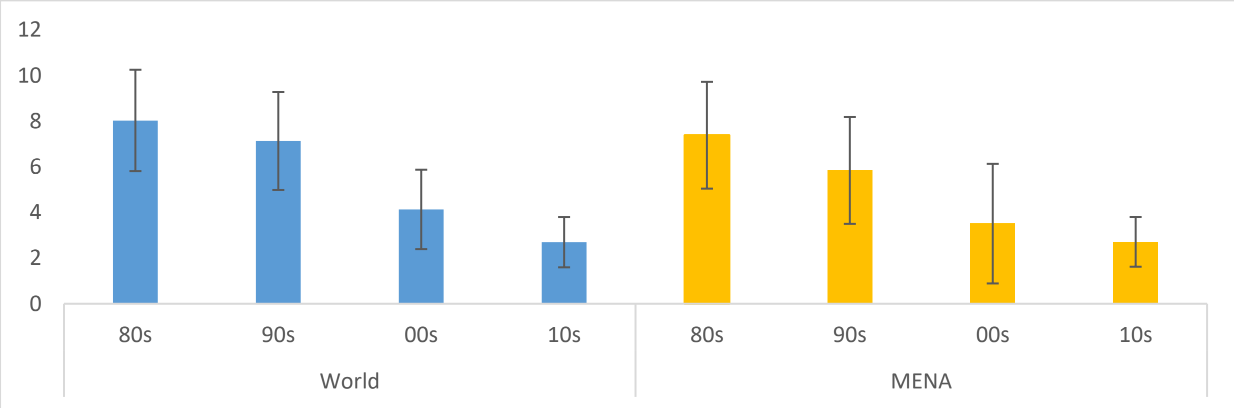
Figure 1.1 shows a general comparison of GDP growth between the world and the MENA region from 1978 to 2018. The pattern is nearly the same, as can be clearly seen in the figure, but whenever the MENA exceeded the world indicator during this period, it was due to the increase and volatility in oil prices. It is well-known that oil prices are the primary driver of GDP growth in the MENA indicator. The spike in 1990[10] is an example of the effect of oil prices on this GDP growth, for crude oil prices increased to more than 111 percent at the time. Abed and Davoodi (2003) comment that the increase in oil prices has benefited the oil-producing countries immensely, and the benefit has spread to non-oil producing countries in the region by the appreciation of workers' remittances, capital flows and trade.

The academic literature on economic growth reveals the effect of a stable and developing financial system on increasing the level of economic growth in a country and a region. Naceur and Ghazouani (2007) used a sample of 11 MENA region countries to examine the relationship between financial development and economic growth. They summarised the financial development procedures using the surveys provided by Pagano (1993) and Levine (1997): financial intermediaries lower the costs of gathering and processing information and improve resource allocation. Second, banks are encouraged

[10] During the Gulf War.

to exert corporate governance that can reduce credit rationing[11]. Third, countries benefit from the financial intermediaries who have the expertise to minimise risks by diversifying and repackaging portfolios. Finally, customers' needs are met by various financial services and products introduced by the banks.

Figure 1.2: Inflation rate (%) for the world and the MENA region from 1978 to 2018



Source: World Development Indicators, World Bank

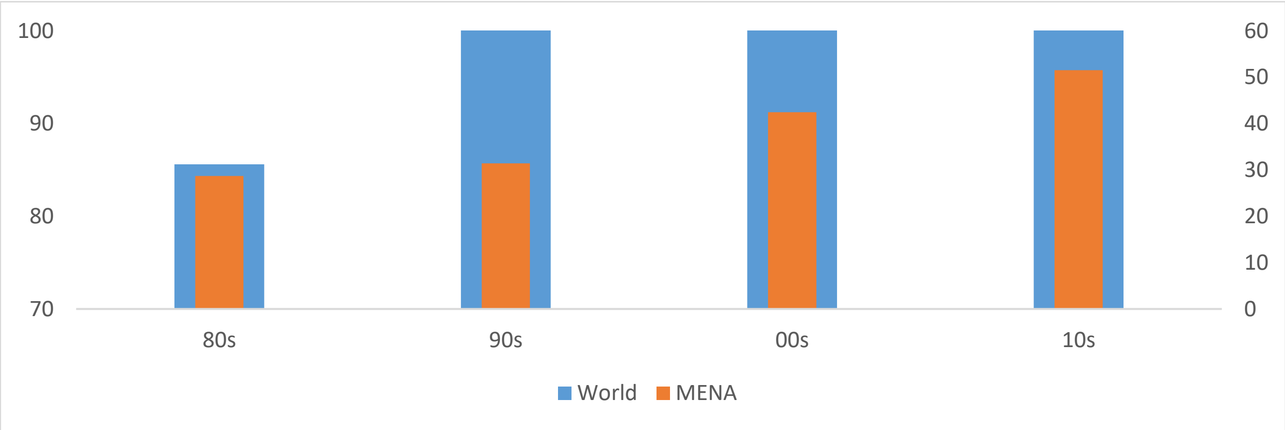
In Figure 1.2, a clear trend over the last four decades shows declining inflation around the world, to which the MENA was no exception. On average, the highest world inflation rate was around 8 percent and for the MENA was 7 percent. The greatest difference between the world and the MENA inflation rates appeared during the 2000s when the world inflation rate was highly variable. El-Erian et al. (1996) traced the inflation rate in the MENA region during the 80s and 90s. They found that oil-producing countries that set a tighter monetary policy usually have a lower inflation rate than non-oil producing countries, except at the beginning of the 1990s, when the opposite occurred. Strengthening fiscal and monetary policies has helped some MENA countries, for instance, Egypt and Tunisia, to reduce their inflation rate significantly.

Ghazouni and Naceur (2004) found an inverse relationship in the MENA region between inflation and the performance of the financial sector[12], but with no evidence of the thresholds levels. Similarly, Huybens and Smith (1999) argued that the consequences of the negative effect start with credit market frictions, which then adversely influence economic growth. Put differently, high levels of inflation increase credit rationing that diminishes intermediary transactions and capital formation, hence a downturn in long-run financial activities.

[11] Credit Rationing is "*a situation in which lenders are unwilling to advance additional funds to borrowers at the prevailing market interest rate*" (See Calomiris, C.W. and Longhofer, S.D., 2008. pg.8).
[12] Stock markets and banking sector developments.

Up to now, various MENA resources have not been fully exploited due to major drawbacks in different sectors, for instance, countries in the region have failed to create jobs to absorb the expansion of work force, lack of economic inclusiveness, limited economic diversification[13] and operating banks have been heavily engaged in sovereign lending (Naceur et al., 2014). Nabil and Arezki (2012) mention that macroeconomic volatility negatively affects economic growth in the MENA region, particularly in saving/investment decisions. Figures (1.3) and (1.4) below compare data on the world's and the MENA's domestic credit and savings trade-off.

Figure 1.3: Domestic credit to the private sector (% of GDP) for the world and the MENA region from 1978 to 2018

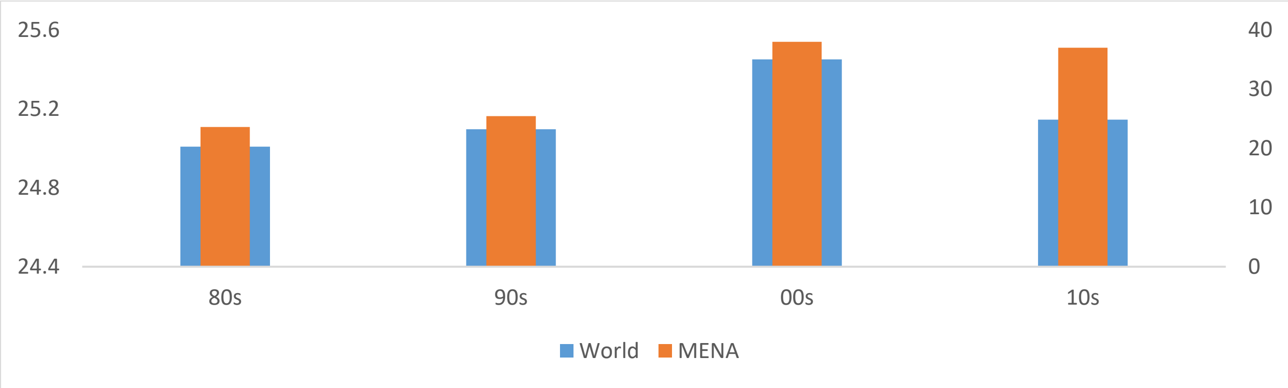


Source: World Development Indicators, World Bank

Although the ratio between domestic credit to the private sector and GDP appears to be an insignificant indicator in our model, it is worth comparing it with the world ratio and checking its trend during the examined period because any sharp rise in this ratio without proper monitoring and supervision can increase the non-performing loans in the banking system. Figure 1.3 shows that the ratio between domestic credit to the private sector and GDP in the MENA is lower than the world ratio throughout the whole period examined. This indicator refers to the size of financial resources provided by the banks to meet the demand for credit to fund the investment and entrepreneurial projects that can boost the economy and gives a clear view of financial sector performance. For the past 40 years, the world's indicator has increased by 54.2 percent, but in the MENA region, this has increased by only 31 percent. This suggests that the MENA economies use only limited financial resources to fund firms, as we will present in the next subsection.

[13] See Nabil and Arezki (2012).

Figure 1.4: Gross domestic savings (% of GDP) for the world and the MENA region from 1978 to 2018



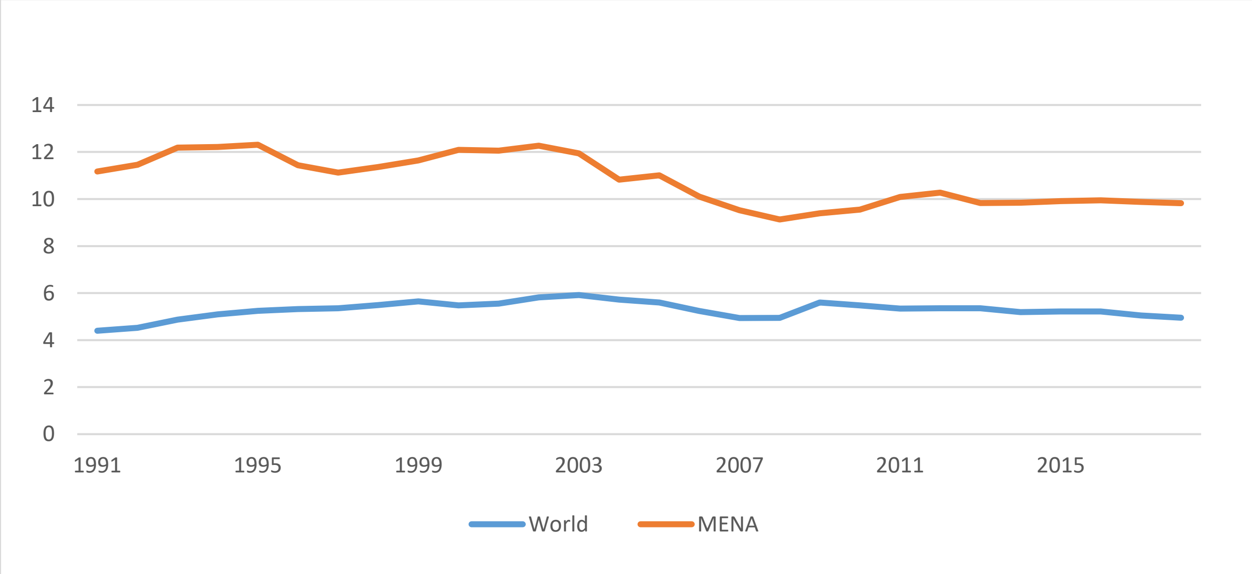
Source: World Development Indicators, World Bank

To complete the picture, we introduce the ratio of domestic savings to GDP. As shown in Figure 1.4, this ratio had been growing around the world and the MENA region until the 2000s. Afterwards, the world indicator declined as far as 25 percent, whereas the MENA countries tended to maintain their ratio of 37 percent. It can be concluded that the MENA economies do not use this high level of liquidity efficiently to fund projects. One more point worth noting is that households and firms tend to save more because of their limited investment opportunities and the absence of well-developed financial markets. Naceur et al. (2014) indeed maintain that there is a positive relationship between savings and the demand for financial services[14].

Based on World Bank (2004) statistics, the MENA's total labour force expanded from 104 million workers in 2000 to approximately 146 million in 2010; it is expected to reach 185 million by 2020. However, the governments of this region have not taken advantage of the expansion of the labour force to create more jobs. Thus, the region has registered a higher unemployment rate than any region in the World (Nabil and Arezki, 2012).

[14] The higher saving rate tends to increase the flow of capital to the stock market.

Figure 1.5: Unemployment rate (% of total labour force) for the world and the MENA region from 1978 to 2018



Source: World Development Indicators, World Bank

As clearly shown in Figure 1.5, a wide gap separates the world's and the MENA's unemployment rates from 1991 to 2018. The competitive advantage of the MENA region lies in its young populations, whose average median age is 25 years. It is considered a tremendous opportunity to benefit the economy by putting the abilities of the working population to use and promoting entrepreneurial activities, thus freeing up resources for investment. Abed and Davoodi (2003) report that the employment rate in the MENA region has been growing. However, the effect of the rapid population growth is that a massive number of young job seekers cannot be employed due to the limited capacity of the market to absorb them. Exploiting such an opportunity could boost economic growth in the region. Following World Bank recommendations, the future of the MENA region depends on the efficiency with which its potential resources, human and economic, can be released and used. Acemoglu (2001) argued that financial constraints adversely affect employment in any economy since they prevent the arrival of innovative firms that create new jobs.

Gatti et al. (2012) found that financial variables (particularly decreased banking concentration) can be used to reduce the unemployment rate, but it depends on the labour market context. Thus, whenever the market has a low level of labour regulation, union density and wage bargaining coordination, regulators should promote market-based finance. The increase of intermediated credit[15] and banking concentration is beneficial for employment only when the labour regulation level is strong. From another perspective,

[15] Gatti et al. (2012) find that when workers are protected by their unions, firms are pushed to boost their productivity and monitoring by financial institutions becomes profitable, thus enhancing intermediated credit to favour employment.

Abed and Davoodi (2003) note that the growth of total factor productivity in the MENA region is low; this refers to the growth associated with the efficient use of physical capital and labour as production factors.

In view of all the above evidence, the economic performance of the MENA region is clearly below its potential. Thus, the MENA economies need to evaluate the trends of the macroeconomic variables described previously to assess the advantages and disadvantages of each of them for the economy.

1.2.2.c MENA – the financial sector

According to the Arab Monetary Fund (AMF), financial stability is crucial. In the last three decades, all the countries in the MENA region have been working on financial reform programmes and focusing on financial inclusion so as to encourage everyone to use a range of financial services. As part of this effort, the MENA countries are trying to raise their levels of competition, employment creation, and income.

During the mid-1980s, after a period of critical economic situations, many of the MENA countries started to stabilise their economies, as was discussed in the previous subsection. For instance, they tolerated high inflation rates, budget deficits, depreciation in exchange rates, public ownership of the financial institutions and unstructured monetary policies. Not only these adverse conditions but others also played a significant role in the process of banking crises in this region, which we discuss in presenting our results. In this regard, restructuring the monetary system that has a market orientation[16] was the priority for the MENA countries, especially Egypt, Jordan, Yemen, Tunisia, Algeria, Morocco, and Mauritania (Elsafti, 2007). Lee (2002) indicated that only since the 1990s countries in the MENA region have begun to reform their financial systems to be more attractive to all market participants. Creane et al. (2004) assessed the reformed financial sectors in the MENA countries. They found that the region was performing well as a group precisely in financial openness, financial regulations, and supervision, although their degree of financial development varied.

Banks in both their Islamic and conventional forms are a dominant element in the financial landscape of the MENA countries. In a comprehensive study of the region's banking industry, the AMF (2015) reports that banks' assets form 130 percent of GDP for the GCC countries, 145 percent for the high-income countries and 120 percent for the non-GCC countries. The countries in this region are significantly different from each other; each has its individual economic structure and policies. Most of the banks in Egypt, Lebanon, Yemen, Morocco, Tunisia, and Jordan are private, whereas those in

[16] A market orientation refers to the identification of the needs of customers and the creation of products and services that satisfy them.

Algeria, Syria, Iraq and Libya are state-owned. The banks are the primary source of external funding since the credit supplied by them reached 60 percent of the GDP for households and corporations. In total, credit for the private sector reached 41 percent of GDP, but it varies across countries; it is 14.5 percent in Algeria, 29.1 percent in Egypt and 5.1 percent in Yemen.

In terms of bank lending, some countries depend on the available liquidity to fund public sector projects at preferential rates and fund government debt. On average, the credit to the private sector as a percentage of GDP is 41 percent for the region; many countries have lower percentages, such as Algeria (14.5 percent) and Egypt (29.1 percent). In the case of the loan-to-deposit ratio, Lebanon has the lowest ratio compared to other economies in the region with 38 percent. Tunisia and Morocco exhibit high loan-to-deposit ratios that exceeded 100 percent. However, the banking sectors of Tunisia and Morocco have a critical position in terms of liquidity due to the difficulties in matching the rapid growth of loans with adequate growth of deposits. This dilemma obliges both countries to find various sources of financing, such as issuing bonds.

During and after the political uprising in 2010, banks in Egypt and Tunisia were exposed to a significant drop in their operations, leading to an increase in the non-performing loans that reached 14 percent of total loans in Tunisia and 9.5 percent in Egypt (AMF, 2015). Notably, evidence shows that the non-performing loans in many MENA countries were between 10 and 20 percent of total loans from 2001 to 2003 (Creane et al., 2004). It should be emphasised that the increase of non-performing loans can significantly affect a bank's capital, a fact which we include in our model. Naceur and Kandil (2013) study the impact of the Basel I Accord implementation on credit availability in the MENA region. They point out that the surge in oil prices during the political uprisings significantly affected the region's GDP growth rates, which had been among the highest in the world. Consequently, excessive liquidity and capital inflows in the financial system ensued. Non-GCC countries, too, have made progress in strengthening their banking system through restructuring public banks and adopting Basel I capital requirements. However, it is still not enough to have a robust banking system compared to other countries.

The sophistication and the development of the banking sector in each country vary considerably. The banking sector in the countries of the Gulf Corporation Council (GCC) is considered well developed, efficient and capable of using advanced technology. Over the past two decades, GCC countries have enhanced their banking systems to adapt to recent IMF and World Bank recommendations to increase competition and open up their financial systems. Ben Naceur et al. (2007) point out that most Middle Eastern countries and other emerging economies develop their financial sector by applying structural adjustment programmes and economic reforms. With this in mind, the International Financial System became more interested in investing in stock markets in the MENA region. In 1990, the value of trade for emerging markets was 613 billion dollars, increasing significantly to 2,867 billion dollars in 1999. Yu et al. (2008) demonstrated that twenty international and regional funds were investing in equity markets in the MENA region in 1997. Morocco and Egypt encouraged foreign investors by allowing unrestricted access to their stock markets. Jordan has allowed them to have a 50 percent maximum proportion of ownership in a company's capital. The situation was not the same for the countries of the Gulf Cooperation Council (GCC), which put restrictions on foreign investors. Overall, all these efforts in enhancing the financial markets of the MENA region play a significant role in injecting liquidity and capital flow in the banking sector.

Concerning the relationship between ownership structure and risk-taking, there is considerable debate about the relationship between state-owned banks and the level of risk-taking in credit and liquidity risk. In a study by Lassoued et al. (2016), it was shown that banks operating in the MENA region had changed their ownership structure following the privatisation of state-owned banks and the presence of foreign owners in the last two decades. They used the Z-score as a measurement of banking risk-taking. Moreover, in their check for robustness, they included earnings volatility, loss loan provision ratio, and capital adequacy ratio as banking risk-taking measurements. Using all of the previously mentioned banking risk-taking measurements, they found a positive relationship with risk-taking among state-owned banks before 2008. In comparison, banks under foreign ownership showed a negative correlation. However, since 2008, the relationship has changed, and the impact of ownership structure on risk is negative, no matter what the structure of ownership is. Srairi (2013) found that when the state-owned banks pursue higher risk, it results in increasing the proportion of non-performing loans. From another perspective, because the MENA region has two financial systems (conventional and Islamic), Srairi (2013) concentrates on comparing the risk-taking strategy of conventional and Islamic banks in the MENA region and indicates that the ownership structure is not a significant indicator for differentiating them.

The financial systems in question experienced mixed effects from a high level of concentration, little competition, skilled personnel and the independence of the central banks, government intervention in credit allocation with preferential rates to the public sector, and high barriers to entry (Elsafti, 2007). Apergis and Polemis (2016) evaluated the banking sector of the MENA region in order to check the relationship between competition and efficiency. The results are consistent with the current literature[17] that banking competition across the MENA region is likely to be monopolistic competition. Its magnitude varies from country to country. Anzoategui et al. (2010) found that the banking sectors in the MENA region were less competitive than in other regions due to a worse credit information

[17] For the literature about banking competition in the MENA region, see the next chapter, which contains detailed research, using different methods, about its banking competition and performance.

environment among banks and strict regulations on banks' entry and access to finance. Apergis and Polemis (2016) found that the average cost efficiency is considered very high in the MENA countries compared to other regions due to the lack of diversification. According to World Bank statistics and Rocha (2011), the loan concentration ratio is higher in the MENA region than in any other economy in the world as banks focus on funding large and well-connected enterprises. It is calculated by the ratio of the highest 20 exposures to total equity, which means that a significant part of lending goes to large enterprises. Unfortunately, the average share lending to small and medium-sized enterprises is less than 8 percent of total lending; in the GCC economies, it is 2 percent, and in their non-GCC counterparts, it reaches 13 percent (AMF, 2015).

As a result of globalisation and financial innovation, the effect of a financial crisis can cross borders and spread quickly to different economies around the world. Several studies, however, indicate that the countries in the MENA region were less affected than countries elsewhere by the global financial crisis (GFC) 2007-2009. This was not due to their robust financial system but to their limited exposure to the collapse of equity and commodity prices (Sahut and Mili, 2011). Neaime (2012) highlights the effects of the global financial crisis in the MENA region as mainly a drop in some stock markets and GDP growth rates in the region, especially those in Egypt, Morocco, Jordan, and the United Arab Emirates (UAE) due to their strong links with other international financial markets and high exposure to EU/US banks. After less than a decade of the GFC, the IMF (2014) reports that the emerging markets are much more susceptible to shocks from advanced economies due to the increase of investment linkages and the synchronisation of asset price fluctuations.

CHAPTER 2

Literature Review

2.1 Introduction

This chapter outlines the existing theoretical and empirical literature related to systemic risk, competition, and financial stability, which is a key background for the rest of the thesis.

2.2 Financial Stability and Systemic risk

The impact of financial liberalisation, deregulation, and innovation has been a focus for academic researchers and regulators over the last three decades. These forces substantially affect the financial stability of any economy and constitute challenges for the banking systems, especially in risk management. Sahajwala and Van den Bergh (2000) emphasised that, in response to these trends, regulators have constructed new methods in an effort to improve the quality of bank monitoring processes and examinations and to identify adverse changes in a bank's condition at an earlier stage. They added that these new methods had been used to assess banks' financial performance and the risk profile of individual financial institutions. The early warning system (EWS) is one of these new methods. Inevitably, the recent global financial crisis has stimulated supervisors to update their EWS in step with the new challenges. Thus, the setting of regulations to include risk-based supervision has expanded in an attempt to control the various risks that have emerged in the markets. The IMF (2014) highlights that, after six years of the GFC, regulators now depend heavily on accommodative monetary policies to restore economies. However, the IMF has exposed a critical dilemma of the trade-off between strengthening the economies by encouraging households and businesses to increase their investments and drawing attention to the downside of increasing the risk to financial stability. This underlines the need to put more effort into establishing well-designed macroprudential measures which can maintain financial stability and control risk-taking.

Policymakers aim to establish an EWS that can allow in pre-emptive actions before a possible crisis erupts and allow issues to be resolved with minimum cost to society. Moreover, an efficient EWS helps regulators to identify the level of intervention. Espinosa-Vega et al. (2011) remark that regulators would often prefer to keep a financial institution running even when it is insolvent. This predilection is called regulatory forbearance[18]. What underlies such flexibility is that sometimes if a financial institution is

[18] Regulatory Forbearance is shown in a "*regulatory policy (i.e., a policy implemented by central banks and other regulatory authorities) that permits banks and financial institutions to continue operating even when their capital is fully depleted. Regulators give banks extended periods of time during which they have to comply with regulatory*

given enough time to solve its problems, it can revert to its normal operations. Espinosa-Vega et al. (2011) emphasise that this forbearance should be applied to institutions that are pivotal to the system.

A large and growing body of literature has provided valuable information on the various risks in addition to macroeconomic factors as the key determinants of banking crises around the world (Ergungor and Thompson, 2005; Barrell et al., 2010a; Caggiano et al., 2014). Risk, in general, refers to the downturn in firm value as a response to changes in the business environment. Accordingly, the next subsections provide an overview of the various types of risk that influence the performance and stability of any banking system, namely, interest rate, liquidity, credit (default), and market risk.

2.2.1.a Interest rate risk

According to BIS (2016), interest rate risk refers to current and prospective risk arising from interest rate fluctuations that impact on a bank's capital and earnings, which all banks encounter. Assessing the underlying value of assets, liabilities, and off-balance sheet activities will be affected by interest rate movements and will consequently raise the vulnerability of the economic value of the bank. Changes in interest rates affect banks' net interest income (NII) as a result of changes in interest-rate-sensitive income and expenses. Bessis (2015) mentions that a neutral position for interest rate risk does not exist because interest rate fluctuations always bring gains or losses. Furthermore, excessive interest rate risk, if not managed efficiently, could be considered a major threat to a bank's capital and upcoming earnings (BIS, 2016). Following the Basel capital framework's Pillar 2[19], banks are obliged to disclose how interest rate shocks affect the economic value of their equity and earnings. Therefore, managing interest rate risk is vital to the survival of any bank.

The broad use of the term 'interest rate risk' is equated with mismatch risk, which occurs when assets last longer than liabilities or vice versa. This duration mismatch occurs mainly when the bank is providing long-term loans funded by short-term deposits. Eichengreen and Rose (1998) argued that banks in developing countries should narrow the gap between their assets and liabilities when economic conditions are unstable. The interest rate risk can be measured at the present value, so when there is any adjustment in the discount rates, the present value of future incoming and outgoing cash flows changes. This consequently affects the underlying value of assets, liabilities, off-balance sheet instruments and earnings (BIS, 2016).

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requirements (by securing new capital funds). This inaction reflects the unwillingness of regulators to take disciplinary action against problem banks for some period of time". See https://www.investment-and-finance.net/banking/r/regulatory-forbearance.html

[19] See BIS (2016).

Banks' exposure to interest rate risk is still a matter of debate. Hoffmann et al. (2019) presented the traditional view that banks' exposure to interest rate risk arises through maturity transformation because banks depend on short-term deposits to fund long-term loans. They concluded that, on aggregate, banks' exposure to interest rate risk is small; however, it varies from country to country. An alternative view is that banks can eliminate interest rate risk by properly matching the duration of their assets with liabilities. This view is supported by Hellwig (2014), who observes that banks can keep perfect equilibrium since variable-rate deposits can be used to fund variable-rate loans. Commentators differ over managing the risks associated with interest and non-interest income and the implications of these for the financial system. Williams and Prather (2010) indicate that disintermediation and increased competition have forced banks to change their revenue structure by depending more on non-traditional sources of income other than interest income to increase their profitability levels. This action has critical implications for financial system risk. DeYoung and Roland (2001)[20] point out that banks build relationships with fee-based customers differently from traditional loan-based customers, since revenue from the traditional lending activities tends to be stable over time due to the high switching costs and information costs for borrowers and lenders. In contrast, revenue from fee-based activities fluctuates from period to period due to competition, low information costs and the demand for these products (e.g., mutual funds, data processing services, investment advice) is less stable. Smith et al. (2003) add that banks can reduce the risk associated with interest and non-interest income through diversification. Baele et al. (2007) caution that banks that depend more on non-interest income activities are exposed to high systematic risk[21] (non-diversifiable risk).

Banks as a rule use asset-liability management and hedging instruments, for instance, interest rate derivatives, to control the interest rate risk. In the end, banks want to satisfy customers' needs by arrangements of different types for deposits and loans, thus maintaining a high level of profitability and shareholder value. Several international and national supervisory authorities have set regulatory requirements to measure and manage the interest rate risk. Accordingly, banks use duration gap analysis, simulation analysis, and maturity gap analysis as methodologies for measuring interest rate risk.

Regarding systemic banking crises, a large volume of published studies has described the positive relationship between real interest rates and the probability of a banking crisis (Demirgüç-Kunt and Detragiache, 1998); Hardy and Pazarbasioglu, 1998; Kaminsky and Reinhart, 1999; Davis and Karim, 2008a). Oviedo (2004) concluded that banking crises tend to occur during adverse economic conditions

[20] DeYoung and Roland (2001) present several reasons to doubt the conventional wisdom which claims that fee-based earnings are more stable than loan-based earnings.
[21] Systematic risk "*refers to the risk inherent to the entire market or market segment*". See https://www.investopedia.com/terms/s/systematicrisk.asp

when interest rates are high. Davis and Karim (2008a) interpret the previous conclusion to mean that, during booms, banks want to take advantage of low-cost deposit financing to invest aggressively in higher risk and long-term projects; this produces duration mismatch (accumulation of the interest rate risk). Kaminsky and Reinhart (1999) conclude that recent banking downturns appear to be more from the asset side (non-performing loans) than the liability side (bank runs). Consequently, unexpected interest rate increases during booms and, in downturns, systemic interest rate risk can materialise. Therefore, it is widely recommended to include the real interest rate as one of the explanatory variables when constructing the EWS of a systemic banking crisis in the MENA region.

2.2.1.b Liquidity risk

In transforming liquid liabilities into illiquid assets, a bank is inherently exposed to liquidity risk (LR). This indicates that, when its obligations fall due, the bank is not able to meet them; to be precise, it cannot pay what it owes to its depositors through having either insufficient liabilities to fund the assets or assets that cannot easily be liquidated. Thus, the risk is derived from one side or both sides of the balance sheet. The process depends on how aggressive the strategy is that the bank wants to pursue, leading perhaps to bank runs, fire sales and then a systemic banking crisis. Hence it is common to differentiate between two types of liquidity risk: first, the day-to-day liquidity risk referring to daily withdrawals. This type of transaction is usually predictable and easy to manage, even with a cash shortage, which can be covered by other banks in the interbank market. Second, a liquidity crisis can result from a high demand for withdrawals that exceeds the normal transaction. Thus, banks are obliged to borrow funds at a high interest rate that may exceed the market rate. Such incidents are usually unpredictable and can result from a lack of confidence in the bank itself, the banking system or an unprecedented need for cash. Failure to manage this type of liquidity risk, the absence of central bank intervention or deposit insurance could lead to bank runs and bank insolvency (Casu et al., 2006).

Reinhart and Rogoff (2009) provide an in-depth analysis of banks' operations, that is, the maturity transformation[22], because it raises the vulnerability to bank runs. Santos (2001) relates liquidity risk to the asymmetric information that leads to bank runs. He presents two scenarios; the bank runs may have occurred in response to information related to banks' poor performance so that it will function like a source of discipline. Alternatively, it may have resulted from depositors' panic or asymmetric information among depositors about bank returns. In this case, the bank run is costly because it leads to the premature liquidation of assets, thus damaging the production process. Consequently, contagion runs may erupt and overwhelm the banking system, causing a systemic banking crisis. Diamond and

[22] The mismatch between the maturity and the size of assets and liabilities.

Dybvig (1983) introduce the effect of bank runs in the economy and explain how the government, through deposit insurance and banks, can work to attract deposits during a bank run.

To manage LR, banks hold liquid assets as a buffer to withstand liquidity pressures, especially since the recent turmoil of the global financial crisis in 2007-09. Liquid assets should be those assets that are stable over time, have low transaction costs, and can be easily transferred to cash without losing value. However, the opportunity cost of holding liquid assets can affect banks' earnings because of the low return that such assets generate. The literature records a number of theories regarding liquidity risk and bank runs. Gatev and Strahan (2006) mention that banks could hedge against shocks in market liquidity. They demonstrate that during liquidity shortages, as commercial paper spreads widen, banks generate inflows of funding. Consequently, banks benefit from these flows to provide loans from a different source and need to hold no excess liquid assets.

Almarzoqi et al. (2015) indicate that, as long as there is intense competition in the banking system, the banks should continue to hold more liquid assets. Furthermore, banks operating in the MENA region are relaxed about maintaining their cheap and stable funding from customer deposits, since few alternative investment opportunities are offered (Akhtar, 2011). However, as previously discussed in section 3.3, several countries in the region have difficulties matching their assets and liabilities. Therefore, we add the liquidity ratio in our regression to capture the effect of liquidity risk on increasing or reducing the likelihood of a banking crisis in the MENA region.

2.2.1.c Credit risk

For many years, depository institutions have for several reasons faced difficulties, the relaxation of credit standards for borrowers and counterparties. Portfolio risk management has been poor and economic changes have not been properly considered for efficient banking operations to ensue (BIS, 2000). Credit risk can broadly be defined as the potential that a borrower or counterparty will be unable to meet its obligations (loans) when repayment comes due[23]. The borrower could be an individual, institution, or government. Generally, credit risk is associated with banks' lending activities and refers to the uncertainty of part or all of a loan not being covered (Casu et al., 2006).

For most depository institutions, loans are the most significant and primary source of credit risk, in addition to other financial instruments such as acceptances, foreign exchange transactions and interbank transactions. After the recent global financial crisis, several studies have focused on the percentage of non-performing loans as a significant indicator of a banking crisis. Banks implement various techniques

[23] See BIS (2000).

in assessing, monitoring and selecting creditworthy borrowers in their attempts to reduce the credit risk and maintain it within acceptable parameters. Castro (2013) points out that the origin of banking crises must be understood by making distinctions between the factors that influence banking credit risk, macroeconomic factors affecting the systematic credit risk, and specific factors influencing the unsystematic credit risk. The ratio of domestic credit to the private sector over the GDP was added in the model to capture its impact on the probability of a banking crisis.

The main obstacle to a bank's measuring and minimising credit risk accurately is information asymmetry – when one party has more information than the other, it raises the problems of adverse selection (ex-ante)[24] and moral hazard (ex-post)[25]. Adverse selection may favour one party before the credit offer is signed, and moral hazard may appear after the credit is granted. The lender-borrower problem for a bank cannot be hidden in the same way as the principal-agent problem, in which the two parties have different interests. Davis and Karim (2008a) trace the reason behind the inadequate evaluation of credit risk to the integration of financial cycles and business cycles, which derives from the procyclical movement of providing credit and asset prices. Moreover, they see bank managers as liable to herding behaviour; hence, asymmetric information does not limit the availability of credit. Altman and Saunders (1998) present various forces in the economy that show the importance of measuring credit risk. These forces are associated with the high number of bankruptcies around the world and the disintermediation that affected the primary function of banking operations: the dramatic decline in the value of assets, the growth in off-balance-sheet activities, and the high level of competition in offering loans and credit from banks and other non-financial institutions.

Nowadays, the IMF (2014) insists that banks should attempt to fulfil the demand for credit and maintain a capital buffer when profitability is low. Moreover, the return on equity of 80 percent of the largest institutions' assets is below the cost of the capital demand by shareholders. Thus, banks are much more involved in restructuring activities and repricing existing financial products.

[24] Adverse selection and moral hazard arise when there is an informational differential between two parties, if one of them is less informed; this could lead to a severe problem or market failure. In the banking context, adverse selection refers to a situation in which pricing policy induces low average quality of borrowers, where asymmetric information inhibits banks from distinguishing quality. Put differently, borrowers wish to overstate their creditworthiness. From the other side, banks increase the interest rate to manage credit risk. Hence low-credit-risk borrowers drop out and banks are left with high-credit-risk borrowers (see Greenbaum and Thakor, 2015).

[25] When two parties come into agreement, one party may change his/her behaviour after the contract has been signed or may act contrary to the agreed principles. The term moral hazard is generally used to cover such behaviour. Banks try to minimise this problem through screening and contracting (see Greenbaum and Thakor, 2015).

2.2.1.d Market risk

Let us now turn to interpret market risk as another symptom of the banking crisis. Previous studies mostly defined market risk as to the risk of losses in a firm's value due to fluctuations in interest rates, equity prices, credit spreads, foreign exchange rates, and other indicators that the public market uses to set this value. This is the main reason why banks offering investment banking services are more affected by market risk, since their portfolios are connected to currencies and equities (Davis and Karim, 2008a). For our model, we used the changes in the interest rate and foreign exchange rates to check their effect on the occurrence of banking crises. Regrettably, the unavailability of data prevented us from including the other variables related to asset prices.

In the context of the banking crisis, credit risk is closely integrated with market risk. This integration was evident during the global financial crisis because both risks are pro-cyclical. The degree of market risk was high, due to the collapse of asset prices, and at the same time, credit risk was boosted by falling asset prices (Davis and Karim, 2008a). Banks are always concerned about their market-risk practices, including short-term profit and loss fluctuations and long-term economic risk. Banks assess risk by accumulating their exposure to risk and comparing it with their risk appetite. Heffernan (2005) distinguishes between two types of market risk: general or systematic market risk (which refers to the movements in the prices of all market instruments in response to macro factors) and unsystematic or specific market risk (which can be defined as the uncertainty that arises in situations where the value of one instrument changes because of actions related to the instrument's issuer without affecting other similar instruments in the market).

Mehta et al. (2012) conducted research to extend the current practices of market-risk modelling until it was more applicable to banks. Banks face a dilemma in choosing the appropriate design of market-risk models, and hence, from one standpoint, Mehta et al. (2012) want it for security reasons to be sophisticated and provide accurate results; from another, they want it to be simple, transparent and quick in generating results. Some methods can be used by financial institutions to manage and measure market risk: the Value-at-Risk (VaR) model calculates how much loss a financial institution can suffer in a specific time horizon with a certain probability level. Second, stress testing or scenario analysis is a simulation in which financial institutions are exposed to extraordinary events; then, their degree of stability and how far it can handle such events with the resources it already has can be assessed. Overall, banks can pursue either a conservative or an aggressive strategy in managing their activities. Thus, their strategy affects both the liquidity position and capital adequacy requirements, whose effect on our model we are able to capture.

2.2.1.e Systemic Risk

In the recent past, the international community has required regulators to enhance their efforts to deal with systemic risk; in other words, to identify crucial institutions and markets and build early warning systems of distress (González-Hermosillo and Hesse, 2011). Systemic risk refers to the risk of collapse of the financial system as a whole, due to the possibility of an incident in an individual bank that contagiously spreads instability and its effects to other institutions. According to a definition from the European Central Bank (2009), systemic risk is the uncertainty of a financial system that leads to instability and dysfunction and impairs economic growth and welfare. Thus, the term "systemic crisis" usually refers to a significant collapse of the financial system.

Hartmann et al. (2015) extensively studied the definition and effects of systemic risk from a different perspective. They indicated that a single entity may initiate systemic risk, and its impact could permeate the whole system due to the interlinkage between banks and other sectors, such as the interbank markets, the payments and settlement systems, and retail depositors' interactions with information. It appears that systemic risk is known as an event that entails severe consequences for the economy, and its impact can be national, regional, and international. Hartmann et al. (2015) introduced the key aspect of widespread financial instability. The contagion effect depends on the level of interconnection between financial intermediaries. Damage in one financial intermediary could harm the others in the market and may lead to distress in the banking system. Second, the financial system may collapse due to exogenous aggregate distress (i.e., imbalances in the real economy). Third, endogenous problems (i.e., in response to the behaviour of a single financial institution or all of them combined) could build up over time. Thus, what leads to a severe crisis is that each cause of systemic risk appears in conjunction with one or more of the others[26]. Moreover, these studies have highlighted that, since systemic risk refers to the severe distress of the financial system and not to a regular financial cycle, it is worth differentiating between weak and robust systemic outcomes, and more precisely, between bank runs and banking panic. Allen et al. (2012) present six types of systemic risk, namely: (1) asset price bubbles (i.e., real estate bubbles); (2) liquidity provision and mispricing of assets; (3) multiple equilibria and panics; (4) contagion; (5) sovereign default; (6) currency mismatches in the banking system.

In the new global economy, where systemic risk has become a central issue for regulators, Hartmann et al. (2015) considered systemic risk to be a sign of severe financial instability. This is one of the main ingredients of interpreting the financial crises that negatively impact the whole economy and require regulatory intervention. Bussiere and Fratzscher (2006) endorse the finding that many financial crises

[26] See De Bandt and Hartmann (2000), Hartmann et al. (2015), Allen et al. (2012).

have occurred over the past few decades; most of them have been contagious and spread across countries with destructive economic, social, and political consequences.

From another perspective, Caballero and Simsek (2013) focus on generating risk from the complex structure of the financial system. They conclude that in a good economic situation, banks and their counterparts are most concerned about their situation. However, during distress, their concern turns to the whole system, since it all may be indirectly affected. Additionally, they declare that partial domino effects can have dramatic consequences for raising counterparty risk and setting prudential actions. In measuring systemic risk, Chan-Lau and Gravelle (2005) and Avesani et al. (2006) propose a methodology for measuring the systemic risk of the banking system, using market information, such as credit default swap spreads and the stock prices of individual banks, since both are considered highly liquid markers. Huang et al. (2009) concentrate on applying a new indicator for measuring systemic risk, depending on the price of the insurance that would be paid to protect against losses versus the significant default losses in the next 12 weeks.

It is also worth mentioning the failure of non-systemic banks, a term which has come to be used to refer to the possibility that when banks fail or come close to the point of failing, authorities intervene through either resolution or liquidation. Unfortunately, dealing with these incidents has remained in the national domain. International standard setters have not covered it because the international community has focused on capturing risks associated with the failure of internationally operating banks and cross-border bank failures (Baudino et al., 2018).

In the section that follows, we present in more detail some definitions from various sources of the term 'systemic banking crisis' and of its relationship with other variables.

2.2.2 Definition of a Systemic Banking Crisis

This section explores one type of systemic risk, namely, a banking crisis, in order to understand more of its implications. Several definitions of 'banking crisis' have been proposed in previous studies. For Kaminsky and Reinhart (1999), banking crises refer to the occurrence of two incidents: the intervention of the public sector to merge, close, or take over distressed banks or victims of bank runs, and the assistance of government to inject needed funds into an essential financial institution. This definition was initiated because the data on business failure and non-performing loans had been inaccurate and irregular. Financial institutions tend to hide this information as long as possible. Caprio and Klingebiel (1996) restrict their definition of a banking crisis to events requiring central bank intervention, meaning that the likelihood of a crisis can be determined by the presence or absence of supervisory interventions. Lindgren et al. (1996) differentiate between banking crises and banking problems. The term 'systemic banking crisis' refers to observed incidents of bank runs, portfolio reallocation, intensified government intervention, or the collapse of financial institutions. Banking problems represent non-systemic crises that occur in individual banks or local crises, as discussed in the previous section.

In another significant study, Demirgüç-Kunt and Detragiache (1998) identified a banking crisis by extracting four defining conditions from previous studies. Distress in the banking sector is considered a systemic crisis if one or more of the following conditions endures: first, if the ratio of non-performing assets to total assets is 10 percent or more; second, if the policymaker's intervention to rescue banking fragility reaches at least 2 percent of GDP; third, if banking distress has resulted from the large-scale nationalisation of banks; and finally, if various events in the market occur, for example, massive bank runs, deposit freezes, extended bank holidays and government intervention by generalised deposit guarantees. Following the general perspective of Davis and Karim (2008a), systemic banking risk results from institutions' performances and their correlation with each other. This can be due either to an insolvent bank associated with asymmetric information making a self-fulfilling forecast that becomes contagious or with the close interconnections in the financial system (counterparty exposure) via interbank transactions that have broad negative consequences if any distress afflicts the market.

In a comprehensive study of all the systemic banking crises during the period 1970-2011, Laeven and Valencia (2012) introduce their definition of a banking crisis. It is considered to be systemic if, first, the financial system reports significant signals of financial distress such as bank runs, substantial losses and liquidations in the banking system. Second, if there is a considerable intervention in the form of banking policy being set in response to failures in the banking system. For De Bandt and Hartmann (2000), a systemic crisis is an event that has a severe contagious effect on several financial institutions or markets; these writers distinguish the concept of systemic risk by differentiating between a horizontal and vertical perspective. The horizontal one focuses exclusively on events in the financial sector, and the vertical view is concerned with the effect of systemic risk on the real economy. Borio and Drehmann (2009, pg.39) introduce narrow and broad definitions of ways to identify a banking crisis. The narrow one is that a banking crisis occurs in "countries where the government had to inject capital in more than one large bank and/or more than one large bank failed" and the broad one occurs in "countries that undertook at least two of the following policy operations: issue wholesale guarantees; buy assets; inject capital into at least one large bank or announce a large-scale recapitalisation programme".

Usually, the entities of the financial system integrate: their operations are not isolated, and this is why a systemic crisis leads to widespread failure. The main critical issue is the resilience of the financial system, whereby a financial system is able to differentiate between the normal business cycle and financial distress. If the financial system is resilient, any insolvent bank should be resolvable at a minimum cost to the general economy. Technically, moreover, regulators are the ones responsible for maintaining confidence in the financial system through their methods of dealing with distress events. Hoggarth et al. (2002) demonstrate that if the customers and banks do not have enough confidence in each other for money to be deposited, the payments system will not work, leading to a complete breakdown of the financial system that would incur high costs.

In a major study, Caprio and Klingebiel (2002) surveyed 117 systemic banking crises that had materialised in 93 countries since 1970 and included another 51 non-systemic banking crises that had occurred in 45 countries during the same period. The non-availability of data concerning the size of the losses, the uncertain timeframes of banking insolvencies and the costs of banking crises were the main obstacles to gathering enough information for this database. In another updated study, Laeven and Valencia (2018) updated their banking crises database to end up with 151 systemic banking crises around the globe from 1970 to 2017. Their database contained information on crisis timeframes, the fiscal and output costs of crises, and regulators' interventions to resolve banking crises.

Several extensive cross-sectional studies have adopted logistic regression to determine the leading indicators of the systemic banking crisis (Demirgüç-Kunt and Detragiache, 1998; Barrell et al., 2010a; Caggiano et al., 2014) and have shown evidence that it outperforms other econometric models, as indicated previously in section 3.2.6. It is the appropriate model for answering the research question "What is the possibility of a banking crisis arising in the next t years?" (Davis et al., 2011, pg. 695). We followed the method of Barrell et al. (2010a) in the timing of bank crises by considering only the beginning of the crisis year followed by non-crisis periods. Another model was adopted by Caggiano et al. (2014), who concentrated on dividing the period into three sub-periods: a tranquil time, a crisis year and the years after the crisis year by using the multinomial logit model to overcome the crisis duration bias and predict the arrival of the crisis. Our results were very similar to their empirical results in using the binomial and multinomial logit model[27]. Thus, we decided to use the binomial multivariate logit model, which has long been the model adopted for banking crises.

In the next section, we discuss in general terms the importance of banking competition and reviews the previous literature on the establishing of the industrial organization and the development of this approach with more concentration on measures of bank competition.

2.3 Financial Stability and Bank Competition

A great deal of writing has been published on the concept of competition, in view of its various meanings and interpretations. In his critical review of measures of competition in banking, Leon (2015)

[27] It was mainly adopted for currency crises.

draws on an extensive range of sources to demonstrate the origins of the conceptions of competition. He points out that competition was first discussed in print in the book *The Wealth of Nations* by Adam Smith in 1776. From Smith's perspective, every firm is free to produce and exchange goods in the market, which should be open to domestic and foreign entrants. Thus, markets are structured on the basis of people promoting the public interest by their daily economic decisions. In the long run, with free competition, prices equal the costs of production. Moreover, Smith does not view competition as a state or situation but as an aggressive battle between competitors to generate a higher market share. Because prices are determined by supply and demand, competition pushes prices towards equilibrium. Smith called free market forces the "Invisible hand" that the market has created to increase economic efficiency from the increasing division of labour associated with the processes of production. This hand creates a chain of events that promote social welfare without government intervention. Several authors have considered Smith's view of the conception of competition and instigated two especially significant concepts (McNulty,1967; Vickers, 1995; Blaug, 2001): first, the standard theory that considers the outcomes of competition as static equilibrium. Hence, competition is a static situation in which banks cannot generate abnormal profits by excessive charges, and second, the theory of the Austrian school, which sees competition as a continuing process of rivalry.

In accepting the static state view of competition, Cournot (1838) pioneered the ideal definition of competition, particularly oligopolistic competition and the assumptions required by a competitive situation. The key assumptions can be listed as follows: a considerable number of firms independently offering homogeneous products at the same time, and rivals needing to be familiar with market opportunities (demand) and each competitor's operating costs, to operate in a contestable market, and to refrain from joining a cartel (Leon, 2015). The main advantages of Cournot's idea of competition are that it presents a logical wave between monopolistic and competitive markets in terms of prices and quantities. Furthermore, it produces a constant Nash equilibrium where each rival has no incentive to deviate unilaterally. One major criticism of the version of Cournot's oligopoly model introduced by Bertrand in 1883 was that it argued that rivals should compete on prices and not on the quantity produced. In 1933, Chamberlin added significant contributions to the oligopoly theory and introduced monopolistic competition, which is a type of imperfect competition. In monopolistic competition, a firm adopts the prices previously set by its competitors and ignores the effect of its prices on others. Moreover, producers provide different products from one another and these are not perfect substitutes (Leon,2015).

This view is supported by Park (1998), who argues from a practical point of view that competition should be viewed as involved in a dynamic disequilibrium process rather than a static equilibrium because product homogeneity is unnecessary and each rival competes by adopting better and different product quality, thus heterogeneity. He adds that firms have more than one way of competing: for instance, they may use price or quality, quickly replacing old products with new and advanced ones.

Various studies have assessed the efficacy of oligopoly theory and contributed to developing different forms of market structure and the measurement of competition, which is the basis of structural and non-structural approaches such as those of Jevons (1871), Edgeworth (1881), Clark (1900) and Knight (1921). Before describing these approaches, the other view that considers competition to be a process of rivalry should be explored.

Economists from the Austrian School find competition a sophisticated process of rivalry between firms operating in the market. The behaviour of firms, rather than price cutting, forms the market structure (Park, 1998), and a dynamic strategy is needed to cope with new trends. This process, working towards the application of destructive-creation principles, means that less efficient firms drop out of the market and are replaced by more efficient firms, which boost aggregate efficiency. From this perspective, a market is competitive when rivals are able to create new services and provide incentives to an incumbent to enhance its operation, producing better quality with lower prices (Leon, 2015). Hence, it promotes social welfare. Vickers (1995) notes that the rivalry *"encompasses all sorts of forms of rivalry (market trading, auctions, races, wars of attrition, etc.), instruments of rivalry (prices, advertising, R&D, takeover bids, effort levels, etc.), objects of rivalry (profits, market share, corporate control, promotion, prices, survival, etc.), as well as types of rivals"*[28]. With regard to free-market competition, each firm that creates a new product and applies an aggressive strategy in order to generate more profits before its rivals temporarily derives static monopoly power (Leon, 2015).

Industrial Organisation (IO) is categorised within the study field of economic mechanisms and was formulated to study firms' strategies and the organisation of markets. It has been used to develop tools to set public policies on market regulation (Uzunidis, 2016). Carlton and Perloff (1998) believe that industrial organisation is a branch of microeconomics that analyses the strategic behaviour of economic participants linked to various market structures. The theoretical foundation of industrial organisation was entailed by the neoclassical approach of analysing the markets and shows the actual complications of the perfectly competitive model. In particular, IO rejected free-market entry or exit hypotheses and focused on investigating the role of competitive barriers to entry or exit in a market initiated by the State or based on a firm's production strategies. The assumption that products are homogeneous is also rejected, since the main concern of large firms is to produce different and innovative products and distribute them locally and internationally.

In contrast, small firms tend to survive in the market by specialising in commercial products associated with price advantage. Last, the imperfect information hypothesis was adopted because several studies had found that asymmetric information is one of the causes of market failure (Uzunidis, 2016). Stigler (1968) notes that the IO has focused on investigating the size structure of firms, the causes of this size

[28] See Leon (2015, pg. 8).

structure (mainly economies of scale), the impacts of concentration on competition, and the impact of competition on investment, prices, and innovation.

The theory of industrial organisation has since 1930 gone through various stages of development. It was initiated by the Harvard School and focused on the structure of industry and firms. It promulgated the structure-conduct-performance (SCP) approach and investigated the effect of market power by using the concentration ratio, with its impact on social welfare (Weiss, 1971), and the profitability-concentration hypothesis. This school, moreover, established the root of the concept of efficiency. Later, the Chicago School challenged the SCP approach on the grounds that a high concentration ratio may imply high profit rates due to economies of scale (Goldschmid and Mann, 1974). Further criticism of the profit-concentration hypothesis arose because of using accounting data to measure profit rates. Similarly, Fisher and McGowan (1983) questioned whether profit rates were appropriate for determining market power. Smirlock (1985) found no relationship between concentration and profitability. However, once the market share is accounted for properly, there is a significant and positive relationship between market share and profitability. In terms of the efficient structure hypothesis, Demsetz (1973) and Smirlock (1985) argue that concentration is not a random incident but the outcome of the efficiency of dominant firms operating in the market. A firm that has a comparative advantage in its production becomes large and possesses a high market share. Hence, a market with a number of such firms will be more concentrated. In sum, applying the IO approach was critical because of the difficulties involved in measuring profitability, the chance that the market structure would be endogenous, and the lack of a solid connection between theory and empirical work.

In 1989, there was a dramatic shift in the OI approach, which started a new era with what was called the New Empirical Industrial Organisation (NEIO) established by Bresnahan (1989). The NEIO focuses on using econometric models to estimate specific aspects of conduct in individual industries or similar markets, measure the market power and infer the variations in the collusive-competition behaviour of firms. Regarding market power, Carbó et al. (2009) advise that it should be included in the structural model of banking competition because it measures the degree to which the average bank's marginal revenue differs from average revenue, representing the slope of the demand curve. Shaffer (1989) was a pioneer in applying this approach to the banking industry.

Furthermore, during the 1990s, game theory received particular attention because it focused on strategic decision making and the Nash equilibrium. Thus, industrial economists have taken a growing interest in it. Bagwell and Wolinsky (2002), in the course of various discussions, investigate the contribution of game theory to the theory of industrial organisation and vice versa[29].

[29] The topics that have been discussed in Bagwell and Wolinsky (2002, pg.3) are as follows: *"commitment in two-stage games and the associated theories of strategic-trade policy and entry deterrence; asymmetric-information games and the associated theories of limit pricing and predation; repeated games with public moves and the*

In the next section, we detail the two approaches of industrial organisation theory, each associated with certain competition measures. First, traditional industrial organisation, which focuses on the structural approach of measuring competition by using the concentration ratio and the Herfindahl Hirschman Index (HHI); second, New Empirical Industrial Organisation (NEIO), which was developed from game theory and the adoption of sophisticated econometric models with greater emphasis on identifying market power. The NEIO employs non-structural measures of competition, for instance, the Lerner index, the Panzar-Rosse H-statistic, and the Boone indicator.

2.3.1 The Traditional Industrial Organisation (the Structural Approach)

During the 1930s, the Harvard School was working on significant empirical enquiries that focused on an approach to assessing the structure of industry and firms, not surprisingly after a period of a severe economic crisis that revealed the fragility of the economy. This generated the Structure-Conduct-Performance (SCP) paradigm, developed by Mason (1939) and Bain (1951), which falls within the traditional industrial organisation approach. Mason (1939) states that the size of a firm is essential for determining pricing and production policies in the market. In this regard, Bain (1951) initiated the concentration-profits hypothesis after using profitability data from US manufacturing firms. He finds that dominant firms have higher accounting profits than others operating in the market[30]. Bain (1956) formulates the concept that the market structure of an industry defines its conduct and consequently affects firm performance. Liu et al. (2013) note that Bain's findings were often recognized by other studies, some of which sought to justify government intervention to promote competition. Supporters of the SCP paradigm have tried to classify the existing markets as imperfect by reason of their structure and ask for more regulation to assess the abuse of market power. Conversely, Stigler (1968) and Demsetz (1973)[31] have highlighted that government intervention tends to lower the intensity of competition.

The development of the SCP helped lay down antitrust laws in the United States to promote competition and thus better social welfare. Notably, the Philadelphia Bank case in 1963 let the U.S. Supreme Court formulate Merger Guidelines to the banking industry that were based on antitrust laws. Later, various studies assessed the SCP approach in banking (Smirlock,1985).

According to Lipczynski et al. (2005)[32], the SCP is useful because it helps researchers properly classify all industry data into meaningful segments. It assumes that there is a direct connection between market

associated theory of collusion in markets with public demand fluctuations; mixed-strategy equilibria and purification theory and the associated theory of sales; and repeated games with imperfect monitoring and the associated theory of collusion and price wars".

[30] In particular, he finds that industries that have eight-firm concentration ratios (CR_8) exceeding 70 percent are more profitable than those with a CR_8 less than 70 percent (Liu at al., 2013).

[31] Both of them represent the Chicago School.

[32] Lipczynski et al. (2005) summarize these points from Bain, 1956; Mason, 1948; Clark, 1940; Sosnick, 1958).

structure, conduct and performance, which is consistent with the neoclassical theory of the firm. Imperfect market structure is possible so long as it generates outcomes that comply with acceptable performance standards. Hence, the market structure can capture the error and modify it through improving market conduct and performance.

Further assumptions were suggested regarding the states of equilibrium; perfect information (Ferguson and Ferguson, 1994) leads to assumptions of a perfectly competitive market structure in which firms provide homogeneous products, a large number of small firms operate in the market, firms are price takers, no entry and exit restrictions operate in the long run, and perfect information is available to firms and consumers (Beaulier and Mounts, 2008). These conditions are, of course, unrealistic and cannot be implemented for most industries, especially banking. In terms of the degree of concentration, Meschi (1997) highlights that it is considered a major structural component in the traditional SCP approach that estimates the extent of competition. Under the SCP hypothesis, an uncompetitive situation could result from a highly concentrated market, since this gives firms more opportunities for collusion and a greater range of behavioural options (De-Ramon and Straughan, 2016). For instance, firms can take advantage of market power and charge prices that provide significant economic value – so-called oligopoly and monopoly profits – at the expense of social welfare. Conversely, in markets with higher competition, firms are exposed to different constraints because the returns generated can cover only the cost of capital in the long run and maximise social welfare (Tan, 2016).

The SCP indicates that firms' competitive conduct and performance are determined by the industry structure in which they operate (see Figure 2.1). According to this hypothesis, a higher concentration in the market leads to less competitive firm conduct and higher firm profitability. Liu et al. (2013) mention that, according to the SCP paradigm, an industry that consists of a small number of firms can easily exploit market power and operate in an uncompetitive manner by charging prices above marginal costs. In these cases, the incumbent firms generate huge profits.

The structural characteristics of the market are the number of firms and their size, the extent of market contestability and the extent of product heterogeneity. Freixas and Rochet (1997; 2008) present an in-depth analysis of competition between banks by focusing on non-price competition, such as the asset risk level or the intensity of borrowers' monitoring. They look at the equilibrium of the banking sector under various specifications for the type of competition that prevails in the sector. The market structure is constituted as follows: first, perfect competition (pure competition) refers to a market that has a large number of small firms operating in the market and competing with each other, all of which are price takers. Firms provide similar products, and their main objective is profit maximisation. Barriers to entering and leaving the market, consumer preference and loyalty do not exist in such markets; but any information related to the operations of the market is available at low cost. Second, monopoly refers to the operating and control of an entire market by a single firm. This firm can set any price it wants, and consumers who want the good or service have no option but to pay it. Third, monopolistic competition is an imperfect competition that occurs in the real world as the dominant market structure. Large and dominant firms operate with heterogeneous products in the market, but each firm has a comparative advantage in selling its product to consumers. Thus, firms can charge their own prices. Various options are open to consumers, and products can be chosen according to preference. Fourth, oligopolist competition occurs in markets where a few firms are in control. Hence, competition is limited, and prices are interdependent. If one firm changes its prices, it affects the other firms, and they change their prices (mutually destructive price wars) for fear of significant loss of market share. Entry to and exit from the market are difficult because the few firms take advantage of economies of scale, which is hard for start-up firms to adopt.

Market conduct refers to a firm's behaviour vis-à-vis changes in the market or the economic objective that they want to achieve. Firms adopt and adjust various decision-making activities, such as pricing strategies, product quality, collusion[33], merger, capacity investment, advertising (product design, branding and marketing) and expenditure on research and development (Scherer and Ross, 1990; Lipczynski et al. 2005; Grigorova et al., 2008). These decisions are pursued according to the industry's structural characteristics.

Market performance is the economic outcome resulting from structure and conduct. Its evaluation depends on the allocation of resources. Price-cost margin, profitability, and growth are the main indicators in assessing performance. However, it is computed by means of accounting measures. Neuberger (1997) notably suggests that government policy can function to maintain stability in the market by promoting competition and preventing the accelerated increase of market power in each of the SCP variables.

Figure 2.1: The Structure-Conduct-Performance paradigm[34]

The contestable market theory was initially introduced by Baumol (1982) to assess the predictive power of the SCP paradigm. The term 'contestable market' refers to a market in which firms are able to enter

[33] Collusion may be either explicit, such as an arrangement to construct a cartel, or implicit, through informal understandings (Lipczynski et al. 2005).
[34] Source: Liu et al. (2013)

and exit freely with a low sunk cost. In a market with low barriers to the entry of new firms and lax exit conditions for firms that experience losses, incumbent firms apply aggressive competition to prevent new firms from entering even when the market is highly concentrated. In this sense, market competition is determined by the competitive conduct of firms that are already influenced by the entry and exit conditions rather than the market structure, which is irrelevant in this case (Carbó et al., 2009). Northcott (2004) argues that a competitive situation can appear in very concentrated markets, and a monopoly can appear even when the number of firms is high. Thus, market characteristics such as barriers to entry and exit can influence a firm's behaviour regardless of the actual number of firms operating in the market. Liu et al. (2013) argue that bank conduct is hard to observe; therefore, the models used to determine the SCP relationship usually assess conduct by connecting the market structure to performance. Another significant aspect, Amel (1989) mentions that Baumol's work (1982) on contestability has strengthened the theoretical basis of potential competition, which has been used to justify the relaxing of antitrust constraints on mergers between rivals. Watkins et al. (1985) study the structural change in urban banking markets and its implications for potential competition. Their results suggest that potential competition can be a major issue in less attractive banking markets where entry barriers are high.

2.3.1.1 The Concentration measures

Bikker and Haaf (2002b) warn that measuring competition using concentration measures is vital for a welfare-related public policy associated with market structure and conduct in the banking industry. They add that competition and concentration are connected in theory and empirically analyse them with regard to product markets and geographical areas. It may be useful to turn now to the concentration measurement of bank competition, which was introduced into the SCP model because it indicates that higher concentration causes less competitive bank conduct and ends up with greater profitability (Weill, 2013). The main measures of the market structure following the SCP approach are the concentration ratios (the market share of assets held by the top 3 or 5 banks) and the Herfindahl-Hirschman index (the size of banks in relation to the industry). Weill (2013) claims that these measures were widely used until the 1990s. A large number of empirical works have used the number of banks (fewness) and their relative distribution of sizes (inequality) in a given market to estimate concentration (Leon, 2015; Bikker and Haaf, 2002b).

Hall and Tideman (1967) demonstrate a number of key elements that a good concentration index should have, namely:

- *"Concentration should be a one-dimensional measure;*
- *Concentration in an industry should be independent of the size of the industry;*

- *Concentration should increase if the market share of a firm is increased at the expense of a smaller firm;*
- *If each firm in a given industry is divided into two firms of equal size then the concentration index should be reduced by one-half;*
- *When an industry is divided into N equal-sized firms, a measure of competition should be the decreasing function of N;*
- *A concentration measure should have a range of zero to one (while this property is not strictly necessary, it makes the measure easier to interpret)"*[35].

However, Leon (2015) argues that the available concentration indices do not satisfy all the above criteria. Bikker and Haaf (2002b) note that concentration ratios can capture the structural features of a market and the entry to/exit from a market or the causes of a merger. Moreover, concentration indicators differ in their weighting scheme and structure. Marfels (1971) argues that the weighting scheme of an indicator demonstrates its sensitivity to variations at the tail-end of the bank size distribution. Hence, Marfels (1971) presents four groups of weights (we concentrate in this study on the first two of these) as follows. *"First, weights of unity are attached to the shares of an arbitrarily determined number of banks ranked in descending order ($w_i = 1, \forall i \leq k$), and zero weights are attached to the remaining banks in the industry ($w_i = 0, \forall i > k$). An example is the k-bank concentration ratio. Second, banks' market shares are used as their own weights ($w_i = s_i, \forall i$), so that greater weights are attached to larger banks. These indices take account of all banks in the industry. An example is the Herfindahl-Hirschman index. Third, the rankings of the individual banks are used as weights ($w_i = i, \forall i$), where banks can be ranked in ascending or descending order. All banks are included in computing this index. Fourth, each market share is weighted by the negative of its logarithm ($w_i = -log\ s_i, \forall i$. A smaller absolute weight is thus attached to larger market shares"*[36].

Claessens and Laeven (2003) claim that determining the degree of competition of an industry cannot be exclusively measured by market structure indicators such as concentration ratio and HHI. They add that the threat of entry may be a more significant factor in the behaviour of market participants. In this regard, Azar et al. (2019) accumulate the consequences of high bank concentration presented in the empirical literature, namely, increased entry/exit restrictions that affect economic growth can negatively influence the transmission of monetary policy, lower the ability to set off new technologies, boost inequality and crime; and a wide interest rate spread can affect social welfare. Furthermore, it could dramatically affect the financial system, the lending process (relationships and standards), and labour allocation.

[35] See Leon (2015, pg. 10).
[36] See Bikker and Haaf (2002b, pg. 6).

2.3.1.1.a The k-Bank Concentration ratio

In the 1990s, the empirical research concentrated on determining the impact of bank concentration on competition, using data from the U.S. (Berger et al., 2004). Relevant literature has tested the SCP hypothesis by using the k-bank concentration ratio and HHI as exogenous signals of market power. Berger et al. (2004) state that the data used to estimate the concentration ratio by computing the market shares are treated equally, regardless of the bank's size and type. However, recent research has found evidence that different sizes[37] and types of banks may affect competitive conditions differently. The k-bank concentration ratio is one of the structural approaches to measuring competition and is a widely used measure of concentration because of its simplicity and the small amount of data required to estimate it. It is calculated by summing over the market shares of the k[38] dominant banks operating in the market, as follows:

$$CR_k = \sum_{i=1}^{K} s_i \ , \qquad with\, s_1 \geq \cdots \geq s_K \geq s_N \ , \qquad \forall\, N \geq K \qquad (1)$$

where s_i is the market share of i operating bank, when banks are classified in descending order of market share, and N is the total number of operating banks. The index ranges between zero and one (100 percent). Zero refers to an infinite number of equally sized banks, whereas one indicates that the banks included in the calculation (depending on the chosen k) comprise the entire industry. Hence, the concentration ratio does not take into account the smallness or the size distribution of the remaining banks operating in the market (Leon, 2015).

Historically, the concentration ratio interpretation has been varied. Earlier studies depend on the structure-conduct-performance paradigm, which assumes that competition can be measured by the degree of concentration in the banking industry. Demsetz (1973) argues that the strategy of efficient firms is to operate with lower costs and consequently raise their market share following the efficient-structure theory. However, Demirguc-Kunt et al. (2003) understand that high levels of concentration indicate the significant market power of incumbent firms coupled with uncompetitive behaviour, which gives rise to inefficiencies.

Schaeck and Cihak (2007) introduce several points that clarify the problems with this indicator. First, the concentration ratio is calculated at the national level. However, the banking industry has greatly expanded due to globalisation and competes on an international level. Thus, it may be inappropriate to

[37] For more details on the effect of size (smallness and largeness) and nationality (foreign or domestic) banks on competitiveness, see Berger et al. (2004).
[38] There is no rule for determining the value of k, but commonly used values are 3, 5, or 10 (see Leon, 2015).

depend on the definition of a banking market that observes national boundaries. Second, the concentration ratio, which measures market structure, does not necessarily indicate the level of competitiveness in the industry, a view that had been supported by Baumol et al. (1982) and Bikker (2004). Third, the direction of causality from structure to conduct is problematic and not evident. Leon (2015) notes the ambiguity in interpreting the different levels of concentration. Similarly, Shaffer (2004) introduces concerns over the appropriate definition of the relevant market. For instance, defining a geographical market (local, regional, or national) is far from defining a product market. Moreover, Shaffer insists on the need for the type of equilibrium pricing that estimates the correlation between market structure and conduct. As a result of these concerns from a growing body of literature, Berger et al. (2004) conclude that it is inappropriate to depend on concentration to determine the extent of bank competition and that further research is needed.

2.3.1.1.b The Herfindahl-Hirschman index (HHI)

The Herfindahl-Hirschman index (HHI) has also been used frequently in the empirical literature as a statistical measure of concentration. It is named after two economists, Albert Hirschman (in 1945)[39] and Orris Herfindahl (in 1950)[40]. It is much more data-sensitive than the concentration ratio previously mentioned, since it requires data on the entire distribution of bank sizes (the market share of each bank) (Calkins, 1983). For this reason, Bikker and Haaf (2002a) comment that HHI is often called the full-information index. The lowest value of HHI refers to equal market shares; a high HHI indicates that a firm has an extremely large market share. Rhoades (1995) mentions that the economist community accredited the adoption of HHI as a concentration measure; his evidence is that it has been adopted by the Department of Justice (DoJ) and the Federal Reserve (Fed) in analysing competitive conditions in mergers. He stated that HHI is considered an efficient screening device and a planning tool for regulators and bankers. Cetorelli (1999) states that the antitrust guidelines in banking enforced by the DoJ and the Fed have focused on the process of assessing the competitive impact of merger transactions based on a structural analysis of the banking market. Hence, the concentration rate can be estimated by using the HHI, which is the most common indicator used by the regulators. For instance, according to the antitrust guidelines, "*if the post-merger market HHI is lower than 1,800 points, and the increase in the index from the pre-merger situation is less than 200 points, the merger is presumed to have no anticompetitive effects and is approved by the regulators*"[41] (ibid, p.3).

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[39] Presented in the index to his book "National Power and the Structure of Foreign Trade".
[40] Herfindahl's index was presented in Orris Herfindahl's doctoral dissertation, "Concentration in the U.S. Steel Industry".
[41] See Cetorelli (1999, p.3) for a mathematical example. For more information on horizontal merger guidelines, see Litan (1994), who presents the US antitrust guidelines; and, for the UK banking system, see the Competition Commission and the Office of Fair Trading (2010).

Bikker and Haaf (2002a) note that the HHI serves as a benchmark for the other concentration indices; they review various attempts to connect the HHI with the distributional theory established by Adelman (1969), Kwoka (1985), Hart (1975) and Rhoades (1995). Adelman (1969) and Kwoka (1985) demonstrate the HHI by using the mean and the variance of the bank size distribution. Hart (1975) argues that, in some cases, the exact number of banks operating in the industry is ambiguous, but data about the size of the banking market and banks' size classification are available. Thus, Hart proposes dividing the total distribution of bank sizes into classes and estimating the parameters of the original distribution from the parameters of the first moment distribution if the relationship between the distributed items is unknown. Rhoades (1995) claims that the inequality of banks' market shares could vary significantly between markets, leading to similar HHI values.

It is generally straightforward to calculate this by taking the sum of the squares of the market share of the total operations of banks:

$$HHI = \sum_{i=1}^{N} s_i^2 \, , \quad \forall i = 1, \cdots, N \qquad (2)$$

where s_i is the market share of i operating bank, and N is the total number of banks in the market.

In 2010, the DoJ, the Fed and the Federal Trade Commission released new guidelines for interpreting HHI in banking to avoid the creation of market power. A market with an HHI of less than 1,500 is considered to be unconcentrated or a competitive marketplace. The market is categorised as moderately concentrated if the HHI lies between 1,500 and 2,500. A concentrated market can be seen if the HHI is greater than 2,500. Bos et al. (2017) mention that establishing the new guidelines took into account conditions in a variety of markets, for instance, entry restrictions, market growth rate, increasing demand substitutes, and the adoption of new technology through merger. According to the SCP approach, markets with a high HHI are categorised as weak in competition. However, Demsetz (1973) indicates that a high market share could be the outcome of a firm outperforming its rivals due to its excellent efficiency and not because of anticompetitive conduct. De-Ramon and Straughan (2016) argue that the HHI provides little information about competition intensity, although it gives a proper background to industrial sectors and/or markets. These writers present an example of the UK competition authority that considers the HHI a signal of a competition issue of merger activity that could occur and is worth investigating. Van Leuvensteijn et al. (2011) stress that the HHI does not distinguish between small and large countries.

Bikker and Haaf (2002a) find that the HHI is a popular indicator of measuring competition in the banking industry because of its link to the Cournot competition model. To understand the intuition behind the direct relationship between the HHI and the weighted average of the profit margins of banks under Cournot competition, it may be helpful to present the following proof.

As mentioned above, the Cournot model is a popular economic model of imperfect competition that depends on the amount of output produced by firms (see section 4.2). If we assume oligopolistic competition between *n* firms offering an identical product with different linear marginal costs, the profit of firm *i* is:

$$\pi_i = P(Q)q_i - c_i q_i, \qquad Q = \sum_{i=1}^{n} q_i \tag{3}$$

where π_i is the profit of the i firm, q_i is the output produced by each firm, c_i is the marginal cost of each firm, and P(Q) is the price of the product. In order to maximise the firm's profit, we took the derivative of profit with respect to the quantity:

$$\frac{\partial \pi_i}{\partial q_i} = P'(Q)q_i + P(Q) - c_i \Rightarrow -\frac{dP}{dQ}q_i = P - c_i \tag{4}$$

Then we divided by P to give the profit margin of each firm in the market:

$$\frac{P - c_i}{P} = -\frac{dP}{dQ}\frac{q_i}{P} = -\frac{dP/P}{dQ/Q}\frac{q_i}{Q} = \frac{s_i}{\eta} \tag{5}$$

The market share is $s_i = q_i/Q$, and the elasticity of demand is $\eta = -dlogQ/dlogP$. Thus, when we multiplied the profit margin of each firm by its market share, it gave us:

$$s_1\left(\frac{P - c_1}{P}\right) + \cdots + s_n\left(\frac{P - c_n}{P}\right) = \frac{H}{\eta} \tag{6}$$

where H is the HHI.

However, Bos et al. (2017) advise that there are risks in using the HHI as a competition measure, due to the two types of bias that it encourages: the omitted variable and the aggregation bias, which jointly weaken tests of market power based on the Cournot model. The writers demonstrate their point by showing that the conjectural variation[42] has been omitted from the market power tests even though it is crucial to combine this variable with the firm's market share in explaining collusive rents[43]. Furthermore, they extend the work of Cowling and Waterson (1976) and Cowling (1976) and find that the HHI is accurate only for estimating perfect competition. Thus, Bos et al. (2017) introduce another approach that computes how large a firm should be to reach critical mass as a collusive oligopolist. This critical mass built upon the HHI is considered a market power metric for competition analyses.

[42] The conjectural variation is the intensity of firms' expectation that other rivals will react to their output changes (see Bos et al., 2017). It is merely an elasticity-adjusted Lerner index (see Leon, 2015).
[43] Collusive rent refers to the percentage of the markup attributable to market power (see Bos et al., 2017).

Calkins (1983) sees that tiny errors in computing the dominant firm's market shares lead to considerable differences in the HHI[44]. Berger (1995) contends that the empirical studies which focus on bank efficiency find evidence that the HHI alone cannot be used as a proxy for competition. Like the concentration ratio, markets should be defined appropriately, and other factors should be taken into account to obtain a reliable HHI.

2.3.2 The New Empirical Industrial Organisation (Non-Structural Approach)

Recent years have seen the literature on industrial organisation (IO) shifting from emphasizing market concentration measures of bank competition to concentrate more on bank profitability when market contestability varies (Lamers and Purice, 2017). Thus, the IO has been modified to include additional theoretical foundations and introduce new bank competition measures more advanced than the SCP and the efficient structure hypothesis, the so-called New Empirical Industrial Organisation (NEIO) (Matthews and Thompson, 2008). Shortcomings in the SCP approach and its concentration measures have led economists to apply different methodologies to find empirical evidence for the extent of bank competition through observing conduct directly (Liu et al., 2013). In 1989, there was a dramatic shift in the IO approach, which ushered in a new era of NEIO established by Bresnahan (1989). These new measures are considered non-structural approaches that take bank-level data and profit-maximising firms as a starting point (Lamers and Purice, 2017). Leon (2015) indicates that concentration measures are still adopted in finding the intensity of bank competition, because they are easier to compute. Nevertheless, several studies in the past two decades have emphasised other market structure factors, particularly entry/exit barriers. The NEIO measures discussed here are the Lerner index, the Panzar-Rosse H-statistic, and the Boone indicator.

The NEIO focuses on using econometric models to estimate specific aspects of conduct in individual industries or similar markets, measure market power and infer the variations in the collusive-competition behaviour of firms. The first generation of NEIO non-structural approaches was built upon oligopoly theory (the neoclassical conception of competition) (Leon, 2015) which is one of its major strengths (Liu et al., 2013).

The NEIO observes market conduct in specific industries directly and then interprets the observed patterns to determine the market structure. Under the NEIO, several alternative methodologies have been employed that need reliable data and assumptions. Liu et al. (2013) highlight that a growing empirical literature in the NEIO has investigated the behavioural models that determine how firms set their prices and quantities. Moreover, they demonstrate that the main challenge for NEIO research is to introduce ways of transforming behavioural relationships that are unobservable into relationships where the variables can be observed. The non-structural indicators of the NEIO literature are built from the

[44] See Calkins (1983, p.405) for a mathematical example.

static theory of the firm hypothesised under equilibrium conditions and focus on adopting some form of mark-up over a competitive benchmark (Carbó et al., 2009). Primarily, these measures have been used to compute realised conduct in firm pricing that depends on the measurements of monopoly power initiated by Lerner (1934). Iwata (1974) proposed the conjectural variation parameter to estimate prices in an oligopolistic market. Bresnahan (1982) focused on testing competitive behaviour in contestable markets. Panzar and Rosse (1987) introduced the H-statistic that connects input cost changes to output price changes to determine the intensity of bank competition. More recently, Boone (2008) developed the Boone indicator, which focuses on profits and measures of efficiency in competitive markets.

The following subsection presents frequently used NEIO non-structural measures in banking, namely the Lerner index, the Panzar Rosse H-statistic, and the Boone indicator.

2.3.2.1 The Lerner Index

Much of the literature since the mid-1980s has focused on measuring market power and efficiency to estimate the extent of bank competition. However, measuring the extent of market power has been hotly debated, especially market power between banks, because of its effect on the stability of the financial sector (Coccorese, 2014). From one side, the "competition-fragility" view modelled by Marcus (1984), Chan et al. (1986) and Keeley (1990) refers to the opposite relationship between competition and the bank's market power and profitability. Hence, it encourages banks to operate aggressively and apply risk-taking behaviour to increase returns, consequently undermining the market's stability. On the other side, Boyd and De Nicoló (2005) present the "competition-stability" view, which considers the increase of market power as an indication that the banks should charge higher interest rates, thus making it more difficult for customers to repay loans and boosting moral hazard and adverse selection problems through adopting more risky projects. Consequently, such behaviour increases the volume of nonperforming loans and negatively affects financial stability (Berger et al., 2008).

Leon (2015) mentions that economists have used the Lerner index since the mid-1930s; lately this index has been applied specifically to banking due to the difficulty of determining marginal costs. During the past two decades, marginal costs have been extracted from the translog-cost function, ensuring that more competitive conditions in the market would lead to positive implications for banks, customers, and the entire economy. Using the Lerner index in the banking context helps to capture the mark-up that the banks charge their borrowers by computing the spread between loan interest rates and marginal costs. This is a direct proxy of measuring bank competition (Coccorese, 2014).

In empirical research, the Lerner index, also called the price-cost margin, is a widely used measure of market power. Leon (2015) highlights that the Lerner index originates in static oligopoly theory (the Cournot model), which is the most popular model of imperfect competition. The number of firms is a significant variable for building the Cournot model because n firms set the quantities produced. We label a typical firm *i* and the number of firms from *i* =1 to *i*=*n*. Each firm operating in the market chooses to sell quantities of products higher than or equal to zero ($q_i \geq 0$) taking into account the costs of these quantities, $c_i(q_i)$. The sum of all the quantities produced is (Q= $\sum_{j=1}^{J} q_j$). The market price gained from firms' competition is *P(Q)*. The profit maximisation formula for firm *i* is:

$$\max_{q_i}[(P(Q)q_i - C(q_i, \omega_l)] \tag{7}$$

where q_i is the quantity produced by firm *i,* C(q_i, ω_l) is the total cost of firm *i*, and ω_l is the vector of the market price of the production factors adopted by firm *i*.

The market power of a firm is determined by the spread between the firm's price and its marginal cost. In particular, it can be estimated from using bank-level data and assuming profit-maximising behaviour according to the theoretical price and output determination frameworks. Hence, in perfect competition, the firm's price equals the marginal costs, and whenever these two variables diverge, the market will be less competitive and will come closer to a monopolistic condition (Freixas and Rochet,1997;2008).

Lerner (1934) proposes the Lerner index (L) as a market power measure, as follows:

$$L_{i,t} = \frac{P(Q) - C'_{q_i}(q_i, \omega_l)}{P(Q)} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} \tag{8}$$

where *P* is the output price in the market for firm *i* at time *t*, the sum of all quantities produced is (Q= $\sum_{j=1}^{J} q_j$), $C'_{q_i}(q_i, \omega_l)$ and *MC* is the marginal cost of the firm. The Lerner index equals zero in the situation of perfect competition, and the inverse of the price elasticity of demand is the monopoly condition (optimal mark-up of price exceeds marginal cost)[45].

The monopolist's optimal mark-up is as follows:

$$L_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} = -\frac{1}{\mathrm{E_d}} \tag{9}$$

where E_d is the elasticity of demand for the entire market.

Turning now to discuss the advantages and shortcomings of the Lerner index, as presented in the literature, we see that this index is a non-structural measure of competition that is widely used because of its simplicity and the straightforwardness of its interpretation (Leon, 2015). It captures a firm-year measure of market power and can be used to study the evolution of bank pricing conduct over time (Coccorese, 2014). Beck et al. (2013) mention that computing the Lerner index does not need a full

[45] The inverse elasticity pricing rule.

description of the geographical or product market of the bank. Delis (2012) considers the Lerner index to be a valuable indicator of market power because the banking sectors of several countries show a high correlation between the Lerner index and the Boone indicator. Turk-Ariss (2010) shows that researchers studying banking applications can easily disconnect monopoly and monopsony power by omitting financial costs from total costs and deposit prices. Leon (2015) contends that the Lerner index can be estimated with a limited number of observations.

Among its shortcomings, however, the Lerner index has some major theoretical and practical limitations. Leon (2015) that if the Lerner index is a measure of pricing market power and not a proxy of competition, the pattern between the average market power and the competition intensity over time could be positive. For instance, from the Austrian School perspective, an increase in competition encourages firms to cope with the competition by innovating. Thus, an increase in the Lerner index over time may not be a negative signal of competitive conditions. Boone (2008) concentrates on the efficiency of firms and concludes that even if the Lerner index decreases with competition, the average degree of market power may increase, decline, or remain stable as a result of the reallocation effect from inefficient to efficient firms. It should be noted that efficient firms generate a higher price-cost margin than their counterparts do. Vives (2008) argues that the Lerner index cannot capture clearly the extent of product substitutability. Fernández de Guevara et al. (2005) claim that the Lerner index could overestimate market power when banks' risk-taking is not accounted for, meaning that banks that spend more of their resources on loans generate higher margins. Thus, this issue could be problematic for empirical studies that adopt the Lerner index to investigate the "competition-stability" view (Berger et al., 2009; Beck et al., 2013). The changes in non-competitive factors may account for the variations of Lerner indices across countries and over time. Kotter et al. (2012) note that the conventional way of computing the Lerner index assumes perfect technical and allocative efficiency. However, this assumption is not applicable in the banking context because banks rarely operate under perfect efficiency (Leon, 2015). Moreover, Caffai et al. (2001) observe that operating costs and efficiency change according to the economic environment and banks' response to it.

2.3.2.2 The Panzar-Rosse (PR) H-statistic

The Panzar-Rosse H-statistic is also one of the most widely adopted indicators of bank competition. It was proposed by Panzar and Rosse in 1987. The H-statistic is computed by taking the sum of the elasticities of revenues with respect to input prices. Hence, it captures the transmission of input costs to the firm's revenue. A weak pass-through of costs to revenues is indicated as higher market power. In contrast, full pass-through is interpreted as a highly competitive condition (Leon, 2015; De-Ramon and Straughan, 2016).

The intuition behind estimating the H-statistic is straightforward in two opposed scenarios: monopoly and perfect competition. In the case of monopoly, the primary concern of a monopolist is to maximise profit. This can be obtained when the marginal cost equals the marginal revenue (at equilibrium). Both are the economic measures that set the amount of output and the price per unit that maximises profit. Following an increase in input prices, marginal cost increases. Thus, to preserve the equilibrium between marginal costs and marginal revenue, a monopolistic firm must raise its marginal revenue by reducing the total quantity. Rosse and Panzar (1977) notably mention that when the price elasticity of demand reaches a value above 1, the total revenue will decrease. Hence, an increase in the input prices is not enough to cover the reduction in output. Therefore, the elasticities of the monopolist's revenue compared to costs are negative. The other case is perfect competition. Under this market condition, each firm in equilibrium produces zero economic profits. Any rise in input prices generates an increase in total revenue due to the cost function, which is homogeneous in degree 1 to input prices. Hence, any variation in input prices produces a similar variation in marginal cost. This means that a firm's revenue changes by the value of its total cost, and so the same percentage as its input prices is needed to maintain the same zero economic profit (i.e., total cost equals total revenue) (Leon, 2015). However, a sustained rise in input costs will induce negative economic earnings in the short run. To adjust the market and return to zero economic profit, some firms should exit the market, reducing aggregate supply and boosting output prices such that the revenue of incumbent firms offsets the increase (De-Ramon and Straughan, 2016). Thus, in perfect competition, the elasticity of the firm's revenue to costs will be unity.

Theoretically, measuring competition intensity is identified as computing the sum of the elasticities of the revenue to the underlying input prices. This is what is called the H-statistic; its value ranges from -∞ to +1. In practical terms, the H-statistic generally ranges between zero and one, but if the index reaches negative values, it indicates a perfect monopoly. The H-statistic equals 1 when the input prices and total revenue rise by the same percentage, which occurs when the market is under perfect competition. However, Shaffer (1982) finds evidence that the H-statistic could be 1 for a monopoly in a contestable market (with no barriers to entry). An H-statistic between zero and 1 implies monopolistic competition. Vesala (1995) finds that the H-statistic is non-positive in monopolistic competition without the threat of entry or for a collusive oligopolist. Last, zero or a negative H-statistic is associated with a monopoly.

The H-statistic is obtained by taking the logarithm of revenue on the logarithm input prices and other control variables, as follows:

$$ln(P_{i,t}) = \alpha_i + \beta_1 ln(W_{1,it}) + \beta_2 ln(W_{2,it}) + \beta_3 ln(W_{3,it}) + \gamma ln(Z_{it}) + \delta D + \varepsilon_{it} \qquad (10)$$

where P is the output price for operating bank i at time t. $W_1, W_2, and\ W_3$ are all input prices. Z is a matrix of exogenous control variables.

$$H - statistic = \sum_{j=1}^{J} \beta_j \tag{11}$$

The H-statistic is estimated using the sum of the input price elasticities of the gross revenue ($\beta_1 + \beta_2 + \beta_3$). It is worth noting that the explanation of the H-statistic requires the industry to be in long-run equilibrium insofar as a monopolistic condition needs an endogenous number of firms (Leon, 2015).

We next discuss the advantages and weaknesses of the H-statistic. Panzar and Rosse's H-statistic measures the competitive behaviour of banks without explicitly using data on the market structure since this is calculated by estimating the deviation from competitive pricing (Northcott, 2004). Leon (2015) argues that the success of the PR indicator lies in its simple interpretation and does not need stringent data. Thus, it can be obtained from a relatively small number of observations. The major advantage of the PR model in cross-country studies is that it does not require a specific market definition for the revenue equation; only bank-level data are needed to estimate the revenue equation (Shaffer, 2004).

The PR model, however, suffers from major limitations. One of them, highlighted by Bikker et al. (2009) and Shaffer and Spierdijk (2015), concerns the econometric identification and interpretation of the outcomes. These writers strongly criticise the use of this model as a measure of bank competition. They find evidence that positive values of H-statistic can appear in all types of model and most standard oligopoly conditions. Moreover, their results are robust to whether banks use identical or different costs, products, price or quantity as their strategic variable and whether or not they engage in collusive or competitive behaviour. In interpreting the H-statistic, Panzar and Rosse (1987) emphasise that the sign and the magnitude matter. However, Shaffer and Spierdijk (2017) conclude that the H-statistic requires the behavioural assumption of the bank's position in the market; thus, "neither the sign nor the magnitude of the H-statistic can reliably identify the degree of market power" (ibid, pg.14). Another pitfall is touched on by Leon (2015): that firms where the results of the H-statistic have been different are those which have a constant elasticity of demand. Shaffer (1983) finds it alternatively an increasing function of the Lerner index. Panzar and Rosse (1987), however, indicate the opposite. To be precise, high values of the H-statistic do not necessarily mean low market power.

Furthermore, Northcott (2004) observes that the PR model may not be an accurate and reliable indicator of bank competition for transition economies, although it may be reasonable to use it for developed economies because it is drawn from firm-level data and assumes that the market is in long-run equilibrium (with an endogenous number of firms). Shaffer (1983) demonstrates an equilibrium test to validate the market equilibrium hypothesis, although in long-run equilibrium the profits are uncorrelated with input prices. Hence, the test focuses on using profit rates, such as the return on assets instead of total revenue. Leon (2015) submits that the PR indicator is sensitive to monopsony power. This view is discussed by Shaffer (2004), who stipulates that in estimating the H-statistic, inputs should be homogenous and exogenous prices fixed. In the banking context, the price of deposits is not exogenous; the bank may act like a monopsony only when other savings products are not available. Shaffer (2004) highlights that monopsony power may generate a higher value for the H-statistic and consequently disguise any market power that appears on the output side.

2.3.2.3 The Boone indicator

Recent advances in the study of competition indicators have facilitated the investigation of a new measure called the Boone indicator. Boone (2008) introduced this indicator, which depends on the idea that efficient firms work better and generate more profits in more competitive markets. Thus, it measures the effect of efficiency on performance and relates the measurement to the efficiency hypothesis. Boone (2008) calls his indicator the relative profit difference (RPD), but the empirical literature knows it best as the Boone indicator. De-Ramon and Straughan (2016) reason that the Boone indicator relies on the output-reallocation effect, and hence, when the market is highly competitive, efficient firms are willing to expand their output at a lower cost and generate more profits than less efficient firms. Consequently, less efficient firms exit the market leaving the efficient incumbent firms to expand further. Hence, the output is reallocated to more efficient firms. The degree of competition can be raised either by greater interaction between the rivals operating in the market or by lax barriers to entry (Boone 2008; Van Leuvensteijn et al., 2011; De-Ramon and Straughan, 2016).

Boone (2008) describes this effect in greater detail as follows: If three firms are operating in the market with various level of efficiency, $n'' > n' > n$, a rise in the extent of competition, due either to aggressive interaction between these firms or lower barriers to the entry of others, benefits the most efficient firm such that the profit that is spread between the most and the least efficient firms $(\pi(n'') - \pi(n))$ increases much more quickly than does the profit spread between a less efficient firm and the least efficient firm $(\pi(n') - \pi(n))$. In this intense case, competition rises by $[\pi(n'') - \pi(n)]/[(\pi(n') - \pi(n)]$. From a theoretical point of view, Boone shows that his indicator is a robust measure of competition compared to other structural and non-structural indicators. Moreover, De-Ramon and Straughan (2016) describe the output reallocation effect of the Boone indicator as consistent with the Lerner index and its adjustments.

The Boone indicator can be obtained by running the following equation[46]:

$$ln\pi_{i,t} = \alpha + \beta ln(c_{it}) \qquad (12)$$

where π_{it} is the profit rate of operating firm i at time t, the coefficient β indicates the profit elasticity[47] which is the Boone indicator, and c_{it} is a measure of costs (proxied efficiency). The data required to

[46] The equation that estimates the Boone indicator has been specified in log-linear terms to control for heteroskedasticity (see Van Leuvensteijn et al., 2011).
[47] Put differently, it is the percentage decrease in the profits of firm *i* as a result of a percentage rise in firm *i*'s costs (see Leon, 2015).

obtain the indicator is similar to those of the Lerner index (Schiersch and Schmidt-Ehmcke, 2010). In theory, this indicator is negative because higher costs are associated with lower profits. Boone et al. (2004) and Van Leuvensteijn et al. (2011) use the same methodology to estimate competition intensity by replacing firms with banks and profits by market shares[48].

Interestingly, Van Leuvensteijn et al. (2011)[49] argue that the Boone indicator succeeds in clarifying why other measures of competition such as the HHI and the Lerner index fail as reliable indicators. Xu et al. (2013) investigated the extent of competition in the Chinese loan markets after progressive financial reforms by using the Lerner index, the PR model and the Boone indicator. They found that the Boone indicator outperforms the other measures because it shows that the lending market has been affected by the reforms and has boosted the competitive intensity. However, Schiersch and Schmidt-Ehmcke (2010) claim that the empirical applicability and robustness of the indicator are still unknown. They came to this conclusion after failing to measure correctly the competition among German manufacturing firms. They found that the Lerner index was the only measure that captures the expected competitive changes.

In practice, the Boone indicator requires only data on profits (the market share) and costs to be estimated by a simple linear econometric model. Furthermore, it captures market dynamics and obtains them easily, using a limited number of observations (Leon, 2015). Perhaps the most serious disadvantage of the Boone indicator is that it concentrates on one relationship influenced by competition and ignores other aspects. Another pitfall is that the β coefficient is expected to be negative, but it can also be positive. Tabak et al. (2012) mention that the Boone indicator could be positive in a situation of aggressive competition between rivals if the right level of quality were provided. Traditionally, all non-structural measures of competition assume that firms (banks) provide homogenous goods and services. They may do so in the long run, but not in the short run. The Boone indicator uses costs to reflect differences in efficiency, but when incumbent firms offer heterogeneous goods or services, the extent of competition will increase, so firms may initiate a new strategy[50] (more costs) to cope with the changes in the market as an alternative to reducing prices. Thus, the Boone indicator turns into a positive. Van Leuvensteijn et al. (2011) and Schaeck and Cihák (2014) provide theoretical proof that differentiates the Boone indicator from the HHI and the Lerner index in the banking context.

2.3.3 Financial Stability and Bank Competition: Different Theoretical Mechanisms

Various theoretical models have been put forward to assess the relationship between bank concentration, competition and stability and have made contrasting predictions. Indeed, in dynamic and static models these estimations may differ and have essential interactions with the regulatory framework

[48] $lns_i = \alpha + \beta' lnc_i$, where s_i is the market share of bank i.
[49] See Van Leuvensteijn et al. (2011) for more details.
[50] Innovate with a new product, open branches, target new customers, etc.

components, for example, deposit insurance (Beck, 2008). In our analysis, we focus on two main theoretical views on this issue. The traditional view argues that competition in the banking sector leads to fragility, while the other view suggests that an increase in competition leads to greater stability. Carletti and Hartmann (2003) provide an in-depth analysis of the literature on the relationship between competition and stability in the banking sector. Similarly, in a key study, Allen and Gale (2004) compare the theoretical mechanisms that can produce relationships between competition and stability.

2.3.3.a Competition-Fragility view

The competition-fragility view, also known as the "franchise value"[51] paradigm, was proposed by Marcus (1984), Chan et al. (1986) and Keeley (1990). It was based on the concept that less concentrated and more competitive banking systems are more fragile. According to their theoretical model, banks tend to adopt more excessive risks in more competitive environments where substantial pressure is exerted on profits, resulting in excessive fragility. In markets where competition is limited, however, banks have profit opportunities and capital cushions, thus, fewer incentives to adopt excessive risk (Beck, 2008). Keeley (1990) concludes that the deregulation process in the U.S. in the 1970s and 1980s increased bank competition and eroded monopoly rents. As a result, there was an increase in bank distresses because of the general decline in the value of bank charters. This intensified the agency problem between bank owners and deposit insurance funds. It gave bank owners more incentive to pursue aggressive risk, knowing that guaranteed funds were available from deposit insurance (Allen and Gale, 2004).

Demsetz et al. (1996) define the franchise value as the present value of the stream of profits that a bank as a going concern is anticipated to generate. Its main sources – efficiency, entry to markets protected from competition, and lending relationships – should be valuable. They show a negative relationship between franchise value and both individual bank distress and systemic risk. Their empirical results suggest that banks that are more efficient are the ones that operate in less competitive markets. Furthermore, banks with high franchise value maintain more capital and take on limited portfolio risk, thus helping to reduce overall risk.

For Berger et al. (2009), the competition-fragility view indicates that more bank competition erodes market power and reduces profit margins; therefore, to increase returns, banks may engage in excessive risk. But this may result in reduced franchise value, i.e., the banks' market value beyond their book values. As noted by Beck (2008, p.8), the main justification of this view is that *"profits provide a buffer against fragility and provide incentives against excessive risk-taking".*

[51] Or the "charter value" view can be measured using Tobin's Q (see Demsetz et al. (1996), De Jonghe, O. and Vander Vennet, R. (2008) and Zhao, Y. (2017).

In a condition of perfect competition, banks generate zero profits, and the potential to acquire future profits diminishes (zero franchise value); hence, bankers will relax their asset portfolio selection requirements because they have nothing to lose. At the same time, when banks gain more market power and a positive franchise value, bank managers and owners are motivated to be cautious in their risk-taking activities (Kasman and Kasman, 2015). Commenting on this pattern, Fu et al. (2014) argue that higher franchise value generates more significant opportunity costs during bankruptcy; thus, both managers and owners of banks may be unwilling to intervene in risky investments that promise to improve the asset quality of the banks. Interestingly, Matutes and Vives (2000) point out in a dynamic model of imperfect competition that higher market power plays a role in reducing a bank's default probability.

Allen and Gale (2004) discuss the agent model by Keeley (1990), claiming that financial crises are more likely to arise in less concentrated banking systems because excessive competition negatively affects the franchise value of banks by reducing monopoly rents. Hence, banks are motivated to pursue risky investments to generate more profits as a buffer against deterioration in asset quality. Likewise, Hellmann et al. (2000) mention that competition tends to have a negative influence on the prudent behaviour of banks. Boot and Greenbaum (1993) state that a more competitive environment lowers banks' incentives to properly screen borrowers because banks have fewer informational rents from their relationship with borrowers; hence, the fragility in the banking system rises.

A less competitive environment can have positive repercussions for liability risk. Smith (1984) points out that a reduction in liability risk leads to the greater stability attainable in a less competitive banking system, especially if the information about the probability distribution of depositors' liquidity needs is private. Most importantly, in such market conditions, banking relationships may endure longer. However, Matutes and Vives (1996) claim that bank illiquidity can appear in any market structure because concentration is not a reliable signal of competition.

Another aspect that can influence the relationship between competition and stability is a bank's size. Diamond (1983), Ramakrishnan and Thakor (1984), Boyd and Prescott (1986), Williamson (1986) and others indicate that large banks dominate the banking sector in more concentrated markets because they can capitalise on economies of scale and scope and have better diversification strategies to manage their portfolios. Beck et al. (2006) and Uhde and Heimeshoff (2009) suggest a positive correlation between the size of a bank and organisational complexity. As long as the size of a bank increases and extends to more regions, it obliges managers to use sophisticated financial instruments, though this allows them to build complex corporate organisations with lower transparency. This view is supported by Certorelli et al. (2007), who also argue that larger banks may to a greater extent negatively affect managerial efficiency, manage effective internal corporate control and raise operational risk in a way that is most likely to lead to supervisory failures. Furthermore, large banks may raise concerns about moral hazard if the dominant banks are secured by the presumption that they are too big to fail.

Models of financial contagion provide an alternative explanation for the positive impact of competition on financial stability via interbank markets and payment systems. Allen and Gale (2000) argue that in a perfect competition environment, banks avoid providing liquidity to other banks exposed to a temporary liquidity shortage. Since, in this situation, all banks are price takers, they have no incentive to inject liquidity into a fragile bank; as a result, the troubled bank may affect the whole sector. Similarly, Saez and Shi (2004) state that in an imperfect competition market, a limited number of banks in the same market can cooperate in providing liquidity to any other banks exposed to a temporary liquidity shortage. Boyd et al. (2004) claim that the existence of large banks in the concentrated banking system may promote profits and lessen the probability of financial distress by providing substantial capital buffers to protect these systems from external macroeconomic and liquidity shocks.

Regarding payment systems, banks are no longer the only provider of payments-related services to customers. Nonbanks have entered the market and have offered competing products to bank customers; thus, competition is increasing and affecting the franchise value of banks. Rice (2003) points out that there is a positive relationship between payment-driven revenues and franchise value. Moreover, she argues that financial conglomerates have reduced the franchise value of 98 large banks operating in the U.S. Weisbrod et al. (1992) investigate the evolution of the franchise value of banks operating in the U.S. and Japan. They have found that the main reason for the reduction in the franchise value in both countries is attributable to a decline in corporate demand for bank liquidity. Hence, banks in the U.S. have raised their risk-taking, and Japanese banks have been exposed to reduced earnings.

Policymakers and regulators can enhance banks' franchise value and, thus, prudent risk-taking, by imposing rules and regulations. For instance, deposit insurance schemes and capital requirements have been judged to attenuate the risks. Zhao (2017) argues that banks' franchise value can mediate the connection between the market mechanism and government intervention. Studies of the competition-fragility view show the importance of deposit insurance to mitigate fragility by preventing bank runs (Diamond and Dybvig, 1983). However, the existence of a deposit insurance scheme may introduce sufficient moral hazard to incentivise banks to pursue excessive risk and reduce the incentive of market participants to monitor the system (Beck, 2008). In a comprehensive study of the multiplicative method of deposit insurance, Matutes and Vives (1996) developed a framework that connects incentive and competition theory, concentrating on the rivalry between financial institutions in imperfect competition and the policy implications of deposit insurance. They found that deposit insurance presents welfare trade-offs: on the one hand, this can avoid systemic confidence crises, reduce transport costs and possibly extend the market by boosting the incentive to deposit. On the other, deposit insurance schemes can boost unhealthy competition between rivals, reduce diversification benefits, and consequently magnify the probability of failure. Cordella and Yeyati (2002) present the differences between fixed-rate deposit insurance schemes and risk-adjusted deposit insurance premiums. They find that excessive competition raises deposit interest rates and risk but reduces profits due to applying preliminary schemes. In terms of risk-adjusted deposit insurance premiums, banks will be more flexible over mitigating asset risk, thus reducing the cost of funding even in competitive conditions.

Turning now to consider another regulatory measure, we find that banks' minimum capital requirement can also promote the franchise value and lessen the incentive to take greater risks. Demsetz et al. (1996) argue that banks that build high franchise value will seek to preserve it. Banks may hold more capital than the regulations require in order to limit their exposure to risky borrowers and concentrate on keeping a well-diversified loan portfolio. Moreover, they point out that capital requirements can give bank owners the incentive to avoid excessive risk-taking. However, it is worth mentioning here that the bank's capital position may change over time, depending on changes in economic conditions, interest rates, and loan demand, whereas sources of franchise value, such as those related to efficiency, are stable. Banks with high franchise value are able to operate at little cost and still earn profits even under poor economic conditions. Thus, such banks will have an incentive to avoid excessive risk behaviour throughout the business cycle. Anginer and Demirguc-Kunt (2014) find that high-quality capital forms reduce banks' systemic risk contribution. They argue that the effect of capital on systemic risk is less evident in small banks, in banks operating in countries with more generous safety nets, and in countries that have sound public and private supervision of financial institutions. Hellmann et al. (2000) find evidence that capital requirements and deposit interest ceilings are essential to prevent banks from following excessive risk-taking in a competitive marketplace. However, Keeley and Furlong (1990) argue that higher capital requirements may affect bank equity and this in turn reduces banks' franchise values.

Last, it is important to take into account the number of banks that authorities supervise. Beck et al. (2006) show that the overall stability of a banking system can be enhanced if a more concentrated banking system means a small number of banks operating in the market, since this may alleviate the supervisory burden.

2.3.3.b Competition-Stability view

We next discuss the "concentration-stability" view, which opposes that of the franchise-value proponents. Boyd and De Nicoló (2005) suggest that the argument that more concentrated banking systems boost profits and consequently lead to bank stability does not take into account the potential influence of the banks' market power on firm behaviour. Furthermore, in criticising the competition-fragility view, they highlight the significant effect on regulators and the central banks that have taken anti-competitive action in response to banking instability. They claim that a substantial risk-incentive mechanism exists on the asset side of the bank's balance sheet; less competition allows banks to acquire more rents in their loan markets by charging high loan rates. Hence, it raises the chances of moral hazard and the probability of borrowers' defaulting, consequently boosting the bank's risk of failure. Put differently, concentrated banking systems raise the market's power to let banks increase firms' interest rates. Ultimately, borrowers may engage in excessive risk-taking to pay the high loan instalments and interest rates set by monopolistic banks. Consequently, non-performing loans may increase, negatively affecting banks' performance and raising the probability of distress. Boyd and De Nicoló (2005) find evidence of the positive relationship between concentration and bank instability and thus the probability of systemic distress.

Martinez-Miera and Repullo (2008) mention that Boyd and De Nicoló (2005) have followed the credit rationing perception of Stiglitz and Weiss (1981): they reason that the decline in loan rates in response to high bank competition reduces the probability that the borrower will default. They also see a perfect correlation between loan defaults and the probability of a bank's failure. Hence, they find that competition mitigates the risk of bank failure. Furthermore, as Stiglitz and Weiss (1981) note, higher interest rates tend to boost the riskiness of a loan portfolio due to adverse selection and moral hazard problems. Since higher rates discourage safer borrowers, other borrowers are involved in risky investments and exposed to a higher probability of default. Thus, non-performing loans increase, dramatically affecting the bank's financial position and undermining financial stability (Berger et al., 2017). This view is supported by Caminal and Matutes (2002), who indicate that less competition can lower credit rationing and allow larger loans, thus increasing the probability of bank distress if credit is subject to multiplicative risk. Martinez-Miera and Repullo (2008) show that there is a U-shaped relationship between competition (computed by the number of banks) and bank fragility. They point out that higher interest rates mean higher interest revenues for banks, generating this nonlinear relationship. They argue that the risk-shifting effect dominates in highly concentrated markets, and thus removing barriers to entry reduces the probability of bank distress. However, the margin effect dominates in competitive markets, so more rivals increase the likelihood of failure.

Proponents of the "competition-stability" view also discuss the effect of banking regulation. Mishkin (1999) remarks that larger banks presumably have more chances to get public guarantees or subsidies, following the "too big to fail" doctrine. Thus, the likelihood of moral hazard will rise as a problematic result of the risky investments made by managers of larger banks, who expect to benefit from the government's safety net. Moreover, large banks operating in concentrated markets could increase the risk of contagion, resulting in a positive relationship between concentration and systemic distress (Beck, 2008; Fu et al., 2014). Significant analysis and discussion on the capital requirements are presented by Anginer and Demirguc-Kunt (2014). They suggest that a high capital position can provide a buffer to absorb losses and reduce the effect of systemic risk factors – for instance, asymmetric information, counterparty risk and collective uncertainty – that may generate distresses across institutions. Moreover, they point out that the type of capital matters means that the main emphasis should be given to Tier 1 and tangible equity because, like Tier 2 capital, it is classified as high-quality. They provide suggestive evidence of the substantial benefit of macroprudential policies after crises, which has inevitably strengthened the correlation between capital and systemic stability.

Regarding the issue of the number of banks that authorities supervise, Beck (2008) argues that a positive relationship can be seen between the size and complexity of a bank, confirming that monitoring large banks is more difficult than monitoring small ones. If all the other characteristics of the economy are held constant, concentrated banking systems imply the existence of large banks operating in the market. In the recent trend towards consolidation, Beck (2008) also finds the building of financial conglomerates offers various sophisticated financial services; this, he says, could become a complicated issue for regulators. The finding may confirm the positive relationship between concentration and fragility.

CHAPTER 3

Early Warning Systems for Banking Crises in the MENA Region

3.1 Introduction

The high rate of crises in the world economy since 1970, and particularly the Global Financial Crisis (GFC) of 2007-2009, forced policymakers to put more effort into modifying the rules and regulations for the banking system to ensure greater robustness. Furthermore, particular attention has been paid to determining the factors that help to promote risk-taking and lead to systemic banking crises. Hence, several studies have focused on investigating the leading indicators of systemic banking crises; for example, Demirgüç-Kunt and Detragiache (1998) have sought the main determinants of banking crises in developed and developing countries, Eichengreen and Rose (1998) examined developing countries only, Barrell et al. (2010a) concentrated on examining advanced economies, and Babecký et al. (2013) analysed data from European and OECD countries.

However, there has been no detailed investigation of the systemic banking crises that have occurred in the Middle East and North Africa (MENA), although the MENA region experienced costly banking crises during the 1980s and 2000s (Caprio and Klingebiel, 2002; Laeven and Valencia, 2008, 2013 and 2018). Thus, in order to build a suitable Early Warning System (EWS), this chapter concentrates on determining the leading indicators of systemic banking crises that have occurred in the MENA region.

The MENA region is considered one of the important economic regions in the world because of its geographic location and human and natural resources (El-Erian et al., 1996)[52]. It has the most substantial proportion of world petroleum production and exports and contains about 70 percent of the world's oil reserves and 50 percent of its gas reserves (AMF, 2015). Since the 1990s, MENA's exports to GDP ratio have exceeded the world average because of its petroleum exports (Behar and Freund, 2011). In 2018, the leading oil exporters in the MENA region were Saudi Arabia (the world's largest producer) with 8.8 percent, Iraq 3.6 percent, United Arab Emirates 3.5 percent, Iran 3.36 percent, Qatar 2.8 percent and Kuwait 2.5 percent of global exports (AMF, 2019). Thus, the MENA region has historically produced about a third of the world's oil (Forbes, 2020). Moreover, according to OPEC (2019), most of OPEC's oil reserves are in the Middle East, 64.5 percent of the OPEC total.

[52] IMF Publication.

Their vast natural resources constitute a high proportion of some countries' GDP. For instance, hydrocarbon production accounts for 37 percent of the GDP in Algeria. Cotton, iron, ore, and phosphate are MENA's significant exports. Morocco has most of the world's phosphate reserves, approximately 70 percent, and alone provides 30 percent of the global demand. The service sector and tourism play vital roles in the economic growth of the MENA. On average, the MENA region has a reasonable standard of living compared to other regions; its GDP per capita in 2018 was 8,043 USD. However, the standard of living within the region varies widely: GDP per capita in 2018 ranged from around 69,027 USD for Qatar to 944 USD for Yemen. The oil-producing countries generally have the highest GDP per capita in the region. MENA holds around 7.7 percent of the world's population but shows rapid population growth. Each country in the region is economically, socially, and politically highly diverse.

However, intraregional interaction is fragile, and this affects labour flows and trade in goods and services. Behar and Freund (2011) mention that the MENA region fails to take advantage of global trade integration because of the restrictiveness[53] of the trade regimes in most of the countries in the region.

In the next few years, the economy of MENA will be inclined to grow dramatically (Gurria, 2016)[54] due to the projects of investment in renewable energies, which inevitably will be funded by the banking sector and have the potential to be an essential economic activity. Moreover, some MENA countries[55] are setting new environmental policies[56] to promote green growth. According to OECD (2013), solar and wind energy in the MENA region is considered among the world's greatest. Therefore, supporting investments in this area will contribute to economic growth and create more jobs; the financial intermediaries involved will be dominant players in funding these projects (OECD, 2016).

It should straightaway be clarified, in view of what has been said so far, that financial stability in the MENA region needs to be improved because many countries around the world are economically dependent on it, and it is a dominant provider of natural resources. Therefore, this chapter focuses on finding the leading indicators that contribute to heightening MENA's vulnerability to crises in the region and on providing alerts through building an EWS.

Historically, economists have subscribed to the belief that the leading indicators of banking crises have some connection with macroeconomic variables (Demirgüç-Kunt and Detragiache, 1998; Barrell et al., 2010a). However, in light of recent research, it is becoming difficult in the banking context to ignore

[2] High and complex tariffs, barriers to intra-Arab trade, high logistical costs, and insufficient skills.
[54] Angel Gurria, OECD Secretary-General.
[55] Morocco, Tunisia, Jordan, Egypt and the United Arab Emirates.
[56] For instance, the Jordan Clean Energy Investment Policy Review.

the aggregate banking sector indicators and their correlation with the macroeconomic variables – to be precise, the liquidity and capital adequacy ratios which are significant components of banking regulations – especially since the global financial crisis of 2007-2009. Ergungor and Thompson (2005) point out that interest rate, liquidity, credit and market risk have been the leading indicators of banking crises in the past two decades. In a comprehensive study of banking crises, Barrell et al. (2010a) found that the main determinants of banking crises in OECD countries were banking sector indicators (liquidity and unweighted capital adequacy ratios) and real house price growth. Caggiano et al. (2014) studied low-income countries in Sub-Saharan Africa, following the methodology of Bussiere and Fratzscher (2006), which used a multinomial logit model[57]. Caggiano et al. (2014) reported that regulators concentrate on balance sheet variables when setting prudential frameworks for achieving financial stability. Thus, in the design of the EWSs, banking sector indicators should be included to consider all triggers of a crisis fully. Due to the growing complexity of the financial system, Gramlich et al. (2010) reassessed the existing EWSs for systemic banking crises. They see the EWS as an orientational instrument rather than a signalling technique because supervisors analyse past incidents associated with the systemic risk to set the appropriate regulation (the ex-ante approach), which can help to reduce the need for ex-post regulation. Furthermore, they conclude that an efficient EWS should combine both microprudential and macroprudential perspectives because depending exclusively on microprudential indicators cannot give warnings on possible systemic distress, and macroprudential EWS cannot capture a distress signal from individual institutions.

This study examines sixteen critical episodes in systemic banking in the MENA region from 1978 to 2018 to design appropriate EWS, using the definition by Demirgüç-Kunt and Detragiache (1998) of a systemic banking crisis. Then, as a robustness check, we use the tighter definition provided by Laeven and Valencia (2008, 2013 and 2018). Concerning the examined sample, we covered 19 MENA countries. Our sample included both countries that have been exposed to banking crises and those that have never experienced a banking crisis, namely, Algeria (DZA), Bahrain (BHR), Djibouti (DJI), Egypt (EGY), Iran (IRN), Iraq (IRQ), Israel (ISR), Jordan (JOR), Kuwait (KWT), Lebanon (LBN), Mauritania (MRT), Morocco (MAR), Oman (OMN), Qatar (QAT), Saudi Arabia (SAU), Tunisia (TUN), Turkey (TUR), the United Arab Emirates (UAE) and Yemen (YEM).

According to Demirgüç-Kunt and Detragiache (1998), Barrell et al. (2010a) and Davis et al. (2011), limiting the sample exclusively to countries with crises in their history would end up with a biased sample. Moreover, including countries that never experienced a banking crisis serves as a control in the model. In terms of the chosen region, Van den Berg et al. (2008) focused on the poolability issue. They suggest that EWS forecasters should not combine all the possible heterogeneous countries in one pooled

[57] The multinomial logit model was previously employed in the context of currency crises.

dataset because the prediction quality would suffer. Thus, our decision to examine the systemic banking crises in the MENA region is supported.

Achieving financial stability in this region requires thorough research. This chapter aims to provide a coherent analysis of its systemic risk. It identifies the causes of banking crises which, when understood, might lead to the design of an appropriate EWS. In the new global economy, designing an EWS appears to be a central issue for policymakers, especially after the global financial crisis 2007-09. Several studies have revealed the importance of EWS to regulators. Adopting the perspective of Sahajwala and Van den Bergh (2000), we see that developing an EWS and risk assessment procedures is crucial for stabilising the market. It is an ongoing process to assist supervisors in capturing the changes[58] in the financial system as early as possible and improving the capacity to assess risk in individual institutions. Bussiere and Fratzscher (2006) note that policymakers can use the EWS model to detect economic weaknesses and measure vulnerability to take appropriate action. In a recent study, O'Brien and Wosser (2018) identify the usefulness of the EWS in its capacity to raise the resilience of the financial system by providing regulators with a consistently reliable warning signal to take the proper macroprudential actions before a crisis erupts. It appears that policymakers want an optimal EWS to be set up; such a system could apply preemptive actions before events got beyond control and could relax conflicting pressures at minimum cost to society.

No research has been found that focuses on building an EWS for the MENA region. Banking crises in MENA have been qualitatively analysed or studied only in cross-country panels, in combination with those in developed and developing countries (Demirgüç-Kunt and Detragiache, 1998; Kaminski and Reinhart, 1999; Majerbi and Rachdi, 2014; Hamdaoui, 2016). Therefore, it seems vital to add to the EWS literature by analysing the sixteen banking crises that occurred in the MENA region between 1978 and 2018. It should also be a priority to help policymakers in the MENA region set the appropriate regulations and thus have a positive impact on the economy.

This chapter addresses the following research questions: (1) What are the determinants of systemic banking crises in the MENA region? (2) To what extent the explanatory variables of banking crises consistent with those in other regions are? (3) To what extent our proposed EWS can predict a systemic banking crisis? (4) What are the implications of including both oil and non-oil producing countries?

Our contribution to the literature is twofold. We direct attention to analysing the systemic banking crises that have occurred in the MENA region, since no previous detailed study has investigated the causes of banking crises exclusively in the MENA region, although it has experienced several costly examples

[58] For instance, shadow banking and mortgage-backed securities.

(Caprio and Klingebiel, 2002; Laeven and Valencia, 2008, 2013 and 2018). Second, in the context of building EWS, the variables that have been used previously often consisted exclusively of macroeconomic variables and focused on the effect of their relationship on the probability of a banking crisis. However, in this study, we adopt the methodology of Barrell et al. (2010a) for OECD countries and include the banking sector indicators: the liquidity and unweighted capital adequacy ratios. Notably, we consider the inclusion of liquidity and capital adequacy ratios a crucial step by which regulators can strengthen their macro-prudential regulatory framework and build consistent procedures following Basel III requirements.

To our knowledge, no previous study or database has used the full data on liquidity and unweighted capital adequacy ratios for banks operating in the MENA region from 1978-2018. In order to use these two explanatory variables, we had to construct a dataset. Therefore, we analysed 732 banks operating in the region and gathered data from different sources to construct the liquidity and unweighted capital adequacy (leverage) ratios for the examined period. Moreover, the introduction of the marginal effect showed the contribution of each variable in increasing/decreasing the probability of a banking crisis.

Our empirical results are consistent, using definitions of a systemic banking crisis by both Demirgüç-Kunt and Detragiache (1998) and Laeven and Valencia (2008, 2013 and 2018). We conclude that the most critical banking crisis determinants for the MENA region were GDP growth, GDP per capita and the liquidity and capital adequacy ratios, which all have an inverse relationship with the probability of a systemic banking crisis, while the government budget balance to GDP and inflation was positively correlated with the likelihood. Various robustness checks were used to ensure sound justification for the relationship that we found between the variables. We ran the model with different definitions of the systemic banking crisis and checked whether they would yield consistent results. Moreover, we tested the out-of-sample performance of the binomial logit model. We also engaged these results in building the EWS, which may play an essential role in the structural financial reforms pursued by financial regulators and central banks in the region.

The rest of the chapter is organised as follows. Section 3.2 describes the theoretical overview of banking crises. Section 3.3 and 3.4 present the dataset of our dependent and control variables and the econometric methodology employed. Section 3.5 includes the results and findings of the robustness checks. Section 3.6 concludes and presents some policy implications.

3.2 Theoretical Overview

3.2.1 Introduction

So far, this chapter has focused on the theoretical overview of systemic banking crises. See **Chapter 2** for further discussion on the various definitions of a systemic banking crisis. Before reviewing the empirical research on the design of EWS for the systemic banking crisis, firstly, we present in detail the banking crises that occurred in the MENA region, costs of banking crises, leading indicators, the EWSs and the different methodologies applied in the existing literature. Then, we review some of the empirical literature on EWSs in different economies.

3.2.2 Banking Crisis Episodes in the MENA

This section discusses each systemic and non-systemic banking crisis that occurred in the MENA region in the period under review. Leading indicators of banking crises in the MENA region were different across economies because each marketplace has its structural characteristics and crisis severity. We use the banking crisis databases of Laeven and Valencia (2008, 2013, 2018) and Caprio and Klingebiel (2002) to determine the economic conditions that preceded and succeeded in the crisis.

Sheng (1996) and Caprio and Klingebiel (1996) argue that attempts used to managing financial distress are totally different in developed countries than in emerging markets because the challenging economic situation in emerging markets and crises are often more significant. Hence, best practices from industrial economies cannot be replicated in developing economies.

Claessens et al. (2002) demonstrate three phases of systemic restructuring, especially in emerging economies, first "the containment phase; governments tend to implement policies aimed at restoring public confidence to minimise the repercussions on the real sector of the loss of confidence by depositors and other investors in the financial system. The second phase involves the actual financial, and to a lesser extent, operational, restructuring of financial institutions and corporations. The third phase involves structural reforms, including changes in laws and regulations, privatisation of any nationalised financial institutions and corporations, and so on"[59]. Moreover, they claim that usually, policymakers hesitate to act directly to alerts of the banking crisis, waiting for banks and corporations to resolve their problems (Haggard, 2001). However, early intervention with an effective and comprehensive plan can avoid costs and the dramatic consequences of a systemic crisis (Sheng, 1996).

[59] See Claessens et al. (2002, pg.17).

It appears that there is a consensus on several of the characteristics that caused a banking crisis in each country: lack of regulations, supervision, and skilled personnel (Laeven and Valencia, 2018). Furthermore, the credit structure to the public sector was at preferential rates and fulfilled government needs in short-term operations; there were no financial markets or foreign entry restrictions. Reinhart and Rogoff (2009) note that in smaller economies, the frequency of banking crises rises sharply during the establishment of financial markets. They also draw to our attention that any financial crisis is a cause of various factors amplified together, which affect the economy. Below, we introduce the episodes of banking crises that have occurred in the MENA region since 1980, supplying the start and end date of each crisis. In the section that follows, we will present the costs of banking crises in the MENA region using the previously mentioned databases.

3.2.2.a Algeria (start 1990 – 1992)

In the late 1980s, the financial sector in Algeria was small; all of the banks, insurance companies, and pension funds that were operating in the market were government-owned and provided financial services mainly to public sector investors (Nashashibi, 1998). The Central Bank of Algeria did not fulfil its part in organising the financial sector efficiently; thus, the staff faced considerable problems: lack of competition and experience, each financial institution being responsible for a specific sector and client, negative interest rates, no financial markets, non-negotiable government bonds, few supervisory actions. Moreover, the rediscount window was merely a way of helping banks to get liquidity: preferential credit rates were exclusive to agriculture and real estate, and development projects were needed; current and capital account transactions were restricted as to exchange and financial resources were largely misallocated.

As an oil-producing country, Algeria was affected by the drop in world oil prices from 1986 to 1989. The balance sheet statements of several commercial banks showed a high rate of non-performing loans due to the high concentration on financing public enterprises. After 1990, the government and the Central Bank of Algeria together set out to radically modify the financial sector. The transformation began by focusing on the needs of the market and being more market-oriented, interest rates were liberalised, all the restrictions on current and capital accounts transactions were removed, and flexible policies for dealing with the exchange rate were introduced.

In recent years, the reduction of oil prices is affecting the Algerian economy, inflation is increasing, the government is pursuing a strict strategy on maintaining a high level of public savings and low external debt, social welfare spending has reached 10 percent of GDP, the public deficit will be financed by issuing treasury bonds, market operations and investment projects will be enhanced, and the Dinar is stable. The banking sector comprises six state banks and fourteen foreign capital private banks.

3.2.2.b Djibouti (start 1991 – end 1995)

From 1991 to 1994, Djibouti suffered from a civil war that ruined its economy and increased poverty and unemployment. In 1996 the government with the IMF initiated a three-year plan to solve the problems of the economy. IMF (2004) reviewed the developments and the outcomes of policy reforms achieved by the authorities. Particularly the reestablishment of the macroeconomic fundamentals. They found that the fiscal deficit was declined from 13 percent of GDP at the start of the civil war to 3.3 percent of GDP in 2002. This remarkable decrease was achieved through a decline in expenditures. Regarding the banking sector, Djibouti has a limited number of financial institutions that have restricted their operation in providing short-term financial services; the spread between credit rates and deposits rates is high and limited credit activity[60].

3.2.2.c Egypt (start1980- end 1980)

During the period from 1974 to 1985, Egypt's economic growth increased as a result of the government's integration with the international community, which gave private and public sectors an opportunity to enjoy trade liberalisation. National income rose due to revenues accumulating from the Suez Canal, oil exports, tourism, and workers' remittances from abroad.

After the liberalisation of the Egyptian economy in 1974, the banking system grew by welcoming foreign banks to operate in Egypt, opening Islamic banks, and restructuring the major public sector banks to provide Islamic banking facilities. During 1980, Islamic investment companies (IIC) grew dramatically: it was estimated that their number had reached 105 at the end of 1988, and they accepted deposits from more than 3 million people, amounting to 3.8 billion Egyptian pounds in total, which equalled 7.8 percent of GDP and almost 10 percent of the total of deposits in the banking system.

Investors tend to find IICs while searching for other financial instruments and sources of financing outside the formal banking system. They wanted an alternative to the tight regulations and the difficulties they faced when dealing with conventional banks and a non-functioning capital market and were attracted by the high rate of return that the IICs were offering. The IICs played a significant role

[60] See IMF (2004).

in convincing investors of the advantages of their Shariah-compliant activities; they wanted to attract as many investors as possible, and this had a major social effect in Egypt.

IICs were operating without any supervision from the government until November 1986, when a financial scandal caused them considerable losses from speculating in gold and foreign exchange transactions. The government's intervention came too late, for it did not help them to reform or adapt to the new regulations. Indeed, the government closed the IICs. This crisis was due to the banks' misunderstanding of liberalisation and deregulation of the financial system.

3.2.2.d Israel (start1983-end1986)

Significant analysis and discussion of the Israeli banking crisis were presented by Blass and Grossman (1996). In mid-1983, there was a drop in banking sector share prices, which represented 60 per cent of the Tel Aviv Stock Exchange market capitalisation as a result of much sell-off trading in banking shares. This destabilised the banking system and provoked a bank run by depositors. The government thereupon intervened, shutting down the stock market for eighteen days, devaluing the currency, and taking over five banks, whose shares converted to government bonds of 5 to 6 years of maturity. Subsequent investigation results show that the leading cause of the crisis was banks' fraudulent action, which guaranteed that their share prices would continue to increase. The verdict found bank officials guilty of manipulating investors and breaching the securities and banking law.

3.2.2.e Jordan (start1989- end 1991)

The background to Jordan's economic situation was a deep recession from the mid-1980s until 1991 as a result of the increasing amount of external debt, the high levels of domestic unemployment, a deficit in the balance of payments, falling investments, a drop in the demand for exports and labour, and the collapse in the value of the Jordanian Dinar.

In 1989, budget deficits and current accounts widened dramatically; the total public debt was 9.5 billion USD. Hence, the government failed to meet its foreign debt obligations and resorted to asking the IMF and World Bank for funding and the rearrangement of its foreign debts (Harrigan et al., 2006). After this significant deficit, the Jordanian Dinar depreciated by more than 37 percent, from USD2.70/JD to USD1.7/JD.

Jordan did not implement the IMF adjustment programmes efficiently enough to revitalise its economy; instead, it made the situation worse, especially through liberalising interest rates, which rose high enough to increase the number of non-performing loans. As a result, bank runs and insolvencies occurred (Awad, 2017). The Jordanian economy was then exposed to a twin crisis (currency and banking).

The Central Bank governor, Mohamed Nabulsi, announced measures to overcome the high vulnerability of the economy: restructuring liquidity ratio regulations that forced operating banks to deposit 30 percent of their foreign exchange with the Central Bank and putting constraints on the foreign exchange outflows from Jordan (Leigh and Whitaker, 2003). Awad (2017) notes that the government injected 10 percent of GDP to settle foreign debt obligations and safeguard insolvent banks. These expedients were made to stop the national currency from depreciating and increase liquidity in the economy. Surprisingly, Petra Bank, which was the third largest of the 20 banks operating in Jordan, did not comply with the Central Bank regulations. Therefore, the Central Bank replaced Petra's board of directors. It was in this period that the Petra Bank scandal was exposed.

The Petra Bank was established in 1977 by its co-founder Ahmed Chalabi, an Iraqi businessman and politician. He was one of the most influential businessmen in Jordan due to his connections, especially those with the Jordanian royal family. Chalabi's family members owned companies around the world: Al Rimal and Abhara in Jordan, SCF in London, a gold-dealing company, Socofi, in Geneva; an investment company, the Mebco bank, in Geneva and Beirut, and a Washington arm, Petra International.

After the collapse of the Petra Bank, the results of the investigation by Arthur Andersen showed that the bank's assets were overstated by 200 million USD. It revealed bad debts to a total of about 80 million USD, which had been taken out by Chalabi-linked companies; unsupported foreign currency balances at counter-party banks, to the tune of about 20 million USD; a missing 60 million USD or so in cash via the bank and currency exchange manipulation.

In 1992, Chalabi was found guilty and sentenced in his absence to 22 years' jail on 31 charges of manipulation, theft, misuse of depositor funds and currency speculation. The Jordanian government was obliged to pay out 200 million USD to depositors to prevent a collapse of the entire banking system.

After the end of the Gulf War in 1991, Jordan lost its exports to the Gulf area. Furthermore, many Jordanian workers were expelled from Kuwait and other Gulf countries, and those who were allowed to stay suffered cuts in salary. Jordanian citizens who returned were affected by the rise of interest rates on their old debts, and they did not have easy access to new credit facilities. These actions had a major effect on workers' remittances and Arab financial aid to Jordan, consequently affecting the economic situation. Swaidan and Nica (2002) mention that the Jordanian daily al-Dustur reported that the magnitude of loss reached USD 1.4 billion in 1990 and increased to USD 8.4 billion in 1991, that consist of both direct and indirect losses.

3.2.2.f Kuwait (start 1982-end 1985)

In 1977 an official stock exchange was established in Kuwait, which traded exclusively in government bonds and the securities of companies registered in Kuwait. A few months later, the unofficial stock market "Souk Al-Manakh" was established, an over-the-counter exchange for the trading of 45 companies' securities registered in the Gulf Countries other than Kuwait. In 1981, the return on individual shares on the informal exchange reached 300 percent. This was profitable for everyone, and many people were engaged in trading, even with post-dated cheques, because everyone was sure that the purchase price of the security would increase before the cheques were payable. Moreover, people securitised the post-dated cheques to trade them in a secondary market at a 100 percent interest rate.

The political situation was not stable in Kuwait during the 1980s due to the Iraq-Iran war. Kuwaitis' businesses were threatened; oil revenues decreased, interest rates increased, bank loans were rarely offered, and government spending declined. The result was a massive downturn in investment projects, a flight of capital overseas, and the sale of investors' shares on the "Souk al-Manakh".

The banking crisis in Kuwait started when a creditor wanted to cash his post-dated cheque for 30 million USD from a high-ranking businessman in Kuwait. The bank rejected the cheque because the businessman had nothing in his account. Savers and investors heard of the incident and started runs on the bank, whereupon the Souk al Manakh collapsed, with repercussions on all the Gulf Countries. Investigations announced that 28,800 cheques had bounced, with 94 billion USD stolen from 6,000 investors.

The Government of Sheik Jaber al-Ahmed established a rescue fund called Kuclear, with a capital of 2 billion USD, to limit the impact of the crisis on the economy and protect small investors. He initiated a programme of Difficult Credit Facilities Resettlement. The National Bank of Kuwait, which is the largest commercial bank, was the only survivor of this crisis.

3.2.2.g Lebanon (start 1990 – end 1993)

Historically, the Lebanese banking system was considered the most advanced in the MENA region, but the 1975-1990 civil war slowed down its development and performance. A massive withdrawal of deposits from Lebanese banks resulted in the severe depreciation of the local currency between 1980 and 1990. The absence of Central Bank supervision resulted in underperforming and insolvent banks. For example, the equity to asset ratio was 1.38 percent in 1990, 1.66 percent in 1991, and 1.94 percent in 1992. The ratio of non-performing loans to gross loans was 33.41 percent in 1990, 27.46 percent in 1991, and 24 percent in 1992. At the end of 1991, the Bank of Lebanon intervened to reform the banking system by, for instance, determining the capital requirements, giving unstable banks a grace period to recapitalise in or be delisted, and allowing the Higher Banking Committee to liquidate unsecured banks. In 1992 a law was passed to facilitate mergers and acquisitions in the banking sector. In 1993, its success was shown by the fact that all the banks fulfilled the capital adequacy requirements of Basel I.

3.2.2.h Mauritania (start1984-end1984)

In 1973 Mauritania established an independent Central Bank and started to create its own currency, the Ouguiya. The monetary system consisted of the Central Bank of Mauritania and six commercial banks owned by the government and other foreign investors from Saudi Arabia and Libya.

In 1980 Mauritanian economic growth slowed after a rapid initial expansion (from 1960 to the 1970s) following the country's independence. Iron ore production, which had earned the primary income for economic development, declined as a result of a drop in world market prices. Before 1986 the Mauritanian government budget showed only the expenditures that were financed by domestic resources (iron, fishing, the service sector), but after this date, the IMF and World Bank annually helped the government to prepare its consolidated budget, which in the 1980s was usually in deficit. Between 1980 and 1984, indebtedness was a significant problem; the banking sector was collapsing due to an accumulation of non-performing assets that constituted 45-70 percent of the commercial bank portfolios. To cover its budget deficit, the government would borrow from the Central Bank of Mauritania and the commercial banks, private sector and public enterprises were compelled to borrow from foreign banks to solve their liquidity problems.

In 1985 the IMF and the World Bank intervened to restructure the banking system in Mauritania under the 1985-88 Economic Recovery Programme and adopted a reform program that concentrated on strengthening the country's Central Bank, restructuring the major commercial banks and improving credit policies and banking regulations. At the end of 1988, the total cost of solving the banking crisis was estimated at 15 percent of GDP.

Recently, the Mauritanian economy has been growing due to the recovery in mining and private sector operations, a low inflation rate of 1.9 percent in 2016, a fiscal deficit that reached 3.3 percent of GDP in the same year, and enhanced current accounts. Regulators are working on improving the financial sector to produce more opportunities, easier access to funds to attract local and foreign investments and increased demand for Islamic financial services and instruments.

3.2.2.i Morocco (start1980-end1983)

In the early 1980s, the Moroccan economy was unstable; the budget deficit reached massive levels, inflation was high, and the external debt exceeded GDP. The central role of the financial sector was to finance the government and public sector projects at preferential rates, credit to the private sector was limited, and restrictions on foreign investments were tight. As a result, Morocco suffered from a severe macroeconomic problem.

By the mid-1980s, the government had decided to seek macroeconomic stability by comprehensively restructuring the economy with support from the IMF and World Bank. The restructuring programme was divided into two, one part with the IMF, to pursue general adjustments, concentrating on minimising the fiscal deficit and the country's current account and bring external debt to an end. The other part was to work on sector modifications with the World Bank; the Moroccan government started with trade liberalisation, which rapidly devalued the Moroccan Dirham and has opened the economy to international competition by reducing tariffs and non-tariff restrictions.

3.2.2.j Tunisia (start1991- end1991)

After independence in 1956, the Tunisian government was trying to strengthen its economic position through the financial sector. This sector is deemed small and is dominated by publicly-owned banks, private banks and foreign banks. But these banks were malfunctioning, unable to direct financial resources to productive activities; they had weak credit intermediation, accumulated significant liabilities in consequence, with misallocated resources, and the economy was performing weakly. In the late 1980s and early 1990s, the government played a significant role together with the IMF in liberalising and restructuring the financial sector through money market instruments, modernising the structure of the financial system, and adopting more advanced and international methods of banking supervision.

In 1987, the banking system was restructured to encourage banks to be more competitive, to take their own credit decisions, and allocate their resources efficiently. Interest rates were liberalised. Authorising the Central Bank in advance to make credit decisions and to finance public enterprises at preferential rates was stopped.

In 1991, the Central Bank stopped issuing low-interest, long-term government bonds. The Tunisian government was seeking greater international financial integration to reduce its dependence on internal funding.

By the end of 1991, the Central Bank had enforced prudential banking regulation, but when the regulations were ratified, numerous banks, especially publicly-owned banks, were found to be undercapitalised, and their provision for non-performing loans was insufficient. After this scandal, the Central Bank succeeded in raising the banking system's equity to reach 1.5 percent of GDP and make provisions for tackling non-performing loans that were equivalent to another 1.5 percent. Thus, its recapitalisation needed at least 3 percent of GDP.

3.2.2.k Turkey (start1982- end1984)

Before 1980 the Turkish economy suffered an unstable period with high inflation, an overvalued Turkish lira, and current account deficits, so the government put forward a strategy to overcome these weaknesses. It implemented changes in the structure of prices and income distribution; as a result, real private expenditure dropped, the terms of trade improved, favourable real interest rates were offered on time deposits, and the income velocity of broad money M2 dropped from 5 times in 1980 to 3.4 times in 1985.

However, the liberalisation of the financial system created by offering flexible interest rates was not efficiently supervised and regulated. The high competition in interest rates between banks and brokerage firms led to a banking crisis in mid-1982 due to the liquidation of five banks and brokerage firms that pursued precarious credit transactions. Rescuing the economy from this scandal cost the equivalent of 2.5 percent of GNP.

By 1983 the government had imposed policies to strengthen Central Bank supervision, authorise foreign commercial banks to enter the market, allow local commercial banks to offer short-term credits and foreign exchange deposits in financing trade.

3.2.2.l Turkey (start2000-end 2001)

During the 1990s, the Turkish economy was unstable due to its reliance on short-term capital inflows to finance the current account deficits and considerable fluctuation of economic growth rate between a -5.5 percent and 9.3 percent exchange rate. The interest rate was also volatile. Inflation rates were very high due to the dependence on monetary financing, interest rates on government securities exceeded the ordinary inflation rate, and major sectors of the economy suffered from all these destabilising factors. They led to an unfavourable business environment, especially a banking sector that was fragile and disorganised. For different reasons, the banking sector, the only source of government financing, was deregulated. More than half of the short-term investment securities of the private banks were domestic government securities that were secured by the expectations of public debt sustainability.

Moreover, the country's reliance on foreign funding exposed the economy to capital reversal. It gravely exposed it to exchange rate risk because two-thirds of the banks' liabilities were denominated in foreign currencies. They also had a maturity mismatch problem in their balance sheet accounts because they were prohibited from long-term borrowing in Turkish Lira but could use the money for long-term loans to the government and the private sector.

In November 2000, the lack of confidence in the Turkish banking system had increased to the point where the banks stopped providing interbank credit lines that would weaken domestic banks. Foreign investors started to liquidate their government debt securities and equities. The Demirbank, a medium-sized private bank, could not borrow from the interbank market, so it sold its government debt securities, affecting the value of government securities and their interest rate in the secondary market. Not surprisingly, the panic led most of the banks to sell off their government securities to meet margin calls, in addition to the enormous capital outflow.

At the end of November, the main concern of the Turkish Central Bank was to sustain its domestic assets by not offering emergency lines of credit to banks. As a result, the interbank rate reached 873 percent, banks faced a liquidity problem, and the Turkish lira depreciated. Two banks closed, and 19 banks, including the Demirbank, were taken over by the Savings Deposit Insurance Fund (SDIF). The IMF financed Turkey with 10.5 billion dollars, which stabilised the market and limited the drop in reserves. Thus, the Central Bank succeeded in defending the peg of the Turkish lira to the US dollar, but at the cost of 25 percent of its foreign exchange reserves.

3.2.2.m Yemen (start 1996 – end 1996)

In May 1990, North and South Yemen were merged to form the Republic of Yemen. During the 1990s, the country suffered from its geographical position. 800,000 Yemeni employees were expelled from the Gulf States after the second Gulf War, at a time when it was also suffering internally from its 1994 civil war. As a result, in 1995, the government decided to modify the economic structure and embark on a comprehensive economic reform programme supported by the World Bank, the IMF, and other institutions. Their main objective was to make the economy market-based, financially stable and economically lively.

After the unification of Yemen, the financial system comprised the Central Bank of Yemen, three domestic private banks, four foreign private banks, three state-owned banks, and two specialised state-owned development banks. Overall, the Yemeni government owned 48 percent of the banking sector, which is more significant than any other entity. The banking system at the time was fragile in its capital and credit structure: the ratio of deposits to the money supply was about 23 percent in 1994. Before people were confident in the banking system, they kept their distance from it; the inflation rate was high, the real interest rate was negative, and enough coherent legislation did not support the economy.

3.2.3 The costs of banking crises

A growing body of literature recognises the importance of banking crises and measures the costs of their direct resolution to the regulators and the economy. Reinhart and Rogoff (2009) argued that measuring the bailout costs to a government is difficult and misguided; instead, they considered the fiscal costs as a debt accumulation following a banking crisis. Oviedo (2004) stresses that a banking crisis is costly for any economy due to the costs associated with restructuring the banking system and the negative consequences for various sectors in the economy. In this section, we present the costs of banking crises, as shown by several sources.

Any fragility in a bank harms stakeholders, and the economy's health depends on the extent of the harm. Resolving the problem, however, entails both direct and indirect costs. These include losses to shareholders who may be affected by the lower value of equity holdings, to the banks' depositors, and the creditors exposed to the high default risk of the bank. All or part of their savings and investments will be at risk, and searching for alternative sources may be difficult for prospective borrowers. Bank employees and taxpayers, too, could suffer in the resolution of the crisis. In a major study, Reinhart and Rogoff (2009) establish that banking crises intensify when governments use financial repression[61] as a form of taxation and a backup plan for funding public debt.

Hoggarth et al. (2002) noted that cumulative output losses tend to reach roughly 15-20 percent of annual GDP during crisis periods. They found that output losses in developed countries are higher than in

[61] Financial repression is generally understood to mean the actions imposed by the governments mainly most developing countries to control international capital flows, coupled with restrictions on domestic financial intermediaries. This phenomenon has been extensively discussed in development economics (Giovannini and De Melo (1991).

emerging economies[62]. In analysing the fiscal costs of systemic banking crises, Amaglobeli et al. (2015) measured the median fiscal cost of regulators' intervention throughout the crises between 1980 and 2011. This cost reached 6 percent of GDP, but the authors claim that this percentage does not capture the full impact on public finance. In another measure, the median increase in public debt for the same period exceeded 14 percent of GDP in the four years following each crisis.

Similarly, Reinhart and Rogoff (2009) demonstrated that real government debt increases by 86 percent on average three years after a banking crisis. This debt includes direct and indirect costs. Its magnitude differs according to the response, the severity of the crisis, and whether the economy concerned is advanced or emerging. However, relatively little literature (Laeven and Valencia, 2008, 2012, 2018; Caprio and Klingebiel, 2002) has been published on the fiscal costs of systemic banking crises in the MENA region (see Tables 3.1 and 3.2). Thus, this is an essential issue for future research.

This study uses the cross-sectional study of banking crises database by Caprio and Klingebiel (2002), which presented 113 systemic banking crises in 93 countries from 1970 to 1999, including 50 non-systemic banking crises in 44 countries. Similarly, we follow the database of Laeven and Valencia (2008, 2012, 2018), which introduced all the systemic banking crises in the period 1970-2017 and provided reliable information about policy response and outcomes (increases in public debt, output losses, and fiscal costs); and, likewise, that of Demirgüç-Kunt and Detragiache (1998)[63], who demonstrated the severity of the crises as a percentage of GDP by using a specific definition of systemic banking crises.

In terms of the costs of systemic banking crises, the tables below show the sample from the MENA region using all the databases listed above. They introduce the events that occurred in each country that was recognised as suffering a systemic banking crisis. Caprio and Klingebiel (2002) focused on the resolution of the immediate crisis, for instance, the fiscal costs needed to restore the banking system. The database of Laeven and Valencia (2008, 2012, 2018) database concentrates on output loss in each country as a percentage of the trend GDP[64]. However, some data related to the fiscal costs in the MENA region countries are missing.

[62] Sample of 47 developed and developing countries (Turkey and Egypt are included).
[63] Demirgüç-Kunt and Detragiache (1998) constructed the banking crisis dummy variable depending on five studies: Caprio and Klingebiel (1996), Drees and Pazarbasioglu (1995), Kaminsky and Reinhart (1996), Lindgren, Garcia, and Saal (1996), and Sheng (1995).
[64]Trend GDP by Laeven and Valencia (2008, 2012, 2018). See https://www.imf.org/en/Publications/WP/Issues/2018/09/14/Systemic-Banking-Crises-Revisited-46232

Table 3.1: Systemic and non-systemic banking crises – MENA for the period 1980-2018

Country	**Scope of crisis and Estimated costs**
Systemic banking crises	
Turkey 1982–85	Three banks were merged with the state-owned Agriculture Bank and then liquidated; two large banks were restructured. • Rescue costs totalled 2.5 percent of GNP.
Turkey 2000	Two banks closed, and 19 banks were taken over by the Savings Deposit Insurance Fund. • Fiscal costs are estimated at 30.5 percent of GDP.
Kuwait 1980	An estimated 40 percent of loans were non-performing by 1986.
Algeria 1990–92	Share of non-performing loans in the banking system reached 50 percent.
Djibouti 1991–93	Two of six commercial banks ceased operation in 1991–1992; other banks experienced difficulties.
Egypt 1980	The government closed several large investment companies.
Lebanon 1988–90	Four banks became insolvent. Eleven had to resort to Central Bank lending.
Morocco 1980	Banking sector experienced solvency problems.
Yemen 1996	Banks suffered from extensive non-performing loans and heavy foreign currency exposure.
Israel 1983	Almost the entire banking sector was affected, representing 60 per cent of stock market capitalisation. The stock exchange closed for 18 days, and bank share prices fell more than 40 percent. • About 30 percent of GDP in 1983.
Mauritania 1984–93	In 1984 five major banks had non-performing assets ranging from 45– 70 percent of their portfolios. • Cost of rehabilitation estimated at 15 percent of GDP in 1988.
Non-systemic banking crises	
Turkey 1994	Three banks failed in April 1994. • In June 1994, the authorities spent 1 percent of GDP.

Egypt 1991–95	Four public banks were given capital assistance.
Jordan 1989–90	The third-largest bank failed in August 1989. • The central bank provided overdrafts equivalent to 10 percent of GDP to meet a run on deposits and allowed banks to settle foreign obligations.
Tunisia 1991–95	In 1991 most commercial banks were undercapitalised. • During 1991–94, the banking system raised equity equivalent to 1.5 percent of GDP and made provisions equivalent to another 1.5 percent. Thus, the recapitalisation throughout 1994 required at least 3 percent of GDP.

Source: Caprio and Klingebiel (2003)

Table 3.2: Banking Crises Resolutions and Outcomes - MENA for the period 1980-2018

Country	**Crisis Dates**		**Output Loss**	**Fiscal Costs**	
	Start	**End**	**% of trend GDP**	**% of GDP**	**% of Financial Sector Assets**
Algeria	1990	1994	41.4	…	…
Djibouti	1991	1995	42.6	…	…
Egypt	1980	1980	0.9	…	…
Israel	1983	1986	42.7	30	30.9
Jordan	1989	1991	106.4	10	12.5
Kuwait	1982	1985	143.4	…	…
Lebanon	1990	1993	102.2	…	…
Mauritania	1984	1984	7.5	15	53.2
Morocco	1980	1984	21.9	…	…
Tunisia	1991	1991	1.3	3	5
Turkey	1982	1984	35	2.5	11.7
Turkey	2000	2001	37.6	32	107.2
Yemen	1996	1996	16.4	…	…

Source: Laeven and Valencia (2018)

3.2.4 Risks and leading indicators of banking crises

In this section, we present the explanatory variables that have been used in various EWS models. To better understand the mechanisms of EWS, we should concentrate on the macroeconomic factors and their links with different types of risk.

Financial liberalisation (FL) is a common condition that has a considerable impact on the economy. A variety of studies have established that it can be a source of various systemic risks. Using historical analysis, Reinhart and Rogoff (2009) showed that international banking crises repeatedly occurred during global integration and capital mobility periods. Kaminsky and Reinhart (1999) found that over 70 percent of banking crises resulted from one or another of the liberalisation processes. Similarly, Demirgüç-Kunt and Detragiache (1998) concluded that crisis probability increased a few years after the FL process; they consider the real interest rate a proxy for FL, especially in emerging economies. Davis and Karim (2008a) indicated that in post-liberalised markets, the increase of competition and wider spreads could have a contagious effect on the banking system due to interest rate fluctuations. Honhan (2000) indicated that FL in developing countries is a consequence of high real interest rates and appreciation in their volatility.

Furthermore, Demirgüç-Kunt and Detragiache (1998) note that if FL materialises with deposit insurance and is accompanied by an inefficient regulatory system, banking operations pursue excessive risk leading to a systemic banking crisis resulting from moral hazard. This view was supported by Papi et al. (2015), who found that banking sector fragility can result from introducing FL without robust banking sector surveillance; this opens the door to fraudulent behaviour and excessive risk-taking. Thus, it can be concluded that the real interest rate, which is a proxy for FL, is a direct signal of interest rate risk. From another perspective, Craig et al. (2005) demonstrated the outcomes of FL on credit risk, since the high level of credit risk is due to the spread generated by the increase of loan volumes without implementing proper assessment, leading to the adverse selection problem. Trying to determine the effects of financial liberalisation, Majerbi and Rachdi (2014) found that FL increases the probability of a systemic banking crisis exclusively in the early stages of financial reforms. However, launching advanced financial reforms tends to correlate negatively with the likelihood of a banking crisis.

Caggiano et al. (2014) identify the significant outcomes of high inflation, linking them to macroeconomic instability. This influences the real return on assets, encourages excessive borrowing and decreases the number of savings transactions, and, as a result, increases the likelihood of a banking crisis. Similarly, Duttagupta and Cashin (2008) claim that an economy with high inflation may attract low-quality borrowers and consequently demonstrates the problem of adverse selection. In their major study, Davis and Karim (2008a) concentrate on the impact of high inflation on asset price booms, increasing market risk. Moreover, banks could be affected by market risk, depending on each bank’s construction of its portfolio, if market risk is concentrated in various currencies and equities.

Demirgüç-Kunt and Detragiache (1998) find low fiscal surpluses over GDP a significant indicator of policy mismanagement and fid GDP per capita an assessment factor for structural economic development that should have a positive relationship with the quality of the banking legislation. Duttagupta and Cashin (2008) discuss the weak fiscal position of governments in developing countries, which may not be able to provide funds to support bank fragility. Because banks are heavily exposed to governments, their performance is linked to the nation's fiscal position. Kaminsky (1999) found that such countries could be exposed to capital account problems through sizeable foreign debt in foreign currency and an increase in capital flight, which may trigger debt unsustainability.

With regard to the risks in the banking sector, Eichengreen and Rose (1998) highlight the essential point of the implications of banking system fragility, which can be aggravated by asymmetric information. From one side, banks could end up with severe losses due to adverse selection: low-risk borrowers tend to opt-out of the market when unanticipated costs exceed a certain limit, leaving banks to fund the high-risk borrowers who will be the most likely to leave their debts unpaid, thus augmenting the banks' vulnerability to shocks. From the other side, moral hazard, too, could be a further implication of asymmetric information. Eichengreen and Rose introduce the concept of "gambling-for-redemption behaviour", which describes the behaviour of high-risk borrowers who are so desperate to generate cash that they engage aggressively in risky projects. Furthermore, Barrell et al. (2010b) mention that a deposit insurance[65] scheme can play a role in boosting moral hazard for banks. It can be concluded that banks could increase their risk level, protecting themselves by the "safety net" provided by the deposit insurance scheme and by the central bank as a lender of last resort.

Credit risk accumulation is a result of a significant increase in real credit growth in addition to the appreciation in private sector credit over GDP in pre-crisis periods. Schularick and Taylor (2012) comprehensively analysed the bank credit growth and crises in 14 developed economies during 140 years. They found that credit growth was a highly significant indicator of the future financial crisis. Caggiano et al. (2014) discussed the consequences of excessive credit growth that can increase bank fragility by dramatically affecting the quality of assets and reducing liquidity. Barrell et al. (2018) found that regulators should concentrate on reviewing the nature of credit growth since not all credit-to-GDP expansion leads to credit booms, except when excessive credit influences asset prices. It is conceivable that the lack of adequate supervision encourages banks to pursue an aggressive strategy to catch borrowers, leading to increased credit risk. Narain et al. (2003) examined the effect of credit concentration in less diversified economies and found that their capital on the bank's asset side is positively correlated with credit risk, so the number of non-performing loans is likely to increase; whereas, because the funding depends on few depositors, the liability side is affected by liquidity

[65] Al-Ja'fari and Walker (2011) demonstrate the limited number of explicit deposit insurance systems in the MENA region. Most of the oil producing countries and countries that have state-owned banks depend on a government's blanket guarantees. Deposit insurance is an insignificant variable in our model (see the deposit insurance database by Demirgüç-Kunt et al. (2014)).

constraint. The rise of non-performing loans can result from several factors, for instance, high variation in terms of trade, macroeconomic shocks, and currency depreciation, which all have a significant role in increasing market risk.

Bank cash plus reserves over total bank assets can predict liquidity risk so far as a decline in this ratio means a high systemic liquidity risk. In a comprehensive study, Lang and Schmidt (2016) found that the interaction of liquidity ratios and demand deposit was a statistically significant leading indicator of banking crises. Economic theories suggest that high inflation leads to high nominal interest rates, affecting interest rate risks and impacting asset prices, thus influencing market risk. Kirabaeva (2011) discovered that a tiny increase in interest rates dramatically decreases lending when asymmetric information is in play. From a complementary point of view, Davis and Karim (2008a) present different reasons for banking crises in advanced economies. These countries already have well-established and robust banking systems, but securitised financial markets and aggressive strategies that magnify systemic risks make them fragile.

Recently, banks have begun to launch residential housing finance. Akhtar (2011) describes mortgage loans as reaching about 10 percent of the loan portfolio. Moreover, she contends that banks are modifying their management strategy towards raising long-term lending. However, this strategy avoids the related risks only by supervisors who strictly monitor them. Accordingly, it is worth bearing this trend in mind when constructing the EWS of systemic banking crises in the MENA region by including the associated explanatory variable. A large and growing body of literature has investigated the effect of house prices[66] on a systemic banking crisis. Barrell et al. (2010a) were the pioneers in including house price growth in their construction of an EWS of banking crises in OECD countries, and it has clearly become a highly significant variable. Similarly, Schudel (2015) concluded that house price growth has a positive relationship with the probability of a banking crisis, and it is a reliable leading indicator in the pre-crisis period. However, the significance of its effect diminishes as the crisis approaches the point of eruption. This view is supported by Lainà et al. (2015), who remind us that house price growth is a statistically significant variable for increasing the probability of a systemic banking crisis within three years. In contrast, its impact wanes 12 months before the actual crisis. This section has described the risks and leading indicators of banking crises, moving on now to present the existing literature on the early warning systems (EWSs) for banking crises.

[66] Due to data availability, we did not include house price growth in our model.

3.2.5 Early Warning Systems (EWSs)

Early Warning Systems (EWS) are data-driven approaches and dynamic mechanisms that provide policymakers with signals of possible future crises by deploying the variables associated with past crises. They offer a form of market surveillance.

EWS evaluate the underlying factors associated with systemic crises. Designing an efficient framework for one should involve different elements so that individual banks can understand the risks to themselves as well as to the banking system. Mainly, supervisors are interested and involved in constructing an EWS, from overseeing the variables for assessing risk in the banking system, their easy access to needed information in surveying past crises, and their duty to stabilise the market by regulation and predict future critical conditions. Therefore, it is conceivable that supervisors would be able to construct a simple design for an EWS by using the available data and avoiding over-specification.

Unfortunately, the critical problems for supervisors are the short time between getting a signal and the market going into crisis (forecasting interval) and the best choice of intervention. Gramlich et al. (2010) suggest that running short- and long-term forecasting horizons is the appropriate way to get a moderately accurate forecasting interval and reduce the ambiguity of the results. Kaminsky and Reinhart (1999) define a reasonable period as the maximum interval of the period that should be determined between the signal and the crisis. In their view, any signal that appears within the 12 months before the beginning of the crisis or in the 12 months after the beginning of the crisis is considered a good signal. As a result of the inconsistency in the leading indicators and the variations in the in-sample and out-of-sample results, Davis and Karim (2008a) were more progressive than most previous writers by reducing the ambiguity of the predictive efficiency. They used the multivariate logit and signal extraction model to predict banking crises on the basis of a single panel dataset, which contained enough cross-country and time-series coverage to exceed that of any previous studies.

Much of the existing literature on EWS can be divided into two groups: the pre-2007 writings on the global financial crisis (GFC), which are mainly about currency and sovereign debt crises, and the post-2007 GFC writings, which concentrate more on banking crises. Kaminsky and Reinhart (1999) pioneered the use of the signal extraction approach to predict twin currency and banking crises. They observed that a currency crisis and financial liberalisation often precede a banking crisis; when the twin crises occur at once, the impact is drastically worse than that of one in isolation.

The banking system continues to change and develop over time, introducing various financial services and affecting new sectors in the economy, in addition to its significant contribution to economic growth.

In their critique of the extensive EWS literature, Gramlich et al. (2010) argue that EWS modify the systemic risk arising from the rapid changes in the markets and see the complexity of financial risk increasing. Constant adjustments of EWS are needed. The reliability of the existing factors needs testing: new ones sometimes need to be added, and their weights adjusted. Bussiere and Fratzscher (2006) illustrate the trade-off between the policymaker's preferences and the degree of risk-aversion in constructing the optimal design of an EWS model. Davis and Karim (2008a) use lags and various interaction variables to construct the dynamics of banking crises and benefit from the data in simulating the procyclical of risk. In their assessment, Candelon et al. (2012) provide a toolbox comprising various EWS prediction models (probit, logit, Markov switching models, or some combination of them). The toolbox can be used for any crisis (currency, banking, exchange rate, debt, financial); it indicates the performance of the EWS models, makes in-sample and out-of-sample forecasts and determines an optimal cut-off.

The above arguments suggest that an efficient EWS for the MENA region should be built by assessing historical data and the conditions associated with systemic risk. Such a system will allow supervisors to solve any distress in the system at the least cost. Bussiere and Fratzscher (2006) state that policymakers can use the EWS model to detect economic weaknesses and measure vulnerability to take the appropriate actions. Moreover, the existence of an EWS will enable supervisors to concentrate on the safety and soundness of the banking system, not focusing on individual banking institutions alone (Gramlich et al., 2010). At the same time, it should be noted that an inefficient EWS may produce false signals that can exaggerate any distress in the market.

3.2.6 The Three Methodologies

Several methods for predicting systemic banking crises currently exist. Demirgüç-Kunt and Detragiache (1998), Davis and Karim (2008a), Caggiano et al. (2014) and Barrell et al. (2010a) preferred to use the binomial multivariate logit technique because it outperforms the signal extraction method adopted by Kaminsky and Reinhart (1999) and Borio and Drehmann (2009). A third model is the binary recursive tree applied by Davis and Karim (2008a), which has also been used to focus on financial crises (Duttagupta and Cashin, 2008; Manasse and Roubini, 2009). Alessi et al. (2015) made a comprehensive evaluation of the performance of nine distinct models for anticipating banking crises and concluded that the multivariate logit model outperforms other models. It generates beneficial results in constructing EWS and reduces type I and type II errors. Davis and Karim (2020) reviewed the literature from the period and presented key steps in analysing systemic banking crises and their different methods of prediction.

A recent study by Dabrowski et al. (2016) found that the switching linear dynamic system (SLDS) and the naïve Bayes switching linear dynamic system (NB-SLDS) are better than the signal extraction, logit and hidden Markov models for a European dataset since both models allow explanatory variables to be tracked and changed over time by using a state-space representation that provides accurate results and pre-crisis detection. However, quarterly data were not available, and therefore, we cannot apply SLDS and NB-SLDS for the MENA region. In addition, Dabrowski et al. (2016) used these systems on developed European countries that have in common almost the same economic conditions and financial regulation, but the countries of the MENA region are diverse. It should be noted that Alessi et al. (2015) mention the problem of using the Bayesian approach for out-of-sample forecasts, although it is useful for the in-sample fit. From a statistical point of view, in-sample much more than out-of-sample performance can be affected by outliers, which are well considered to be trustworthy. Berg et al. (2005) evaluated the performance of several early warning systems[67] in predicting currency crises. They focused on out-of-sample performance because the model with accurate out-of-sample forecasts succeeded in many more solid tests[68]. Barrell et al. (2010a) used the multivariate logit technique and were able to identify 66 percent of crises for OECD countries, outperforming a random naïve model which could recognise only 50 percent of crises in the same sample. Bussiere and Fratzscher (2006) followed the same strategy to predict a set of 20 financial crises in emerging markets. They found that the out-of-sample performance was robust and correctly anticipated the greatest number of crises for the period 1993-2001.

More recently, papers have emerged with a variety of findings of the most accurate model for anticipating banking crises. Since every economy has its own structure, banking system, and regulations, the leading indicators for banking distress probably differ from one country to another.

A broad consensus supports the binomial multivariate logit model in developing EWS for different economies. Demirgüç-Kunt and Detragiache (1998) were the first to apply it to 65 developed and developing countries, and in 2005 they updated the research to cover 94 countries around the world. Moreover, Barrell et al. (2010a) successfully examined EWS in 14 OECD countries. Schularik and Taylor (2012) used the logit model to determine if there is a relationship between the history of credit growth and financial crisis, using an annual dataset of 14 developed countries over the years 1870-2008. Davis et al. (2011) used it for crises in Asia and Latin America. Caggiano et al. (2014) explored the use of it in low-income countries in Sub-Saharan Africa. Bussiere and Fratzscher (2006) applied the

[67] The Kaminsky-Lizondo-Reinhart (KLR), the Developing Country Studies Division (DCSD), Goldman Sachs (GS) and Credit Suisse First Boston (CSFB) (see Berg et al., 2005).
[68] First, assessing the performance of a model structure before the Asian crisis (KLR has been used for crisis prediction) and comparing it with the actual outcomes. Second, distinguishing between those predictions and other spreads on dollar-denomination sovereign bonds, credit ratings and the country experts in The Economist Intelligence Unit (EIU) who assess currency crisis risks (Berg et al., 2005).

multinomial logit model for anticipating financial crises in a set of 20 emerging markets for the period 1993-2001. Bussiere and Fratzscher focused on modifying the existing EWS by successfully distinguishing between tranquil periods and post-crisis periods.

This consensus makes it worth applying the multivariate logit model to the MENA region since it provides a credible and accurate basis for designing an EWS. Moreover, it is an efficient model that reduces missed crises (i.e., those when a crisis occurs, but the model gives no signal) and false alarms (i.e., when no crisis actually occurs, but the model indicates that a crisis is likely), which are considered type I and type II errors, respectively (Bussiere and Fratzscher, 2006; Barrell et al., 2010a; Caggiano et al., 2014).

3.2.6.a The Binary Recursive Tree (BRT)

The Binary Recursive Tree (BRT) is a non-parametric statistical methodology that can be used for determining banking crises. It works like a data mining technique that concentrates on evaluating a combination of vulnerabilities as responsible for banking crises rather than the fragility of a single factor. Breiman et al. (1984) developed this model as a data analysis technique. Duttagupta and Cashin (2008) remind us that a banking crisis can occur as a result of a leading indicator crossing an identified threshold and not merely because of a variation in the value of the indicator, especially when the explanatory variables may have a nonlinear effect on the probability of a crisis. To date, several studies have used the BRT model. Manasse et al. (2003) examined its use in sovereign debt crises and Ghosh and Gosh (2002) in currency crises. Duttagupta and Cashin (2008), Davis and Karim (2008b), and Joy et al. (2015) adopted it to build an EWS for systemic banking crises.

Its methodology depends on classifying the non-linear explanatory variable as one that either makes the economic system vulnerable to a crisis or does not. Thus, it determines the explanatory variable value that successfully interprets the dependent variable. An indicator is selected by first differentiating all the possible variables according to their threshold values and then using the result to find a parent node that has two sub-nodes where the probability of a crisis significantly increases or decreases. The process continually repeats itself at each sub-node until all the additional splitting comes to an end, i.e., when all the cases have a similar outcome, or there is only one single case left in the node.

The main outstanding issue concerning this model is the size of the tree that can be determined by the cost of growing and the model's overall fit, which depends on correcting the type I and type II errors.

Traditionally, BRT has been assessed by examining banking crises and has distinct advantages because it does not depend on any assumptions concerning the explanatory variables or follow any specific statistical distribution across cross-sections (Kats, 2006; Duttagupta and Cashin, 2008; Davis and Karim, 2008b). It can be used even with datasets that have missing observations and is not affected by the presence of outliers (Duttagupta and Cashin, 2008). Joy et al. (2015) highlight the usefulness of BRT in determining the crisis threshold for significant variables; therefore, it may significantly simplify the outcomes for regulators and non-technical audiences.

Because it is a non-parametric approach, however, it fails to predict the marginal contributions of every explanatory variable or confidence interval for the predicted thresholds since it does not assume anything to do with a probability distribution (Duttagupta and Cashin, 2008; Joy et al., 2015). Davis and Karim (2008b) concluded that this methodology could not be used for large cross-country datasets because the tree classifies the crises according to region, reckoning that each region has its own factors in the approach to a banking crisis. Another drawback is that some variables can distinguish between crises and non-crisis outcomes, but this may never show up in the tree. This is called the problem of masking; it arises when one variable outperforms another variable, in which case the underperforming one may not be shown in the final tree. To overcome this problem, Babecký et al. (2014) used Bayesian model averaging, which helped to rank and compare the outcomes from linear regression methods and the classification tree.

3.2.6.b The Signal Extraction approach

The Signal Extraction approach is a non-parametric approach developed by Kaminsky and Reinhart (1999) to predict signs of currency and banking crises for industrial and developing countries; it examined whether the malfunction of various economic factors could predict a crisis. The methodology of these writers was to define a crisis, classifying the multiple explanatory variables that could be leading indicators and setting criteria to differentiate between normal behaviour and some signal of a crisis; in the last stage, the indicators were assessed, and if a signal of a crisis appeared, policymakers had to determine whether the crisis would break within a reasonable period or the signal was simply a false alarm (a type II error).

The main critical issues are to evaluate what is a reasonable period for an interval between the signals and the crisis and to set an appropriate threshold. The threshold is the value of the explanatory variable, which lowers the ratio of false alarms to good signals, over a horizon of 12 months before the beginning of the crisis or within 12 months after it. Borio and Drehmann (2009) and Dabrowski et al. (2016) used the noise-to-signal ratio to determine the threshold, which is a method used to reduce a performance measure. Davis and Karim (2008a) noted that when the threshold is high, it means that a signal is more likely to be correct. Thus, regulators can make their own judgments about intervention, depending on their risk preferences in a crisis.

Several researchers adopted the signal extraction approach. Kaminsky and Reinhart (1999) concentrated on the decline in equity returns as a signal of a banking crisis. Borio and Lowe (2002) and Borio and Drehmann (2009) both concluded that the growth of credit and asset prices could be useful indicators for a banking crisis. Davis and Karim (2008a) modified the approach by combining the indicators and weighting them according to their signalling quality. They concluded that GDP growth and terms of trade variations are critical indicators to consider in a banking crisis context. Drehmann and Juselius (2014) found that the credit-to-GDP gap and the debt service ratio outperformed other indicators in predicting a banking crisis.

Subsequent studies introduced the major drawbacks of this approach. Davis and Karim (2008a) stated that this method was useful only for predicting country-specific crises because the optimal threshold may differ from one country to another and over time. Thus, constructing an EWS by determining a specific percentile threshold can limit the prediction process. Berg and Pattillo (1999) used both the multivariate probit and the signal extraction to predict currency crises. They found that the former outperformed the latter since, with the latter approach, each indicator misses a significant number of crises (type I error). Hence, Berg and Pattillo (1999) concluded that this was due to assuming that a threshold for a variable had a distinct value and, whenever this was extended, a crisis might appear. Alessi et al. (2015) had a similar view, believing that it treated early warning indicators in isolation. Gaytán and Johnson (2002) asserted that even weighting the variables according to their noise to signal ratio provides no information related to the model's actual contribution to the instigation of the crisis and or give any indication of the severity of the crisis. Briefly, the signalling approach is popular and useful in predicting crises, but it fails to evaluate each variable separately since it takes the weighted sum of the indicators and does not consider the interrelation of variables that can raise an economy's vulnerability to crisis. From a practical point of view, it is difficult to interpret the results because the probability of the crisis fluctuates.

3.2.6.c A Multivariate Logit model

A multivariate logit model is a parametric approach that is particularly useful in calculating the probability of a banking crisis by using as inputs macroeconomic, institutional, and financial explanatory variables. It is the appropriate model to answer the research question, "What is the possibility that a banking crisis will arise in the next t years?" (Davis et al., 2011, pg.695).

The model was synthesised according to the procedure of Demirgüç-Kunt and Detragiache (1998, 2005) when they covered 77 crises using a global sample that depended on a banking crisis definition by Caprio and Klingebiel (1996) and a sample of systemic banking crises. They found that the possibility of occurrence of a banking crisis is correlated with macroeconomic, institutional and financial factors. Barrell et al. (2010a) followed the same methodology solely for OECD countries and interestingly found different banking crisis determinants, namely, bank liquidity ratio, capital adequacy and house price growth.

Davis and Karim (2008a) noted that using the multivariate logit model for predicting a systemic banking crisis connects the probability of occurrence and non-occurrence to a vector of the number of regressors. Moreover, the likelihood that the dummy dependent variable (banking crisis) has a value of one in a specific period is generated by the value of the logistic cumulative distribution to that particular period, as assessed for the data and parameters. Furthermore, Davis and Karim argued that Demirgüç-Kunt and Detragiache (1998) did not apply a fixed effect logit model because the use of this model suggests that the banking crisis is a dummy, and a country-defined dummy would still be perfectly correlated for non-crisis countries. It should be noted that the multivariate logistic model with banking crisis countries alone would be considered a biased sample (Demirgüç-Kunt and Detragiache,1998). The model is idiosyncratic in interpreting the results since the value of the coefficients does not mean that the increase of likelihood of a crisis by one unit increases the corresponding regressors. Instead, the coefficients represent the effect of change in each explanatory variable on the maximum likelihood estimation, known as the marginal effect.

Data availability is a critical issue when applying this model to different economies, for each economy is singular. Berg et al. (2005) have confirmed the effectiveness of logit regression for constructing an EWS, saying that it focuses on the correlation between all the explanatory variables and checks the statistical significance of each variable. Although the signalling approach is popular and useful in predicting crises, it takes the weighted sum of the indicators and does not evaluate each variable separately. Moreover, it does not consider the interrelation of the variables that can raise the vulnerability to a crisis in an economy. From a practical point of view, it is difficult to interpret the results because the probability of a crisis is not constant.

3.2.7 Early Warning Systems in different economies

This section presents an overview of the various models applied to build an EWS for different economies. Building EWS for systemic banking crises in the MENA region will warn policymakers that they must take pre-emptive action long enough before crises erupt, resolve them at least cost to society and use the warning to enhance macro-prudential policy.

To date, several studies have highlighted factors associated with banking crises by using different models to design an EWS for economies around the world. Barrell et al. (2010a) used the multivariate logit technique to develop an EWS for the OECD countries. They listed three main explanatory variables for banking crises: capital adequacy, liquidity ratios, and property prices[69]. O'Brien and Wosser (2018), seeking to build a flexible EWS, applied multivariate logit probabilities to 27 developed economies. Joy et al. (2017) examined 36 advanced economies between 1970 and 2010 using the Classification and Regression Tree (CART) and Random Forest techniques. They found that the net interest spread and house prices were the leading indicators of a banking crisis. Systemic banking crises in Asia and Latin America were examined separately and in a pool through the use of logit, signal extraction and a binary recursive tree by Davis et al. (2011). They found that each model highlighted different explanatory variables for each region, and the performance of the combined sample was poor. Thus, examining regions separately would seem the best approach to constructing an EWS. Using a panel probit model, Wong et al. (2010) identified that macroeconomic factors, currency exchange distress, credit indices, and cross-border crises were the main explanatory variables in the banking crises of the 11 member economies of the East Asia Pacific (EMEAP)[70].

Oet et al. (2013) highlighted the application of models for systemic risk to reveal the factors that clarify financial stress in the US banking system. Caggiano et al. (2014) estimated an EWS for systemic banking crises in low-income countries in Sub-Saharan Africa. The fundamental factors were low economic growth, lack of liquidity in the banking system and high currency exchange spread in the banks' balance sheets. Qin and Luo (2014) drew attention to capital account openness as a significant indicator of systemic banking crises, according to the level of economic development in the G20 countries. Maghyereh and Awartani (2014) introduced the effectiveness of using the simple hazard model to design an EWS of banking crises in the GCC countries by concentrating on bank-level data alone. Coudert and Idier (2018) studied the euro area according to the early warning properties of some indicators, relying on several models. Geršl and Jašová (2018) provided an in-depth analysis of banking

[69] Due to data non-availability, we did not include asset prices in our model.
[70] The Executives' Meeting of the East Asia Pacific (EMEAP) are Australia, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand.

crises in emerging economies to explore the variable of suitable credit as an early indicator of a banking crisis. From a different perspective, a large and growing body of literature has investigated the development of EWS for companies (e.g., Li and Wang, 2014) and for small and medium-sized enterprises (e.g., Koyuncugil and Ozgulbas, 2012). After reviewing the above literature and using the available data, we constructed the model in section 3.4 to apply it to the MENA region.

3.3 Data Description

3.3.1 Data – Definitions and Sources

3.3.1.a Dependent variable – the banking crisis

In this chapter, we used a binary banking crisis dummy as the banking crisis dependent variable. The definition of the term ‘systemic banking crisis’ derives from Demirgüç-Kunt and Detragiache (1998) (D&D) and Laeven and Valencia (2008, 2013 and 2018) (L&V). Therefore, we should first clarify what is meant in each study by ‘systemic banking crisis’.

According to Demirgüç-Kunt and Detragiache (1998), a systemic banking crisis breaks out if any of the following conditions occur to violate their pre-set limits. The non-performing assets to total assets ratio should not exceed 10 percent; the minimum bailout cost of financial distress should not exceed 2 percent of GDP; large scale nationalisation or any abnormal incident, such as bank runs, deposit freezes, regulatory intervention as a result of distress or prolonged bank holidays should not affect the banking system.

Laeven and Valencia (2008, 2013 and 2018) pursued a tighter definition of a systemic banking crisis that should meet two conditions: the banking system should be exposed to significant financial distress signals such as bank runs, bank liquidations and/or banking system losses and a collapse of the banking system that would urge regulators to intervene. Observing these combined conditions, our sample is left with 16 systemic banking crises in the MENA region during the period 1978-2017 to examine under the definition by Demirgüç-Kunt and Detragiache (1998) and 13 systemic banking crises under that by Laeven and Valencia (2008, 2013 and 2018). The sample covers banking crisis and non-banking crisis countries, namely: Algeria (DZA), Bahrain (BHR), Djibouti (DJI), Egypt (EGY), Iran (IRN), Iraq (IRQ), Israel (ISR), Jordan (JOR), Kuwait (KWT), Lebanon (LBN), Mauritania (MRT), Morocco (MAR), Oman (OMN), Qatar (QAT), Saudi Arabia (SAU), Tunisia (TUN), Turkey (TUR), United Arab Emirates (UAE) and Yemen (YEM). Table 3.3 shows the examined sample based on the above definitions of a banking crisis. The countries’ abbreviations are based on the World Bank codes.

Table 3.2: Banking crises in the MENA region for the period 1980-2018

Country	D&D	L&V
Algeria - DZA	1990	1990
Djibouti - DJI	1991	1991
Egypt - EGY	1980, 1990	1980
Israel - ISR	1983	1983
Jordan - JOR	1989	1989
Kuwait - KWT	1983	1982
Lebanon - LBN	1988	1990
Mauritania - MRT	1984	1984
Morocco - MAR	1983	1980
Tunisia - TUN	1991	1991
Turkey - TUR	1982,1991, 1994, 2000	1982, 2000
Yemen - YEM	1996	1996

Note: D&D- Demirgüç-Kunt and Detragiache (1998), L&V- Laeven and Valencia (2008, 2013 and 2018).

The binary variable is a dummy variable with two possible outcomes. The year of the systemic banking crisis takes the value of one; the presence of a banking crisis and all the remaining observations in the examined period take the value of zero, denoting the absence of a banking crisis. We pursue this classification of the dummy variable to eliminate the endogeneity problems that might be generated if we considered other classifications since the start and end dates of crises might be determined ambiguously; we should also be mindful of the effect of outstanding crises on the explanatory variables (Barrell et al., 2010a). Caprio and Klingebiel (2002) stated that it was difficult to accurately determine the timeframes of banking distress when gathering episodes of the systemic banking crisis and accordingly asked finance experts to review their database. An alternative approach would have been to omit post-crisis observations (Demirgüç-Kunt and Detragiache,2005). The evidence from Beck et al. (2006) and Barrell et al. (2010a) yielded similar results for both classifications. Moreover, Davis and Karim (2008a) have indicated that omitting post-crisis observations would diminish the power to capture further banking crises because they can continue to erupt afterwards and may not indicate much about banking crises in different economies. Similarly, Caggiano et al. (2016) argued that treating the post-crisis period the same as the pre-crisis period or removing it from the sample risks ignoring valuable information associated with the extension of a crisis.

We have N countries i={1,2,3,…N} that we monitor during T periods t={1,2,3,…T}. For each country and each year, we monitor the binary dependent variable (probability of banking crisis) Y, and the probability of crisis occurrence denoted by P:

$$Y = \begin{cases} 1 \text{ with probability } \Pr(Y = 1) = P \\ 0 \text{ with probability } \Pr(Y = 0) = 1 - P \end{cases} \quad (1)$$

3.3.1.b Independent variables – Macroeconomic indicators

Turning now to the explanatory variables, we want to explain the banking crisis (Y) by a vector of independent variables (X). Data were collected from various databases and resources. For macroeconomic and financial variables, we used the World Development Indicators (WDI), which is a World Bank database; the IMF International Financial Statistics (IFS) and Datastream. Data were retrieved on a yearly basis.

As cited above, a large volume of published studies considers that most banking crises are due to homogenous leading indicators that can explain banking crises in different regions because most of them have the same origin and outcomes (Demirgüç-Kunt and Detragiache,1998; Kaminsky and Reinhart, 1999). Conversely, Hamdaoui (2016) considered that banking crises are heterogeneous, and each one has different leading indicators. This view was supported by Lund-Jensen (2012), who defined systemic risk as constituted by various risk factors (credit-to-GDP growth, equity price growth, real effective exchange rate and others). Therefore, our independent variables (Table 3.5) were chosen in response to the following authors: Demirgüç-Kunt and Detragiache,1998; Kaminsky and Reinhart, 1999; Barrell et al., 2010a; Caggiano et al., 2014. We then had three groups of explanatory variables: first, the macroeconomic fundamentals, which are real GDP growth, real interest rate, GDP per capita, the terms of trade, inflation, nominal exchange rate, government budget to GDP and current account balance to GDP; second, the monetary conditions, the broad money (M2) cover of international reserves, and the ratio between domestic credit to the private sector and GDP; and third, the banking sector indicators; liquidity and unweighted capital adequacy ratios, which are discussed in the next section.

Demirgüç-Kunt and Detragiache (1998) highlighted some of the behaviour of the explanatory variables, which they say could be affected by the banking crisis after its onset. For instance, the real interest rate could decline as a result of the monetary policy with which regulators usually relax their control of an economy. Moreover, once a banking crisis begins, the credit-to-GDP ratio could fall and affect the growth of GDP. Hamdaoui (2016) presented the extreme scenario and causes of a banking crisis: asset price appreciation and credit expansion that constitute a bubble in the economy as a result of deregulation and financial liberalisation, and a severe loss and market disruption in the aftermath, a high level of non-performing loans, liquidity problems, and then government intervention with taxpayers' funds. Furthermore, the banking crisis contagion effect could arise if the crisis affects other regions.

Before proceeding to examine the explanatory variables, we should describe each variable and predict its sign and its correlation in increasing or reducing the probability of a banking crisis.

3.3.1.b.1 Real GDP growth (↑↓)

The positive relation between GDP growth and financial development has been confirmed empirically by the existing literature. Whenever real GDP growth increases, it boosts the economy, thus having a positive impact on the market. Low and negative GDP growth often leads to lower consumption and investment, job cuts and falling incomes.

It has been shown that real GDP growth negatively correlates with the probability of a banking crisis. As found by Demirgüç-Kunt and Detragiache (1998) and Davis and Karim (2008a), the slow growth of real GDP could be a leading indicator of a banking crisis since, in most instances, a crisis is preceded by slow growth. Likewise, Drehmann et al. (2011) found that real GDP growth slowed down before a crisis, but GDP growth became negative afterwards. Approximately two years later, the growth rate reverts to normal. Demirgüç-Kunt and Detragiache (1998) used real GDP growth to capture the opposite effect of the increasing value of non-performing loans. Similarly, Caggiano et al. (2014) connected the impact of real GDP growth on the banking system because economic growth raises borrowers' ability (individuals and institutions) to pay their obligations when due; thus, non-performing loans become fewer. For Drehmann et al. (2011), the GDP growth rate was also the best indicator for setting countercyclical capital buffers because it captures the aggregate business cycle. Overall, The GDP growth could significantly decrease crisis probability.

3.3.1.b.2 Real Interest rate (↑↑)

The real interest rate has a direct influence on banks' performance. Eichengreen and Rose (1998) indicated that banks' fragility could increase because of adverse selection. For instance, when the interest rate is high, the economy slows, and banks find it difficult to distinguish between good and bad borrowers. Moreover, the rational behaviour of low-risk borrowers is to opt out of the market due to the price mechanism. Thus, banks will have only risky borrowers to fund (adverse selection), and credit risk increases, as well as the probability of default. Subsequently, transferring assets to non-performing loans adversely affects a bank's profitability and consequently may heighten the vulnerability of the banking system to shocks. Demirgüç-Kunt and Detragiache (1998) concluded that a high real interest rate negatively affects bank balance sheets if banks cannot manage them properly by raising the lending rates as fast as possible (Asset-Liability Management). Hamdaoui (2016) points out that the high interest rate directly impacts debtors' solvency by reducing their ability to service their debts. However, Bordo and Meissner (2012) found a negative relationship between the interest rate and credit cycles since more than two lags' increases in credit growth can increase the probability of a banking crisis.

Moreover, Demirgüç-Kunt and Detragiache (1998) introduced various reasons for increasing the real interest rate: an increase in the inflation rate, the setting of a restrictive monetary policy, a rise in the international interest rate and financial liberalisation when removing interest rate control. This argument may also apply to most of the MENA countries.

Galbis (1995) concluded that a high real interest rate could result from the financial liberalisation process. Similarly, Demirgüç-Kunt and Detragiache (1998) considered the real interest rate to be a proxy of financial liberalisation since it increases the fragility of the banking system by encouraging excessive risk-taking. Davis and Karim (2008a) considered the real interest rate an indicator of the interest rate risk, which is an essential part of banking activities because assets last longer than liabilities. Therefore, according to the literature, the real interest rate is expected to correlate with the increased likelihood of a banking crisis positively.

3.3.1.b.3 Inflation (↑↑)

Much of the existing literature on banking crises pays particular attention to the effect of inflation. The inflation rate is a dominant indicator due to its impact on the economy through several channels. Demirgüç-Kunt and Detragiache (1998), Davis and Karim (2008a), and Caggiano et al. (2014) believed that high inflation is likely to be associated with macroeconomic vulnerability, in particular, high nominal rates. Consequently, it affects profitability, discourages savings and puts much pressure on borrowing activities. Inflation is an essential indicator representing macroeconomic mismanagement, which adversely influences the stability of the market. Duca and Peltonen (2013) concluded that inflation is a leading indicator of a banking crisis exclusively in emerging economies. Several studies found a positive relationship between inflation and crisis probability.

3.3.1.b.4 GDP per Capita (↑↓)

GDP per capita is an indicator of the structural economic development in each country (Davis and Karim, 2008a). It shows the social and economic quality of life. Büyükkarabacak and Valev (2010) confirmed the results of Demirgüç-Kunt and Detragiache (2005) that low-income level economies are much more vulnerable than richer ones to systemic banking crises.

3.3.1.b.5 Foreign Exchange (↑↓)

Currency depreciation can destabilise the banking sector. Eichengreen and Rose (1998) presented two views of the relationship between foreign exchange and banking crises. The first is that economies with pegged rates are more susceptible to banking crises (positive correlation) because these economies encounter problems associated with foreign capital. However, economies permitting flexible exchange rates can easily hedge against this risk, moderate their capital inflow and diminish the downturn of the banking system. The second is that economies with pegged exchange rates are negatively correlated with banking crises because a regime of this kind may "discipline erratic policymakers". In particular, when the domestic banking system is exposed to problems related to lax aggregate demand policies, the world will intervene to resolve the shock to the exchange rate commitment. In conclusion, when foreign shock tends to threaten the banking system's stability, flexible exchange rates are preferable. Conversely, a pegged regime is better during instability caused by a domestic downturn (Eichengreen and Rose, 1998).

Davis and Karim (2008a) found that macroeconomic shocks are more likely to occur in small open economies due to adverse changes in trade and currency depreciation, which could weaken an economy, thereby increasing non-performing loans. Caggiano et al. (2014) submitted that the banking sector could be destabilised due to currency depreciation, mainly if banks are highly vulnerable to foreign exchange risk. Hardy and Pazarbasioglu (1998) found it essential to add a foreign exchange variable in predicting a systemic banking crisis since it may contain useful information. However, its significance is eliminated when it is included with other leading indicators. However, when used in isolation, the predictive power of foreign exchange may be substantial. Eichengreen and Rose (1998) had acknowledged that unanticipated fluctuations of the real exchange rate could adversely influence a borrower's ability to fund his debts to a bank, even when these fluctuations were due to domestic or foreign economic policies. Demirgüç-Kunt and Detragiache (1998) have indicated that currency depreciation and the likelihood of a banking crisis are not correlated.

3.3.1.b.6 M2 to foreign exchange reserves (↑↑)

Demirgüç-Kunt and Detragiache (1998) have found it essential to include M2 to foreign exchange reserves in countries with an exchange rate peg (i.e., most MENA countries) to test if capital outflow can play a role in initiating banking sector problems. Caggiano et al. (2014) highlighted the ratio between the positive relationship of M2 with foreign exchange reserves and the probability of a banking crisis. Hence, an increase in this ratio leads to greater vulnerability to capital outflows. Hutchison and Glick (2000) found an increase in the M2 over foreign reserve ratio refers to a decrease in foreign currency. This particular ratio had a consistently positive effect on banking crisis occurrence.

3.3.1.b.7 Terms of Trade (↑↓)

Beck et al. (2006) focused on the movements of external terms of trade in order to capture the macroeconomic developments in economies that could affect the quality of bank assets. Deterioration in terms of trade refers to the increased import prices relative to export prices, leading to a fall in living standards and the tendency of imported goods to be more expensive. Eichengreen and Rose (1998) found that deterioration in terms of trade affects the profitability of domestic firms and may have an impact on their capacity to repay their debts (credit risk); consequently, the banking system is destabilised, particularly in emerging and small countries which have less experience and fewer instruments (export diversification) for reducing the risk (Eichengreen and Rose, 1998). Similarly, Hardy and Pazarbasioglu (1999) highlighted that a downturn in terms of trade could influence a country's competitiveness and diminish the corporate sector's profitability, hence increasing the instability of the economy. However, Demirgüç-Kunt and Detragiache (1998) found no evidence of the effect of terms on trade on the probability of banking crises in the sample they examined.

3.3.1.b.8 Government budget balance to GDP (↑↓)

Including the ratio of a government's budget balance to GDP shows the ability of the government to fund a fragile banking system and covers any relevant costs in restructuring the banking system quickly after a crisis. Barrell et al. (2010b) find the fiscal deficit as a leading indicator heightening the probability of banking crises because it reduces the capacity of the bank to recapitalise.

3.3.1.b.9 Current account balance to GDP (↑↓)

Liquid financing needs to overcome and cover any systemic crisis in the banking system. Barrell et al. (2010b) mentioned a link between current account deficits and the greater probability of a banking crisis; for instance, excessive credit expansion, which results from deficits with monetary inflows, overheats the banking system. Likewise, Reinhart and Rogoff (2009) held the view that expanding the deficit of current accounts could significantly increase the probability of a banking crisis. This view was also supported by McKinnon and Pill (1996), who presented a chain of events that tended to increase the current account deficit, starting with capital inflows in a weak regulatory banking system, excessive cycles of over-lending, high levels of liquidity contributing to consumption booms, and increased asset prices. Eichergreen and Rose (1998) and Hardy and Pasarbasioglu (1999) found that current account deficits are not significant indicators of a banking crisis, even when accompanied by a change in a banking sector's foreign liabilities.

3.3.1.b.10 Domestic credit to the private sector to GDP (↑↑)

It becomes apparent that excessive credit growth leads to a severe financial crisis, such as the global financial crisis of 2007-2009. An appreciation of this ratio without proper supervision by regulators affected the value of the assets and reduced the liquidity in the market. Pill and Pradhan (1995) considered the domestic credit to the private sector to GDP as the best explanatory variable to capture financial liberalisation. Joyce (2011) remarked that capital inflows and financial deregulation could lead to an excessive increase of domestic credit to the private sector, which is considered a sign of "over-borrowing".

3.3.1.c Independent variables – Banking sector indicators

We turn now to the main contribution of this paper, which is the inclusion of the banking sector indicators (liquidity) and the unweighted capital adequacy (leverage) ratios. The structure of the banking dataset was synthesised according to the procedure of Barrell et al. (2010a) for OECD countries. The bank-level dataset was gathered from Fitch Connect, which offers fundamental global macro- and bank-level data. We collected the unconsolidated financial statements of 732 banks operating in 19 MENA countries in our balanced panel sample. All the data were annual and quoted in US dollars.

Regarding the type of banks that we examined, we concentrated our analysis exclusively on universal commercial banks, Islamic banks, retail and consumer banks, and wholesale banks. The reason for including Islamic and conventional banks was that all the studied countries have dual banking systems. Moreover, both types follow the Basel guidelines because the standards of the Islamic Financial Services Board are not yet completed (El-Ansary et al., 2019). Other types were excluded to avoid double counting and because they had different structures and regulations, for instance, bank holding companies, private banks and investment banks. Table (3.4) shows the list of banks in each country. The examined bank-level data cover the period from 1978 to 2018.

Table 3.3: Sample description of sample countries and number of operating banks in the MENA for the period 1978-2018

Country	**Number of Banks**
Algeria	19
Bahrain	58
Djibouti	5
Egypt	47
Iran	27
Iraq	34
Israel	27
Jordan	22
Kuwait	38
Lebanon	72
Mauritania	16
Morocco	34
Oman	20
Qatar	17
Saudi Arabia	25
Tunisia	25
Turkey	173
United Arab Emirates	61
Yemen	12

Source: Fitch Connect.

It is necessary here to clarify precisely the equations used to calculate the banks' regulatory variables, which are the liquidity and unweighted capital adequacy (leverage) ratios based on definitions and data from Fitch Connect. The bank liquidity ratio, first, is the ratio of the sum of liquid assets for all banks over the end of year deposit and money market funding, as presented in the balance sheet. Second, the unweighted capital adequacy (leverage) ratio[71] is the ratio of capital and reserves for all banks to total assets. The inclusion of balance sheet variables in building an EWS gives useful insights to regulators when setting prudential policies to maintain financial stability in the economy (Caggiano et al., 2014).

[71] Risk adjusted capital adequacy data were not available.

Furthermore, to be consistent with the previous research, we should consider Barrell et al. (2010a), who found that the capital adequacy and liquidity ratios were highly significant variables in reducing the likelihood of a banking crisis.

A good deal of literature has been published on liquidity and capital adequacy ratios, taking into consideration the Basel III framework, which was a vital element of the Basel Committee's action after the global financial crisis. The main purpose of the Basel amendments was to enhance financial stability, based on the Committee's view that a resilient banking system helps to support the real economy and positively affects the sustainability of economic growth. The regulatory framework revisions focused on modifying the credit risk and the operational risk measurements to make them much more robust and enhance the risk sensitivity of the standardised approaches, which would help compare banks' capital ratios. In contrast, internal-modelled approaches have been subject to certain constraints. Moreover, Basel reviewed the risk-weighted capital ratio and emphasised the need to maintain an adequate level of capital and liquidity (Basel III, 2017).

3.3.1.d Descriptive statistics

The table below illustrates the definitions, abbreviations and sources for each macroeconomic and banking sector explanatory variable that was studied in our model. It is worth noting that we reviewed the consistency of the definitions and the calculated data because we had gathered our data from many sources.

Table 3.4: Variable definitions and sources

Variable	**Definition**	**Source**
GDP growth (annual %) GDPg	The annual percentage growth rate of GDP at market prices based on constant local currency.	WDI
GDP per capita (US$) GDPpc	Gross domestic product divided by midyear population.	WDI
Real interest rate (%) RIR	Lending interest rate adjusted for inflation as measured by the GDP deflator.	IFS
Terms of trade (%) TOT	The average price of exports over the average price of imports.	WDI
Inflation (annual %) INF	Annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.	WDI
Current account balance (% of GDP) CAgdp	Sum of net exports of goods and services, net primary income, and net secondary income over GDP.	WDI
Domestic credit to the private sector (% of GDP) DCgdp	Financial resources provided to the private sector by financial corporations over GDP.	WDI
Foreign Exchange rate (%) FX	Rate of change of the nominal effective exchange rate.	WDI
M2/Reserves (%) M2R	The ratio of M2 to foreign exchange reserves of the central bank	IFS

Government Budget Balance (% of GDP) GBBgdp	Government net lending (+) and net borrowing (-) over GDP. It equals government revenue minus expenditure.	IFS
Liquidity Ratio (%) LIQ	Liquid Assets + Available for Sale Securities / Total Deposits, Money Market and Short-term Funding.	Fitch Connect & Author's own calculation
Total Regulatory Capital Ratio (%) LEV	Total Regulatory Capital Ratio as reported by the entity or the capital and reserves to the end of total assets (unweighted capital adequacy ratio).	Fitch Connect & Author's own calculation

Note: This table presents the definitions of variables used in the regression analysis and data sources. WDI-World Development Indicators-World Bank database, IFS- International Financial Statistics-IMF database.

Table (3.6) shows the statistical properties of the explanatory variables used in the logistic regression to build the EWS in the MENA region. The table reports the number of observations, mean, maximum and minimum and the standard deviation for each regressor.

Table 3.5: Descriptive statistics

Variable	**Obs**	**Mean**	**Max**	**Min**	**Std.Dev.**
GDP growth (annual %)	779	3.87	82.81	-64.05	8.83
Real interest rate (%)	779	0.68	51.95	-463.16	30.34
Inflation (annual %)	779	13.23	487.2	-27.52	37.10
Government Budget Balance (% of GDP)	779	-2.29	61.70	-151.31	11.47
M2/Reserves (%)	779	6.04	108.11	0.18	8.40
Domestic credit to the private sector (% of GDP)	779	39.35	107.25	1.27	23.81
Current account balance (% of GDP)	779	1.32	106.84	-240.52	17.94
Foreign Exchange rate (%)*	779	228.40	1913.63	0.29	549.77
GDP per capita (US$)*	779	8920.85	38508.72	518.50	10887.06
Terms of trade (%)	779	90.76	301.51	8.42	40.69
Liquidity Ratio (%)*	779	48.44	103.64	18.39	22.78
Total Regulatory Capital Ratio (%)	779	19.06	106.2	0.42	10.03

Note: Variables marked * were winsorised at 95 percent. Obs-number of observations, Std.Dev.-Standard deviation. The variables are in level.

Before running the model, we examined in more detail the correlation between the independent variables by calculating the correlation matrix. One was based on the levels of the regressors and lagged variables for the second matrix. Tables 3.7 and 3.8 below illustrate that the right-hand-side variables are not highly correlated except for the known negative correlation between inflation and the real interest rate. Moreover, there was a positive correlation between the ratio of the government budget balance to GDP and the ratio of the current account to GDP.

Table 3.6: Correlation matrix for the regressors for the period 1978-2018

	LIQ	LEV	GDPg	GDPpc	INF	GBBgdp	DCgdp	TOT	CAgdp	RIR	M2R
LEV	0.2322										
GDPg	0.0345	-0.0003									
GDPpc	-0.0658	0.2033	0.0573								
INF	-0.0543	-0.1593	0.0007	-0.1261							
GBBgdp	0.0206	0.0615	0.0362	0.3636	-0.1351						
DCgdp	-0.2237	0.0452	-0.0227	0.2944	-0.1382	-0.0084					
TOT	0.0123	-0.0179	0.0519	0.0838	0.1052	0.0225	0.2844				
CAgdp	0.0144	0.0486	0.0328	0.4122	-0.0506	**0.6159**	-0.0926	0.0234			
RIR	0.0732	0.1652	-0.0108	0.0260	**-0.7766**	0.0321	0.0685	-0.1200	-0.0348		
M2R	-0.0823	-0.1854	0.0029	-0.1720	0.0493	-0.1034	-0.0277	-0.0755	-0.0760	-0.0353	
FX	0.0541	-0.1175	0.0471	-0.1805	0.1432	-0.1277	-0.0776	0.0794	-0.0703	-0.1561	-0.0365

Note: GDPg-GDP growth (annual %), GDPpc-GDP per capita (US$), RIR-Real interest rate(%), TOT-Terms of trade (%), INF-Inflation (annual %), CAgdp-Current account balance (% of GDP), DCgdp-Domestic credit to the private sector (% of GDP), FX-Foreign Exchange rate(%), M2R-M2/Reserves(%), GBBgdp-Government Budget Balance (% of GDP), LIQ-Liquidity Ratio(%), LEV-Total Regulatory Capital Ratio(%). The variables are in level.

Table 3.7: Correlation matrix for the one-year lagged regressors for the period 1978-2018

	LIQ	LEV	GDPg	GDPpc	INF	GBBgdp	DCgdp	TOT	CAgdp	RIR	M2R
LEV	0.2261										
GDPg	0.0328	0.0058									
GDPpc	-0.0667	0.2273	0.0614								
INF	-0.0538	-0.1653	0.0009	-0.1235							
GBBgdp	0.0141	0.0577	0.0362	0.3684	-0.1351						
DCgdp	-0.2212	0.0690	-0.0188	0.2802	-0.1358	-0.0066					
TOT	0.0097	-0.0249	0.0518	0.0891	0.1082	0.0254	0.2832				
CAgdp	0.0090	0.0485	0.0329	0.4157	-0.0518	**0.6159**	-0.0905	0.0287			
RIR	0.0726	0.1590	-0.0095	0.0297	**-0.7790**	0.0320	0.0733	-0.1231	-0.0349		
M2R	-0.0842	-0.1858	0.0018	-0.1732	0.0479	-0.1037	-0.0264	-0.0772	-0.0782	-0.0341	
FX	0.0512	-0.1411	0.0523	-0.1790	0.1431	-0.1290	-0.0822	0.0729	-0.0703	-0.1629	-0.0390

Note: GDPg-GDP growth (annual %), GDPpc-GDP per capita (US$), RIR-Real interest rate(%), TOT-Terms of trade (%), INF-Inflation (annual %), CAgdp-Current account balance (% of GDP), DCgdp-Domestic credit to the private sector (% of GDP), FX-Foreign Exchange rate(%), M2R-M2/Reserves(%), GBBgdp-Government Budget Balance (% of GDP), LIQ-Liquidity Ratio(%), LEV-Total Regulatory Capital Ratio(%). The variables are in level.

3.3.1.e Data used to construct the EWS

Having defined the liquidity and leverage ratios, we now discuss how we constructed balanced panel data for use in our model.

The main obstacle we encountered running the multivariate logistic regression was to have balanced panel data for the liquidity and unweighted bank capital (leverage) ratios that were not available for direct use in our model. Thus, we had to construct and generate the ratios by reviewing historical data, forecasting trends, and applying predictive analysis. A preliminary step was to collect the baseline data from the balance sheet and the income statements of each bank in each country from Fitch Connect. Depending on the available data, we used information on all the banks operating in the examined sample of the MENA region during the period 1978-2018 to classify the liquid assets. Then we calculated several types of liquidity and capital adequacy ratios. We analysed the results and checked their consistency with Fitch's actual data and trends during the period in question. We had unbalanced data on the 732 banks operating in our sample of the MENA region, with 779 annual observations, when we combined the data into a country-level dataset. The gaps during the 1980s obliged us to draw data from different sources; thus, we gathered some figures from central banks, the Arab Monetary Fund (AMF) and the operating banks' financial statements or projections. To heighten our accuracy in predicting the missing data, we checked historical macroeconomic data, which could affect the banking industry in each economy that we examined. After doing so, we constructed a balanced panel of data, filling the gaps by interpolation and using the constant growth model. We tried to remain consistent with the actual data by following the trends in our chosen period and using different liquidity and capital adequacy ratios in our model until we could establish the ratios that had a significant correlation with the dependent variable.

This chapter concentrates on building an EWS; thus, we lagged all the variables by one year to help handle the potential endogeneity of the explanatory variables (Demirgüç-Kunt and Detragiache, 1998; Barrell et al., 2010a; Bordo et al., 2011; Caggiano et al., 2014), and because it gives insights into developments in an economy before a crisis erupts (Barrell et al., 2010a). In order to obtain consistent empirical results and to minimise the effect of measurement errors and extreme observations, the following independent variables were winsorised using the 5 and 95 percentiles: GDP per capita, liquidity ratio and foreign exchange.

In summary, our balanced panel data contained the banking crises as a dependent variable and the macroeconomic and banking sector variables as independent variables from 1978-2018, and we ran the logistic regression using all observations[72], even if some of the independent variables had fluctuated in response to the banking crisis.

3.4 Methodology

Since the adoption of the binomial multivariate logit model by Demirgüç-Kunt and Detragiache (1998) for building EWSs, it has been a benchmark model (Caggiano et al., 2014). Therefore, in order to align our study with past literature, we build an EWS for predicting systemic banking crises in the MENA region by using the multinomial logit model. Mainly for the following reasons, it considers the interdependencies of regressors such that a crisis could occur if these regressors were combined (Davis and Karim, 2008a), reduces the number of missed crises (i.e., when the crisis occurs, but the model gives no signal) and false alarms (i.e., when no crisis actually occurs but the model indicates that a crisis is likely to ensue) which are considered type I and type II errors[73], respectively (Bussiere and Fratzscher, 2006; Barrell et al., 2010a; Caggiano et al., 2014).

As discussed in section 3.2.6.c, above, the multivariate logit model is a parametric approach that is particularly useful in calculating the unconditional probability of a banking crisis, given the input of its macroeconomic, institutional, and financial explanatory variables. Thus, the occurrence of an unconditional banking crisis is a function of a vector of regressors and a vector of unknown parameters. Due to the ambiguity of the start and end dates of a banking crisis and the timing of each crisis, we follow Barrell et al.'s methodology (2010) by assuming a one-year duration of the crisis. Therefore, our dependent variable, a binary banking crisis dummy, takes the value of one for a given year if it is a banking crisis country, and takes the value of zero for a given year if it is a non-banking crisis country.

Turning now to our estimator, we applied the cumulative logistic distribution function, which consists of the probability when the dummy variable has a value of one to the logit of the vector of n explanatory variables,as follows.

$$\mathrm{Prob}(\mathrm{Y_{it}} = 1) = \mathrm{F}(\beta \mathrm{X_{it}}) = \frac{e^{\beta' x_{it}}}{1+e^{\beta' x_{it}}} \qquad (2)$$

where $\mathrm{Y_{it}}$ is the banking crisis dummy for the country (i) at period (t), β is the vector of coefficients, $\mathrm{x_{it}}$ is the vector of explanatory variables, and $\mathrm{F}(\beta \mathrm{X_{it}})$ is the cumulative logistic distribution.

[72] Conversely, any elimination of observations after the occurrence of a banking crisis leads to the loss of episodes of multiple crises in each country. Moreover, the decision about the way to construct the panel sby choosing observations is "arbitrary" (Demirgüç-Kunt and Detragiache, 1998).

[73] In general, it has been observed that, depending on the policymakers' point of view, type II error is less troublesome than type I error because it appears to be less costly from the welfare side, since policymakers need to set pre-emptive policies, whereas missing a crisis can severely affect the welfare cost (Bussiere and Fratzscher, 2006).

The log-likelihood function (the natural log of the odds ratio[74]) that we obtained to get the actual parameter estimates is

$$\log_e L = \sum_{i=1}^{n} \sum_{t=1}^{T} [(Y_{it} \log_e F(\beta' X_{it})) + (1 - Y_{it}) \log_e (1 - F(\beta' X_{it}))] \qquad (3)$$

Based on Equation (3), the log-likelihood function shows that the parameters on $X_{i,t}$ are not constant marginal effects of the regressor on banking crises likelihood because the regressor's effect is conditional on the values of all other regressors at time t. Notably our model had more than one explanatory variable. The sign (positive/negative) of the coefficients could be easily interpreted since it shows the direction of change in the likelihood of a crisis. Demirgüç-Kunt and Detragiache (1998) note that the magnitude of the change depends on the cumulative distribution function slope β'X(i,t). However, explaining the value of the coefficients is different under the logistic specification, since when we maximise the log-likelihood function, the parameters obtained are not constant marginal effects of explanatory variables on the probability of a crisis because of the non-linearity of the underlying relationship (Davis and Karim, 2008a). Accordingly, the interpretation of the estimates is as follows: if the results obtained are positive, it indicates that the value of the leading indicator (explanatory variable) increases with the probability of a banking crisis erupting. In contrast, if it is negative, it means that the probability of a crisis declines when the explanatory variable increases. Due to logit singularity in interpretation, the coefficient (β_i) shows the impact of each leading indicator (X_i) when other remaining regressors are at their sample mean values (Barrell et al., 2010a). Thus, following the interpretation of Demirgüç-Kunt and Detragiache (1998), an increase in the probability of a banking crisis relies on the original probability and the initial values of all the regressors and their coefficients.

Table 3.9 summarises the moves of the logit from -∞ to +∞ when probability goes from 0 to 1. The logit reaches a negative and highly exaggerated magnitude when the odds ratio declines from 1 to 0 and becomes positive and large in size as the odds ratio rises from 1 to ∞.

Table 3.8: Summary of the movement of the logit model between 0 and 1.

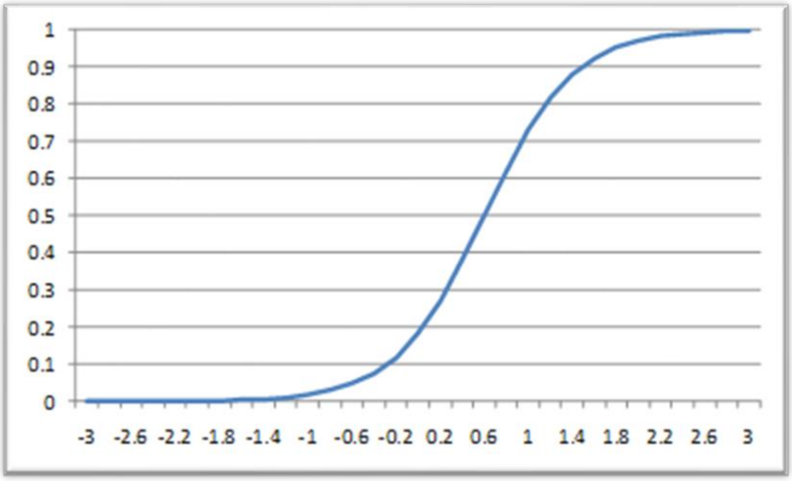
Probability	**Odds ratio**	**Log-likelihood function**
$\mathbf{P_i = 0}$ (No Crisis)	$\frac{P_i}{1 - P_i} = 0$	$\text{logit}\ (\ln(0)) = -\infty$
$\mathbf{P_i = 1}$ (Crisis)	$\frac{P_i}{1 - P_i} = +\infty$	$\text{logit}\ (\ln(1)) = +\infty$

[74] The odds ratio equals the probability of a banking crisis to its complement (the probability of no banking crisis).

We can present this by constructing the sigmoidal logistic cumulative distribution (Figure 3.1), which indicates that if the crisis probability is already at its highest or lowest value, the leading indicator will slightly impact on the crisis. However, if the probability of a crisis reaches around 0.5 marks, the impact of the same leading indicator is more likely to precipitate a crisis (Davis and Karim, 2008a). Therefore, policymakers should observe the leading indicator(s) of a systemic banking crisis and try to set pre-emptive policies or actions that could significantly reduce its probability.

Figure 3.1: Sigmoid curve of P-crisis

P-Crisis



X-data

Regarding the use of panel data, country fixed effects may be employed to check whether the dependent variable varies across a country independently of the regressors. However, under the logit estimation, running country fixed effects mean that dummies of the countries that did not experience a banking crisis will be perfectly correlated with the dummies of those that did have a banking crisis. This approach would lead us to eliminate the countries that have not been exposed to a banking crisis during the examined period; thus, we would end up with a biased sample and coefficients (Greene, 2000; Demirgüç-Kunt and Detragiache, 1998; Davis and Karim, 2008a).

3.5 Model Performance and Prediction

3.5.1 Empirical results

In order to answer the research question: "What are the determinants of banking crises in the MENA region?" we begin by estimating the binomial logit model by including all the selected explanatory variables. We lagged all the listed variables by one period for the following reasons: because it would let us evaluate the economic development of the economy before the crisis erupted; second, it eliminates the impact of the endogeneity of the dependent variable on the regressors; third, it is a crucial step in building an EWS because a change in the leading indicators takes some time to have a widespread effect on the economy (Barrell et al., 2010a).

Our examined sample was analysed using the general-to-specific approach that was adopted by Barrell et al. (2010a). It consists of running the regression using all the variables listed in Table 3.5 as a general model that includes the key determinants of banking crises based on the theoretical framework. One of the advantages of running a general regression is that it makes it unnecessary to impose any previous assumptions about which variables have a more robust theoretical link with each crisis probability. Therefore, we started by including all the variables. Then we repeated the process several times in order to remove the least statistically significant variable at each repetition. When we had reached the stage where all the remaining regressors were statistically significant, we terminated the process, thus obtaining a very parsimonious model associated with an increased or reduced probability of systemic banking crises in the MENA region.

Our results show that banking systems in the MENA region could encounter systemic banking crises when changes occur in both macroeconomic and banking sector variables. This finding is consistent with those in the previous literature from various developed and developing economies. Table 3.10 shows the empirical results, using the Demirgüç-Kunt and Detragiache (1998) systemic banking crisis definition explained previously in section (2.2.2), which gave us in the end 16 systemic banking crises as a dependent variable. We began by including all the examined regressors, and then we omitted the least significant variable according to the general-to-specific approach, as can be seen from the data in Table 3.10 and their corresponding probability (in parentheses).

Table 3.10 below illustrates the breakdown of the regressors to yield the following significant variables (the leading indicators), namely, liquidity ratio (LIQ), GDP per Capita (GDPpc), Inflation (INF) and unweighted regulatory capital (LEV). We may recall that the first three regressors were statistically significant from the first examination of the sample. In contrast, LEV started to be statistically significant after 2013 (see Table 3A.3). Moreover, Government Budget Balance to GDP (GBBgdp) and Current Account to GDP (CAgdp) were statistically significant variables till 1990 (see Table 3A.1 and 3A.2); thus, in building the EWS, we cannot ignore their effect.

Table 3.9: The general to specific approach D&D

LIQ(-1)	-0.031	-0.031	-0.031	-0.031	-0.030	-0.030	-0.031	-0.034	-0.039
	(0.006)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)	(0.007)	(0.003)	(0.000)
GDPpc(-1)	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0004	-0.0004
	(0.031)	(0.031)	(0.030)	(0.030)	(0.018)	(0.012)	(0.012)	(0.004)	(0.008)
INF(-1)	0.010	0.010	0.010	0.008	0.008	0.009	0.008	0.009	0.007
	(0.045)	(0.045)	(0.046)	(0.011)	(0.013)	(0.007)	(0.008)	(0.004)	(0.013)
LEV(-1)	-0.052	-0.053	-0.052	-0.050	-0.051	-0.050	-0.050	-0.060	-0.065
	(0.071)	(0.071)	(0.071)	(0.077)	(0.075)	(0.078)	(0.087)	(0.050)	(0.036)
GBBgdp(-1)	0.067	0.067	0.063	0.063	0.053	0.053	0.052	0.064	
	(0.151)	(0.149)	(0.164)	(0.163)	(0.209)	(0.207)	(0.225)	(0.137)	
DCgdp(-1)	-0.014	-0.014	-0.014	-0.014	-0.012	-0.012	-0.013		
	(0.239)	(0.239)	(0.253)	(0.248)	(0.296)	(0.305)	(0.255)		
GDPg(-1)	-0.030	-0.030	-0.028	-0.028	-0.027	-0.020			
	(0.278)	(0.277)	(0.30)	(0.30)	(0.301)	(0.416)			
TOT(-1)	0.013	0.013	0.012	0.012	0.010				
	(0.240)	(0.241)	(0.244)	(0.259)	(0.323)				
CAgdp(-1)	-0.024	-0.024	-0.024	-0.026					
	(0.455)	(0.456)	(0.438)	(0.409)					
RIR(-1)	0.003	0.003	0.003						
	(0.602)	(0.598)	(0.596)						
M2R(-1)	0.008	0.008							
	(0.616)	(0.615)							
FX(-1)	-0.0001								
	(0.950)								

Note: estimation period 1978-2018; p-value in parentheses; LIQ-liquidity ratio, GDPpc-GDP per capita, INF-inflation, LEV-unweighted capital adequacy ratio, GBBgdp-government budget balance to GDP, DCgdp-domestic credit to private sector to GDP, GDPg-GDP growth, TOT-change of terms of trade, CAgdp-current account to GDP, RIR-real interest rate, M2R-M2 to reserve ratio, FX-change of foreign exchange rate. D&D-Demirgüç-Kunt and Detragiache (1998) definition of banking crisis.

As expected in the context of the MENA region, the macroeconomic and banking sector indicators were statistically significant. We began by interpreting the macroeconomic variables; it appeared that GDPpc was negatively correlated with the probability of a banking crisis. It can be seen from Table 3.6 that the maximum amount of GDPpc is 38,509 US dollars, and the minimum amount is 519 US dollars, implying that the gaps between the MENA region economies are enormous. Thus, increasing the GDPpc level in some of the MENA region countries could raise the standard of living and institutional quality. Furthermore, injecting more funds into the economy and increasing the ability to pay back debts when due, hence fewer non-performing loans. Regarding the inflation level, most MENA countries have experienced high inflation rates that affect their economic performance; for instance, Israel during the 1980s and 1990s, Algeria and Lebanon during the 1990s, Egypt, Iran, Iraq, Turkey, and Yemen ever since 1980. Regulators should be aware of such results that very high inflation can increase the vulnerability to the systemic banking crisis (Duttagupta and Cashin, 2008) and indeed is considered one of the leading indicators.

Concerning the banking sector indicators, the regulators in the MENA economies have devoted much effort to reform their financial systems. While some programmes and policies have been implemented, other amendments have not so far been applied. In both cases, the MENA's financial systems still need to be well constructed to attain financial stability and intervene more in funding individuals and institutions whose investment projects create jobs and raise economic growth.

Based on our results and relating them to the episodes of banking crises in section 3.2.2, one year before the crisis, the banking systems in the MENA region are prone to engage in tremendous credit activities for the public sector and limited access to the private sector, despite their deposit levels. Also, they give preferential rates to fund governmental projects in some countries, which involves increasing the total of non-performing loans and the likelihood of a systemic banking crisis.

Our results are in line with those of the subsequent studies that examined the banking industry in the MENA region from different perspectives. In a comprehensive study, Pearce (2011) indicated that the financial systems in the MENA region are bank-dominated: in 2008, the bank assets constituted 63.3 percent of GDP. Banks rely on funding from the government and large corporations, and, at the same time, they have weak access to deposits compared to the GDP per head. Pearce (ibid) added that microenterprises are considered significant employers in the market because of their large numbers. Therefore, over the past decade, regulators have launched financial inclusion activities to encourage households, individuals and enterprises to benefit from the range of services provided by the banks and other financial institutions for boosting trade and investments.

Similarly, Zaghdoudi et al. (2013) admitted that access to financial services in the MENA region is still lower than in other developing countries. But, remarkably, since the 1990s, household deposits and savings have slightly risen relative to GDP. Ghenimi et al. (2017) examined the impact of liquidity and credit risks on banking stability in the MENA region and found that the two variables were negatively correlated. In particular, loan growth has had a negative impact on banking stability, but the return on assets and unweighted capital adequacy ratios have a significant and positive correlation to the reduced risk of banking insolvency, especially in times of financial distress.

Overall, these results suggest that banking systems in the MENA region tend to have a low probability of a systemic banking crisis so long as they have high capital adequacy and liquidity ratios one year before a crisis. To take into account also of the level of GDP per capita and inflation. Regulators mandate banks to maintain a healthy level of capital, adequate liquid assets on their balance sheet and policies set to reduce the effect of high inflation and low GDP per capita one year before a crisis. Those who comply are less likely to experience a systemic banking crisis.

Based on the results in Table 3.10, our final EWS is shown below in Equation (4):

$$\log\left[\frac{\mathrm{p(crisis)}}{1-\mathrm{p(crisis)}}\right] = \underset{(2.48)}{0.007\mathrm{Inf}(-1)} - \underset{(-2.65)}{0.0004\mathrm{GDPpc}(-1)} - \underset{(-3.41)}{0.039\mathrm{Liq}(-1)} - \underset{(-2.09)}{0.065\mathrm{LEV}(-1)} \qquad (4)$$

where p(crisis) is the probability of a banking crisis occurring, Inf is the inflation rate, GDPpc is the GDP per capita, Liq is the liquidity ratio, LEV is the unweighted capital adequacy ratio, and t-statistics are presented below each coefficient.

3.5.1.a Early Warning System (EWS) predictive power

In terms of the predictive power of our EWS, Table 3.11 shows the following estimated tests to assess the performance of our binomial logistic model: in-sample classification accuracy, Wald test, Akaike's information criterion (AIC), the Receiver Operating Characteristic (ROC) curve and its associated Area Under the ROC (AUROC).

Table 3.10: Baseline model test statistic

Regression	D&D
Probability cut-off	0.021
Number of Crises	16
Number of Obs.	760
% Crises correct	62.5
% no crises correct	62.37
% Type I error	37.63
% Type II error	37.5
Area under ROC	0.705
Wald $\mathbf{Chi^2}$	156.71
AIC[75]	0.215

Note: D&D-Demirgüç-Kunt and Detragiache (1998) definition of banking crisis, ROC-the Receiver Operating Characteristic, AIC- Akaike's information criterion.

We concentrated on assessing the goodness-of-fit of our EWS through determining the called crises depending on the in-sample probability as a cut-off threshold, following the practice of Demirgüç-Kunt and Detragiache (1998), Kaminsky and Reinhart (1999) and Barrell et al. (2010a). As shown in Table 3.11, our model appears to perform well, based on our threshold[76] of 0.021 (2.1%). Our model succeeds in predicting 10 out of 16 banking crises in the MENA region during the estimated period. Overall, 62.5 percent of crises were correctly called, missed crises (type I errors) constituted 37.63 percent and false alarms (type II errors), 37.5 percent.

Table 3.12 presents the prediction accuracy of our EWS in our report of the estimated probability of crisis for each country using the actual in-sample crisis likelihood against our EWS fitted values which is the cut-off threshold of 0.021 (2.1%), following the approach of Demirgüç-Kunt and Detragiache (1998), Kaminsky and Reinhart (1999) and Barrell et al. (2010a). Thus, the in-sample estimated probability compares actual and fitted values of the dependent variable for each country. Hence, we call a banking crisis once the fitted value exceeds the cut-off threshold. Moreover, most of the banking crises were predicted one and three years before the start date of the actual banking crisis. Regarding the banking crises that were not anticipated, if we return to section 3.2.2, where we present the banking episodes of each country, we observe that Djibouti and Yemen were exposed to high uncertainty due to civil wars; thus, it was not surprising that our EWS did not envisage their banking crises.

[75]The Information criterion AIC = -2/N * LL + 2 * k/N, where *N* is the number of examples in the training dataset, *LL* is the log-likelihood of the model on the training dataset, and *k* is the number of parameters in the model. See https://machinelearningmastery.com/probabilistic-model-selection-measures/

[76] Calculating the threshold (cut-off) means dividing the number of banking crises by the number of observations, i.e. 16/760.

Turning next to Kuwait, an oil-producing country, its inflation rates during the examined period were lower than those in other countries. Its GDP per capita is considered one of the highest not only in the MENA region but globally. The Kuwaiti banking system is stable and promising. However, the incident of a banking crisis in 1983 was due to investors securitising cheques; they were looking for short-term returns in an unofficial stock market (Souk Almanakh). The government intervened immediately to cover the losses, so the effect on the economy was not severe. The banking crisis in Mauritania was due to a high government deficit; when the prices of several commodities dropped, it affected the consumption among individuals and institutions and resulted in a rise of around 70 percent in non-performing loans.

Table 3.11: Banking Crises and estimated probability: our model as an EWS

Country	**Crisis Year**	**In-sample estimated probability**	**Not predicted**	**Predicted 1 year prior**	**Predicted 3 years prior**
Algeria	1990	0.0850	-	✓	✓
Djibouti	1991	0.0147	✓	-	-
Egypt	1980	0.0216	-	✓	-
Egypt	1990	0.0366	-	✓	✓
Israel	1983	0.0280	-	✓	✓
Jordan	1989	0.0307	-	✓	✓
Kuwait	1983	0.0003	✓	-	-
Lebanon	1988	0.5720	-	✓	✓
Mauritania	1984	0.0141	✓	-	-
Morocco	1983	0.1991	-	✓	✓
Tunisia	1991	0.0808	-	✓	✓
Turkey	1982	0.0525	-	✓	✓
Turkey	1991	0.0616	-	✓	✓
Turkey	1994	0.0334	-	✓	✓
Turkey	2000	0.0124	-	✓	✓
Yemen	1996	0.0122	✓	-	-

Note: In-sample prediction. Threshold probability is equal to the in-sample crisis frequency, which is 0.021, according to the approach of Demirgüç-Kunt and Detragiache (1998).

3.5.1.b Marginal effects

The empirical performance of our EWS model can be better interpreted and gives a meaningful ranking of each variable in each country by computing the marginal effect, which captures the average effect of changes in each explanatory variable on the probability of a crisis (Greene, 2000) for the examined period, 1978-2018. Greene (ibid) noted that the marginal effects show the immediate response of the dependent variable (BC) to a change in the independent variables at the end of the measurement period. The marginal effects can be computed either by the outcomes of the sample means of the data or by evaluating the marginal effects at each observation and then taking the sample average of the individual marginal effects (Greene, ibid).

Following the methodology of Barrell et al. (2010a) in calculating the marginal effect (see Table 3.13) for each country, we maintained all other variables at their sample mean values and increased inflation (INF), liquidity ratio (LIQ) and the unweighted capital adequacy ratio (LEV) by one percentage point and the GDP per capita (GDPpc) by the standard deviation of GDP per capita for each country. Applying the marginal effects helped us in two ways. Our results showed the coefficients at low values; thus, using the marginal effects provided an appropriate interpretation of the logistic model results. Moreover, our results emphasised the essential leading indicator for each country.

To illustrate these points, Table 3.13 reports the marginal effect of each variable on the estimated crisis probability for the entire examined period, 1978-2018. It is apparent from Table 3.10 that the coefficients of the GDP per capita (GDPpc) during the examined period were very low yet statistically significant. Still, when we calculated the marginal effect, it showed that increasing the (GDPpc) by its standard deviation for each country reduced the likelihood of a banking crisis. For instance, the highest impacts occurred in Morocco, Iran, and Egypt. A one-point increase in the unweighted capital adequacy ratio (LEV) alone would have reduced the banking crisis probability by at least 0.64 percent in Morocco, 0.25 percent in Iran and Egypt, and 0.17 percent in Jordan. Increasing the liquid assets, specifically in Moroccan banks can reduce the likelihood of a crisis. These results confirm that implementing financial reforms in the MENA region's banking sector can help build a robust industry that can fund and thus boost the economy. Even though the marginal effect of inflation was low in all the examined countries, it was still a statistically significant indicator that the probability of a banking crisis had increased.

Table 3.12: Marginal effect of the variable on crisis probability

Country	Inflation	GDP per capita	Liquidity ratio	Leverage ratio
Algeria	0.000	-0.007	-0.001	-0.001
Bahrain	0.000	-0.012	-0.001	-0.001
Djibouti	0.011	-0.233	-0.057	-0.096
Egypt	0.028	-1.131	-0.148	-0.247
Iran	0.029	-1.944	-0.150	-0.251
Iraq	0.004	-0.281	-0.019	-0.031
Israel	0.000	-0.018	-0.001	-0.001
Jordan	0.019	-0.825	-0.101	-0.169
Kuwait	0.000	0.000	0.000	0.000
Lebanon	0.007	-0.595	-0.035	-0.059
Mauritania	0.013	-0.209	-0.070	-0.118
Morocco	0.073	-2.731	-0.384	-0.644
Oman	0.002	-0.201	-0.009	-0.014
Qatar	0.000	0.000	0.000	0.000
Saudi Arabia	0.000	-0.059	-0.002	-0.004
Tunisia	0.019	-0.867	-0.097	-0.163
Turkey	0.003	-0.329	-0.017	-0.028
United Arab Emirates	0.000	0.000	0.000	0.000
Yemen	0.008	-0.138	-0.043	-0.072

Note: Author's own calculations. The marginal effect is shown of a one-point increase in inflation (INF), the Liquidity ratio (LIQ) and the Unweighted capital adequacy ratio (LEV), and by the standard deviation of the GDP per capita (GDPpc). Values are in percentage points.

3.5.1.c Robustness of the baseline model

In addition to the in-sample prediction, Demirgüç-Kunt and Detragiache (1998) and Davis and Karim (2008a) applied two tests to assess the quality of the model: first, the Wald test statistics that check the null hypothesis of whether all coefficients equal zero. According to our result, the null hypothesis was rejected because all the coefficients were significantly different from zero; second, Akaike's Information Criterion helped to compare the quality of the two models used, the D&D (baseline model) and the L&V (robustness check model). Recent studies have shown an increasing interest in evaluating the EWS through the Receiver Operating Characteristic (ROC) curve and its associated Area Under the ROC (AUROC).

Traditionally, regulators' main concern is to find the optimal EWS that provides signals whereby the systemic risk is reduced. Drehmann and Juselius (2014) indicated that early warning systems are essential for setting macroprudential policies to reduce the adverse outcomes of systemic banking crises. They added that the optimal EWS must have robust statistical predictive power and provide proper signals early enough to allow policymakers to intervene promptly and effectively. Moreover, it should be stable enough to comply with policymakers' trends in maintaining financial stability in the economy.

In terms of regulators' practices, the utility function is the main criterion invoked to assess a policy over time, and changes in EWS can emit different signals. However, it is difficult to evaluate the quality of these signals, especially when there is no indication of the estimated costs and benefits of macroprudential policies. Elliot and Leili (2013) suggested a technique that could help to evaluate EWSs, namely, by checking the entire Receiver Operating Characteristic (ROC) curve. This gives an overview of any signal among all the possible utility functions and the trade-off between missed crises (Type I errors) and false alarms (Type II errors), which this function implies. Hence the full mapping of the ROC curve was used to provide a comprehensive picture of such a trade-off.

The ROC is an advanced technique that is currently being used to determine the ability to make a binary classification in predicting banking crises, in addition to its associated Area Under the ROC (AUROC) estimate. These techniques are considered to produce better measurements because they depend on the entire set of thresholds (Barrell et al., 2018) and have been used by several researchers (Schularick and Taylor (2012), Drehmann and Juselius (2014) and Barrell et al. (2017)) in the context of banking crises. The ROC was selected for its reliability and validity as a diagnostic test that captures the sensitivity (true positive rate TPR) on the Y-axis and one minus the specificity (the false positive rate, FPR) on the X-axis. So, according to our model, the ROC curve indicates a function of false alarms versus missed crises (Barrell et al., 2018). The ideal point in the curve is the plot in the top left corner, where the FPR of zero and TPR of one are indicated. The ROC in a binary classification plot all thresholds c on the real line, $\mathrm{I}(\widehat{\mathrm{p}} - \mathrm{c} > 0)$, the indicator function is $\mathrm{I}(.), \widehat{\mathrm{p}}$ represents the linear model prediction that constitutes a continuous signal. As long as threshold c remains large and negative, the classifier calls a crisis aggressively; thus, all signals exceed the threshold, and the TPR and FPR reach one. In contrast, when threshold c appears to be large and positive, the classifier limits its ability to call a crisis because all signals are at a lower level than the threshold, and the TPR and FPR amount to zero. In the middle area between these two points, the classifier should show a TPR greater than the FPR so the ROC curve can exceed the 45-degree line of the null (Schularick and Talylor, 2012). In terms of predicting banking crises, a rule of thumb is that the AUROC should be higher than 50 percent – indeed, the higher, the better – to outperform a random coin toss, which is a totally uninformative signal (Barrell et al., 2018).

We introduced a brief background about the ROC and its associated AUROC to determine the leading indicators that contribute to systemic banking crises in the MENA region either through using Demirgüç-Kunt and Detragiache (1998) or in the definition by Laeven and Valencia (2008, 2013 and 2018). According to the results, there is a consistency between the two models; thus, checking the AUROC can help determine which one could be more informative.

3.5.2 Out-of-sample performance

3.5.2.a Overview

Based on the results discussed previously, we contend that an EWS built on liquidity and unweighted capital adequacy ratios, GDP per capita and inflation can significantly help policymakers and regulators in the MENA region by improving their ability to detect and avoid banking crises. To validate our claim, let us now turn to the out-of-sample prediction for all the countries in our sample to check whether our EWS can identify the banking crises that have erupted in the MENA region since 1978.

In order to be able to test the out-of-sample performance of our EWS, we needed to run the binomial logistic model over restricted periods to estimate the likelihood of a crisis in the following years[77]. However, there is a trade-off between the best time for cutting the in-sample for out-of-sample prediction and the number of out-of-sample crises. According to our examined sample, most of the banking crises were clustered in the 1980s and 1990s and very few since, and the last banking crisis was in Turkey in 2000. Therefore, to evaluate the model, we had to partition the in-sample at a period that gave enough out-of-sample crises to assess our EWS. Partitioning the in-sample too early affects the reliability in estimating the crises. Thus, we started to partition the sample in 1989 to check whether the out-of-sample prediction is called the nine banking crises. Next, we partition the in-sample in 1998 to review our estimation of the crisis that occurred in Turkey (2000). Moreover, we wanted to examine whether our out-of-sample prediction called any crisis in 2007 and 2008 during the Global Financial Crisis (cutting the sample in 2006) and tested the Arab Spring[78] of 2011 (cutting the sample in 2009). It is worth noting that we were using the same in-sample cut-off threshold, which was 2.1%, following the criteria of Barrell et al. (2010a).

[77] This follows the practice of Barrell et al. (2010a).
[78] The Arab Spring was a series of anti-government protests and pro-democracy uprisings that occured across different countries in the Arab world in the early 2010s. It erupted in response to oppressive regimes, the low standard of living and youth frustration in Tunisia. Then it spreaded to five other countries: Libya, Egypt, Yemen, Syria and Bahrain. It resulted in regime changes and the ousting of several dictators in Tunisia, Egypt, Libya and Yemen.

The out-of-sample performance result (see Table 3A.4) revealed that 7 out of 9 banking crises from 1989 onwards were correctly predicted, namely, Algeria and Egypt (1990), Jordan (1989), Tunisia (1991), Turkey (1991, 1994, 2000). We failed to call Djibouti (1991) and Yemen (1996). As noted in section 3.2.2, however, the banking crisis in Djibouti was caused by the civil war's destabilising of the economy. Likewise, Yemen was exposed to the same consequences of a civil war that began in 1994, as well as the implementation of financial reforms in 1995. Consequently, the confidence level in the banking system was shallow. This may explain why our EWS did not call these two crises.

3.5.2.b Crisis dating

As previously stated, estimates must reckon with ambiguity or subjective judgement (Barrell et al., 2010a) over the start and end dates of the banking crises in each country. For this reason, we considered it a banking crisis if the EWS called a crisis one year before, the same year, and after one year. In the second trial of cutting the in-sample in 1998, our out-of-sample succeeded in calling the only banking crisis that was seen in Turkey (2000).

The result concerning Iran is remarkable. Our EWS in-sample, out-of-sample and by using the various definitions of systemic banking crisis were able to call a banking crisis in 2011, which was the year of the Embezzlement Scandal initiated by an investment company to secure loans worth 2.6 billion dollars. Ebrahimi et al. (2019) stated that six Iranian banks were involved, three of them state-owned, one partially owned by the government, and two privately owned. They added that banks that were involved in this scandal were under extensive and intense scrutiny and were compelled to limit their lending transactions. It should be noted that in the updated version of their systemic banking crises database Laeven and Valencia (2018) did not count this incident, either systemic or non-systemic banking crisis.

3.5.2.c Correlation with the global financial crisis (GFC) 2007-09

As a further test, we used the same cut-off threshold to derive out-of-sample predictions for all the countries in our sample for 2007 and 2008 to check whether our EWS could estimate a signal of crisis during the global financial crisis of 2008. Based on our results above, the unweighted capital adequacy ratio was not a significant indicator before 2013 under the definition of a crisis by Demirgüç-Kunt and Detragiache (1998). Thus, we derived the out-of-sample prediction by adding all the leading indicators which are liquidity ratio (LIQ), inflation (INF), GDP per capita (GDPpc), and unweighted capital adequacy ratio (LEV). Next, we excluded the unweighted capital adequacy ratio and then tested the result using Laeven and Valencia's definition (2008, 2013 and 2018), including all the leading indicators that were statistically significant.

Table 3.14 illustrates the false alarms (type II errors) which were detected. It should be noted that false alarms centralised in Egypt, Iran, Morocco, Yemen and Mauritania in 2007 using the two definitions for both in-sample and out-of-sample estimations. Therefore, these results need to be interpreted with caution because many papers have investigated the effect of the subprime crisis on the MENA region. It has been found that the economies in this region were less affected than the developed economies, as previously stated (section 3.2). However, economic conditions in the region were unstable. The remarkable result is the effect of including the factor of unweighted capital adequacy (LEV): even though it was not significant during the subprime period under the definition of Demirgüç-Kunt and Detragiache (1998), still brought down the number of false alarms in several countries.

Table 3.13: Out-of-sample prediction – the Global Financial Crisis (GFC) 2007-2009

		D&D			**L&V**	
Country	Year	In-sample	Out of sample-all variables	Out of sample-LEV not included	In-sample	Out of sample-all variables
Algeria	2007	-	-	-	X	X
	2008	-	-	X	X	X
Bahrain	2007	-	-	-	-	-
	2008	-	-	-	-	-
Djibouti	2007	-	-	-	X	X
	2008	X	-	X	X	X
Egypt	2007	X	X	X	X	X
	2008	X	X	X	X	X
Iran	2007	X	X	X	X	X
	2008	X	X	X	X	X
Iraq	2007	-	-	-	-	-
	2008	-	-	-	-	-
Israel	2007	-	-	-	-	-
	2008	-	-	-	-	-
Jordan	2007	-	X	X	-	-
	2008	-	X	X	-	-
Kuwait	2007	-	-	-	-	-
	2008	-	-	-	-	-
Lebanon	2007	-	-	X	-	-

	2008	-	-	-	-	-
Mauritania	2007	X	X	X	X	X
	2008	-	-	X	-	-
Morocco	2007	X	X	X	X	X
	2008	X	X	X	X	X
Oman	2007	-	-	-	-	-
	2008	-	-	-	-	-
Qatar	2007	-	-	-	-	-
	2008	-	-	-	-	-
Saudi Arabia	2007	-	-	-	-	-
	2008	-	-	-	-	-
Tunisia	2007	-	-	X	-	-
	2008	-	-	X	-	-
Turkey	2007	-	-	-	-	-
	2008	-	-	-	-	-
United Arab Emirates	2007	-	-	-	-	-
	2008	-	-	-	-	-
Yemen	2007	-	X	X	X	X
	2008	X	X	X	-	X
Total		9	11	17	12	13

Note: estimation period 2007-2008. X-False Alarm, LEV- unweighted capital adequacy ratio. D&D- Demirgüç-Kunt and Detragiache (1998), L&V- Laeven and Valencia (2008, 2013 and 2018).

In a recent study, Gordon (2018) traced the impact of the GFC on the MENA region. He argues that banks operating in the MENA region played no role in the crisis simply because the financial instruments (mortgage-backed securities and credit default swaps) that caused the crisis were rare[79] in this region’s financial system. Some banks were exposed to severe losses during the crisis due to the global reduction in some economic activities, for instance, trade and investments. The Gulf Cooperation Council (GCC) economies were influenced more than any others in the region due to their open financial systems, but their governments’ support helped them recover quickly. Banks in Bahrain and the United Arab Emirates were exposed to severe losses due to the dramatic drop in the real estate and construction markets. Government debt in Lebanon increased. Economic insecurity materialized in Egypt and Iraq. However, he added that banks operating in the MENA, particularly banks operating in the GCC countries, were well-capitalised, providing self-insurance and protection against insolvency. Trad et al. (2017) found that Islamic banks operating in the MENA region during the GFC were more

[79] None of the banks operating in the MENA issued these instruments and sold it in the local markets.

stable and profitable than conventional banks. Moreover, as usual, inflation negatively affected their profitability, whereas the GDP growth rate acted positively.

Regarding the false alarms in Morocco, it was evident that the economic situation was fragile due to the microfinance crisis in the same period of the GFC. Rozas et al. (2014) highlighted the causes of the microfinance crisis as aggressive competition, excessive growth, poor governance, weak supervisory actions, poor lending discipline and multiple borrowing transactions. They added that non-performing loans increased massively across all regions of the country. Chehade (2013) claim that the sector-wide credit risk reached 14 percent, and the rate of one of the leading microfinance institutions spiked to 38 percent. Therefore, our estimation should not be considered as a pure false alarm. Remarkably, our EWS was able to capture this vulnerability in the economy.

In the early 2000s, the Egyptian government decided to launch the Egyptian Bank Reform Plan (2004-2009) to overcome the problems of an excessive level of defaults in the banking sector. In particular, national debt, low level of investment to GDP, uncontrollable foreign exchange rate and poor government policies negatively affected economic growth. Above all, the independence of the Central Bank was low (Iyer, 2011). Similarly, Abed-Baki (2011) discussed the positive consequences of the initiative, but at some point, the GFC meltdown impeded the macroeconomic objectives. Thus, we also were able to capture this vulnerability, as can be seen from the table.

All the studies reviewed here support our EWS results from an out-of-sample prediction on the effect of the GFC in the MENA region. Economic instability was evident at the same time; thus, our EWS managed to capture the economies' vulnerability and estimate the crises shown in Table 3.14.

3.5.2.d Correlation with the Arab Spring

In the aftermath of the Arab Spring, which started in Tunisia in 2010 and spread to other Arab countries such as Egypt, Libya[80], Bahrain, and Yemen, a considerable body of literature investigated its effect on the MENA economies.

[80] Libya was not included in the analysis due to a lack of available data.

Table 3.14: Testing the EWS on Arab Spring countries

		D&D			L&V	
Country	Year	In sample	Out of sample- All variables	Out of sample- LEV not included	In sample	Out of sample- All variables
Bahrain	2010	-	-	-	-	-
	2011	-	-	-	-	-
Egypt	2010	-	X	X	-	-
	2011	X	X	X	-	-
Tunisia	2010	-	-	X	-	-
	2011	-	-	X	-	-
Yemen	2010	-	-	X	-	-
	2011	-	-	X	-	-

Note: X-False Alarm, LEV- unweighted capital adequacy ratio. D&D- Demirgüç-Kunt and Detragiache (1998), L&V- Laeven and Valencia (2008, 2013 and 2018).

According to Malik and Awadallah (2013), the shortage of economic opportunities, poverty and unemployment were the leading causes of the Arab revolutions. They brought up evidence that the labour force in the MENA region had increased three times more during the period 1996-2006 than it had in other developing countries, especially in all the Arab Spring countries that had high youth population and female participation in the labour force. These demographic changes in the labour force increased the number of people who were desperately looking for employment. The youth unemployment rate in the MENA region is considered one of the highest rates in the world. From another point of view, Kitchen (2012) argues that regime corruption, particularly in Tunisia and Egypt, has deprived most of the population of engaging in and using economic opportunities.

A recent study by Arayssi et al. (2019) examined the economic ramifications of the Arab Spring. They reported that the Arab Spring had initiated a weak economic environment in the region that influenced people's wellbeing, tourism, consumption, imports/exports, the performance of financial markets, and foreign direct investments. Overall, in the aftermath of the political reconfigurations, the MENA region's annual GDP growth rate decreased drastically compared to that of other developing economies. In his analysis of its effect on the risk and return of MENA banks, Ghosh (2016) found that the Arab Spring had reduced bank profitability by 0.2 percent and increased risk by 0.4 percent. In contrast, Islamic banks were not affected by political conflict.

It is apparent from Table 3.15 that the in-sample predictions for the Arab Spring period 2010 and 2011 did not call a crisis except for Egypt in 2011 (a false alarm), under the definition of Demirgüç-Kunt and Detragiache (1998) and called none under the definition by Laeven and Valencia (2008, 2013 and 2018).

Thus, the results show consistency with the updated database of banking crises by Laeven and Valencia (2018).

3.5.2.e Out-of-sample prediction using L&V definition

Turning now to the out-of-sample predictions, by using the definition by Laeven and Valencia (2008, 2013, and 2018), the results showed consistency with the in-sample prediction of no crisis. However, employing the definition by Demirgüç-Kunt and Detragiache (1998) increased the type II errors when we dropped the unweighted capital adequacy ratio from our model for Egypt, Tunisia and Yemen. In light of the results presented above, the in-sample and out-of-sample performances were both consistent in causing a false alarm in Egypt in 2011. Yet this is not surprising, for Egypt was exposed to severe losses in its economy. Echevarría and García-Enríquez (2019) investigated the impact of the Arab Spring on macroeconomic indicators in Egypt in the period 2011-2017. They found that the accumulated loss of GDP per capita growth rate reached 12.04 percent, and the accumulated loss in the aggregate real GDP was 582.5 billion dollars.

Bitar et al. (2016) examined the effect of some risk- and non-risk-based regulatory capital ratios on bank risk and performance in the region. They found that regulators and banks, especially in periods of crisis, should comply with Basel's capital requirements to enhance bank profitability and efficiency and protect them against different types of risk. They tested the results by controlling for the Arab Spring and found them robust. Therefore, including the unweighted capital adequacy ratio for our out-of-sample prediction seemed to be essential, although it was insignificant during the Arab Spring under the definition by Demirgüç-Kunt and Detragiache (1998).

3.5.3 Robustness checks

We ran several robustness tests for our EWS to check whether our results would change. First, we examined the alternative definition of 'systemic banking crisis' introduced by Laeven and Valencia (2008, 2013 and 2018), which relies on a much tighter definition and has different crisis dates[81]. Second, we re-estimated the model exclusively for countries that had experienced banking crises. Then we dropped the countries one by one from the examined sample to check whether our results were driven by specific country conditions since we had included oil-producing countries and countries that had many banks, such as Turkey and Lebanon.

[81] The systemic banking crises in some economies are the same in the used databases but timed differently.

With regard to the definition of a systemic banking crisis, we examined whether our results were driven by the classification of Demirgüç-Kunt and Detragiache (1998), which we had adopted. In the empirical literature presented in section 2.2.2, a variety of definitions are employed. The classifications use the start and end dates of each crisis, whether it was a systemic or non-systemic banking crisis, and other criteria. Therefore, we tested our model by adopting as a robustness check two widely used definitions of the systemic banking crisis: one by Demirgüç-Kunt and Detragiache (1998) as discussed previously and the other by Laeven and Valencia (2008, 2013 and 2018).

Table 3.15: The general to specific approach using L&V definition of banking crisis

GDPg(-1)	-0.080	-0.080	-0.079	-0.077	-0.081	-0.075	-0.070	-0.069
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)
GDPpc(-1)	-0.0003	-0.0003	-0.0003	-0.0003	-0.0003	-0.0004	-0.0004	-0.0003
	(0.039)	(0.039)	(0.038)	(0.026)	(0.013)	(0.009)	(0.009)	(0.010)
LEV(-1)	-0.079	-0.078	-0.077	-0.078	-0.083	-0.083	-0.078	-0.081
	(0.016)	(0.016)	(0.016)	(0.016)	(0.010)	(0.011)	(0.016)	(0.012)
GBBgdp(-1)	0.109	0.109	0.107	0.099	0.105	0.105	0.102	0.091
	(0.019)	(0.019)	(0.011)	(0.017)	(0.010)	(0.010)	(0.011)	(0.014)
LIQ(-1)	-0.026	-0.026	-0.025	-0.025	-0.026	-0.026	-0.026	-0.026
	(0.025)	(0.024)	(0.024)	(0.028)	(0.017)	(0.017)	(0.018)	(0.018)
INF(-1)	0.010	0.010	0.010	0.010	0.010	0.010	0.005	
	(0.080)	(0.080)	(0.082)	(0.079)	(0.069)	(0.065)	(0.314)	
RIR(-1)	0.015	0.015	0.015	0.015	0.015	0.014		
	(0.387)	(0.386)	(0.383)	(0.374)	(0.385)	(0.378)		
TOT(-1)	0.009	0.009	0.009	0.008	0.008			
	(0.473)	(0.473)	(0.478)	(0.519)	(0.503)			
DCgdp(-1)	-0.008	-0.008	-0.008	-0.007				
	(0.542)	(0.542)	(0.559)	(0.581)				
CAgdp(-1)	-0.016	-0.016	-0.016					
	(0.638)	(0.632)	(0.623)					
M2R(-1)	0.005	0.005						
	(0.776)	(0.775)						
FX(-1)	0.0002							
	(0.901)							

Note: estimation period 1978-2018; p-value in parentheses; GDPg-GDP growth, GDPpc-GDP per capita, LEV-unweighted capital adequacy ratio, GBBgdp-government budget balance to GDP, LIQ-liquidity ratio, INF-inflation, RIR-real interest rate, TOT-change of terms of trade, DCgdp-domestic credit to private sector to GDP, CAgdp-current account to GDP, M2R-M2 to reserve ratio, FX-change of foreign exchange rate. L&V- Laeven and Valencia (2008, 2013 and 2018).

Based on the definition and database of a systemic banking crisis by Laeven and Valencia (2008, 2013 and 2018), we listed 13 banking crises that occurred in the MENA region during the period 1978-2018. Again, we ran the binomial logistic regression to determine the leading indicators of banking crises in the MENA region. As can be seen from Table 3.16, the results of the general-to-specific approach show that systemic banking crises could materialise due to changes in the macroeconomic and banking sector indicators, a result broadly consistent with our baseline specification. The results indicate that there was a significant negative correlation between GDP growth (GDPg), GDP per Capita (GDPpc), unweighted capital adequacy ratio (LEV), Liquidity ratio (LIQ) and the probability of systemic banking crises. The more interesting correlation is with the ratio of the government budget balance to GDP (GBBgdp), which has a positive correlation with the likelihood of banking crises. According to the definition of GBBgdp and the empirical literature, the correlation between the GBBgdp and the likelihood of a banking crisis is supposed to be negative, which indicates that an increased ratio of government surplus to GDP should lower the probability of a banking crisis. According to Demirgüç-Kunt and Detragiache (1998), it is essential to include a government surplus to GDP because it represents the government's financing needs. Thus, governments may postpone any policies related to strengthening banks' position during periods of deficit, and the inability to control the deficit may affect the prime objectives of financial liberalisation. Arjomand et al. (2016) present the links between budget deficiency and serious economic problems, particularly inflation and current account deficits. They insist that most of the fiscal deficit in the MENA economies has been financed using banking facilities, oil revenues and total exchange saving account withdrawal.

We applied further statistical tests to capture the effect of the GBBgdp due to the uncommon sign of the correlation coefficient with the probability of a banking crisis. Based on our data, the GBBgdp ratios range from the lowest deficit of -151.31 percent for Kuwait in 1991 to the highest surplus of 62 percent for the same country in 1980. Therefore, we tested whether our results were driven by a deficit or surplus of the GBBgdp by introducing a dummy variable that took the value of one if a country was in deficit and zero otherwise. The results showed a significant positive correlation between the fiscal surplus to GDP and the probability of a crisis, while the fiscal deficit to GDP appeared not to be significant. Thus, we reviewed the data and found that about 78 percent of the observations had a deficit value over the examined period, whereas only 28 percent had a surplus value. Moreover, most of the surplus values were in oil-producing economies.

We then captured the effect of oil-producing in a country by introducing a dummy variable which took the value of one if a country was oil-producing and zeroes if it was not. The results of the oil dummy show that there is a significant negative correlation between oil-producing economies and the banking crisis likelihood, which contradicts the previous results. Several trials were also made to test the correlation and interaction between the independent variables (GBBgdp, CAgdp, GDPpc and GDPg), but none of them changed the significance of the results previously presented.

As a result of this inconsistency, we tried running the binomial regression without Kuwait (see Appendix Table 3A.5) because its fiscal surplus was the highest of all the oil-producing economies during the examined period. The results show that GBBgdp was not significant. The marginal effect (see Appendix Table 3A.6) demonstrates that these results were the effect of an increase of one percent in GBBgdp in oil-producing countries, which has a shallow impact on increasing the probability of a banking crisis. It is worth mentioning here that various studies find that fiscal policy is procyclical in oil-producing countries. Lopez-Murphy and Villafuerte (2010) investigate the average fiscal responses of oil-producing countries to the oil price cycle. They found that fiscal policy has been procyclical and has remarkably affected the fluctuations of economic activity. Furthermore, they reported a small decrease in oil prices could lead to substantial financing needs after a short period. Hence, regulators in oil-producing countries should consider the GBBgdp as a significant indicator that may increase the probability of a systemic banking crisis.

Table 3.16: Logit model test statistic using L&V definition

Regression	**L&V**
Probability cut-off	0.017
Number of Crises	13
Number of Observation	760
% Crises correct	76.92
% no crises correct	68.41
% Type I error	31.59
% Type II error	23.08
Area under ROC	0.734
Wald $\mathbf{Chi^2}$	148.73
AIC	0.183

Note: L&V- Laeven and Valencia (2008, 2013 and 2018) definition of banking crisis. ROC-the Receiver Operating Characteristic, AIC- Akaike's information criterion.

Table 3.17 lists the performances of our binomial logit model in terms of the estimation power of our EWS when using the definition by Laeven and Valencia (2008, 2013 and 2018). This model appears to perform well: According to its threshold of 0.017 (1.7%), it succeeded in calling 10 out of the 13 banking crises in the MENA region during the estimated period. Overall, 76.92 percent of crises were correctly called, while missed crises (type I errors) were 31.59 percent of the total, and false alarms (type II errors) were 23.08 percent. Wald test statistics indicated that all the coefficients were significantly different from zero.

Although there is a consistency in the GDPpc and banking indicators (liquidity ratio and unweighted capital adequacy ratio) between the D&D model and L&V associated with the banking crisis, the L&V model outperformed the D&D model; the percentage of correctly forecast banking crises was higher, and that of missed crises and false alarms was lower. Based on the AIC measurement[82] that helps to estimate each model's quality in terms of the in-sample fit to predict the likelihood of systemic banking crisis, the definition made by L&V was better because its rate was lower. Furthermore, the AUROC was higher for L&V, indicating that this model was much more informative.

Next, we apply another robustness check to test whether our results hold if we change our binary banking crisis dummy to take on value one from the start date of the crisis till the end date (the value of one when the country is still experiencing a crisis) and zero otherwise. However, as was mentioned before that the start and end dates of the banking crises are ambiguous, and the same crisis is timed differently (Barrell et al., 2010a). Still, we use the available information from Caprio and Klingebiel (2002), Demirgüç-Kunt and Detragiache (1998) and Laeven and Valencia (2008, 2013, 2018) (see section 3.2.3) to run the test. We applied this test to investigate whether a one-year duration affected our results because we assumed that post-crisis periods as non-crisis. However, the economy we examine could still be in a crisis. It can be seen from the results in Table 3.18 that our estimates continue to be robust, and the significance of our coefficients consistent, except for the GBBgdp, which we previously indicated that Kuwait drove the GBBgdp coefficient to be significant.

[82] In terms of AIC measurement; the low rate indicates better fit.

Table 3.17: Impact of crisis dates on variable significance

D&D		
Variables	**Final result**	**Robustness result**
LIQ(-1)	-0.039 (0.000)	-0.0105 (0.075)
GDPpc(-1)	-0.0004 (0.008)	-0.0004 (0.000)
INF(-1)	0.007 (0.013)	0.0074 (0.005)
LEV(-1)	-0.065 (0.036)	-0.0693 (0.000)
L&V		
GDPg(-1)	-0.069 (0.003)	-0.0367 (0.022)
GDPpc(-1)	-0.0003 (0.010)	-0.0001 (0.001)
LEV(-1)	-0.081 (0.012)	-0.0518 (0.006)
GBBgdp(-1)	0.091 (0.014)	0.0203 (0.370)
LIQ(-1)	-0.026 (0.018)	-0.0254 (0.000)

Note: estimation period 1978-2018; p-value in parentheses; D&D using Demirgüç-Kunt and Detragiache (1998) definition of banking crisis. L&V using Laeven and Valencia (2008, 2013, 2018) definition of banking crisis.GDPg-GDP growth, GDPpc-GDP per capita, LEV-unweighted capital adequacy ratio, GBBgdp-government budget balance to GDP,LIQ-liquidity ratio, INF-inflation.

With regard to the country elimination tests, it was believed essential to check whether our results were driven by a particular country or group of countries. We, therefore, eliminated the countries that had never experienced systemic banking crises, namely, Iran, Iraq, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. Our results remained robust to the results of the model presented in Table 3.10 because they remained statistically significant at a 95 percent significance level, apart from a slight change from the GDPpc. This change occurred because the six countries that were dropped were oil-producing countries. Hence, their GDPpc is higher than those in other countries. Second, we eliminated Algeria, Egypt, Kuwait, Turkey and Lebanon in turn. As shown in Table 3.19, the results of our driving variables remained significant at the 99, 95 and 90 percent significant levels.

Table 3.18: Results of the country elimination tests using D&D definition

D&D							
Variable	**All**	**BC**	**Algeria not included**	**Egypt not included**	**Kuwait not included**	**Turkey not included**	**Lebanon not included**
INF(-1)	0.007	0.001	0.007	0.007	0.011	0.007	0.007
	(0.013)	(0.013)	(0.013)	(0.011)	(0.009)	(0.031)	(0.013)
GDPpc(-1)	-0.0004	-0.0002	-0.0004	-0.0003	-0.001	-0.0004	-0.0004
	(0.008)	**(0.113)**	(0.0073)	(0.0163)	(0.001)	(0.013)	(0.008)
LIQ(-1)	-0.039	-0.030	-0.038	-0.046	-0.031	-0.031	-0.039
	(0.0006)	(0.008)	(0.0009)	(0.0003)	(0.006)	(0.010)	(0.001)
LEV(-1)	-0.065	-0.101	-0.063	-0.055	-0.059	-0.100	-0.065
	(0.036)	(0.004)	(0.059)	(0.083)	(0.085)	(0.011)	(0.036)

Note: estimation period 1978-2018; p-value in parentheses; D&D using Demirgüç-Kunt and Detragiache (1998) definition of BC. BC-systemic banking crisis countries, INF-Inflation, GDPpc-GDP per Capita, LIQ-Liquidity ratio, LEV-Leverage ratio, D&D- Demirgüç-Kunt and Detragiache (1998).

To summarise, we ran a number of robustness tests for our binomial logit model to build the appropriate EWS for systemic banking crises in the MENA region, which had hitherto received no specific attention in the literature. Our in-sample and out-of-sample predictions performed fairly well in predicting systemic banking crises. The L&V model was found superior to the D&D model because it was more informative. Our results are robust to different definitions, timing, dating and country elimination. Overall, we argue that our EWS should have significant implications for helping regulators and banks operating in the MENA region to trace the leading indicators, set the appropriate policies, stabilise the industry and reduce any sector fragility before systemic banking crises become manifest. Regulators can use our EWS with confidence.

3.6 Conclusion

In this chapter, particular attention has been paid to determining the factors that lead to systemic banking crises in economies around the world. Thus, this study develops an early warning system (EWS) for predicting systemic banking crises in the MENA region using the binomial logit model. This study may give useful insights to policymakers about the leading indicators that affect the banking system in each country and each region.

We built our EWS using the available data for the period 1978-2018; the panel data set comprised 19 economies, 12 of which had experienced one or more systemic banking crises. Data availability was a critical issue, mainly when it came to having balanced panel data for the liquidity and unweighted bank capital (leverage) ratios. Thus, we had to construct the ratios through reviewing historical data, trend forecasting and applying predictive analysis. We included countries that had never had a banking crisis, lagging all the variables by one period and considering only the beginning date of the crisis to avoid endogenous effects. The sample covered banking crisis and non-banking crisis countries, namely, Algeria, Djibouti, Egypt, Israel, Jordan, Kuwait, Lebanon, Mauritania, Morocco, Tunisia, Turkey, Yemen, Bahrain, Iran, Iraq, Oman, Qatar, Saudi Arabia, United Arab Emirates. The dataset was constructed as balanced panel data.

In order to align our study with previous literature, we gathered all the explanatory variables that had previously been used for different economies. Demirgüç-Kunt and Detragiache (1998, 2005) covered 77 crises using a global sample, which depends on the definition by Caprio and Klingebiel (1996) and a sample of crises. They found that the possibility of a banking crisis occurring is correlated with macroeconomic, institutional, and financial factors. Barrell et al. (2010a) followed the same procedure solely for OECD countries. They interestingly found different results of banking crisis determinants, i.e., the bank liquidity ratio, capital adequacy and lagged house price growth. Berg et al. (2005) confirmed the effectiveness of logit regression for constructing EWSs because it focuses on the correlation between all the explanatory variables and checks the statistical significance of each variable.

For bank-level data, we concentrated on financial statements and ratios for a sample of 732 Islamic and conventional banks operating in the MENA region gathered from Fitch Connect. The examined data covered the period 1978-2018 on an annual basis.

In the context of the MENA, our results showed that banking systems could encounter systemic banking crises when there were changes in both the macroeconomic and banking sector variables; this result is consistent with the previous literature on both developed and developing economies. The empirical results using the definition by Demirgüç-Kunt and Detragiache (1998) of a systemic banking crisis concerned 16 systemic banking crises as a dependent variable. These results suggest that banking systems in the MENA region with high capital adequacy and liquidity ratios one year before a crisis tend to have a low probability of a systemic banking crisis. Also relevant are the level of GDP per capita and inflation. Regulators who force banks to maintain a healthy level of capital and adequate liquid assets on their balance sheet and set policies to reduce the effect of high inflation and low GDP per capita are less likely to experience a systemic banking crisis. However, the classification by Laeven and Valencia (2008, 2013 and 2018) showed that there was a significant negative correlation between GDP growth (GDPg), GDP per Capita (GDPpc), unweighted capital adequacy ratio (LEV), Liquidity ratio (LIQ) and the probability of systemic banking crises.

The more interesting correlation was with the government budget balance to GDP (GBBgdp), which positively correlates with the likelihood of banking crises. According to the definition of GBBgdp in the empirical literature, the correlation between the GBBgdp and the likelihood of a banking crisis is supposed to be negative, which indicates an increased ratio of government surplus to GDP should lower the probability of a banking crisis. Further tests were applied that foster the conclusion that Kuwait exclusively influenced the positive correlation between GBBgdp and banking crisis probability. Thus, after dropping its observation results, we showed that GBBgdp is no longer a significant indicator. The most prominent finding to emerge from the analysis is that there is a broad implication of oil producers.

We ran a number of robustness tests for our binomial logit model to build the appropriate EWS for systemic banking crises in the MENA region. This task had received no specific attention in the literature. Our in-sample and out-of-sample predictions performed fairly well in predicting systemic banking crises, and we found that the L&V model was superior to the D&D model in being more informative.

In particular, our findings underline the importance of concentrating on macroeconomic and banking indicators to avert future systemic banking crises in the MENA region. Moreover, they will be of interest to policymakers who are reassessing their financial policies, and implementing financial reforms, especially in the context of financial inclusion. Many economies in the region already use and comply with international banking regulations and have a macroprudential framework. Other economies are still making only limited progress in monitoring banking stability. If this is so, systemic risk can materialise at any time, making it essential to keep working on strengthening the banking industry with the assistance of international financial institutions. Last, it should be noted that the EWS is a necessary tool for setting the appropriate policies to safeguard the fragile areas in the industry. Still, the findings should be interpreted with caution and not as a substitute for a reasonable judgement in maintaining stability at a low cost.

Our results have important policy implications when policymakers and regulators in the MENA region evaluate or initiate various regulations or adopt financial reforms. Claessens et al. (2002) point out that resolving the systemic banking crisis is not easy; opinions vary a lot on what is the appropriate or best practice. Several different and contradictory recommendations have been adopted to limit the fiscal losses of crises. However, there was no consensus regarding the implementation of these recommendations, especially in individual cases, as empirical views remain limited. Sheng (1996) and Caprio and Klingebiel (1996) argue that attempts used to managing financial distress are totally different in developed countries than in emerging markets because the challenging economic situation in emerging markets and crises are often more significant. Hence, best practices from industrial economies cannot be replicated in developing economies. This study contributes to the debate in terms of MENA.

Overall, this study strengthens the idea that policymakers in the MENA region should apply persistent efforts to build up solid supervisory capacity and strictly comply with the international regulations concerning the proportion of liquidity and capital adequacy ratios. Our findings provide robust insights on both banking indicators. Furthermore, regulators should establish an effective macroprudential framework for any deficiency in the financial system that could contribute to rising systemic risk. Some countries in the MENA region have already applied various policies and techniques such as reserve requirements and limits on loan concentration. To overcome bank runs incentives, Baer and Klingebiel (1995) suggest that regulators need to deal with all insolvent and marginally solvent institutions in parallel. Furthermore, they argue that regulators intervention tools in emerging markets should be simple because of weak regulations, limited supervision, and lack of reliable financial solvency data. Regulatory reform in the financial system should be a priority to promote confidence and inclusion of the financial system operating in the MENA region. In the end, policymakers can benefit from the signals of the EWSs, but they should never be used exclusively to make decisions and substitute regulators judgement and interpretations.

As previously stated, most of the systemic banking crises erupted in the MENA region between the 1980s and 1990s, which was the same period that several countries have made deliberate financial reform programmes. Thus, further study is needed to fully understand the implications of financial liberalisation on the MENA banking crises.

3.7 Appendix

3.7.1 Leading Indicators using different periods

In this section, we present the results of our baseline model using different sample periods. As can be seen from the data in Table 3A.1 that the main leading indicators over the period 1978-1990 were liquidity ratio (LIQ), government budget balance over GDP (GBBgdp), current account over GDP (CAgdp), and real interest rate (RIR). These results provide important insights into checking those indicators when designing an EWS for banking crises in the MENA region in addition to the main leading indicators.

Table 3A.1: The general to specific approach D&D (sample period: 1978-1990)

LIQ(-1)	-0.063	-0.062	-0.060	-0.062	-0.060	-0.059	-0.067
	(0.006)	(0.006)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
GBBgdp(-1)	0.130	0.128	0.130	0.132	0.125	0.118	0.117
	(0.027)	(0.027)	(0.024)	(0.020)	(0.020)	(0.022)	(0.024)
CAgdp(-1)	-0.105	-0.104	-0.103	-0.105	-0.101	-0.100	-0.116
	(0.050)	(0.049)	(0.050)	(0.045)	(0.046)	(0.0459)	(0.006)
TOT(-1)	0.022	0.021	0.021	0.021	0.021	0.020	0.023
	(0.183)	(0.188)	(0.185)	(0.173)	(0.185)	(0.188)	(0.123)
GDPg(-1)	-0.036	-0.040	-0.040	-0.042	-0.037	-0.035	-0.033
	(0.467)	(0.413)	(0.407)	(0.378)	(0.412)	(0.434)	(0.451)
RIR(-1)	-0.009	-0.010	-0.011	-0.010	-0.010	-0.013	-0.013
	(0.482)	(0.232)	(0.230)	(0.234)	(0.241)	(0.037)	(0.041)
GDPpc(-1)	0.000	0.000	0.000	0.000	0.000	0.000	
	(0.545)	(0.543)	(0.550)	(0.519)	(0.517)	(0.569)	
INF(-1)	0.004	0.004	0.004	0.004	0.003		
	(0.611)	(0.600)	(0.594)	(0.591)	(0.615)		
M2R(-1)	0.006	0.006	0.007	0.007			
	(0.709)	(0.714)	(0.665)	(0.679)			
DCgdp(-1)	-0.006	-0.005	-0.003				
	(0.751)	(0.781)	(0.853)				
LEV(-1)	0.018	0.014					
	(0.771)	(0.810)					
FX(-1)	0.005						
	(0.826)						

Note: estimation period 1978-1990; p-value in parentheses; LIQ-liquidity ratio, GDPpc-GDP per capita, INF-inflation, LEV-unweighted capital adequacy ratio, GBBgdp-government budget balance to GDP, DCgdp-domestic credit to private sector to GDP, GDPg-GDP growth, TOT-change of terms of trade, CAgdp-current account to GDP, RIR-real interest rate, M2R-M2 to reserve ratio, FX-change of foreign exchange rate. D&D-Demirgüç-Kunt and Detragiache (1998) definition of banking crisis.

Table 3A.2 presents the results obtained using all previously mentioned leading indicators during different periods. It is apparent from this table that liquidity ratio (LIQ) is statistically significant and the main leading indicator during the examined period in addition to the GDP per capita (GDPpc). However, inflation (INF) and unweighted capital adequacy ratio (LEV) were statistically significant after 2003 and 2013 (see Table 3A.3), respectively.

Table 3A.2: Leading indicators based on different periods using D&D

Period	1978-1990	1978-1991	1978-1995	1978-2000	1978-2003	1978-2018
BC	10	13	14	16	16	16
No. of obs.	209	228	304	399	456	741
LIQ(-1)	-0.063***	-0.034**	-0.040***	-0.035***	-0.034***	-0.031***
	(0.006)	(0.018)	(0.004)	(0.005)	(0.008)	(0.006)
GBBgdp(-1)	0.130**	0.081	0.062	0.057	0.064	0.067
	(0.027)	(0.105)	(0.235)	(0.249)	(0.157)	(0.151)
CAgdp(-1)	-0.105**	-0.025	-0.016	-0.024	-0.036	-0.024
	(0.050)	(0.525)	(0.669)	(0.497)	(0.276)	(0.455)
TOT(-1)	0.022	0.002	0.004	0.012	0.012	0.013
	(0.183)	(0.867)	(0.729)	(0.266)	(0.253)	(0.240)
GDPg(-1)	-0.036	-0.016	-0.011	-0.029	-0.030	-0.030
	(0.467)	(0.687)	(0.736)	(0.285)	(0.285)	(0.278)
RIR(-1)	-0.009	-0.010	-0.002	0.001	0.002	0.003
	(0.482)	(0.398)	(0.732)	(0.813)	(0.784)	(0.602)
GDPpc(-1)	0.000	0.000*	0.000**	0.000**	0.000**	0.000**
	(0.545)	(0.090)	(0.045)	(0.030)	(0.034)	(0.031)
INF(-1)	0.004	0.004	0.006	0.008	0.009***	0.010**
	(0.611)	(0.489)	(0.362)	(0.132)	(0.010)	(0.045)
M2R(-1)	0.006	-0.002	-0.002	0.000	0.003	0.008
	(0.709)	(0.894)	(0.889)	(0.998)	(0.871)	(0.616)
DCgdp(-1)	-0.006	-0.001	0.000	-0.011	-0.013	-0.014
	(0.751)	(0.969)	(0.983)	(0.381)	(0.311)	(0.239)
LEV(-1)	0.018	-0.015	-0.012	-0.016	-0.030	-0.052*
	(0.771)	(0.766)	(0.773)	(0.626)	(0.348)	(0.071)
FX(-1)	0.005	-0.003	-0.001	0.000	-0.001	0.000
	(0.826)	(0.892)	(0.795)	(0.841)	(0.829)	(0.950)

Note: BC- Banking crisis, No.of obs.-number of observations, p-value in parentheses; *** p<0.01, ** p<0.05, * p<0.1 represent significance levels. LIQ-liquidity ratio, GDPpc-GDP per capita, INF-inflation, LEV-unweighted capital adequacy ratio, GBBgdp-government budget balance to GDP, DCgdp-domestic credit to private sector to GDP, GDPg-GDP growth, TOT-change of terms of trade, CAgdp-current account to GDP, RIR-real interest rate, M2R-M2 to reserve ratio, FX-change of foreign exchange rate. D&D- Demirgüç-Kunt and Detragiache (1998) definition of banking crisis.

Table 3A.3: Leading indicators using D&D

Period	1978-2000	1978-2010	1978-2013	1978-2018
BC	16	16	16	16
No. of obs.	418	608	665	760
LIQ(-1)	-0.044***	-0.043***	-0.042***	-0.039***
	(0.000)	(0.000)	(0.000)	(0.001)
GDPpc(-1)	0.000**	0.000**	0.000**	0.000***
	(0.017)	(0.016)	(0.013)	(0.008)
INF(-1)	0.006**	0.007**	0.007**	0.007**
	(0.037)	(0.018)	(0.016)	(0.013)
LEV(-1)	-0.026	-0.050	-0.055*	-0.065**
	(0.425)	(0.126)	(0.094)	(0.036)

Note: BC- Banking crisis, No.of obs.-number of observations, p-value in parentheses; *** p<0.01, ** p<0.05, * p<0.1 represent significance levels. LIQ-liquidity ratio, GDPpc-GDP per capita, INF-inflation, LEV-unweighted capital adequacy ratio. D&D- Demirgüç-Kunt and Detragiache (1998) definition of banking crisis.

3.7.2 Out-of-sample performance

Table 3A.4: Banking Crises and estimated probability: Out-of-sample prediction 1989-2018

Country	**Crisis Year**	**Out-of-sample estimated probability**	**Not predicted**
Algeria	1990	0.0310	-
Djibouti	1991	0.0184	✓
Egypt	1990	0.0512	-
Jordan	1989	0.0238	-
Tunisia	1991	0.0649	-
Turkey	1991	0.0358	-
Turkey	1994	0.0223	-
Turkey	2000	0.0250	-
Yemen	1996	0.0045	✓

Note: Out-of-sample prediction using the in-sample threshold probability 0.021, following the approach of Demirgüç-Kunt and Detragiache (1998).

3.7.3 Elimination test

We re-estimated the binomial logit by dropping each banking crisis economy in turn. The country elimination test (see Table 3A.5) was used to assess our coefficients for robustness when using the definition by Laeven and Valencia (2008, 2013 and 2018) of the banking crisis. We found that our results remained robust to the results of the L&V model because they all, except for Kuwait, remained statistically significant at the 99, 95 and 90 percent significant levels. This means that Kuwait alone accepts the significance of GBBgdp.

Table 3A.5: Results of the country elimination tests using L&V definition

L&V						
Variable	**All**	**Algeria not included**	**Egypt not included**	**Kuwait not included**	**Turkey not included**	**Lebanon not included**
GDPg(-1)	-0.069	-0.071	-0.069	-0.052	-0.070	-0.069
	(0.0025)	(0.0021)	(0.0026)	(0.0291)	(0.0051)	(0.0025)
GBBgdp(-1)	0.091	0.098	0.090	0.006	0.098	0.091
	(0.0143)	(0.0098)	(0.0159)	**(0.8861)**	(0.0159)	(0.0143)
GDPpc(-1)	0.000	0.000	0.000	-0.001	0.000	0.000
	(0.0094)	(0.0074)	(0.0122)	(0.0063)	(0.0161)	(0.0094)
LIQ(-1)	-0.026	-0.025	-0.030	-0.023	-0.023	-0.026
	(0.0179)	(0.0261)	(0.0108)	(0.0487)	(0.0499)	(0.0179)
LEV(-1)	-0.081	-0.078	-0.072	-0.090	-0.101	-0.081
	(0.0116)	(0.0232)	(0.0243)	(0.0171)	(0.0069)	(0.0116)

Note: estimation period 1978-2018; p-value in parentheses; L&V using the definition of BC by Laeven and Valencia (2008, 2013 and 2018). BC-systemic banking crises countries, GDPg-real GDP growth, GBBgdp-Government Budget Balance to GDP, GDPpc-GDP per Capita, LIQ-Liquidity ratio, LEV-Leverage ratio.

3.7.4 Marginal effect

A further test was to assess the marginal effect of each variable on the estimated probability of a crisis for the entire period of 1978-2018 that we examined. We used sample mean values of the leading indicators according to the L&V model to derive the marginal effect apart from GDPpc, where we used its standard deviation since it is a level variable. It is apparent from Table 3A.6 that the coefficients of the GBBgdp for oil-producing countries are very low, particularly the GCC economies (Bahrain, Kuwait, Qatar, Saudi Arabia, and United Arab Emirates). The results below are consistent with the D&D model; for instance, the coefficient of the GDPpc is very low, but an increase by the standard deviation of each country reduces the likelihood of a banking crisis. For instance, the highest impact occurs in IRN and MAR.

Table 3A.6: Marginal effect of a one percent increase in the probability of a crisis using L&V definition

Country	GDPg	GBBgdp	GDPpc	LIQ	LEV
Algeria	-0.006	0.008	-0.029	-0.002	-0.007
Bahrain	-0.001	0.002	-0.018	-0.001	-0.002
Djibouti	-0.117	0.166	-0.240	-0.045	-0.136
Egypt	-0.170	0.241	-0.664	-0.065	-0.198
Iran	-0.241	0.341	-1.614	-0.092	-0.281
Iraq	-0.023	0.033	-0.182	-0.009	-0.027
Israel	-0.001	0.002	-0.020	-0.001	-0.002
Jordan	-0.101	0.143	-0.421	-0.039	-0.117
Kuwait	0.000	0.000	-0.001	0.000	0.000
Lebanon	-0.014	0.020	-0.124	-0.005	-0.016
Mauritania	-0.141	0.199	-0.210	-0.054	-0.164
Morocco	-0.432	0.608	-1.545	-0.165	-0.503
Oman	-0.021	0.030	-0.271	-0.008	-0.025
Qatar	0.000	0.000	0.000	0.000	0.000
Saudi Arabia	-0.008	0.011	-0.098	-0.003	-0.009
Tunisia	-0.136	0.193	-0.619	-0.052	-0.159
Turkey	-0.021	0.029	-0.219	-0.008	-0.024
United Arab Emirates	0.000	0.000	0.000	0.000	0.000
Yemn	-0.054	0.076	-0.087	-0.021	-0.062

Note: Author’s own calculations. Values are in percentage points. L&V- Laeven and Valencia (2008, 2013 and 2018), GDPg-real GDP growth, GBBgdp-Government Budget Balance to GDP, GDPpc-GDP per Capita, LIQ-Liquidity ratio, LEV-Leverage ratio.

CHAPTER 4

Bank Competition and Convergence in the Middle East and North Africa (MENA)

4.1 Introduction

Over the last few decades, market conditions in the global banking industry have experienced a paradigm shift that deserves particular attention. Technological innovation in the form of internet banking and financial technology (FinTech,) financial deregulation, geopolitical events, a process of intense consolidation, and globalisation in the financial markets have forced banks to operate differently (Berger et al., 1995; Bikker and Spierdijk, 2008; Turk-Ariss, 2009). Precisely, through competing with each other locally and internationally by offering a variety of complex products and services to satisfy customers' needs and consequently enhance social welfare and economic growth.

Liu et al. (2013) point out that competition in banking is crucial because it promotes efficiency in the production process and the allocation of financial operations. Accordingly, the whole industry feels the impact of the regulations that policymakers have set to control banking competition. The World Bank Group (2013) indicates that competition is good for the banking industry because it enhances efficiency and maximises social welfare, but it is also designed to maintain its stability. Shaffer and Spierdijk (2017) note that policymakers are keen to enhance competition between banks because of its direct influence on reducing prices and boosting total welfare. According to Overvest (2017), policymakers and researchers have concentrated more on banking competition since the financial crisis of 2007-2009, and the banking landscape has changed, especially in developed countries.

Many authors have studied banking competition. Smith (1998) focuses on the consequences of increased banking competition for macroeconomic performance. Some studies have focused on banking competition as it affects financial stability (Allen and Gale, 2004; Beck et al., 2006; Anginer et al., 2014; Corbae and Levine, 2019) and described how it could reduce systemic risk (Schaeck et al., 2009). Because anticompetitive practices, coupled with market failures in the banking industry, impair the productive efficiency of the economy (Goddard and Wilson, 2009), Bikker and Spierdijk (2008) use data from all over the world to investigate developments in banking competition over time. Liu et al. (2013) review the theoretical and methodological issues related to bank competition indicators and emphasise the adoption of indicators and careful interpretation when assessing competition. Others have examined the intensity of competition between banks by using one or several measures in a specific country or across countries over a long period (Coccorese, 2004; Schaeck et al., 2009; Bikker et al., 2012; De-Ramon and Straughan, 2016). Many theoretical studies have investigated the consequences of banking competition on access to finance, prices and the quality of financial products, financial innovation, and economic development (Leon, 2015).

However, determining the most accurate measure is still under debate because each indicator infers something different about the level of banking competition. Bikker and Spierdijk (2017) claim that it is useless to try to generalise the soundness of competition measures as a whole. Leon (2015) provides a critical review of banking competition measures by discussing the strengths and weaknesses of each indicator. He reasons that the evolution of various banking competition methods results from the complexity of competition: it is a complex notion that cannot be observed directly. Northcott (2004) and Carbò et al. (2009) state that there is no consensus on the best predictor of bank competition.

The importance and originality of this study rest on transcending the current literature and being the first to apply structural and non-structural approaches to banking competition in each country in the MENA region as well as the whole region over the extended period of 1995-2018. Our broad dataset covers a period of significant economic and political events in the region. Furthermore, we adopt the portmanteau approach of De-Ramon and Straughan (2016) in estimating all the banking competition measures previously used in the literature. Subsequently, we compare the results in different countries over the period and assess the trends of competition intensity. We classify our results by country and then by MENA region. Next, we adopt the World Bank's country classification by income: lower middle income (Egypt, Iraq, and Morocco), upper-middle (Algeria, Iran, Jordan, Lebanon, Tunisia, and Turkey), and high (Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates). We also divide the region into oil-producing countries (Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, and Oman) and others (Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, and Israel).

Furthermore, to our best knowledge, no previous study has investigated the region's convergence with regard to bank competition. The results are presented first for the whole MENA region, and then divided into GCC countries and non-GCC countries to illustrate whether banks integrate through convergence. Thus, our purpose in this study is to fill the gap in the empirical literature by exploring the level of competitiveness, identifying the main drivers of competition, and testing convergence – even though some barriers to entry still exist in parts of the MENA region – and the heterogeneity of its national economies. Assessing the level of banking competition is crucial for policymakers in this region who set monetary policies that reduce the costs of financial products and services, ease access to finance, and enhance bank efficiency (Anzoategui et al., 2010). Furthermore, we investigate the extent of the effect of the Global Financial Crisis (GFC) 2007-2009 on the intensity of bank competition in the region. Thus, we hope to provide insights into the measurement of competition between the MENA banks and help policymakers use this study's results when setting new competition policies.

Historically, a tremendous amount of research has investigated the measurement of banking competition. It is divided into two streams: first, the traditional Industrial Organization (IO) approach formulated according to the basic conditions of banking, market structure, conduct and performance, and public policy (Neuberger, 1998) which is called the Structure-Conduct-Performance paradigm. It indicates that a highly concentrated industry incurs lower costs from collusion, which leads to anticompetitive actions and higher profitability (Tan, 2016). Well-known examples of IO measures are the K-bank concentration ratio and the Herfindahl Hirschman Index (HHI). As used by earlier researchers, this approach limits the assessment exclusively to the market structure indices that could be influenced by factors other than the competition (Baumol et al., 1983; Claessens and Laeven, 2004; Leon, 2015). However, the determination of competitiveness should incorporate the bank's behaviour, specifically during the past few decades, which have witnessed many changes in the industry (Coccorese, 2017). As noted by Shaffer and Spierdijk (2017), IO theorists have failed to predict models related to the unique oligopoly equilibrium outcome or to get those outcomes that are associated with rational behaviour. They add that all of the oligopoly equilibrium concepts[83] have different assumptions and estimations.

Several authors in recent years have vigorously challenged the IO approach. Therefore, in response to the limited estimations of this approach, a non-structural approach to banking competition measurements has been developed, namely, the New Empirical Industrial Organization (NEIO) measures which emphasise the efficiency hypothesis. It shows that high profitability is generated from the high operating efficiency of the largest bank(s) and is not due to a high concentration. These measures depend on market power to determine the competitive conduct of banks. They work from the oligopoly theory and a static model, for instance, the Lerner index and Panzar-Rosse H-statistic model. Shaffer and Spierdijk (2017) stipulate that any measure of market power should be linked to economic welfare considerations. Subsequently, researchers developed the Boone indicator, which concentrates on investigating the market dynamics independently of static analysis (Leon, 2015).

A study by the World Bank Group (2013), among others, demonstrates the decomposition of interest rate spreads as another approach to measuring bank competition. However, this approach should be applied with caution, controlling for various factors, such as macroeconomic performance, taxes on financial institutions, the quality of the judicial environment, and other factors related to the bank's operation, before estimating the intensity of competition.

Different authors have measured banking competition intensity in a variety of ways without reaching consensus regarding the most accurate indicator or consistent results when using more than one

[83] For instance, Cournot, Bertrand, limit pricing, contestable markets, consistent conjectures (Shaffer and Spierdijk, 2017).

indicator. The concentration measurement K-bank concentration ratio and the Herfindahl Hirschman Index (HHI) rely on a bank's market share, following the oligopoly theory. Theoretically, both emphasise the number of banks and their distribution according to size. The main assumptions among theorists are that a bank's main goal is to maximise profits, it provides homogeneous products, and that the largest banks act as a cartel (Saving, 1970). The level of concentration could be increased either through enlarging the largest bank(s) and/or reducing the numbers of the non-dominant bank(s), or vice versa. The concentration ratio totally ignores any non-dominant banks in the market. Instead, the HHI takes account of the market share of all the banks in the market and assigns a more significant proportion of earnings to the dominant banks. Shaffer and Spierdijk (2017) consider that competition measures which emphasise market shares should primarily review how the market structure is defined to overcome measurement error, assess the market's power and maintain consumer welfare. In particular, they should check whether a dominant bank benefits from barriers to entry that protect its monopolistic opportunity to set higher prices or owes its position to offering high-quality products at low prices compared to its competitors. The World Bank Group (2013) indicates that concentration measures are poor predictors of banking competition since the predictive accuracy of these measures is influenced by the market's contestability. Hence, banks act under the threats of entry and exit; when new banks freely enter the market, banks increase the level of their competitiveness and offer an easy exit for unprofitable banks when the market is highly concentrated. This view is supported by Bikker et al. (2014) and other authors, who link the intensity of banking competition with the data on banks' performance and not with the industry's structure.

The Lerner (1934) index uses quantitative analysis in order to illuminate the direct function of prices and the marginal cost associated with economic relevance. Dansby and Willig (1979) state that the Lerner index presents the slope of the social welfare function. However, it is also subject to measurement error if the marginal cost is not estimated accurately from observable and reliable data. The Panzar-Rosse H-statistic model is one of the most common measures in the recent empirical literature for determining competition intensity. Shaffer and Spierdijk (2017) note that the H-statistic reflects the reaction of profit-maximising banks to exogenous variations in input prices. Bikker et al. (2012) point out that assessing the level of competition by using the H-statistic requires reliable information about costs and market equilibrium. However, Shaffer and Spierdijk (2017) conclude that the H-statistic cannot be fully interpreting unless behavioural assumptions are made about a bank's position in the market. Thus, "*neither the sign nor the magnitude of the H-statistic can reliably identify the degree of market power*" (ibid, pg.14). Much of the recent literature on banking competition pays particular attention to the Boone indicator (Bikker and Van Leuvensteijn, 2015). Boone (2008) developed a new indicator that depends on Relative Profit Differences (RPD). This measure is encapsulated by the notion that "competition rewards efficiency" (Schiersch and Schmidt-Ehmcke, 2010). Efficiency is defined as offering similar financial products at a lower cost. Hence, in a market with an increasing level of competition, inefficient banks should lose more profitability than efficient ones. Casu and Girardone (2006) and Bikker and Spierdijk (2008) argue that an increase in competition intensity forces banks to enhance their efficiency and consolidation. Perotti and Suarez (2002) claim that there is a direct relationship between competition and efficiency, in which more efficient banks perform better than less efficient ones and generate a higher market share.

A great global transformation has occurred in the banking sector, whereby large multinational banks and a few financial institutions played a significant role in establishing the new structure of the banking industry, referred to as a consolidation wave. Perotti and Suarez (2002) remind us that the process of global financial integration has removed barriers to entry, offered easy access to various financial products, and reduced the cost of capital. In an investigation into the developments in banking competition during the past few decades, Bikker and Spierdijk (2008) have found that, on average, the variations in the intensity of global competition have been small. For instance, the Euro area, the United States, and Japan experienced a major increase in their competition level in the decade preceding the financial crisis of 2007-2009. Similarly, the level of competition in the emerging markets increased over the same period. Lamers and Purice (2017) find that deregulation in the United States allowed banks to operate differently as it was one of the main factors that raised the level of competition. In particular, the Riegle-Neal Interstate Banking and Branching Efficiency Act[84] removed restrictions on opening bank branches and gave more incentive to efficient banks to acquire or merge with another bank anywhere in the country, and the Gramm-Leach-Bliley Act authorised banks to engage in non-traditional financial activities. A similar trend of increased competition has appeared in Europe. The European banking market started its integration process after the single market was set up, following the approval of the coordination law of the Second Banking Directive in 1989, and then the implementation of the Monetary Union, which enlarged the European Union. All these procedures have allowed banks to operate and offer financial services in all other member countries.

In the case of the MENA region, banks are the main providers of various financial products to the private and public sectors because the financial system is bank-based. Banks may also fund government budget deficits as they do in other emerging countries (Turk-Ariss, 2009). In the 1980s, when few large banks and state-owned institutions were operating, central banks imposed strict financial regulations. Most countries developed economically and financially after the mid-1990s as a result of deregulation, liberalisation, and the reduction of entry restrictions. In a comprehensive study of bank competition in the MENA region, Turk-Ariss (2009) agrees that the governance structure of banks is developing too, due to accession to the World Trade Organization (WTO) and solid commitment to a course of financial liberalisation and reforms. Consequently, there was a massive change in the ownership structure of

[84] See: https://www.federalreservehistory.org/essays/riegle_neal_act_of_1994

banks in the MENA region, from state to private control and from purely domestic operation to more foreign interventions. Moreover, relaxing restrictions on foreign entrants have improved the competitive conditions in the markets. For instance, a number of leading international financial institutions such as Citigroup, Standard Chartered, and HSBC have established several branches across the MENA countries and now compete with domestic banks. Foreign investments in the banking sector have boosted competition intensity by adopting new technologies, advanced risk management techniques, and the use of professional human capital. Furthermore, the presence of international banks enhances compliance policies (disclosure, transparency, governance), which overall has led to a sophisticated regulatory environment and financial stability. From another standpoint, the intensity of bank competition in the MENA region may be influenced by the rivalry between Islamic and conventional banks.

These factors have played a pivotal role in promoting the general efficiency of the system and enhancing the competitive conditions. The banking industry in Jordan, Morocco, Egypt, Lebanon, Turkey, Israel, and the GCC countries is considered well developed, stable, compliant to the Basel regulations regarding capital adequacy, and resilient to crisis. Various bilateral and multilateral economic and trade agreements since the 2000s have boosted the integration process, allowing fiscal and monetary regulations to be better coordinated and trade barriers to be eliminated. Yet, in a study investigating the intensity of bank competition in the MENA region between 1994 and 2008, Anzoategui et al. (2010) found a low level of competition across countries due to barriers to entry and a lack of solid information on credit. In another major study, Polemis (2015) has found that the banking sector in the MENA region is characterised as monopolistic.

As previously stated, the intensity of competition increased before the global financial crisis of 2007-2009 but was not necessarily its cause. Anginer et al. (2012) and the World Bank Group (2013) demonstrate that the leading causes of the crisis were the lack of adequate risk management, lax supervision and the aggressive strategy of the dominant banks to increase their market power. In fact, the effect of the bailout rescue program in this crisis and the subsequent policy responses exacerbated the consolidation and affected the competition intensity in the developed countries. The World Bank Group (2013) states that some policymakers and academics believe that the financial turmoil was increased in part by the banks competing to provide financial products such as subprime lending. Furthermore, others complained about government support for the dominant banks, which increased concentration and reduced competition intensity and access to credit. Thus, in the future, market instability may arise as a result of moral hazard. The Lerner index and the Boone indicator results for countries with huge amounts of credit facilities and a housing boom showed the deterioration of the banking competition after the crisis period.

Bikker and Spierdijk (2017) believe that measuring banking competition is crucial to an economy if it uses reliable and well-established methods. However, it is a challenging task that may distort the policy implications affecting the welfare of consumers and firms. Thus, the present study aims to comprehensively investigate the intensity of banking competition by means of various indicators to present reliable results for each country in the MENA region. Then we employ the results from measuring banking competition measures to look for convergence in the MENA, following the approach of Weill (2009, 2013). Past empirical studies using bank-level data on banks operating in the MENA have been limited and focused on using only one or two indicators (Al-Muharrami et al., 2006; Turk-Ariss, 2009; Anzoategui et al., 2010; Polemis, 2015; González et al.,2017).

The rest of the chapter is organised as follows. Section 4.2 reviews previous literature on the measures of bank competition. We continue by discussing the tests of convergence in bank competition in the MENA region. Section 4.3 discusses the definitions and sources of the data and variables. In Section 4.4, we describe and justify the methodology applied in our analysis. In Section 4.5, we demonstrate and discuss the results of the chapter's empirical analysis. Section 4.6 concludes and presents some policy implications.

4.2 Theoretical Overview

4.2.1 Introduction

In this chapter, we focus on the theoretical overview of bank concentration and competition measures. See **Chapter 2** for further discussion on the background of the two approaches of industrial organisation theory, each associated with certain competition measures. The traditional industrial organisation, which focuses on the structural approach of measuring competition by using the concentration ratio and the Herfindahl Hirschman Index (HHI). The New Empirical Industrial Organisation (NEIO), which was developed from game theory and the adoption of sophisticated econometric models with greater emphasis on identifying market power. The NEIO employs non-structural measures of competition, for instance, the Lerner index, the Panzar-Rosse H-statistic, and the Boone indicator. In the section below, we review some of the empirical literature on the intensity of bank competition from different perspectives. Then, we focus on convergence with regard to bank competition.

4.2.2 Estimates of competition measures

Over the past four decades, major developments and transformations have occurred in the banking industry that has encouraged researchers to investigate the intensity of banking competition. A considerable amount of literature has been published on measuring banking competition with a focus on finding accurate measures. Smith (1998) writes about the consequences of increased banking competition for macroeconomic performance. Some studies have focused on the effects of banking competition on financial stability (Allen and Gale, 2004; Beck et al., 2006; Berger et al., 2009; Anginer et al., 2014; Corbae and Levine, 2019; Davis et al., 2019) and how it can reduce systemic risk (Schaeck et al.,2009), because anti-competitive practices, coupled with market failures in the banking industry, negatively impact the productive efficiency of the economy (Goddard and Wilson, 2009). Casu and Girardone (2006) state that deregulation has accelerated competition as a result of the initiation of non-traditional financial products, which increase consolidation and efficiency. Perotti and Suarez (2002) demonstrate the direct relationship between competition and efficiency, in which more efficient banks perform better than less efficient ones and generate a higher market share. Schaeck and Cihák (2012) provide robust evidence that competition encourages banks to hold more capital than they are legally obliged to hold. Berger et al. (2008) argue that a highly concentrated market encourages financial institutions to adopt more risk-taking investments if they believe they are too big to fail and protected by explicit and implicit government safety nets.

To calculate concentration ratios, recent writers have focused on the contestable market theory, emphasising both existing incumbents and potential rivals rather than exclusively on incumbents (De-Ramon and Straughan, 2016). Many of these studies, which concentrate on firms' behaviour, measure competition by looking at performance-based data, in particular revenues and costs (Matthews et al., 2007; Berger et al., 2009; Schaeck and Cihák, 2010; De-Ramon and Straughan, 2016).

More recent attention has focused on including one or more performance-based measures, in addition to market concentration ratios. For instance, De-Ramon and Straughan (2016) investigate competition intensity in the United Kingdom deposit-taking sector. They use both structural and non-structural measures and find that banks operating in the UK can extract market rents and generate positive economic profits. Their results indicate the reduced intensity of competition over the examined period due to increasing concentration coupled with an overall trend of increased market power. Similarly, Carbó et al. (2009) estimate the use of banking competition from structural and non-structural measures across 14 European economies from 1995 to 2001. They find no consistency in their results: the net interest margin, return on assets, H-statistic, Lerner index, and HHI, however, are weakly related. In a recent study, Davis and Karim (2019) use two banking competition indices (the H-statistic and the Lerner index) to investigate the short- and long-run relationships for banks operating in the 27 EU countries by dividing the sample period into the six years before and since the GFC 2007. Their study offers some important insights into the relation of competition to stability, taking into account the effect of the GFC 2007. They find that both their bank competition measures have a positive short-run relationship with risk. In contrast, long-run effects vary: the H-statistic shows a negative relationship with risk and the opposite correlation with the Lerner index. Silva-Buston (2019) finds a negative relationship between competition and the excess component of systemic risk by using European bank-level data.

Mamatzakis et al. (2005) pay particular attention to measuring concentration and competition in South-Eastern Europe over the period 1998-2002 using Panzar and Rosse, HHI, and the 3-bank concentration ratio. They report that the region is under monopolistic competition. Foreign penetration and the accelerated level of concentration in Latin America prompt Levy Yeyati and Micco (2007) to examine the implications for competition intensity. The results of the k-firm concentration ratio, HHI and the Panzar Rosse approach help to imply that foreign penetration has lowered the degree of competition and the fragility of the banking sector is positively related to competition. Casu and Girardone (2006) demonstrate that the performance-based indicators outperform the structural measures because, driven by the firm's conduct, they are much more theoretically sound, and they should not define a narrow geographic market. Mirzaei and Moore (2014) use non-structural measures to determine the intensity of banking competition for 146 economies worldwide. They conclude that concentration negatively affects competition in developing economies, that contestability theory holds exclusively in less-developed banking industries, and that inter-industry competition in advanced countries is pivotal for promoting competitiveness in the banking system.

The Lerner index of monopoly power (Lerner, 1934), as outlined above, has frequently been used in empirical work to determine the trends in banking competition. As previously stated, the Lerner index is a measure of market power that is proxied by the price mark-up over marginal cost (De-Ramon and Straughan, 2016) and falls within the NEIO literature. Coccorese (2014) states that the Lerner index is computed as the difference between price and marginal cost overprice because it identifies the degree to which "*the price charged by a firm in a market diverges from the price that would emerge in case of perfect competition*"[85]. Bikker et al. (2012) and Shaffer (2004) are aware that the popularity of adopting the Lerner index lies in its simplicity for running the econometric model using the available firm-level data. Moreover, it can be derived from profit-maximising equilibrium conditions. Shaffer (1989) is a pioneer in applying this measure to the banking industry, specifically, to the US loan market and the Canadian banking industry.

Berger et al. (2009) differentiate between the "competition-fragility" view and the "competition-stability" view on the basis of market power, profit margins and risk-taking. They conclude that banks with an accelerated degree of market power tend to have less risk exposure, and in their examined sample, market power raises loan risk. In a cross-sectional study, Casu and Girardone (2009) investigate the relationship between competition and efficiency in the banking industries of several European economies and find that market power and efficiency have positive causation; however, the causality direction from efficiency to competition is weak. Angelini and Cetorelli (2003) estimate the degree of

[85] See Coccorese (2014, pg.76).

competition for the Italian banking sector using the Lerner index for 1984-1997. Their results were consistent with previous study findings: that deregulation of the banking industry in Europe significantly increased banking competition. Furthermore, they find nothing significant related to gaining market power for banks engaged in mergers and acquisitions.

Similarly, Coccorese (2005) focused on examining the Italian banking sector for a more extended period (1988-2000) using the Lerner index. The evidence shows that there is no conflict between concentration and competition in the examined industry. Coccorese (2009) finds that monopolistic banks can take partial advantage of their market power, unlike typical monopoly conduct. In a recent comprehensive study, Coccorese (2014) estimates the Lerner index using the stochastic frontier approach for a large group of countries, i.e., 87 national banking markets during 1994-2012. He finds considerable advantages in using this approach and concludes that there is a positive correlation between the stochastic Lerner index and return on assets. Thus, his result is consistent with the theoretical model of market power and profitability. Beck et al. (2013) demonstrate that average Lerner indices for his examined countries are statistically and positively related to other competition indicators.

The Panzar-Rosse H-statistic is another indicator that has been widely used in estimating the extent of competition in banking studies. Using PR methodology, Claessens and Laeven (2004) use bank-level data from 50 countries to investigate the extent of competition and determine the factors associated with differences in this indicator across countries. They find that competition is higher in countries with weak barriers to entry and greater foreign bank entry. Moreover, they conclude that there is no evidence of an inverse relationship between competition and concentration. Coccorese (2004) by means of the PR H-statistic, assesses the competitive conditions in the Italian banking sector. The results show that there is a positive correlation between the degree of competition and local economic performance.

Similarly, Schaeck et al. (2009) assess the competitive behaviour of banks measured by the PR and its implications for banking system fragility. Their findings show that the competitive conduct of financial institutions reduces the likelihood of systemic risk and extends the survival period of the banking system. Schaeck and Cihák (2012) use the PR approach to confirm the correlation between competition and bank capital ratios and provide useful policy implications. They demonstrate that setting restrictions on the banking sector does not restrain competition and that the rights of poor shareholders negatively affect economic performance, allowing banks to hold higher capital ratios. Schaeck and Cihák (2010) argue that policymakers who set policies to promote competition may positively influence the efficiency and soundness of the banking industry. Using the H-statistics, De Bandt and Davis (2000) investigate the impact of the Economic and Monetary Union (EMU) on market conditions for banks operating in countries with a single currency. They find evidence that large banks' behaviour is not fully competitive compared to that of U.S. banks. In small banks, the level of competition is notably low, particularly in France and Germany.

The more recent studies using the PR H-statistic to examine competition in developed economies are as follows: Nathan and Neave (1989); Shaffer (1993); Molyneux et al. (1994); Molyneux et al. (1996); Bikker and Groeneveld (1998); Hondroyiannis et al. (1999); Carbó et al. (2009); Matthews et al. (2007); Hempell (2002). However, few studies have investigated the banking competition intensity in developing economies. These include Mamatzakis et al. (2005); Levy Yeyati and Micco (2007); Gelos and Roldos (2004); Prasad and Ghosh (2005); Drakos and Konstantinou (2005); Yildirim and Philppatos (2007); and Ventouri(2018).

Recently, the Boone indicator has been developed to concentrate on profits and measures of efficiency in competitive sectors (Boone, 2008). Schaeck and Cihák (2010) assess the effect of competition on bank soundness by using the Boone indicator for European and U.S. banks. They find a link from competition to soundness through the competition-efficiency hypothesis and the heterogeneous response of different banks to competition. In a sample of European banks, Schaeck and Cihák (2014) reuse the Boone indicator to assess the impact of competition on banking stability. They interpret efficiency as a channel between competition and stability. Consequently, stable banks benefit more from competition than fragile banks do.

So far, very little attention has been paid to investigating the extent of banking competition in the MENA region. Murjan and Ruza (2002) apply the PR H-statistic to examine the banking competition in nine MENA economies during 1993-1997. The results show that the banking industries in the MENA can be classified as monopolistic competition and that the GCC countries are less competitive than the non-oil producing economies. Likewise, the studies by Al-Muharrami et al. (2006), Turk-Aris (2009), Abuzayed et al. (2012) and Polemis (2015) are consistent with the previously mentioned result in applying the same methodology, but they extended their sample to include more countries and a longer period. In addition, Polemis (2015) employs the Lerner index, the adjusted Lerner index, and conduct parameters to strengthen his empirical findings. He finds similar results from all the measures in which the banking industry in the MENA region has a low level of significant market power. Anzoategui et al. (2010) use both the PR H-statistic and the Lerner index to investigate the intensity of bank competition in the MENA during 1994-2008. They suggest that banking competition in the region is weak compared with that in other regions due to a poor credit information environment and high barriers to entry. González et al. (2017) investigated the relationship between competition and bank stability for several banks operating in the MENA region during 2005-2012. They conclude that an increase in banking competition in GCC economies tends to reduce the level of financial stability. However, in non-GCC countries, which are considered uncompetitive markets, the rise in competition boosts financial stability.

Table 4.1 below summarises the most recent empirical studies using the competition measures discussed above. These studies apply various methodologies and data, either exclusively to cover one country, many countries, a specific region, or the world. As can be seen from the table below, the most extensive papers concentrate on using non-structural measures to estimate banking competition intensity over time in developed and developing countries.

Table 4.1: Studies of banking competition measures.

Study	Region	Number of banks	Period	Measure(s)
De-Ramon and Straughan (2016)	UK	127	1989-2013	HHI, L, H-statistic, B
Carbó et al. (2009)	EU	58	1995-2001	HHI, L, H-statistic
Mamatzakis et al. (2005)	Transition countries (Central and Eastern European countries)	87	1998-2002	CR, HHI, H-statistic
Levy Yeyati and Micco (2007)	Latin America	-	1993-2002	CR, HHI, H-statistic
Berger et al. (2009)	World	43	2007	HHI, L
Matthews et al. (2007)	UK	11	1980-2004	H-statistic, L
Casu and Girardone (2006)	EU	63	1997-2003	CR, H-statistic
Logan (2004)	UK	357	1989-2003	CR, HHI
Demirguc-Kunt and Pería (2010)	Jordan[86]	-	1994-2006	L, H-statistic
Anzoategui et al. (2010)	MENA	250	2002-2008	L, H-statistic
Hempell (2002)	Germany	3473	1993-1998	CR, H-statistic
González et al. (2017)	MENA	356	2005-2012	HHI, H-statistic
Saif-Alyousfi et al. (2020)	GCC	70	1998-2016	L, B
Mirzaei and Moore (2014)	World	7517	1999-2011	L, B
Rhoades (1995)	US	1684	1990-1992	HHI
Davis et al. (2019)	EU and US	8216 EU 1270 US	1998-2016	L
Coccorese (2014)	World	116	1994-2012	L
Coccorese (2005)	Italy	8+	1988-2000	L
Fernández de Guevara et al. (2007)	EU	45	1993-2000	L
Casu and Girardone (2009)	EU	73	2000-2005	L
Angelini and Cetorelli (2003)	Italy	954	1983-1997	L
Spierdijka and Zaourasa (2018)	US	2165	2000-2014	L
Shaffer and Spierdijka (2020)	US	5281	2011-2017	L
Coccorese (2004)	Italy	204	1997-1999	H-statistic
Bikker et al. (2012)	World	73	1994-2004	H-Statistic
Schaeck et al. (2009)	World	-	1998-2005	H-statistic
Schaeck and Cihák (2012)	EU	43	1999-2005	H-statistic
Goddard and Wilson (2009)	G7	166	2001-2007	H-statistic
Murjan and Ruza (2002)	AME	141	1993-1997	H-statistic
Turk-Ariss (2009)	MENA	205	2000-2006	H-statistic
Nathan and Neave (1989)	Canada	31	1982-1984	H-statistic
Shaffer (1993)	Canada	-	1965-1989	H-statistic

[86] Demirguc-Kunt and Pería (2010) claim that, according to the Central Bank of Jordan, law (Article No 45/c) had by this time prohibited the publication of any individual bank-level data; thus they estimated the H-statistic and the Lerner index for 91 countries and used this estimation to assess the degree of coemption in Jordan.

Molyneux et al (1994)	EU	9480	1986-1989	H-statistic
Molyneux et al. (1996)	Japan	72	1986-1988	H-statistic
Bikker and Groeneveld (1998)	EU	892	1989-1996	H-statistic
Hondroyiannis et al. (1999)	Greece	20	1993-1995	H-statistic
De Bandt and Davis (2000)	EU and US	757	1992-1996	H-statistic
Bikker and Haaf (2002a)	EU and non-EU countries	5444	1988-1998	H-statistic
Gischer and Stiele (2008)	Germany	428	1993-2002	H-statistic
Gelos and Roldos (2004)	EU and Latin America (Emerging markets)	126	1994-1999	H-statistic
Prasad and Ghosh (2005)	India	64	1996-2004	H-statistic
Drakos and Konstantinou (2005)	Transition countries (Central and Eastern European countries)	218	1992-2000	H-statistic
Yildirim and Philppatos (2007)	Transition countries (Central and Eastern European countries)	562	1993-2000	H-statistic
Macit (2012)	Turkey	32	2005-2010	H-statistic
Polemis (2015)	MENA	137	1997-2012	H-statistic
Ventouri(2018)	ASEAN	1512	2007-2016	H-statistic
Schaeck and Cihák (2010)	EU	-	1995-2005	B
Schaeck and Cihák (2014)	EU	43	1995-2005	B
van Leuvensteijn et al. (2011)	EU and G2	140	1992-2004	B

Source: Authors. Notes: Regions- EU: European Union countries; MENA: Middle East and North Africa; AME: Arab Middle East Countries; GCC: Gulf Cooperation Council; ASEAN: Association of the South East Asia Nations; G2: People's Republic of China and United States of America; G7: Canada, France, Germany, Italy, Japan, United Kingdom and United States of America; UK: United Kingdom; US: United States of America. Measure(s): of banking competition: CR: Concentration ratios; HHI: Herfindahl_Hirschman Index; L: Lerner index; H-statistic: Panzar-Rosse H-statistic; B: Boone indicator. Casu and Girardone (2006) and De-Ramon and Straughan (2016) have similar tables. The study by Shaffer and Spierdjik (2020) contains a table for earlier studies using the Lerner index and their output identification.

De-Ramon and Straughan (2016) warn that the results of performance-based measures need to be interpreted with caution. Kumbhakar et al. (2012) note that the Lerner index is estimated with error due to the unobservable nature of output prices and marginal costs, which they compute using the total cost. Vives (2008) indicates that it is challenging to assess changes in competition because the Lerner index cannot capture the extent of product substitutability. De-Ramon and Straughan (2016) suggest that when estimating firms' mark-ups, changes in efficiency should be taken into account. Regarding the Panzar-Rosse model, Bikker et al. (2012) demonstrate that it needs more data related to costs and market equilibrium. Shaffer and Spierdijk (2017) conclude that the H-statistic requires a behavioural assumption about the banking position in the market; thus "neither the sign nor the magnitude of H-statistic can reliably identify the degree of market power" (ibid, pg.14). With regard to the Boone indicator, Van Leuvensteijn et al. (2011) admit that the main limitation of this indicator is that it can be distorted where firms compete to generate a higher market share rather than maximizing their profits or where firm outputs become gradually more heterogeneous.

4.2.3 Convergence

A growing body of writers recognises the importance of convergence, especially since the globalisation and liberalisation of economies. The term “convergence” was first used in development economics to assess relationships in the economic growth of poor and rich countries (see Barro et al., 1991). Bernard and Durlauf (1994) demonstrate a framework for interpreting and understanding tests of convergence hypotheses. It considers two types of convergence. The first is beta-convergence,[87] referring to the tendency for emerging (poor) countries to grow faster than rich countries. For instance, Andreano et al. (2013) apply conditional beta-convergence to assess the economic growth of the MENA countries during the period 1950-2007. Second, sigma-convergence indicates a decline in the dispersion of levels of income across countries (Sachs and Warner, 1995).

In the banking literature, convergence is fast becoming a key instrument in assessing efficiency, productivity, performance, policies and competition. Weill (2009) investigates whether financial integration has actually occurred in the EU banking markets by using convergence in banking efficiency during the period 1994-2005. He finds robust evidence of a process of convergence in cost efficiency across European countries. Casu and Girardone (2010) use both beta and sigma convergence to assess the EU deregulation policies' results on the banking industry's performance and efficiency. Their results provide robust insights into the convergence of efficiency levels towards the EU mean, but there is no evidence of any overall development of efficiency levels to produce optimal practice. In this regard, Evans et al. (2008) examine the deregulation process in the European Union. The results of testing banks’ profitability show that deregulation and the openness of markets to international competition promote the convergence of the banking industries, but these are not among their strategies for managing assets and liabilities. Fung (2006) investigates the convergence in productivity among bank holding companies in the US which depend on scale economies and X-efficiency. He finds no evidence of absolute convergence or that the initially smaller BHCs tend to grow faster than the larger ones. However, he finds conditional convergence, referring to the initial variations in X-efficiency among BHCs, which can initiate permanent differences in steady-state productivity.

Coleman (1994) examines the relationship between global economic integration and policy convergence in the banking industry in Canada, the US, the UK, Germany and France. He finds evidence of considerable convergence in the membership of policy communities and the organisation of state agencies, mainly in their modes of policymaking and policy styles. However, the convergence on the corporate levels of their methods of policymaking is limited. Similarly, Busch (2002) scrutinises

[87] Called the catch-up effect.

the divergence and convergence of the state regulation of the banking sector using case studies from the US, the UK, Germany and Switzerland. In terms of regulatory content and policy, he concludes that there is substantial but imperfect convergence, none of which occurs in the political processes and institutional dimensions. Concerning the policy disclosures, it is to some extent consistent with the frame of international competitiveness, whereas national issues dominate the day-to-day legislative debates[88]. In an analysis of banking regulatory convergence in the southern and eastern Mediterranean countries, Ayadi et al. (2013) argue that substantial improvements have been implemented. Still, shortfalls in legal rights, deposit insurance, political interference and entry barriers need addressing.

Argent (2002) investigates the extent of convergence between the Australian retail banking industry and its US and UK counterparts. He argues that the restructuring of the financial services sector has led to much greater diversity in the financial institutions and services, which seems consistent with the increasingly homogenised financial space developing in the advanced Western economies. After China joined the World Trade Organization (WTO), regulatory reforms encouraged Brau et al. (2013) to examine the impact of this step on the asset allocation and capitalisation of the Chinese banks. They find no evidence that the four segments of banks operating in China – The Big Four, Majority State, Majority Private, and Majority Foreign banks- have converged towards common asset allocation and capitalisation approaches. However, domestic banks were consistent in meeting their targets. Matthews and Zhang (2009) use the concepts of conditional convergence to examine the productivity of the commercial banks operating in China during the period 1997-2007, where they have found significant convergence of productivity growth to the peer group defined by bank-specific variables. Saab and Vacher (2007) estimate the degree of integration of retail banks operating in the Communauté Economique et Monétaire d'Afrique Centrale (CEMAC) and competition intensity at the regional level. Although they found price convergence in the average interest rate spreads, it was not due to increased cross-border flows in financial services. Rather, the excess liquidity in the region may be the reason for this price convergence. Moreover, the lack of sound legal and regulatory frameworks, proper infrastructure and markets have been key factors in the limited bank competition in the region. In a recent analysis, Bulut et al. (2015) investigate the degree of convergence of profit rates in the Turkish banking industry. They find that only two banks' profits out of the ten largest banks in operation converge to the average. Thus, they conclude that the competition that can boost profits to competitive levels in the banking sector is limited.

To date, few studies have investigated the tests of convergence for bank competition. Weill (2013) was the first to demonstrate the reliability of using this approach to competition. He measures the intensity of bank competition in all EU economies during the 2000s and checks its convergence. The results show that bank competition shows no general trend during the examined period, but banks may integrate

[88] For instance, money laundering in the case of Switzerland and banking legislation concerning access to bank accounts for everyone in Germany (see Busch, 2002).

through convergence. In particular, the results of the Lerner index and the Panzar-Rosse H-statistics support the view of convergence across the EU. According to Weill (2013, pg.104), "Beta-convergence implies that countries with a lower level of bank competition have faster growth rates than countries with a higher level of competition". "Sigma-convergence is observed if each country's level of bank competition is converging to the average level of the group of countries" (ibid, pg.104). Similarly, Marius Andries and Cãpraru (2012) provide evidence of convergence in bank competition across 27 EU economies. To the best of our knowledge, this is the first study to investigate convergence in bank competition across MENA countries using various structural and non-structural competition measures.

4.3 Data Description

Our estimations were made in two stages. First, we computed the banking competition measures using the unconsolidated bank-level balance sheet and income statement data from Fitch Connect for the period 1995-2018. We used the unconsolidated data to avoid double counting. Our examined sample of an unbalanced panel included data on commercial, development, retail and consumer, private and Islamic[89] banks operating in 16 MENA countries, namely: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and the United Arab Emirates. The original sample included 19 MENA countries; however, we omitted Djibouti, Mauritania, and Yemen because of data availability and the low number of observations available. Table 4.2 shows the number of banks for each country in each year of our sample. The highest number of banks used was 450 operating banks in 2014, and the lowest, 330, was in 1995. Turkey, Lebanon, and the United Arab Emirates had the largest number of banks in the region over the period under study. It is worth noting that our sample covered most of the banks operating in the MENA region in terms of their number and total assets.

[89] Islamic banks were included with conventional banks in many earlier studies on banking competition, such as those by Coccorese (2014), Anzoategui et al. (2010), and Turk-Ariss (2010).

Table 4.2: Number of banks and observations used in the estimation of banking competition measures over the period 1995-2018

	Algeria	**Bahrain**	**Egypt**	**Iran**	**Iraq**	**Israel**	**Jordan**	**Kuwait**	**Lebanon**	**Morocco**	**Oman**	**Qatar**	**Saudi Arabia**	**Tunisia**	**Turkey**	**United Arab Emirates**	**Total**
1995	9	19	31	14	9	18	16	16	49	14	14	11	15	20	50	25	330
1996	9	19	39	14	9	18	16	16	51	14	14	11	15	22	51	25	343
1997	9	20	39	14	10	18	16	16	50	14	14	12	15	23	51	25	346
1998	8	19	39	15	10	19	16	16	52	12	15	12	15	25	51	26	350
1999	8	19	38	15	10	20	16	17	49	12	15	12	15	24	54	26	350
2000	9	21	37	15	11	20	16	17	45	11	15	12	13	25	50	27	344
2001	9	21	38	15	10	20	16	18	38	11	13	12	14	24	51	29	339
2002	12	24	38	16	9	20	16	23	38	11	12	12	13	24	45	29	342
2003	15	24	36	16	10	18	16	27	36	13	12	12	13	22	44	30	344
2004	15	26	33	16	10	15	16	27	34	16	12	12	14	22	51	32	351
2005	16	31	33	16	13	12	17	30	33	18	12	13	14	23	48	33	362
2006	17	34	32	16	16	12	18	29	34	17	12	14	14	23	51	34	373
2007	17	38	34	16	18	12	18	31	37	17	12	14	13	23	44	36	380
2008	17	40	34	16	21	12	18	31	39	18	12	14	14	24	44	39	393
2009	17	41	34	17	20	12	17	33	41	18	12	13	14	24	44	38	395
2010	17	39	33	16	24	11	17	31	43	18	12	14	14	24	43	35	391
2011	18	39	33	16	26	11	17	32	47	22	12	14	14	23	74	34	432
2012	18	36	33	18	25	11	17	33	46	23	13	14	14	21	83	36	441
2013	18	34	33	20	24	11	18	32	42	20	14	14	14	21	84	38	437
2014	18	34	33	21	24	13	19	33	41	22	14	15	16	22	87	38	450
2015	18	35	32	22	20	14	20	32	40	20	14	14	16	22	88	36	443
2016	18	35	32	25	19	14	20	31	39	19	14	13	16	22	90	36	443
2017	18	36	32	22	18	14	19	31	38	18	13	13	16	22	88	37	435
2018	18	35	31	20	13	14	19	31	37	16	13	13	15	21	86	37	419
No. of Obs.	348	453	577	367	229	330	406	379	676	314	270	245	282	348	1079	629	6932

Note: The number of banks operating in the MENA region was retrieved from Fitch Connect. The observations used in the estimation cover the period 1995-2018 (Author's own calculations).

Table 4.3 shows the descriptive statistics for the bank-level data variables used to estimate banking competition measures, such as total assets, total costs, total revenues, total loans, and the input prices (deposits, labour, and physical capital). The total costs were computed as the sum of the interest expenses, personnel expenses, and other operating and administrative expenses. Moreover, we made 6,880 observations estimations altogether. We managed to estimate the Lerner index using yearly bank-level data, and then we took their averages to construct the country measure. However, we could not take the same approach with the H-statistic and Boone indicator because of the low number of observations. Thus, we first ran the panel least square using a four-year window (6 periods) and a rolling estimation with a 4-year window, following Ventouri's (2018) approach for each country, the entire region, and the region classifications (lower middle income, upper middle income, high income, oil-producing, and non-oil-producing countries). In terms of the H-statistic, we also tested the equilibrium by replacing the dependent variable from gross revenue over the total assets to return on assets in order to generate the E-statistic that measures the sensitivity of profit with respect to the variations in input prices (Ventouri, 2018).

Table 4.3: Descriptive statistics

	Total assets	**Total costs**	**Gross revenues**	**Total loans**	**Price of deposits**	**Price of labour**	**Price of physical capital**
Mean	8740	628	367	4780	6.54	1.40	3.36
Median	2030	141	79	931	4.12	1.10	2.60
Max	237000	33300	11100	168000	58.40	10.60	24.50
Min	3.88	0.23	0.018	0.0002	0.19	0.10	0.22
No. of Obs	6932	6932	6932	6932	6932	6932	6932

Note: The table displays the averages in the variables for the period 1995-2018 that were used to estimate the banking competition measures and the total number of observations. Total assets, total costs, total revenues, and total loans are in millions of dollars. Input prices (deposit, labour, and physical capital) are shown as percentages. No. of Obs- number of observations.

Second, we took the averages of the banking competition measures for each country each year and constructed a balanced panel with data from 368 observations to investigate the convergence in bank competition for the MENA region between 1995 and 2018, following the approach by Weill (2013).

Table 4.4 shows the definitions and descriptions of the variables, the banking competitions measures, and the tests of convergence estimated in this study.

Table 4.4: Variables definition and sources

Variable	Symbol	Definition	References	Sources
Bank's output price	$P_{i,t}$	Ratio of gross revenues to total assets for operating bank i at time t	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Total cost	$C_{i,t}$	Total operating and financial costs (expenses) for operating bank i at time t (million USD)	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Total assets	$Q_{i,t}$	Amount of total assets (million USD), a proxy for bank output.	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Price of deposits	$W_{1,it}$	Ratio of interest expense over total deposits and money market funding.	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Price of labour	$W_{2,it}$	Ratio of personnel expenses to total assets	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Price of capital	$W_{3,it}$	Ratio of other operating and administrative expenses to fixed assets	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Marginal cost	MC_{it}	Marginal costs, the coefficients of the translog cost function	Claessens and Laeven (2004)	Author's own calculations
Profit	$\pi_{i,t}$	Pre-tax return on assets, calculated as the ratio of net income to total assets.	De-Ramon and Straughan (2016)	Fitch Connect and Author's own calculations
Measures of concentration				
CR5 (total assets)	CR_k	Ratio of total assets of the five largest banks to total assets of all banks operating in the market.	De-Ramon and Straughan (2016)	Author's own calculations
HHI (revenue)	HHI_r	Sum of the squares of each bank's total revenues to total revenues of all banks in the market.	De-Ramon and Straughan (2016)	Author's own calculations
HHI (total assets)	HHI_{ta}	Sum of the square of each bank's total assets to total assets of all banks in the market.	Kasman and Kasman (2015)	Author's own calculations
HHI (total deposits)	HHI_{td}	Sum of the square of each bank's total deposits to total deposits of all banks in the market.	Kasman and Kasman (2015)	Author's own calculations
HHI (total loans)	HHI_{tl}	Sum of the square of each bank's total loans to total loans of all banks in the market.	Kasman and Kasman (2015)	Author's own calculations
Measures of competition				
Lerner index	$L_{i,t}$	A measure of price-cost margin.	Lerner (1934), Bikker (2004), Anginer et al. (2014), and Davis et al. (2019)	Author's own calculations
H-statistic	$H - \text{statistic}$	Sum of the revenue elasticities to the underlying input prices.	Panzar and Rosse	Author's own calculations

			(1982,1987), and Claessens and Laeven (2004)	
E-statistic	$E - \text{statistic}$	Sum of the revenue elasticities to the underlying input prices depending on the long-run equilibrium.	Panzar and Rosse (1982,1987), and Claessens and Laeven (2004)	Author's own calculations
Boone indicator	β	The coefficient of the profitability model. $\ln\pi_{i,t} = \alpha + \beta\ln(mc_{it})$	Boone (2008), De-Ramon and Straughan (2016)	Author's own calculations
Measures of convergence				
Beta convergence	β	The coefficient of the β-convergence test $\ln\text{Competition}_{i,t} - \ln\text{Competition}_{i,t-1} = \alpha + \beta\ln\text{Competition}_{i,t-1} + \sum_{i=1}^{16}\text{Country}_i$	Weill (2013)	Author's own calculations
Sigma convergence	β	The coefficient of the σ-convergence test $\Delta X_{i,t} = \alpha + \beta X_{i,t-1} + \sum_{i=1}^{16}\text{Country}_i$	Weill (2013)	Author's own calculations
Control variables				
Equity to total assets	Z_{it}	Ratio of total equity to total assets.	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Net loans to total assets	Z_{it}	Ratio of net loans to total assets.	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations
Bank size	Z_{it}	The logarithm of assets.	Claessens and Laeven (2004)	Fitch Connect and Author's own calculations

4.4 Methodology

There are several methods available in the empirical literature for measuring bank competition. These methods can be divided into structural and non-structural approaches. The structural approach follows the perspective of the traditional Industrial Organisation (IO) in measuring bank competition based on the SCP model. As previously stated, the SCP model focuses on the concentration of the market through the market share as a vital variable. According to SCP, higher concentration leads to less competitive conduct and generates higher profitability for the bank. The k-bank asset concentration and HHI are the leading concentration indices that were widely applied until the 1990s.

In terms of the non-structural approach that falls under the NEIO, the shortcomings of the SCP model encourage authors to develop new tools for measuring the extent of bank competition by concentrating more on measuring the bank conduct directly. It includes the Lerner index, a widely used measure of market power, and also called the price-cost margin. The Panzar-Rosse H-statistic is computed by taking the sum of the elasticities of revenues with respect to the input prices. Hence, it captures the transmission of input costs through to the bank's revenue. The Boone indicator depends on the idea that efficient banks work better and generate more profits in more competitive markets, so it measures the effect of efficiency on bank performance. We use all previously mentioned indicators to determine the extent of bank competition in the MENA region and across countries.

Furthermore, we apply further research to investigate convergence in bank competition. We replicate Weill (2009) methodology to compute the Beta-convergence test, which "implies that countries with a lower level of bank competition have faster growth rates than countries with a higher level of bank competition" and Sigma-convergence tests that "observe if each country's level of bank competition is converging to the average level of the group of countries"[90].

In the following subsections, we will present the methodology of each bank competition indicator used in our analysis. We begin with the measures of concentration, the k-bank concentration ratio and the HHI. Then we will discuss three non-structural models: The Lerner index, the Panzar-Rosse H-statistic, and the Boone indicator.

4.4.1 The 5-Bank Asset Concentration

The k-bank concentration ratio is constructed directly from the data available of the three, five, or ten largest banks operating in the market, and it is straightforward to calculate. The k-bank asset concentration ratio estimates the market share of the k banks in the market:

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[90] See Weill (2013, pg.104).

$$CR_k = \sum_{i=1}^{K} s_i \ , \qquad with\ s_1 \geq \ \cdots \geq s_K \geq s_N \ , \qquad \forall\ N \geq K \qquad\qquad (1)$$

where s_i is the market share of i operating bank, when banks are classified in descending order of market share using total assets, and N is the total number of operating banks. This indicator provides equal emphasis to the k dominant banks and does not take into account small banks in the market. Bikker and Haaf (2002a) tell us that there is no rule regarding the optimal value of k, so the number of banks to include is an arbitrary decision. In the present analysis, we adopt the value of the 5-bank concentration ratio due to the variation in the number of banks operating in each country in the MENA region. Zero refers to an infinite number of equally sized banks; hence, the market is in a state of perfect competition, whereas one indicates that the banks (depending on the chosen k) included in the calculation comprise the entire industry, which indicates a monopoly situation.

4.4.2 The Herfindahl-Hirschman Index (HHI)

The HHI is a statistical measure of the bank's concentration that has been considered a benchmark for assessing other concentration indices (Bikker and Haaf, 2002a). It falls under the SCP paradigm that proposes an increasing relationship between the market concentration and market power (alternatively, greater concentration, less competitive conduct, greater profits). Rhoades (1995) states that HHI is an efficient screening device and a planning tool for regulators and bankers. It is much more data-sensitive than the concentration ratio previously mentioned since it requires data on the size distribution of the entire bank (market share of each bank) (Calkins, 1983). For this reason, Bikker and Haaf (2002a) remark that HHI is often called the full-information index. The lowest value of HHI refers to equal market shares, and a high HHI indicates that one firm has a substantial market share.

It is widely applied in the banking context due to its simplicity in calculation; it takes the sum of the squared market share of all banks operating in the market, namely:

$$HHI \ = \sum_{i=1}^{N} s_i^2 \ , \ \ \forall i = 1, \cdots, N \qquad\qquad (2)$$

where s_i is the market share of i operating bank, and N is the total number of banks in the market. We compute the HHI by using the total revenue market share, total deposit market share, total loans market share, and total assets market share to check the consistency of the indicator, replicating the methodology of several previous studies, such as Rhoades (1995), Berger et al. (2008), Kasman and Kasman (2015).

4.4.3 The Lerner Index

The Lerner index (price-cost margin) is one of the non-structural measures of competition that measures the market power of a bank by computing the divergence between the bank's price and its marginal cost (Lerner, 1934). It was applied to banking only recently because of the difficulty of determining marginal costs (Leon, 2015). We computed it for each bank in operation and each year of our examined sample using the standard approach and then took the aggregate to determine the Lerner index of each country in each year.

The Lerner index (L) was estimated as:

$$L_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} \qquad (3)$$

where P is the output price which is computed as the ratio of gross revenues to total assets for operating bank i at time t , and MC is the marginal cost. The subscript i denotes bank i, and t denotes time t.

Depository institutions are involved in various financial activities, some of which can be considered both inputs and outputs (De-Ramon and Straughan, 2016). Moreover, it is difficult to measure the prices of outputs and marginal costs. Berger and Humphrey (1997) consider the "production approach" where deposits are the main input of products providing financial services to customers. In contrast, Freixas and Rochet (1997,2008) employ the "intermediation approach" that shows that deposits are an intermediate input in the production of loans. In line with the common empirical literature, we took deposits as an input to the production of multiple financial products. For the output price, we used the single-output approach, following Fernández de Guevara et al. (2007), Berger et al. (2009) and Weill (2013), to take total assets as a proxy. $P_{i,t}$ was computed as total revenues (interest and non-interest income) over total assets.

Regarding the marginal cost, it was extracted from the estimation of the parameters of the translog- cost function following the methodology of Anginer et al. (2014), Beck et al. (2013) and Weill (2013). The translog-cost function was derived as:

$$\begin{aligned} log\,(C_{it}) = \alpha &+ \beta_1 log\,(Q_{it}) + \beta_2 (log(Q_{it}))^2 + \beta_3 log(W_{1,it}) + \beta_4 log(W_{2,it}) \\ &+ \beta_5 log(W_{3,it}) + \beta_6 log(Q_{it}) log(W_{1,it}) + \beta_7 log(Q_{it}) log(W_{2,it}) \\ &+ \beta_8 log(Q_{it}) log(W_{3,it}) + \beta_9 (log(W_{1,it}))^2 + \beta_{10} (log(W_{2,it}))^2 \\ &+ \beta_{11} (log(W_{3,it}))^2 + \beta_{12} log(W_{1,it})\, log(W_{2,it}) + \beta_{13} log(W_{1,it}) log(W_{3,it}) \\ &+ \beta_{14} log(W_{2,it}) log(W_{3,it}) + \delta Dummies + \varepsilon_{it} \qquad (4) \end{aligned}$$

where $C_{i,t}$ is the total operating and financial costs (expenses) for operating bank i at time t, $Q_{i,t}$ is total assets, which is a proxy for bank output. The input prices $W_{j,i,t}$ reflected $W_{1,i,t}$ as the ratio of interest expense to total deposits and money market funding was a proxy for the input price of deposits, $W_{2,i,t}$ was the ratio of personnel expenses to total assets as a proxy of input price of labour, and $W_{3,i,t}$ the ratio of other operating and administrative expenses to fixed assets as a proxy for the input price of equipment (fixed capital). The subscript *i* denotes bank *i*, and *t* denotes time *t*. The time and bank-level fixed effects were employed, respectively, in line with the existing literature[91]. Additionally, as a robustness check, we re-estimate the Lerner index using the total of loans as a proxy for output to capture the effect of credit since lending is the main activity for depository institutions (Kick and Prieto, 2013, Coccorese, 2014, De-Ramon and Straughan, 2016).

Following the methodology of Weill (2013), we had to normalise total costs and input prices by one input price through imposing the following restriction of linear homogeneity on input prices.

$$\beta_3 + \beta_4 + \beta_5 = 1 \,;\, \beta_6 + \beta_7 + \beta_8 = 0 \,;\, \beta_9 + \beta_{12} + \beta_{13} = 0 \,;\, \beta_{10} + \beta_{12} + \beta_{14} = 0 \,;\, \beta_{11} + \beta_{13} + \beta_{14} = 0 \qquad (5)$$

The marginal cost used in estimating the Lerner index was derived from the following equation:

$$MC_{it} = \frac{\partial C_{it}}{\partial Q_{it}} = \frac{C_{it}}{Q_{it}}\left[\beta_1 + 2\beta_2 log(Q_{it}) + \beta_6 log(W_{1,it}) + \beta_7 log(W_{2,it}) + \beta_8 log(W_{3,it})\right] \qquad (6)$$

The standard interpretation of the index is as follows: in perfect competition, the price equals marginal cost, and economic profits are zero. A wider spread between price and marginal cost indicates greater monopoly power (Leon, 2015). A positive Lerner index indicates that there is a rise in a bank's market power where output price exceeds the marginal cost. However, according to Shaffer and Spierdijk (2015), the magnitude of a positive index cannot be used to estimate how much market power is. Spierdijka and Zaourasa (2018) point out that the positive Lerner index represents a welfare loss for consumers because of deviations from marginal-cost pricing and this kind of loss is not necessarily due to market power. It could simply indicate the firm's need to generate non-negative profits.

We replicated the methodology of Fernández de Guevara et al. (2005) and Weill (2013) to compute the Lerner index of each country in the MENA region by averaging the individual Lerner indices. Leon (2015) presents the formula of Lerner index for country j as follows:

[91] Berger et al. (2009), Anzoategui et al. (2010), Weill (2013), De-Ramon and Straughan (2016).

$$L_j = \sum_{i \in j} \phi_{ij} L_{ij} \quad (7)$$

where L_{ij} is the Lerner index of bank i in country j and ϕ_{ij} the weighting of bank i. The unweighted Lerner index implies that $\phi_i = 1/N$, where N is the number of banks in country j.

It is worth noting that some outliers can influence the mean values of the Lerner index. Therefore, as a robustness check of our results, we also computed the median values for the Lerner indices by country and by year and then took the average to determine the regional level in line with the approach of Weill (2013).

4.4.4 The Panzar-Rosse H-statistic

Many researchers have used the Panzar-Rosse H-statistic proposed by Panzar and Rosse (1987) to measure the extent of bank competition. It has been widely applied in the banking context. It falls under the non-structural measures of the NEIO, meaning that it concentrates on the actual behaviour of banks instead of the structure of the banking market (Weill, 2013). The H-statistic is computed by taking the sum of the elasticities of revenues with respect to the input prices. Hence, it captures the transmission of input costs to the firm's revenue. The weak pass-through of costs to revenues is indicated as higher market power. In contrast, full pass-through is interpreted as a highly competitive condition (Leon, 2015; De-Ramon and Straughan, 2016). In our analysis, we adopted the empirical strategy used by Shaffer (1983), Claessens and Laeven (2004), Casu and Girardone (2006), Turk-Ariss (2009), Ventouri (2018) and Davis and Karim (2019) to estimate the competitive conditions of the MENA region and its individual countries. They were calculated from the following natural logarithm equation:

$$ln(P_{i,t}) = \alpha_i + \beta_1 ln(W_{1,it}) + \beta_2 ln(W_{2,it}) + \beta_3 ln(W_{3,it}) + \gamma ln(Z_{it}) + \delta Dummies + \varepsilon_{it} \quad (8)$$

where P is the output price which is computed as the ratio of gross revenues to total assets for operating bank i at time t. $W_1, W_2, and\ W_3$ are similar to the input prices of Equation 4 defined above. Z is a matrix of exogenous control variables; total equity over total assets, net loans over total assets, and the logarithm of assets (a proxy of size). We took the natural logarithms of all the examined variables. The subscript i denotes bank i, and t denotes time t. Bank-level fixed effects were included following the methodology of Anzoategui et al. (2010) and verified by the results of the Housman test. The view of Turk-Ariss (2009) is that bank effects are most appropriate for capturing variations in individual data because bank-level data used are for banks operating in the same industry and the same country. Similarly, Ventouri (2018) mentions that they allow for heterogeneity across the banks.

$$H - statistic = \sum_{j=1}^{J} \beta_j \quad (9)$$

The H-statistic was estimated using the sum of the input price elasticities of gross revenues ($\beta_1 + \beta_2 + \beta_3$). Outcomes were interpreted as follows: an H-statistic less than or equal to 0 is a sign of monopoly; an H-statistic equal to 1 represents perfect competition, and an H-statistic between 0 and 1 indicates monopolistic competition (Panzar and Rosse, 1982). Nathan and Neave (1989) state that the PR model assumes that the observations that have been used (or the banking industry itself) are in long-run equilibrium. Therefore, we investigated this assumption in the following equilibrium test equation to check whether this condition was satisfied by replacing the gross revenue over total assets with the natural logarithm of returns on assets (ROA).

$$ln(1 + ROA_{i,t}) = \alpha_i + \beta_1 ln(W_{1,it}) + \beta_2 ln(W_{2,it}) + \beta_3 ln(W_{3,it}) + \gamma ln(Z_{it}) + \delta Dummies + \varepsilon_{it} \quad (10)$$

Where ROA is the return on assets. We took the natural logarithm of ROA plus one because some of the operating banks had negative values. For this estimation, we considered the equilibrium E-statistic (sum of $\delta_1 + \delta_2 + \delta_3$) which test for long-run equilibrium. Thus, we test whether the E-statistic statistically equals zero using the F-test statistic, which indicates that the return on assets was not related to input prices, and the market was in equilibrium (Anzoategui et al., 2010). This equilibrium test was previously applied by Shaffer (1982), Molyneux et al. (1996), Claessens and Laeven (2004), Anzoategui et al. (2010), Ventouri (2018).

$$E - statistic = \sum_{j=1}^{J} \delta_j \quad (11)$$

We assessed the H-statistic variations and carried out the equilibrium test over time by using explorative yearly and rolling window testing for the sixteen major economies in the MENA region, then the entire region, and the associated classifications.

4.4.5 The Boone Indicator

Recently, a new measure has been developed by Boone (2008) that captures the effect of competition on the performance of efficient banks (Schaeck and Cihák, 2014). Boone (2008) introduced this indicator depending on the idea that efficient firms (firms with lower marginal costs) work better and generate more profits in more competitive markets; thus, it measures the effect of efficiency on performance and is related to efficiency hypothesis. Boone (2008) calls his initiated indicator a measure of relative profit differences (RPD), but it is well-known in the empirical literature as the Boone indicator. De-Ramon and Straughan (2016) point out that the Boone indicator relies on the output-reallocation effect (see section 2.3.2.3), meaning that efficient firms are willing to expand their output at lower costs, generating more profits than less efficient firms do when the market is highly competitive. Consequently, less efficient firms exit the market leaving incumbent (efficient) firms more room for expansion. Hence, the output is reallocated to more efficient firms. The degree of competition can be raised either by greater interaction between the rivals operating in the market[92] or lax barriers to entry (Boone, 2008; Van Leuvensteijn et al., 2011; De-Ramon and Straughan, 2016).

In line with the empirical literature, we estimated the extent of bank competition in our sample by computing the elasticity of profits to marginal costs (Boone, 2008; Van Leuvensteijn et al., 2011; Schaeck and Cihák, 2014; De-Ramon and Straughan, 2016[93]). We obtained the elasticity by regressing the natural logarithm of profits on the natural logarithm of marginal costs[94] as follows:

$$ln\pi_{i,t} = \alpha + \beta ln(mc_{it}) \qquad (12)$$

where π_{it} [95]is the return on assets, a proxy for the profits operating bank *i* at time *t*, the coefficient β indicates the Boone indicator, and mc_{it} is the marginal costs, which was previously computed using the translog-cost function. The subscript *i* denotes bank *i*, and *t* denotes time *t*. Bank-level fixed effects were derived following the methodology of Schaeck and Cihák (2014) and verified by the results of the Hausman test. The negative values of the Boone indicator refer to a high degree of bank competition because the reallocation effect is more substantial. Van Leuvensteijn et al. (2011) and Schaeck and Cihák (2014) provide theoretical proof that differentiates the Boone indicator from HHI and the Lerner index in the banking context.

4.4.6 Tests of Convergence

We turn now to present the tests of convergence applied to estimate convergence in bank competition by using all the previously discussed indicators (structural and non-structural approaches) for the whole sample of MENA countries over the period 1995-2018. To date, few studies have investigated the tests of convergence for bank competition. To the best of our knowledge, no previous study has investigated the MENA region by using panel data on structural and non-structural measures of bank competition. Weill (2013) was the first to demonstrate the reliability of using this approach to competition. He measured the bank competition intensity in all EU economies during the 2000s and checked the convergence in bank competition. Following the empirical methodology pursued by Weill (2013), we obtained the Beta (β) and sigma (σ) convergence tests by estimating the following equations:

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[92] Shift from Cournot to Bertrand competition (see Schaeck and Cihák, 2014).

[93] Schaeck and Cihák (2014) use average costs instead of marginal costs and De-Ramon and Straughan (2016) use average costs of variables.

[94] Other studies have expressed the profits and costs in levels other than logarithm specification; however, this method introduces a biased sample to the profitable banks because it allows for non-positive profit values to be introduced (see Leon, 2015). Using the logarthim specification helps to interpret the estimated coefficient as an elasticity.

[95] $\pi_i = (p_i - mc_i)q_i$

The β-convergence test or the catch-up effect:

$$lnCompetition_{i,t} - lnCompetition_{i,t-1} = \alpha + \beta lnCompetition_{i,t-1} + \sum_{i=1}^{15} Country_i \qquad (13)$$

where $Competition_{i,t}$ represent each bank competition indicator of country i in year *t*, $Competition_{i,t-1}$ the bank competition indicator of country i in year *t-1*, $Country_i$ is a country dummies, fifteen country dummies have been used in the models to avoid dummy variable trap, $\alpha\ and\ \beta$ are the coefficients to be estimated from data. $\beta - convergence$ is derived from fixed effects for countries to control the country effects. Negative values of the β coefficient reflect the fact that $\beta - convergence$ takes place and the larger the divergence between the bank competition indicator of the current year ($Competition_{i,t}$) and the previous year ($Competition_{i,t-1}$) indicate that all countries converge quickly. Put differently, the higher the β coefficient in relative terms, the quicker the tendency to converge (Casu and Girardone, 2010).

The σ-convergence test (cross-sectional dispersion)

$$\Delta X_{i,t} = \alpha + \beta X_{i,t-1} + \sum_{i=1}^{15} Country_i \qquad (14)$$

where $ln\ Competition_{i,t}$ is the natural logarithm of the average bank competition indicator of country *i* in year *t*, $MCompetition_t$ is the average of $ln\ Competition_{i,t}$ for each period, $X_{i,t} = ln\ Competition_{i,t} - MCompetition_t$, $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $\alpha\ and\ \beta$ are the coefficients to be estimated from data. $\sigma - convergence$ is derived from the fixed effects for countries to control the country effects. The negative values of the σ coefficient show that $\sigma - convergence$ is present, meaning that the country’s bank competition levels are converging quickly to the MENA average. It is worth noting that Beta-convergence and sigma-convergence are ultimately complementary measures, but not excludable ones. Put differently, Beta-convergence is important but not sufficient condition for sigma-convergence to occur (Weill, 2013).

So far, this section has focused on the methodologies used in our analysis. Table 4.5 presents an overview of all the indicators of bank competition. The following section discusses the empirical results.

Table 4.5: Characteristics of bank competition indicators:

Measure	**Definition**	**Range**	**Outcome**	**References**
Structural Approach				
5-Bank asset concentration ratio	Sum of top 5-bank market shares	0 – 1	↑ concentration ↓ banking competition 0 → perfect competition 1 → the top 5 banks making up the entire industry	Saving (1970)
Herfindahl-Hirschman index (HHI)	Sum of all squared market shares; sensitive to the entrance of new entry banks	0 – 10,000	Less than 1,500 → competitive marketplace 1,500-2,500 → moderately concentrated marketplace 2,500 or greater → Highly concentrated marketplace	Cowling and Waterson (1976) Bikker and Haaf (2002b)
Non-structural Approach				
Lerner index	1 – (marginal cost/price)	0 – 1	$L = 0$ → perfect competition $\mathrm{P} = \mathrm{MC}$ ∴ economic profit $= 0$ $L > 0$ → Oligopoly or monopoly[96] $\mathrm{P} > \mathrm{MC}$ → firm market power increases ∴ less competition Lerner index ≤ 0 unknown, additional information needed	Lerner (1934) Spierdijk and Zaouras (2017)
H-statistic	Sum of elasticities of total revenue with respect to each input price	$-\infty$ to +1	$H > 1$ Oligopoly $\mathrm{H} = 1$ perfect competition $0 < \mathrm{H} < 1$ monopolistic competition $\mathrm{H} \leq 0$ pure monopoly[97]	Panzar and Rosse (1987) World Bank Group (2013) Leon (2015)
Boone indicator	Relative profit differences	$-\infty\ to\ 0$	$-\infty$ perfect competition ∴ the more negative, the higher the degree of banking competition Boone indicator could be positive (see section 2.3.2.3)	Boone (2008)

4.5 Empirical results

In this section, we estimate the bank competition indicators presented in section 4.4 and based on the bank-level data available from Fitch Connect. Our examined sample of an unbalanced panel includes data on the commercial, development, retail and consumer, private and Islamic banks operating in 16 MENA countries over the period 1995-2018. Our analysis centred on Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and the United Arab Emirates. The yearly results of each indicator are presented in the Appendix section below.

[96] depends on the elasticity (the price-sensitivity) of demand and strategic interaction with the rivals.
[97] See De-Ramon and Straughan (2016).

The first set of analyses presents the results of the structural indicators (5-bank assets concentration ratio and the HHI). Next, all the non-structural measures (Lerner index, PR H-statistics, and Boone indicators) are derived from coefficients estimated from panel regressions following the related literature. The results illustrate all the bank competition indicators in each country and in the entire MENA region. Moreover, we use World Bank classifications to present the results for lower-middle-income[98], upper-middle-income[99], high-income[100], Oil-producing[101], and non-oil-producing[102] countries.

Regarding the convergence tests, first, we present the results for the entire region, and then we divide our examined sample into the Gulf Cooperation Council (GCC)[103]countries and non-GCC countries, as the remaining countries in our sample. In the last subsection, we discuss the comparisons between all indicators. It should be noted that the results of each bank competition indicator for each country over the period 1995 to 2018 are presented in the Appendix.

4.5.1 The 5-Bank Asset Concentration

The 5-bank concentration ratio is constructed directly from the data available for the five largest banks operating in each MENA country. We compute it by summing over the market shares of the five dominant banks based on their total assets, as shown in section 4.4.1. The results of the concentration ratio are shown in Table 4A.1. In interpreting the results, as previously stated, zero refers to an infinite number of equally sized banks; hence, the market here is in a state of perfect competition, whereas one indicates that the banks included in the calculation comprise the entire industry, which indicates a monopoly (if there is only one company in the market) or an oligopoly (if a small number of firms dominates).

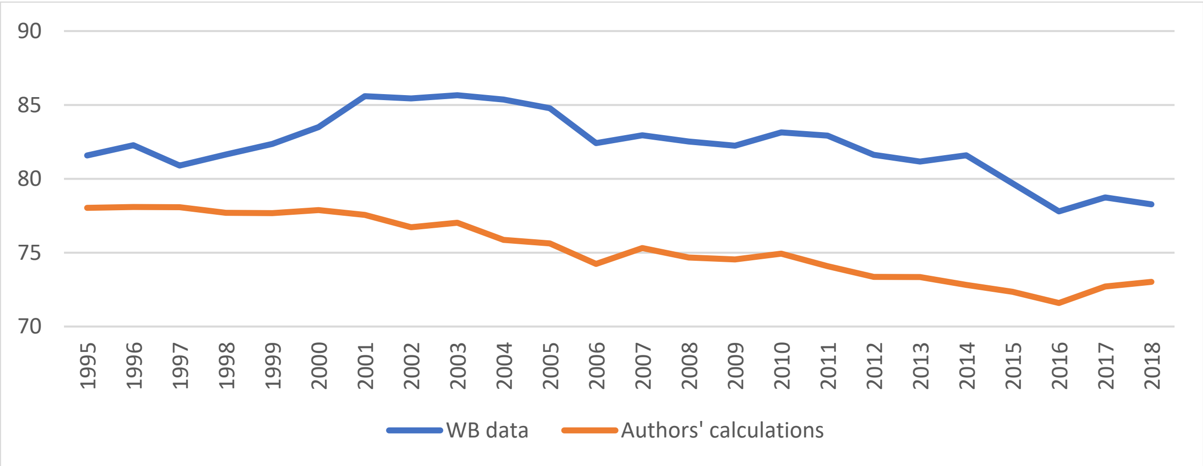
As can be seen from the table, the lowest concentration ratio during recent years, around 50 percent, was in Turkey. In contrast, the highest was in Algeria and Bahrain during the early period of our examined sample; it reached almost 95 percent, indicating that the five largest banks during that period controlled the banking sector in those two countries. There was no significant change in the concentration ratio in most countries over the period 1995-2018. For instance, Algeria and Bahrain ranged between 94 and 80 percent, Jordan, Kuwait, Morocco, Oman, Qatar, and Tunisia between 80 and 70 percent, Egypt and Saudi Arabia between 70 and 60 percent, and the United Arab Emirates was one of the less concentrated markets in the region. One unanticipated finding was the immense change in recent years in Iran and Iraq, from highly concentrated markets to less concentrated ones. On average,

[98] Egypt, Iraq, and Morocco.
[99] Algeria, Iran, Jordan, Lebanon, Tunisia, and Turkey.
[100] Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates.
[101] Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, and Oman.
[102] Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, and Israel.
[103] Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates.

the MENA region is considered a concentrated market, indicating less competition according to the concentration ratio. Even when we divide the region into different groups, based on income or on the production of oil countries (see Figure 4A.1), the results are similar to the overall average, and nothing new is particularly significant.

Figure 4.1 shows the trend of the 5-bank concentration ratio over the period 1995-2018 for the entire region and compares the data from Fitch Connect with those from the World Bank measurement; the datasets are not identical but moves in almost a similar trend. Anzoategui et al. (2010) find evidence from the top three banks that the average concentration ratio for MENA was 57.8 percent over the period 2002-2008. Our result shows a percentage of almost 76, and the World Bank data[104] is 84 percent over the same period. Turk-Ariss (2009) believes that the MENA region has been highly concentrated in past decades; however, there is cross-country evidence that the banking industries in the MENA are contestable.

Figure 4.1: 5-Bank Asset Concentration



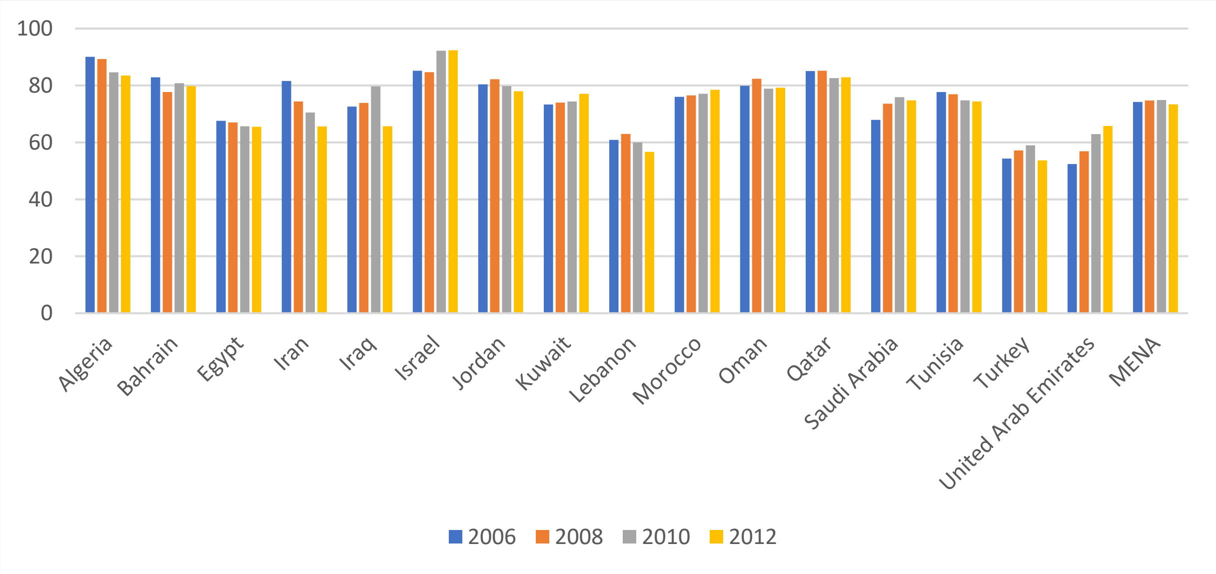
Note: WB-World Bank data

Fernández de Guevara and Maudos (2017) and others have investigated bank competition changes before, during, and after the Global Financial Crisis (GFC) 2007-2009. Many European financial institutions have been restructured; consequently, a low number of rivals remain in operation in the market, leading to a highly concentrated market. Regarding the MENA region, several studies indicate that the countries were less affected than countries elsewhere by the GFC of 2007-09. This was due not to their robust financial system but their low exposure to the collapse of equity and commodity prices (Sahut and Mili, 2011). It can be seen from the data in Figure 4.2 that there was no significant change in the level of bank competition across countries before (2006), during (2008), or after the GFC (2010

[104] Global Financial Development database.

and 2012). Thus, the result of this indicator, which can be added to the existing literature, is that bank competition intensity did not change before, during or after the GFC.

Figure 4.2: 5-Bank Asset Concentration before, during, and after the Global Financial Crisis (GFC) 2007-2009



In this section, we were cautious in interpreting the results as we cannot depend exclusively on the 5-bank concentration ratio to estimate the degree of competition in the MENA region because there are limits to how far the indicator can reflect. As discussed in section 2.3.1.1.a, the 5-bank concentration ratio is a poor proxy for competition (Cetorelli, 1999; Claessens and Laeven, 2004). Schaeck and Cihák (2014) mention that relying on concentration indicators will yield misleading inferences. Thus, we estimate the level of bank competition in the MENA region by applying all the most frequently used indicators and not exclusivley depend on one indicator.

4.5.2 The Herfindahl-Hirschman Index (HHI)

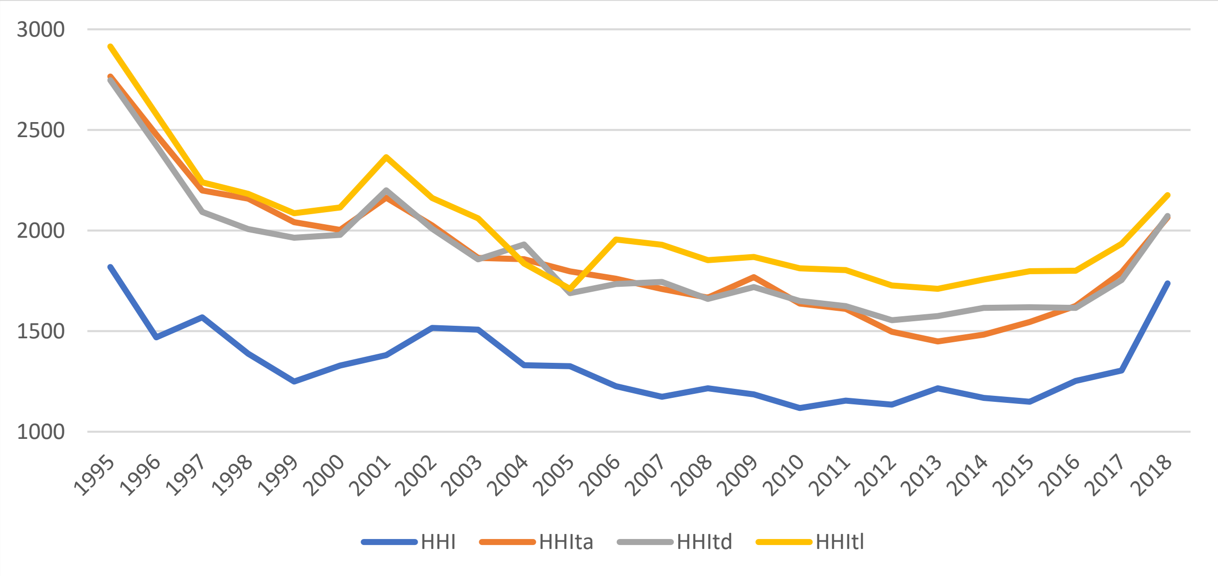
We turn next to discussing the results of the HHI, which is one of the structural approaches used to measure bank competition. We calculated the HHI by taking the sum of the squared market share of all banks operating in the market, using data on gross revenues, total assets, total deposits, and total loans. The results of the HHI are shown in Tables 4A.2, 4A.3, 4A.3, 4A.4 and 4A.5.

Regarding the results of HHI-Revenue, Bahrain, followed by Saudi Arabia, Tunisia, and the United Arab Emirates, was the most competitive marketplace, with an HHI of less than 1,500 over 1995-2018. The highly concentrated marketplaces were Algeria, Morocco, Jordan, Qatar, Oman, and Israel. Egypt and Turkey used to be highly concentrated during the mid-1990s. The average HHI-Revenue for all 16 countries ranged from 1118 (lowest) in 2010 to 1819 (highest) in 1995. Figure 4A.2 shows the breakdown of the indicator according to the WB classification. Lower middle-income countries were highly concentrated during the mid-1990s and then became more competitive with an HHI-Revenue of less than 1500. The non-oil-producing countries behaved similarly but at lower values. The upper-middle-income countries started to be highly concentrated only recently. High-income countries are competitive marketplaces with results of less than 1500 during the entire period. Last, the oil-producing countries were moderately concentrated as marketplaces.

It is clear that using balance sheet items (assets, deposits, loans) boosts the values of the HHI, and the data can, in some ways, be interpreted as consistent. Overall, Lebanon, Tunisia, Saudi Arabia, and the United Arab Emirates are considered competitive marketplaces due to their less concentrated industries. On average, the remaining countries are moderately concentrated, except for Iraq and Qatar, which are less competitive and have high HHI.

Figure 4.3 below presents the progression of the HHI over the examined sample. Overall, the HHI trend moves in the same direction regardless of the data used (gross revenue, total assets, total deposits, and total loans). The value is lower for the HHI-revenue. The MENA region moves from a highly concentrated marketplace to a much more moderately concentrated one, which is positive for initiating a competitive environment in the banking industry.

Figure 4.3: The Herfindahl-Hirschman Index (HHI) of the MENA region

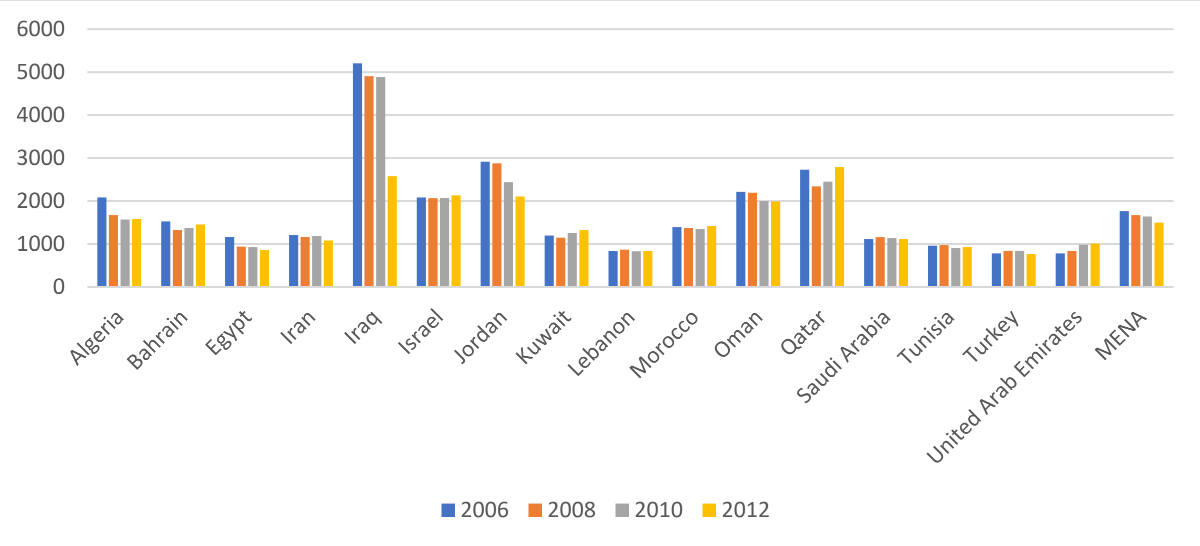


Note: Author's calculations. HHI-based on revenues, HHI-to-total assets, HHI-to-total deposits and HHI-to-total loans.

Another indicator confirms that there is no evidence that competition intensity has changed as a result of the GFC in the MENA region (see Figure 4.4). Any changes of competition in the Iraqi banking system are due to the improved political and security conditions in the same period, not to the GFC.

Khalaf (2018) investigates the performance of the Iraqi banking system over the period 2000-2010 and finds that the GFC did not influence it[105].

Figure 4.4: HHI-Total Assets before, during and after the Global Financial Crisis (GFC) 2007-2009



4.5.3 The Lerner Index

Moving on now to consider the non-structural approaches based on the NEIO model, which measures competition by focusing on the bank's behaviour in a specific market, The Lerner index (price-cost margin) measures the market power of a bank through computing the divergence between the bank's price and its marginal cost (Lerner, 1934), but measuring Lerner index is not straightforward because it is difficult to measure the prices of outputs and marginal costs, so we need first to estimate the marginal costs from the translog costs function (see section 4.4.3) following the methodology of Anginer et al. (2014), Beck et al. (2013) and Weill (2013). In terms of the bank's output price, we first use the total assets then the total loans as a robustness check. The Lerner index is computed for each bank, and we obtain the unweighted mean value as the aggregate measure. Furthermore, we recalculate the Lerner index by taking the median value following Weill (2013) approach. In perfect competition, the price equals marginal cost, and economic profits are zero. A wider spread between price and marginal cost indicates greater monopoly power (Leon, 2015). A positive Lerner index indicates that a bank's market power rises and price exceeds marginal costs (Shaffer and Spierdijk, 2015).

The results of the Lerner indices for each country and each year are displayed as follows: first, we show the Lerner index using total assets as an output measure and taking the mean values of each bank to generate the aggregate index in Table 4A.6. In the following figure, Figure 4A.4, we show first the

[105] See Khalaf (2018) for the reasons.

pattern of the overall average of the MENA's lower-middle income, upper-middle income, high income, oil-producing, and non-oil-producing countries and next to the results of the median values in Table 4A.7 following Figure 4A.5. After this, we present the Lerner index using the total loans as a proxy for bank output and obtaining the mean for the aggregate value of the index in Table 4A.8. Last, we show the median values in Table 4A.9.

As can be seen in Table 4A.6, the mean Lerner index for each country is variable. On average, none of them reaches zero (perfect competition) or one (monopoly) over the examined period. The highest Lerner index was Bahrain with 0.81, which had a different concentration ratio, meaning that, on average, the output prices of banks operating in the market exceeded marginal costs, thus boosting their market power and being a less competitive market. Lebanon, in contrast, has the lowest Lerner index, which shows it to be a more competitive marketplace. The Lerner indices for Jordan, Kuwait, Tunisia, Saudi Arabia, and Israel were stable over the period. The indices for Egypt and Morocco increased in recent years. In contrast, those for Iraq and Iran declined, which is considered a positive sign of a competitive marketplace. Figure 4A.4 illustrates the patterns of the Lerner indices for the entire region, LMI, UMI, HI, OP, and NOP. The Lerner indices increased and fluctuated from 2001 until 2011 in the HI and OP countries but remained constant in the UMI and NOP countries. The average Lerner index for all sixteen MENA countries ranged from 0.33 to 0.48 over the period.

We first checked these findings by computing the median, taking the mean Lerner index when the output price was the total loans, and then taking the median. Regarding the median Lerner index (Q=total assets) for each country and each year, we obtained similar conclusions, as can be seen from the data in Table 4A.7 and Figure 4A.5, showing the patterns over the period. Thus, our results remain robust. A huge change occurred when we used the total loans as a proxy for bank output. The results in Table 4A.8 show the Lerner indices in many countries with a number of negative values. Spierdijk and Zaouras (2016) state that getting a negative Lerner index requires extra information to assess the presence or absence of market power. Therefore, it was difficult to compute the results of the mean Lerner index using total loans. However, the median Lerner index (Q=total loans) shows reliable results to consider, and when we compare these with the results for the median Lerner index (Q=total assets), the pattern is almost similar for most of the countries in the sample, but the values are much higher. Thus, our results when using the median Lerner index (Q=total loans) may be robust.

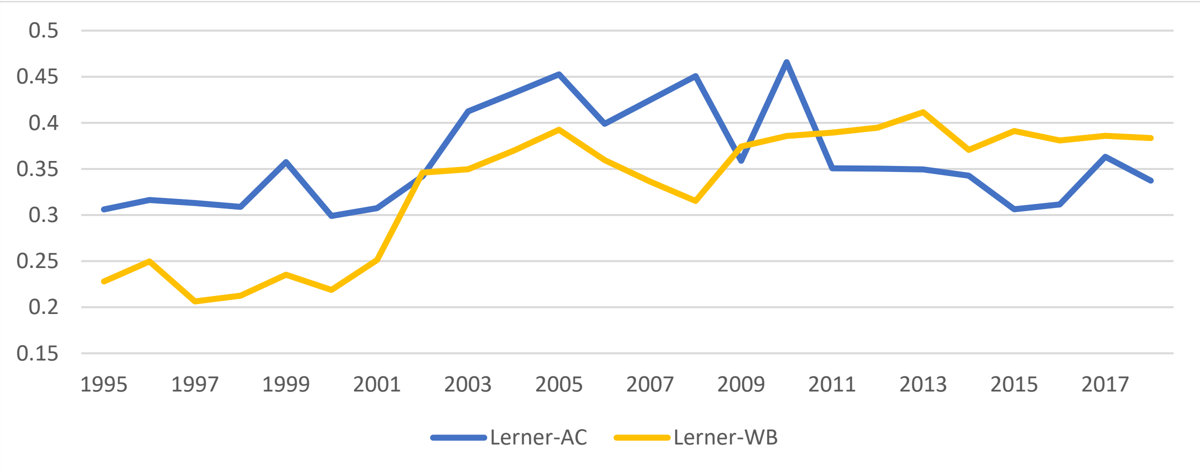
Anzoategui et al. (2010) use the Lerner index to investigate the level of bank competition in twelve[106] MENA countries for the period 1994-2008. They find that most countries have witnessed an appreciation in the Lerner index; GCC countries have a higher index than other non-GCC countries. Thus, they conclude that the banking sectors in the MENA region, particularly the GCC countries, are

[106] Algeria, Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and the the United Arab Emirates.

less competitive than other non-GCC countries. Similarly, Polemis (2015) concentrates on the MENA countries but examines eight[107] of them over the period 1997-2012. He finds that there is some variation across countries. The lowest Lerner index of 0.021 for the period in question is for the United Arab Emirates, and the highest of 0.634 is for Egypt. The total average of the MENA region is equal to 0.324. Because our sample consists of a broader period and more countries, we compute the Lerner Index for the same examined sample of Polemis (2015) and get an almost similar value of o.345 for the MENA region.

Figure 4.5 below presents the progression of the Lerner index over the examined sample, using both our calculations and World Bank data. The trend is almost similar over the period, except the period between 2005 and 2011, which in some ways differs. But by checking the value of the index, we can see that the change is not significant. On average, the MENA region fluctuated in a range of 0.33 to 0.48 according to our calculations and between 0.41 and 0.21 for WB data. It can be seen that after 2011 the MENA region became much more stable with moderate competition conditions.

Figure 4.5: Mean Lerner index – MENA



Note: the Lerner-AC is the Lerner index based on the author's calculations using the mean Lerner index (Q=total assets). The Lerner-WB is the Lerner index applied to the World Bank data.

We next check whether the Lerner index of the MENA region was affected by the financial crisis. According to the results in Figures 4.6 and 4.7, the MENA region Lerner index remained stable over the period 2006-2012, confirming that the intensity of bank competition did not change. Checking the results of the mean Lerner index across countries revealed that most of them were stable except for Bahrain, Kuwait, and the United Arab Emirates, which were higher in 2008 than before and after the GFC. Bahrain's median Lerner index was high as well (see Figure 4.6). Anzoategui et al. (2010) see that the average Lerner index for GCC countries is higher than Eastern Europe, Latin America, and Sub-Saharan Africa over 2002-2008. This confirms our result that three GCC countries had a high Lerner index in 2008.

[107] Algeria, Egypt, Israel, Jordan, Morocco, Oman, Saudi Arabia, and the United Arab Emirates.

Figure 4.6: Mean Lerner index before, during and after the Global Financial Crisis (GFC) 2007-2009

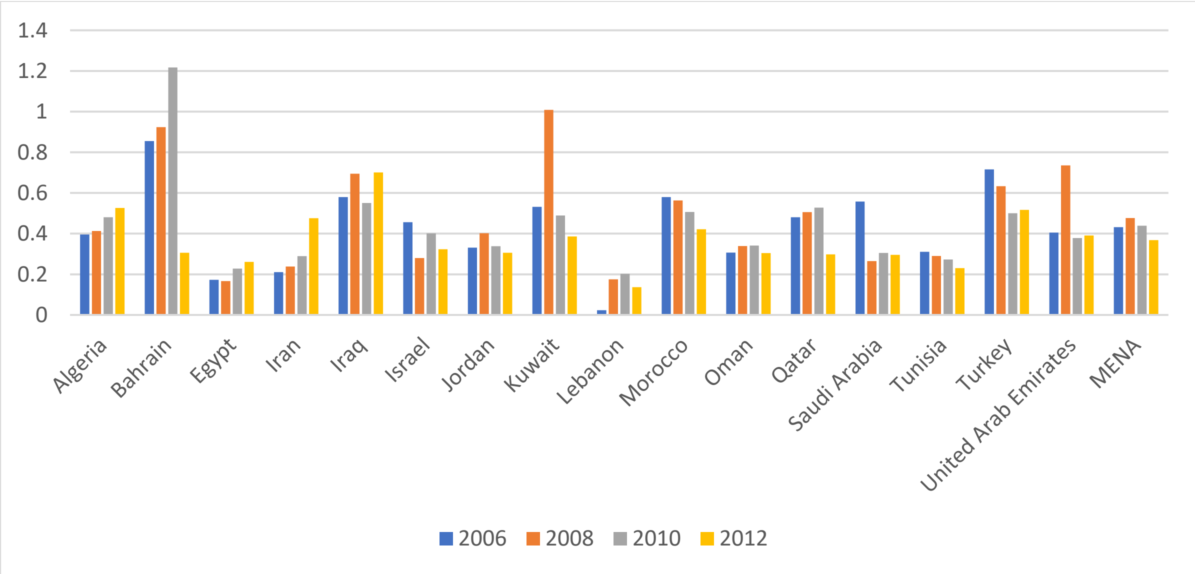
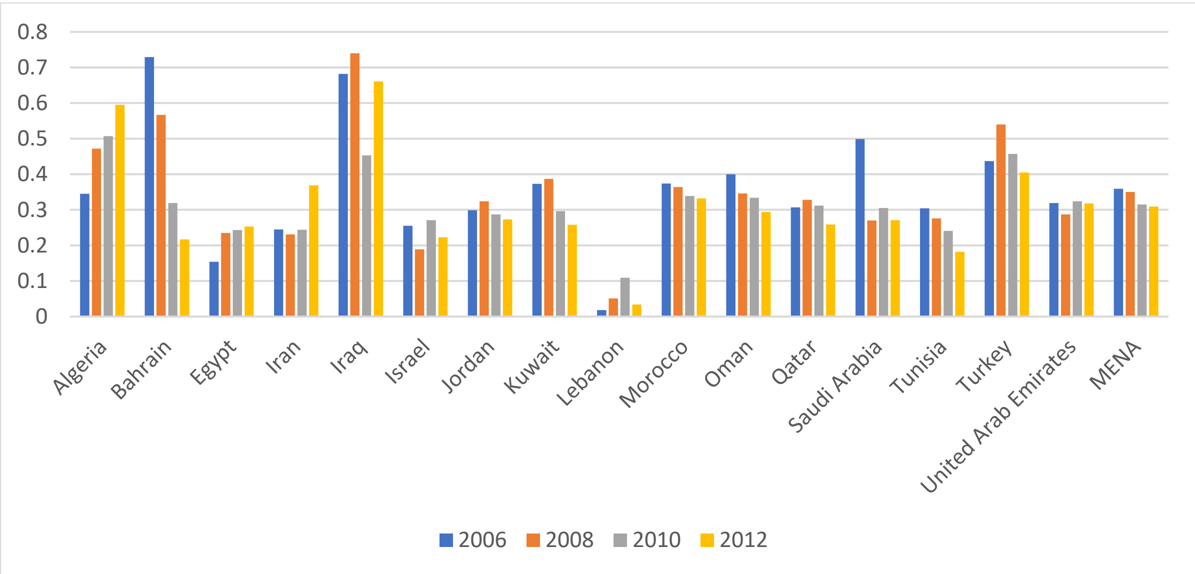


Figure 4.7: Median Lerner index before, during and after the Global Financial Crisis (GFC)2007-2009

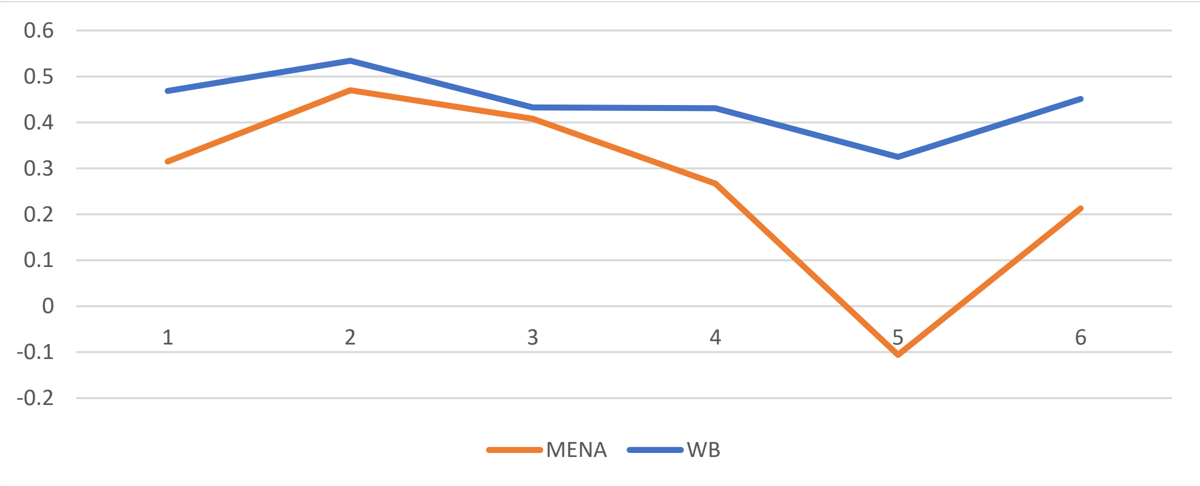


4.5.4 The Panzar-Rosse H-statistic

Turning now to the results obtained with the PR model, which are displayed in Table 4A.10, we estimated the PR H-statistic using the methodology of Shaffer (1983), Claessens and Laeven (2004), Casu and Girardone (2006), Turk-Ariss (2009), Ventouri (2018) and Davis and Karim (2019) to estimate the competitive conditions of the whole MENA region and its countries. The H-statistic was computed by taking the sum of the elasticities of revenues (the dependent variable) with respect to the input prices (funding, labour, and physical capital). Moreover, we added a number of bank-specific factors as control variables (see Equation 8). Hence, it captured the transmission of input costs to the bank's revenue. Bank-level fixed effects were included following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test.

Figure 4.8 below presents the progression of the H-Statistic over the examined sample, using both our calculations and World Bank data. The trend is almost similar over the period. However, the World Bank indicator does not include all our examined sample countries due to data availability in their database.

Figure 4.8: H-Statistic – MENA



Note: the H-Statistic-MENA is based on the author's calculations. The H-Statistic-WB is from the World Bank database.

In terms of interpretation, when the H-statistic equals zero, it indicates a monopoly market in which a reduction in input prices leads to reduced marginal costs but does not reduce revenues (Carbó et al., 2009). When the H-statistic equals 1, however, the sign of a perfect state of competition means that a reduction in input prices will lead to a decrease in marginal costs and revenues of the same value as a cost reduction, indicating sufficient evidence for the absence of market power (Polemis, 2015). An H-statistic between zero and 1 shows that the market is in a monopolistic condition. However, Bikker et al. (2012) argue that an H-statistic between zero and one cannot be reliably considered to correspond to monopolistic competition because they find evidence that similar values can be generated from short-run or long-run competition in the case of constant returns to scale.

Claessens and Laeven (2004) point out that the PR model is only valid if the market is in equilibrium. Thus, we also ran a panel regression to estimate the equilibrium test by replacing the gross revenue over total assets with the natural logarithm of returns on assets (ROA), which should not be related to input prices in equilibrium. Put differently, when the market is in equilibrium, the rise in input prices will have a minimal or no effect on banks' profitability (Ventouri, 2018). We estimated the H-statistic over six sub-periods, each period being four years long; then, we adopted a rolling estimation that consisted of 21 sub-periods (a 4-year window). The rolling estimation was applied using a 4-year window and repeatedly implemented for every one-year gap.

The H-statistics of individual countries are presented in Table 4A.10 (6 sub-periods) and 4A.12 (rolling estimation). The results of the equilibrium tests (see Equation 10 and 11) are displayed in Table 4A.10 (6 sub-periods), 4A.13 (rolling estimation). The MENA estimation results of Equations (10) and (11) are displayed in Tables 4.5 (6 sub-periods) and 4.6 (rolling estimation). The equilibrium test estimation results of the MENA region are in Table 4A.11 (6 sub-periods) and 4A.14 (rolling estimation). Figures 4A.6 (6 sub-periods) and 4A.7 (rolling estimation) show the pattern of H-statistics in the entire region, LMI, UMI, HI, OP, and NOP countries. In Appendix B (section 4.7.2), we present the ordinary least-squares (OLS) regression results of LMI[108], UMI[109], HI[110], OP[111], and NOP[112] countries separately.

It is apparent from Table 4A.10 that the H-statistics of the banks operating under conditions of monopolistic competition in most of the MENA region countries lie between zero and one. Our finding is consistent with several authors who have used the PR model to investigate the level of bank competition in the MENA region, such as Murjan and Ruza (2002), Al-Muharrami et al. (2006), Turk-Ariss (2009), Anzoategui et al. (2010), Polemis (2015), and Gonzάlez et al. (2017). Moreover, the estimations of equilibrium tests in the same table indicate that most of the countries over the examined period are in a state of equilibrium, meaning that the summation of the parameters is different from zero and verified by the F-test statistic that does not reject the null hypothesis (E=0). Moreover, we present the OLS regression results (equilibrium test) estimation for the entire region in Table 4A.11. Closer inspection of Table 4A.10 shows that the H-statistics varied across countries; on average, the most competitive country was Oman (0.78)[113], followed by Tunisia, Saudi Arabia, and Turkey. At the same time, the lowest H-statistics that indicate monopoly or pure monopoly conditions were for Iran (-0.03), followed by Algeria, Qatar, and Bahrain. The competitive conditions in Egypt, Lebanon, Morocco, and Qatar improved in recent years. Figure 4A.6 presents the breakdown of the region according to income and whether the country produces oil. The pattern of H-statistics for the LMI countries started at almost zero and was negative, and then after mid-2000, it improved as banking became more competitive. In contrast with the HI countries in recent years, where conditions moved more into monopoly, the UMI countries moved between 0.65 and 0.37, indicating marketplaces with monopolistic competition. Both the OP and the NOP countries were operating in monopolistic competition during the mid-1990s but declined to monopolies during the 2000s. The NOP countries, in particular, sharply reduced the H-statistic during the GFC but have recovered faster than the OP countries in recent years.

[108] See Tables 4B.1, 4B.2
[109] See Tablese 4B.3, 4B.4
[110] See Tables 4B.5, 4B.6
[111] See Tables 4B.7, 4B.8
[112] See Tables 4B.9, 4B.10
[113] Consistent with Polemis' result (2015), because Oman has the highest H-statistic with 0.971.

The results of estimating the OLS regression for the MENA region are shown in Table 4.6. The correlation between the dependent variable (gross revenue over total assets) and each of the independent variables in each period (input prices, total equity over total assets (TETA) varies – Net loans over total assets (NetLnTA), Total assets (TA)). The input prices reflect the funding costs (W_1); which indicates that the higher the interest expense paid by banks compared to their total deposits and money market funding, the greater the allocation of revenues. Moreover, the ratio of personnel expenses to total assets is a proxy of the input price of labour (W_2), and the ratio of other operating and administrative expenses to fixed assets is a proxy for input price of equipment (fixed capital) (W_3). Regarding the control variables, TETA shows the leverage differences in the risk preferences across banking institutions, NetLnTA captures the degree of credit risk, and TA is a proxy for bank size. As can be seen in Table 4.6, most of the variables are highly statistically significant over the examined period.

In the first period, all the variables were statistically significant; the average funding (W_1), NetLnTA, and TA were negatively correlated: the higher the ratio, the lower the income. In contrast, labour, physical capital and TETA are all positive. The physical capital ratio was positive and significant over the entire period for the MENA region; however, the sign and the level of significance of the other variables varied. The R^2 for the MENA region estimation and those of individual countries exceeded the value of 0.60, so the proportion of the variance for the dependent variable (Bank's output price) was significantly explained by the independent variables previously mentioned. Considering the overall periods in the MENA, we were able to reject both null hypotheses (H=0, monopoly) and (H=1, perfect competition) because on the basis of our results, the banking sectors in the MENA countries operated under monopolistic competition except for period 5, when we could not reject the null hypothesis (H=0, monopoly).

Table 4.6: PR model (H-statistic) results of the MENA region banking system using a 4-year window

Dependent variable:lnP	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Ln$\boldsymbol{W_1}$	-0.064***	-0.032	-0.039	0.04	-0.033	0.049**
	(0.006)	(0.455)	(0.149)	(0.309)	(0.139)	(0.045)
Ln$\boldsymbol{W_2}$	0.256***	0.347***	0.218***	0.023	-0.206***	-0.069
	(0.000)	(0.000)	(0.000)	(0.698)	(0.001)	(0.282)
Ln$\boldsymbol{W_3}$	0.122***	0.155***	0.228***	0.208***	0.133***	0.233***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnTETA	0.251***	0.152***	0.205***	0.079	0.125***	0.462***
	(0.000)	(0.001)	(0.000)	(0.188)	(0.009)	(0.000)
lnNetLnTA	-0.089**	-0.103*	0.061**	0.119***	0.131***	-0.011
	(0.028)	(0.054)	(0.017)	(0.008)	(0.000)	(0.758)
lnTA	-0.073**	-0.107**	0.017	0.010	-0.302***	-0.134**
	(0.029)	(0.016)	(0.485)	(0.842)	(0.000)	(0.024)
Constant	2.569***	3.632***	1.038**	0.231	5.556***	3.675***
	(0.000)	(0.000)	(0.034)	(0.831)	(0.000)	(0.002)
Number of obs.	1085	1069	1115	1160	1217	1246
$\boldsymbol{R^2}$	0.935	0.865	0.920	0.764	0.855	0.832
H-statistic	0.315	0.470	0.408	0.267	-0.106	0.213
H=0 (Monopoly)	Reject	Reject	Reject	Reject	Fail to Reject	Reject
H=1 (Perfect Competition)	Reject	Reject	Reject	Reject	Reject	Reject

Notes: Author's calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-values are in parentheses. MENA=Middle East and North Africa. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). P denotes the bank's output price which is the gross revenues over total assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. H-statistic: $\mathrm{H} = 1$ perfect competition, $0 < \mathrm{H} < 1$ monopolistic competition, $\mathrm{H} < 0$ monopoly.

To ensure the robustness of our results, we re-estimated the OLS regression in order to investigate the factors that explain the level of bank competition in MENA by using a rolling estimation for the individual countries and the entire region, with the LMI, UMI, HI, OP, and NOP countries over the period 1995-2018 following Ventouri (2018). Table 4A.12 presents the H-statistics of all sixteen countries, most of them operating under monopolistic competition. This finding is consistent with the classification for the earlier period and with a number of the studies previously mentioned. Each country's average, maximum and minimum values are almost similar to the values in the first approach (6 sub-periods), except for Morocco. There the minimum value differs a little but moves in the same direction as in the first approach. The equilibrium tests in Table 4A.13 show that the majority are different from zero. Hence, most of the countries over the examined period are in a state of equilibrium, meaning that the summation of the parameters is different from zero. Furthermore, it can be seen from the patterns in Figure 4A.7 that the H-statistics in the MENA, LMI, UMI, HI, OP, and NOP countries are moving in the same direction as in the first approach. Hence, our finding remains robust.

The estimation results are displayed in Table 4.7 below; most of the variables are statistically significant. The sign and the level of significance vary from period to period, so we are unable to generalise the correlation between the dependent variable (banks' output prices) and the independent variables. The R^2 for the MENA region estimation using the rolling estimation is high. Given the overall periods in the MENA, we can be able to reject both null hypotheses (H=0, monopoly, and H=1, perfect competition) because, according to our results, the banking sectors in MENA are still operating under monopolistic competition.

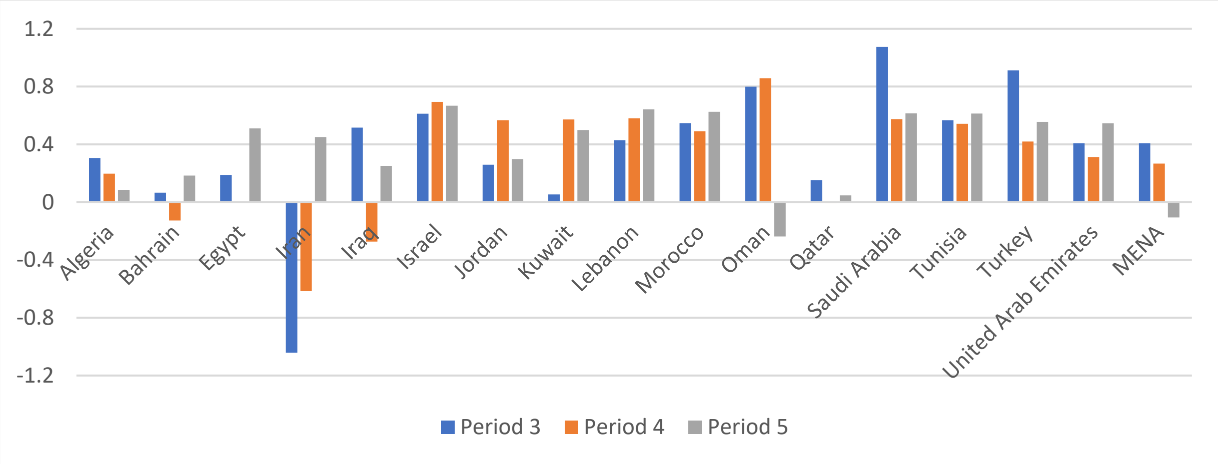
At the end of this section, we want to check whether using the H-statistic confirms our findings of the effect of GFC on the intensity of bank competition in the MENA region. As shown in Figure 4.9, the H-statistic of each country and the entire region fluctuate. Still, it is worth mentioning that we were unable to run the regression on an annual basis because of the low number of observations. For this reason, we divide our examined sample into sub-samples, so each period consists of 4 years. Hence, it is hard to demonstrate the effect of GFC on the level of bank competition in MENA using H-statistics. Although some countries like Lebanon, Morocco, Tunisia, United Arab Emirates, and Israel have H-statistics, which were almost stable, there is no evidence that the GFC influenced the level of their bank competition. This confirms the findings of the other indicators.

Table 4.7: PR model (H-statistic) regression results of the MENA countries banking system using rolling estimation 4-year window

Dependent variable:lnP	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**	**Period 7**	**Period 8**	**Period 9**	**Period 10**	**Period 11**	**Period 12**	**Period 13**	**Period 14**	**Period 15**	**Period 16**	**Period 17**	**Period 18**	**Period 19**	**Period 20**	**Period 21**
$\ln\mathbf{W_1}$	-0.064	-0.057	-0.053	-0.004	-0.032	-0.082	-0.126	-0.018	-0.039	-0.067	0.056	0.064	0.036	0.056	0.014	-0.003	-0.033	-0.030	-0.022	0.016	0.049
	(0.006)	(0.022)	(0.241)	(0.936)	(0.455)	(0.023)	(0.000)	(0.538)	(0.149)	(0.026)	(0.155)	(0.118)	(0.309)	(0.056)	(0.590)	(0.886)	(0.139)	(0.173)	(0.337)	(0.419)	(0.045)
$\ln\mathbf{W_2}$	0.256	0.278	0.205	0.275	0.347	0.427	0.371	0.483	0.218	0.338	0.277	0.038	0.023	0.079	0.015	0.007	-0.206	-0.109	-0.156	-0.043	-0.069
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.487)	(0.698)	(0.171)	(0.825)	(0.920)	(0.001)	(0.084)	(0.012)	(0.367)	(0.282)
$\ln\mathbf{W_3}$	0.122	0.139	0.177	0.133	0.155	0.186	0.264	0.238	0.228	0.138	0.130	0.167	0.208	0.262	0.311	0.255	0.133	0.158	0.200	0.234	0.233
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnTETA	0.251	0.347	0.330	0.169	0.152	0.083	0.145	0.176	0.205	0.128	0.156	0.138	0.079	0.190	0.137	0.169	0.125	0.096	0.234	0.301	0.462
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.046)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.012)	(0.188)	(0.001)	(0.007)	(0.002)	(0.009)	(0.031)	(0.000)	(0.000)	(0.000)
lnNetLnTA	-0.089	-0.128	-0.158	0.050	-0.103	-0.147	-0.142	-0.087	0.061	0.122	0.179	0.135	0.119	0.111	0.147	0.140	0.131	0.038	0.014	-0.059	-0.011
	(0.028)	(0.003)	(0.001)	(0.433)	(0.054)	(0.001)	(0.000)	(0.003)	(0.017)	(0.000)	(0.000)	(0.001)	(0.008)	(0.001)	(0.000)	(0.000)	(0.000)	(0.089)	(0.564)	(0.010)	(0.758)
lnTA	-0.073	-0.087	-0.149	-0.097	-0.107	0.001	0.082	0.122	0.017	-0.029	-0.096	-0.078	0.010	0.154	0.006	-0.085	-0.302	-0.217	-0.111	-0.152	-0.134
	(0.029)	(0.010)	(0.000)	(0.022)	(0.016)	(0.987)	(0.027)	(0.000)	(0.485)	(0.280)	(0.004)	(0.062)	(0.842)	(0.004)	(0.904)	(0.088)	(0.000)	(0.000)	(0.024)	(0.000)	(0.024)
Constant	2.569	3.193	4.235	3.314	3.632	1.517	-0.148	-0.097	1.038	2.052	3.714	2.299	0.231	-2.195	0.684	2.421	5.556	4.094	1.975	3.728	3.675
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.076)	(0.842)	(0.858)	(0.034)	(0.000)	(0.000)	(0.010)	(0.831)	(0.051)	(0.500)	(0.015)	(0.000)	(0.000)	(0.054)	(0.000)	(0.002)
Number of obs.	1085	1082	1074	1068	1069	1072	1086	1099	1115	1125	1137	1150	1160	1177	1190	1204	1217	1224	1237	1243	1246
$\mathbf{R^2}$	0.935	0.919	0.900	0.857	0.865	0.877	0.907	0.925	0.920	0.885	0.832	0.787	0.764	0.798	0.819	0.814	0.855	0.848	0.841	0.886	0.832
H-statistic	0.315	0.360	0.329	0.405	0.470	0.531	0.509	0.702	0.408	0.409	0.463	0.269	0.267	0.397	0.340	0.258	-0.106	0.018	0.022	0.207	0.213
H=0 (Monopoly)	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Fail to Reject	Reject	Reject	Reject	Reject
H=1 (Perfect Competition)	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Reject

Notes: Author's own calculations. P-value are in parentheses. MENA-Middle East and North Africa. Period 1(1995-1998), period 2 (1996-1999), period 3 (1997-2000), period 4 (1998-2001), period 5(1999-2002), period 6(2000-2003), period 7(2001-2004), period 8(2002-2005), period 9(2003-2006), period 10(2004-2007), period 11(2005-2008), period 12(2006-2009), period 13(2007-2010), period 14(2008-2011), period 15(2009-2012), period 16(2010-2013), period 17(2011-2014), period 18(2012-2015), period 19(2013-2016), period 20(2014-2017), period 21(2015-2018). P denotes the bank's output price which is the gross revenues over total assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. H-statistic: $\mathrm{H} = 1$ perfect competition, $0 < \mathrm{H} < 1$ monopolistic competition, $\mathrm{H} < 0$monopoly.

Figure 4.9: PR H-statistics before, during and after the Global Financial Crisis (GFC) 2007-2009



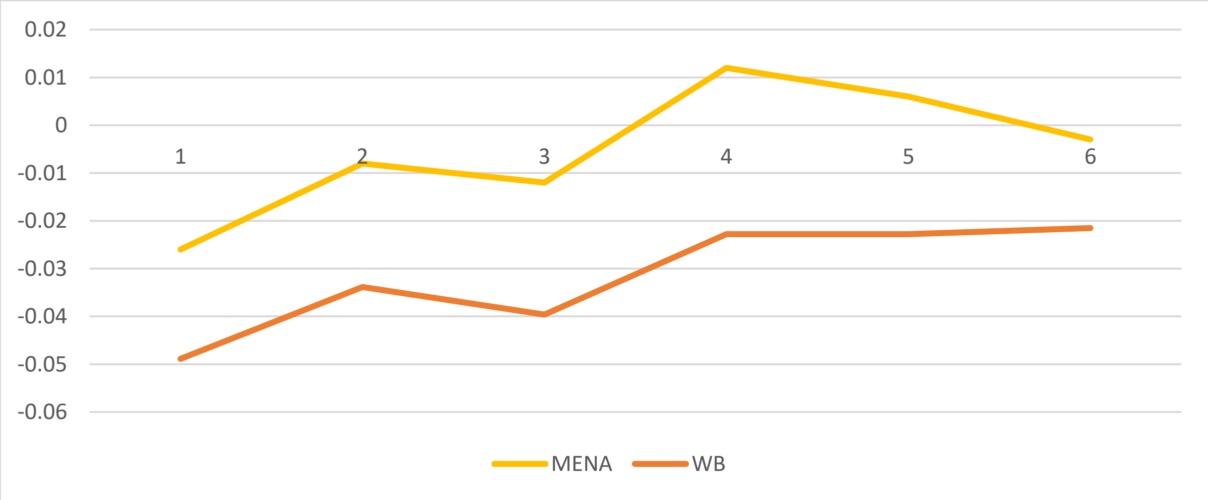
Note: Period 3 (2003-2006), Period 4 (2007-2012), and Period 5 (2011-2014)

4.5.5 The Boone Indicator

In this section, we analyse the evolution of bank competition measured with the most recent model, the Boone indicator for MENA banks between 1995 and 2018, following Schaeck and Cihák (2014). We ran Equation 12 for each country, the entire region, and the LMI, UMI, HI, OP, and NOP countries using the same timeframe as that for the H-statistic. First, we divided the examined sample into six sub-periods, then we reran the regressions with the rolling estimation of a 4-year window. The final estimation results of coefficients that reflect the Boone indicator are displayed in Table 4A.15 (6 sub-periods) and 3A.16 (rolling estimation). Figure 4A.8 shows the pattern of the Boone indicator of the MENA region and the LMI, UMI, HI, OP, and NOP countries based on OLS regression results. To date, there has been no detailed investigation of the level of bank competition in the MENA region that uses the Boone indicator except one by Albaity et al. (2019), who examine the correlation between competition and bank stability in the MENA region, in particular, the moderating effect of Islamic as opposed to conventional banks across eighteen countries over the period 2006-2015. These writers use the Lerner index and the Boone indicator as independent variables without demonstrating the change of competition across countries, and their main concern is to compare Islamic and conventional banks in the MENA. Hence, for the first time, our research explores a full dataset with the Boone indicator for sixteen countries, the MENA region, and the LMI, UMI, HI, OP, and NOP countries over the period 1995-2018.

Figure 4.10 below presents the progression of the Boone indicator over the examined sample, using both our calculations and World Bank data. The trend is almost similar over the period.

Figure 4.10: Boone indicator – MENA



Note: the Boone indicator-MENA is based on the author's calculations. The Boone indicator-WB is from the World Bank database.

Before discussing and comparing the Boone indicator across countries, the interpretation of the indicator should be explained. A negative value refers to a high degree of bank competition because of the more substantial reallocation effect (see section 4.4.5). From Table 4A.15, we can see that bank competition varies considerably across countries. On average, Turkey is the most competitive marketplace of β (-0.082) of them all over the entire examined period, followed by Egypt (-0.021) and Qatar (-0.014). Kuwait (0.15), Morocco (0.06), Lebanon (0.06), and Oman (0.04) are the least competitive banking systems. From comparing their performance over the periods in this table, it is apparent that the Iranian, Iraqi, and Qatari banking systems have become more competitive, like Israel, which has been stable during the examined period.

From Figure 4A.8, it can be seen that by far the lowest Boone indicator applies to the OP countries, which reflect more intense competition from the mid-1990s to the end of the period. In contrast, the NOP countries' banking sectors were more competitive during the first half (periods 1,2 and 3), but their Boone indicator increased after this. The HI and LMI countries fluctuated and significantly increased in the last period; hence, they moved closer to a state of monopoly. The UMI countries fluctuated between 0.03 and -0.06, taking up an intermediate position.

Turning to the estimation results of the MENA region, which are presented in Table 4.8, we see that the marginal costs extracted from the translog cost function are statistically significant in most of the examined periods, and negatively correlated with the profitability ratio (ROA) except in periods 4 and 5. So an increase of one percent in marginal costs reduces the ROA by 0.026 percent for the first period, 0.008 percent for the second, 0.012 for the third period, and 0.003 for the sixth period. The positive values in period 4 and 5 are interpreted by Leuvensteijin et al. (2011) as follows: the higher the marginal costs of the bank, the more profit it will generate, reflecting the presence of extreme levels of bank competition on quality (Tabak et al., 2012). Moreover, R^2 is high, which indicates that this model explains 90 percent or more of the behaviour of bank profitability.

Table 4.8: Boone indicator results of the MENA region banking system using a 4-year window

Dependent variable:lnROA	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**
lnmc	-0.026***	-0.008**	-0.012**	0.012**	0.006	-0.003
	(0.000)	(0.022)	(0.012)	(0.029)	(0.165)	(0.695)
Constant	0.020	0.065***	0.063***	0.125***	0.109***	0.078***
	(0.118)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	1076	1071	1117	1165	1223	1254
R^2	0.953	0.957	0.953	0.926	0.969	0.900
Boone Indicator	-0.026	-0.008	-0.012	0.012	0.006	-0.003

Notes: Author's calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-values are in parentheses. MENA-Middle East and North Africa. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). *ROA* denotes the bank's return on assets. mc-marginal costs. Bank-level fixed effects were derived following the methodology of Schaeck and Cihák (2014) and verified by the results of the Hausman test. Number of obs. is the number of observations.

The estimation results of the rolling estimation across countries, the MENA region, and the LMI, UMI, HI, OP, and NOP countries over the period 1995-2018 are reported in Table 4A.16. On average, our results are identical in trend and value. Furthermore, we report the OLS regression results of the MENA region in Table 4.9, marginal costs are negatively correlated with the bank's profitability and statistically significant in most periods, which confirms the previous results.

The Boone indicator is a recent measure of bank competition that also confirms that the degree of bank competition has not varied before, during, or post GFC in the MENA region (see Figure 4.11). It is worth noting that we combine four years in each period, so any change such as Tunisia, Lebanon, and Turkey showed has other causes than the GFC.

Figure 4.11: the Boone indicator before, during and after the Global Financial Crisis (GFC)2007-2009

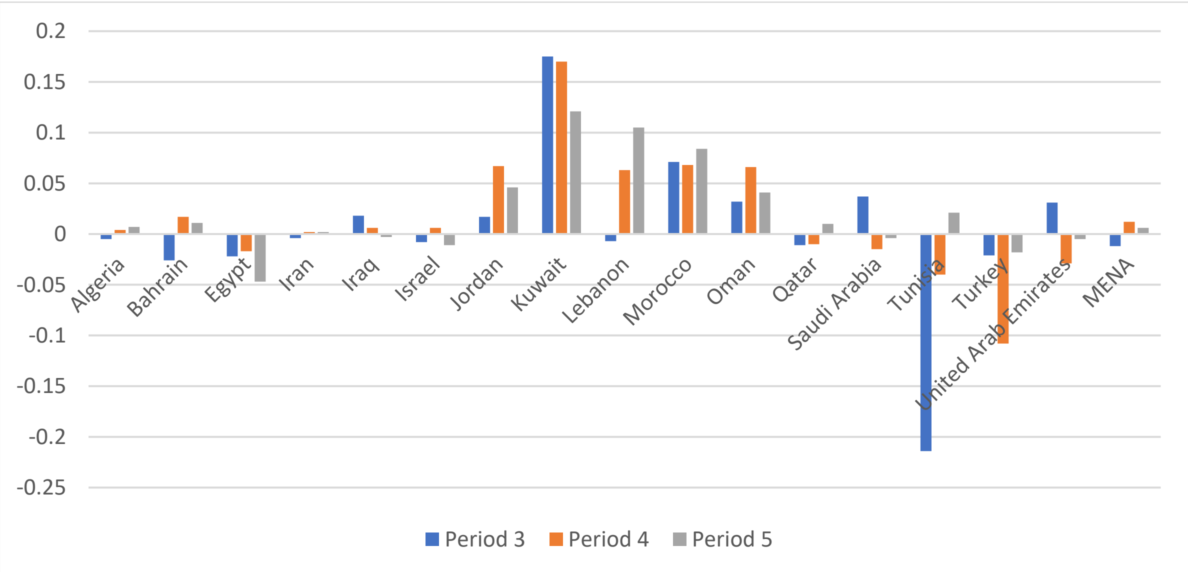


Table 4.9: Boone indicator (MENA), rolling estimation

Dependent variable:lnROA	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15	Period 16	Period 17	Period 18	Period 19	Period 20	Period 21
lnmc	-0.026	-0.028	-0.010	-0.003	-0.008	-0.020	-0.023	-0.013	-0.012	-0.008	-0.009	0.014	0.012	0.014	0.004	0.000	0.006	0.007	-0.001	0.015	-0.003
	(0.000)	(0.000)	(0.038)	(0.376)	(0.022)	(0.000)	(0.000)	(0.002)	(0.012)	(0.049)	(0.035)	(0.007)	(0.029)	(0.005)	(0.386)	(0.974)	(0.165)	(0.126)	(0.910)	(0.040)	(0.695)
Constant	0.020	0.016	0.063	0.081	0.065	0.037	0.029	0.059	0.063	0.075	0.071	0.132	0.125	0.130	0.103	0.090	0.109	0.112	0.087	0.132	0.078
	(0.118)	(0.274)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	1076	1075	1070	1069	1071	1074	1087	1100	1117	1128	1140	1154	1165	1183	1197	1210	1223	1230	1244	1251	1254
R^2	0.953	0.936	0.947	0.970	0.957	0.945	0.942	0.942	0.953	0.958	0.948	0.941	0.926	0.937	0.948	0.954	0.969	0.960	0.950	0.894	0.900
Boone Indicator	-0.026	-0.028	-0.010	-0.003	-0.008	-0.020	-0.023	-0.013	-0.012	-0.008	-0.009	0.014	0.012	0.014	0.004	0.000	0.006	0.007	-0.001	0.015	-0.003

Note: Author's own calculations. MENA-Middle East and North Africa. Period 1(1995-1998), period 2(1996-1999), period 3(1997-2000), period 4(1998-2001), period 5(1999-2002), period 6(2000-2003), period 7(2001-2004), period 8(2002-2005), period 9(2003-2006), period 10(2004-2007), period 11(2005-2008), period 12(2006-2009), period 13(2007-2010), period 14(2008-2011), period 15(2009-2012), period 16(2010-2013), period 17(2011-2014), period 18(2012-2015), period 19(2013-2016), period 20(2014-2017), period 21(2015-2018). Boone indicator: $-\infty$ perfect competition, ∴ the more negative, the higher the degree of banking competition. P-value are in parentheses. *ROA* denotes the bank's return on assets. mc-marginal costs. Bank-level fixed effects were derived following the methodology of Schaeck and Cihák (2014) and verified by the results of the Hausman test. Number of obs. is the number of observations.

4.5.6 Comparison across banking competition indicators

In this study, we have attempted to determine the intensity of bank competition in sixteen MENA countries by using both structural (5-bank concentration ratio and HHI) and non-structural approaches (Lerner index, H-statistic, and Boone indicator). Each indicator has its advantages and shortcomings presented in section 2.3, ruling out any consensus in the literature on the best measure for assessing competition (Leon, 2015). Similarly, Carbó et al. (2009) and Liu et al. (2013) argue that different bank competition indicators do not justify the same inferences about competition, a comment which applies to our case, in particular, across countries, in contrast to the overall estimation for the MENA region, which was consistent.

Table 4.10 shows the means of the major competition measures of the banking market across our 16 MENA countries as well as for the entire region in the period 1995-2018. It is apparent from the ranking in the table below that there are significant cross-country variations in the adopted competition measures. For the 5-bank assets concentration ratio, Lebanon, Turkey, and the United Arab Emirates are the most competitive marketplaces, consistent with the HHI results. In contrast, Israel, Algeria, and Bahrain are highly concentrated markets, which reflect less bank competition. Regarding the ranking of the Lerner index, it ranges from 10 percent in Lebanon and 21 percent in Iran to 68 percent in Turkey and 81 percent in Bahrain. In terms of the H-statistic, most of the countries are operating under monopolistic competition. It can be seen that the H-statistics range from 0.78 (Oman) to -0.03 (Iran). According to the Boone indicator, Tunisia, Turkey, and Egypt are among the most competitive countries in the MENA.

From these data, we can infer that the banking sector in the MENA region is not characterized by perfect competition or monopoly. We find sufficient evidence that the MENA region has been operating under a monopolistic competition regime. Although concentration ratios reflect more about highly concentrated marketplaces, the results of non-structural approaches (Lerner index, H-statistic, and Boone indicator) confirm that the MENA banking systems do not pursue anti-competitive behaviour. A number of countries in the MENA region have adopted financial regulatory reforms that positively affect the competitive conditions in the banking industries (Murjan and Ruza, 2002; Polemis, 2015; Rachdi et al., 2018).

Table 4.10: Ranks of banking competition measures for MENA countries over 1995-2018

Country	5-Bank Concentration	Rank	HHI	Rank	Lerner Index	Rank	H-statistic	Rank	Boone indicator	Rank
Algeria	87.7	15	2087	12	0.37	8	0.11	15	-0.002	7
Bahrain	86.7	14	2364	13	0.81	16	0.27	13	0.004	10
Egypt	71.7	4	1205	5	0.24	3	0.35	10	-0.021	3
Iran	76.1	9	1452	9	0.21	2	-0.03	16	-0.002	8
Iraq	74.0	6	5352	16	0.51	14	0.44	8	0.006	11
Israel	88.1	16	2038	11	0.33	7	0.55	5	-0.004	6
Jordan	80.9	12	3027	14	0.27	5	0.37	9	0.006	12
Kuwait	74.6	7	1240	7	0.44	12	0.30	11	0.150	16
Lebanon	58.1	1	803	1	0.10	1	0.54	6	0.055	14
Morocco	76.8	10	1388	8	0.42	10	0.30	12	0.058	15
Oman	77.4	11	1848	10	0.37	9	0.78	1	0.038	13
Qatar	82.1	13	3153	15	0.42	11	0.17	14	-0.014	4
Saudi Arabia	72.6	5	1220	6	0.31	6	0.62	2	0.003	9
Tunisia	75.9	8	962	4	0.26	4	0.62	3	-0.082	1
Turkey	59.9	2	899	2	0.68	15	0.60	4	-0.057	2
United Arab Emirates	61.9	3	936	3	0.45	13	0.47	7	-0.005	5
MENA	75.3[114]		1873[115]		0.39[116]		0.26[117]		-0.005[118]	

Note: Author's calculations. Mean values. The ranking process is based on the value that gives perfect competition (PC) for each indicator. Concentration ratio, HHI-total assets, Mean Lerner index (Q=total assets), and Boone indicator (6 sub-periods) are shown; the lowest value indicates PC, in contrast to the H-statistic (6 sub-periods), where the higher ones reflect PC.

4.5.7 Tests of Convergence

Following the results of the bank competition measures in the MENA region, the empirical results finally address the tests of convergence adopted to investigate convergence in bank competition. Ventouri (2018) investigates the intensity of banking competition of the Association of the South East Asian Nations and examines the change as a result of the endorsement of the ASEAN financial integration framework and the creation of a framework for banking integration. She finds that banking integration can boost competition and lead to a convergence of the competition level in each country. Moreover, Ventouri (2018) highlights that the increased competition may not influence banks in countries with higher competition intensity compared to those with lower competition intensity; in some cases, leading banks operating in less competitive markets could be the ones that dominate the regional market. Another unanticipated finding is that countries with many banks in operation may have lower

[114] Highly concentrated.
[115] Between 1,500 and 2,500 so it reflects a moderately concentrated marketplace.
[116] Neither perfect competition (LI=0) nor monopoly (LI=1).
[117] Between 0 and 1, thus indicating a monopolistic competition condition.
[118] Slightly negative but cannot be considered perfect competition.

competitive intensity and be highly concentrated compared to countries with fewer banks. This could occur when the largest banks in a country tend to dominate the domestic banking industry.

In terms of the MENA region, several integration agreements have been made in the last three decades. These agreements are as follows: Pan-Arab Free Trade Agreement (PAFTA) is an industrial and trade agreement that has operated since 1998. The member countries are Algeria, Egypt, Jordan, Bahrain, Djibouti, Tunisia, United Arab Emirates, Saudi Arabia, Sudan, Syria, Iraq, Oman, Palestine, Qatar, Kuwait, Lebanon, Libya, Morocco, and Yemen. It involves both resource-poor countries and resource-rich countries (Carrère et al., 2012). The Gulf Cooperation Council (GCC) is a political and economic union for all Arab States of the Persian Gulf except Iraq, so it consists of Saudi Arabia, Kuwait, Oman, the United Arab Emirates, Bahrain and Qatar. It was signed in1981, and its customs union was endorsed in 2003 and its common market by 2007. The countries in it have been working to initiate a common currency but have not yet launched one. The AGADIR agreement was signed in 2004 to establish a free trade zone between the Arab Mediterranean Nations – Tunisia, Jordan, Egypt, and Morocco. The Arab Maghreb Union (AMU) was established in 1989 between Algeria, Libya, Mauritania, Morocco, and Tunisia. This study aims to extend our analysis by investigating whether these banking integration agreements play a role in convergence in bank competition in the MENA region.

Weill (2013) was the first to demonstrate the reliability of using tests of convergence in bank competition. He measures the intensity of bank competition in all EU economies during the 2000s and checks the convergence in bank competition. According to (ibid, pg.104), "Beta-convergence implies that countries with a lower level of bank competition have faster growth rates than countries with a higher level of competition". "Sigma-convergence is observed if each country's level of bank competition is converging to the average level of the group of countries". We applied all the measures of bank competition previously analysed to examine both tests of convergence for the full sample of MENA countries over the period 1995-2018 and find whether convergence in bank competition had taken place in the entire region. We then compared the result of banking integration in the GCC the non-GCC countries, as shown in the following subsections.

4.5.7.a Tests of Convergence of the 5-Bank Asset Concentration

Simple statistics was used to compute the concentration ratio of the MENA region, which shows a high level of concentration of 75 percent (see section 4.5.1). Then we proceeded to the tests of convergence. The results obtained from the regression model are set out in Table 4.11, which shows evidence of β-convergence and σ-convergence in bank competition between the MENA countries for the 5-bank concentration ratio, since both results are negative and significant at the 1 percent level. The result of β-convergence means that each year the countries with more intense competition improve competition less than the countries where competition in the banking industries is lowest. In terms of σ-convergence, the dispersion of each country's level of bank competition is diminishing and converging to the average level of the entire region during the examined period.

Table 4.11: Tests of convergence of 5-Bank Asset Concentration (MENA)

	Coefficient	**t-value**
$\boldsymbol{\beta}$ Convergence		
Intercept	0.351***	3.675
$\mathbf{ln}(\boldsymbol{BnkCon_{i,t-1}})$	-0.082***	3.708
Adjusted $\boldsymbol{R^2}$	0.04	
N	368	
$\boldsymbol{\sigma}$ Convergence		
Intercept	0.000	0.000
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.087***	3.771
Adjusted $\boldsymbol{R^2}$	0.05	
N	368	

Note: the table shows the results of the β Convergence and σ Convergence using the 5-Bank Concentration ratio. For β Convergence, the estimated variable is $\ln(BnkCon_{i,t}) - \ln(BnkCon_{i,t-1})$ is the natural logarithm of the 5-bank concentration ratio of country i in year t and year t-1. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}, X_{i,t} = \ln BnkCon_{i,t} - MBnkCon_t, \ln(X_{i,t})$ is the natural logarithm of the 5-bank concentration ratio of country i in year t and $MBnkCon_t$ the mean of $\ln(BnkCon_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

4.5.7.b Tests of Convergence of the Herfindahl-Hirschman Index (HHI)

With regard to HHI, we apply the tests of convergence using the different variables in calculating the HHI for the MENA region, namely, gross revenues, total assets, total deposits, and total loans. The results of β-convergence and σ-convergence are negative and statistically significant at a 1 percent level for all the indicators presented in Table 4.12, so our finding is robust to the concentration ratio. β and σ convergence indicate that convergence in bank competition has been shown in the MENA countries. The values of β, σ coefficients and the adjusted R^2 for HHI-gross revenue are the highest of all, although it has the lowest HHI values.

Table 4.12: Tests of convergence of Herfindahl-Hirschman (HHI) index (MENA)

	$\mathbf{HHI_{GR}}$		$\mathbf{HHI_{TA}}$		$\mathbf{HHI_{TD}}$		$\mathbf{HHI_{TL}}$	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence								
Intercept	3.351***	10.951	1.936***	9.138	2.209***	9.859	2.184***	9.516
$\mathbf{ln}(\boldsymbol{HHI}_{\boldsymbol{i,t-1}})$	-0.491***	10.998	-0.265***	9.194	-0.302***	9.902	-0.295***	9.565
Adjusted $\boldsymbol{R^2}$	0.23		0.177		0.20		0.19	
N	368		368		368		368	
$\boldsymbol{\sigma}$ Convergence								
Intercept	0.000	0.000	-0.042***	4.835	-0.048***	5.545	-0.050***	5.505
$\mathbf{ln}(\boldsymbol{X}_{\boldsymbol{i,t-1}})$	-0.506***	11.088	-0.0271***	8.653	-0.313***	9.605	-0.308***	9.171
Adjusted $\boldsymbol{R^2}$	0.23		0.16		0.19		0.17	
N	368		368		368		368	

Note: the table shows the results of the β Convergence and σ Convergence using Herfindahl-Hirschman (HHI) index. We calculate the HHI index for gross revenues HHI_{TR}, total assets HHI_{TA}, total deposits HHI_{TD}, and total loans HHI_{TL}. For β Convergence, the estimated variable is $\ln(HHI_{i,t}) - \ln(HHI_{i,t-1})$ is the natural logarithm of the HHI index of country i in year t and year t-1. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln HHI_{i,t} - MHHI_t$, $\ln(X_{i,t})$ is the natural logarithm of the HHI index of country i in year t and $MHHI_t$ the mean of $\ln(HHI_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

4.5.7.c Tests of Convergence of the Lerner index

We calculate the Lerner index using mean values by country and by year, then re-estimate the index using median values to overcome the effect of outliers in mean values as a robustness check. We provide evidence of the presence of β convergence and σ convergence in bank competition between the MENA countries using both mean and median Lerner indices (see Table 4.13). Indeed, the coefficients are negative and statistically significant at the 1 percent level in both tests. Hence, the results of mean/median Lerner index are consistent with the previously mentioned indicators.

Table 4.13: Tests of convergence of Lerner index (MENA) Q=Total Assets

	Mean Lerner indices		**Median Lerner indices**	
	Coefficient	t-value	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence				
Intercept	0.126***	8.818	0.066***	6.568
$\mathbf{ln}(\boldsymbol{Lerner}_{\boldsymbol{i,t-1}})$	-0.397***	9.144	-0.249***	6.973
Adjusted $\boldsymbol{R^2}$	0.161		0.0971	
N	368		368	
$\boldsymbol{\sigma}$ Convergence				
Intercept	0.000	0.000	0.000	0.000
$\mathbf{ln}(\boldsymbol{X}_{\boldsymbol{i,t-1}})$	-0.414***	9.358	-0.280***	7.644
Adjusted $\boldsymbol{R^2}$	0.169		0.120	
N	368		368	

Note: the table shows the results of the β Convergence and σ Convergence using the Lerner index. For β Convergence, the estimated variable is $\ln(Lerner_{i,t}) - \ln(Lerner_{i,t-1})$ is the natural logarithm of the Lerner index of country i in year t and year t-1. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln Lerner_{i,t} - MLerner_t$, $\ln(X_{i,t})$ is the natural logarithm of the Lerner index of country i in year t and $MLerner_t$ the mean (median) of $\ln(Lerner_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively. The Lerner index is winsorised at 99%.

4.5.8.d Tests of Convergence of the Panzar-Rosse H-statistic

As can be seen in Table 4.14, even when using the PR H-statistic model, bank competition in the MENA countries has converged. The negative and significance level of the coefficients confirm the findings.

Table 4.14: Tests of convergence of Panzar-Rosse H-statistic (MENA)

	H-statistic	
	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence		
Intercept	0.058***	4.835
$\mathbf{ln}(\boldsymbol{H-statistic_{i,t-1}})$	-0.165***	5.356
Adjusted $\boldsymbol{R^2}$	0.05	
N	368	
$\boldsymbol{\sigma}$ Convergence		
Intercept	0.000	0.000
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.179***	5.792
Adjusted $\boldsymbol{R^2}$	0.06	
N	368	

Note: the table shows the results of the β Convergence and σ Convergence using the Panzar and Rosse (1982,1987) methodology of obtaining the H-statistic. We calculate the $H-statistic$ by dividing the sample (1995-2018) into subsamples of 4 years for each period. The H-statistic displays the responsiveness of bank revenues to input prices. For validity, we have already estimated the E-statistics that shows whether the market is in equilibrium. For β Convergence, the estimated variable $\ln(H-statistic_{i,t})-\ln(H-statistic_{i,t-1})$ is the natural logarithm of the H-statistic of country i in year t and year t-1. For σ Convergence, the estimated variable is $\Delta X_{i,t}=X_{i,t}-X_{i,t-1}$, $X_{i,t}=\ln H-statistic_{i,t}-MH-statistic_t$, $\ln(X_{i,t})$ is the natural logarithm of the $H-statistic$ of country i in year t and $MH-statistic_t$ the mean of $\ln(H-statistic_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

4.5.8.e Tests of Convergence of the Boone indicator

Regarding the most recent bank competition measure, the Boone indicator results in Table 4.15 again show convergence in bank competition in the MENA countries. We find evidence from the negative sign and the significance level that countries that displayed a lower level of bank competition level improved faster than countries with a higher degree of bank competition. Furthermore, each country's level of bank competition is converging quickly to the average level of the MENA.

Table 4.15: Tests of convergence of Boone indicator (MENA)

	Boone Indicator	
	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence		
Intercept	0.003***	2.721
$\mathbf{ln}\, \boldsymbol{Boone_{i,t-1}})$	-0.262***	7.852
Adjusted $\boldsymbol{R^2}$	0.13	
N	368	
$\boldsymbol{\sigma}$ Convergence		
Intercept	0.000	0.000
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.280***	8.150
Adjusted $\boldsymbol{R^2}$	0.14	
N	368	

Note: the table shows the results of the β Convergence and σ Convergence using the Boone indicator. We calculate the Boone indicator by dividing the sample (1995-2018) into subsamples of 4 years for each period. For β Convergence, the estimated variable $\ln(Boone_{i,t}) - \ln(Boone_{i,t-1})$ is the natural logarithm of the Boone indicator of country i in year t and year t-1. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln Boone_{i,t} - MBoone_t$, $\ln(X_{i,t})$ is the natural logarithm of the Boone indicator of country i in year t and $MBoone_t$ the mean of $\ln(Boone_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively. The Boone indicator is winsorised at 99%.

4.6 Conclusion

Determining the level of bank competition is important because it has several encouraging implications for the industry and the entire economy. It affects the access to finance, allocation of capital resources, the development of all sectors operating in the economy, economic growth and the degree of financial stability (Petersen and Rajan, 1995; Dell'Aricca and Marquez, 2004; Beck et al., 2004; Liu et al., 2013).

The measurement of banking competition is divided into two streams. First, the traditional Industrial Organization approach (IO) has been formulated on the basis of the conditions, market structure, conduct and performance and public policy (Neuberger, 1998) and assumes that there is a causal and stable relationship between them (World Bank Group, 2013). This approach is called the Structure-Conduct-Performance paradigm. It proposes that dominant banks are keen to adopt anticompetitive behaviour, and competition intensity is negatively related to the concentration results. The main indicators of this approach are the top k-largest banks and the Herfindahl-Hirschman index (HHI). The concentration ratio is computed from the market share of assets owned by the k-largest banks in a given market. The value of the concentration ratio should be between 0 and 100. The HHI is estimated as the sum of the squared market share of every bank operating in the market. This indicator takes all banks into account and assigns a high proportion to the most dominant banks. The HHI varies between 0 and 10,000. According to both indicators, if only one bank is operating in the market, the concentration ratio will be 100 percent, and the HHI will be 10,000, and the converse will hold good for a perfectly competitive market.

Over the past few decades, most research in banking competition has emphasised the use of the "new empirical industrial organisation" approach as a result of the limitations of the concentration measures as predictors of competition. The new indicators are the Lerner index, the Panzar-Rosse H-statistic, and the Boone indicator. These measures depend on the bank's pricing behaviour (market power). The Lerner index is computed as the difference between output prices (gross bank revenue to total assets) and marginal costs, which is calculated according to the translog cost function. The Lerner index varies between 0 and 1; a higher value means less competition. The Panzar-Rosse H-statistic presents the elasticity of bank revenues to input prices. It is estimated using the log of gross bank revenues on the log of input prices (prices of deposits, price of personnel, and price of equipment and fixed capital); taking the sum of the estimated coefficients captures the H-statistic. It varies between less than 0, and above 1. The value of 1 shows a perfectly competitive market because, in this stage, the increase of input prices raises the marginal costs and gross revenues by the same value. The last measure of the degree of competition is the Boone indicator, which depends on the relationship between efficiency (the marginal costs) and performance in terms of profits. It is estimated by taking the log of the return on assets that presents the profits and regressing to the log of marginal costs (the first derivative of the translog cost function); the coefficient of the regression captures the indicator. According to the Boone indicator, more efficient banks generate higher profits, and the more negative the indicator, the higher the competition intensity.

This study set out to investigate the level of bank competition in sixteen MENA countries (Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and the United Arab Emirates) by estimating the most frequently used measures in the literature, the 5-bank concentration ratio, HHI, Lerner index, PR H-statistic, and Boone indicator over the period 1995-2018. Then we extended our analysis to find whether convergence in bank competition had taken place in the MENA countries following Weill's (2013) approach. For the Lerner index, PR H-statistic and Boone indicator, we applied panel data econometric techniques. The results were displayed for each country, the entire region, and the World Bank classification that we used to generate results for lower middle income, upper middle income, high income, oil-producing, and non-oil-producing countries. To our best knowledge, no previous study has investigated bank competition intensity using both structural and non-structural approaches in addition to the tests of convergence in bank competition across the region.

Our study has provided sufficient evidence that there are variations in bank competition intensity across countries. In general, the banking sectors in the MENA region are highly concentrated according to the 5-bank concentration ratio, moderately concentrated marketplace following the classification of the HHI, neither perfectly competitive nor monopolistic according to the mean and median Lerner index results. The region has monopolistic competition, as the PR H-statistic calls it; the Boone indicator shows a slightly negative value, but this does not betoken a perfectly competitive condition. The results are consistent with Murjan and Ruza (2002), Al-Muharrami et al. (2006), Turk-Ariss (2009), Anzoategui et al. (2010), Polemis (2015), and González et al. (2017). It should be noted here that none of the previously mentioned studies used the same as our approach in terms of indicators, sample and period. Based on our results, we confirm the view of Polemis (2015) that the highly concentrated banking sectors of the MENA do not seem to lead to anti-competitive behaviour because most of the countries in MENA have implemented financial reforms and are committed to applying international standards and relaxing their barriers to entry. All these initiatives tend to greater intensity in banking competition.

We investigate whether the Global Financial Crisis (GFC) 2007-2009 influenced bank competition levels across countries and the entire region by dividing part of the examined period into before, during and after GFC. The results indicate that bank competition levels did not change but remained almost constant over the observed period.

Economic integration can play a pivotal role in promoting bank competition in the MENA region because competitive marketplaces could contribute to reducing the prices of financial services and ease access to finance for its households and businesses. This was why the study investigated the evolution and convergence in bank competition in the MENA region over the period 1995-2018 to give insights into the banking industry. To do so, we employed all the frequently used bank competition indicators: the 5-bank concentration ratio, HHI, Lerner index, PR H-statistic, and Boone indicator to investigate whether bank competition in the MENA countries had converged. We included an assessment of the speed and direction of the banking market's integration. We found statistically significant evidence of the convergence we had sought. These findings were confirmed by all the indicators and both tests of convergence (β-convergence and σ-convergence). Most of the indicators of convergence in bank competition levels found evidence of banking integration in the GCC countries more than the non-GCC countries. This finding was confirmed by the greater value of Beta (β) and sigma (σ) in absolute value[119].

The findings of this research provide insights for policymakers and regulators who wish to enhance competition policies in the banking industry since it will help keep markets open, support economic integration, and remove barriers to entry. Consequently, it will increase total welfare and maintain the stability of the banking system. Central banks or competition authorities set policies to control competition to encourage new banks to enter the market, treat large and small banks fairly, and enable banks to satisfy customers' needs. The failure of a bank should not affect the economy.

In sum, policymakers should maintain low prices, high quality, and innovation across banks to improve the resilience of the banking system in each country and the MENA region as a whole. However, policymakers should properly review their policies and consider the views of De Nicoló et al. (2012)

[119] See Casu and Girardone (2010).

and the International Monetary Fund (2013) that any relaxation of policies related to licensing, branching, and removing anti-competitive actions can also ease access to credit, which is associated with less monitoring. Thus, aggressive competition between banks may affect the efficiency of their operations. On this account, regulators should adequately assess the banking industry and apply competition policy cautiously to design suitable macroprudential policies that promote financial stability.

Polemis (2015) mentions that policymakers in the MENA region should set competition policy to support financial stability and initiate proper conditions for stable financial markets in both the short and the long term by keeping markets open, strengthening integration, and relaxing barriers to entry. Furthermore, the access to international organisations and more incentives given to foreign financial institutions can improve the competitive conditions in the markets because the presence of international banks enhances compliance policies (disclosure, transparency, governance), which overall leads to a sophisticated regulatory environment and financial stability.

On the micro-level, the adoption of new technologies, advanced risk management techniques, and professional human capital from foreign banks incentivises domestic banks to adopt the same strategies and put themselves on the same footing as their peers (Turk-Ariss, 2009), hence, raising the level of competition. Similarly, Murjan and Ruza (2002) suggest that the MENA region regulators should pursue further liberalisation of the financial systems to achieve a more competitive environment. In this regard, Turk-Ariss (2009) confirms that most MENA countries are committed to financial liberalisation. Thus, banks are required to comply with the international accounting standards and prudential guidelines of capitalization and governance. Hence, their high concentration gives insights to regulators when they set pro-competitive policies to develop contestable markets and boost stability. Schaeck and Cihák (2014) state that policymakers should take into consideration that the impact of competition on stability is conditional upon the banks' conditions and soundness.

Liu et al. (2013) want regulators and researchers to focus on determining the appropriate method of assessing the extent of bank competition and evaluating the changes in competition level over a sustained period. Furthermore, they argue that the more precise the indicator, the more accurate any estimations of the econometric model used because any policy based on such estimations may be inappropriate if the bank competition level is mistaken or inaccurate.

More broadly, this study has thrown up many questions in need of further investigation. For instance, study the effect of financial liberalisation on bank competition and the consequences of bank competition on financial stability in the MENA region using structural and non-structural measures.

4.7 Appendix

4.7.1 Appendix A

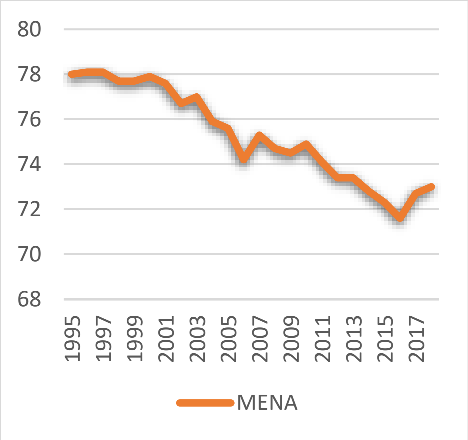
Table 4A.1: 5-Bank Asset Concentration ratio

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	94.1	93.7	93.1	93.1	93.4	92.4	91.5	90.2	90.5	90.7	89.7	90.1	89.9	89.3	85.0	84.6	84.7	83.5	81.7	82.0	81.5	80.9	80.3	79.7
Bahrain	94.6	94.4	94.0	93.9	94.4	94.2	93.3	92.5	92.7	86.5	84.4	82.9	82.0	77.7	76.0	80.8	80.6	79.8	85.9	83.9	84.7	81.3	85.5	85.5
Egypt	77.6	77.4	77.8	77.6	77.4	78.0	78.8	77.2	75.5	73.9	71.8	67.6	64.4	67.0	65.3	65.7	65.2	65.5	65.5	67.8	68.2	74.3	70.9	71.2
Iran	82.4	85.3	89.4	84.5	84.7	90.2	90.1	82.6	88.7	88.0	84.6	81.6	78.4	74.4	71.1	70.5	69.1	65.6	67.3	62.5	60.6	57.2	59.5	59.1
Iraq	82.2	82.2	82.2	82.1	82.3	82.0	82.6	81.4	80.7	79.2	84.4	72.6	71.6	73.9	75.9	79.7	69.7	65.7	64.2	67.8	63.0	55.9	55.3	60.3
Israel	88.5	87.3	88.9	83.4	83.4	83.5	83.4	83.4	83.9	85.7	86.3	85.2	85.0	84.7	92.5	92.2	92.3	92.4	92.3	91.9	92.1	92.1	92.2	92.1
Jordan	86.7	87.2	86.7	86.8	86.2	85.5	84.8	84.6	84.8	84.3	81.3	80.4	81.6	82.2	81.9	79.8	79.4	78.0	76.3	74.4	73.5	72.5	72.1	71.7
Kuwait	74.5	74.6	74.1	73.5	72.9	72.8	73.9	72.9	71.7	68.6	70.8	73.3	74.2	74.0	74.4	74.4	74.7	77.1	77.1	77.4	76.1	76.4	80.6	80.3
Lebanon	57.3	58.6	60.5	57.7	55.3	54.4	56.1	55.0	56.4	59.2	60.3	60.9	64.0	63.0	61.9	60.0	56.8	56.7	57.0	57.7	56.3	55.9	56.0	56.3
Morocco	72.0	71.7	71.5	71.1	72.4	71.6	72.2	73.2	74.6	77.0	76.2	76.0	75.1	76.5	77.5	77.1	77.8	78.5	81.5	81.7	82.7	83.2	86.8	86.1
Oman	69.3	69.7	67.1	74.4	78.1	77.8	80.2	79.6	78.2	78.0	78.6	79.9	83.3	82.4	80.4	78.9	80.0	79.2	78.5	77.0	77.6	76.7	76.8	76.9
Qatar	79.0	77.0	76.7	75.7	76.6	77.7	79.6	80.3	80.9	81.1	81.4	85.1	87.7	85.2	84.6	82.6	82.8	82.9	83.6	83.1	84.8	86.3	87.5	88.5
Saudi Arabia	69.7	69.8	67.5	71.3	72.5	77.6	76.3	75.1	75.3	68.5	68.0	67.9	73.5	73.6	75.8	75.9	76.0	74.8	73.8	72.4	72.2	72.2	71.6	71.7
Tunisia	76.1	76.1	75.8	74.9	75.6	78.0	79.2	80.2	79.7	79.3	78.7	77.7	78.5	76.9	76.8	74.8	74.9	74.4	73.5	71.3	71.3	71.4	73.4	73.1
Turkey	78.0	76.9	76.4	75.2	72.5	65.6	58.0	58.7	60.2	57.4	54.2	54.3	60.3	57.2	58.2	59.0	56.0	53.7	52.1	51.3	51.1	50.7	50.3	50.9
United Arab Emirates	66.6	67.6	67.4	67.8	65.2	64.8	61.0	60.8	58.5	56.5	59.3	52.4	55.6	56.9	55.3	62.9	65.4	65.8	63.3	62.9	61.9	58.6	64.6	64.9
MENA	78.0	78.1	78.1	77.7	77.7	77.9	77.6	76.7	77.0	75.9	75.6	74.2	75.3	74.7	74.5	74.9	74.1	73.4	73.4	72.8	72.3	71.6	72.7	73.0
LMI	77.3	77.1	77.2	76.9	77.4	77.2	77.9	77.3	76.9	76.7	77.5	72.0	70.3	72.5	72.9	74.2	70.9	69.9	70.4	72.4	71.3	71.1	71.0	72.6
UMI	79.1	79.6	80.3	78.7	78.0	77.7	76.6	75.2	76.7	76.5	74.8	74.2	75.4	73.8	72.5	71.5	70.1	68.7	68.0	66.5	65.7	64.8	65.3	65.1
HI	67.8	67.5	67.0	67.5	67.9	68.6	68.5	68.1	67.7	65.6	66.1	65.8	67.7	66.8	67.4	68.5	69.0	69.0	69.3	68.6	68.7	67.9	69.9	70.0
OP	77.2	77.5	77.2	77.8	78.2	79.4	79.4	77.9	78.1	76.3	77.1	75.4	76.8	76.2	75.3	76.2	75.3	74.3	73.7	73.1	72.2	70.5	72.0	72.7
NOP	78.8	78.7	79.0	77.6	77.1	76.4	75.7	75.6	76.0	75.4	74.1	73.1	73.9	73.1	73.8	73.7	72.9	72.4	73.0	72.5	72.5	72.7	73.4	73.4

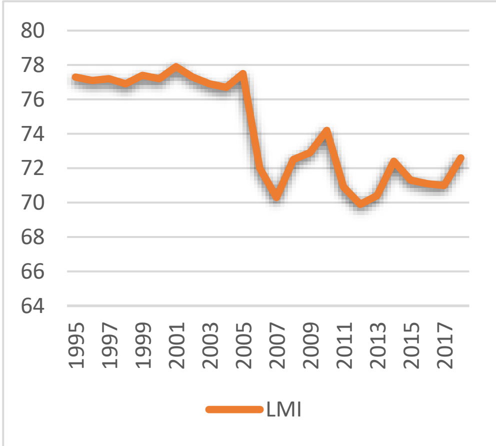
Note: Author's own calculations. Values are in percentage. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). 5-Bank asset concentration ratio: ↑ concentration ↓ banking competition, 0 → perfect competition, 100 → 5 banks make up the entire industry.

Figure 4A.1: Changes in banking competition using 5-Bank Asset Concentration ratio

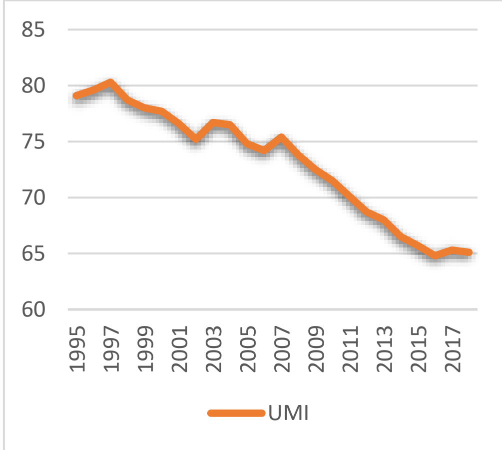
(a) MENA region



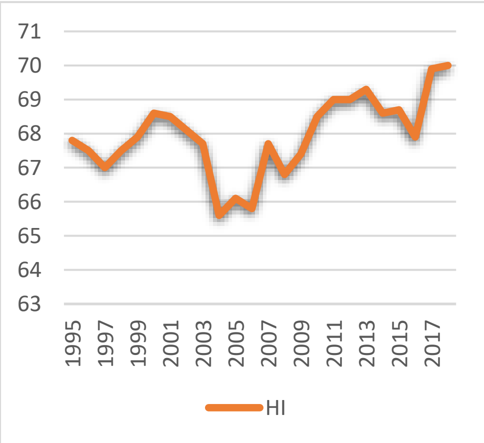
(b) Lower Middle Income countries



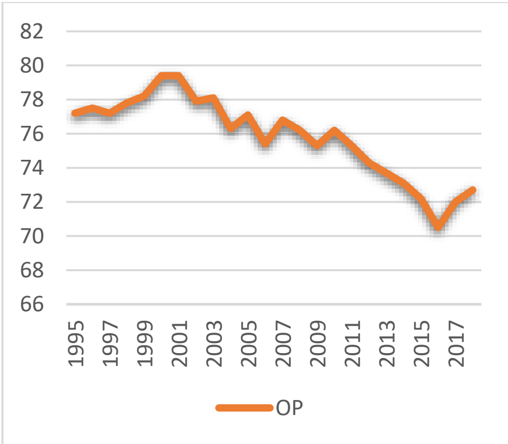
(c) Upper Middle Income countries



(d) High Income countries



(e) Oil-producing countries



(f) Non-oil-producing countries

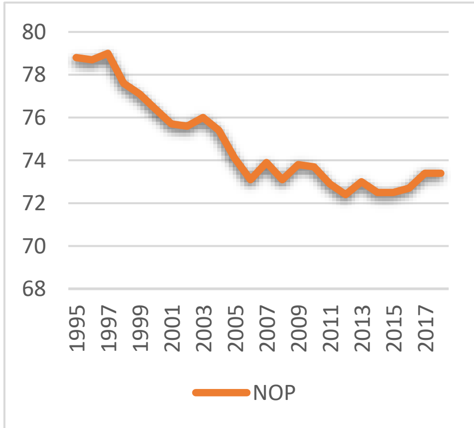


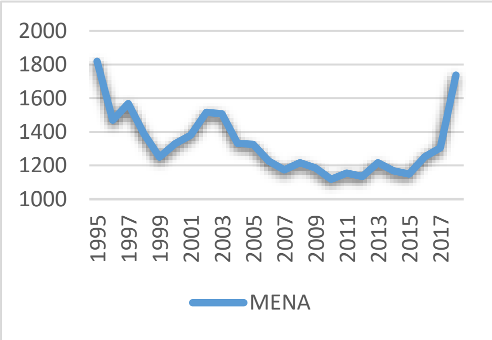
Table 4A.2: The Herfindahl_Hirschman index (HHI)Revenue

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	2306	2232	4171	3721	2614	2389	2354	2086	3176	1836	3161	2940	1623	1612	1798	1482	1383	1358	1480	1609	1697	1519	1532	3018
Bahrain	90	91	86	83	53	46	51	39	44	39	82	42	62	56	35	66	23	15	30	33	21	19	23	24
Egypt	5956	974	912	818	811	868	662	716	721	836	897	830	781	736	700	1025	760	826	871	827	858	1451	988	897
Iran	2714	2742	3031	952	960	885	807	630	972	969	1165	715	1404	1380	1541	1361	1410	1346	1484	732	649	769	1459	6685
Iraq	601	643	562	729	416	1133	58	3641	1170	909	61	52	64	53	83	80	131	185	201	132	107	145	125	101
Israel	1978	2027	1914	1956	1880	2017	2918	2793	3086	1922	1913	2195	2139	1848	1019	787	965	1015	2153	2100	2028	1909	1820	1801
Jordan	3188	3256	3181	3062	2925	2950	2852	2743	2708	2536	2162	2374	2395	2378	2328	2134	1980	1897	1919	1856	1850	1827	1857	1950
Kuwait	709	592	551	597	577	662	907	1046	927	647	626	790	1000	1479	1270	1075	1372	1340	1206	1220	1142	1309	1284	1335
Lebanon	443	482	561	554	580	614	701	718	671	792	854	1010	1036	989	911	885	1019	993	953	1020	988	1272	983	1059
Morocco	1641	1624	1379	1361	1241	1581	1551	1567	1608	2205	2244	1433	1376	1496	1442	1441	1762	1711	1498	1532	1593	1601	2010	2080
Oman	1158	1176	1189	1376	1628	1958	1747	1887	1861	1919	1818	2074	2022	2267	2420	2138	2138	2018	1954	1986	1927	1850	2018	1924
Qatar	3667	3253	3224	2950	2981	2997	2648	2658	2501	2405	2184	1997	1629	1691	1739	1867	2042	2189	2472	2467	2411	3250	3131	3274
Saudi Arabia	967	988	1071	987	1070	969	1038	1101	1079	1204	1035	811	942	903	899	902	870	848	868	860	868	873	822	811
Tunisia	766	769	708	684	662	707	700	727	813	796	778	822	810	788	768	727	726	736	743	708	659	693	712	722
Turkey	2073	1770	1673	1488	713	624	2263	1090	1973	1528	1463	868	830	1071	1071	1093	1059	852	845	817	813	822	988	916
United Arab Emirates	839	883	879	887	886	862	829	811	810	746	772	668	663	701	940	820	835	830	786	789	770	728	1121	1202
MENA	1819	1469	1568	1388	1250	1329	1380	1516	1507	1331	1326	1226	1174	1216	1185	1118	1155	1135	1216	1168	1149	1252	1305	1737
LMI	2733	1080	951	969	823	1194	757	1975	1166	1316	1067	772	740	762	742	849	884	907	857	830	853	1065	1041	1026
UMI	1915	1875	2221	1743	1409	1361	1613	1332	1719	1410	1597	1455	1350	1370	1403	1280	1263	1197	1237	1124	1110	1150	1255	2392
HI	1176	1126	1114	1105	1134	1189	1267	1292	1288	1110	1054	1072	1057	1118	1040	957	1031	1032	1183	1182	1146	1242	1277	1296
OP	1620	1564	1835	1525	1391	1482	1299	1733	1562	1329	1353	1256	1168	1261	1336	1216	1273	1264	1306	1225	1197	1305	1436	2294
NOP	2017	1374	1302	1251	1108	1176	1462	1299	1453	1332	1299	1197	1179	1170	1034	1020	1037	1006	1126	1112	1101	1199	1173	1181

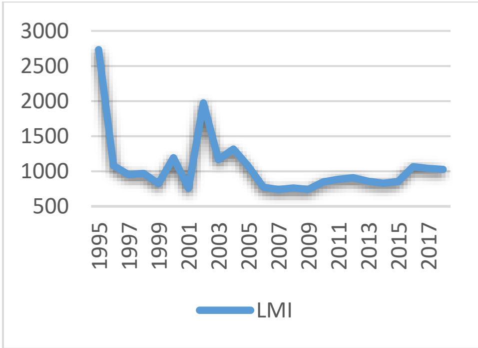
Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Herfindahl-Hirschman index (HHI): Less than 1,500 → competitive marketplace, 1,500-2,500 → moderately concentrated marketplace, 2,500 or greater → Highly concentrated marketplace.

Figure 4A.2: Changes in banking competition using HHI-Revenue

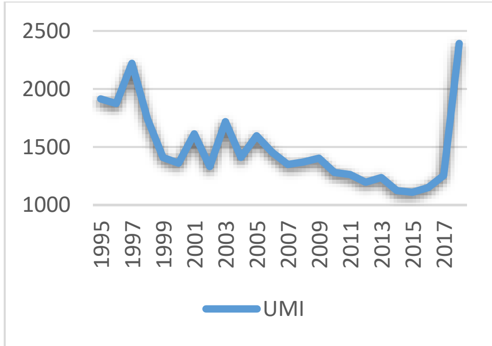
(a) MENA region



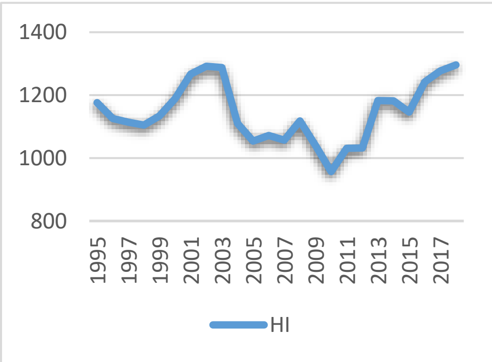
(b) Lower Middle Income countries



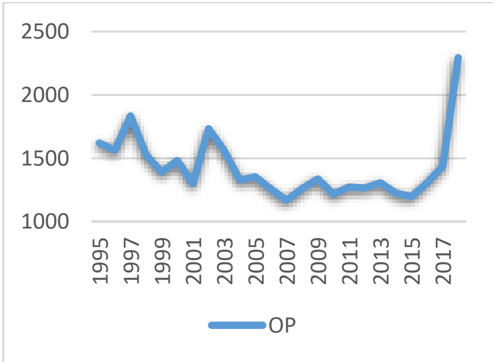
(c) Upper Middle Income countries



(d) High Income countries



(e) Oil-producing countries



(f) Non-oil-producing countries

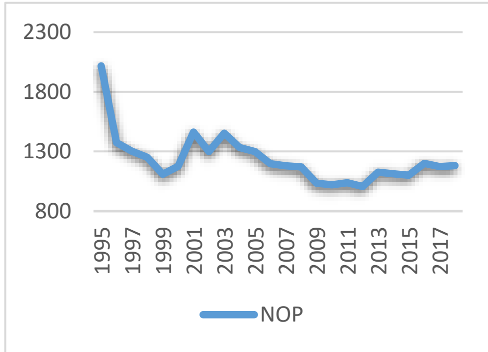


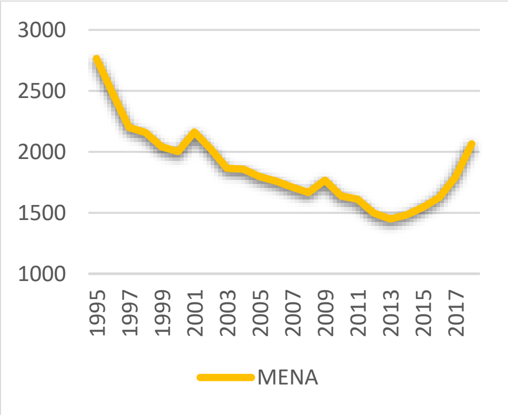
Table 4A.3: HHI-total assets

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	2143	2262	2968	3240	2782	2529	2329	2249	2347	2039	2138	2080	1703	1670	1733	1566	1550	1583	1823	1989	1731	1451	1435	2748
Bahrain	4201	4252	4321	4117	3654	3747	3875	3822	3214	1699	1568	1522	1525	1326	1304	1375	1411	1452	1485	1446	1449	1384	1309	1285
Egypt	5053	1146	998	940	987	1111	1086	1016	1069	1067	1149	1164	973	940	911	924	846	853	852	826	890	1559	1247	1321
Iran	2547	2557	2524	1718	1646	1535	1525	1389	1484	1489	1342	1209	1155	1164	1080	1185	1228	1078	1127	912	860	938	1284	1862
Iraq	10000	10000	5183	5541	5105	4904	7458	5218	3368	5040	5462	5203	4928	4906	6834	4888	4039	2577	1374	2346	3890	4696	6648	8847
Israel	2071	2179	2131	1917	1871	1871	1841	1980	2062	2193	2169	2079	2058	2064	2059	2075	2163	2130	2122	2108	2065	1932	1890	1875
Jordan	4014	4139	4256	4145	4156	4084	3789	3776	3837	3635	3055	2915	3114	2872	2609	2439	2292	2103	2098	2088	1961	1803	1745	1711
Kuwait	1484	1422	1287	1181	1166	1162	1112	1132	1122	1084	1142	1195	1165	1147	1209	1260	1273	1318	1284	1264	1305	1272	1379	1385
Lebanon	602	649	661	633	614	647	787	677	672	751	766	833	900	867	805	827	827	835	975	1046	1036	1007	955	909
Morocco	1399	1374	1233	1208	1223	1195	1199	1286	1299	1501	1362	1390	1349	1372	1364	1348	1433	1422	1448	1453	1460	1476	1745	1775
Oman	1153	1207	1152	1408	1598	1795	1920	2184	2007	2056	2020	2213	2230	2193	2129	1997	2102	1987	1975	1881	1780	1755	1806	1808
Qatar	4043	3728	3925	3956	3598	3276	3612	3753	3589	3418	2762	2727	2446	2337	2325	2448	2697	2793	2887	2728	2675	3170	3282	3489
Saudi Arabia	1375	1393	1495	1484	1360	1347	1329	1298	1226	1275	1184	1110	1140	1154	1163	1135	1127	1117	1098	1088	1090	1090	1093	1103
Tunisia	1200	1039	960	962	963	977	994	1019	994	982	971	961	987	967	927	901	915	928	909	888	876	883	918	961
Turkey	1871	1334	1112	1151	1042	984	884	739	705	684	821	779	768	843	821	843	846	765	747	740	734	742	801	811
United Arab Emirates	1088	950	979	934	894	892	868	866	828	810	835	780	915	841	1015	982	1025	1009	974	922	922	845	1136	1150
MENA	2765	2477	2199	2158	2041	2003	2163	2025	1864	1858	1797	1760	1710	1666	1768	1637	1611	1497	1449	1483	1545	1625	1792	2065
LMI	5484	4173	2471	2563	2438	2403	3247	2507	1912	2536	2658	2586	2417	2406	3036	2387	2106	1618	1225	1542	2080	2577	3213	3981
UMI	2063	1997	2080	1975	1867	1792	1718	1641	1673	1597	1516	1463	1438	1397	1329	1294	1276	1216	1280	1277	1200	1137	1190	1500
HI	1927	1891	1911	1875	1768	1761	1819	1879	1756	1567	1460	1453	1435	1383	1400	1409	1475	1476	1478	1430	1411	1431	1487	1512
OP	2979	2940	2439	2433	2269	2180	2519	2261	1996	2151	2111	2065	1960	1927	2186	1933	1880	1683	1568	1641	1782	1902	2258	2799
NOP	2551	2014	1959	1884	1814	1827	1807	1789	1732	1564	1483	1455	1459	1406	1350	1342	1342	1311	1330	1324	1309	1348	1326	1331

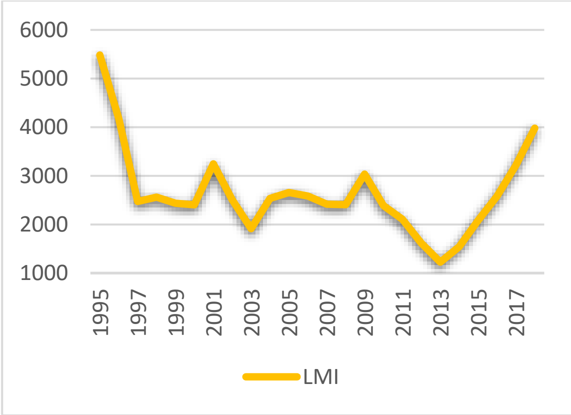
Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Herfindahl-Hirschman index (HHI): Less than 1,500 → competitive marketplace, 1,500-2,500 → moderately concentrated marketplace, 2,500 or greater → Highly concentrated marketplace.

Figure 4A.3: Changes in banking competition using HHI-Total Assets

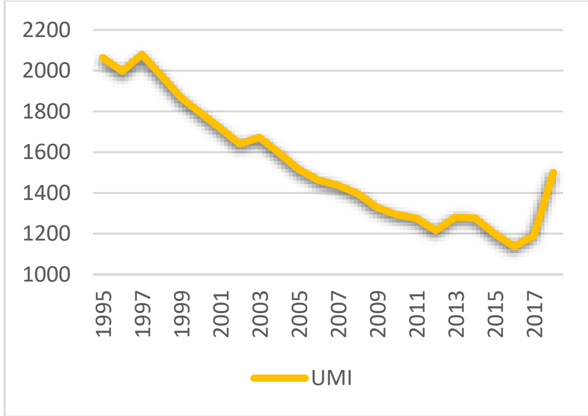
(a) MENA region



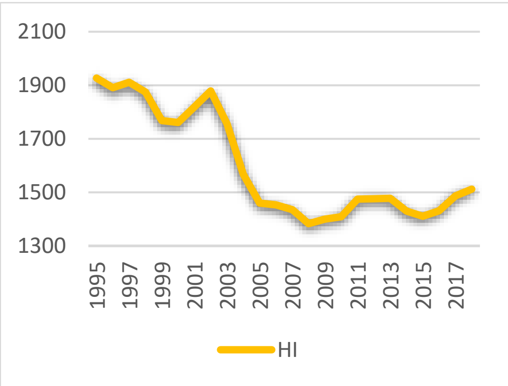
(b) Lower Middle Income countries



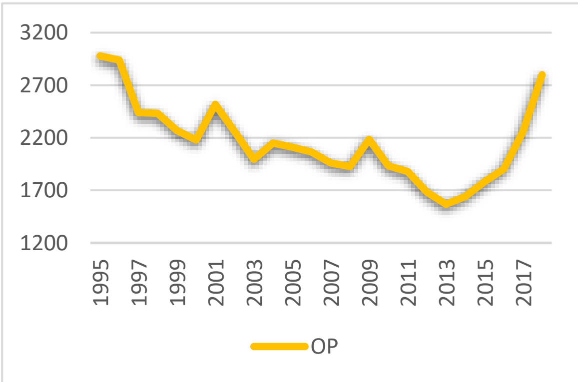
(c) Upper Middle Income countries



(d) High Income countries



(e) Oil-producing countries



(f) Non-oil-producing countries

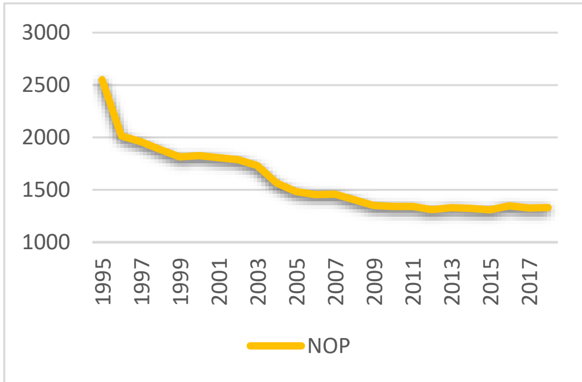


Table 4A.4: HHI-Total deposits

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	1869	1891	2380	2458	2012	1948	1943	2011	2307	2024	2515	2799	2511	2326	1913	1896	1863	1696	1793	1824	1801	1534	1492	2831
Bahrain	3728	3781	3685	3601	2876	3062	2988	3044	2588	1735	1602	1476	1389	1094	1144	1236	1208	1299	1329	1267	1277	1243	1213	1232
Egypt	5605	1186	1098	1105	1079	1116	1123	1104	1128	1084	1169	1129	947	1034	1027	1089	1092	1073	1024	1090	1069	1760	1495	1657
Iran	2548	2560	2758	1791	1712	1674	1640	1501	1597	1585	1446	1312	1220	1213	1140	1176	1170	1048	1101	884	833	884	1275	1891
Iraq	10000	10000	5093	5116	5216	5199	8910	5683	3544	6501	3636	4522	5179	4419	5991	5018	4431	3886	4044	4991	5006	4661	5770	8338
Israel	2061	2128	2081	1809	1761	1757	1838	1974	2064	1955	1901	1852	1822	1794	1748	1746	1831	1850	2086	2034	2047	1972	1958	1936
Jordan	4654	4754	4434	4387	4317	4233	4084	4101	4072	3847	3233	3061	3077	2980	2767	2602	2536	2407	2279	2199	2074	1921	1837	1845
Kuwait	1250	1234	1212	1175	1177	1188	1135	1137	1076	1028	961	987	1019	1036	1110	1189	1180	1246	1248	1292	1303	1304	1433	1439
Lebanon	608	643	667	632	616	641	731	687	725	827	846	907	935	889	878	842	844	831	880	904	871	867	831	869
Morocco	1453	1432	1266	1249	1289	1288	1312	1424	1447	1531	1393	1383	1349	1370	1380	1344	1444	1429	1440	1445	1513	1527	1965	1986
Oman	1161	1205	1140	1358	1595	1820	1824	2013	1922	2045	1998	2296	2251	2430	2223	2039	2175	1882	1849	1849	2050	1741	1759	1823
Qatar	4027	3556	3550	3342	3445	3523	3541	3493	3233	2856	2572	2437	2408	2210	2232	2325	2332	2439	2494	2485	2469	2909	3071	3246
Saudi Arabia	1195	1173	1209	1212	1347	1331	1301	1275	1267	1234	1092	1071	1189	1137	1192	1197	1183	1171	1144	1134	1132	1121	1113	1126
Tunisia	1108	1035	956	901	908	935	948	946	996	997	970	928	933	917	896	849	868	884	854	827	823	834	876	924
Turkey	1681	1233	988	1041	1190	1076	1041	949	952	883	936	866	849	932	979	965	902	795	764	747	741	733	796	786
United Arab Emirates	1005	957	957	944	888	862	833	806	787	763	756	726	839	784	886	884	928	932	876	877	888	833	1178	1224
MENA	2747	2423	2092	2007	1964	1978	2199	2009	1857	1931	1689	1734	1745	1660	1719	1650	1624	1554	1575	1616	1618	1615	1754	2072
LMI	5686	4206	2486	2490	2528	2534	3782	2737	2040	3038	2066	2344	2492	2274	2799	2484	2323	2129	2169	2509	2529	2649	3077	3994
UMI	2078	2019	2030	1868	1792	1751	1731	1699	1775	1694	1658	1645	1587	1543	1429	1388	1364	1277	1278	1231	1191	1129	1184	1524
HI	1803	1754	1729	1680	1636	1693	1683	1718	1617	1452	1360	1356	1365	1311	1317	1327	1355	1352	1378	1367	1396	1390	1466	1503
OP	2882	2822	2287	2174	2174	2193	2641	2240	1967	2254	1872	2019	2077	1944	2086	1966	1908	1788	1818	1917	1935	1873	2136	2740
NOP	2612	2024	1897	1841	1754	1763	1758	1778	1747	1607	1506	1450	1412	1376	1352	1334	1341	1321	1332	1314	1302	1357	1371	1404

Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Herfindahl-Hirschman index (HHI): Less than 1,500 → competitive marketplace, 1,500-2,500 → moderately concentrated marketplace, 2,500 or greater → Highly concentrated marketplace.

Table 4A.5: HHI-Total Loans

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Algeria	2800	2714	3142	2972	2444	2229	2148	2202	3389	2230	2986	3360	3025	2782	2075	2107	2295	2010	1816	1835	1851	1816	1742	2844
Bahrain	4023	4091	4076	4125	3298	3444	3316	3334	2865	1721	1631	1580	1475	1220	1288	1367	1394	1458	1444	1407	1393	1342	1310	1334
Egypt	5720	1249	1183	1151	1130	1172	1183	1150	1171	1117	1214	1165	999	1083	1109	1155	1163	1143	1085	1140	1102	1831	1526	1665
Iran	2617	2697	2619	1883	1824	1832	1699	1713	1726	1533	1315	1278	1267	1239	1159	1172	1160	1103	1193	935	898	953	1357	1973
Iraq	10000	10000	5115	5092	5162	5152	9204	5279	3456	3415	2250	5665	6086	5649	6785	6074	5591	5131	5351	6455	6870	6446	7460	8971
Israel	2121	2132	2073	1950	1903	1897	1858	2012	2050	2111	2077	2056	2083	2006	1972	1927	2021	2039	2040	1987	2031	1954	1955	1926
Jordan	4898	5036	4782	4765	3987	4234	4773	4800	4729	4058	3504	3233	3271	3173	2868	2691	2577	2283	2195	2129	2006	1863	1785	1808
Kuwait	1671	1756	1736	1726	1673	1688	1644	2066	1917	1667	1551	1477	1436	1423	1514	1651	1544	1618	1581	1624	1635	1630	1789	1802
Lebanon	627	659	680	649	624	651	737	687	730	841	850	908	942	892	888	851	856	841	897	926	893	891	860	914
Morocco	1705	1654	1439	1426	1430	1430	1441	1507	1517	1586	1382	1369	1364	1358	1363	1317	1417	1391	1401	1437	1521	1520	1982	1995
Oman	1270	1288	1219	1515	1772	2062	1992	2193	2105	2120	2045	2415	2293	2503	2276	2046	2208	2014	1917	1947	2287	1864	1790	1853
Qatar	3988	3413	3487	3270	3362	3481	3538	3459	3172	2926	2634	3029	2681	2395	2493	2564	2623	2686	2674	2603	2636	3081	3355	3539
Saudi Arabia	1213	1213	1259	1260	1391	1376	1332	1299	1280	1240	1149	1124	1195	1163	1235	1254	1233	1220	1182	1165	1131	1129	1108	1133
Tunisia	1194	1142	1048	1036	1022	954	967	984	1025	1024	990	970	964	949	927	870	868	894	877	847	846	855	901	942
Turkey	1583	1072	886	1016	1308	1244	1068	1000	969	957	956	895	895	1012	1032	1049	952	833	798	774	778	795	903	921
United Arab Emirates	1206	1136	1088	1085	1046	993	930	895	861	834	831	768	887	800	916	900	951	961	916	899	888	837	1124	1198
MENA	2915	2578	2239	2182	2086	2115	2364	2161	2060	1836	1710	1956	1929	1853	1869	1812	1803	1727	1710	1757	1798	1800	1934	2176
LMI	5808	4301	2579	2556	2574	2585	3943	2645	2048	2039	1615	2733	2816	2696	3085	2848	2724	2555	2612	3011	3165	3266	3656	4210
UMI	2286	2220	2193	2053	1868	1857	1899	1898	2095	1774	1767	1774	1727	1674	1491	1457	1451	1327	1296	1241	1212	1196	1258	1567
HI	1937	1879	1867	1866	1806	1868	1826	1907	1781	1577	1490	1556	1506	1439	1462	1464	1497	1499	1469	1454	1500	1480	1554	1598
OP	3096	3027	2458	2350	2334	2351	2811	2388	2238	1996	1845	2389	2359	2244	2307	2221	2201	2093	2079	2183	2275	2220	2466	2914
NOP	2734	2129	2021	2015	1838	1878	1918	1934	1882	1677	1576	1522	1499	1461	1431	1403	1406	1360	1342	1331	1321	1381	1403	1438

Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Herfindahl-Hirschman index (HHI): Less than 1,500 → competitive marketplace, 1,500-2,500 → moderately concentrated marketplace, 2,500 or greater → Highly concentrated marketplace.

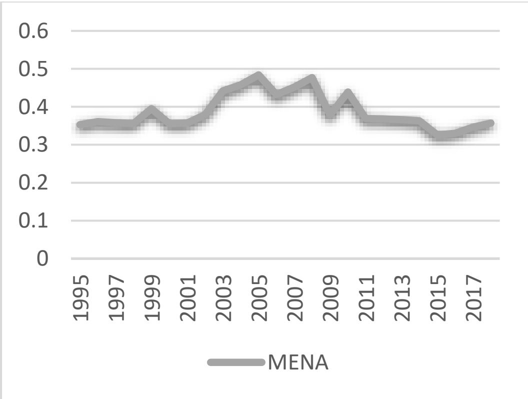
Table 4A.6: Mean Lerner indices (Q=Total assets) of operating banks

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	0.373	0.270	0.262	0.323	0.274	0.294	0.051	0.275	0.380	0.336	0.345	0.396	0.457	0.413	0.403	0.481	0.548	0.526	0.492	0.403	0.418	0.405	0.358	0.421
Bahrain	0.730	0.703	0.751	0.653	0.877	0.783	0.796	1.002	0.998	0.944	0.846	0.855	1.037	0.924	0.581	1.217	0.482	0.306	0.448	0.933	0.726	0.670	1.284	1.011
Egypt	0.238	0.248	0.240	0.245	0.249	0.187	0.121	0.083	0.175	0.133	0.126	0.173	0.193	0.167	0.273	0.228	0.178	0.261	0.319	0.337	0.360	0.494	0.333	0.332
Iran	0.162	0.165	0.171	0.167	0.197	0.212	0.371	0.355	0.342	0.342	0.244	0.211	0.142	0.238	0.300	0.289	0.369	0.476	0.318	0.284	-0.007	-0.038	-0.014	-0.172
Iraq	0.482	0.482	0.482	0.483	0.481	0.485	0.476	0.493	0.450	0.546	0.511	0.580	0.708	0.695	0.558	0.551	0.626	0.701	0.728	0.395	0.333	0.433	0.342	0.297
Israel	0.375	0.403	0.384	0.125	0.234	0.295	0.178	0.346	0.252	0.375	0.335	0.456	0.427	0.280	0.331	0.401	0.296	0.323	0.321	0.336	0.334	0.334	0.328	0.339
Jordan	0.190	0.194	0.122	0.182	0.179	0.165	0.189	0.222	0.329	0.325	0.427	0.331	0.369	0.402	0.301	0.338	0.309	0.306	0.275	0.287	0.294	0.306	0.278	0.260
Kuwait	0.069	0.192	0.292	0.294	0.350	0.310	0.322	0.400	0.681	0.638	0.913	0.532	0.766	1.009	0.329	0.489	0.457	0.386	0.396	0.344	0.299	0.298	0.403	0.502
Lebanon	0.124	0.163	0.161	0.131	0.092	0.009	-0.014	0.051	0.054	0.011	0.047	0.023	0.043	0.175	0.140	0.202	0.149	0.137	0.145	0.115	0.109	0.167	0.162	0.112
Morocco	0.389	0.415	0.359	0.257	0.301	0.395	0.178	0.242	0.446	0.534	0.571	0.580	0.561	0.563	0.506	0.507	0.418	0.422	0.421	0.431	0.420	0.429	0.371	0.394
Oman	0.408	0.384	0.420	0.443	0.432	0.449	0.350	0.393	0.458	0.439	0.467	0.307	0.384	0.339	0.381	0.341	0.437	0.304	0.249	0.262	0.287	0.319	0.237	0.286
Qatar	0.402	0.442	0.438	0.467	0.448	0.400	0.457	0.509	0.507	0.464	0.551	0.481	0.522	0.506	0.362	0.528	0.354	0.298	0.321	0.301	0.276	0.177	0.204	0.575
Saudi Arabia	0.166	0.204	0.211	0.214	0.196	0.205	0.373	0.373	0.308	0.456	0.593	0.558	0.333	0.265	0.295	0.305	0.293	0.296	0.286	0.278	0.291	0.268	0.288	0.306
Tunisia	0.212	0.217	0.229	0.319	0.333	0.304	0.282	0.159	0.273	0.262	0.267	0.311	0.293	0.290	0.287	0.273	0.238	0.230	0.239	0.248	0.252	0.241	0.256	0.251
Turkey	0.937	0.872	0.851	0.823	1.010	0.667	1.066	0.804	1.083	1.049	0.908	0.716	0.645	0.633	0.639	0.500	0.368	0.517	0.380	0.380	0.343	0.382	0.363	0.497
United Arab Emirates	0.392	0.415	0.364	0.578	0.670	0.542	0.515	0.353	0.337	0.475	0.593	0.405	0.353	0.736	0.363	0.378	0.379	0.391	0.510	0.476	0.484	0.390	0.349	0.303
MENA	0.353	0.361	0.358	0.356	0.395	0.356	0.357	0.379	0.442	0.458	0.484	0.432	0.452	0.477	0.378	0.439	0.369	0.368	0.366	0.363	0.326	0.330	0.346	0.357
LMI	0.370	0.382	0.360	0.328	0.344	0.355	0.258	0.273	0.357	0.404	0.403	0.444	0.487	0.475	0.446	0.429	0.408	0.461	0.490	0.388	0.371	0.452	0.349	0.341
UMI	0.333	0.313	0.299	0.324	0.347	0.275	0.324	0.311	0.410	0.388	0.373	0.331	0.325	0.358	0.345	0.347	0.330	0.365	0.308	0.286	0.235	0.244	0.234	0.228
HI	0.318	0.343	0.357	0.347	0.401	0.373	0.374	0.422	0.443	0.474	0.537	0.449	0.478	0.507	0.330	0.457	0.337	0.288	0.316	0.366	0.337	0.307	0.387	0.415
OP	0.307	0.319	0.330	0.371	0.381	0.362	0.364	0.394	0.433	0.462	0.527	0.434	0.458	0.525	0.374	0.420	0.433	0.422	0.413	0.343	0.298	0.282	0.271	0.315
NOP	0.399	0.402	0.387	0.342	0.409	0.350	0.349	0.364	0.451	0.454	0.441	0.431	0.446	0.429	0.382	0.458	0.305	0.313	0.319	0.383	0.355	0.378	0.422	0.400

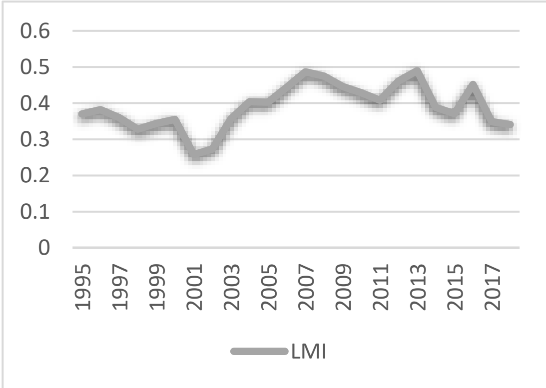
Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Lerner index: $\mathrm{P} = \mathrm{MC}$ → perfect competition, $\therefore\ economic\ profit\ = 0$, $P > MC$ → firm market power increases, $\therefore\ less\ competition$. The Lerner index is winsorised at 99%.

Figure 4A.4: Changes in banking competition using mean Lerner Index (Total Assets as proxy for bank output)

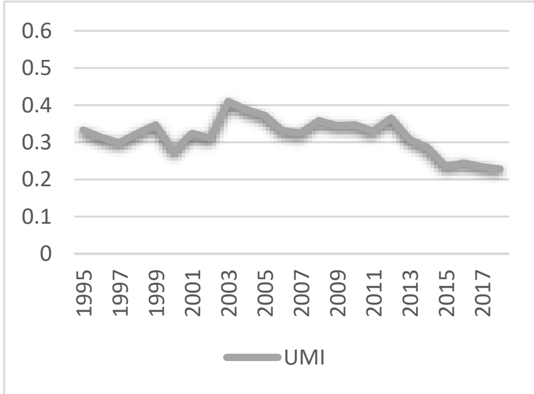
(a) MENA region



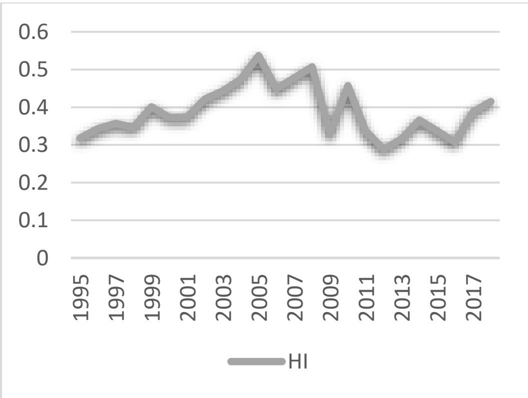
(b) Lower Middle Income countries



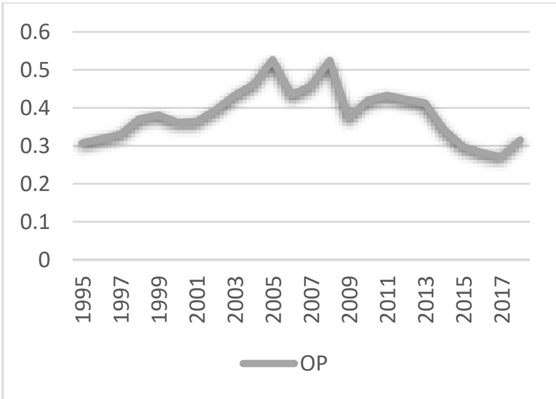
(c) Upper Middle Income countries



(d) High Income countries



(e) Oil-producing countries



(f) Non-oil-producing countries

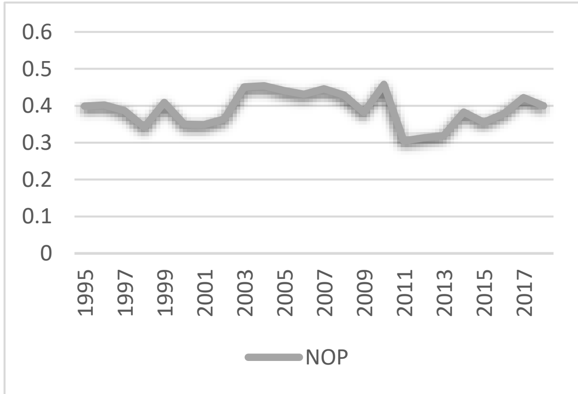


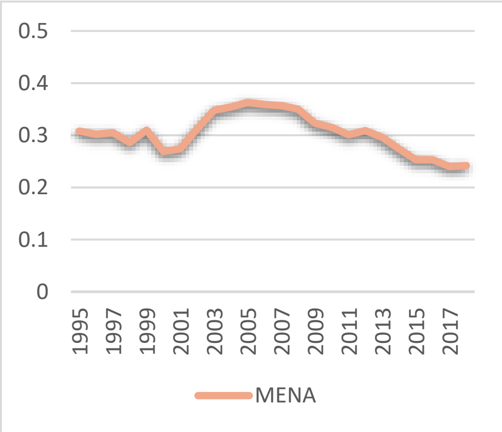
Table 4A.7: Median Lerner indices (Q=total assets) of operating banks

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	0.321	0.196	0.262	0.300	0.366	0.206	0.136	0.180	0.276	0.286	0.310	0.345	0.371	0.472	0.413	0.507	0.538	0.595	0.476	0.400	0.419	0.387	0.334	0.411
Bahrain	0.511	0.468	0.544	0.371	0.476	0.367	0.362	0.584	0.562	0.553	0.481	0.729	0.665	0.567	0.391	0.319	0.265	0.217	0.195	0.256	0.275	0.324	0.378	0.387
Egypt	0.202	0.195	0.208	0.212	0.191	0.199	0.118	0.108	0.166	0.068	0.130	0.154	0.218	0.235	0.278	0.243	0.159	0.253	0.295	0.309	0.282	0.363	0.279	0.273
Iran	0.279	0.266	0.263	0.241	0.255	0.237	0.443	0.357	0.438	0.397	0.393	0.245	0.213	0.231	0.274	0.244	0.401	0.369	0.248	0.334	0.083	-0.050	-0.027	-0.076
Iraq	0.506	0.506	0.506	0.506	0.506	0.506	0.506	0.506	0.505	0.654	0.513	0.682	0.731	0.740	0.551	0.453	0.544	0.661	0.766	0.367	0.322	0.354	0.358	0.253
Israel	0.249	0.282	0.197	0.114	0.121	0.138	0.039	0.131	0.173	0.230	0.173	0.255	0.283	0.189	0.232	0.271	0.179	0.223	0.216	0.230	0.240	0.237	0.226	0.235
Jordan	0.164	0.181	0.156	0.166	0.162	0.172	0.159	0.163	0.338	0.326	0.468	0.299	0.302	0.324	0.239	0.287	0.285	0.273	0.268	0.269	0.290	0.300	0.282	0.274
Kuwait	0.045	0.124	0.160	0.165	0.251	0.152	0.209	0.212	0.273	0.339	0.428	0.373	0.468	0.387	0.303	0.296	0.276	0.258	0.268	0.259	0.244	0.228	0.239	0.279
Lebanon	0.124	0.066	0.133	0.052	0.055	-0.007	-0.031	0.022	0.032	0.005	0.019	0.018	-0.013	0.051	0.036	0.109	0.052	0.034	0.044	0.009	0.050	0.071	0.017	0.001
Morocco	0.407	0.436	0.401	0.201	0.342	0.361	0.332	0.358	0.371	0.396	0.393	0.374	0.386	0.364	0.339	0.339	0.340	0.332	0.304	0.346	0.302	0.330	0.309	0.323
Oman	0.354	0.345	0.393	0.355	0.358	0.347	0.335	0.481	0.466	0.426	0.412	0.400	0.348	0.346	0.332	0.334	0.322	0.294	0.255	0.286	0.242	0.247	0.243	0.261
Qatar	0.232	0.292	0.234	0.299	0.247	0.252	0.355	0.406	0.399	0.325	0.367	0.307	0.305	0.328	0.271	0.312	0.313	0.259	0.254	0.239	0.216	0.169	0.160	0.152
Saudi Arabia	0.124	0.173	0.188	0.185	0.190	0.195	0.259	0.299	0.290	0.338	0.413	0.499	0.330	0.270	0.288	0.305	0.282	0.271	0.282	0.267	0.282	0.253	0.290	0.301
Tunisia	0.140	0.165	0.199	0.275	0.348	0.272	0.346	0.200	0.277	0.288	0.306	0.304	0.301	0.276	0.316	0.241	0.177	0.182	0.181	0.181	0.216	0.224	0.230	0.214
Turkey	0.955	0.825	0.711	0.800	0.791	0.601	0.512	0.637	0.687	0.661	0.554	0.437	0.531	0.540	0.604	0.457	0.346	0.405	0.331	0.304	0.263	0.305	0.253	0.321
United Arab Emirates	0.309	0.321	0.320	0.342	0.301	0.303	0.302	0.354	0.310	0.368	0.441	0.319	0.279	0.287	0.298	0.324	0.339	0.318	0.351	0.327	0.326	0.304	0.277	0.266
MENA	0.308	0.302	0.305	0.286	0.310	0.269	0.274	0.312	0.348	0.354	0.363	0.359	0.357	0.350	0.323	0.315	0.301	0.309	0.296	0.274	0.253	0.253	0.240	0.242
LMI	0.372	0.379	0.372	0.307	0.346	0.355	0.318	0.324	0.347	0.372	0.345	0.403	0.445	0.446	0.389	0.345	0.348	0.416	0.455	0.341	0.302	0.349	0.315	0.283
UMI	0.330	0.283	0.287	0.306	0.330	0.247	0.261	0.260	0.341	0.327	0.342	0.275	0.284	0.316	0.314	0.307	0.300	0.309	0.258	0.249	0.220	0.206	0.181	0.191
HI	0.228	0.251	0.255	0.229	0.243	0.219	0.233	0.308	0.309	0.322	0.339	0.360	0.335	0.297	0.264	0.270	0.247	0.230	0.228	0.233	0.228	0.220	0.227	0.235
OP	0.271	0.278	0.291	0.299	0.309	0.275	0.318	0.349	0.370	0.392	0.410	0.396	0.381	0.383	0.341	0.347	0.377	0.378	0.362	0.310	0.267	0.237	0.234	0.231
NOP	0.344	0.327	0.319	0.274	0.311	0.263	0.229	0.275	0.326	0.316	0.315	0.321	0.334	0.318	0.304	0.283	0.226	0.240	0.229	0.238	0.240	0.269	0.247	0.253

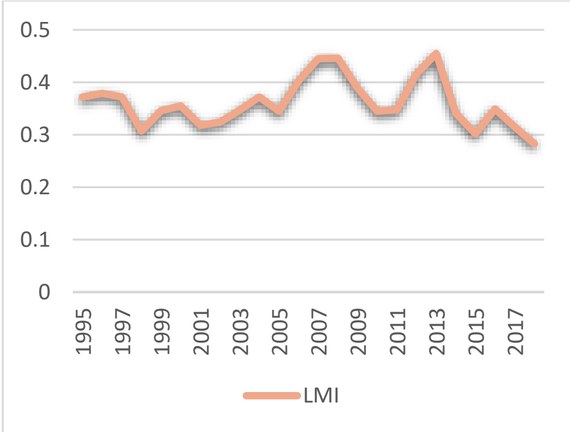
Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Lerner index: $P = MC \rightarrow$ perfect competition, $\therefore$ $economic\ profit\ = 0$, $P > MC \rightarrow$ firm market power increases, $\therefore$ $less\ competition$. The Lerner index is winsorised at 99%.

Figure 4A.5: Changes in banking competition using median Lerner Index (Total Assets as proxy for bank output)

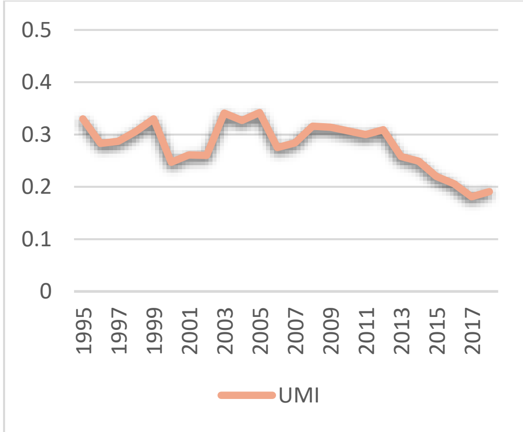
(a) MENA region



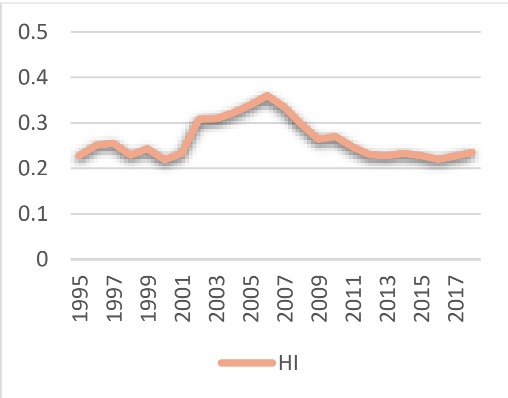
(b) Lower Middle Income countries



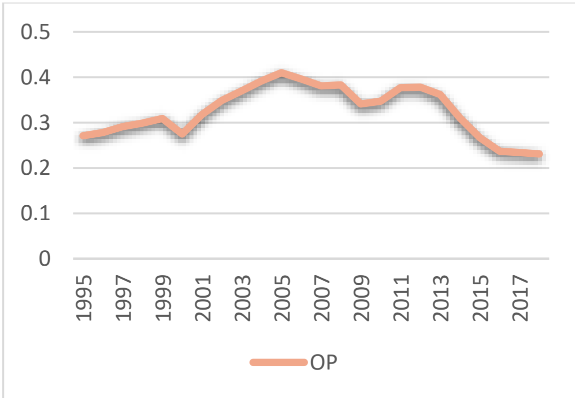
(c) Upper Middle Income countries



(d) High Income countries



(e) Oil-producing countries



(f) Non-oil-producing countries

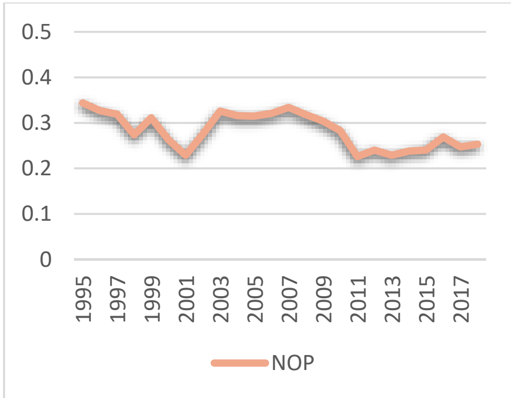


Table 4A.8: Mean Lerner indices (Q=loans) of operating banks

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	0.25	0.09	0.02	0.09	0.16	0.16	-0.39	0.13	0.25	0.21	0.22	0.22	0.34	0.28	0.21	0.41	0.49	0.47	0.44	0.35	0.37	0.36	0.30	0.36
Bahrain	0.23	0.13	0.02	-0.23	0.01	-0.14	0.09	0.55	0.66	0.58	0.39	0.27	0.49	-1.15	0.06	0.50	-0.02	-1.46	-0.68	0.63	0.23	0.44	1.06	0.66
Egypt	0.06	0.09	0.09	0.10	0.11	0.04	-0.09	-0.11	-0.02	-0.09	-0.15	-0.16	-0.18	-0.16	0.01	-0.03	-0.11	0.00	0.08	0.10	0.11	0.24	-0.10	-0.07
Iran	-0.13	-0.13	-0.10	-0.10	-0.05	-0.02	0.16	0.19	0.17	0.19	0.04	0.04	-0.20	0.10	0.16	-0.07	-0.03	0.34	0.07	0.00	-0.37	-0.50	-0.37	-0.69
Iraq	0.28	0.28	0.28	0.28	0.28	0.29	0.28	0.30	0.22	0.35	0.39	0.31	0.51	0.34	0.18	0.28	0.11	0.19	0.46	0.23	0.66	0.26	0.44	0.31
Israel	0.29	0.33	0.28	-0.01	0.10	0.17	0.02	0.23	0.12	0.21	0.08	0.25	0.27	0.09	0.11	0.16	0.02	0.06	0.06	0.10	0.11	0.11	0.10	0.11
Jordan	0.06	0.06	-0.06	0.02	0.01	-0.03	0.02	0.05	0.19	0.20	0.34	0.23	0.27	0.32	0.19	0.24	0.21	0.20	0.14	0.15	0.16	0.19	0.16	0.13
Kuwait	-0.86	-0.64	-0.25	-0.33	-0.11	-0.24	-0.29	-0.03	0.33	0.13	0.28	-0.44	0.21	-1.76	-2.80	-0.51	-1.19	-0.19	-0.17	-0.26	-1.60	-2.94	-0.10	-0.55
Lebanon	-0.15	-0.14	-0.13	-0.21	-0.25	-0.43	-0.51	-0.46	-0.55	-0.64	-0.56	-0.64	-0.58	-0.27	-0.36	-0.19	-0.23	-0.25	-0.24	-0.37	-0.39	-0.34	-0.41	-0.59
Morocco	0.35	0.38	0.31	0.15	0.24	0.25	-0.32	-0.28	0.03	0.21	0.30	0.36	0.46	0.49	0.44	0.47	0.38	0.38	0.37	0.38	0.37	0.38	0.32	0.34
Oman	0.40	0.37	0.40	0.42	0.41	0.42	0.25	0.32	0.35	0.20	0.23	-1.55	-0.45	-0.35	-0.46	-2.01	0.32	-0.72	-2.74	-1.56	-0.58	0.11	-0.42	0.02
Qatar	0.29	0.34	0.33	0.35	0.32	0.24	0.33	0.40	0.40	0.35	0.44	0.33	0.39	0.39	0.23	0.41	0.25	0.19	0.23	0.21	0.18	0.03	0.08	0.46
Saudi Arabia	-0.10	-0.08	-0.05	0.00	-0.04	-0.02	0.22	0.27	0.20	0.36	0.51	0.44	0.21	0.12	0.18	0.20	0.20	0.21	0.20	0.19	0.19	0.17	0.19	0.21
Tunisia	0.18	0.18	0.20	0.30	0.31	0.29	0.30	0.18	0.25	0.24	0.24	0.27	0.23	0.22	0.20	0.19	0.17	0.14	0.19	0.20	0.20	0.19	0.21	0.20
Turkey	0.65	0.56	0.52	0.49	0.64	0.24	0.18	0.27	0.73	0.80	0.71	0.49	0.46	-0.10	0.39	0.34	0.08	0.34	0.26	0.01	0.26	0.30	0.27	0.40
United Arab Emirates	0.27	0.30	0.24	0.19	0.27	0.06	0.17	0.27	0.28	0.40	0.43	0.29	0.22	0.62	0.19	0.19	0.13	0.11	0.31	-0.08	0.14	0.08	-0.05	-0.30
MENA	0.13	0.13	0.13	0.10	0.15	0.08	0.03	0.14	0.23	0.23	0.24	0.04	0.17	-0.05	-0.07	0.04	0.05	0.00	-0.06	0.02	0.00	-0.06	0.10	0.06
LMI	0.23	0.25	0.23	0.18	0.21	0.19	-0.05	-0.03	0.07	0.16	0.18	0.17	0.26	0.22	0.21	0.24	0.13	0.19	0.30	0.24	0.38	0.29	0.22	0.19
UMI	0.14	0.10	0.08	0.10	0.14	0.04	-0.04	0.06	0.17	0.16	0.16	0.10	0.09	0.09	0.13	0.15	0.12	0.21	0.14	0.06	0.04	0.03	0.03	-0.03
HI	0.07	0.09	0.12	0.05	0.12	0.06	0.10	0.25	0.29	0.28	0.29	-0.05	0.17	-0.25	-0.31	-0.13	-0.04	-0.22	-0.35	-0.10	-0.17	-0.25	0.11	0.08
OP	0.05	0.07	0.11	0.11	0.15	0.11	0.09	0.23	0.27	0.27	0.32	-0.04	0.15	-0.03	-0.26	-0.14	0.04	0.08	-0.15	-0.12	-0.13	-0.30	0.01	-0.02
NOP	0.21	0.20	0.16	0.08	0.15	0.05	-0.04	0.06	0.18	0.19	0.17	0.13	0.18	-0.07	0.13	0.21	0.06	-0.07	0.02	0.15	0.13	0.19	0.20	0.15

Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Lerner index: $\mathrm{P} = \mathrm{MC}$ → perfect competition, $\therefore\ economic\ profit\ = 0$, $P > MC$ → firm market power increases, $\therefore\ less\ competition$. The Lerner index is winsorised at 99%.

Table 4A.9: Median Lerner indices (Q = loans) of operating banks

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Algeria	0.27	0.18	0.12	0.28	0.25	0.21	-0.05	0.08	0.19	0.16	0.28	0.28	0.34	0.42	0.35	0.46	0.52	0.54	0.45	0.38	0.40	0.35	0.28	0.38
Bahrain	0.47	0.37	0.36	0.32	0.37	-0.37	-0.24	0.56	0.52	0.37	0.40	0.55	0.45	0.54	0.29	0.20	0.21	0.11	0.10	0.19	0.27	0.28	0.34	0.17
Egypt	0.10	0.12	0.12	0.12	0.17	0.03	0.02	-0.02	-0.04	-0.15	-0.10	-0.01	0.02	0.09	0.15	0.16	0.01	0.09	0.10	0.18	0.16	0.23	0.02	0.01
Iran	0.22	0.20	0.18	0.17	0.16	0.10	0.37	0.38	0.36	0.34	0.35	0.14	0.11	0.11	0.20	0.15	0.30	0.25	0.14	0.18	-0.17	-0.36	-0.26	-0.34
Iraq	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.52	0.38	0.43	0.49	0.43	0.33	0.48	0.42	0.50	0.60	0.26	0.25	0.26	0.18	0.08
Israel	0.17	0.20	0.10	0.00	0.06	0.07	-0.10	0.05	0.06	0.07	0.03	0.11	0.17	0.06	0.07	0.17	0.04	0.06	0.03	0.07	0.08	0.06	0.06	0.09
Jordan	0.10	0.12	-0.02	0.07	0.01	0.02	0.04	-0.01	0.20	0.22	0.38	0.24	0.26	0.25	0.16	0.19	0.17	0.21	0.16	0.17	0.17	0.22	0.18	0.17
Kuwait	-0.74	-0.30	-0.22	-0.30	-0.09	-0.04	0.04	0.10	0.15	0.23	0.31	0.22	0.24	0.17	0.19	0.15	0.15	0.16	0.15	0.12	0.13	0.12	0.13	0.12
Lebanon	-0.18	-0.18	-0.14	-0.29	-0.34	-0.36	-0.44	-0.38	-0.55	-0.48	-0.49	-0.62	-0.55	-0.36	-0.41	-0.28	-0.32	-0.32	-0.27	-0.35	-0.36	-0.28	-0.40	-0.45
Morocco	0.34	0.38	0.33	0.14	0.28	0.26	0.22	0.18	0.22	0.31	0.31	0.33	0.35	0.32	0.30	0.32	0.30	0.28	0.27	0.28	0.26	0.28	0.22	0.26
Oman	0.37	0.36	0.38	0.34	0.36	0.34	0.30	0.46	0.46	0.42	0.38	0.36	0.31	0.31	0.31	0.31	0.28	0.27	0.24	0.25	0.19	0.19	0.19	0.20
Qatar	0.12	0.21	0.16	0.24	0.17	0.11	0.26	0.36	0.36	0.25	0.31	0.20	0.18	0.26	0.18	0.22	0.24	0.20	0.19	0.19	0.15	0.08	0.10	0.08
Saudi Arabia	-0.16	-0.11	-0.10	-0.02	0.00	-0.06	0.07	0.19	0.20	0.27	0.35	0.39	0.25	0.18	0.21	0.22	0.21	0.21	0.22	0.20	0.22	0.17	0.21	0.22
Tunisia	0.14	0.13	0.15	0.29	0.34	0.26	0.33	0.20	0.25	0.29	0.27	0.28	0.25	0.24	0.27	0.23	0.16	0.14	0.12	0.16	0.19	0.18	0.18	0.20
Turkey	0.73	0.55	0.42	0.51	0.39	0.35	0.10	0.35	0.51	0.48	0.39	0.26	0.46	0.35	0.54	0.39	0.23	0.31	0.23	0.22	0.16	0.20	0.18	0.21
United Arab Emirates	0.28	0.29	0.27	0.29	0.24	0.25	0.22	0.34	0.29	0.35	0.35	0.23	0.17	0.25	0.16	0.20	0.21	0.22	0.29	0.27	0.25	0.22	0.20	0.16
MENA	0.16	0.18	0.16	0.16	0.17	0.10	0.10	0.20	0.22	0.23	0.24	0.21	0.22	0.23	0.21	0.22	0.20	0.20	0.19	0.17	0.15	0.14	0.11	0.10
LMI	0.28	0.30	0.28	0.22	0.28	0.23	0.21	0.19	0.19	0.23	0.20	0.25	0.29	0.28	0.26	0.32	0.24	0.29	0.32	0.24	0.23	0.25	0.14	0.12
UMI	0.21	0.17	0.12	0.17	0.13	0.10	0.06	0.10	0.16	0.17	0.20	0.10	0.14	0.17	0.18	0.19	0.18	0.19	0.14	0.12	0.07	0.05	0.03	0.03
HI	0.06	0.13	0.12	0.11	0.14	0.04	0.07	0.26	0.26	0.25	0.27	0.26	0.22	0.22	0.18	0.18	0.17	0.15	0.15	0.16	0.16	0.14	0.15	0.13
OP	0.10	0.15	0.15	0.18	0.19	0.16	0.20	0.29	0.30	0.32	0.34	0.28	0.26	0.27	0.24	0.27	0.29	0.29	0.29	0.23	0.18	0.13	0.13	0.11
NOP	0.23	0.21	0.17	0.14	0.16	0.03	-0.01	0.12	0.15	0.14	0.15	0.14	0.18	0.19	0.17	0.17	0.10	0.11	0.09	0.11	0.12	0.15	0.10	0.08

Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Lerner index: $\mathrm{P} = \mathrm{MC} \rightarrow$ perfect competition, $\therefore\ economic\ profit\ =\ 0$, $P > MC \rightarrow$ firm market power increases, $\therefore\ less\ competition$. The Lerner index is winsorised at 99%.

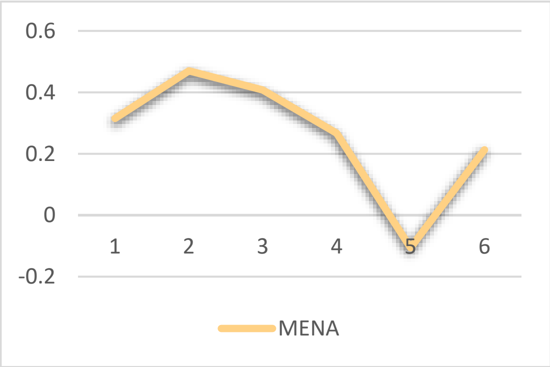
Table 4A.10: H-statistic and E-statistic (4 years window)

Measure	H-statistic						E-statistic					
Country/Period	1	2	3	4	5	6	1	2	3	4	5	6
Algeria	-0.172	0.111	0.306	0.197	0.086	0.149	0.002	-0.004	-0.009	-0.005	0.000	-0.002
Bahrain	0.947	-0.148	0.066	-0.127	0.184	0.673	-0.008	-0.044	-0.014	0.009	0.007	0.028
Egypt	0.359	0.396	0.189	0.005	0.511	0.665	0.012	0.001	0.001	0.018	-0.005	0.033
Iran	0.424	-0.088	-1.042	-0.616	0.451	0.701	-0.007	-0.002	0.006	-0.003	-0.001	0.004
Iraq	0.545	0.590	0.516	-0.273	0.252	1.037	0.000	0.005	0.005	-0.067	0.001	0.013
Israel	0.214	0.482	0.612	0.694	0.668	0.602	0.000	-0.017	-0.009	-0.002	-0.002	-0.002
Jordan	0.359	0.609	0.259	0.567	0.298	0.113	-0.054	-0.034	0.013	-0.006	-0.007	-0.005
Kuwait	0.547	-0.023	0.054	0.573	0.500	0.133	0.048	-0.069	-0.010	0.044	-0.001	-0.011
Lebanon	0.505	0.386	0.429	0.580	0.642	0.686	0.005	0.006	-0.003	0.019	0.053	0.043
Morocco	-0.487	-0.003	0.547	0.491	0.626	0.612	0.075	-0.011	-0.019	0.038	0.025	0.030
Oman	1.136	1.595	0.799	0.858	-0.237	0.552	0.017	0.014	-0.006	0.030	0.033	0.009
Qatar	-0.161	0.263	0.152	-0.006	0.047	0.754	-0.035	-0.015	-0.026	-0.022	-0.004	-0.042
Saudi Arabia	0.480	0.442	1.075	0.575	0.615	0.534	-0.002	-0.003	0.055	-0.005	0.004	0.000
Tunisia	1.141	0.309	0.567	0.543	0.614	0.552	0.020	-0.016	0.002	0.022	-0.006	0.002
Turkey	0.548	0.774	0.912	0.420	0.556	0.383	-0.047	-0.024	-0.022	-0.014	0.011	-0.019
United Arab Emirates	0.664	0.490	0.408	0.312	0.546	0.406	-0.007	-0.004	0.004	-0.040	-0.011	-0.021
MENA	0.315	0.470	0.408	0.267	-0.106	0.213	-0.043	0.014	0.001	-0.005	-0.008	-0.021
LMI	-0.077	-0.654	-0.194	-0.097	0.227	0.457	-0.102	-0.008	-0.025	0.005	-0.042	0.021
UMI	0.462	0.647	0.374	0.579	0.484	0.385	-0.058	0.038	0.001	0.026	0.017	-0.039
HI	0.275	0.175	0.588	0.292	-0.618	0.075	-0.029	-0.028	0.008	-0.019	-0.009	-0.010
OP	0.395	0.324	0.235	0.296	0.115	0.107	-0.027	-0.013	0.012	-0.022	-0.004	-0.003
NOP	0.305	0.510	0.574	0.077	-0.278	0.245	-0.057	0.020	-0.020	0.003	-0.021	-0.028

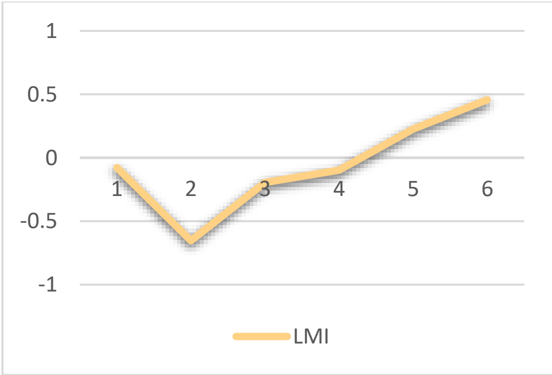
Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). H-statistic: $H = 1$ perfect competition, $0 < H < 1$ monopolistic competition, $H < 0$ monopoly.

Figure 4A.6: Changes in banking competition using PR H-statistic (6 sub-periods)

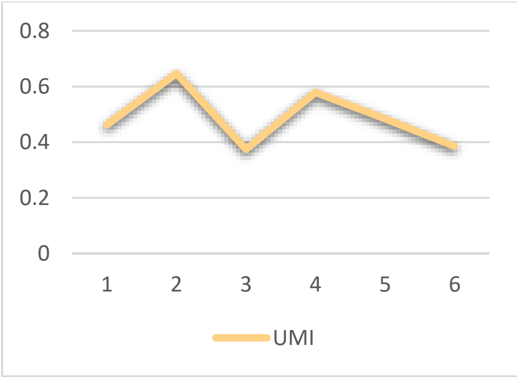
(a) MENA region



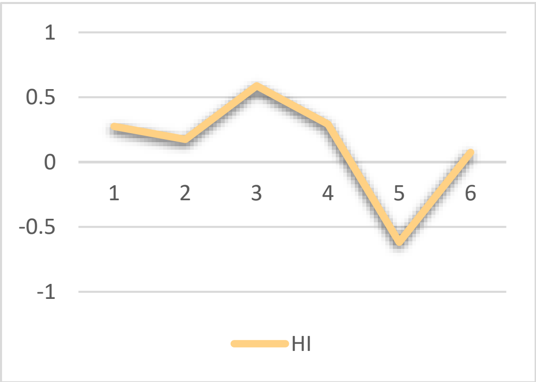
(b) Lower Middle Income countries



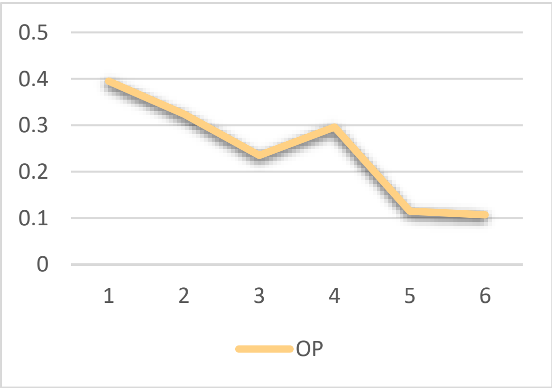
(c) Upper Middle Income countries



(d) High Income countries



(e) Oil-producing countries



(f) Non-oil-producing countries

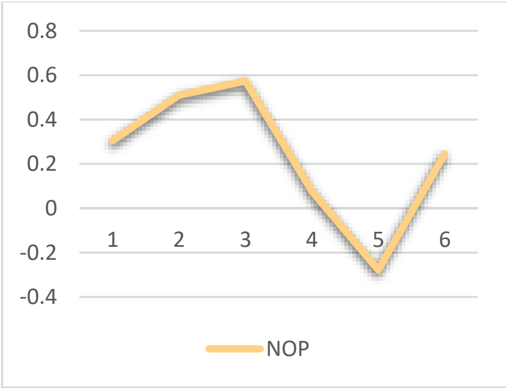


Table 4A.11: PR model (E-statistic) results of the MENA region banking system using 4-year window

Dependent variable:lnROA	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**
LnW_1	-0.005*	0.001	0.000	-0.003	-0.012***	-0.003
	(0.073)	(0.801)	(0.972)	(0.299)	(0.000)	(0.386)
LnW_2	-0.026***	0.029***	0.002	0.002	0.006	-0.022**
	(0.000)	(0.000)	(0.737)	(0.736)	(0.261)	(0.013)
LnW_3	-0.011***	-0.015***	-0.001	-0.003	-0.001	0.003
	(0.000)	(0.000)	(0.806)	(0.439)	(0.619)	(0.607)
lnTETA	0.043***	0.051***	0.034***	0.051***	0.064***	0.076***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnNetLnTA	-0.001	-0.001	-0.016***	0.004	0.000	-0.001
	(0.913)	(0.838)	(0.000)	(0.327)	(0.960)	(0.918)
lnTA	-0.027***	-0.010***	-0.004	-0.029***	-0.008**	-0.044***
	(0.000)	(0.003)	(0.237)	(0.000)	(0.040)	(0.000)
Constant	0.562***	0.483***	0.230***	0.804***	0.368***	1.103***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	1085	1069	1115	1159	1217	1246
R^2	0.962	0.971	0.960	0.939	0.979	0.921
E-statistic	-0.043	0.014	0.001	-0.005	-0.008	-0.021
E=0 (LR equilibrium)	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject
Prob>F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. MENA-Middle East and North Africa. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). *ROA* denotes the bank's return on assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. E-statistic is the long-run equilibrium test. F- is for F test.

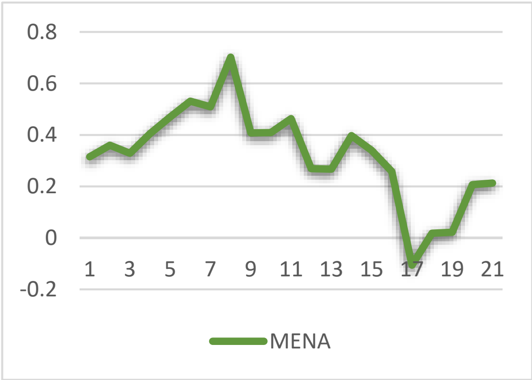
Table 4A.12: H-statistic, Rolling estimation

Country/Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Algeria	-0.172	-0.154	-0.165	0.053	0.111	0.292	0.226	0.277	0.306	0.112	0.268	0.314	0.197	0.245	-0.018	0.034	0.086	0.160	0.150	0.102	0.149
Bahrain	0.947	0.626	0.192	0.058	-0.148	-0.073	-0.001	0.045	0.066	0.043	0.050	-0.023	-0.127	-0.150	-0.136	0.055	0.184	0.416	0.585	0.787	0.673
Egypt	0.359	0.386	0.317	0.331	0.396	0.457	0.461	0.360	0.189	0.138	-0.004	0.098	0.005	0.140	0.375	0.501	0.511	0.559	0.591	0.630	0.665
Iran	0.424	0.198	0.167	0.089	-0.088	-0.193	-0.366	-0.834	-1.042	-1.133	-0.879	-0.654	-0.616	0.114	0.360	0.374	0.451	0.662	0.424	0.544	0.701
Iraq	0.545	0.546	0.548	0.557	0.590	0.600	0.621	0.461	0.516	0.498	0.549	0.295	-0.273	0.159	0.311	0.269	0.252	0.401	0.547	0.875	1.037
Israel	0.214	0.403	0.585	0.659	0.482	0.429	0.396	0.400	0.612	0.484	0.809	0.740	0.694	0.660	0.669	0.674	0.668	0.662	0.644	0.623	0.602
Jordan	0.359	0.411	0.442	0.589	0.609	0.414	0.348	0.337	0.259	0.240	0.263	0.479	0.567	0.641	0.515	0.392	0.298	0.216	0.196	0.112	0.113
Kuwait	0.547	0.356	0.218	0.117	-0.023	0.047	0.015	-0.016	0.054	-0.034	0.221	0.365	0.573	0.549	0.348	0.445	0.500	0.505	0.642	0.290	0.133
Lebanon	0.505	0.490	0.419	0.355	0.386	0.286	0.407	0.526	0.429	0.517	0.506	0.505	0.580	0.589	0.627	0.688	0.642	0.642	0.635	0.657	0.686
Morocco	-0.487	-1.024	-1.005	-0.388	-0.003	0.299	0.351	0.458	0.547	0.550	0.513	0.471	0.491	0.452	0.414	0.436	0.626	0.602	0.589	0.606	0.612
Oman	1.136	1.457	1.720	1.487	1.595	1.326	1.341	1.172	0.799	0.821	0.608	0.718	0.858	0.550	0.253	-0.068	-0.237	0.791	0.363	0.538	0.552
Qatar	-0.161	-0.120	0.439	0.357	0.263	0.183	-0.008	0.202	0.152	0.026	0.041	-0.007	-0.006	-0.140	-0.106	-0.108	0.047	0.033	0.177	0.301	0.754
Saudi Arabia	0.480	0.513	0.505	0.511	0.442	0.342	0.439	0.719	1.075	1.060	1.119	0.922	0.575	0.574	0.492	0.584	0.615	0.588	0.514	0.496	0.534
Tunisia	1.141	1.100	0.953	0.280	0.309	0.343	0.366	0.454	0.567	0.520	0.484	0.483	0.543	0.549	0.542	0.765	0.614	0.545	0.440	0.458	0.552
Turkey	0.548	0.592	0.612	0.611	0.774	0.774	0.843	1.079	0.912	0.780	0.656	0.537	0.420	0.442	0.479	0.504	0.556	0.579	0.465	0.466	0.383
United Arab Emirates	0.664	0.601	0.642	0.563	0.490	0.520	0.530	0.598	0.408	0.392	0.374	0.333	0.312	0.195	0.395	0.512	0.546	0.545	0.514	0.454	0.406
MENA	0.315	0.360	0.329	0.405	0.470	0.531	0.509	0.702	0.408	0.409	0.463	0.269	0.267	0.397	0.340	0.258	-0.106	0.018	0.022	0.207	0.213
LMI	-0.077	-0.366	-1.086	-1.155	-0.655	-0.263	-0.055	-0.035	-0.194	0.289	0.092	0.138	-0.097	0.328	0.524	0.686	0.227	0.291	0.154	0.347	0.457
UMI	0.462	0.492	0.457	0.687	0.647	0.581	0.533	0.769	0.374	0.449	0.602	0.295	0.579	0.735	0.535	0.470	0.484	0.511	0.195	0.325	0.385
HI	0.275	0.287	0.273	0.400	0.175	0.379	0.281	0.563	0.588	0.482	0.489	0.391	0.292	0.166	-0.167	-0.328	-0.618	-0.361	-0.050	0.134	0.075
OP	0.395	0.164	-0.205	0.219	0.324	0.518	0.304	0.250	0.235	0.384	0.664	0.274	0.296	0.329	0.285	0.211	0.115	0.218	0.226	0.123	0.107
NOP	0.305	0.448	0.473	0.466	0.510	0.542	0.524	0.794	0.574	0.445	0.296	0.165	0.077	0.369	0.360	0.324	-0.278	-0.086	-0.034	0.257	0.245

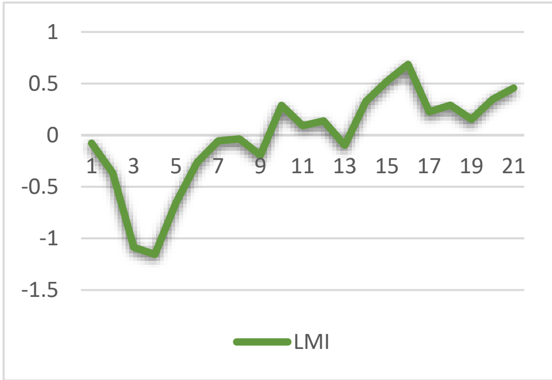
Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Period 1(1995-1998), period 2(1996-1999), period 3(1997-2000), period 4(1998-2001), period 5(1999-2002), period 6(2000-2003), period 7(2001-2004), period 8(2002-2005), period 9(2003-2006), period 10(2004-2007), period 11(2005-2008), period 12(2006-2009), period 13(2007-2010), period 14(2008-2011), period 15(2009-2012), period 16(2010-2013), period 17(2011-2014), period 18(2012-2015), period 19(2013-2016), period 20(2014-2017), period 21(2015-2018). H-statistic: $H = 1$ perfect competition, $0 < H < 1$ monopolistic competition, $H < 0$ monopoly.

Figure 4A.7: Changes in banking competition using PR H-statistic (Rolling estimation)

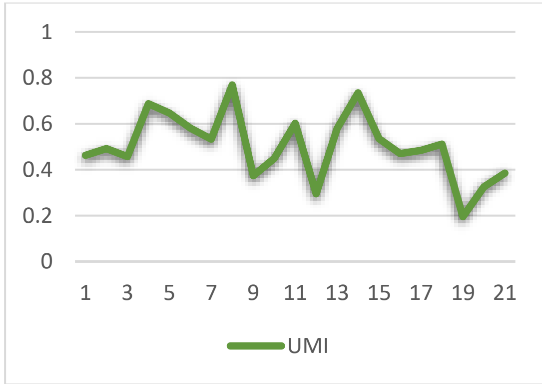
(a) MENA region



(b) Lower Middle Income countries

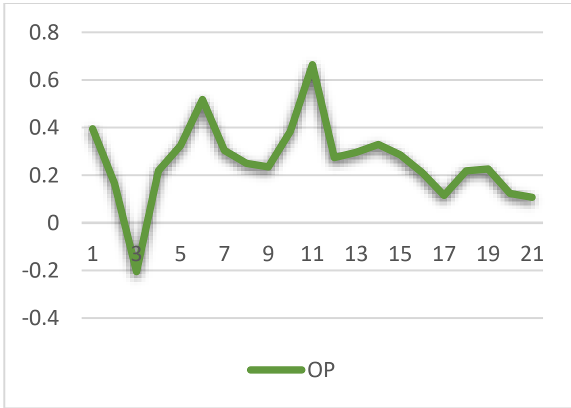


(c) Upper Middle Income countries



(d) High Income countries

(e) Oil-producing countries



(f) Non-oil-producing countries

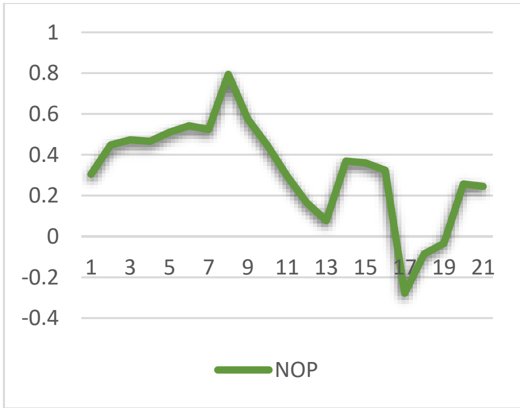


Table 4A.13: E-statistic, rolling estimation

Country/Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Algeria	0.002	-0.002	-0.005	-0.003	-0.004	-0.003	-0.003	-0.009	-0.009	0.001	0.000	0.002	-0.005	-0.007	-0.008	-0.003	0.000	0.000	0.000	-0.003	-0.002
Bahrain	-0.008	-0.026	-0.034	-0.037	-0.044	-0.032	-0.019	-0.009	-0.014	-0.027	-0.004	0.001	0.009	0.024	0.019	0.018	0.007	0.013	0.015	0.024	0.028
Egypt	0.012	0.011	0.010	0.005	0.001	-0.001	-0.003	0.007	0.001	0.000	-0.005	0.011	0.018	0.021	0.015	0.007	-0.005	-0.008	0.018	0.022	0.033
Iran	-0.007	-0.007	-0.003	0.002	-0.002	0.000	0.004	0.003	0.006	0.005	0.003	-0.001	-0.003	-0.010	-0.008	-0.006	-0.001	-0.002	0.003	0.005	0.004
Iraq	0.000	0.000	0.001	0.001	0.005	0.004	0.006	0.003	0.005	0.004	0.011	-0.025	-0.067	-0.026	-0.006	-0.003	0.001	0.005	-0.002	0.011	0.013
Israel	0.000	0.002	-0.007	-0.005	-0.017	-0.016	-0.020	-0.021	-0.009	0.003	0.001	-0.002	-0.002	-0.003	-0.002	-0.003	-0.002	-0.003	-0.003	-0.003	-0.002
Jordan	-0.054	-0.069	-0.043	-0.026	-0.034	-0.059	-0.053	-0.018	0.013	0.028	0.023	-0.009	-0.006	-0.007	-0.006	-0.004	-0.007	-0.009	-0.006	-0.005	-0.005
Kuwait	0.048	-0.009	-0.039	-0.065	-0.069	-0.051	-0.035	-0.026	-0.010	-0.017	0.028	0.025	0.044	0.046	0.018	0.013	-0.001	-0.005	-0.013	-0.001	-0.011
Lebanon	0.005	0.004	0.005	0.007	0.006	0.001	-0.006	-0.004	-0.003	0.015	0.021	0.008	0.019	0.027	0.036	0.060	0.053	0.041	0.040	0.046	0.043
Morocco	0.075	0.097	0.065	-0.016	-0.011	0.017	-0.015	-0.022	-0.019	-0.018	0.015	0.035	0.038	0.045	0.043	0.033	0.025	0.024	0.023	0.025	0.030
Oman	0.017	0.023	0.040	0.022	0.014	0.001	-0.002	0.000	-0.006	0.016	0.026	0.028	0.030	0.019	0.021	0.030	0.033	0.022	0.015	0.013	0.009
Qatar	-0.035	-0.032	-0.005	-0.009	-0.015	-0.020	-0.030	-0.021	-0.026	-0.038	-0.032	-0.030	-0.022	-0.010	0.000	-0.003	-0.004	-0.002	-0.002	-0.012	-0.042
Saudi Arabia	-0.002	-0.007	-0.007	-0.007	-0.003	-0.001	0.005	0.018	0.055	0.056	0.047	0.021	-0.005	-0.012	-0.009	0.001	0.004	0.004	-0.001	0.000	0.000
Tunisia	0.020	-0.002	-0.017	-0.037	-0.016	-0.006	0.003	0.015	0.002	0.019	0.038	0.030	0.022	0.008	0.002	0.001	-0.006	0.020	0.018	0.026	0.002
Turkey	-0.047	-0.077	-0.081	-0.062	-0.024	0.002	0.004	-0.002	-0.022	-0.027	-0.025	-0.023	-0.014	-0.005	0.005	0.007	0.011	0.004	-0.002	-0.006	-0.019
United Arab Emirates	-0.007	-0.005	-0.005	-0.004	-0.004	0.002	0.006	0.016	0.004	-0.007	-0.040	-0.057	-0.040	-0.033	-0.041	-0.023	-0.011	-0.008	-0.011	-0.014	-0.021
MENA	-0.043	-0.039	-0.018	0.000	0.014	-0.012	-0.013	0.014	0.001	0.016	-0.007	-0.011	-0.005	0.011	-0.003	-0.016	-0.008	-0.004	-0.008	-0.010	-0.021
LMI	-0.102	0.039	0.004	-0.008	-0.008	-0.021	-0.012	-0.031	-0.025	-0.009	0.007	0.007	0.005	-0.026	-0.019	-0.012	-0.042	-0.014	0.004	0.013	0.021
UMI	-0.058	-0.082	-0.021	0.009	0.038	-0.003	-0.009	0.024	0.001	0.028	0.009	0.029	0.026	0.026	0.014	0.001	0.017	0.007	-0.012	-0.021	-0.039
HI	-0.029	-0.007	-0.014	-0.018	-0.028	-0.022	-0.025	-0.001	0.008	0.012	-0.026	-0.037	-0.019	0.011	-0.015	-0.026	-0.009	0.001	0.005	-0.009	-0.010
OP	-0.027	-0.014	-0.018	-0.019	-0.013	-0.006	-0.004	0.012	0.012	0.021	-0.031	-0.033	-0.022	0.006	0.003	0.006	-0.004	0.003	0.001	-0.002	-0.003
NOP	-0.057	-0.051	-0.019	0.008	0.020	-0.012	-0.014	-0.001	-0.020	0.002	0.008	-0.001	0.003	0.014	-0.013	-0.032	-0.021	-0.027	-0.022	-0.010	-0.028

Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Period 1(1995-1998), period 2(1996-1999), period 3(1997-2000), period 4(1998-2001), period 5(1999-2002), period 6(2000-2003), period 7(2001-2004), period 8(2002-2005), period 9(2003-2006), period 10(2004-2007), period 11(2005-2008), period 12(2006-2009), period 13(2007-2010), period 14(2008-2011), period 15(2009-2012), period 16(2010-2013), period 17(2011-2014), period 18(2012-2015), period 19(2013-2016), period 20(2014-2017), period 21(2015-2018).

Table 4A.14: PR model (E-statistic) regression results of the MENA countries banking system using rolling estimation 4-year window

Dependent variable:lnROA	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15	Period 16	Period 17	Period 18	Period 19	Period 20	Period 21
lnW_1	-0.005	-0.003	0.002	0.002	0.001	0.008	0.010	0.011	0.000	0.000	-0.011	-0.016	-0.003	0.002	0.002	-0.001	-0.012	-0.012	-0.011	-0.005	-0.003
	(0.073)	(0.424)	(0.755)	(0.530)	(0.801)	(0.031)	(0.010)	(0.011)	(0.972)	(0.898)	(0.001)	(0.000)	(0.299)	(0.540)	(0.421)	(0.559)	(0.000)	(0.000)	(0.000)	(0.233)	(0.386)
lnW_2	-0.026	-0.023	-0.012	0.001	0.029	-0.006	-0.012	0.013	0.002	0.018	0.003	0.000	0.002	0.010	-0.004	-0.012	0.006	0.016	0.011	-0.010	-0.022
	(0.000)	(0.013)	(0.129)	(0.834)	(0.000)	(0.247)	(0.016)	(0.011)	(0.737)	(0.000)	(0.496)	(0.927)	(0.736)	(0.093)	(0.595)	(0.059)	(0.261)	(0.005)	(0.049)	(0.256)	(0.013)
lnW_3	-0.011	-0.013	-0.007	-0.003	-0.015	-0.015	-0.011	-0.009	-0.001	-0.002	0.001	0.004	-0.003	0.000	-0.001	-0.003	-0.001	-0.008	-0.009	0.005	0.003
	(0.000)	(0.001)	(0.046)	(0.198)	(0.000)	(0.000)	(0.006)	(0.022)	(0.806)	(0.525)	(0.692)	(0.135)	(0.439)	(0.917)	(0.769)	(0.490)	(0.619)	(0.012)	(0.007)	(0.414)	(0.607)
lnTETA	0.043	0.008	0.007	0.038	0.051	0.044	0.052	0.032	0.034	0.039	0.038	0.064	0.051	0.046	0.060	0.075	0.064	0.056	0.070	0.063	0.076
	(0.000)	(0.165)	(0.188)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnNetLnTA	-0.001	0.011	0.013	0.011	-0.001	0.015	0.004	-0.012	-0.016	-0.006	-0.003	0.010	0.004	0.006	0.007	0.005	0.000	-0.013	-0.013	0.003	-0.001
	(0.913)	(0.094)	(0.027)	(0.010)	(0.838)	(0.001)	(0.377)	(0.005)	(0.000)	(0.010)	(0.215)	(0.001)	(0.327)	(0.078)	(0.012)	(0.035)	(0.960)	(0.000)	(0.000)	(0.500)	(0.918)
lnTA	-0.027	-0.021	-0.022	-0.013	-0.010	-0.015	-0.009	0.005	-0.004	-0.013	-0.020	-0.020	-0.029	-0.018	-0.010	-0.008	-0.008	-0.020	-0.029	-0.060	-0.044
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.001)	(0.044)	(0.157)	(0.237)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.059)	(0.092)	(0.040)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.562	0.400	0.488	0.457	0.483	0.459	0.330	0.095	0.230	0.511	0.573	0.618	0.804	0.633	0.421	0.350	0.368	0.622	0.826	1.486	1.103
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.216)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	1085	1082	1074	1068	1069	1072	1086	1099	1115	1125	1136	1149	1159	1176	1190	1204	1217	1224	1237	1243	1246
R^2	0.962	0.937	0.949	0.977	0.971	0.955	0.952	0.950	0.960	0.969	0.960	0.958	0.939	0.945	0.957	0.964	0.979	0.976	0.972	0.915	0.921
E-statistic	-0.043	-0.039	-0.018	0.000	0.014	-0.012	-0.013	0.014	0.001	0.016	-0.007	-0.011	-0.005	0.011	-0.003	-0.016	-0.008	-0.004	-0.008	-0.010	-0.021
E=0 (LR equilibrium)	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject
Prob>F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Author's own calculations. P-value are in parentheses. MENA-Middle East and North Africa. Period 1(1995-1998), period 2(1996-1999), period 3(1997-2000), period 4(1998-2001), period 5(1999-2002), period 6(2000-2003), period 7(2001-2004), period 8(2002-2005), period 9(2003-2006), period 10(2004-2007), period 11(2005-2008), period 12(2006-2009), period 13(2007-2010), period 14(2008-2011), period 15(2009-2012), period 16(2010-2013), period 17(2011-2014), period 18(2012-2015), period 19(2013-2016), period 20(2014-2017), period 21(2015-2018). *ROA* denotes the bank's return on assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. E-statistic is the long run equilibrium test. F- is for F test.

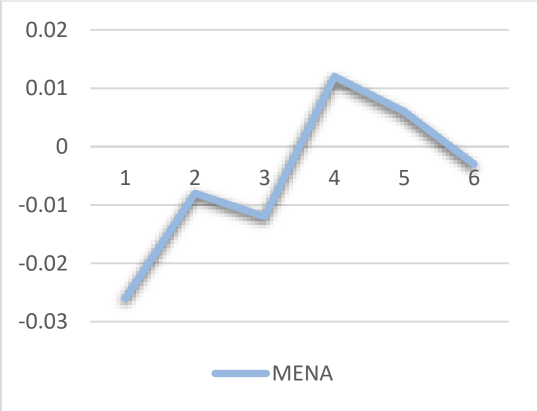
Table 4A.15: Boone indicator, 4 years window

Country/Period	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
Algeria	-0.012	-0.005	-0.005	0.004	0.007	-0.001
Bahrain	0.020	-0.069	-0.026	0.017	0.011	0.068
Egypt	-0.044	-0.037	-0.022	-0.017	-0.047	0.039
Iran	0.004	-0.010	-0.004	0.002	0.002	-0.003
Iraq	0.013	0.013	0.018	0.006	-0.003	-0.013
Israel	0.004	-0.006	-0.008	0.006	-0.011	-0.010
Jordan	-0.078	-0.041	0.017	0.067	0.046	0.027
Kuwait	0.227	0.068	0.175	0.170	0.121	0.140
Lebanon	0.045	0.034	-0.007	0.063	0.105	0.090
Morocco	0.014	-0.007	0.071	0.068	0.084	0.118
Oman	0.048	0.024	0.032	0.066	0.041	0.018
Qatar	-0.013	-0.016	-0.011	-0.010	0.010	-0.046
Saudi Arabia	0.023	-0.012	0.037	-0.015	-0.004	-0.009
Tunisia	-0.284	0.019	-0.214	-0.040	0.021	0.009
Turkey	-0.074	-0.062	-0.021	-0.108	-0.018	-0.059
United Arab Emirates	-0.018	0.002	0.031	-0.029	-0.005	-0.010
MENA	-0.026	-0.008	-0.012	0.012	0.006	-0.003
LMI	0.009	-0.001	-0.020	-0.004	-0.011	0.014
UMI	-0.058	0.004	-0.011	0.027	0.024	-0.047
HI	-0.003	-0.035	-0.007	-0.001	-0.005	0.027
OP	-0.011	-0.012	-0.003	-0.005	-0.004	-0.009
NOP	-0.032	-0.007	-0.017	0.025	0.021	0.001

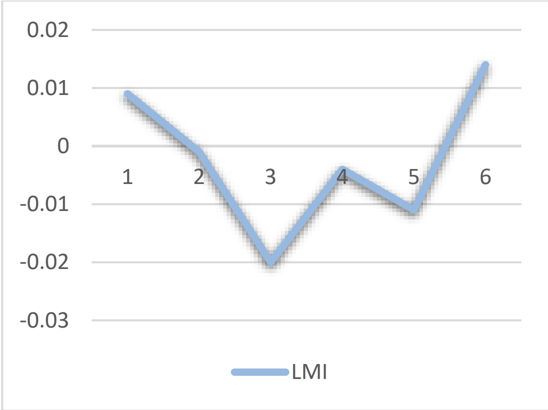
Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). Boone indicator: $-\infty$ perfect competition, ∴ the more negative, the higher the degree of banking competition.

Figure 4A.8: Changes in banking competition using Boone Indicator (6 sub-periods)

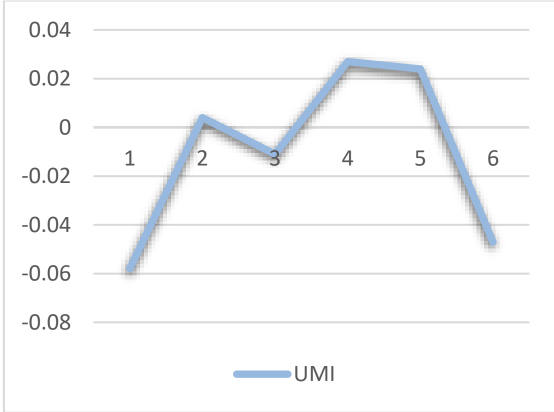
(a) MENA region



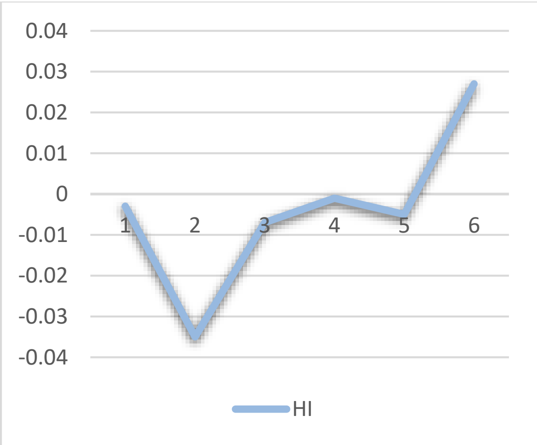
(b) Lower Middle Income countries



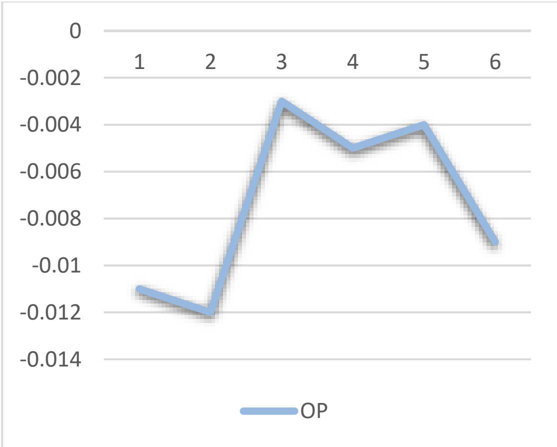
(c) Upper Middle Income countries



(d) High Income countries



(e) Oil-producing countries



(f) Non-oil-producing countries

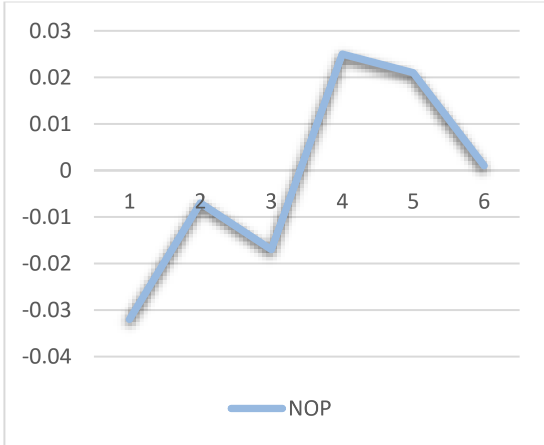


Table 4A.16: Boone indicator, rolling estimation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Algeria	-0.012	-0.012	-0.011	-0.007	-0.005	-0.005	-0.005	-0.005	-0.005	0.000	0.003	0.003	0.004	0.004	0.005	0.007	0.007	0.004	0.002	-0.001	-0.001
Bahrain	0.020	0.013	-0.049	-0.066	-0.069	-0.059	-0.056	-0.049	-0.026	-0.032	-0.007	0.000	0.017	0.023	0.017	0.019	0.011	0.010	0.010	0.059	0.068
Egypt	-0.044	-0.049	-0.065	-0.064	-0.037	-0.030	-0.024	-0.029	-0.022	-0.020	-0.018	-0.008	-0.017	-0.023	-0.028	-0.036	-0.047	-0.054	-0.003	0.004	0.039
Iran	0.004	0.001	-0.001	-0.002	-0.010	-0.011	-0.011	-0.011	-0.004	0.001	0.004	-0.001	0.002	0.003	0.004	0.003	0.002	0.001	-0.001	0.000	-0.003
Iraq	0.013	0.013	0.013	0.013	0.013	0.014	0.015	0.016	0.018	0.015	0.019	0.005	0.006	0.005	-0.002	0.000	-0.003	-0.006	-0.012	-0.009	-0.013
Israel	0.004	0.005	0.003	0.000	-0.006	-0.009	-0.014	-0.017	-0.008	-0.002	0.007	0.007	0.006	-0.001	-0.002	-0.006	-0.011	-0.009	-0.010	-0.009	-0.010
Jordan	-0.078	-0.096	-0.062	-0.047	-0.041	-0.062	-0.075	-0.064	0.017	0.088	0.069	0.077	0.067	0.066	0.075	0.047	0.046	0.040	0.034	0.033	0.027
Kuwait	0.227	0.113	0.054	0.056	0.068	0.171	0.242	0.234	0.175	0.143	0.102	0.165	0.170	0.176	0.207	0.221	0.121	0.107	0.098	0.102	0.140
Lebanon	0.045	0.045	0.065	0.060	0.034	0.021	0.010	-0.005	-0.007	0.051	0.043	0.051	0.063	0.072	0.080	0.093	0.105	0.093	0.097	0.096	0.090
Morocco	0.014	0.011	0.006	-0.001	-0.007	0.022	0.046	0.063	0.071	0.071	0.065	0.073	0.068	0.071	0.073	0.072	0.084	0.098	0.112	0.113	0.118
Oman	0.048	0.035	0.039	0.035	0.024	0.017	0.027	0.037	0.032	0.062	0.057	0.053	0.066	0.055	0.054	0.056	0.041	0.038	0.034	0.025	0.018
Qatar	-0.013	-0.013	-0.016	-0.016	-0.016	-0.016	-0.011	-0.012	-0.011	-0.013	-0.015	-0.014	-0.010	-0.004	0.001	0.006	0.010	0.007	-0.007	-0.019	-0.046
Saudi Arabia	0.023	-0.030	-0.033	-0.022	-0.012	0.010	0.021	0.046	0.037	0.033	0.035	-0.003	-0.015	-0.017	-0.016	-0.009	-0.004	-0.002	-0.006	-0.007	-0.009
Tunisia	-0.284	-0.340	-0.391	-0.144	0.019	0.019	0.009	-0.006	-0.214	-0.220	-0.176	-0.145	-0.040	0.020	0.049	0.033	0.021	0.028	-0.001	0.005	0.009
Turkey	-0.074	-0.086	-0.085	-0.088	-0.062	-0.044	-0.036	0.004	-0.021	-0.062	-0.103	-0.140	-0.108	-0.059	-0.030	-0.025	-0.018	-0.040	-0.059	-0.058	-0.059
United Arab Emirates	-0.018	-0.004	0.001	0.004	0.002	-0.001	-0.001	0.019	0.031	0.034	0.006	-0.023	-0.029	-0.040	-0.037	-0.019	-0.005	0.004	0.001	-0.001	-0.010
MENA	-0.026	-0.028	-0.010	-0.003	-0.008	-0.020	-0.023	-0.013	-0.012	-0.008	-0.009	0.014	0.012	0.014	0.004	0.000	0.006	0.007	-0.001	0.015	-0.003
LMI	0.009	0.009	0.004	0.000	-0.001	-0.007	0.010	-0.030	-0.020	-0.024	-0.013	0.009	-0.004	-0.012	-0.010	-0.005	-0.011	-0.010	-0.018	-0.001	0.014
UMI	-0.058	-0.061	-0.022	0.008	0.004	-0.019	-0.024	-0.007	-0.011	0.001	-0.004	0.031	0.027	0.030	0.019	0.006	0.024	0.025	0.017	-0.007	-0.047
HI	-0.003	-0.007	-0.017	-0.029	-0.035	-0.023	-0.027	-0.028	-0.007	-0.008	-0.013	-0.007	-0.001	0.005	-0.002	-0.003	-0.005	-0.007	-0.010	0.034	0.027
OP	-0.011	-0.015	-0.016	-0.026	-0.012	-0.007	-0.009	-0.005	-0.003	0.003	-0.006	-0.005	-0.005	0.001	-0.004	0.003	-0.004	-0.013	-0.018	-0.011	-0.009
NOP	-0.032	-0.034	-0.008	0.002	-0.007	-0.025	-0.027	-0.015	-0.017	-0.015	-0.011	0.029	0.025	0.028	0.015	-0.004	0.021	0.022	0.015	0.036	0.001

Note: Author's own calculations. MENA-Middle East and North Africa, LMI-Lower Middle Income (Egypt, Iraq, Morocco), UMI-Upper Middle Income(Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey), HI-High Income(Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates), OP-Oil Producing Countries(Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria, Oman), NOP-Non-Oil-Producing Countries(Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel). Period 1(1995-1998), period 2(1996-1999), period 3(1997-2000), period 4(1998-2001), period 5(1999-2002), period 6(2000-2003), period 7(2001-2004), period 8(2002-2005), period 9(2003-2006), period 10(2004-2007), period 11(2005-2008), period 12(2006-2009), period 13(2007-2010), period 14(2008-2011), period 15(2009-2012), period 16(2010-2013), period 17(2011-2014), period 18(2012-2015), period 19(2013-2016), period 20(2014-2017), period 21(2015-2018). Boone indicator: $-\infty$ perfect competition, $\therefore$ the more negative, the higher the degree of banking competition.

Table 4A.17: Boone indicator (MENA), rolling estimation

Dependent variable:lnROA	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**	**Period 7**	**Period 8**	**Period 9**	**Period 10**	**Period 11**	**Period 12**	**Period 13**	**Period 14**	**Period 15**	**Period 16**	**Period 17**	**Period 18**	**Period 19**	**Period 20**	**Period 21**
lnmc	-0.026	-0.028	-0.010	-0.003	-0.008	-0.020	-0.023	-0.013	-0.012	-0.008	-0.009	0.014	0.012	0.014	0.004	0.000	0.006	0.007	-0.001	0.015	-0.003
	(0.000)	(0.000)	(0.038)	(0.376)	(0.022)	(0.000)	(0.000)	(0.002)	(0.012)	(0.049)	(0.035)	(0.007)	(0.029)	(0.005)	(0.386)	(0.974)	(0.165)	(0.126)	(0.910)	(0.040)	(0.695)
Constant	0.020	0.016	0.063	0.081	0.065	0.037	0.029	0.059	0.063	0.075	0.071	0.132	0.125	0.130	0.103	0.090	0.109	0.112	0.087	0.132	0.078
	(0.118)	(0.274)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	1076	1075	1070	1069	1071	1074	1087	1100	1117	1128	1140	1154	1165	1183	1197	1210	1223	1230	1244	1251	1254
$\boldsymbol{R^2}$	0.953	0.936	0.947	0.970	0.957	0.945	0.942	0.942	0.953	0.958	0.948	0.941	0.926	0.937	0.948	0.954	0.969	0.960	0.950	0.894	0.900
BooneIndicator	-0.026	-0.028	-0.010	-0.003	-0.008	-0.020	-0.023	-0.013	-0.012	-0.008	-0.009	0.014	0.012	0.014	0.004	0.000	0.006	0.007	-0.001	0.015	-0.003

Note: Author's own calculations. MENA-Middle East and North Africa. Period 1(1995-1998), period 2(1996-1999), period 3(1997-2000), period 4(1998-2001), period 5(1999-2002), period 6(2000-2003), period 7(2001-2004), period 8(2002-2005), period 9(2003-2006), period 10(2004-2007), period 11(2005-2008), period 12(2006-2009), period 13(2007-2010), period 14(2008-2011), period 15(2009-2012), period 16(2010-2013), period 17(2011-2014), period 18(2012-2015), period 19(2013-2016), period 20(2014-2017), period 21(2015-2018). Boone indicator: $-\infty$ perfect competition, $\therefore$ the more negative, the higher the degree of banking competition. P-value are in parentheses. *ROA* denotes the bank's return on assets. mc-marginal costs. Bank-level fixed effects were derived following the methodology of Schaeck and Cihák (2014) and verified by the results of the Hausman test. Number of obs. is the number of observations.

4.7.2 Appendix B

The tables below illustrate the results of the panel regression models to estimate H-statistics and the associated equilibrium tests using different samples, concentrating on lower middle income (LMI), upper middle income (UMI), high income (HI), oil-producing (OP), and non-oil-producing (NOP) countries.

Table 4B.1: PR H-statistic results of the Lower Middle-Income (LMI) economies banking system using 4-year window

Dependent variable:lnP	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**
lnW_1	-0.374*	0.765***	-0.108	0.1645	0.010*	0.015
	(0.061)	(0.001)	(0.365)	(0.210)	(0.060)	(0.790)
lnW_2	0.327	-1.745***	-0.279	-0.61***	-0.079	0.019
	(0.234)	(0.000)	(0.110)	(0.000)	(0.669)	(0.850)
lnW_3	-0.030	0.326***	0.193***	0.348***	0.206**	0.423***
	(0.425)	(0.000)	(0.000)	(0.000)	(0.033)	(0.000)
lnTETA	0.350**	-0.028	0.125***	0.077	0.094	0.360***
	(0.050)	(0.708)	(0.000)	(0.550)	(0.354)	(0.001)
lnNetLnTA	0.706***	-0.660***	-0.019	0.006	0.014	0.004
	(0.000)	(0.001)	(0.833)	(0.923)	(0.757)	(0.922)
lnTA	-0.104	-0.163	0.029	-0.150	0.002	-0.181**
	(0.641)	(0.496)	(0.640)	(0.271)	(0.988)	(0.023)
Constant	2.949	-2.537	-2.066**	1.667	0.144	5.596***
	(0.505)	(0.602)	(0.049)	(0.555)	(0.949)	(0.001)
Number of obs.	178	169	182	196	202	204
R^2	0.823	0.817	0.901	0.827	0.815	0.906
H-statistic	-0.077	-0.654	-0.194	-0.097	0.227	0.457
H=0 (Monopoly)	Fail to reject	Fail to reject	Fail to reject	Fail to reject	Reject	Reject
H=1(Perfect Competition)	Reject	Reject	Reject	Reject	Reject	Reject

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. LMI-Lower Middle-income countries (Egypt, Iraq, Morocco) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). P denotes the bank's output price which is the gross revenues over total assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations H-statistic: $\mathrm{H} = 1$ perfect competition, $0 < \mathrm{H} < 1$ monopolistic competition, $\mathrm{H} < 0$ monopoly.

Table 4B.2: PR model (E-statistic) results of the Lower Middle Income (LMI) economies in the MENA region banking system using 4-year window

Dependent variable:lnROA	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**
$\mathbf{lnW_1}$	0.006	0.008	-0.031***	0.007	0.007**	0.016***
	(0.759)	(0.164)	(0.004)	(0.294)	(0.033)	(0.000)
$\mathbf{lnW_2}$	-0.108***	-0.016**	0.013	0.000	-0.044***	0.008
	(0.000)	(0.039)	(0.398)	(0.956)	(0.000)	(0.124)
$\mathbf{lnW_3}$	0.000	0.000	-0.007	-0.001	-0.006	-0.002
	(0.996)	(0.875)	(0.139)	(0.560)	(0.330)	(0.443)
lnTETA	0.102***	0.033***	0.022***	0.073***	0.065***	0.082***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnNetLnTA	0.021	0.004	-0.017**	0.001	0.005*	0.008***
	(0.287)	(0.377)	(0.041)	(0.828)	(0.098)	(0.001)
lnTA	-0.004	-0.017***	-0.029***	0.010*	-0.027***	-0.007
	(0.846)	(0.004)	(0.000)	(0.055)	(0.001)	(0.122)
Constant	-0.034	0.455***	0.642***	0.039	0.621***	0.479***
	(0.940)	(0.000)	(0.000)	(0.725)	(0.000)	(0.000)
Number of obs.	178	169	182	196	202	204
$\mathbf{R^2}$	0.907	0.989	0.955	0.975	0.957	0.990
E-statistic	-0.102	-0.008	-0.025	0.005	-0.042	0.021
E=0 (LR equilibrium)	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject
Prob>F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. LMI-Lower Middle-income countries (Egypt, Iraq, Morocco) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). *ROA* denotes the bank's return on assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. E-statistic is the long-run equilibrium test. F- is for F test.

Table 4B.3: PR H-statistic results of the Upper Middle-Income (UMI) economies banking system using 4-year window

Dependent variable:lnP	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
lnW_1	-0.127***	-0.026	-0.016	0.111*	-0.057***	0.087**
	(0.005)	(0.666)	(0.699)	(0.081)	(0.007)	(0.026)
lnW_2	0.515***	0.514***	0.1626**	0.286***	0.255***	-0.218*
	(0.000)	(0.000)	(0.025)	(0.003)	(0.000)	(0.067)
lnW_3	0.074**	0.160***	0.228***	0.183**	0.285***	0.516***
	(0.049)	(0.003)	(0.000)	(0.019)	(0.000)	(0.000)
lnTETA	0.167***	0.137**	0.2612***	-0.249***	0.153***	0.726***
	(0.000)	(0.025)	(0.000)	(0.004)	(0.000)	(0.000)
lnNetLnTA	0.159**	-0.113	0.093***	0.234***	0.220***	-0.112
	(0.018)	(0.113)	(0.005)	(0.002)	(0.000)	(0.248)
lnTA	-0.037	-0.093*	-0.086**	0.079	-0.111***	0.172*
	(0.240)	(0.078)	(0.018)	(0.236)	(0.008)	(0.086)
Constant	2.796***	4.108***	3.177***	-0.526	4.029***	-2.054
	(0.000)	(0.000)	(0.000)	(0.701)	(0.000)	(0.297)
Number of obs.	507	499	504	528	581	605
R^2	0.963	0.856	0.918	0.743	0.935	0.735
H-statistic	0.462	0.647	0.374	0.579	0.484	0.385
H=0 (Monopoly)	Reject	Reject	Reject	Reject	Reject	Reject
H=1 (Perfect Competition)	Reject	Reject	Reject	Reject	Reject	Reject

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. UMI-Upper Middle-income countries (Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). P denotes the bank's output price which is the gross revenues over total assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. H-statistic: $\mathrm{H} = 1$ perfect competition, $0 < \mathrm{H} < 1$ monopolistic competition, $\mathrm{H} < 0$ monopoly.

Table 4B.4: PR model (E-statistic) results of the Upper Middle-Income (UMI) economies banking system using 4-year window

Dependent variable:lnROA	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
lnW_1	-0.027***	0.004	0.009	-0.009*	-0.019***	-0.002
	(0.001)	(0.398)	(0.176)	(0.055)	(0.000)	(0.519)
lnW_2	0.012	0.048***	-0.005	0.018***	0.036***	-0.015*
	(0.337)	(0.000)	(0.698)	(0.008)	(0.000)	(0.065)
lnW_3	-0.043***	-0.013***	-0.004	0.017***	0.000	-0.023***
	(0.000)	(0.002)	(0.553)	(0.002)	(0.940)	(0.000)
lnTETA	0.032***	0.052***	0.070***	0.039***	0.077***	0.074***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnNetLnTA	0.019	0.001	-0.021***	0.006	0.002	-0.021***
	(0.125)	(0.876)	(0.000)	(0.262)	(0.421)	(0.002)
lnTA	-0.032***	-0.018***	0.005	-0.033***	-0.013**	-0.066***
	(0.000)	(0.000)	(0.374)	(0.000)	(0.027)	(0.000)
Constant	0.696***	0.790***	0.134	1.023***	0.667***	1.533***
	(0.000)	(0.000)	(0.229)	(0.000)	(0.000)	(0.000)
Number of obs.	507	499	504	528	581	605
R^2	0.966	0.976	0.953	0.972	0.981	0.970
E-statistic	-0.058	0.038	0.001	0.026	0.017	-0.039
E=0 (LR equilibrium)	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject
Prob>F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. UMI-Upper Middle-income countries (Algeria, Iran, Jordan, Lebanon, Tunisia, Turkey) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). *ROA* denotes the bank's return on assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. E-statistic is the long-run equilibrium test. F- is for F test.

Table 4B.5: PR H-statistic results of the High Income (HI) economies banking system using 4-year window

Dependent variable:lnP	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
lnW_1	-0.057**	-0.056	-0.015	-0.013	-0.094**	-0.017
	(0.027)	(0.375)	(0.685)	(0.772)	(0.048)	(0.573)
lnW_2	0.032	0.219*	0.446***	0.267**	-0.538***	0.025
	(0.691)	(0.067)	(0.000)	(0.012)	(0.000)	(0.742)
lnW_3	0.299***	0.013	0.157**	0.039	0.0143	0.067
	(0.000)	(0.855)	(0.018)	(0.586)	(0.836)	(0.125)
lnTETA	0.405***	0.022	0.354***	0.371***	-0.026	0.115
	(0.000)	(0.870)	(0.000)	(0.001)	(0.867)	(0.163)
lnNetLnTA	-0.224***	-0.063	0.096*	0.128	0.143***	-0.011
	(0.000)	(0.514)	(0.058)	(0.154)	(0.005)	(0.768)
lnTA	-0.098	-0.193	0.137***	-0.041	-0.595***	-0.529***
	(0.138)	(0.134)	(0.002)	(0.676)	(0.000)	(0.000)
Constant	2.833**	4.074*	-0.369	2.234	9.751***	11.575***
	(0.023)	(0.094)	(0.681)	(0.288)	(0.000)	(0.000)
Number of obs.	400	401	429	436	434	437
R^2	0.943	0.898	0.936	0.804	0.837	0.933
H-statistic	0.275	0.175	0.588	0.292	-0.618	0.075
H=0 (Monopoly)	Reject	Reject	Reject	Reject	Fail to Reject	Reject
H=1 (Perfect Competition)	Reject	Reject	Reject	Reject	Reject	Reject

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. HI- High income countries (Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). P denotes the bank's output price which is the gross revenues over total assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. H-statistic: $\mathrm{H} = 1$ perfect competition, $0 < \mathrm{H} < 1$ monopolistic competition, $\mathrm{H} < 0$ monopoly.

Table 4B.6: PR model (E-statistic) results of the High Income (HI) economies banking system using 4-year window

Dependent variable:lnROA	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
lnW_1	-0.001	0.000	-0.003	-0.003	-0.001	-0.005
	(0.757)	(0.993)	(0.306)	(0.547)	(0.628)	(0.581)
lnW_2	-0.017**	0.004	0.019**	-0.001	-0.001	-0.027
	(0.014)	(0.703)	(0.011)	(0.943)	(0.862)	(0.203)
lnW_3	-0.012***	-0.032***	-0.008	-0.015*	-0.006	0.022*
	(0.001)	(0.000)	(0.137)	(0.096)	(0.123)	(0.072)
lnTETA	0.044***	0.035***	0.030***	0.056***	0.015*	0.043*
	(0.000)	(0.001)	(0.000)	(0.000)	(0.078)	(0.064)
lnNetLnTA	-0.009**	-0.010	-0.001	0.003	-0.001	0.005
	(0.020)	(0.159)	(0.836)	(0.761)	(0.623)	(0.653)
lnTA	-0.014**	0.045***	0.009***	-0.023*	0.002	-0.046*
	(0.012)	(0.000)	(0.009)	(0.055)	(0.776)	(0.055)
Constant	0.284***	-0.954***	-0.026	0.599**	0.008	1.130**
	(0.007)	(0.000)	(0.707)	(0.020)	(0.950)	(0.029)
Number of obs.	400	401	429	435	434	437
R^2	0.963	0.971	0.981	0.876	0.986	0.859
E-statistic	-0.029	-0.028	0.008	-0.019	-0.009	-0.010
E=0 (LR equilibrium)	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject
Prob>F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. HI- High income countries (Bahrain, Israel, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). *ROA* denotes the bank's return on assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. E-statistic is the long-run equilibrium test. F- is for F test.

Table 4B.7: PR H-statistic results of the Oil-producing (OP) economies banking system using 4-year window

Dependent variable:lnP	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**
lnW_1	-0.132**	-0.078	-0.054	0.047	0.068**	-0.028
	(0.038)	(0.286)	(0.199)	(0.490)	(0.041)	(0.633)
lnW_2	0.246***	0.408***	0.010	0.230**	-0.110	-0.140
	(0.003)	(0.009)	(0.266)	(0.030)	(0.173)	(0.305)
lnW_3	0.282***	-0.005	0.190***	0.020	0.158***	0.274***
	(0.000)	(0.927)	(0.001)	(0.803)	(0.000)	(0.002)
lnTETA	0.314***	0.141*	0.394***	-0.105	0.080	0.860***
	(0.000)	(0.060)	(0.000)	(0.295)	(0.231)	(0.000)
lnNetLnTA	-0.327***	-0.075	0.064	0.166**	0.058*	0.078
	(0.000)	(0.253)	(0.141)	(0.024)	(0.070)	(0.219)
lnTA	0.065	-0.003	0.049	0.172*	-0.260***	-0.088
	(0.310)	(0.971)	(0.195)	(0.071)	(0.000)	(0.587)
Constant	-0.190	1.004	-0.038	-3.272	5.536***	2.923
	(0.877)	(0.553)	(0.962)	(0.126)	(0.000)	(0.395)
Number of obs.	399	399	452	476	500	507
R^2	0.911	0.799	0.843	0.592	0.825	0.682
H-statistic	0.395	0.324	0.235	0.296	0.115	0.107
H=0 (Monopoly)	Reject	Reject	Reject	Reject	Reject	Reject
H=1 (Perfect Competition)	Reject	Reject	Reject	Reject	Reject	Reject

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. OP- Oil-producing countries (Algeria, Iraq, Iran, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). P denotes the bank's output price which is the gross revenues over total assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. H-statistic: $\mathrm{H} = 1$ perfect competition, $0 < \mathrm{H} < 1$ monopolistic competition, $\mathrm{H} < 0$ monopoly.

Table 4B.8: PR model (E-statistic) results of the Oil-producing economies banking system using 4-year window

Dependent variable:lnROA	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**
lnW_1	-0.003	-0.003	0.003	-0.013***	0.002	0.004*
	(0.663)	(0.389)	(0.209)	(0.000)	(0.427)	(0.069)
lnW_2	-0.020***	0.000	0.016***	-0.001	0.000	0.008
	(0.010)	(0.967)	(0.006)	(0.791)	(0.953)	(0.106)
lnW_3	-0.004	-0.010***	-0.007*	-0.007**	-0.005*	-0.015***
	(0.203)	(0.000)	(0.062)	(0.028)	(0.080)	(0.000)
lnTETA	0.011**	0.012***	0.020***	0.020***	0.015***	0.002
	(0.016)	(0.000)	(0.000)	(0.000)	(0.003)	(0.633)
lnNetLnTA	-0.011**	-0.001	0.001	-0.002	-0.001	0.001
	(0.029)	(0.652)	(0.688)	(0.433)	(0.552)	(0.807)
lnTA	-0.013**	0.001	0.006**	-0.006	0.000	-0.002
	(0.022)	(0.812)	(0.020)	(0.148)	(0.964)	(0.749)
Constant	0.207*	0.004	0.034	0.131	0.060	0.088
	(0.063)	(0.951)	(0.502)	(0.150)	(0.510)	(0.478)
Number of obs.	399	399	452	476	500	507
R^2	0.955	0.991	0.982	0.973	0.985	0.990
E-statistic	-0.027	-0.013	0.012	-0.022	-0.004	-0.003
E=0 (LR equilibrium)	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject
Prob>F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. OP- Oil-producing countries (Algeria, Iraq, Iran, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). *ROA* denotes the bank's return on assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. E-statistic is the long-run equilibrium test. F- is for F test.

Table 4B.9: PR H-statistic results of the Non-Oil-producing (NOP) economies banking system using 4-year window

Dependent variable:lnP	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
lnW_1	-0.054**	-0.012	-0.004	-0.014	-0.113***	0.052**
	(0.027)	(0.817)	(0.913)	(0.705)	(0.000)	(0.012)
lnW_2	0.323***	0.287***	0.376***	-0.253***	-0.267***	-0.027
	(0.000)	(0.001)	(0.000)	(0.000)	(0.005)	(0.635)
lnW_3	0.036	0.235***	0.202***	0.343***	0.101	0.220***
	(0.171)	(0.000)	(0.000)	(0.000)	(0.129)	(0.000)
lnTETA	0.215***	0.185***	0.147***	0.175**	0.183***	0.270***
	(0.000)	(0.001)	(0.000)	(0.013)	(0.006)	(0.000)
lnNetLnTA	0.154***	-0.158*	0.063**	-0.010	0.187***	-0.147***
	(0.006)	(0.056)	(0.039)	(0.854)	(0.000)	(0.000)
lnTA	-0.102***	-0.124**	-0.005	-0.183***	-0.303***	-0.147***
	(0.008)	(0.023)	(0.890)	(0.002)	(0.000)	(0.003)
Constant	3.373***	4.068***	2.055***	3.570***	5.016***	3.625***
	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)
Number of obs.	686	670	663	684	717	739
R^2	0.948	0.884	0.950	0.872	0.872	0.923
H-statistic	0.305	0.510	0.574	0.077	-0.278	0.245
H=0 (Monopoly)	Reject	Reject	Reject	Reject	Fail to Reject	Reject
H=1 (Perfect Competition)	Reject	Reject	Reject	Reject	Reject	Reject

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. NOP-Non-Oil-producing countries (Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel) in the MENA region according to the World Bank classifications. Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). P denotes the bank's output price which is the gross revenues over total assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. H-statistic: $\mathrm{H} = 1$ perfect competition, $0 < \mathrm{H} < 1$ monopolistic competition, $\mathrm{H} < 0$ monopoly.

Table 4B.10: PR model (E-statistic) results of the Non-Oil-producing (NOP) economies banking system using 4-year window

Dependent variable:lnROA	**Period 1**	**Period 2**	**Period 3**	**Period 4**	**Period 5**	**Period 6**
lnW_1	-0.003	0.006	-0.009*	0.004	-0.017***	0.000
	(0.424)	(0.194)	(0.098)	(0.444)	(0.000)	(0.951)
lnW_2	-0.038***	0.030***	-0.010	0.006	-0.012*	-0.038***
	(0.000)	(0.000)	(0.324)	(0.521)	(0.088)	(0.004)
lnW_3	-0.016***	-0.016***	0.000	-0.007	0.008	0.010
	(0.000)	(0.000)	(0.967)	(0.222)	(0.112)	(0.259)
lnTETA	0.069***	0.065***	0.038***	0.088***	0.106***	0.118***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lnNetLnTA	0.001	-0.007	-0.028***	0.002	0.005**	0.012
	(0.870)	(0.343)	(0.000)	(0.736)	(0.015)	(0.205)
lnTA	-0.035***	-0.014***	-0.015***	-0.036***	-0.022***	-0.049***
	(0.000)	(0.003)	(0.007)	(0.000)	(0.000)	(0.000)
Constant	0.745***	0.625***	0.420***	1.097***	0.735***	1.302***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of obs.	686	670	663	683	717	739
R^2	0.962	0.966	0.951	0.924	0.983	0.881
E-statistic	-0.057	0.020	-0.020	0.003	-0.021	-0.028
E=0 (LR equilibrium)	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject	Fail to Reject
Prob>F	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Author's own calculations. *,**,*** denote significance at 10%, 5%, and 1% levels, respectively. P-value are in parentheses. NOP-Non-Oil-producing countries (Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey, Israel) in the MENA region according to the World Bank classifications.Period 1 (1995-1998), period 2 (1999-2002), period 3 (2003-2006), period 4 (2007-2010), period 5 (2011-2014), period 6 (2015-2018). *ROA* denotes the bank's return on assets, W_1 is the ratio of interest expense over total deposits and money market funding, W_2 is the ratio of personnel expenses to total assets, W_3 is the ratio of other operating and administrative expenses to fixed assets, TETA is total equity over total assets, NetLnTA is the ratio of net loans over total assets, TA is the logarithm of total assets (a proxy of size). Bank-level fixed effects were derived following the methodology of Anzoategui et al. (2010) and verified by the results of the Hausman test. Number of obs. is the number of observations. E-statistic is the long-run equilibrium test. F- is for F test.

4.7.3 Appendix C

Table 4C.1 and 4C.2 show the results of tests of convergence for GCC and non-GCC countries. The results are consistent with the results of the MENA and statistically significant at 1 percent for GCC countries and 5 perecnt for non-GCC countries. As can be seen from the tables below, the coefficient β is higher for GCC countries, which indicates that the countries converge faster to bank competition than non-GCC countries and quickly converge to the average level of the MENA. Hence, trade and banking integration has contributed to promoting convergence in bank competition in GCC countries.

Table 4C.1: Tests of convergence of 5-Bank Asset Concentration (GCC)

	Coefficient	**t-value**
$\boldsymbol{\beta}$ Convergence		
Intercept	0.891***	4.106
$\mathbf{ln}(\boldsymbol{BnkCon_{i,t-1}})$	-0.206***	4.099
Adjusted $\boldsymbol{R^2}$	0.082	
N	138	
$\boldsymbol{\sigma}$ Convergence		
Intercept	0.006**	2.175
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.132***	3.132
Adjusted $\boldsymbol{R^2}$	0.038	
N	138	

Note: the table shows the results of the β Convergence and σ Convergenece using 5-Bank Concentration ratio. For β Convergence, the estimated variable is $\ln(BnkCon_{i,t}) - \ln(BnkCon_{i,t-1})$ is the logarithm of the 5-bank concentration ratio of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln BnkCon_{i,t} - MBnkCon_t$, $\ln(X_{i,t})$ is the logarithm of the 5-bank concentration ratio of country i in year t and $MBnkCon_t$ the mean of $\ln(BnkCon_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

Table 4C.2: Tests of convergence of 5-Bank Asset Concentration (non-GCC)

	Coefficient	**t-value**
$\boldsymbol{\beta}$ Convergence		
Intercept	0.227**	2.126
$\mathbf{ln}(\boldsymbol{BnkCon_{i,t-1}})$	-0.054**	2.202
Adjusted $\boldsymbol{R^2}$	0.033	
N	230	
$\boldsymbol{\sigma}$ Convergence		
Intercept	-0.003	1.473
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.069**	2.503
Adjusted $\boldsymbol{R^2}$	0.041	
N	230	

Note: the table shows the results of the β Convergence and σ Convergenece using 5-Bank Concentration ratio. For β Convergence, the estimated variable is $\ln(BnkCon_{i,t}) - \ln(BnkCon_{i,t-1})$ is the logarithm of the 5-bank concentration ratio of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln BnkCon_{i,t} - MBnkCon_t$, $\ln(X_{i,t})$ is the logarithm of the 5-bank concentration ratio of country i in year t and $MBnkCon_t$ the mean of $\ln(BnkCon_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

With respect to tests of convergence for GCC countries and non-GCC countries using HHI (gross revenue, total assets, total deposits, and total loans), results in Tables 4C.3 and 4C.4 illustrate that results are consistent with the previously discussed indicator in terms of the sign and significance level. But in terms of the magnitude, it is different. From the results below, we can see that non-GCC countries have higher β and σ, which reflect that non-GCC countries that displayed the lowest bank competition improved faster than GCC countries and quicker to the average.

Table 4C.3: Tests of convergence of Herfindahl-Hirschman (HHI) index (GCC)

	$\mathbf{HHI_{TR}}$		$\mathbf{HHI_{TA}}$		$\mathbf{HHI_{TD}}$		$\mathbf{HHI_{TL}}$	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence								
Intercept	1.744***	4.614	0.716***	3.258	0.696***	3.317	0.867***	3.559
$\mathbf{ln}(\boldsymbol{HHI_{i,t-1}})$	-0.265***	4.621	-0.098***	3.297	-0.096***	3.339	-0.118***	3.586
Adjusted $\boldsymbol{R^2}$	0.118		0.094		0.105		0.095	
N	138		138		138		138	
$\boldsymbol{\sigma}$ Convergence								
Intercept	-0.062***	2.783	-0.014	1.468	-0.022**	2.113	-0.023**	2.205
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.267***	4.739	-0.131***	3.745	-0.152***	4.326	-0.174***	4.515
Adjusted $\boldsymbol{R^2}$	0.124		0.099		0.128		0.130	
N	138		138		138		138	

Note: the table shows the results of the β Convergence and σ Convergence using Herfindahl-Hirschman (HHI) index. We calculate the HHI index for total revenues HHI_{TR}, total assets HHI_{TA}, total deposits HHI_{TD}, and total loans HHI_{TL}. For β Convergence, the estimated variable is $\ln(HHI_{i,t}) - \ln(HHI_{i,t-1})$ is the logarithm of the HHI index of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln HHI_{i,t} - MHHI_t$, $\ln(X_{i,t})$ is the logarithm of the HHI index of country i in year t and $MHHI_t$ the mean of $\ln(HHI_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

Table 4C.4: Tests of convergence of Herfindahl-Hirschman (HHI) index (non-GCC)

	$\mathbf{HHI_{TR}}$		$\mathbf{HHI_{TA}}$		$\mathbf{HHI_{TD}}$		$\mathbf{HHI_{TL}}$	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence								
Intercept	3.760***	9.202	2.579***	8.644	3.179***	9.838	2.893***	8.963
$\mathbf{ln}(\boldsymbol{HHI_{i,t-1}})$	-0.539***	9.254	-0.353***	8.692	-0.433***	9.877	-0.391***	9.006
Adjusted $\boldsymbol{R^2}$	0.253		0.236		0.289		0.247	
N	230		230		230		230	
$\boldsymbol{\sigma}$ Convergence								
Intercept	0.084***	2.960	-0.063***	4.977	-0.062***	5.326	-0.066***	5.144
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.571***	9.457	-0.363***	8.076	-0.437***	9.159	-0.389***	8.152
Adjusted $\boldsymbol{R^2}$	0.263		0.209		0.259		0.210	
N	230		230		230		230	

Note: the table shows the results of the β Convergence and σ Convergence using Herfindahl-Hirschman (HHI) index. We calculate the HHI index for total revenues HHI_{TR}, total assets HHI_{TA}, total deposits HHI_{TD}, and total loans HHI_{TL}. For β Convergence, the estimated variable is $\ln(HHI_{i,t}) - \ln(HHI_{i,t-1})$ is the logarithm of the HHI index of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln HHI_{i,t} - MHHI_t$, $\ln(X_{i,t})$ is the logarithm of the HHI index of country i in year t and $MHHI_t$ the mean of $\ln(HHI_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

The results of tests of convergence in bank competition in GCC and non-GCC countries using non-structural approaches (the Lerner index, PR H-statistic, and Boone indicator) are reported in the tables below (see Tables 4C.5-4C.10). The results are consistent with previously discussed indicators (5-bank concentration ratio, and HHI); the coefficients are negative and statistically significant at 1 percent. Thus, results confirm the presence of convergence in bank competition in GCC and non-GCC countries and coefficients' values in absolute value are greater for GCC countries so this indicates that convergence in bank competition has improved faster in GCC countries compared to non-GCC countries.

Table 4C.5: Tests of convergence of Lerner index (GCC) Q=Total Assets

	Mean Lerner indices		**Median Lerner indices**	
	Coefficient	t-value	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence				
Intercept	0.217***	7.362	0.071***	4.533
$\mathbf{ln}(\boldsymbol{Lerner}_{\boldsymbol{i,t-1}})$	-0.572***	7.467	-0.247***	4.615
Adjusted $\boldsymbol{R^2}$	0.269		0.112	
N	138		138	
$\boldsymbol{\sigma}$ Convergence				
Intercept	0.037***	4.650	0.006*	1.848
$\mathbf{ln}(\boldsymbol{X}_{\boldsymbol{i,t-1}})$	-0.617***	7.791	-0.334***	5.642
Adjusted $\boldsymbol{R^2}$	0.288		0.170	
N	138		138	

Note: the table shows the results of the β Convergence and σ Convergence using Lerner index. For β Convergence, the estimated variable is $\ln(Lerner_{i,t}) - \ln(Lerner_{i,t-1})$ is the logarithm of the Lerner index of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln Lerner_{i,t} - MLerner_t$, $\ln(X_{i,t})$ is the logarithm of the Lerner index of country i in year t and $MLerner_t$ the mean (median) of $\ln(Lerner_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively. The Lerner index is winsorised at 99%.

Table 4C.6: Tests of convergence of Lerner index (non-GCC) Q=Total Assets

	Mean Lerner indices		**Median Lerner indices**	
	Coefficient	t-value	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence				
Intercept	0.069***	4.735	0.064***	4.891
$\mathbf{ln}(\boldsymbol{Lerner}_{\boldsymbol{i,t-1}})$	-0.249***	5.094	-0.250***	5.335
Adjusted $\boldsymbol{R^2}$	0.072		0.090	
N	230		230	
$\boldsymbol{\sigma}$ Convergence				
Intercept	-0.011***	2.616	-0.003	0.946
$\mathbf{ln}(\boldsymbol{X}_{\boldsymbol{i,t-1}})$	-0.274***	5.496	-0.262***	5.622
Adjusted $\boldsymbol{R^2}$	0.088		0.102	
N	230		230	

Note: the table shows the results of the β Convergence and σ Convergence using Lerner index. For β Convergence, the estimated variable is $\ln(Lerner_{i,t}) - \ln(Lerner_{i,t-1})$ is the logarithm of the Lerner index of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln Lerner_{i,t} - MLerner_t$, $\ln(X_{i,t})$ is the logarithm of the Lerner index of country i in year t and $MLerner_t$ the mean (median) of $\ln(Lerner_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively. The Lerner index is winsorised at 99%.

Table 4C.7: Tests of convergence of Panzar-Rosse H-statistic (GCC)

	H-statistic	
	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence		
Intercept	0.065***	2.788
$\mathbf{ln}(\boldsymbol{H-statistic_{i,t-1}})$	-0.175***	3.132
Adjusted $\boldsymbol{R^2}$	0.048	
N	138	
$\boldsymbol{\sigma}$ Convergence		
Intercept	0.004	0.268
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.197***	3.512
Adjusted $\boldsymbol{R^2}$	0.066	
N	138	

Note: the table shows the results of the β Convergence and σ Convergence using Panzar and Rosse (1982,1987) methodology of obtaining H-statistic. We calculate the $H-statistic$ by dividing the sample (1995-2018) into subsamples of 4 years for each period. H-statistic displays the responsiveness of bank revenues to input prices. For validity, we have already estimated the E-statistics, that shows whether the market is in equilibrium. For β Convergence, the estimated variable is $\ln(H-statistic_{i,t}) - \ln(H-statistic_{i,t-1})$ is the logarithm of the H-statistic of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln H - statistic_{i,t} - MH - statistic_t$, $\ln(X_{i,t})$ is the logarithm of the $H - statistic$ of country i in year t and $MH - statistic_t$ the mean of $\ln(H - statistic_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

Table 4C.8: Tests of convergence of Panzar-Rosse H-statistic (non-GCC)

	H-statistic	
	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence		
Intercept	0.054***	4.039
$\mathbf{ln}(\boldsymbol{H-statistic_{i,t-1}})$	-0.158***	4.424
Adjusted $\boldsymbol{R^2}$	0.051	
N	230	
$\boldsymbol{\sigma}$ Convergence		
Intercept	-0.002	0.228
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.166***	4.647
Adjusted $\boldsymbol{R^2}$	0.060	
N	230	

Note: the table shows the results of the β Convergence and σ Convergence using Panzar and Rosse (1982,1987) methodology of obtaining H-statistic. We calculate the $H-statistic$ by dividing the sample (1995-2018) into subsamples of 4 years for each period. H-statistic displays the responsiveness of bank revenues to input prices. For validity, we have already estimated the E-statistics, that shows whether the market is in equilibrium. For β Convergence, the estimated variable is $\ln(H-statistic_{i,t}) - \ln(H-statistic_{i,t-1})$ is the logarithm of the H-statistic of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln H - statistic_{i,t} - MH - statistic_t$, $\ln(X_{i,t})$ is the logarithm of the $H - statistic$ of country i in year t and $MH - statistic_t$ the mean of $\ln(H - statistic_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively.

Table 4C.9: Tests of convergence of Boone indicator (GCC)

	Boone Indicator	
	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence		
Intercept	0.009***	3.730
$\mathbf{ln}\ \boldsymbol{Boone_{i,t-1}})$	-0.321***	5.350
Adjusted $\boldsymbol{R^2}$	0.147	
N	138	
$\boldsymbol{\sigma}$ Convergence		
Intercept	0.004**	2.076
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.281***	5.095
Adjusted $\boldsymbol{R^2}$	0.132	
N	138	

Note: the table shows the results of the β Convergence and σ Convergence using Boone indicator. We calculate the Boone indicator by dividing the sample (1995-2018) into subsamples of 4 years for each period. For β Convergence, the estimated variable is $\ln(Boone_{i,t}) - \ln(Boone_{i,t-1})$ is the logarithm of the Boone indicator of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln Boone_{i,t} - MBoone_t$, $\ln(X_{i,t})$ is the logarithm of the Boone indicator of country i in year t and $MBoone_t$ the mean of $\ln(Boone_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively. The Boone indicator is winsorised at 99%.

Table 4C.10: Tests of convergence of Boone indicator (non-GCC)

	Boone Indicator	
	Coefficient	t-value
$\boldsymbol{\beta}$ Convergence		
Intercept	0.001	0.785
$\mathbf{ln}\ \boldsymbol{Boone_{i,t-1}})$	-0.250***	6.054
Adjusted $\boldsymbol{R^2}$	0.118	
N	230	
$\boldsymbol{\sigma}$ Convergence		
Intercept	-0.002	1.279
$\mathbf{ln}(\boldsymbol{X_{i,t-1}})$	-0.279***	6.398
Adjusted $\boldsymbol{R^2}$	0.132	0.132
N	230	230

Note: the table shows the results of the β Convergence and σ Convergence using Boone indicator. We calculate the Boone indicator by dividing the sample (1995-2018) into subsamples of 4 years for each period. For β Convergence, the estimated variable is $\ln(Boone_{i,t}) - \ln(Boone_{i,t-1})$ is the logarithm of the Boone indicator of country i in year t and year t-1, respectively. For σ Convergence, the estimated variable is $\Delta X_{i,t} = X_{i,t} - X_{i,t-1}$, $X_{i,t} = \ln Boone_{i,t} - MBoone_t$, $\ln(X_{i,t})$ is the logarithm of the Boone indicator of country i in year t and $MBoone_t$ the mean of $\ln(Boone_{i,t})$ for each period. The results of country dummy variables are not reported. *, **, *** denote the significance level at the 10%, 5%, and 1% levels, respectively. The Boone indicator is winsorised at 99%.

CHAPTER 5

Bank Competition and Financial Stability in the Middle East and North Africa (MENA) region

5.1 Introduction

In the new global economy, the effect of competition on the stability of banks has become a central issue for academics and regulators, particularly since the global financial crisis (GFC) of 2007-2009. It is now well established from various studies that there are two strands in the literature assessing the relationship between competition and stability in banking. However, neither theoretical nor empirical studies have reached conclusive findings on this relationship (Davis and Karim, 2019; Beck, 2008). Under the traditional "competition-fragility" view, also called the "charter value" view of banking modelled by Marcus (1984), Chan et al. (1986) and Keeley (1990), the more concentrated and less competitive banking systems tend to be, the more stable ones. Over the past two decades, however, Boyd and De Nicol*ó* (2005) have found evidence of the positive relationship between competition and banking system fragility that may consequently increase the probability of systemic distress; this is called the "competition-stability" view.

A significant reason behind the ambiguity of the relationship between competition and stability is that appropriate measures of both are lacking. Decades of theoretical and empirical research have attempted to provide cohesive approaches for assessing financial stability, but the interdependence and complexity of the financial system elements and the economy make this a challenging task. Bank stability is usually measured either by systemic or individual bank distress. Measuring bank competition, for its part, is subject to different theories in the literature. Liu et al. (2013) review the theoretical and methodological issues related to bank competition indicators and emphasise the adoption of indicators and careful interpretation in assessing competition. Leon (2015) provides a critical review of banking competition measures by discussing the strengths and weaknesses of each indicator. Bikker and Spierdijk (2017) claim that it is useless to try to generalise the soundness of competition measures. Northcott (2004) states that there is no consensus on the best measure of bank competition because the current indicators provide inconsistent results across countries, within countries and over time. Carbò et al. (2009) point out that each indicator of bank competition depends on different things and is affected by cross-country variations such as cost efficiency, fee income levels and macroeconomic indicators. Some studies have focused on banking competition as it affects financial stability (Allen and Gale, 2004; Beck et al., 2006; Anginer et al., 2014; Corbae and Levine, 2019) and have described how it could reduce systemic risk (Schaeck et al.,2009). Others have examined the intensity of competition between banks by using one or several measures in a specific country or across countries over a long period (Coccorese, 2004; Schaeck et al., 2009; Bikker et al., 2012; De-Ramon and Straughan, 2016). Many theoretical studies have investigated the consequences of banking competition on access to finance, on prices and the quality of financial products, financial innovation, and economic development (Leon, 2015). However, determining the most accurate measure is still a matter of debate because each indicator implies something different about the level of banking competition.

Some empirical papers have emerged that offer contradictory findings of the relationship between market concentration and financial stability. Berger et al. (2009) indicate that the two views do not initiate opposing assessments of the relationship between bank competition and financial stability. They argue that bank risks may not rise even if market power provides incentives for riskier asset portfolios since banks can secure their franchise value by adopting various methods such as increasing equity capital, selling credit derivatives, and reducing interest rate risk to compensate for greater risk exposure. In contrast, Boyd et al. (2006) note that the two strands make contradictory predictions about a bank's risk-taking but similar predictions regarding portfolio allocations. Martinez-Miera and Repullo (2008) suggest that both strands have merit and claim that there is a nonlinear, inverse U-shaped relationship between bank competition and risk. They find evidence that excessive competition can either boost or mitigate bank risk-taking, depending on the degree of competition in the market at the time.

A substantial body of papers has focused on investigating the relationship between competition and bank stability using data from one country, from pairs of countries at a time and from larger groups of countries. However, there have been few empirical investigations into the situation of banks operating across the MENA region. Thus, it is of interest to assess the relationship between the region's banking competition and financial stability. The data in the present sample come from banks operating in sixteen MENA countries over the period 1995- 2018, namely: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and the United Arab Emirates. The original sample included nineteen MENA countries; however, because of data availability and the low number of observations, we omitted Djibouti, Mauritania, and Yemen. It is worth noting that our sample covers most of the banks operating in the MENA region in terms of their number and total assets. We divide the sample into two subsamples according to their oil production.

The financial systems in the MENA region have since the 1990s undergone intense financial reforms for the sake of macroeconomic stability. However, one of the main challenges influencing the region's financial systems is the volatility in the hydrocarbon sector. It is well-known that MENA economies depend on oil, which exposes them to global oil price fluctuations. Prasad et al. (2016) argue that there is a direct connection between heavy dependency on oil and less diversified economies, mainly in most oil-producing countries, leading to high vulnerability for their fiscal revenues and export outcomes. On the other side, oil-importing economies in the region are also exposed to similar risks. This boosts their macroeconomic volatility and their limited external and fiscal buffers and weak policy frameworks.

Hence, oil exporters and importers are highly susceptible to shocks. Furthermore, most countries in the region have high levels of public debt, fiscal and current account deficits, limited foreign exchange reserves, and a massive credit concentration level (more than 40 percent of credit facilities are allocated for personal and real estate loans). Following the changes in global financial regulation and the importance of setting macroprudential policies[120] in response to the GFC, MENA countries have adopted prudential regulation in terms of capital and liquidity. Moreover, various central banks have set up a financial stability unit, constructed stress testing of banks and are in the process of building an early warning system (Prasad et al., 2016).

The importance and originality of the present study derive from transcending the current literature and being the first to use several competition measures (5-bank concentration ratio, the Herfindahl-Hirschman Index (HHI) and the Lerner index) of the MENA region and bank risk measures (Insolvency risk (Z-score), credit risk, liquidity risk, portfolio risk and leverage risk). Furthermore, because the region has suffered from political instability and socio-economic turmoil for almost a century, we include an indicator of political risk in the model to assess its effect on bank stability. Investigating this effect is crucial for policymakers in this region who set monetary policies specifically to enhance financial stability and ensure macroeconomic stability. Thus, we hope to provide insights into the relationship between competition and stability in the MENA region and offer results that will help policymakers set new policies or comply with international standards.

Given our data and the results of the Hausman test, we adopted the fixed-effect model in panel ordinary least square (OLS), but the use of empirical data brought the problem of heteroskedasticity. To overcome this problem, the most common method is to use the GMM (Generalized Method of Moments) model (Berger et al., 2009). Thus, we employed dynamic panel data regression using a systemic GMM model as a robustness check and treated activity restrictions, capital regulatory freedom and economic freedom index[121] as instrumental variables, following the methodology of Martinez-Miera and Repullo (2008), Berger et al. (2009), Anginer and Demirguc-Kunt (2014) and Danisman and Demirel (2019). We tested the goodness of fit (the validity of the instrumental variables (IV)) using the Sargan test (J-statistics), which implies that the null hypothesis of over-identifying restrictions was not rejected, and there was only a first-order autocorrelation (AR1). Hence, second-order autocorrelation

[120] Prasad et al. (2016) make a detailed study of the implementation of macroprudential policies in 12 Arab countries through demonstrating the outcome of a survey conducted by the International Monetary Fund (IMF) and the Arab Monetary Fund (AMF).

[121] The economic freedom index is calculated based on 12 quantitative and qualitative factors, grouped into four broad categories, or pillars, of economic freedom: Rule of Law (property rights, government integrity, judicial effectiveness), Government Size (government spending, tax burden, fiscal health), Regulatory Efficiency (business freedom, labor freedom, monetary freedom), and Open Markets (trade freedom, investment freedom, financial freedom). (See https://www.heritage.org/index/about)

(AR2) was unlikely to be significant, although more important to consider than AR1 because it indicates that the model does not suffer from second-order autocorrelation (Roodman, 2009).

The rest of this chapter is organised as follows. Section 5.2 reviews the previous literature on competition and stability in banking. Section 5.3 discusses the definitions and sources of the data and variables. In Section 5.4, we describe and justify the methodology applied in our analysis. In Section 5.5, we demonstrate and discuss the results of the chapter's empirical analysis. Section 5.6 concludes and presents some policy implications.

5.2 Theoretical Overview

A considerable amount of literature has been published on the relationship between banking competition and stability. However, neither theoretical nor empirical studies have been conclusive about this relationship (Beck, 2008; Davis and Karim, 2019). During the mid-1980s, several studies found that more concentrated and less competitive banking systems tended to be more stable – the "franchise value" view of banking modelled by Marcus (1984), Chan et al. (1986) and Keeley (1990). However, Boyd and De Nicoló (2005) show in their evidence over the past two decades the positive relationship between concentration and banking system fragility that may consequently increase the probability of systemic distress.

In a comprehensive study, Beck (2008) demonstrated several major activities that have changed the banking systems all over the world and have influenced bank competition and the soundness of the system; for instance, an anti-competitive policy to set activity and branching restrictions and capital controls on external borrowing/lending that were imposed after financial crises occurred in industrialised economies in the 1930s and the financial liberalisation during the 1970s and 1980s that caused banking fragility in many developed and developing countries. Moreover, the deregulation of the financial systems before the GFC 2007-2009, the rapid consolidation of banks around the world and the establishment of financial conglomerates, which provided a number of financial products, have raised alerts for policymakers regarding competition and stability of the banking system.

5.2.1 Measuring Financial Stability and Competition

A significant reason for the inconclusiveness about the relationship between competition and stability is that it is difficult to measure both these things appropriately. Bank stability is usually measured either by systemic or individual bank distress. Broadly speaking, systemic bank distress can be defined as the situation when the banking system cannot for some time perform any of its usual intermediary functions for the economy (Beck, 2008). The literature on systemic bank distress has gone further, introducing several specific definitions.

For Kaminsky and Reinhart (1999), a banking crisis signifies the occurrence of two events: the bank runs that consequently lead to closure or merges or drive the public sector to intervene and take over distressed banks and government to inject needed funds into an important financial institution. This definition has been recognised that financial institutions tend to hide this information as long as possible. Hence, data on bank failure and non-performing loans is mostly inaccurate and irregular. Klingebiel (1996) restricts his definition of a banking crisis to events requiring central bank intervention, meaning that the likelihood of a crisis can be determined by the presence or absence of supervisory interventions.

In another significant study, Demirgüç-Kunt and Detragiache (1998) identified a banking crisis by four conditions extracted from previous studies. Distress in the banking sector is considered a systemic crisis if one or more of the following conditions endures. First, if the ratio of non-performing assets to total assets is 10 percent or more. Second, if the policymaker's intervention to rescue banking fragility affects at least 2 percent of GDP. Third, if the banking distress has resulted from the large-scale nationalisation of banks. Finally, if various actions are taken in the market, such as massive bank runs, deposit freezes, extended bank holidays and government intervention by generalised deposit guarantees.

In a comprehensive study of all systemic banking crises during the period 1970-2017, Laeven and Valencia (2008, 2013, 2018) consider a banking crisis. Namely, it is considered to be systemic if, first, there are significant signals of financial distress in the financial system such as bank runs, substantial losses and liquidations in the banking system. Second, if there is a considerable intervention in the form of setting banking policy as a response to failures in the banking system. Borio and Drehmann (2009) introduce narrow and broad definitions of a banking crisis. The narrow one is that a banking crisis occurs in "countries where the government had to inject capital in more than one large bank and/or more than one large bank has failed"[122] and the broad one is that it occurs in "countries that undertook at least two of the following policy operations: issue wholesale guarantees; buy assets; inject capital into at least one large bank or announce a large-scale recapitalisation programme" (ibid, pg.39).

Nevertheless, researchers who have attempted to define systemic bank distress have met a major obstacle in determining the exact start and end year of the crisis. Reviewing all the papers and databases, as mentioned above, has meant that definitions and exact crisis periods for individual crises differ.

The main concerns of policymakers and bank supervisors are not exclusively those of systemic bank distress. Individual bank fragility also matters because it puts pressure on a country's safety net strategy (Beck, 2004). Moreover, various systemic bank crises have started in individual banks since failures of large banks can lead to systemic crises. Recently, the rapid consolidation of banks and the expansion of international financial institutions across borders have been able to trigger a crisis in several economies

[122] See Borio and Drehmann (2009, pg. 39).

as a result of the fragility of any of their large financial institutions, e.g., the GFC in 2007-2009 that started with the collapse of Lehman Brothers in the United States and moved to other economies, mainly developed countries, all around the world.

The literature on individual bank distress has highlighted several forms of measurement. The Z-score technique, a bank-level indicator of distance-to-default, has been employed as a proxy for financial fragility, which is the sum of the return on assets and the capital-asset ratio over the standard deviation of the return on assets (De Nicoló et al., 2006). A higher Z-score indicates a lower probability of insolvency risk and greater bank stability. Another indicator that has been used as a proxy for bank fragility is the non-performing loan ratio, which is an ex-post measure of credit risk (Jiménez et al., 2013). It is worth noting that the probability of individual bank distress may not necessarily result in an actual systemic banking crisis (Beck, 2008).

With regard to bank competition, many papers have been written on the measurements and effects of banking competition. Liu et al. (2013) review the theoretical and methodological issues related to such bank competition indicators as the concentration ratio, Herfindahl-Hirschman index (HHI), Lerner index, the Panzar and Rosse model and the Boone indicator, and emphasise the adoption of indicators and careful interpretation in assessing competition. Determining the most accurate measure is still in question because each indicator implies something different about the level of banking competition. Bikker and Spierdijk (2017) claim that it is useless to try to generalise the soundness of competition measures as a whole. Leon (2015) provides a critical review of banking competition measures by discussing the strengths and weaknesses of each indicator. He reasons that the evolution of various banking competition methods results from the complexity of competition: it is a complex notion that cannot be observed directly. Northcott (2004) and Carbò et al. (2009) state that there is no consensus on the best predictor of bank competition because every predictor yields an individual result; hence researchers misinterpret the competitive structure and behaviour within a given economy.

Smith (1998) focuses on the consequences of increased banking competition for macroeconomic performance. Other studies have focused on banking competition as it affects financial stability (Allen and Gale, 2004; Beck et al., 2006; Anginer et al., 2014; Corbae and Levine, 2019) and described how it could reduce systemic risk (Schaeck et al.,2009). Bikker and Spierdijk (2008) use data from all over the world to investigate developments in banking competition over time, given that anti-competitive practices, coupled with market failures in the banking industry, impair the productive efficiency of the banking industry the banking industry the economy (Goddard and Wilson, 2009). Other writers have examined the intensity of competition between banks by using one or several measures in a specific country or across countries over a long period (Coccorese, 2004; Schaeck et al., 2009; Bikker et al., 2012; De-Ramon and Straughan, 2016). Many theoretical studies have investigated the consequences of banking competition on access to finance, prices and the quality of financial products, financial innovation and economic development (Leon, 2015).

Historically, research on the measurement of banking competition is divided into two streams: first, the traditional Industrial Organization (IO) approach, formulated according to the basic conditions of banking, market structure, conduct and performance and public policy (Neuberger, 1998); this is called the Structure-Conduct-Performance paradigm. It indicates that a highly concentrated industry incurs lower costs from collusion, which leads to anti-competitive actions and higher profitability (Tan, 2016). Well-known examples of IO measures are the K-bank concentration ratio and the Herfindahl Hirschman Index (HHI). This approach limits the assessment exclusively to the market structure indices that could be influenced by factors other than the level of competition, such as barriers to entry, and performance measures that are influenced by the country's macro-performance, the taxing of financial institutions, quality of the judicial system, and other, bank-specific, measures, for instance, risk preferences (Baumol et al. 1983; Claessens and Laeven, 2004; Leon, 2015). Similarly, Coccorese (2017) points out that bank competition measurements that depend exclusively on the market structure are "crude" measures. He adds that the determination of competitiveness should incorporate a bank's behaviour[123], specifically during the past few decades, which have witnessed many industry changes. Shaffer and Spierdijk (2017) note that IO theorists have failed to provide models related to the unique oligopoly equilibrium outcome or to agree on the outcomes associated with rational behaviour. They add that all the oligopoly equilibrium concepts have different assumptions and estimations. For instance, the Cournot oligopoly theory[124] , which is the most popular model of imperfect competition, constructs a model based on quantities. Bertrand (1883) criticizes the Cournot oligopoly theory claiming that firm-relevant strategies are prices. Chamberlin (1933) and Robinson (1933) develop a workable competition theory, which means that the market consists of a mixture of competition and monopoly. Overall, Vives (2001) mentions that the static oligopoly theory has been criticized because it recognises the various forms of market structure.

Several writers in recent years have vigorously challenged the IO approach. Therefore, in response to the limited estimations of this approach, a non-structural approach to banking competition measurements was developed, namely, the New Empirical Industrial Organization (NEIO) measures which emphasise the efficiency hypothesis. This approach shows that high profitability is generated from the high operating efficiency of the largest bank(s) and is not due to a high concentration. In 1989, there was a dramatic shift in the IO approach, which ushered in a new era of NEIO established by Bresnahan (1989). These new measures are considered non-structural approaches that took as their starting point bank-level data and profit maximising firms (Lamers and Purice, 2017). Leon (2015)

[123] For instance, bank's ownership, and competition in different lines of business (see Coccorese, 2017).
[124] See Cournot (1838).

indicates that concentration measures are still adopted in finding the intensity of bank competition because they are easier to compute. Nevertheless, in the past two decades, several studies have emphasized other market structure factors, particularly entry/exit barriers. The NEIO focuses on using econometric models to estimate specific aspects of conduct in individual industries or similar markets, measure market power, and infer the variations in firms' collusive competition behaviour. The NEIO avoids the shortcomings of the SCP approach because it does not specify the market structure but instead infers it from regression. The first generation of NEIO non-structural approaches was built up based on oligopoly theory (the neoclassical conception of competition) (Leon, 2015), which is one of its major strengths (Liu et al., 2013).

The NEIO observes market conduct in specific industries directly and then interprets the observed patterns to determine the market structure. Under the NEIO, several alternative methodologies have been employed that need reliable data and assumptions. Liu et al. (2013) highlight that a growing empirical literature in the NEIO has investigated the behavioural models that determine how firms set their prices and quantities. Moreover, they demonstrate that the main challenge for NEIO research is to introduce ways of transferring behavioural relationships that are unobservable in the relationships where the variables can be observed. The non-structural indicators of the NEIO literature are built from the static theory of firm hypothesises under equilibrium conditions and focus on adopting some form of mark-up over a competitive benchmark (Carbó et al., 2009). Primarily, these measures have been used to compute realized conduct in firm pricing that depends on the measurements of monopoly power initiated by Lerner (1934). Iwata (1974) proposes the conjectural variation parameter for estimating prices in an oligopolistic market. Bresnahan (1982) focuses on testing competitive behaviour in a contestable market. Panzar and Rosse (1987) introduce the H-statistic, which determines bank competition intensity by connecting input cost changes to output price changes. Not long ago, Boone (2008) developed the Boone indicator, which focuses on profits and efficiency measures in competitive markets. It is considered to represent the new generation of non-structural measures, which depends on the market dynamics independently of static analysis (Leon, 2015).

Another significant aspect of assessing the relationship between competition and stability is the vital need to take into account various indicators of the regulatory framework (see Beck (2008), Berger et al. (2008), Uhde and Heimeshoff (2009), Anginer and Demirguc-Kunt (2014), Fu et al. (2014) and others) because these indicators can give insights into the contestability of the banking system, for instance, activity restrictions, supervisory power, capital regulatory, entry requirements and other regulatory requirements that may influence the structure of the market.

5.2.2 Bank Competition and Stability studies

The emerging empirical literature offers contradictory findings of the relationship between market concentration and financial stability (Uhde and Heimeshoff, 2009). We begin by introducing literature with a focus on one country, then move to pairs of countries and finally to cross-country studies.

5.2.2.a Bank-level studies

Keeley (1990) investigates the relationship mentioned above by using a sample of large US bank holding companies and finds evidence that bank competition increased following the deregulation[125] in the 1980s that reduced banks' capital cushions and raised risk premiums; it was reflected in the increase of interest rates on certificates of deposit. He concludes that higher competition eroded franchise values, and this consequently reduced the stability of the U.S. banking system. Demsetz et al. (1996) extend Keeley's (1990) empirical analysis and find that banks with greater charter value hold more capital and experience lower asset risk than banks with less charter value. Furthermore, banks with greater charter value maintain substantial diversified loan portfolios. Similarly, Dick (2006) focuses on the changes in regulations and market composition in the U.S. banking industry over the period 1993-1999. He concludes that the increase in charge-off losses and loan loss provisions resulted from the deregulation process in the 1990s. Akins et al. (2016) use a large sample of public and private banks operating in the U.S. to examine the relationship between bank competition and financial stability. They conclude that banks exposed to a less competitive environment tend to engage in risky activities, more regulatory intervention, and high vulnerability to failure.

Numerous studies have attempted to explain the diverse findings on the bank competition-stability relationship in Europe. Salas and Saurina (2003) show that liberalisation measures have boosted competition and eroded Spanish banks' market power. They find evidence that banks with less charter value have a lower equity-assets ratio and are exposed to higher credit risk. Another advocate of the franchise value view, Jiménez et al. (2007) use the Lerner index as a measure of the market power of Spanish banks for the period 1988 to 2003. They conclude that there is a negative relationship between market power and non-performing loans. However, they confirm that there is no evidence about the relationship between non-performing loan ratios and market structure measured by concentration ratios. Bofondi and Gobbi (2004) examine the relationship in the Italian banking system between entry into local credit markets and the default rates of the loans extended by the entrants. They conclude that default rates rise as the number of participants operating in the market rises.

Kasman and Kasman (2015) find similar results using the Turkish banking industry over the period 2002-2012 and report a positive relationship between competition and financial stability proxied by the

[125] The relaxation of state branching restrictions.

Z-score. Yaldız and Bazzana (2010) investigate the impact of market power on loan risk in the Turkish banking industry over the period 2001–2009; their results support the competition-stability view. Interestingly, Jeon and Lim (2013) focus on investigating the Korean banking system. They report new evidence that the relationship between competition and stability varies according to the type of bank, in particular, whether this is commercial or mutual. Zhao et al. (2010) confirm that deregulation measures in the Indian banking industry boost competition and, as a result, provide an incentive to take excessive risk.

Various studies have investigated bank competition and financial stability across pairs of countries. Bordo et al. (1995) compare the U.S. and Canadian banking systems in the twentieth century. They find greater financial stability in the Canadian than in the U.S. banks due to the oligopolistic market structure in Canadian banking, in particular, the interest rates paid on deposits and interest income acquired on securities which were higher in Canada, whereas the interest rates charged on loans were more or less similar in these countries.

Interestingly, Hoggarth et al. (1998) provide an in-depth analysis comparing the most stable banking systems in the world, those of the United Kingdom and Germany. Their results show that the UK banking system is more competitive but less stable than the German banking system. In another major study, Staikouras and Wood (2000) note a greater degree of competition and more stability in the Spanish banking system than the Greek one.

5.2.2.b Cross-country studies

A substantial and growing body of empirical literature has emerged which tests the relationships of concentration, competition and financial stability using large cross-country time-series datasets. Beck et al. (2006) mainly assess competition-fragility and competition-stability hypotheses, using data on 69 countries over the period 1980 to 1997 using panel logit models. They reveal that systemic banking crises are less likely to occur in highly concentrated banking systems, even after controlling for variations in the regulatory policies of the commercial banks and the national institutions influencing competition, macroeconomic conditions and shocks to the economy. Further, they disclose tentative evidence that concentrated banking systems provide incentives to banks to diversify risk, but they educe no evidence related to the supervision process. Lastly, they point out that bank concentration is not a sign of a lack of competition and claim that systemic banking crises are less likely to occur in more competitive banking systems.

Boyd et al. (2006) employ two samples in their analysis: first, a cross-section of 2500 small rural banks operating in the U.S., and, second, a panel of 2600 banks from 134 countries (omitting all the developed countries) over the period 1993 to 2004. They find evidence of a positive and significant relationship between the probability of bank failure and concentration. Moreover, there is no trade-off between bank competition and stability. Interestingly, De Nicoló and Loukoianova (2007) extend the results of Boyd et al., using data from 133 non-industrialised countries over the period 1993–2004. They present a model that predicts the relationship between banks' risk of default, market structure, bank ownership, and banks' screening and bankruptcy costs. They state that bank ownership significantly enhances the positive relationship between bank concentration and risk when included in the model. A sample of 1872 publicly traded banks from 63 countries over the period 1997 to 2009 was chosen by Anginer et al. (2012), using the Lerner index and default risk. They find a positive relationship between competition and systemic stability. Their results remain robust even when bank asset concentration is used as an alternative measure of competition.

In a study by Beck et al. (2006), based on data from 69 countries, it is shown that countries with less market concentration are less likely to experience financial distress. Uhde and Heimeshoff (2009) conclude that there is an inverse relationship between bank concentration and financial stability through analysing aggregated data for the EU-25 countries. Agoraki et al. (2011) focus their study on the Central and Eastern European banking system; their results suggest that market power is inversely related to banks' risk-taking behaviour. In a recent study, Davis and Karim (2019)[126] use two banking competition indices (the H-statistic and the Lerner index) to investigate the short- and long-run relationships for banks operating in the 27 EU countries by dividing the sample period into the six years before and since the GFC 2007. Their study offers some important insights into the relation of competition to stability, taking into account the effect of the GFC 2007. They find that both their bank competition measures have a positive short-run relationship with risk. In contrast, long-run effects vary: the H-statistic shows a negative relationship with risk and the opposite correlation with the Lerner index.

In an analysis of 14 Asia-Pacific countries, Fu et al. (2014) show that greater concentration promotes financial fragility and also that lower pricing power fosters bank risk exposure. Liu et al. (2012) use various bank-specific risk measures for five South-East Asian countries; their results show that competition is negatively related to most risk measures. These authors suggest that bank competition does not erode bank stability. In an investigative study of South-East Asian banking systems, Molyneux and Nguyen-Linh (2008) find no evidence that competition boosts bank risk-taking. In a recent study, Noman et al. (2017) employ various competition measures and bank stability indicators to investigate the competition-stability nexus in the Association of Southeast Asian Nations over the period 1990 to 2014. Their results suggest that the H-statistics (on competition) is positively related to the Z-score (stability) and the equity ratio but inversely related to the non-performing loan ratio. As measured by the Lerner index, market power is negatively related to the Z-score and equity ratio and positively to the non-performing loan ratio.

[126] See Davis and Karim (2019): they present a table summarizing recent empirical studies on bank competition and risk in banking.

In a study that sets out to test the two views, Berger et al. (2009) regress the indicators of loan risk, bank risk and bank equity capital for 23 developed economies on various indicators of market power, in addition to measures of the business environment. They propose the traditional competition-fragility view and find evidence that supports only one element of it, which is that market power induces loan portfolio risk. These authors suggest that banks may increase their equity capital ratios to overcome this problem and protect their franchise value. Schaeck et al. (2009) report that banks operating in a more competitive marketplace hold higher capital buffers, and in their results, these authors suggest that there is little likelihood that competitive banking markets will experience systemic banking crises. Schaeck and Cihak (2008) gathered financial data from ten European countries and the U.S. for the period 1995 to 2005 to investigate the relationship between soundness and bank competition captured by the Boone indicator. They find a positive relationship and note that financial stability benefits highly concentrated banking markets. A number of cross-country studies suggest that anti-competitive regulatory policies such as imposing restrictions on entry and a bank’s activities are inversely related to bank stability. Levine and Barth (2001) and Beck et al. (2006) assert that banking systems which set anti-competitive policies are more likely to experience systemic banking crises. However, capital regulations are not significantly related to such incidents. Using the H-statistics, De Bandt and Davis (2000) investigate the impact of the Economic and Monetary Union (EMU) on market conditions for banks operating in countries with a single currency. They find evidence that large banks’ behaviour is not fully competitive when compared with that of U.S. banks. In small banks, the level of competition is notably low, particularly in France and Germany.

In her analysis, Turk-Ariss (2010) examines how variations of market power affect bank efficiency and stability in developing countries[127] for the period 1999-2005. The results suggest that a rise in the degree of market power generates greater bank stability and boosts profit efficiency, notwithstanding substantial losses. This in some ways supports the traditional competition-fragility hypothesis. Similarly, Yeyati and Micco (2007) use a sample of commercial banks from eight Latin American countries over the period 1993–2002 and employ the Z-score as a proxy for financial stability and the Panzar and Rosse (1987) H-statistic for competition. They find that there is a positive relationship between bank risk and competition, but the coefficient of bank concentration is not significant.

Although extensive research has been carried out on the relationship between concentration, competition and financial stability, few studies have investigated this in the MENA region. Naceur and Omran (2011) concentrate on the effect of bank regulation, concentration and financial and institutional development on commercial bank margins and profitability, using 173 banks from ten MENA countries for the period 1988-2005. Their results suggest that bank capitalisation and credit risk significantly affect the bank's net interest margin, cost efficiency, and profitability. Furthermore, there is no evidence,

[127] Sixty countries from Africa, East/South Asia and the Pacific, Eastern Europe and Central Asia, Latin America and the Caribbean, and the Middle East.

except for inflation, on the impact of measuring macroeconomic and financial development on the net interest margin. Regarding regulatory and institutional variables, research has shown their effect on bank performance. Using data from 276 banks operating in eighteen MENA countries over the period 2006 to 2015, Albaity et al. (2019) have found that competition had a negative and significant impact on stability and profitability indicators but a positive effect on the non-performing loans ratio.

Interestingly, they report that Islamic banks are less competitive, but a boost in competition motivates them to pursue higher risk-taking behaviour than conventional banks exhibit. González et al. (2017) gather data from 19 MENA countries during the period 2005 to 2012 to investigate the competition-stability nexus. Their results show an inverse relationship between competition and stability, particularly in the Gulf states. In terms of the non-Gulf countries, a rise in competition in uncompetitive markets may create a surge in financial stability. They suggest that although concentration is not associated with uncompetitive markets, the model's market structure is an essential ingredient. Ghenimi et al. (2017) concentrate on investigating the primary sources of banking fragility, using a sample of 49 banks in the MENA region during the period 2006 to 2013, particularly the relationship between liquidity and credit risk and its effect on bank stability. They show that each type of risk has its own impact on bank stability; and, further, that their interaction induces bank instability.

Overall, there is a consensus from several studies that a positive relationship links bank competition to stability. However, there are conflicting results on the relationship between concentration and stability (Beck, 2008). Berger et al. (2009) indicate that the two views do not initiate opposing estimations regarding the relationship between bank competition and financial stability. They argue that bank risks may not rise even if market power provides incentives for riskier asset portfolios, since banks can secure their franchise value by adopting such varied methods as increasing equity capital, selling credit derivatives and reducing the interest rate risk to compensate for the greater exposure to risk as a whole. Boyd et al. (2006) note that the two strands predict opposed results of bank risk-taking but encourage similar views on portfolio allocations. They also show that both hypotheses can predict that banks will allocate greater amounts of their total assets to lending as bank competition rises. Berger et al. (2004) and Beck (2008) confirm that market structure measurements may not be appropriate to competition because the concentration of the banking system can affect stability through other ways than competition.

5.2.3 Political Risk and Bank Stability

Despite the importance of political risk, there is little evidence of its effect on bank risk. A search of the literature reveals few studies which focus on the impact of political risk on the stability and efficiency of the banking sector. Liu and Ngo (2014) observe that "political interference"[128] in banking has been the most important risk since the global financial crisis (GFC) of 2007-09. Beck (2011) argues that the link between politics and banking is complex, and further work is needed to fully understand its implications for the banking system, particularly in the aftermath of the GFC. Similarly, Calomiris and Haber (2014) compare the frequent systemic banking crises that have occurred in the U.S. with the total absence of them in Canada since 1840 and claim that the reason may be the different political institutions in the two countries.

In a comprehensive study, Roe and Siegel (2011) report strong evidence that political instability severely affects financial development. Furthermore, they point out that in explaining financial fragility, political instability is a significant issue. In markets with a more democratic environment, political institutions tend to maintain and enhance bank stability, which can effectively protect all the minor and major participants in the market. Several studies support this view: Bordo and Rousseau (2006) write about the effect of stable political regimes and more restrictions on political power; Girma and Shortland (2008) about the country's democratic characteristics; and Verdier and Quintyn (2010) about political accountability. Similarly, Ashraf (2017) investigates the impact of political institutions on bank risk-taking behaviour, using data on banks from 98 countries between 1998 and 2007 and then extending this period to 2014. He concludes that sound political institutions provide incentives for banks to take excessive risks and notes that political and legal institutions complement each other in affecting banks' risk-taking behaviour. Cheng et al. (2019) argue that banks with fewer political connections tend to take low risks due to moral hazards. Interestingly, they claim that banks with political connections are able to provide many loans with more minor loan-loss provisions, unlike banks with fewer political connections, particularly during periods of higher policy uncertainty.

In a recent cross-sectional study of 69 emerging and developing countries, Bermpei et al. (2018) conclude that political stability and control of corruption play an essential and positive role in strengthening the impact of capital regulation and activity restrictions on bank stability. By drawing on the concept of political risk, Chen et al. (2015) also focus on the effect of corruption. They use data from 35 emerging economies and find that corruption raises bank risk-taking because it provides an adverse sign of corporate governance.

Regarding the context of the MENA region, it has suffered from political instability and socio-economic turmoil[129] for almost a century. Since World War II, the MENA region has experienced several wars and conflicts; for instance, the Arab-Israeli war in 1948, civil wars in Lebanon (1975-1990), in Sudan (1985-2005), ongoing multi-sided conflicts in Iraq, Syria, Yemen and Libya, the Kurdish-Turkish

[128] This was a result of the biannual Banking Banana Skins survey, convened jointly by the Centre for the Study of Financial Innovation (CSFI) and Pricewaterhousecoopers (PwC) (see Liu and Ngo, 2014).
[129] (See Gasiorowski (2016) and Al-Shboul et al. (2020)).

conflict which began in 1978 and the military operations of the first and second Gulf wars (1981-2003). In the past decade, major episodes of political violence have occurred in relation to the Arab Spring, namely, a series of anti-government protests in Tunisia, Libya, Egypt, Yemen, Syria and Bahrain. In addition, social violence and rebellion have been seen in many countries in the MENA, notably regarding the economic sanctions against Iran, Syria, Sudan and Qatar. Ghenimi et al. (2017) mention that the global financial crisis (GFC) 2007-09 and the oil price crisis in 2014 negatively affected the banking systems because these incidents contributed to reducing the availability of credit across the region. Agnello and Sousa (2012), however, claim that the GFC triggered investors' confidence. Alqahtani et al. (2017) point out that, between 2014 and 2017, oil prices decreased by 70 percent, leading to a massive reduction in bank profits and credit.

Following the reforms in the developed countries after the dramatic effect of the GFC, the authorities in the MENA region have implemented various global and local regulatory and policy reforms to overcome the adverse impact of political and economic instability. They include the financial liberalisation policies that have removed barriers to the entry of foreign investors, the adoption of World Trade Organization (WTO) guidelines, and the Basel II and III accords that encourage banks to mitigate risk by boosting liquidity, capital, supervisory power and market discipline (Al-Shboul et al., 2020). Haque and Brown (2017) claim that political and economic turmoil in the MENA region, in addition to the changes in regulatory reforms, is considered a significant source of political risk. Ashraf (2017) mentions that political risk influences bank risk through the quality of a country's legal institutions and the competition in the banking industry. This view is supported by Al-Shboul et al. (2020), who state that government uncertainties and greater information asymmetries also influence bank risk.

Al-Shboul et al. (2020) argue that it is essential to investigate the relationship between political risk and bank risk-taking in the context of the political economy of the countries in the MENA region. A study by Herrala and Turk-Ariss (2016) show that political stability determines firms' investment portfolio mainly via its impact on credit conditions. Moreover, political instability imposes borrowing restrictions and limits capital accumulation, thereby negatively affecting economic growth. Ghosh (2016) investigates the effect of the Arab Spring[130] on MENA banks during the period 2000 to 2012, saying that it reduced profitability and increased bank risk. Evidence shows that bank lending has not been affected, but the lending rate has increased roughly by 1.3 points. In a recent study, Al-Shboul et al. (2020) employ several measures[131] of bank risk-taking and find that political instability has a

[130] The Arab Spring was a series of anti-government protests and pro-democracy uprisings that occurred across different countries in the Arab world in the early 2010s. It erupted in response to oppressive regimes, the low standard of living and youth frustration in Tunisia. Then it spread to five other countries: Libya, Egypt, Yemen, Syria and Bahrain. It resulted in regime changes and the ousting of several dictators in Tunisia, Egypt, Libya and Yemen.
[131] Insolvency, credit, liquidity, portfolio, and leverage risk (see Al-Shboul (2020).

statistically significant effect on bank stability. Generally, results show that political risk enhances bank risk in every action taken to reduce bank stability in the MENA region.

Overall, assessing the relationship between political risk and bank stability is complex, and there is still no conclusive evidence of its implications. Before proceeding to present our dataset, it is important to clarify the variables used in our model.

5.2.4 Overview of the variables

In the subsections that follow, we present specific definitions of the variables referred to, with a focus on the MENA region. Then we report the expected sign of each variable, as discussed in the research literature.

5.2.4.1 Dependent variables

5.2.4.1.a Bank risk measures

A large and growing body of literature has investigated the relationship between competition and bank soundness; for this task, a number of techniques have been developed. Beck et al. (2006), Demirgüç-Kunt and Detragiache (2002), Barrell et al. (2010) have focused on historical episodes of banking crises as a proxy of financial soundness. However, Uhde and Heimeshoff (2009) argue that although a banking crisis can be an appropriate measure of banking stability, its significance may be distorted because of the following features. First, dating the beginning and end of banking distress is uncertain because banking crises are defined differently across countries. Second, it might be implied that a banking crisis could result from regulatory failure; thus, regulators may be less inclined to declare such an incident. Third, the failure of dominant banks operating in the market compels regulators to implement financial restructuring programmes to avoid the effects of contagion.

In the context of the MENA region, we face even more particularly problematic data issues. In the particular sample under scrutiny, we cannot depend on historical episodes of banking crisis to assess the stability of the banking sector or to measure financial soundness because, according to the data of the updated version of systemic bank crises constructed by Laeven and Valencia (2018), only two systemic banking crises occurred during the period in question: Yemen in 1996 and Turkey in 2000. Bearing this in mind, we follow Uhde and Heimeshoff (2009) and Fu et al. (2014) and take the banks' probability of bankruptcy as a proxy for bank fragility, applying the Z-score technique and other measures of bank risk-taking as a robustness test (Danisman and Demirel, 2019; Al-Shboul et al., 2020). Berger et al. (2017) note that it is essential to treat loan risk and banks risk as dependent variables when investigating the impact of market power on bank risk.

As discussed in section 5.2, the Z-score has been widely used in the literature as a stability measure (Boyd and Runkle, 1993; Laeven and Levine, 2009; De Nicoló et al., 2003; Houston et al., 2010; Lepetit and Strobel, 2013; Davis and Karim, 2018). It indicates the extent of bank insolvency risk by measuring the number of times of standard deviation that a bank's rate of return on assets (ROA) has to undergo for the bank to be insolvent (Al-Shboul et al., 2020). It is calculated by using the accounting information of the return on assets, its volatility and leverage for each bank *i* operating in country *j* at time *t*, as follows:

$$Z_{i,j,t} = \frac{ROA_{i,j,t} + TE_{i,j,t}/TA_{i,j,t}}{\sigma ROA_{i,j,t}} \qquad (1)$$

where $Z_{i,j,t}$ is the Z-score for bank *i* operating in country *j* at time *t*, ROA is the return on assets, TE/TA is the total equity over total assets (capital ratio) ,and σROA is the standard deviation of return on assets (ROA volatility).

The Z-score contains two components: the leverage risk, which is the equity to assets ratio over the standard deviation of the return on assets; and the portfolio risk, which is the return on assets over its standard deviation (Lepetit et al., 2008; Barry et al., 2011). Hence, the Z-score rises with the bank's profitability proxied by the ROA and capital ratio and falls with increasing return volatility (Uhde and Heimeshoff, 2009). Put differently, a higher (lower) Z-score implies a lower (higher) probability of default (insolvency) risk. Since the three risk measures are highly skewed, we follow the approach of Laeven and Levine (2009), Houston et al. (2010) and Beck et al. (2013) by taking the natural logarithm of the measures.

As indicated previously, another measure of bank risk-taking is liquidity risk (Bourgain et al., 2012). It is computed by using the ratio of liquid assets over total assets for bank *i* operating in country *j* at time *t*. Higher values imply lower liquidity risk exposure because depository institutions are able to obtain cash for unanticipated withdrawals from their liquid assets.

$$Liq_{i,j,t} = \frac{LiqA_{i,j,t}}{TA_{i,j,t}} \qquad (2)$$

where $Liq_{i,j,t}$ is the liquidity ratio which is used as a proxy for the liquidity risk for bank *i* operating in country *j* at time *t*, LiqA is the liquid assets, TA is the total assets.

Credit risk is another measurement that gives insights into the assessment of financial stability (Houston et al., 2010; Berger et al., 2017; Roman et al., 2015). It is calculated by using the ratio of non-performing loans to gross loans for bank *i* operating in country *j* at time *t*. A higher value of the index implies a higher bank credit risk.

$$CR_{i,j,t} = \frac{NPL_{i,j,t}}{100 - NPL_{i,j,t}} \qquad (3)$$

where $NPL_{i,j,t}$ is the ratio of non-performing loans to gross loans for bank *i* operating in country *j* at time *t*.

5.2.4.2 Independent variables

Uhde and Heimeshoff (2009) point out that when investigating the effect of banking concentration on stability, it is essential to control for macroeconomic, bank-specific, regulatory and institutional indicators that are likely to have an impact on market structures financial stability or both. Moreover, we use control variables to mitigate the omitted variable biases that could cause the endogeneity problem.

5.2.4.2.a Concentration and competition measures

The measurement of banking competition is divided into two streams: first, the traditional Industrial Organization approach (IO) that was formulated from the basic conditions, market structure, conduct and performance and public policy (Neuberger, 1998). This approach is called the Structure-Conduct-Performance paradigm. It proposes that dominant banks are keen to adopt anti-competitive behaviour, and competition intensity is negatively related to concentration results. The leading indicators of this approach are the top k-largest banks and the Herfindahl-Hirschman index (HHI). The second approach (the “New Empirical Industrial Organisation” approach) has been emphasised by most researchers on banking competition over the past few decades to mitigate the limitations of the concentration measures as predictors of competition. The most widely used indicator in the banking literature is the Lerner index.

The k-bank concentration ratio is constructed directly from the data available of the three, five, or ten largest banks operating in the market and is straightforward to calculate. The k-bank asset concentration ratio estimates the market share of the k banks in the market:

$$CR_k = \sum_{i=1}^{K} s_i \ , \qquad with\ s_1 \geq \ \cdots \geq s_K \geq s_N \ , \qquad \forall\ N \geq K \qquad (4)$$

where s_i is the market share of i operating bank, when banks are classified in descending order of market share and N is the total number of operating banks. Thus, this indicator emphasises the k dominant banks equally and does not take into account small banks in the market. We adopt the value of the 5-bank concentration ratio due to the different numbers of banks operating in the countries of the MENA region. Zero is used when there is an infinite number of equally sized banks; hence, the market is in a condition of perfect competition, while one indicates that the banks (depending on the chosen k) included in the calculation construct the entire industry, which demonstrates a monopoly situation.

The HHI is a statistical measure of the bank's concentration that is considered the benchmark for assessing other concentration indices (Bikker and Haaf, 2002). It falls under the SCP paradigm that argues an increasing relationship between market concentration and market power. Put differently; it means greater concentration: less competitive conduct: greater profits. It is much more data-sensitive than the concentration ratio previously mentioned because it requires data on the size distribution of all the banks (meaning the market share of every bank) (Calkins, 1983). The lowest value of HHI refers to equal market shares, and a high HHI indicates that one firm has a substantial market share.

The HHI is widely applied in the banking context due to the simplicity of its calculation: it takes the sum of the squared market share of all banks operating in the market, that is:

$$HHI = \sum_{i=1}^{N} s_i^2 \ , \ \ \forall i = 1, \cdots, N \qquad (5)$$

where s_i is the market share of i operating bank and N is the total number of banks in the market. We compute the HHI by using total assets market share.

The Lerner index (price-cost margin) is one of the non-structural measures of competition that measures the market power of a bank through computing the divergence between the bank's price and its marginal cost (Lerner, 1934). We compute the Lerner index for each operating bank and each year of our examined sample using the standard approach.

The Lerner index (L) is estimated as:

$$L_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} \qquad (6)$$

where P is the output price, which is computed as the ratio of gross revenues to total assets for operating bank i at time t with MC as the marginal cost. The subscript i denotes bank i and t denotes time t. In line with the common empirical literature, we take deposits as an input to the production of multiple financial products. For the output price, we use the single-output approach following Fernández Guevara et al. (2007), Berger et al. (2009) and Weill (2013) to take total assets as a proxy. $P_{i,t}$ is computed as total revenues (interest and non-interest income) over total assets.

5.2.4.2.b Bank-level variables

With regard to the bank-specific variables, in line with the relevant literature (Houston et al., 2010; Beck et al., 2013; Berger et al., 2015), we employ several bank characteristics as control variables that are widely used as determinants of bank risk. The control variables bank size, liquidity, profitability and capitalisation are used to account for the bank's business model.

The bank size is obtained by taking the natural logarithm of total assets. Boyd and Runkle (1993) state that larger banks can diversify their income sources and be more stable than small banks. Laeven et al. (2016) highlight the debate on bank size as a determinant of systemic risk by introducing these reasons for it: first, large banks were the most vulnerable institutions in the Global Financial Crisis of 2007-09; then, over the past two decades, the size of the large banks has considerably increased' and finally that large banks tend to engage in more risky investments and have lower capital ratios. These authors find evidence that systemic risk rises with bank size.

$$BnkS_{i,j,t} = \ln(TA_{i,j,t}) \tag{7}$$

where $BnkS_{i,j,t}$ is bank size for bank *i* operating in country *j* at time *t*. TA, is the total assets for bank.

We use the ratio of net loans to total assets as a measure of liquidity. Cornett et al. (2011) claim that banks may tend to hold more liquid assets to overcome any monetary shocks that could affect their loan portfolio.

$$\mathrm{NetLNTA}_{i,j,t} = \frac{NetLN_{i,j,t}}{TA_{i,j,t}} \tag{8}$$

where NetLN is the net loans, TA is the total assets for bank *i* operating in country *j* at time *t*. The ratio of net loans to total assets.

Moreover, the ratio of net interest margin as a measure of profitability is employed to provide insights into the profitability of the bank's lending and investing activities (Fu et al., 2014). Chalermchatvichien et al. (2014) note that banks with solid operational profitability acquire stable income streams.

$$NIM_{i,j,t} = \frac{NII_{i,j,t}}{AvgEA_{i,j,t}} \tag{9}$$

where NII is the net interest income, Avg EA is the average earning assets for bank *i* operating in country *j* at time t. The bank's net interest income can be expressed as a share of its interest-bearing (total earning) assets.

We also use the capital adequacy ratio as a proxy for bank capitalisation. Furlong and Keeley (1989) mention that banks that hold a capital ratio more than the minimum requirements undermine banks' incentive to engage in risky investments by reducing the moral hazard problem initiated by deposit insurance; they also have a larger buffer against losses. Similarly, Anginer and Demirgüç-Kunt (2014) find that higher capital requirements reduce system-wide fragility.

5.2.4.2.c Industry-level variables

Turning now to discuss the banking-industry-level variables, we see that Beck et al. (2006) mention that it is vital to use cross-country variation in bank regulatory policies and national institutions in estimating the impact of concentration and competition on bank stability because it gives indications of the competition-stability relationship through a simple robustness check. It also provides more information about the links between bank regulations, the institutional environment and financial stability. Al-Shboul et al. (2020) argue that solid bank regulation and supervision tend to minimise adverse selection and moral hazard, hence, enhancing bank stability. In line with previous studies (Beck et al., 2006; Laeven and Levine, 2009; Goddard et al., 2001), we use activity restrictions, supervisory power, and capital regulatory and deposit insurance as control variables.

Activity restrictions give an insight into the bank's ability to offer fee-paying products. It indicates the extent of regulatory restrictiveness for bank involvement in the securities market, insurance activities, real estate activities, and the ownership of non-financial firms (Fu et al., 2014). Imposing greater activity restrictions may play a role in improving bank stability because it prevents banks from engaging in risky lines of business. However, it negatively affects a bank's portfolio diversification, which in turn limits financial stability and tends to make it more fragile (Uhde and Heimeshoff, 2009).

The supervisory power index indicates the extent to which a country's supervisory body has the authority to impose corrective actions in banking decisions. Anginer et al. (2014) argue that higher supervisory power may boost financial stability through enhancing market discipline and reducing risk-taking incentives and moral hazard.

The capital regulatory index proposed by Barth et al. (2004) is an indicator of initial capital stringency and capital requirements. Uhde and Heimeshoff (2009) claim that greater capital stringency provides an incentive for prudent behaviour. They expect soundly capitalised banks to be more stable than others with less capital. Furthermore, Schaeck and Cihak (2007) and Schaeck et al. (2006) use banks' capital ratio as a proxy for financial soundness; thus, it is an appropriate variable to include in our analysis.

The last three variables mentioned above are obtained from readily available data[132] from the World Bank database of Bank Regulation and Supervision Survey (BRSS) constructed and updated by Barth et al. (2001, 2008a, 2008b), Cihak et al. (2012), and Anginer et al. (2019).

Deposit insurance schemes have an essential role in reducing fragility by preventing bank runs. However, this initiates a moral hazard problem because it tends to motivate banks to make risky

[132] There is a particular disadvantage with the BRSS-World Bank database because it shows a block data for several years. Consequently, some changes that took place such as different macroeconomic conditions, policy applications, and changes in accounting and regulatory standards were not reflected in the data. However, we use this database to remain in line with previously mentioned authors.

investments (Demirgüç-Kunt and Detragiache, 2002; Uhde and Heimeshoff, 2009; Fu et al., 2014). Similarly, Diamond and Dybvig (1983) state that in competitive marketplaces, generous deposit insurance may mitigate bank stability. We use deposit insurance as a dummy variable that takes the value of one if a country has an explicit deposit insurance scheme and zero otherwise.

5.2.4.2.d Country-level variables

The rate of GDP growth is a macroeconomic control variable in the model that captures the fluctuations in economic activity. Jokipii and Monnin (2013) find a positive correlation between banking stability and real GDP growth and argue that this correlation can be adopted to enhance GDP growth forecasts. Kasman and Kasman (2015) state that the annual growth rate of real GDP is included because problem loans develop in line with the business cycle.

Following Uhde and Heimeshoff (2009) approach, we include the economic freedom index, which is a time-variant composite index of ten single freedoms constructed by the Heritage Foundation[133]. Greater freedoms may lead to either higher stability or greater fragility. Increasing the level of freedom may encourage banks to engage in various business lines and diversify their portfolios efficiently, which tends to boost their financial soundness. Yet relaxing the regulations gives an insight into banks' adopting an aggressive strategy and engaging in risky investments that consequently lead to greater bank fragility.

Investigating the trade-off between concentration, competition and financial stability, particularly in the MENA region, compels us to check whether political risk indicators play a role since the MENA region has been exposed to political and socio-economic turmoil for almost a century (Al-Shboul et al., 2020). We gather the political risk data of each country from two sources: the political risk in the International Country Risk Guide (ICRG) published by the Political Risk Services Group (the PRS Group); and, as a robustness check, the political stability and absence of violence index which is one of the Worldwide Governance Indicator components published by the World Bank and Kaufmann et al. (2009).

The ICRG provides a monthly political risk index for 140 countries around the world; we compute the average values to transform the index into annual values to use in our model. It captures the overall political stability of each country as reflected in twelve risk components covering political and social characteristics. The index ranges from zero to one hundred, where a higher (lower) value implies higher (lower) political stability or lower (higher) degree of political risk. An alternative indicator of political risk is the political stability and absence of violence index that varies from -2.5 to 2.5, where higher (lower) values indicate higher (lower) political stability.

[133] See Caudill et al. (2000) for the reason behind using the Heritage Foundation data.

Table 5.1 below shows the variables used in our model, as discussed in the literature, to explain the factors determining the relationship between concentration, competition and risk.

Table 5.1: Variables expected sign

Variable	Expected sign
Dependent variables: Bank stability measures	
Portfolio risk	
Leverage risk	
Z-score (insolvency risk)	
Liquidity risk	
Credit risk	
Main independent variables	
Bank Competition measures	
5-Bank Concentration ratio	(+/-)
HHI	(+/-)
Lerner index	(+/-)
Independent control variables	
Bank-level data	
Size	(+/-)
Net Loans to Total assets	(-)
Net interest margin	(-)
Capital adequacy ratio	(-)
Industry-level data	
Activity restrictions	(+/-)
Supervisory power	(+/-)
Capital regulation	(+/-)
Deposit insurance	(-)
Country-level data	
GDPg	(-)
Economic Freedom	(+/-)
Political stability (WGI)	(-)
Political risk (ICRG)	(-)

5.3 Data

In order to test the hypothesis of stability, fragility and political indicators, we now discuss the data of our model using the sample that consists of sixteen MENA countries over the period 1995-2018.

5.3.1 Variable definitions and sources

We present the definitions and sources of the variables used in the model (see Table 5.2), starting with the variables used to determine the level of bank risk according to the concentration and competition indicators and then to discuss the bank-specific, industry-specific and country-specific variables. The bank-level data are obtained from the Fitch Connect database. We compute bank competition measures using the unconsolidated bank-level balance sheet and income statement data for the period 1995-2018. We used the unconsolidated data to avoid double counting. In measuring the extent of bank competition, we included the commercial, development, retail and consumer, private and Islamic banks operating in the region. All value data are expressed in US dollars.

The data on regulatory indices are gathered from the World Bank databases in the Bank Regulation, and Supervision Survey (BRSS)[134] constructed and updated by Barth et al. (2001, 2008a,b), Cihak et al. (2012), Anginer et al. (2019). The BRSS explores various aspects of bank regulation and supervision around the world since 2001, based on a survey completed by the regulators in each country. In particular, we used data on activity restrictions and capital regulatory and supervisory power as presented in the five surveys, depending on the coverage period of each survey. For the economic freedom index[135], data came from the Heritage Foundation. They consist of twelve quantitative and qualitative factors that provide in-depth knowledge about each country's political and economic developments (Miller et al., 2020). Data on deposit insurance are from the World Bank. The deposit insurance database was constructed by Demirgüç-Kunt et al. (2014, 2015).

Regarding the political risk indicators, we gathered two indicators from different sources. The first is the PRS Group which constructs the International Country Risk Guide (ICRG), rating every country in the world. It shows three subcategories of risk: political, financial and economic. In our analysis, we depend on the political risk rating that covers political and social attributes. The other political risk indicator is taken from one component of the World Governance Indicators (WGI), produced by Kaufmann et al. (2009), which is Political Stability and Absence of Violence. Lastly, data on the growth of the Gross Domestic Product are taken from the World Bank Development Indicators.

Table 5.2: Definitions of variables

Variable	Definition	Data sources
Dependent variables: Bank stability measures		
Portfolio risk	$= (-1) * Ln\left[ROA_{i,j,t}/\sigma(ROA)_{i,j,t}\right]$, where $ROA_{i,j,t}$ is return on assets for bank *i* operating in country *j*, at time *t* and $\sigma(ROA_{i,t})$, the standard deviation of $ROA_{i,j,t}$. A lower/higher value indicates lower/higher bank portfolio risk	Fitch Connect and author's own calculations
Leverage risk	$= (-1) * Ln\left[TETA_{i,j,t}/\sigma(ROA)_{i,j,t}\right]$, where $TETA_{i,j,t}$, total equity to total assets ratio for bank *i* operating in country *j* at time *t*; and σ $(ROA_{i,j,t})$, the standard deviation of the return of assets. A lower/higher value indicates lower/higher bank leverage risk	Fitch Connect and author's own calculations
Z-score (insolvency risk)	$= (-1) * Ln\left[1 + \left(ROA_{i,j,t} + TETA_{i,j,t}\right)/\sigma(ROA)_{i,j,t}\right]$, where $ROA_{i,j,t}$ represents the return on assets for bank *i* operating in country *j* at time *t*; $TETA_{i,j,t}$, total equity to total assets ratio for bank *i* operating in country *j* at	Fitch Connect and author's own calculations

[134] In our sample, the MENA countries that filled out the 2001 survey are as follows: Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, and Turkey. The 2003 Survey: Algeria, Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey, and United Arab Emirates. The 2007 survey: Algeria, Bahrain, Egypt, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman and Saudi Arabia. The 2011 survey: Bahrain, Egypt, Iraq, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Tunisia, Turkey, and United Arab Emirates. The 2019 survey: Bahrain, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and Turkey.

[135] Due to data availability we used the Economic Freedom index following the approach of Uhde and Heimeshoff (2009).

	time t; and σ($ROA_{i,j,t}$), the standard deviation of the $ROA_{i,j,t}$. A lower/higher value indicates a lower/higher bank default risk (more financial stability)	
Liquidity risk	$= (-1) * Ln(LiqA_{i,j,t}/TA_{i,j,t})$, the liquidity ratio is used as a proxy for the liquidity risk for bank *i* operating in country *j* at time *t*, LiqA is the liquid assets, TA is the total assets. A lower/higher value indicates lower bank liquidity risk and vice versa	Fitch Connect and author's own calculations
Credit risk	$= Ln[NPL_{i,j,t}/(100 - NPL_{i,j,t})]$, where $NPL_{i,t}$ is the ratio of non-performing loans to gross loans for bank *i* operating in country *j* at time *t*. A lower/higher value indicates a lower/higher bank credit risk and vice versa.	Fitch Connect and author's own calculations
Main independent variables		
Bank Competition measures		
5-Bank Concentration ratio	$CR_k = \sum_{i=1}^{K} s_i$, $with\, s_1 \geq \cdots \geq s_K \geq s_N$, $\forall\, N \geq K$, where s_i is the market share of i operating bank, when banks are classified in descending order of market share and N is the total number of operating banks. The ratio of total assets of the five largest banks to total assets of all banks operating in the market used to determine the market share. It is a country-level structural measure of bank concentration	Fitch Connect and author's own calculations
HHI	$HHI = \sum_{i=1}^{N} s_i^2$, $\forall i = 1, \cdots, N$, where s_i is the market share of i operating bank and N is the total number of banks in the market. The Herfindahl-Hirschman index (HHI) computed as the sum of the square of each bank's total assets to the total assets of all banks in the market. It is a country-level structural measure of bank concentration	Fitch Connect and author's own calculations
Lerner index	$L_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}}$, where *P* is the output price, which is computed as the ratio of gross revenues to total assets for operating bank *i* at time *t* with *MC* as the marginal cost. The subscript *i* denotes bank *i* and *t* denotes time *t*. It is a measure of price-cost margin. It is a bank-level non-structural measure of bank competition	Fitch Connect and author's own calculations
Independent control variables		
Bank-level data		
Size	= ln($TA_{i,j,t}$), where TA, is the total assets for bank *i* operating in country *j* at *t*. The natural logarithm of total assets	Fitch Connect and author's own calculations
NetLNTA	$= NetLN_{i,j,t}/TA_{i,j,t}$, where NetLN is the net loans, TA is the total assets for bank *i* operating in country *j* at time *t*. The ratio of net loans to total assets	Fitch Connect
NIM	$= NII_{i,j,t}/Avg\, EA_{i,j,t}$, where NII is the net interest income, Avg EA is the average earning assets for bank *i* operating in country *j* at time *t*. This is the bank's net interest income as a share of its interest-bearing (total earning) assets	Fitch Connect
Capital adequacy ratio (CAR)	The total capital of the banking system expressed as a percentage of its risk-weighted credit exposures. The measure of CAR used is that based on Basel rules and includes Tier 2 capital	Fitch Connect and author's own calculations
Industry-level data		
Activity restrictions	The index aggregates measures that indicate whether bank activities in the securities, insurance and real estate markets; and ownership and control of non-financial firms are unrestricted, permitted, restricted, or prohibited. The aggregate index ranges from 0 to 16. Higher values show greater activity restrictions initiated by legal requirements	World Bank Survey of Bank Regulation and Supervision
Supervisory power	The index shows the power of the supervisory body/agency in taking specific actions against bank management and directors, shareholders and bank auditors. The index ranges between 0 and 14. Higher values indicate greater supervisory power	World Bank Survey of Bank Regulation and Supervision
Capital regulation	The index measures the overall capital stringency. The index ranges from 0 to 9. Higher values denote greater stringency	World Bank Survey of Bank Regulation and Supervision
Deposit insurance	A dummy variable that takes one if the country has deposit insurance and zero otherwise	World Bank Deposit insurance database Demirgüç-Kunt et al. (2014, 2015).
Country-level data		

GDPg	The growth rate of the Gross domestic product	World Bank Development Indicators
Economic Freedom	This index covers twelve freedoms depending on four quantitative and qualitative factors: 1.The rule of law that focuses on property rights, government integrity and judicial effectiveness. 2. Government size which evaluates government spending, tax burden and fiscal health. 3. Regulatory efficiency concentrates on business freedom, labour freedom and monetary freedom. 4. Finally, open markets that measure trade freedom, investment freedom and financial freedom. The index ranges from 0 to 100. Higher scores indicate healthy societies, efficient allocation of resources, pro-competition measures and economic prosperity	The Heritage Foundation
Political stability (WGI)	This index measures the likelihood of political instability and/or politically motivated violence, including terrorism. It varies from −2.5 to 2.5. Higher/lower values correspond to higher/lower political stability	Worldwide Governance Indicators (WGI), World Bank
Political risk (ICRG)	This index measures the political stability of the countries based on twelve risk components that cover both political and social attributes. The political risk components are as follows: government stability, socio-economic conditions, investment profile, internal conflict, external conflict, corruption, military in politics, religious tensions, law and order, ethnic tensions, democratic accountability and quality of bureaucracy. The index ranges from 0 to 100. Higher/lower values indicate a higher/lower degree of political risk or lower/higher political stability	International Country Risk Guide (ICRG) database, The PRS Group

5.3.2 Sample

The sample data focus on banks operating in sixteen MENA countries over the period 1995-2018, namely: Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, Turkey and United Arab Emirates. The original sample included nineteen MENA countries; however, we had to omit Djibouti, Mauritania and Yemen because of data availability and the low number of observations. It is worth noting that our sample covers most of the banks operating in the MENA region in terms of number and total assets. We divide the sample into two subsamples based on oil production according to the World Bank classification, the U.S. Energy Information Administration (EIA)[136] database and the Organization of the Petroleum Exporting Countries (OPEC). The oil-producing countries are Saudi Arabia, Iraq, Iran, the United Arab Emirates, Kuwait, Qatar[137], Algeria and Oman[138]. The non-oil-producing countries are Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey and Israel. Table 5.3 shows the number of banks for each country in our sample. Turkey, Lebanon and the United Arab Emirates have the largest number of banks in the region during the period under study.

[136] The U.S. Energy Information Administration (EIA) is a principal agency of the U.S. Federal Statistical System, responsible for collecting, analysing, and disseminating energy information. (See www.eia.gov)
[137] Qatar left the OPEC in 1st of January 2019.
[138] Oman is a non-OPEC participating country but has a long and rich history of collaboration with the organization (see https://www.opec.org/opec_web/en/press_room/4863.htm).

Table 5.3: Number of banks operating in the MENA region

Country	Number of banks
Algeria	19
Bahrain	58
Egypt	47
Iran	27
Iraq	34
Israel	27
Jordan	21
Kuwait	40
Lebanon	74
Morocco	36
Oman	19
Qatar	17
Saudi Arabia	24
Tunisia	27
Turkey	174
United Arab Emirates	60
Total	704

Source: Fitch Connect Database from Fitch Solutions

5.3.3 Descriptive statistics

The descriptive statistics of the variables used in our model are displayed in Table 5.4. All the financial ratios used in the model are winsorised at 99 percent and in level. Our examined sample of an unbalanced panel contains 4930 observations, starting with the variables used to determine the level of bank risk following the concentration and competition indicators and then discussing the bank-specific, industry-specific and country-specific variables. As can be seen from the table, portfolio risk has the highest mean value (4.170), with a standard deviation of 1.550 compared to other bank stability indicators, followed by the liquidity risk mean value (3.118), with a standard deviation of 0.781. The lowest mean value is the credit risk, with 0.199 and 3.190 standard deviations. Regarding the insolvency risk (Z-score), the mean value is 1.497, and the standard deviation is 0.862. The concentration ratios mean that the value is almost 72, which indicates a highly concentrated marketplace, while the HHI using total assets and total deposits market share means that values are above 1500, showing a moderately concentrated marketplace. The Lerner indices mean that value equals 0.389 with a standard deviation of 0.476. The highest mean value of the bank-specific indicators is the net loans to total assets, with 45.057 percent followed by bank size with 21.371 mean value and the capital adequacy ratio of

16.437 percent. Looking at the remaining control variables, the country-specific indicators mean and standard deviation values differ across countries.

Table 5.4: Descriptive statistics

	Obs.	Mean	Median	Max.	Min.	Std. Dev.
Dependent variables						
Portfolio risk	4930	4.170	4.413	6.155	-4.665	1.550
Leverage risk	4930	1.236	0.943	3.946	0.035	0.922
Z-SCORE	4930	1.497	1.344	3.977	0.033	0.862
Liquidity risk	4930	3.118	3.186	5.206	0.163	0.781
Credit risk	4930	0.199	0.571	9.200	-9.220	3.190
Independent variables						
Competition measures						
Concentration ratio	4930	72	74	95	50	12
HHI_TA	4930	1565	1163	6834	633	1062
HHI_TD	4930	1583	1176	10000	608	1136
Lerner Index	4930	0.389	0.299	2.965	-0.547	0.476
Bank-level data						
Bank size	4930	21.371	21.330	25.140	16.676	1.775
Net Loans to total assets	4930	45.057	46.587	97.610	0.086	22.353
Net interest margin	4930	3.441	3.035	16.525	-3.133	2.721
Capital adequacy ratio	4930	16.437	16.692	37.000	4.517	4.552
Industry-level data						
Supervisory power	4930	10.450	11.000	14.000	4.000	2.152
Deposit insurance	4930	0.590	1.000	1.000	0.000	0.492
Capital regulatory	4930	5.665	5.000	10.000	2.000	2.314
Economic Freedom	4930	63.099	62.900	77.700	17.945	7.732
Activity restriction	4930	10.311	11.000	14.000	6.000	1.875
Country-level data						
Political risk (ICRG)	4930	62.526	62.958	79.333	32.583	9.857
Political Stability(WGI)	4930	-0.647	-0.793	1.224	-3.181	0.878
GDP growth	4930	4.725	4.410	54.158	-33.101	4.949

Note: Z-score, Credit risk, liquidity risk, portfolio risk, leverage risk and total assets (bank size) are in log. Remaining variables are in level. The higher the dependent variables, the higher the risk. Financial ratios are winsorised at 99%. Obs.-observations, Max-maximum, Min-minimum, Std.Dev.-standard deviation.

Table 5.5 shows the correlation matrix of the variables included in the models. We observe that our three alternative measures of bank concentration (5-Bank concentration ratio, HHIta and HHItd) are strongly positively correlated (at correlation coefficients of 0.687, 0.672 and 0.979, respectively). The table reveals that the liquidity risk is negatively correlated with the ratio of net loans to total assets. Moreover, the correlation between the existence of deposit insurance and the political risk of the ICRG is also negative. Regarding the two alternative political risk measures (PI-ICRG and PS-WGI), their correlation coefficient of 0.854 is strongly positively correlated. Other significant correlated variables are between the political risk indicator (PI-ICRG) and the Economic Freedom index of 0.547.

Table 5.5: Correlation matrix

	Z-score	**Cred**	**Liq.**	**Port.**	**Lev.**	**Con**	**HHIa**	**HHId**	**Ler**	**Size**	**NL/TA**	**NIM**	**CP**	**SP**	**DI**	**PI**	**PS**	**GDPg**	**AREC**	**CREG**	**EF**
Z-score	1																				
Cred	0.049	1																			
Liq.	-0.111	-0.085	1																		
Port.	0.424	-0.045	-0.075	1																	
Lev.	**0.988**	0.061	-0.106	0.286	1																
Con	0.322	-0.206	0.011	0.147	0.314	1															
HHIa	0.262	-0.127	0.110	0.115	0.257	**0.687**	1														
HHId	0.235	-0.138	0.131	0.137	0.225	**0.672**	**0.979**	1													
Lerner	0.096	0.124	0.114	0.143	0.082	0.022	-0.007	-0.001	1												
Size	-0.027	0.029	-0.274	-0.248	0.008	0.002	-0.019	-0.050	-0.197	1											
NL/TA	0.143	0.198	**-0.576**	-0.005	0.149	0.224	0.076	0.047	-0.061	0.274	1										
NIM	0.021	0.239	0.011	0.111	0.004	-0.142	0.006	0.043	0.211	-0.125	0.157	1									
CP	-0.107	0.027	0.129	-0.070	-0.101	-0.142	-0.018	0.021	0.202	0.015	-0.157	0.140	1								
SP	-0.100	0.024	0.197	0.036	-0.112	-0.140	-0.012	0.044	0.097	-0.126	-0.132	0.128	0.219	1							
DI	-0.292	-0.096	0.152	-0.076	-0.298	-0.382	-0.053	0.014	0.013	-0.156	-0.328	0.238	0.245	0.227	1						
PI	0.240	0.113	-0.097	0.040	0.249	0.400	0.254	0.220	0.164	0.058	0.269	-0.150	0.178	0.005	**-0.514**	1					
PS	0.198	0.165	-0.099	0.087	0.197	0.250	0.215	0.183	0.152	0.050	0.225	-0.085	0.237	0.163	-0.496	**0.854**	1				
GDPg	0.001	-0.002	0.113	-0.035	0.006	0.020	0.114	0.106	0.062	-0.002	-0.065	0.056	-0.049	0.164	0.061	0.026	0.040	1			
AREC	0.108	-0.023	-0.085	0.064	0.106	-0.039	0.070	0.093	-0.111	0.035	-0.052	0.045	-0.153	-0.038	0.118	-0.078	-0.118	0.002	1		
CREG	0.030	-0.054	-0.225	-0.034	0.036	-0.058	0.109	0.090	-0.007	0.217	0.123	0.010	0.131	-0.027	0.227	-0.121	-0.028	-0.114	-0.138	1	
EF	0.210	0.017	-0.243	-0.071	0.233	0.287	0.209	0.164	0.101	0.224	0.299	-0.127	0.179	-0.075	-0.095	**0.547**	0.444	-0.013	0.036	0.322	1

Note: Cred-Credit risk, Liq-Liquidity risk, Port-Portfolio risk, Lev-Leverage risk, Con-Concentration ratio, HHIa-HHI total assets, HHId-HHI total deposits, Ler-Lerner index, Size-Bank size, NL/TA-net loans to total assets, NIM-net interest margin, CP-Capital adequacy ratio, SP-Supervisory Power, DI-Deposit insurance, PI-Political risk (ICRG), PS-Political Stability (WGI), GDPg-GDP growth, AREC-Activity restriction, CREC-Capital regulatory, EF-Economic Freedom.

5.4 Methodology

The existing literature has sought to shed light on the relationship between concentration, competition and stability; we use insights and methodology from the literature to construct the baseline model, taking into account all the relevant control variables (Berger et al. 2009; Uhde and Heimeshoff, 2009; Fu et al., 2014; Laeven et al., 2016; Damisman and Demirel, 2019) using bank-level, industry-level and country-level data from 16 MENA economies over the period 1995 to 2018.

5.4.1 Baseline model

To examine the effect of concentration and competition on bank risk-taking, we employ our unbalanced panel data to construct the following baseline econometric models:

$$Bank\ Risk_{i,j,t} = \beta_0 + \beta_1 CON_{j,t} + \beta_2 LER_{i,j,t} + \sum_{k=1}^{k} \beta_k X_{i,j,t}^{k} + \sum_{l=1}^{l} \beta_l X_{j,t}^{l} + \sum_{m=1}^{m} \beta_m X_{j,t}^{m} + \varepsilon_{it} \quad (10)$$

where $Bank\ Risk_{i,j,t}$ indicates the bank risk-taking indicators (insolvency (Z-score), credit, liquidity, portfolio and leverage risk) and the indices i,j,t denote bank, country and time, respectively. $CON_{j,t}$ represents the 5-bank concentration ratio, or alternatively the HHI (total assets or total deposits) for country *j* at time *t*. $LER_{i,j,t}$ is the Lerner index for bank *i* in country *j* at time *t* which is a proxy for bank competition. $X_{i,j,t}^{k}$ is a vector of the bank-specific variables that represent the characteristics of each bank operating in the MENA region (size, net loans to total assets, net interest margin and capital adequacy ratio). $X_{j,t}^{l}$ is a vector of time-varying industry-specific variables, in particular the regulation and supervision indices (dummy variables of the deposit insurance and supervisory power). $X_{j,t}^{m}$ is a vector of the country time-dependent macroeconomic (GDP growth) indicator and the political risk (ICRG) indicator. ε_{it} is the error term.

The Z-score is calculated by using the accounting information of the return on assets, its volatility and leverage for each bank *i* operating in country *j* at time *t*, as follows:

$$Z_{i,j,t} = \frac{ROA_{i,j,t} + TE_{i,j,t}/TA_{i,j,t}}{\sigma ROA_{i,j,t}} \quad (1)$$

where $Z_{i,j,t}$ is the Z-score for bank *i* operating in country *j* at time *t*, ROA is the return on assets, TE/TA is the total equity over total assets (capital ratio) , and σROA is the standard deviation of return on assets (ROA volatility). The Z-score contains two components: the leverage risk, which is the equity to assets ratio over the standard deviation of the return on assets, and the portfolio risk, which is the return on assets over its standard deviation. Since the three risk measures are highly skewed, we follow the approach of Laeven and Levine (2009), Houston et al. (2010), and Beck et al. (2013) by taking the natural logarithm of the measures. Afterwards, we multiply the result by (-1) so that a higher value indicates a higher risk of bank default, leverage risk and portfolio risk to facilitate the comparison with the interpretations of other measurements (Danisman and Demirel, 2019).

The liquidity risk is computed by using the ratio of liquid assets over total assets for bank *i* operating in country *j* at time *t.* Higher value implies lower liquidity risk exposure because depository institutions are able to obtain cash for unanticipated withdrawals from their liquid assets. Again, we adopt the natural logarithm of the ratio, then multiply it by (-1) to be consistent with other measures used in our study.

$$Liq_{i,j,t} = \frac{LiqA_{i,j,t}}{TA_{i,j,t}} \qquad (2)$$

where $Liq_{i,j,t}$ is the liquidity ratio which is used as a proxy for the liquidity risk for bank *i* operating in country *j* at time *t*, LiqA is the liquid assets, TA is the total assets.

The credit risk is calculated by using the ratio of non-performing loans to gross loans for bank *i* operating in country *j* at time *t.* A higher value of the index implies a higher bank credit risk. Again, the natural logarithm transformation is conducted.

$$CR_{i,j,t} = \frac{NPL_{i,j,t}}{100 - NPL_{i,j,t}} \qquad (3)$$

where $NPL_{i,j,t}$ is the ratio of non-performing loans to gross loans for bank *i* operating in country *j* at time *t*.

In terms of banking competition indicators, we first introduce the k-bank concentration ratio, which is constructed directly from the data available of the three, five, or ten largest banks operating in the market and is straightforward to calculate. The k-bank asset concentration ratio estimates the market share of the k banks in the market:

$$CR_k = \sum_{i=1}^{K} s_i \ , \qquad with\ s_1 \geq \cdots \geq s_K \geq s_N \ , \qquad \forall\ N \geq K \qquad (4)$$

where s_i is the market share of i operating bank, when banks are classified in descending order of market share and N is the total number of operating banks. Thus, this indicator emphasises the k dominant banks equally and does not take into account small banks in the market. We adopt the value of the 5-bank concentration ratio due to the variation in the number of banks operating in the countries of the MENA region.

Regarding the HHI, it is widely applied in the banking context due to the simplicity of its calculation: it takes the sum of the squared market share of all banks operating in the market, that is:

$$HHI = \sum_{i=1}^{N} s_i^2 \ , \ \ \forall i = 1, \cdots, N \qquad (5)$$

where s_i is the market share of i operating bank and N is the total number of banks in the market. We compute the HHI by using total assets market share.

We compute the Lerner index (price-cost margin) for each operating bank and each year of our examined sample using the standard approach.

The Lerner index (L) is estimated as:

$$L_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} \qquad (6)$$

where *P* is the output price, which is computed as the ratio of gross revenues to total assets for operating bank *i* at time *t* with *MC* as the marginal cost. The subscript *i* denotes bank *i* and *t* denotes time *t*.

In line with the common empirical literature, we take deposits as an input to the production of multiple financial products. For the output price, we use the single-output approach following Fernández Guevara et al. (2007), Berger et al. (2009) and Weill (2013) to take total assets as a proxy. $P_{i,t}$ is computed as total revenues (interest and non-interest income) over total assets.

Regarding the marginal cost, it is extracted from the estimation of the parameters of the translog cost function following the methodology of Anginer et al. (2014), Beck et al. (2013) and Weill (2013). The translog cost function is derived as:

$$\begin{aligned} log\,(C_{it}) = \alpha &+ \beta_1 log\,(Q_{it}) + \beta_2 (log(Q_{it}))^2 + \beta_3 log(W_{1,it}) + \beta_4 log(W_{2,it}) \\ &+ \beta_5 log(W_{3,it}) + \beta_6 log(Q_{it}) log(W_{1,it}) + \beta_7 log(Q_{it}) log(W_{2,it}) \\ &+ \beta_8 log(Q_{it}) log(W_{3,it}) + \beta_9 (log(W_{1,it}))^2 + \beta_{10} (log(W_{2,it}))^2 \\ &+ \beta_{11} (log(W_{3,it}))^2 + \beta_{12} log(W_{1,it})\, log(W_{2,it}) + \beta_{13} log(W_{1,it}) log(W_{3,it}) \\ &+ \beta_{14} log(W_{2,it}) log(W_{3,it}) + \delta Dummies \\ &+ \varepsilon_{it} \end{aligned} \qquad (11)$$

where $C_{i,t}$ is total operating and financial costs (expenses) for operating bank i at time t, and $Q_{i,t}$ is total assets, which is a proxy for bank output. The input prices $W_{j,i,t}$ reflect $W_{1,i,t}$ the ratio of interest expense to total deposits and money market funding, as a proxy for the input price of deposits; $W_{2,i,t}$ the ratio of personnel expenses to total assets, as a proxy of input price of labour; and $W_{3,i,t}$ the ratio of other operating and administrative expenses to fixed assets as a proxy for the input price of equipment (fixed capital). The subscript *i* denotes bank *i* and *t* denotes time *t*. The time and bank-level fixed effects are employed, in line with the existing literature.

Following Weill's (2013) methodology, we must normalise total costs and input prices by one input price; hence we impose the following restriction of linear homogeneity on the input prices.

$$\beta_3 + \beta_4 + \beta_5 = 1 \,;\, \beta_6 + \beta_7 + \beta_8 = 0 \,;\, \beta_9 + \beta_{12} + \beta_{13} = 0 \,;\, \beta_{10} + \beta_{12} + \beta_{14} = 0 \,;\, \beta_{11} + \beta_{13} + \beta_{14} = 0 \qquad (12)$$

The marginal cost used in estimating the Lerner index is derived from the following equation:

$$MC_{it} = \frac{\partial C_{it}}{\partial Q_{it}} = \frac{C_{it}}{Q_{it}}\left[\beta_1 + 2\beta_2 log(Q_{it}) + \beta_6 log(W_{1,it}) + \beta_7 log(W_{2,it}) + \beta_8 log(W_{3,it})\right] \quad (13)$$

Overall, we focused our analysis by using both structural and non-structural measures of bank competition to investigate the concentration, competition and stability nexus in the MENA region.

All financial ratios used in our models were winsorised at 99 percent to avoid the effect of outliers and correct for potential data entry errors, following Berger et al. (2009) and Anginer and Demirguc-Kunt (2014). Furthermore, we lagged all of the independent variables by one period to reduce the possible impact of endogeneity and reverse causality (Beck et al., 2013; Anginer and Demirgüç-Kunt, 2014; Schaeck and Cihak, 2014; Davis et al., 2019; Danisman and Demirel, 2019). The use of lagged independent variables reduces the possible presence of endogeneity. However, the omitted variables problem could be a possible cause of endogeneity. Thus, we used the system GMM to deal with problems of endogeneity and heteroskedasticity. Following Schaeck and Cihak (2007); Berger et al. (2009); Uhde and Heimeshoff (2009); Anginer and Demirguc-Kunt (2014), we considered activity restrictions, capital regulatory restrictions and Economic Freedom as instrumental variables.

As a first step, we ran the baseline panel Ordinary Least Squares (OLS) model with country fixed effect as confirmed by the Hausman tests. The country level was adopted when clustering the standard error term. Then we ran the GMM as a robustness check, using the full sample (16 MENA economies). Next, we re-estimated the models after we divided the sample into two subsamples based on oil production according to the World Bank classification, the U.S. Energy Information Administration (EIA) database and the Organization of the Petroleum Exporting Countries (OPEC). OPEC is made up of the oil-producing countries Saudi Arabia, Iraq, Iran, United Arab Emirates, Kuwait, Qatar, Algeria and Oman. The non-oil-producing countries are Bahrain, Egypt, Morocco, Jordan, Lebanon, Tunisia, Turkey and Israel.

Other robustness checks that were conducted employed an alternative measurement of concentration, namely, the Herfindahl-Hirschman Index (HHI) using the market share of total assets and total deposits. Moreover, we used another political risk indicator, the political stability index constructed by the World Bank that measures the likelihood of political instability and/or politically motivated violence, including terrorism. Following Martinez-Miera and Repullo (2008) and Berger et al. (2009), we included the Lerner index quadratic (squared) term in our models to force a nonlinear relationship between the degree of market power and the different measures of bank risk exposure. Furthermore, we excluded country-level variables (GDP growth and political risk (ICRG)) following Berger et al. (2009) to check whether our results remained robust.

5.5 Empirical results

5.5.1 Unit root test

This section reveals the main results from our models and several robustness checks. As a first step, we ran four panel unit root tests[139] to check the stationarity of the variables (see Table 5.6); namely, the Levin-Lin-Chu (LLC) test proposed by Levin et al. (2002), which assumes a common unit root process for all countries; the Im-Pesaran-Shin (IPS) test proposed by Im et al. (2003), which allows for individual unit root processes between countries and the Fisher-ADF (augmented Dickey-Fuller) and Fisher-PP (Phillips and Perron) tests, which combine the p-values from individual unit root tests proposed by Choi (2001).

According to the results in the table below, all the variables were stationary in levels since we strongly rejected the null hypothesis of unit roots in our panel sample, except for the results of the Fisher-type tests for two variables (the Concentration ratio and the Supervisory Power index). However, these two variables are stationary in level according to the LLC and IPS tests. Maddala and Wu (1999) differentiate between the above tests and argue that the Fisher-type tests outperform the others because they are simple and straightforward to use. Barreira and Rodrigues (2005) assert that the LLC and IPS tests are the most important references of the panel unit root tests that depend on cross-sectional independence. Following the methodology of Al-Shboul et al. (2020), as long as our variables are stationary, we need not run a panel cointegration test, a point confirmed by Pedroni (2004).

[139] See http://www.eviews.com/help/helpintro.html#page/content/advtimeser-Unit_Root_Testing.html

Table 5.6: Panel unit root tests

Variables	Levin-Lin-Chu		Im-Pesaran-Shin		Fisher-ADF		Fisher-PP	
Dependent variables								
Z-SCORE	-96.5352	(0.000)	-24.6363	(0.000)	2599.42	(0.000)	2813.69	(0.000)
Credit risk	-62.7847	(0.000)	-26.0275	(0.000)	1764.87	(0.000)	1883.41	(0.000)
Liquidity risk	-209.452	(0.000)	-39.8042	(0.000)	1826.45	(0.000)	2080.27	(0.000)
Portfolio risk	-96.9566	(0.000)	-28.1118	(0.000)	2631.37	(0.000)	2964.05	(0.000)
Leverage risk	-97.4633	(0.000)	-24.4941	(0.000)	2602.62	(0.000)	2834.88	(0.000)
Independent variables								
Competition measures								
Concentration ratio	-2.59347	(0.005)	9.15612	(1.000)	935.793	(1.000)	1021.96	(1.000)
HHI_total assets	-100.907	(0.000)	-97.0184	(0.000)	17039.8	(0.000)	10671	(0.000)
HHI_total deposits	-66.4171	(0.000)	-67.9033	(0.000)	13146.4	(0.000)	6671.50	(0.000)
Lerner index	-289.345	(0.000)	-89.9683	(0.000)	1559.57	(0.000)	1640.03	(0.000)
Bank-level data								
Bank size	-537.74	(0.000)	-130.749	(0.000)	1322.03	(0.000)	1716.15	(0.000)
Net Loans to total assets	-57.8345	(0.000)	-17.3526	(0.000)	1583.77	(0.000)	1978.69	(0.000)
Net interest margin	-86.0466	(0.000)	-17.2143	(0.000)	1501.02	(0.000)	1738.56	(0.000)
Capital adequacy ratio	-35.4272	(0.000)	-40.1047	(0.000)	4314.76	(0.000)	4337.31	(0.000)
Industry-level								
Supervisory power	-1.81233	(0.035)	13.2485	(1.000)	514.966	(1.000)	1024.87	(0.228)
Deposit insurance	-4.11551	(0.000)	-3.01081	(0.001)	291.115	(0.000)	1307.02	(0.000)
Country-level								
GDPg	-75.4195	(0.000)	-79.095	(0.000)	8343.23	(0.000)	7733.01	(0.000)
Political risk(ICRG)	-9.116	(0.000)	-1.616	(0.053)	1394.03	(0.599)	1071.63	(1.000)
Political Stability (WGI)	-19.6759	(0.000)	-10.7713	(0.000)	1883.62	(0.000)	1902	(0.000)

Note: P-value in parentheses.

5.5.2 Hausman test

According to our data and the results of the Hausman test (see Table 5.7), it was appropriate to adopt the fixed-effect model, and we employed heteroskedasticity-robust standard errors to estimate the t-statistic following the methodology of Beck et al. (2013). However, using empirical data entailed the problem of heteroskedasticity. The most common method of overcoming this problem is to use the GMM (Generalized Method of Moments) estimator (Berger et al., 2009). Thus, we employed a dynamic panel data regression that adopted the GMM model as a robustness check. This model was proposed by Arellano and Bond in 1991 and Blundell and Bond in 1998 (Bond et al., 2001). We tested the goodness of fit (the validity of the instrumental variables (IV)) using the Sargan test (J-statistics), which implies that a null hypothesis of over-identifying restrictions was not rejected, and there is only a first-order autocorrelation (AR1). Hence, a second-order autocorrelation (AR2) should not be significant or more important than an AR1 because it indicates that the model does not suffer from second-order autocorrelation (Roodman, 2009).

Table 5.7: Hausman tests

Risk measures	Chi-Sq. Statistic	P-value
Z-SCORE	148.509	(0.000)
Credit risk	34.038	(0.001)
Liquidity risk	47.819	(0.000)
Portfolio risk	71.873	(0.000)
Leverage risk	130.775	(0.000)

5.5.3 Main results and discussions

The baseline empirical results of estimating the relationship between concentration, competition and stability using the Panel OLS fixed effect model with country dummies are displayed in Table 5.8 above. Our model shows a full set of sources of the risks to which we think banks are subject. All the models include the concentration ratio and the Lerner index as bank competition measures; higher values of both measures indicate higher degrees of market power, showing a less competitive environment. In all models, we also control for differences in bank size, the net loans to total assets ratio, net interest margin, capital adequacy ratio, supervisory power, deposit insurance (dummy variable), political risk and GDP growth to control for varying business environments and levels of economic development, following Berger et al. (2009). All financial ratios were winsorised at 99 percent to avoid the effect of outliers and correct for potential data entry errors. The independent variables were lagged by one period to reduce the possible impact of endogeneity and reverse causality.

Columns 1-5 in Table 5.8 treat the various types of bank risk indicators as dependent variables, reported as insolvency risk (Z-score), credit risk, liquidity risk, portfolio risk and leverage risk. It should be noted that all bank risk indicators in the columns were computed such that an increase in the variables indicates an increase in bank risk. The p-values are calculated using heteroskedasticity-robust standard errors. The concentration ratio and Lerner index coefficients are significantly negative, which shows that the bank risk, including the different risk exposures with various risk measures, reduces with greater concentration and market power, except for the credit risk results. Put differently, a rise in competition increases bank risk, which is consistent with the competition-fragility view. Thus, the stability of the banking systems in the MENA region deteriorates with excessive competition because of the decline in the banks' charter values (Keeley, 1990). The absolute value of the concentration ratio coefficients ranges from 0.09 percent to 2.3 percent, and the Lerner index varies between 5.2 percent and 7.2 percent. Our results are similar to those of González et al. (2017) and Albaity et al. (2019), who also use MENA region data and the results of testing 25 European countries (see section 5.2.2) by Uhde and Heimeshoff (2009).

Regarding the control variables, capital adequacy ratio and deposit insurance are negatively correlated with the banks' risk measures, indicating that the increase in the capital adequacy ratio and the existence of deposit insurance play an essential role in mitigating bank risk-taking, which is consistent with the empirical literature and complies with international regulatory actions. Anginer and Demirgüç-Kunt (2014) find that higher capital requirements reduce system-wide fragility. Fu et al. (2014) state that credible deposit insurance can boost financial stability by reducing the probability of bank runs. The ratio of a bank's size and that of net loans to total assets are only positively significant with the liquidity risk. These findings are consistent with Beck (2008) and Laeven et al. (2016). Cornett et al. (2011) claim that banks may tend to hold more liquid assets to overcome any monetary shocks that could affect their loan portfolio. The supervisory power is positively correlated with insolvency and leverage risk, showing that one unit increase in the supervisory power index admits an increase in both types of risk of between1.2 percent and 1.4 percent, in contrast to the findings of Al-Shboul et al. (2020) that large banks in the MENA have lower levels of risk. The political risk indicator is significant at the 10 percent level, indicating that the higher the value of the ICRG political risk indicator (meaning the lower the degree of political risk), the lower the liquidity risk. The R-squared across all models are relatively high, except for credit risk.

Table 5.8: Competition and bank stability: Panel fixed effect regressions

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio (-1)	-0.010***	0.007	-0.012***	-0.023***	-0.009***
	(-2.932)	(0.317)	(-3.036)	(-3.069)	(-3.076)
Lerner index (-1)	-0.072**	0.559*	-0.066	-0.114	-0.052*
	(-2.044)	(1.784)	(-1.226)	(-1.020)	(-1.653)
Bank size (-1)	0.015	0.177	0.116***	-0.019	0.007
	(0.614)	(1.135)	(3.864)	(-0.234)	(0.331)
Net loans to total assets(-1)	0.000	0.002	0.020***	-0.003	0.000
	(0.098)	(0.143)	(10.674)	(-1.120)	(0.337)
Net interest margin (-1)	-0.003	-0.029	-0.004	-0.033	-0.001
	(-0.452)	(-0.428)	(-0.310)	(-1.070)	(-0.105)
Capital adequacy ratio(-1)	-0.015***	0.035	0.003	-0.035***	-0.012***
	(-5.739)	(1.577)	(1.005)	(-5.358)	(-5.416)
Supervisory Power (-1)	0.014*	0.077	-0.008	-0.005	0.012*
	(1.822)	(1.279)	(-0.986)	(-0.208)	(1.703)
Deposit insurance (-1)	-0.315***	-0.670**	0.153	-0.579*	-0.261***
	(-3.476)	(-2.201)	(1.578)	(-1.861)	(-3.618)
Political risk (ICRG) (-1)	0.005	-0.004	-0.008*	0.005	0.003
	(1.499)	(-0.189)	(-1.687)	(0.486)	(1.215)
GDPg (-1)	0.003	0.008	0.001	0.001	0.003
	(1.611)	(0.344)	(0.364)	(0.135)	(1.410)
Constant	-0.948	-5.254	-5.338***	-0.939	-0.501
	(-1.175)	(-1.090)	(-6.350)	(-0.364)	(-0.700)
Observations	2,867	2,282	2,788	2,867	2,867
R-squared	0.788	0.340	0.682	0.644	0.839
Number of bank_id	280	238	268	280	280

Notes: This table demonstrates the results of the Panel OLS fixed-effect model with country dummies. The standard error terms is clustered by country. All financial ratios are winsorised at 99 percent. Explanatory variables are lagged by one period. Robust t-statistics are reported below each estimated coefficient using heteroskedasticity-robust standard errors. *** p<0.01, ** p<0.05, * p<0.1 represent significance levels.

To further develop the analysis, we investigated the relationship between concentration, competition and financial stability by dividing the sample into two subsamples according to oil production (see section 5.3.2). Like all the models of MENA countries, the models of the subsamples are estimated using fixed effects panel regression, as confirmed by the Hausman tests. Table 5.9 presents the empirical results obtained from using the data of the oil-producing economies. The coefficient of concentration ratio in column 4 is the only negatively significant variable, suggesting that an increase of bank market power lowers the portfolio risk level, confirming the previous results that support the competition-fragility view. The bank size enters the regression as significantly positive at the 1 percent level, indicating that increases in bank size boost bank risk, which is expected in the theoretical framework. The net loan to asset ratio is also positively correlated with the liquidity risk in oil-producing economies. There is a robust negative correlation between capital adequacy ratio and bank risk measures, even in oil-producing economies, showing the importance of holding sufficient capital and complying with regulations to mitigate the various types of risk. The magnitude of the positive relationship between supervisory power and bank risk increases beyond that in all MENA economies, indicating that giving more power to supervisory agencies tends to increase bank risk; hence, banks with greater market power are more inefficient (Danisman and Demirel, 2019).

Table 5.9: Competition and bank stability: Panel fixed effect regressions for oil-producing economies

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio (-1)	-0.011	0.017	-0.006	-0.052***	-0.010
	(-1.010)	(0.294)	(-0.485)	(-2.659)	(-0.904)
Lerner index (-1)	-0.006	-0.019	0.011	-0.039	-0.019
	(-0.088)	(-0.032)	(0.086)	(-0.190)	(-0.301)
Bank size (-1)	0.101**	0.377	0.167**	0.227**	0.085**
	(2.408)	(1.137)	(2.577)	(2.063)	(2.035)
Net loans to total assets(-1)	0.003	0.012	0.018***	-0.003	0.003
	(1.254)	(0.632)	(3.326)	(-0.359)	(1.317)
Net interest margin (-1)	0.012	0.087	0.002	0.056	0.011
	(0.807)	(0.684)	(0.079)	(0.878)	(0.773)
Capital adequacy ratio(-1)	-0.018***	0.064	0.006	-0.056	-0.016***
	(-2.748)	(1.024)	(0.474)	(-1.537)	(-2.847)
Supervisory Power (-1)	0.037*	0.044	-0.024	0.031	0.033*
	(1.947)	(0.361)	(-1.186)	(0.482)	(1.800)
Deposit insurance (-1)					
Political risk (ICRG) (-1)	-0.003	-0.033	-0.003	-0.018	-0.001
	(-0.534)	(-1.036)	(-0.303)	(-1.144)	(-0.142)
GDPg (-1)	0.002	0.056*	-0.002	-0.013	0.003
	(0.661)	(1.963)	(-0.460)	(-1.415)	(1.059)
Constant	-3.171***	-9.831	-6.921***	-3.060	-2.848***
	(-3.541)	(-1.134)	(-5.333)	(-0.948)	(-3.220)
Observations	810	704	767	810	810
R-squared	0.780	0.412	0.639	0.507	0.823
Number of bank_id	99	85	90	99	99

Notes: This table demonstrates the results of the Panel OLS fixed-effect model with country dummies. The standard error terms are clustered by country. All financial ratios are winsorised at 99 percent. Explanatory variables are lagged by one period. Robust t-statistics are reported below each estimated coefficient using heteroskedasticity-robust standard errors. *** p<0.01, ** p<0.05, * p<0.1 represent significance levels.

In terms of the non-oil producing economies, the results in Table 5.10 show more robustness with all the outcomes of the MENA economies. The concentration ratio and Lerner index coefficients are significantly negative, which shows that the bank risk, including the different risk exposures with various risk measures, reduces with greater concentration and market power, except for the credit risk results. The change varies between 1.2 percent and 2.7 percent for the concentration ratio and 9.8 percent and 10 percent for the Lerner index. The capital adequacy ratio and deposit insurance are also consistent and negatively correlated with the banks' risk measures. Even the non-oil-producing economies confirm the importance of capital and the existence of deposit insurance schemes. Remarkably, the positive correlation between GDP growth and bank risk measures is more significant in non-oil-producing economies. The magnitudes may be low, but they are still significant.

Table 5.10: Competition and bank stability: Panel fixed effect regressions for non-oil-producing economies

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio (-1)	-0.013***	-0.014	-0.015***	-0.027***	-0.012***
	(-3.547)	(-0.602)	(-3.560)	(-3.464)	(-3.474)
Lerner index (-1)	-0.101**	0.772*	-0.098*	-0.126	-0.073**
	(-2.341)	(1.857)	(-1.817)	(-1.134)	(-1.998)
Bank size (-1)	-0.043	-0.021	0.067**	-0.164	-0.045
	(-1.255)	(-0.143)	(2.138)	(-1.512)	(-1.536)
Net loans to total assets(-1)	-0.002	-0.007	0.020***	-0.006**	-0.001
	(-1.103)	(-0.472)	(11.369)	(-2.197)	(-0.894)
Net interest margin (-1)	-0.009	-0.096	-0.006	-0.063**	-0.006
	(-1.182)	(-1.236)	(-0.443)	(-2.193)	(-1.071)
Capital adequacy ratio(-1)	-0.015***	0.023	0.003	-0.034***	-0.012***
	(-5.711)	(0.930)	(0.869)	(-6.320)	(-5.245)
Supervisory Power (-1)	0.008	0.077	-0.004	-0.006	0.005
	(1.004)	(1.111)	(-0.499)	(-0.249)	(0.820)
Deposit insurance (-1)	-0.254***	-0.472	0.157*	-0.479	-0.202***
	(-2.659)	(-1.361)	(1.659)	(-1.460)	(-2.701)
Political risk (ICRG) (-1)	0.003	0.010	-0.011**	-0.005	0.001
	(0.752)	(0.358)	(-2.042)	(-0.444)	(0.303)
GDPg (-1)	0.007**	-0.024	0.006	0.018***	0.004*
	(2.355)	(-0.702)	(1.304)	(2.808)	(1.802)
Constant	1.010	0.521	-3.928***	3.253	1.319
	(0.934)	(0.109)	(-4.516)	(0.949)	(1.373)
Observations	2,057	1,578	2,021	2,057	2,057
R-squared	0.746	0.294	0.698	0.723	0.789
Number of bank_id	181	153	178	181	181

Notes: This table demonstrates the results of the Panel OLS fixed-effect model with country dummies. The standard error terms is clustered by country. All financial ratios are winsorised at 99 percent. Explanatory variables are lagged by one period. Robust t-statistics are reported below each estimated coefficient using heteroskedasticity-robust standard errors. *** p<0.01, ** p<0.05, * p<0.1 represent significance levels.

5.5.4 Robustness checks

Following the methodology of Berger et al. (2009), we re-estimated the relationship between bank competition and financial stability presented in Equation 10, using a two-step system GMM. Table 5.11 displays the regression results that show some different results. We used the same independent variables as we used for the panel fixed effect models. Financial variables were winsorised at 99 percent, and again all bank risk indicators in the columns were computed such that an increase in the variables indicated an increase in bank risk. The GMM model was used to deal with problems of endogeneity and heteroskedasticity. We considered activity restrictions, capital regulatory restrictions and Economic Freedom as instrumental variables, in line with Schaeck and Cihak (2007); Berger et al. (2009); Uhde and Heimeshoff (2009); and Anginer and Demirguc-Kunt (2014). We tested the goodness of fit (the validity of the instrumental variables (IV)) using the Sargan test (J-statistics), which implied that the null hypothesis of over-identifying restrictions was not rejected, and there was only a first-order autocorrelation (AR1). Hence, second-order autocorrelation (AR2) should not be significant and more important than (AR1) because it indicates that the model does not suffer from second-order autocorrelation (Roodman, 2009).

The concentration ratios and Lerner index remain consistent with the previous results. Both variables are proxies for bank competition and show the significant negative relationship between competition and stability, supporting the competition-fragility view. Notably, insolvency risk and leverage risk are more economically significant. Bank size is positively correlated with bank risk-taking, which is consistent with the “too big to fail” doctrine. Put differently; larger banks presumably have more chances to acquire public guarantees or subsidies. Thus, the likelihood of the problem of moral hazards will rise as a result of the propensity of managers of larger banks to engage in risky investments since they benefit from the government’s safety net. Moreover, large banks operating in concentrated markets such as the MENA could raise the risk of contagion, resulting in a positive relationship between concentration and systemic distress (Beck, 2008; Fu et al., 2014).

The capital adequacy ratio and deposit insurance remain robust. So does the correlation between the net loans to total assets ratio and the liquidity risk. Remarkably, there is a significant inverse relationship between the net interest margin and the bank-risk measures, showing that the bank’s profitability can mitigate risk. Supervisory power is significantly negatively correlated, meaning that when regulators impose actions on bank management, directors, shareholders and bank auditors, it reduces liquidity and portfolio risk, which is consistent with Al-Shboul et al. (2020). Political risk and GDP growth turn out to be more positively and negatively significant, respectively. The Hansen-Sargan over-identification test and the Arellano and Bond AR (1) and AR (2) for autocorrelation are displayed at the bottom of Table 5.11 below. These tests confirm the validity of the instruments used in the model. Overall, the findings of the various risk indicators considered in columns 1-5 indicate that, after controlling for endogeneity and heteroscedasticity, the relationship between market power and banks’ risk-taking is inverse and significant.

Table 5.11: Competition and bank stability: two-step system GMM regressions

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio	-0.006*	0.037	-0.013***	-0.009	-0.008***
	(-1.678)	(0.836)	(-3.130)	(-0.635)	(-2.618)
Lerner index	-0.420***	0.362	-0.050	0.433	-0.338**
	(-2.783)	(0.316)	(-0.614)	(1.195)	(-2.509)
Bank size	-0.046	-0.110	0.005	0.197**	0.062**
	(-1.405)	(-0.392)	(0.180)	(2.072)	(1.994)
Net loans to total assets	0.003	-0.021	0.012***	0.010	0.005*
	(0.939)	(-0.819)	(3.900)	(1.098)	(1.711)
Net interest margin	-0.102***	-0.240	0.018	-0.270***	-0.080***
	(-3.310)	(-1.276)	(1.431)	(-4.035)	(-2.625)
Capital adequacy ratio	-0.008*	0.089	-0.001	-0.015	-0.011**
	(-1.765)	(1.650)	(-0.283)	(-0.778)	(-2.058)
Supervisory Power	0.003	-0.088	-0.039***	-0.157***	0.008
	(0.242)	(-0.546)	(-2.790)	(-3.642)	(0.805)
Deposit insurance	-0.172**	-0.547	0.139	-0.182	-0.202**
	(-2.089)	(-0.500)	(1.512)	(-0.574)	(-2.411)
Political risk (ICRG)	0.007*	-0.021	0.011***	0.054***	0.008**
	(-1.964)	(-0.337)	(2.805)	(3.386)	(-2.450)
GDPg	-0.010**	-0.022	-0.001	-0.014	-0.013***
	(-2.017)	(-0.400)	(-0.337)	(-0.791)	(-2.684)
L.Z-score	0.619***				
	(13.840)				
L.credit risk		0.208***			
		(3.881)			
L.liquidity risk			0.633***		
			(11.866)		
L.portfolio risk				0.417***	
				(7.525)	
L.leverage risk					0.675***
					(15.382)
Constant	1.191	2.169	-1.294*	0.740	1.649**
	(1.550)	(0.366)	(-1.829)	(0.301)	(2.334)
Observations	2,999	2,306	2,893	2,999	3,000
Number of bank_id	278	228	268	278	279
Sargan (J-Statistic) (p-value)	0.387	0.359	0.601	0.363	0.346
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.874	0.963	0.937	0.330	0.650

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory restrictions and Economic Freedom. The Sargan test's null hypothesis of over-identifying restrictions is not rejected. A valid autocorrelation test in the dynamic panel data-AR (1) in first differences was rejected, but not with regard to the AR (2). A robust option was used to provide a heteroskedastic and autocorrelation-consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

Tables 5.12 and 5.13 provide the results of the system GMM models using data from the oil and non-oil producing countries. It can be seen from the data in Table 5.12 that the results of the system GMM are more economically significant for the oil-producing economies. The concentration ratios determine the correlation between competition and financial stability since the Lerner index is insignificant. The negative correlation varies from 0.3 percent to 14.7 percent, also supporting the competition-fragility nexus. The existence of a deposit insurance scheme is statistically significant in mitigating bank risk-taking in oil-producing countries, whereas the results from non-oil-producing economies tend to be more consistent with the results for all MENA countries. However, the Lerner index turns out to be insignificant. Bank size is significant at the 1 and 10 percent levels and remains positive. Net loans to asset ratios vary in their correlation with bank risk measures; they are negatively correlated with credit risk but positively correlated with the remaining dependent variables. The existence of deposit insurance schemes is significant for mitigating different types of bank risk. The political risk indicator is slightly significant for the insolvency risk; thus, it does not substantially affect the financial stability of the non-oil-producing countries.

Table 5.12: Competition and bank stability: two-step system GMM regressions for the oil-producing economies

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio	-0.030**	-0.147**	0.001	-0.033**	-0.018***
	(-2.279)	(-2.600)	(0.715)	(-2.112)	(-3.183)
Lerner index	0.113	-0.663	-0.021	-0.268	-0.000
	(0.736)	(-0.778)	(-0.462)	(-0.610)	(-0.006)
Bank size	0.147	-0.517	-0.007	0.006	0.018
	(1.205)	(-0.497)	(-0.647)	(0.107)	(0.661)
Net loans to total assets	0.008	0.023	0.003***	0.008	0.002
	(0.683)	(0.208)	(3.302)	(1.596)	(0.931)
Net interest margin	0.081	0.210	-0.011	-0.066*	-0.007
	(1.307)	(0.373)	(-1.124)	(-1.789)	(-0.387)
Capital adequacy ratio	-0.019	-0.231*	-0.004	0.006	-0.010
	(-1.132)	(-1.727)	(-0.586)	(0.227)	(-0.866)
Supervisory Power	0.056	0.656*	-0.006	-0.067*	0.036
	(0.834)	(1.789)	(-0.818)	(-1.672)	(0.642)
Deposit insurance	-1.383***	-3.627	0.054	0.557	-0.988***
	(-3.583)	(-1.408)	(0.811)	(1.488)	(-4.528)
Political risk (ICRG)	-0.009	-0.028	0.007**	-0.008	-0.010
	(-0.782)	(-0.250)	(2.482)	(-0.616)	(-0.918)
GDPg	0.004	0.067	0.002	-0.018*	0.004
	(0.845)	(1.285)	(0.758)	(-1.718)	(1.620)
L.Z-score	0.251***				
	(2.914)				
L.credit risk		0.327***			
		(4.907)			
L.liquidity risk			0.790***		
			(19.542)		
L.portfolio risk				0.336***	
				(5.095)	
L.leverage risk					0.681***
					(10.960)
Constant	-6.852***	-0.740	-1.057***	0.707	-1.568
	(-2.694)	(-0.029)	(-3.062)	(0.410)	(-1.238)
Observations	749	628	807	863	608
Number of bank_id	98	79	88	99	88
Sargan (J-Statistic) (p-value)	0.110	0.335	0.349	0.166	0.131
Arellano-Bond AR(1)	0.001	0.001	0.000	0.004	0.000
Arellano-Bond AR(2)	0.214	0.517	0.826	0.399	0.143

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory restrictions and Economic Freedom. The Sargan test's null hypothesis of over-identifying restrictions was not rejected. A valid autocorrelation test in dynamic panel data-AR(1) in first differences was rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroskedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5.13: Competition and bank stability: two-step system GMM regressions for non-oil-producing economies

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio	-0.006**	0.045	-0.004**	-0.017***	-0.009***
	(-2.074)	(1.251)	(-2.090)	(-3.907)	(-2.622)
Lerner index	0.011	-0.102	-0.037	0.012	0.010
	(0.152)	(-0.185)	(-0.801)	(0.088)	(0.161)
Bank size	0.073*	0.540	0.025	-0.023	0.099***
	(1.940)	(1.253)	(0.972)	(-0.250)	(2.659)
Net loans to total assets	0.002	-0.046**	0.014***	0.007**	0.002*
	(1.641)	(-2.119)	(8.441)	(2.028)	(1.658)
Net interest margin	-0.014	-0.159	0.009	-0.044**	-0.015
	(-1.278)	(-1.053)	(0.654)	(-2.307)	(-1.391)
Capital adequacy ratio	-0.002	0.039	-0.003	-0.012**	-0.001
	(-0.729)	(0.923)	(-0.914)	(-2.057)	(-0.524)
Supervisory Power	0.002	0.087	-0.021**	0.036*	-0.003
	(0.250)	(0.700)	(-2.586)	(1.762)	(-0.346)
Deposit insurance	-0.267***	0.051	0.057	-0.802***	-0.208***
	(-4.055)	(0.088)	(0.886)	(-5.118)	(-3.276)
Political risk (ICRG)	0.006*	0.019	-0.003	0.002	0.004
	(1.691)	(0.356)	(-0.488)	(0.266)	(1.161)
GDPg	0.006	-0.009	0.001	-0.001	0.008**
	(1.615)	(-0.165)	(0.338)	(-0.163)	(2.390)
L.Z-score	0.641***				
	(11.805)				
L.credit risk		-0.008			
		(-0.115)			
L.liquidity risk			0.548***		
			(13.107)		
L.portfolio risk				0.732***	
				(15.758)	
L.leverage risk					0.611***
					(10.203)
Constant	0.996	-14.693	-1.967***	-2.723	2.074**
	(1.012)	(-1.388)	(-2.680)	(-1.140)	(2.087)
Observations	2,136	1,423	2,086	2,136	2,137
Number of bank_id	179	148	180	179	180
Sargan (J-Statistic) (p-value)	0.306	0.116	0.369	0.284	0.316
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.392	0.937	0.909	0.449	0.520

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory and Economic Freedom. The Sargan tests' null hypothesis of over-identifying restrictions is not rejected. A valid autocorrelation test in dynamic panel data-AR(1) in first differences is rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroscedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

In a study investigating the effect of increased competition on the risk of bank distress, Martinez-Miera and Repullo (2008) find that there are two opposite effects. First is the risk-shifting effect, which shows that excessive competition leads to lower loan rates and consequently lowers the non-performing loans; hence, boosting banks' stability. Second is the margin effect, which implies that more competition tends to reduce loan rates and as a result, reduces the revenues from performing loans that provide a buffer against loan defaults; hence, it boosts banks' fragility. Their findings suggest that the risk-shifting effect may be found in monopolistic markets, while the margin effect dominates in competitive markets. Thus, a U-shaped relationship exists between competition and the risk of bank failure. Following Martinez-Miera and Repullo (2008) and Berger et al. (2009) methodologies, we allow for a nonlinear relationship between financial stability and market structure by including the Lerner quadratic term as a robustness check for both the panel fixed effect and system GMM. Berger et al. (2009) mention that, in order to assess the relationship between the degree of market power and the bank risk measures, we have to calculate the inflection point[140] of each quadratic function and compare it with the distribution of the variable.

Table 5.14 shows the bank market power and bank risk-taking non-linearity models. It can be seen from this table that the inflection points for the significant models are outside the range of the Lerner index in the sample (see Table 5.4); thus, they do not affect the relationship between bank market power and bank risk-taking. The results of the system GMM regressions in Table 5.15 are consistent with the previous results. However, the inflection point of the portfolio risk model appears to be 1.989, which is around the second percentile of the Lerner index distribution, implying that more than 98 percent of the data lies below the inflection point. This suggests a negative relationship between market power and portfolio risk.

[140] Inflection point= [(-1)*(Lerner index coefficient)/(2)*(Lerner squared coefficient)]

Table 5.14: Competition and bank stability non-linearity regressions

VARIABLES	(1) Z-score	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Lerner index (-1)	-0.117***	0.417	-0.041	-0.346***	-0.082**
	(-3.148)	(1.063)	(-0.641)	(-2.803)	(-2.494)
Lerner^2 index (-1)	0.008***	0.018	-0.002	0.038***	0.006***
	(3.664)	(0.824)	(-0.588)	(2.961)	(3.534)
Inflection point	***7.313***			***4.553***	***6.833***
Bank size (-1)	0.027	0.173	0.128***	0.011	0.018
	(1.140)	(1.134)	(4.272)	(0.151)	(0.883)
Net loans to total assets(-1)	0.001	0.002	0.021***	-0.002	0.001
	(0.588)	(0.153)	(10.754)	(-0.567)	(0.842)
Net interest margin (-1)	-0.007	-0.022	-0.011	-0.039	-0.005
	(-1.160)	(-0.327)	(-0.798)	(-1.335)	(-0.946)
Capital adequacy ratio(-1)	-0.013***	-0.036*	0.004	-0.030***	-0.011***
	(-5.159)	(-1.659)	(1.480)	(-4.970)	(-4.884)
Supervisory Power (-1)	0.017**	0.075	-0.005	0.001	0.014**
	(2.217)	(1.269)	(-0.601)	(0.051)	(2.126)
Deposit insurance (-1)	-0.277***	-0.676**	0.189*	-0.472	-0.225***
	(-3.216)	(-2.227)	(1.855)	(-1.518)	(-3.341)
Political risk (ICRG) (-1)	0.003	-0.001	-0.010**	0.002	0.002
	(0.981)	(-0.062)	(-2.208)	(0.242)	(0.620)
GDPg (-1)	0.004*	0.009	0.001	0.003	0.003
	(1.764)	(0.396)	(0.326)	(0.545)	(1.526)
Constant	-1.875***	-4.826	-6.362***	-3.281	-1.377**
	(-2.922)	(-1.145)	(-8.068)	(-1.617)	(-2.462)
Observations	2,867	2,282	2,788	2,867	2,867
R-squared	0.788	0.341	0.680	0.644	0.838
Number of bank_id	280	238	268	280	280

Notes: This table demonstrates the results of the Panel OLS fixed-effect model with country dummies. The standard error terms are clustered by country. All financial ratios are winsorised at 99 percent. Explanatory variables are lagged by one period. Robust t-statistics are reported below each estimated coefficient using heteroskedasticity-robust standard errors.*** p<0.01, ** p<0.05, * p<0.1 represent significance levels.

Table 5.15: Competition and bank stability non-linearity regressions

VARIABLES	(1) Z-score	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Lerner index	-0.327**	0.543	0.071	-0.362	-0.247*
	(-2.162)	(0.375)	(0.649)	(-0.796)	(-1.908)
Lerner^2 index	0.006	-0.055	-0.015	0.091***	0.002
	(0.468)	(-0.512)	(-1.496)	(3.730)	(0.166)
Inflection point	***27.25***			***1.989***	***61.75***
Bank size	0.033	-0.128	0.015	0.153*	0.046*
	(1.124)	(-0.464)	(0.634)	(1.670)	(1.693)
Net loans to total assets	0.000	-0.026	0.011***	0.005	0.002
	(0.183)	(-0.974)	(3.741)	(0.512)	(0.756)
Net interest margin	-0.086***	-0.225	0.012	-0.232***	-0.056**
	(-3.078)	(-1.196)	(0.951)	(-3.734)	(-2.299)
Capital adequacy ratio	-0.009*	0.083	-0.004	0.027	-0.011**
	(-1.958)	(1.566)	(-0.908)	(1.452)	(-2.316)
Supervisory Power	0.002	-0.111	-0.026*	-0.147***	0.004
	(0.183)	(-0.755)	(-1.879)	(-3.448)	(0.463)
Deposit insurance	-0.141*	0.530	-0.224***	-0.112	-0.150**
	(-1.784)	(0.465)	(-2.738)	(-0.355)	(-1.990)
Political risk (ICRG)	-0.008**	0.013	0.001	-0.051***	-0.009***
	(-2.378)	(0.247)	(0.318)	(-3.879)	(-2.932)
GDPg	0.011**	-0.041	-0.000	-0.003	0.013***
	(2.086)	(-0.697)	(-0.030)	(-0.160)	(2.692)
L.Z-score	0.644***				
	(18.292)				
L.credit risk		0.215***			
		(4.050)			
L.liquidity risk			0.640***		
			(12.488)		
L.portfolio risk				0.417***	
				(7.694)	
L.leverage risk					0.721***
					(23.660)
Constant	0.673	3.578	-1.883***	-0.662	0.951*
	(1.051)	(0.642)	(-3.187)	(-0.294)	(1.675)
Observations	2,999	2,306	2,893	2,999	3,000
Number of bank_id	278	228	268	278	279
Sargan (J-Statistic) (p-value)	0.388	0.981	0.599	0.326	0.380
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.893	0.421	0.954	0.505	0.613

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory restrictions and Economic Freedom. The Sargan test's null hypothesis of over-identifying restrictions is not rejected. A valid autocorrelation test in dynamic panel data-AR(1) in first differences was rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroskedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

Furthermore, to extend our robustness checks, we re-estimated the models using an alternative concentration ratio indicator: the Herfindahl-Hirschman Index (HHI) calculated by employing the data of total assets and total deposits. We also used as an alternative measure of political risk the political stability and absence of violence indicator, which is one of the Worldwide Governance Indicators.

Moreover, we included time dummies in the system GMM models following Roodman's (2009) methodology. Lastly, we excluded country-level variables (GDP growth and political risk indicator) in line with the robustness check by Berger et al. (2009). The results of the previously mentioned robustness checks are reported in Tables 5A.1 to 5A.8. Overall, there was a consensus regarding the significant negative relationship between bank competition and bank risk measures, supporting the competition-fragility nexus. Remarkably, there was a significant inverse relationship between the capital adequacy ratio and the existence of deposit insurance schemes in the MENA region. These main results are essential in constructing the appropriate policies for boosting stability. Regarding the use of the HHI-total assets or HHI total deposits, the results remain robust. Still, the magnitudes are low, so it is appropriate to continue using the 5-bank concentration ratio. Regarding the political stability indicator of the WGI, the signs and the significant level vary without providing substantial evidence of its relationship with bank risk measures. Our results remain robust to the inclusion of year dummies in two-step system GMM models by excluding country-specific variables (GDP growth and the political risk indicator). Overall, the main findings remain unchanged (see Appendix, Tables 5A.1 to 5A.8).

5.6 Conclusion

This study investigates the link between concentration, competition and bank risk for the MENA economies. The concentration ratio and the Lerner index are measures of bank competition: the higher values of both indicators indicate higher degrees of market power, which means a less competitive environment. Our panel models include insolvency risk (Z-score), credit risk, liquidity risk, portfolio risk and leverage risk, which reflect the extent of stability in the market. We also control bank size, the net loans to total assets ratio, net interest margin, capital adequacy ratio, supervisory power, deposit insurance (dummy variable), political risk and GDP growth to control for differences in the business environment and economic development, following the structure of Berger et al. (2009). Using aggregate financial data from more than 700 banks operating in 16 MENA countries over the period 1995 to 2018, our empirical results from panel estimations provide evidence consistent with the "competition-fragility" view.

The results show that the concentration ratio and Lerner index are significantly negative, which suggests that, except for the credit risk results, bank risk, including the different risk exposures with various risk measures, reduces with greater concentration and market power. Regarding the control variables, the capital adequacy ratio and deposit insurance are negatively correlated with the banks risk measures, indicating that an increased capital adequacy ratio and the existence of deposit insurance play an essential role in mitigating bank risk-taking, which is consistent with the empirical literature and complies with international regulatory actions. The size of a bank and the ratio of net loans to total assets are only positively significant for the liquidity risk. These findings are consistent with those of Beck (2008) and Laeven et al. (2016). Cornett et al. (2011) claim that banks may tend to hold more liquid assets to overcome any monetary shocks that could affect their loan portfolio. The supervisory power is positively correlated with insolvency and leverage risk. In contrast to the findings of Al-Shboul et al. (2020) that large banks in the MENA have lower levels of risk, the political risk indicator is significant at the 10 percent level, indicating that the higher the value of the ICRG political risk indicator (meaning the lower the degree of political risk) the lower the liquidity risk. Overall, our findings indicate that banks are more stable in a more concentrated and less competitive environment.

Several robustness tests were applied. We re-estimated the relationship between bank competition and financial stability using a two-step system GMM following the methodology of Berger et al. (2009). We used the Lerner quadratic term to capture the presence of a non-linear relationship between competition and risk, in line with the conclusions of Martinez-Miera and Repullo (2008). It is worth noting that there is no evidence for the non-linearity of competition. Furthermore, we re-ran the models using an alternative concentration ratio indicator, which is the Herfindahl-Hirschman Index (HHI) calculated by employing data on total assets and total deposits. As an alternative measure of political risk, we also used the political stability and absence of violence indicator, which is one of the Worldwide Governance Indicators. Moreover, we included time dummies in system GMM models following Roodman's (2009) methodology. Lastly, we excluded country-level variables (GDP growth and political risk indicator) in line with the robustness check by Berger et al. (2009). Remarkably, our findings remain robust. In terms of including the political risk indicator in the model, the magnitude of the coefficients is low, which implies that these are not key variables that significantly affect the stability of the region. Al-Shboul et al. (2020), in contrast, find an inverse relationship between political risk and bank stability.

Our findings provide several essential issues for policymakers in the economies of the MENA region. Regulators should control the competitive environment between banks but should not apply anti-competitive measures that affect the financial reforms implemented by several economies in the MENA region in the last two decades. Regulators could promote the development of financial innovations to mitigate risk and increase the efficiency of the financial system. We find evidence of the significant effect of deposit insurance schemes in the region, even though several studies confirm the link between deposit insurance and moral hazard. Hence, regulators should be alert when increasing the coverage.

Moreover, regulators should continue to comply with the international regulations and requirements concerning capital adequacy and liquidity in order to maintain a sound banking system. Further research should be undertaken to explore the effect of macroprudential policy and bank competition on bank risk, particularly in the MENA region. Too little attention has so far been paid to investigating the banking systems of this region.

5.7 Appendix

Table 5A.1: Competition and bank stability: Panel fixed effect regressions (HHIta)

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
HHI_TA (-1)	0.000	-0.000	-0.000**	0.000	0.000
	(1.363)	(-0.123)	(-2.072)	(0.127)	(1.031)
Lerner index (-1)	-0.047	-0.547*	-0.085	-0.087	-0.033
	(-1.215)	(-1.740)	(-1.461)	(-0.782)	(-0.961)
Bank size (-1)	0.033	0.168	0.114***	0.008	0.022
	(1.244)	(1.131)	(4.007)	(0.088)	(0.980)
Net loans to total assets(-1)	0.001	0.001	0.021***	-0.002	0.001
	(0.629)	(0.105)	(10.107)	(-0.748)	(0.846)
Net interest margin (-1)	-0.009	-0.026	-0.008	-0.046	-0.006
	(-1.450)	(-0.382)	(-0.611)	(-1.494)	(-1.207)
Capital adequacy ratio(-1)	-0.013***	0.034	0.004	-0.032***	-0.011***
	(-4.975)	(1.578)	(1.154)	(-4.833)	(-4.753)
Supervisory Power (-1)	0.018**	0.074	-0.007	0.001	0.015**
	(2.191)	(1.247)	(-0.820)	(0.057)	(2.108)
Deposit insurance (-1)	-0.221***	-0.726*	0.074	-0.488*	-0.190***
	(-2.599)	(-1.867)	(0.713)	(-1.808)	(-2.732)
Political risk (ICRG) (-1)	0.002	-0.002	-0.009*	0.000	0.001
	(0.661)	(-0.074)	(-1.858)	(0.004)	(0.369)
GDPg (-1)	0.004	0.008	0.001	0.001	0.003
	(1.591)	(0.339)	(0.245)	(0.114)	(1.379)
Constant	-2.073***	-4.607	-5.878***	-3.055	-1.499**
	(-2.677)	(-1.120)	(-7.455)	(-1.174)	(-2.302)
Observations	2,867	2,282	2,788	2,867	2,867
R-squared	0.787	0.340	0.682	0.643	0.837
Number of bank_id	280	238	268	280	280

Notes: This table demonstrates the results of the Panel OLS fixed-effect model with country dummies. The standard error terms is clustered by country. All financial ratios are winsorised at 99 percent. Explanatory variables are lagged by one period. Robust t-statistics are reported below each estimated coefficient using heteroskedastic-robust standard errors.*** p<0.01, ** p<0.05, * p<0.1 represent significance levels.

Table 5A.2: Competition and bank stability: two-step system GMM regressions (HHIta)

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
HHI_Total Asset	-0.000*	0.000	-0.000**	0.000	-0.000***
	(-1.873)	(0.004)	(-1.975)	(0.450)	(-3.067)
Lerner index	-0.393***	0.235	-0.099	-0.530	-0.292**
	(-2.698)	(0.196)	(-1.107)	(-1.406)	(-2.289)
Bank size	-0.051*	-0.124	-0.006	-0.177*	-0.071**
	(-1.727)	(-0.431)	(-0.207)	(-1.831)	(-2.517)
Net loans to total assets	0.002	-0.026	0.012***	0.006	0.004
	(0.812)	(-1.005)	(3.811)	(0.602)	(1.625)
Net interest margin	-0.086***	-0.213	0.018	-0.284***	-0.056**
	(-3.021)	(-1.135)	(1.467)	(-4.372)	(-2.269)
Capital adequacy ratio	-0.008*	0.084	-0.003	0.015	-0.010**
	(-1.705)	(1.549)	(-0.711)	(0.835)	(-2.073)
Supervisory Power	0.000	-0.121	-0.029**	-0.156***	0.003
	(0.020)	(-0.776)	(-1.978)	(-3.612)	(0.305)
Deposit insurance	-0.193**	0.566	-0.270***	0.225	-0.228***
	(-2.313)	(0.441)	(-2.770)	(0.739)	(-2.638)
Political risk (ICRG)	-0.007*	0.013	0.005	0.047***	-0.007**
	(-1.757)	(0.225)	(1.305)	(3.468)	(-2.101)
GDPg	0.009*	-0.035	0.000	-0.015	0.012**
	(1.849)	(-0.622)	(0.075)	(-0.827)	(2.418)
L.Z-score	0.619***				
	(15.020)				
L.credit risk		0.212***			
		(3.991)			
L.liquidity risk			0.655***		
			(13.099)		
L.portfolio risk				0.416***	
				(7.602)	
L.leverage risk					0.673***
					(17.090)
Constant	0.975	3.519	-1.504**	0.222	1.393**
	(1.527)	(0.604)	(-2.190)	(0.093)	(2.426)
Observations	2,999	2,306	2,893	2,999	3,000
Number of bank_id	278	228	268	278	279
Sargan (J-Statistic) (p-value)	0.410	0.980	0.569	0.397	0.408
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.909	0.356	0.931	0.325	0.689

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory and Economic Freedom. The Sargan tests' null hypothesis of over-identifying restrictions is not rejected. Valid Autocorrelation test in dynamic paned data-AR(1) in first differences are rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroskedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5A.3: Competition and bank stability: Panel fixed effect regressions (HHItd)

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
HHI_Total Deposits (-1)	-0.000**	0.000	-0.000***	-0.000	-0.000**
	(-2.564)	(0.189)	(-3.158)	(-0.881)	(-2.303)
Lerner index (-1)	-0.037	0.561*	-0.092	-0.066	-0.023
	(-0.901)	(1.798)	(-1.582)	(-0.570)	(-0.638)
Bank size (-1)	0.040	0.176	0.107***	0.020	0.028
	(1.498)	(1.194)	(3.845)	(0.234)	(1.257)
Net loans to total assets(-1)	0.001	0.002	0.020***	-0.002	0.001
	(0.871)	(0.126)	(9.948)	(-0.582)	(1.072)
Net interest margin (-1)	-0.010	-0.026	-0.008	-0.047	-0.007
	(-1.493)	(-0.379)	(-0.586)	(-1.486)	(-1.268)
Capital adequacy ratio(-1)	-0.013***	0.035	0.003	-0.031***	-0.011***
	(-4.966)	(1.612)	(1.109)	(-4.854)	(-4.729)
Supervisory Power (-1)	0.018**	0.076	-0.007	0.002	0.015**
	(2.196)	(1.300)	(-0.872)	(0.097)	(2.126)
Deposit insurance (-1)	-0.152*	-0.655	0.007	-0.374	-0.130*
	(-1.886)	(-1.617)	(0.072)	(-1.507)	(-1.967)
Political risk (ICRG) (-1)	0.001	-0.003	-0.007	-0.002	-0.000
	(0.266)	(-0.135)	(-1.544)	(-0.183)	(-0.005)
GDPg (-1)	0.004*	0.008	0.000	0.001	0.003
	(1.745)	(0.354)	(0.099)	(0.215)	(1.517)
Constant	-2.302***	-4.874	-5.666***	-3.474	-1.704***
	(-2.952)	(-1.195)	(-7.352)	(-1.329)	(-2.608)
Observations	2,867	2,282	2,788	2,867	2,867
R-squared	0.789	0.340	0.684	0.643	0.838
Number of bank_id	280	238	268	280	280

Notes: This table demonstrates the results of the Panel OLS fixed-effect model with country dummies. The standard error terms are clustered by country. All financial ratios are winsorised at 99 percent. Explanatory variables are lagged by one period. Robust t-statistics are reported below each estimated coefficient using heteroskedastic-robust standard errors.*** p<0.01, ** p<0.05, * p<0.1 represent significance levels.

Table 5A.4: Competition and bank stability: two-step system GMM regressions (HHItd)

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
HHI_Total Deposits	-0.000**	0.000	-0.000*	-0.000	-0.000***
	(-2.029)	(0.220)	(-1.769)	(-0.488)	(-2.944)
Lerner index	-0.412***	0.308	-0.099	-0.449	-0.308**
	(-2.751)	(0.254)	(-1.084)	(-1.227)	(-2.363)
Bank size	-0.051*	-0.133	-0.007	-0.183*	-0.066**
	(-1.657)	(-0.468)	(-0.226)	(-1.909)	(-2.269)
Net loans to total assets	0.002	-0.025	0.012***	0.008	0.004
	(0.768)	(-0.941)	(3.832)	(0.778)	(1.431)
Net interest margin	-0.085***	-0.210	0.018	-0.262***	-0.052**
	(-2.985)	(-1.123)	(1.495)	(-4.154)	(-2.177)
Capital adequacy ratio	-0.008*	0.084	-0.003	-0.013	-0.010**
	(-1.724)	(1.565)	(-0.621)	(-0.713)	(-2.125)
Supervisory Power	0.002	-0.109	-0.028*	-0.156***	0.005
	(0.152)	(-0.678)	(-1.896)	(-3.590)	(0.572)
Deposit insurance	-0.196**	0.462	-0.272***	-0.227	-0.224***
	(-2.435)	(0.370)	(-2.706)	(-0.769)	(-2.712)
Political risk (ICRG)	-0.007**	0.006	0.004	0.052***	-0.008**
	(-2.009)	(0.099)	(0.972)	(3.662)	(-2.571)
GDPg	0.009*	-0.032	0.001	-0.015	0.012**
	(1.858)	(-0.563)	(0.273)	(-0.813)	(2.485)
L.Z-score	0.608***				
	(14.572)				
L.credit risk		0.211***			
		(3.979)			
L.liquidity risk			0.657***		
			(12.607)		
L.portfolio risk				0.416***	
				(7.529)	
L.leverage risk					0.667***
					(16.658)
Constant	0.990	3.832	-1.415**	0.150	1.322**
	(1.498)	(0.677)	(-2.014)	(0.064)	(2.232)
Observations	2,999	2,306	2,893	2,999	3,000
Number of bank_id	278	228	268	278	279
Sargan (J-Statistic) (p-value)	0.410	0.356	0.597	0.359	0.414
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.920	0.976	0.930	0.325	0.716

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics in are below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory and Economic Freedom. The Sargan tests' null hypothesis of over-identifying restrictions is not rejected. Valid Autocorrelation test in dynamic paned data-AR(1) in first differences are rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroskedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5A.5: Competition and bank stability: Panel fixed effect regressions (Political Stability (WGI))

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio (-1)	-0.004	-0.003	-0.013***	-0.017**	-0.004
	(-1.334)	(-0.156)	(-3.365)	(-2.427)	(-1.509)
Lerner index (-1)	-0.055	0.290	-0.071	-0.059	-0.037
	(-1.529)	(0.980)	(-1.185)	(-0.515)	(-1.202)
Bank size (-1)	0.007	0.160	0.110***	-0.022	-0.001
	(0.275)	(0.936)	(3.463)	(-0.224)	(-0.037)
Net loans to total assets(-1)	0.001	0.007	0.019***	-0.004	0.001
	(0.453)	(0.515)	(9.924)	(-1.317)	(0.709)
Net interest margin (-1)	-0.006	-0.015	-0.001	-0.034	-0.002
	(-0.772)	(-0.203)	(-0.093)	(-0.964)	(-0.415)
Capital adequacy ratio(-1)	-0.011***	0.045*	-0.001	-0.031***	-0.009***
	(-4.804)	(1.959)	(-0.296)	(-5.015)	(-4.459)
Supervisory Power (-1)	0.022***	0.069	-0.005	-0.000	0.019***
	(2.779)	(1.286)	(-0.652)	(-0.004)	(2.721)
Deposit insurance (-1)	-0.427***	-0.692**	0.122	-0.993	-0.343***
	(-3.601)	(-2.064)	(1.060)	(-1.607)	(-3.821)
Political Stab. (WGI)(-1)	-0.063**	0.140	-0.067	-0.036	-0.069***
	(-2.106)	(0.683)	(-1.515)	(-0.416)	(-2.799)
GDPg (-1)	0.003	0.019	-0.006	0.000	0.003
	(1.260)	(0.928)	(-1.566)	(0.006)	(1.095)
Constant	-1.006	-4.679	-5.503***	-0.926	-0.637
	(-1.420)	(-1.006)	(-6.912)	(-0.379)	(-1.043)
Observations	2,576	2,031	2,507	2,576	2,576
R-squared	0.819	0.379	0.689	0.668	0.865
Number of bank_id	279	238	267	279	279

Notes: This table demonstrates the results of the Panel OLS fixed-effect model with country dummies. The standard error terms is clustered by country. All financial ratios are winsorised at 99 percent. Explanatory variables are lagged by one period. Robust t-statistics are reported below each estimated coefficient using heteroskedastic-robust standard errors.*** p<0.01, ** p<0.05, * p<0.1 represent significance levels.

Table 5A.6: Competition and bank stability: two-step system GMM regressions (Political Stability (WGI))

VARIABLES	(1) Insolvency risk	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio	-0.001	-0.045***	-0.013***	0.000	-0.011***
	(-0.720)	(-4.392)	(-2.860)	(0.012)	(-4.224)
Lerner index	-0.017	-0.171	0.008	-1.010***	0.029
	(-0.296)	(-0.614)	(0.105)	(-2.759)	(0.494)
Bank size	0.027**	0.069	0.013	-0.064	0.012
	(2.156)	(0.953)	(0.447)	(-0.560)	(1.094)
Net loans to total assets	0.001	-0.011	0.014***	0.009	0.001
	(0.724)	(-1.428)	(4.345)	(0.815)	(0.958)
Net interest margin	0.009	-0.072	0.015	-0.308***	-0.008
	(1.197)	(-0.824)	(1.055)	(-4.199)	(-0.729)
Capital adequacy ratio	-0.009***	0.006	-0.001	0.018	-0.011***
	(-3.464)	(0.180)	(-0.271)	(0.955)	(-3.919)
Supervisory Power	0.070	0.027	0.187**	0.254	0.184***
	(1.026)	(0.104)	(1.990)	(0.823)	(3.561)
Deposit insurance	-0.215***	-0.308	-0.088*	-0.378**	-0.033
	(-7.866)	(-1.246)	(-1.765)	(-2.202)	(-1.025)
Political Stab. (WGI)	0.028***	-0.012	-0.027**	-0.111***	0.023***
	(4.098)	(-0.204)	(-2.384)	(-2.759)	(3.877)
GDPg	0.005**	0.024	0.002	0.015	-0.001
	(2.323)	(0.808)	(0.416)	(0.759)	(-0.464)
L.Z-score	0.552***				
	(15.386)				
L.credit risk		0.186***			
		(3.546)			
L.liquidity risk			0.606***		
			(11.826)		
L.portfolio risk				0.426***	
				(6.837)	
L.leverage risk					0.607***
					(13.715)
Constant	-1.410***	-4.080*	-1.052	0.214	-0.018
	(-4.051)	(-1.921)	(-1.442)	(0.078)	(-0.057)
Observations	2,709	2,062	2,632	2,709	2,251
Number of bank_id	278	226	268	278	255
Sargan (J-Statistic) (p-value)	0.327	0.338	0.489	0.299	0.276
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.110	0.982	0.971	0.835	0.142

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory and Economic Freedom. The Sargan tests' null hypothesis of over-identifying restrictions is not rejected. Valid Autocorrelation test in dynamic paned data-AR(1) in first differences are rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroskedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5A.7: Competition and bank stability: two-step system GMM regressions (year dummies Roodman (2009))

VARIABLES	(1) Z-score	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio	-0.006*	0.032	-0.012**	-0.011	-0.007**
	(-1.841)	(0.622)	(-2.018)	(-0.807)	(-2.534)
Lerner index	-0.426***	0.458	-0.061	-0.803**	-0.315**
	(-2.948)	(0.334)	(-0.688)	(-2.047)	(-2.481)
Bank size	-0.046	0.303	0.022	-0.046	0.080**
	(-1.150)	(0.768)	(0.593)	(-0.333)	(2.137)
Net loans to total assets	0.005	-0.012	0.010***	0.005	0.006**
	(1.609)	(-0.396)	(2.670)	(0.548)	(2.200)
Net interest margin	-0.097***	-0.299	0.018	-0.320***	-0.074***
	(-3.355)	(-1.242)	(1.355)	(-4.294)	(-2.697)
Capital adequacy ratio	-0.016***	0.079	-0.002	0.036	-0.015***
	(-3.432)	(1.220)	(-0.316)	(1.434)	(-3.294)
Supervisory Power	0.000	-0.370	-0.027	-0.189***	0.016
	(0.019)	(-1.280)	(-1.031)	(-2.687)	(1.366)
Deposit insurance	-0.206**	1.472	0.118	0.135	-0.220**
	(-2.566)	(1.063)	(1.181)	(0.408)	(-2.561)
Political risk (ICRG)	-0.009**	-0.011	0.011	0.045**	-0.010***
	(-2.366)	(-0.145)	(1.552)	(2.497)	(-2.769)
GDPg	0.009*	0.070	-0.006	0.015	0.009**
	(1.726)	(0.878)	(-1.192)	(0.471)	(1.992)
Constant		-1.981		-1.170	
		(-0.285)		(-0.434)	
Observations	2,999	2,306	2,893	2,999	3,000
Number of bank_id	278	228	268	278	279
Sargan (J-Statistic) (p-value)	0.161	0.932	0.425	0.122	0.139
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.362	0.954	0.854	0.450	0.531

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory and Economic Freedom. The Sargan tests' null hypothesis of over-identifying restrictions is not rejected. Valid Autocorrelation test in dynamic paned data-AR(1) in first differences are rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroskedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

Table 5A.8: Competition and bank stability: two-step system GMM regressions-excluding country-level variables (GDPg and political risk indicator)

VARIABLES	(1) Z-score	(2) Credit risk	(3) Liquidity risk	(4) Portfolio risk	(5) Leverage risk
Concentration ratio	-0.006*	0.026	-0.005	0.017	-0.008***
	(-1.849)	(0.696)	(-1.375)	(1.367)	(-2.710)
Lerner index	-0.372***	0.207	-0.023	-0.859**	-0.289**
	(-2.742)	(0.176)	(-0.285)	(-2.297)	(-2.398)
Bank size	-0.051	-0.121	0.012	-0.157	-0.068**
	(-1.634)	(-0.437)	(0.488)	(-1.475)	(-2.274)
Net loans to total assets	0.002	-0.026	0.013***	0.009	0.003
	(0.569)	(-1.179)	(4.267)	(0.867)	(1.209)
Net interest margin	-0.089***	-0.211	0.009	-0.380***	-0.067**
	(-3.187)	(-1.231)	(0.702)	(-5.089)	(-2.547)
Capital adequacy ratio	-0.002	0.086	0.001	-0.037*	0.003
	(-0.437)	(1.631)	(0.163)	(-1.838)	(0.609)
Supervisory Power	-0.006	-0.117	-0.024*	-0.091**	-0.003
	(-0.556)	(-0.897)	(-1.836)	(-2.088)	(-0.299)
Deposit insurance	-0.198**	0.703	-0.177*	-0.188	-0.230**
	(-2.304)	(0.775)	(-1.889)	(-0.522)	(-2.567)
L.Z-score	0.634***				
	(14.344)				
L.credit risk		0.212***			
		(3.945)			
L.liquidity risk			0.633***		
			(12.105)		
L.portfolio risk				0.442***	
				(8.064)	
L.leverage risk					0.693***
					(16.163)
Constant	1.131	2.212	-1.581***	0.821	1.614**
	(1.558)	(0.367)	(-2.704)	(0.313)	(2.400)
Observations	2,999	2,306	2,893	2,999	3,000
Number of bank_id	278	228	268	278	279
Sargan (J-Statistic) (p-value)	0.407	0.973	0.619	0.377	0.411
Arellano-Bond AR(1)	0.000	0.000	0.000	0.000	0.000
Arellano-Bond AR(2)	0.562	0.347	0.920	0.386	0.344

Notes: This table shows bank-level two-step system GMM regressions with robust standard errors. All financial ratios are winsorised at 99 percent. All t-statistics are in parentheses below each estimated coefficient. Instrumental variables are activity restrictions, capital regulatory and Economic Freedom. The Sargan tests' null hypothesis of over-identifying restrictions is not rejected. Valid Autocorrelation test in dynamic paned data-AR(1) in first differences are rejected, but not with regard to the AR(2) test. A robust option was used to provide a heteroskedastic and autocorrelation consistent (HAC) variance-covariance matrix (Roodman, 2009). *** significant at 1%, ** significant at 5%, * significant at 10%.

CHAPTER 6

6.1 CONCLUSION

Over the last few decades, market conditions in the global banking industry have experienced a paradigm shift that deserves particular attention. Technological innovation in the form of internet banking and financial technology (FinTech,) financial deregulation, geopolitical events, a process of intense consolidation, and globalisation in the financial markets have forced banks and policymakers to operate differently (Berger et al., 1995; Bikker and Spierdijk, 2008; Turk-Ariss, 2009).

During the mid-1980s, after a period of critical economic situations, many MENA countries started stabilising their economies. For instance, they tolerated high inflation rates, budget deficits, depreciation in exchange rates, public ownership of the financial institutions and unstructured monetary policies. Not only these adverse conditions but others also played a significant role in the process of banking crises in this region. In this regard, restructuring the monetary system that has a market orientation was the priority for the MENA countries, especially Egypt, Jordan, Yemen, Tunisia, Algeria, Morocco, and Mauritania (Elsafti, 2007). Lee (2002) indicated that only since the 1990s countries in the MENA region have begun to reform their financial systems to be more attractive to all market participants. Creane et al. (2004) assessed the reformed financial sectors in the MENA countries. They found that the region was performing well as a group precisely in financial openness, financial regulations, and supervision, although their degree of financial development varied.

This thesis was designed to determine the factors that help promote risk-taking and lead to systemic banking crises to build a suitable Early Warning System (EWS) for the MENA region. Furthermore, we investigate the level of banking competition and convergence across the region, and study the relationship between concentration, competition and financial stability. Most studies in these fields have only focused on examining developed and developing economies, with limited emphasis on the MENA region. The importance and originality of this thesis rest on transcending the current literature and being the first to apply several techniques and data to extensively study the banking sector in the MENA region from different concepts.

The findings of **Chapter 3** strengthen the ideas that policymakers in the MENA region should apply persistent efforts to build up solid supervisory capacity and strictly comply with the international regulations concerning the proportion of liquidity and capital adequacy ratios. Our findings provide robust insights on both banking indicators. Furthermore, regulators should establish an effective macroprudential framework for any deficiency in the financial system that could contribute to rising systemic risk. Some countries in the MENA region have already applied various policies and techniques such as reserve requirements and limits on loan concentration. To overcome bank runs incentives, Baer and Klingebiel (1995) suggest that regulators need to parallel deal with all insolvent and marginally solvent institutions. Furthermore, they argue that regulators intervention tools in emerging markets should be simple because of weak regulations, limited supervision, and lack of reliable financial solvency data. Regulatory reform in the financial system should be a priority to promote confidence and inclusion of the financial system operating in the MENA region. In the end, policymakers can benefit from the signals of the EWSs, but they should never be used exclusively to make decisions and substitute regulators judgement and interpretations.

In terms of the findings of **Chapter 4**, it provides insights for policymakers and regulators who wish to enhance competition policies in the banking industry since it will help to keep markets open, support economic integration, and remove barriers to entry. Consequently, it will increase total welfare and maintain the stability of the banking system. Central banks or competition authorities set policies to control competition to encourage new banks to enter the market, treat big and small banks fairly, and enable banks to satisfy customers' needs. The failure of a bank should not affect the economy.
In sum, policymakers should maintain low prices, high quality, and innovation across banks to improve the resilience of the banking system in each country and the MENA region as a whole. However, policymakers should properly review their policies and consider the views of De Nicolo et al. (2012) and the International Monetary Fund (2013) that any relaxation of policies related to licensing, branching, and removing anti-competitive actions can also ease access to credit and this is associated with less monitoring. Thus, aggressive competition between banks may affect the efficiency of their operations. On this account, regulators should adequately assess the banking industry and apply competition policy cautiously to design suitable macroprudential policies that promote financial stability. On the micro-level, the adoption of new technologies, advanced risk management techniques, and professional human capital from foreign banks incentivises domestic banks to adopt the same strategies and put themselves on the same footing as their peers (Turk-Ariss, 2009), hence, raising the level of competition. In this regard, Turk-Ariss (2009) confirms that most MENA countries are committed to financial liberalisation. Thus, banks are required to comply with the international accounting standards and prudential guidelines of capitalization and governance. Hence, their high concentration gives insights to regulators when they set pro-competitive policies to develop contestable markets and boost stability.

Our results of **Chapter 5** provide several essential issues for policymakers in the economies of the MENA region. Regulators should control the competitive environment between banks but should not apply anti-competitive measures that affect the financial reforms implemented by several economies in the MENA region in the last two decades. Regulators could promote the development of financial innovations to mitigate risk and increase the efficiency of the financial system. We find evidence of the significant effect of deposit insurance schemes in the region, even though several studies confirm the link between deposit insurance and moral hazards. Hence, regulators should be alert when increasing the coverage. Moreover, regulators should continue to comply with the international regulations and requirements concerning capital adequacy and liquidity in order to maintain a sound banking system.

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