Essays on Efficiency, Stability, Governance, and Regulations in Financial Institutions

A Thesis submitted for the degree of Doctor of Philosophy

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Abstract

The thesis takes into consideration the influences of financial regulation and supervision and assesses the banking system from two key aspects: banking stability and banking efficiency. Concerning stability, the thesis considers two subjects. The first subject deals with the determinant of the capital adequacy ratio in exporting oil countries, particularly in the case of Gulf Cooperation Council (GCC) countries. The second focuses on examining the impacts of financial regulations and supervision on bank stability, taking into account bank business models, bank size, and economic development. In the context of efficiency, the research sheds light on whether financial regulations and supervision contribute towards enhancing or impeding efficiency across countries and different economic blocs. The first empirical chapter (**chapter 2**) has investigated how the GCC oil-rich countries' banks set their capital adequacy and examined how capital adequacy responds to changes in micro, macro, and market contestability indicators, using panel data for 89 commercial banks in 6 GCC countries over the period 1998–2013. We employed the estimator of generalized method of moments in this study. The results reveal that most of the market contestability indicators together with loans are primary sources of risks and positively affect the capital adequacy ratio. The second empirical study (**chapter 3**) has attempted to explore whether financial regulations and supervision enhance or impede bank efficiency. The study has applied the Semi-Oriented Radial Measure (SORM) using a Data Envelopment Analysis (DEA) to capture efficiency levels across 7853 banks in 102 countries over the period 2000–2014. We contribute to this study by examining the influence of financial regulations and supervision on operational efficiency, captured through SORM, across regional economic blocs, income groups, and financial crisis. We find that financial regulations and supervision are multifaceted concepts due to sizeable variations of their impact on efficiency across economic blocs and income groups. Finally, the third empirical study (**chapter 4**) has re-evaluated the stability levels across 2210 banks in 47 countries over the period 2000-2016 through an innovative CAMELS-DEA rating system. This study contributes towards investigating the influence of regulations and supervision on bank stability by taking into

account bank business models, size, and economic development by using the quantile approach. The result emphasizes that financial regulations, in general, and supervision, particularly, are multifaceted concepts. Thus, regulations and supervision might have a positive or negative effect on stability due to variations in bank business models, bank size, and economic development.

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Declaration

'I certify that this work has not been accepted in substance for any degree and is not concurrently being submitted for any degree or award, other than that of the Ph.D., being studied at the Brunel University. I also certify that this thesis has been written by me and it is entirely the result of my own investigations, except where otherwise identified by references, and that I have not plagiarized another's work'.

Some material in **Chapter 2** was presented during the proceedings of the Second Middle East Conference on Global Business, Economics, Finance and Banking, Dubai-UAE, 22–24 May 2015. Paper ID: D515.

Conference Papers

Chapter 2 entitled '*Determinants of Capital Adequacy Ratio in Oil Exporting Countries: Evidence from GCC Commercial Banks*' was presented at the Second Middle East Conference on Global Business, Economics, Finance and Banking, Dubai (UAE), 22–24 May 2015.

Chapter 3 entitled '*Do financial regulations enhance or impede Semi-Oriented Radial Measure (SORM) operational efficiency banks? Evidence across countries and economic bloc'* was presented at the Brunel Research Student Conference, May 2016. The poster was chosen by the Vice-Dean, Research, for the purpose of presentation at the CBASS Research Day, 9 June 2016.

Chapter 4 entitled '*Which banks are less stable? The influence of bank regulations, business models, and size on the risk-taking incentives: a quantile approach*' may be presented at a high-profile conference, and potentially published in a leading international journal (ABS 3) in collaboration with the principle supervisor.

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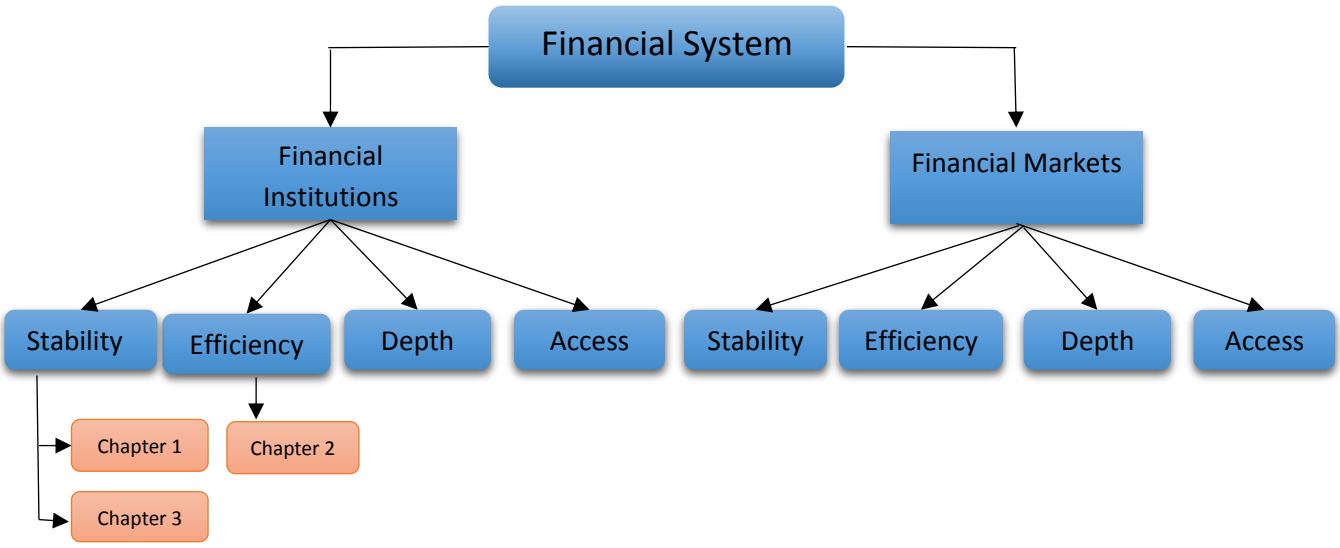
Chapter One

Introduction

1.1. Motivation:

Economists have clearly recognized the substantial role of the financial system as the fundamental pillar of welfare economics. It is important to recognize the primary function of the financial system in facilitating the deployment and allocation of economic resources spatially and timely. However, in uncertain economic conditions, the financial system might fail to harmonise with the changes in the financial environment(Pasiouras et al., 2009). Hence, since the onset of the global financial crisis, we have increasingly heard about the need for reforms in the financial system to enhance financial stability and resolve the crisis. Indeed, reforms in the financial system are not entirely new, despite the wave of reforms in the aftermath of the recent global financial crisis. Historically, shocks in the financial market have called for reforms in the financial system. For example, the Latin American debt crisis and Asian financial crisis, though the success of these reforms is questionable due to the recurrence and breadth of such crises. Undoubtedly, the primary functions of the financial system have always essentially been the same in all the countries, from West to East. However, there are sizeable differences that include variations in cultural, political, and historical backgrounds; additionally, variations exist in the institutional mechanisms through which the reforms are applied. Besides, although there is substantial and varied evidence on the role of financial system in shaping economic development, there are serious shortcomings due to the differences across countries based on the quality of financial information, soundness of corporate governance, mechanism of diversified risk, and facilitation of trade. These differences might impede any reform vision in the financial system (Merton, 1990). Therefore, there is a need to develop benchmark financial systems across the world for evaluating financial soundness and economic performance. This might provide a clear picture of financial conditions in each country, especially in a financial environment of rapid changes and increased movement towards global connections among different financial systems across the globe.

Figure 1-1: 4x2 Frameworks for Financial System



At the most basic conceptual level, the financial system relies on four characteristics of the financial institutions and markets. First, financial depth reflects the size of financial institutions and markets. Second, financial access refers to individuals who use and are capable of using financial institutions and markets. Third, financial efficiency indicates the degree of efficiency in financial institutions and markets. Finally, financial stability refers to levels of stability in financial institutions and markets. In this regard, Čihák et al. (2012) developed a 4x2 framework for a financial system based on these four characteristics of financial institutions and markets to capture the key features of the financial system, as illustrated in Fig 1-1. However, some of these characteristics of the financial system are not functions in themselves. As an illustration, financial depth is a proxy for the overall extent of financial services, which may be provided by the financial system. Similarly, financial access just provides an 'approximation of the breadth of use of particular financial institutions and instrument' but does not offer good-quality investment opportunities, regardless of the collateral of the individual. In return, a sound financial system is a combination of financial stability and financial efficiency in a financial system, generally, and in financial institutions particularly (Aspachs et al., 2007). Soundness of major financial institutions, such as banks is necessary, to improve the financial system (Greenspan, 1997). The

major financial institutions are sources of funding for most other economic sectors, and any distress of financial institutions might affect the economic system as a whole.

It is good to know that the soundness of the banking system has emerged as a main concern for regulators in the light of the rapidly changing global banking events. Therefore, and in order to enhance the banking system's stability and efficiency, the Basel Committee on Banking Supervision introduced Basel I in 1988. Although, currently, The Basel Accord is not legally binding many countries worldwide have adopted the Accord that has had an essential effect on banking supervision and capital regulation. This proposal is based on three key pillars: enhanced capital requirements; better supervisory practices; and improved market discipline. Overall, these three financial regulation dimensions may impact on efficiency and stability in the banking sector through forcing banks to make accurate information disclosure that empowers private sector monitoring of the banks and enhances private agents to exert corporate control (Barth et al., 2004).

The capital requirement plays a crucial role in aligning the respective positions of depositors, creditors and bank owners. Besides its role as a buffer against losses, this is a positive feature of capital requirement and may enhance stability and efficiency in the banking industry. However, a higher capital requirement may increase the banks' incentives to take more risks and reduce their willingness to screen and lend. Thus, due to high risk-taking behaviours, the capital requirement may impede the bank's performance (Rime, 2001).

With regard to supervision, powerful supervision may limit the banks' abilities from engaging in excessive risk-taking behaviour; this may enhance the banks' performance. Nevertheless, powerful supervision may have a negative influence on the soundness of the banking system. Supervisors may seek to gain private interests. Hence, under such circumstances, supervision is strongly linked with corruption that may impede the development of the banking sector (Barth et al., 2013b).

In the context of market contestability, contestability is considered to be a main determinant in enhancing stability and efficiency in the banking industry. Thus, market contestability can effect stability through shaping the degree of competition and testing institutional quality. The underlying concept behind market contestability is profits and market-share may explain more

fully the differences in the levels of stability and efficiency between countries and financial institutions (De Bandt and Davis, 2000).

Moreover, the asymmetric information has increased the importance of reforms in financial regulations. Thus, the appropriate financial regulations can play an integral part in the growth of a country's economy and assist the economy to deal with the changing global economic patterns. Moreover, the other importance of financial regulation is to increase the effective functioning of the financial system in order to enhance its ability to absorb shocks and to maintain financial stability.

The analysis presented in this thesis coupled with unique and rich datasets highlight the multidimensional nature of financial stability and financial efficiency in the banking industry. In addition, it sheds some light on the impact of financial policies on financial efficiency and stability. To some extent, the previous studies do not explicitly include the dimensions capturing financial policy such as financial regulations and supervision concerning sizeable variations across time and countries, which is an important motivation for this thesis. Therefore, the main objective of this thesis is examining the influence of financial regulation and supervision on financial stability and efficiency across different countries and institutions. However, this thesis goes beyond this motivation and aims to answer some general substantive questions *in three different chapters*. **Chapter 2** highlights how a change in the micro and macroeconomic and market contestability conditions can influence capital adequacy. **Chapter 3** raises the question whether financial regulations enhance or impede Semi-Oriented Radial Measure (SORM) operational efficiency of banks. **Chapter 4** deals with to what extent financial regulations affect bank stability.

1.2. Objectives, methodologies, and contributions

As it will be discussed in **Chapter 2**, the subject of adequate level of capital requirement remains to be a debatable matter across the literature. However, a few studies have investigated the determinants of capital adequacy ratio in exporting oil countries, in general, and Gulf Cooperation Council (GCC) countries, particularly, where banking industry has an implicit government guarantee. Chapter 2 contributes towards investigating the impact of the micro and macroeconomic and market contestability conditions on the capital adequacy ratio in GCC oil-

rich countries' banks, using a dynamic generalized method of moments (GMM) system. In order to accomplish this aim, we formulate the following research objectives:

- To compare the average of capital adequacy ratio in GCC banks with international benchmarking, e.g. GCC with Group of Eight (G8) and Organisation for Economic Co-operation and Development (OECD).
- To investigate the influence of micro and macroeconomics variables on capital adequacy ratio.
- To examine the effect of market contestability variables on capital adequacy ratio in GCC banks.
- To compare the influence of micro and macroeconomic and market contestability variables on capital adequacy ratio.

In **Chapter 3**, it is highlighted that the responsibility of financial regulations to shape a well-functioning financial system is still an arguable matter. Barth et al. (2004) have shown this dialectic by developing a public interest view that is in contradiction to a private interest view. Indeed, it should be known that effective financial regulation is more important to structure a stable financial system than a sizeable one. In this regard, this chapter contributes towards investigating whether financial regulations enhance or impede efficiency in banks, by using the innovative Semi-Oriented Radial Measure (SORM) with large and rich datasets in measuring banking efficiency across countries. The objectives in Chapter 3 are as follow:

- To evaluate bank efficiency levels across time and countries, using the Semi-Oriented Radial Measure (SORM).
- To examine the influence of financial regulations, supervision, and governance on bank efficiency across countries.
- To compare the effects of financial regulations, supervision, and governance across different economic blocs, e.g. APEC, EU, USAN, AF, and CAEU[1].

[1] APEC stands for Asia-Pacific Economic Cooperation, EU refers to the European Union, USAN stands for the Union of South American, AF-blocs are referred to the Economic Community of West African States (ECOWAS), COMESA stands for Common Market for Eastern and Southern Africa, SADC refers to the Southern African Development Community (SADC), and CAEU stands for the Council of Arab Economic Unity (Arab League).

- To compare the effects of financial regulations, supervision, and governance groupings based on economic development, i.e. developed economies, developing economies, and fuel- exporting countries.
- To examine the influence of financial regulations, supervision, and governance on bank efficiency before, during, and after the financial crisis.

Chapter 4 sheds light on the argument whether tight financial regulations and strict supervision improve or impede stability in financial institutions. Traditional perspective emphasizes the role of tight financial regulations in reinforcing financial stability (Barth et al., 2004). Conversely, modern perspective indicates that onerous regulations may attenuate the ability of banks to provide financial resources for other economic sectors. This may lead to reducing productivity and increasing the risk of default (Hakenes and Schnabel, 2011b). In fact, financial regulations and supervision are multifaceted concepts. In other words, the effects of financial regulations and supervision on bank stability might change based on different bank business models or on the variation in bank size or even on economic behaviour. Therefore, the primary concern of this chapter is to examine the effects of financial regulations and supervision on bank stability, by distinguishing bank business models, bank size, and economic development through an innovative CAMELS-DEA rating system and quantile technique. The following objectives would help to achieve this aim:

- To evaluate bank stability across countries and time, using CAMELS-DEA rating system.
- To examine the effects of financial regulations and supervision on bank stability by using quantile technique.
- To examine the effects of financial regulations and supervision on bank stability based on bank business models, bank size, and economic development.
- To examine the effects of governance and independent supervision on bank stability.

1.3. Thesis outline and key findings

The remainder of this thesis is organized as follows. **Chapter 2** seeks to narrow the gap in the literature on the determinants of capital adequacy ratio in capital-rich oil exporting countries. In *Section 2.4* of this chapter, the results show that market contestability indicators are the primary

sources of risk to banks in the GCC countries. **Chapter 3** investigates the impacts of financial regulations and supervision on Semi-Oriented Radial Measure (SORM) operational efficiency across countries and economic blocs. The results in *Section 3.4* of this chapter reveal that macroeconomic conditions, such as intergovernmental agreement (economic blocs), financial crises, and economic development, may lead to variations in the influence of financial regulations and supervision on bank efficiency. For example, capital requirement stringency has positive significant effect in explaining bank efficiency. Conversely, capital requirement stringency has adverse effects in bank efficiency in less-developed countries. **Chapter 4** assesses the determinants of bank stability from the aspect of financial regulations and supervisions. The results in *Section 4.4* seem to emphasize that financial regulations, in general, and supervision, in particular, are multifaceted concepts. For example, private monitoring and supervision negatively influence the stability in emerging markets, while both have a positive impact on stability in advanced markets. Finally, **Chapter 5** presents the major conclusions of this thesis and summarizes the main findings. In practice, this chapter offers recommendations for bank managers, policy-makers, and investors. We also shed some light on the limitations of this research followed by recommendations for future research that are beyond the scope of this research.

Chapter Two

Determinants of Capital Adequacy Ratio in Oil Exporting Countries: Evidence from Commercial Banks in Gulf Cooperation Council (GCC) Countries

Abstract

This paper analyses the determinants of banks' Capital Adequacy Ratios (CARs) by using panel data for 89 commercial banks in 6 Gulf Cooperation Council (GCC) countries in the period between 1998 and 2013. We employed a General Method of Moments estimator in this study, and the results showed that market contestability indicators and loans are the primary sources of risk to banks in the GCC countries. However, GCC countries' banks gained the benefit of diversification through the positive effect of profit and liquidity on capital adequacy. Apparently, the study also shows an adverse impact of most macroeconomic indicators on the capital adequacy of banks in GCC countries. However, GCC countries' banks take advantage of high government spending; this assists them to anticipate low risks and counteract market risks. Furthermore, the findings of this study show that liquidity and profit had a strong influence on capital adequacy before the financial crisis period, and this influence disappeared post the crisis. Contrarily, market contestability factors and deposit ratio were found to have a strong influence after the period of crisis.

Keywords: capital adequacy; Capital Adequacy Ratios (CARs); Gulf Cooperation Countries (GCC) banks; financial crisis; market contestability ; oil price ; panel data and diversification

2.1. Introduction

It is a well-known fact that the trend in the financial industry is towards globalization. Apart from traditional bank activities, the non-traditional bank activities result in greater banking risks. Therefore, the enhancement of banking financial stability has become an important matter for financial policy makers. Capital adequacy ratio is the cornerstone of financial soundness and the primary instrument when facing any financial distress.

However, the concern about maintaining adequate levels of Capital Adequacy Ratio (CAR) increased after the 2008 financial tsunami. Thus, financial authorities worldwide, which manage the excessive risk-taking behaviour in the banking industry, imposed higher levels of CAR.

Indeed, there is a debate on the responsibility of imposes excessive capital adequacy ratio in enhancing financial soundness. The traditional views show strong capital adequacy to be an essential buffer against financial distress (Barrios and Blanco, 2003). However, the new approach towards capital adequacy indicated that holding a high level of capital adequacy ratio might limit the bank's role as a financial supporter of other economic sectors and might reflect the weaknesses in risk management. Moreover, in some cases, the bank's obligations may exceed the CAR (Arnold et al., 2012).

Therefore, the study on the determinants of capital adequacy might assist the researcher to reveal the role of capital adequacy in enhancing financial stability. The GCC countries may help us to achieve our goal of investigating, especially, the motivations of banks in these countries to hold levels of capital adequacy that exceed international standards, since they have an implicit government guarantee (Ghosh, 2014).

It is more interesting to know that capital adequacy is greater in GCC countries when compared to some advanced economies. For example, Bahrain's average CAR is around 19%, while it is 13% in Canada. Moreover, Saudi Arabia's CAR may reach 18%, while it is around 14.5% in the United States of America. Thus, the CARs in some GCC countries are 5–6 percentage points higher than some advanced economies (IMF, 2014).

To the best of our knowledge, with the use of panel data models, this paper is the first to investigate how banks in the GCC oil-rich countries banks set their CARs. The study also takes

into account how CAR in each of these countries responds to changes in the micro and macroeconomic and market contestability conditions.

The contributions of this paper are mainly threefold. The study relies on examining the influence of micro and macroeconomic and market contestability concepts and on the behaviour of capital adequacy, especially in emerging markets. Consequently, Barth et al. (2001) experimented with the application of market contestability indicators to measure the degree of competition in the financial sectors of GCC countries. Over the last few years, the banking industry in GCC countries has witnessed high levels of competition due to a rise in the number of domestic or international banks; additionally, high competition related to banking activities and regulations may create sources of risk that can impact CAR (Dickens and Philippatos, 1994). However, to the best of our knowledge, no study has attempted to investigate the effect of market contestability indicators on CAR.

This study's second contribution is to investigate the determinants of capital adequacy ratio with respect to banks in the oil-rich countries. The GCC countries have one of the largest proven crude oil reserves in the world[2]. The banking industry in GCC countries plays an essential role in the economy by providing finance for other economic sectors and firms. Particularly, due to the underdeveloped bond market, the small and medium enterprises (SMEs) rely almost solely on loans provided by banks. Consequently, the capital adequacy ratio may be affected by the behaviour of the financial system of the GCC countries. Furthermore, GCC countries rely greatly on the hydrocarbon sectors through which the petroleum industry may influence the financial system and other market inductors (Rocha et al., 2011). This supports the recent opinion about the behaviours displayed by the GCC countries. The GCC countries enjoyed an economic boom due to higher oil revenues, especially after 2005. Therefore, the GCC countries were able to increase their nominal GDP to over $1,118.2 billion in 2011 and reduce interest rates. In 2008, their oil revenues were considered a key driver of the 6.4% growth in GDP, while the non-oil GDP growth reached 7.5% in the same period. Moreover, the high oil price supported the national budgets of GCC countries and the increase in government expenditures(Ghosh, 2014). Concerning the financial system, the banking industry in GCC countries grew to 10% in 2014.

[2] According to GulfBase, GCC Economic Overview, http://www.gulfbase.com/GCC/AboutGCC?pageID=93

These figures made this region the largest economic and financial system in the Middle East and North Africa (MENA). Additionally, the GCC countries have the same economic behaviour, financial system, unified customs system, and social characteristics (Ghosh, 2014). In this respect, we aim to study the influences of micro and macroeconomic indicators, including the oil price indicator, on capital adequacy.

The study's third contribution is to examine the behaviour of the CAR before and after the global financial crisis period. The global financial crisis has led banks to re-examine their capital adequacy ratios to determine their appropriate ratios (Demirguc-Kunt et al., 2013). However, the impact of the global financial crisis on the GCC countries makes them worth studying. The banks in GCC countries increased credit provision for accommodating domestic financing needs[3]. Moreover, banks in the GCC region are witnessing migratory money moving from the Western economies; the funds of the banks of the GCC countries were invested in western banks but were returned to the GCC countries due to the global financial crisis. Consequently, GCC countries' banks have become more concerned about employing capital adequacy as a tool to protect themselves from losses on their assets. While most countries suffer from low capital adequacy, GCC countries experience high capital adequacy. However, it may be costly to the banks to hold high levels of capital adequacy. This view is supported by Ghosh (2014), who pointed out that 'increased capital adequacy enhances bank safety. However, increased capital might induce a bank to assume greater risk. If this effect outweighs the buffer effect of capital, a highly capitalized bank might experience a higher probability of failure'. As a result, a significant amount of money is stuck to meet capital adequacy requirements for provisions for risk management; this may affect banks' investments and other activities.

Beside the above objectives, this study aims to examine whether banks in the GCC countries have been influenced by changes to both regulations and supervision. In addition, it aims to determine whether banks in the GCC countries can gain the benefits of diversification[4] and government spending. Accordingly, the researcher was motivated by all these objectives to study the GCC countries' behaviours on capital adequacy. However, to the best of our knowledge, this is one of the first studies to investigate the determinants of capital adequacy in oil exporting

[3] Audi, B. (2012). Saudi Arabia Economic Report. Lebanon: Audi Saradar Group.

[4] Diversification is the approach of the Modern Portfolio Theory (MPT). MPT suggests that a well-diversified approach assists in maximizing returns and reducing risk

countries. In addition to the influence of macroeconomic indicators on capital adequacy, the study contributes towards examining the influence of oil prices.

Finally, we hope that this study will assist in re-evaluating the behaviour of the CARs of the GCC countries. In turn, this may help to enhance the stability of banks in the GCC countries. Moreover, the study hopes that the findings will assist the GCC banking industry's financial decision-makers and risk managers. It is also hoped that the study may help to establish some benchmarks for future research on the CARs of the GCC countries.

The remainder of this paper is organized as follows. Section 2 contains a literature review. Section 3 presents the model used by the researcher and the characteristics of the database. Section 4 provides a detailed account of the empirical results, and Section 5 sets out the researcher's conclusions.

2.2. Literature review

Before proceeding with the literature review, the study considers that it is essential to define capital adequacy. Although there is wide acceptance of capital adequacy ratio as a measure of financial stability, there is still no clear unified definition that identifies the primary functions of capital adequacy. On the one hand, some scholars have highlighted that the primary function of capital adequacy ratio is 'to ensure that banks hold enough resources to absorb shocks to their balance sheets' and, consequently, protect themselves against the risk of credit losses (Barrios & Blanco, 2003). On the other hand, some scholars have defined capital adequacy ratio as a buffer against customers' withdrawals of their deposits. Akhter and Daly (2009) went further than others by considering CAR as a tool that is used to stabilise banking stability systems and measure financial health. Nevertheless, the following definition by the Basel Committee on Banking Supervision is most widely used: 'a measure of a bank's capital that is expressed as a percentage of a bank's risk-weighted credit exposures' (BIS, 2015). The researcher uses this definition in this paper. Therefore, as per the definition, the CAR aims to counteract the risk to the banks created by bank indicators and market power variables (Fonseca and González, 2010) and (Akhter and Daly, 2009). Thus, to understand either the relationship between capital adequacy and bank indicators or capital adequacy and market power, it is first necessary to realize the relationship between capital adequacy and risk. Capital requirement regulations

support the view that capital adequacy works as a buffer against risk from using the option-pricing model (Furlong and Keeley, 1989) and (VanHoose, 2007). Similarly, Episcopos (2008) pointed out that restrictions on risky assets induced weak capital adequacy. Therefore, there is a positive relationship between risk and capital adequacy, wherein high risk creates strong capital adequacy and low risk leads to low capital adequacy.

However, some studies may challenge the idea of capital adequacy as a buffer against risk. Koehn and Santomero (1980) and Kim and Santomero (1988) stated that it is unnecessary to increase capital adequacy because of high risk. They found that banks could offset low capital adequacy with high profits arising from investment in high-risk assets. For example, if banks lower the leverage to reduce risk and hold low capital, then the profits may decline. Consequently, bank owners may hold low capital adequacy but invest in risky assets to increase profits. Thus, high-profits offset low capital adequacy.

Owing to the previous argument, a study of the determinants of capital adequacy may help in understanding the behaviour of capital adequacy. Therefore, traditionally, researchers focused on studying the impact of bank indicators and market power on the behaviour of capital adequacy. Wall and Peterson (1995) speculated on the impact of bank specific indicators on CAR, and they found a negative relationship. This result is consistent with the findings of (Koehn and Santomero, 1980) and (Kim and Santomero, 1988). Other studies went further in evaluating this relationship. Nier and Baumann (2006) pointed out that although bank indicators often motivated banks to hold high capital adequacy, banks may have held low capital adequacy by dint of government support. This was considered a buffer against risk.

Contrarily, Jackson et al. (1999) argued against the approach taken by (Wall and Peterson); they pointed out that there was no clear evidence to support the assumption that capital adequacy behaved in a way that was not representative of the bank indicators. Moreover, Barrios and Blanco (2003) examined the behaviour of capital adequacy on Spanish commercial banks and concluded from the empirical results that the bank indicators were still considered the primary determinants of capital requirements in Spanish commercial banks. This view was inconsistent with the findings of Nier and Baumann (2006). Recently, Fonseca and González (2010) found that bank indicators had a strong influence on capital adequacy.

In context of the role of banking sector in oil exporting countries, there is debate about the relationship between banking sector and it role in economic growth of oil exporting countries. Barajas et al. (2013) indicated that the role of banking industry in oil countries become weak as as the degree of oil-dependence increase. Moreover, they show that banking sector tends to be smaller in resource-dependent economies as oil exporting countries. Although banking sectors may constitute a small component of the overall economic in most oil countries, its role in diversification and management of risk, liquidity creation and foreign capital inflow have been identified among factors that can spur long-term economic growth (Kurronen, 2015).

Moreover, it important to know that bank failures in emerging markets may lead to dramatic effects on whole economy. The cost of distortion of resource allocation and restructuring the recapitalisation for distress banks may have burdened the economies for many years. Therefore, and in order to maintaining soundness of the banking system, financial policy makers have imposed on individual bank to meet capital adequacy requirements in which used for protect depositors and promote the stability and efficiency of financial systems around the world.

Although the researchers focused on the relationship between bank indicators and capital adequacy, many recent studies, especially since the Asian financial crisis, investigated the linkage between market power or macroeconomic indicators and capital adequacy. Researchers, such as Caprio and Klingebiel (1996) and Demirgüç-Kunt and Detragiache (1998), found that micro indicators had a strong impact on capital adequacy. Furthermore, by creating a model that included both micro- and macroeconomic indicators, other researchers, such as Gonzalez-Hermosillo (1999), found significant influences of microeconomic indicators on capital adequacy.

The remaining part of this literature review explains in detail the effect of micro- and macroeconomic indicators and market contestability on capital adequacy.

2.2.1. Bank-specific variables inducing change in banks' capital adequacy

There are internal indicators of the influence of bank-specific variables on capital adequacy ratio, whereby this bank-specific variable induces changes in one of the pillars of capital adequacy. The change occurs in the numerator (capital levels) or denominator (risk-weighted assets), or, occasionally, in both numerator and denominator. Hahn (1966), Ediz et al. (1998), and Kashyap

and Stein (1997) tried to investigate the influence of bank-specific variables on capital adequacy and found the possibility of changes to capital adequacy requirements. Hahn (1966) analysed the factors that might influence the capitalization of banks and examined the influence of profitability ratios, bank size, and bank growth on the quantity and quality of capital adequacy. He concluded that capital is used as a buffer that enhanced banks' safety. Moreover, between 1989 and 1995, Ediz et al.(1998) examined UK banks to investigate the impact of balance sheet ratios and income ratios on capital adequacy behaviours under tightened capital adequacy requirements. They considered whether banks were able to increase or reduce capital adequacy in such situations. They found that UK banks might change their capital adequacy ratios by boosting their capital rather than through bank loans. Therefore, increasing equity leads to the creation of safety buffers for banks and increases stability in the financial system.

Moreover, Kashyap and Stein (1997) provided evidence from the European Central Bank that low balance-sheet strength might have an influence on capital adequacy and create safety issues during a downturn period, due to which banks might have low capital adequacy. Therefore, countries with inadequate capital adequacy ratios may suffer more because of the high levels of non-performing loans and consequent level of risks.

In contrast to the previous views, Kishan and Opiela (2000) highlighted the fact that despite having lower capital adequacy and hence higher risk-taking tendency, some banks were still able to finance their loans during a downturn through government support. Moreover, Jagtiani et al. (1995) stated that there is no relationship between off-balance sheet ratio and binding capital adequacy constraints. Therefore, this ratio could not reflect the banks' risks.

Although a few research studies attempted to downplay the significant relationship between microeconomic variables and capital adequacy, in fact, microeconomic indicators were considered major factors that affected capital adequacy. By investigating the influence of microeconomic variables on capital adequacy for 1337 banks in 70 countries, between 1992 and 2002, Fonseca and González (2010) provided substantial evidence to support the relationship between microeconomic variables and capital adequacy. They found that the manner in which capital adequacy behaved is based on the financial ratios of banks. These ratios may provide an incentive to banks to take risks arising from investments in risky assets. Hence, it might help the banks to have high capital adequacy to counteract high risk-taking.

Accordingly, by taking into account the analytical and critical elements, the following section investigates the impact of some of the bank-specific variables on capital adequacy.

Loan loss provisions

The essential function of Loan Loss Provisions (LLP) is to reflect future losses in bank loans. Although it may be difficult to estimate the expected future losses in banks' portfolios, the LLP ratio is still considered an important measure of the state of risk of banks, which may have either a positive or negative influence on capital adequacy (Anandarajan et al., 2005). Therefore, Rime (2001) used loan losses as indicators to determine capital adequacy and stated that high loan losses led to reductions in the total amount of capital adequacy. This controversial view is based on the assertion that, during adverse financial situations, banks fail to increase their capital adequacy because of liquidity leakage.

However, a majority of research studies proved positive relationship between LLP and capital adequacy. They found that in times of financial distress high LLP had a positive impact on capital adequacy. This means that banks must increase equity to overcome financial distress and enhance capital adequacy to counteract any risk. Other researchers examined this relationship from the perspective of regulations on LLP. In light of the changes emerging from the 1989 regulations, Kim and Kross (1998) conclude that banks can manage low capital ratios through reduced lending. It would lead to reduced risk and, thus, banks can have adequate capital adequacy appropriate to the level of risk.

Furthermore, by examining the changes banks underwent after 1989, Ahmed et al. (1999) found a positive influence of lending on capital adequacy. They highlighted that LLP had a positive effect on capital adequacy ratio because of high risk and poor management. Therefore, there is an abnormal relationship between LLP and capital adequacy. This means that LLP may be regarded as a warning tool that measures future risks in every bank and whether there is control of capital adequacy (Louzis et al., 2012). Ahmad et al. (2008) supported this view by proving a positive relationship between LLP and capital adequacy ratio to avoid high risk in the future.

Bank size

Bank size is considered an important determinant of capital adequacy; this is because of the relationship between the size of the bank portfolio and level of risk. Choi (2000) pointed out that

large banks had access to high capital adequacy, which protected them from the risk of bankruptcy. Other scholars, such as Shrieves and Dahl (1992), Rime (2001), Jackson et al. (2002), and Akhter and Daly (2009), created considerable debate regarding bank size. Jackson et al.(2002) pointed out that large banks strive to maintain a high credit rating. It suggests that large banks hold high capital reserves, which means that these banks have high capital adequacy.

However, Shrieves and Dahl (1992) found that large banks may have low capital adequacy due to high diversification. They also pointed out that the size of a bank's assets is considered an important determinant of capital adequacy. Rime (2001) provided further explanation of Shrieves and Dahl's results by stating that large banks were highly diversified. Asset diversification reduces risks, which consequently leads to low capital adequacy.

Furthermore, Ahmad et al. (2008) were more critical of this relationship between bank size and capital adequacy; they pointed out that increased earnings lead to greater diversification, which reduce risks. Therefore, banks, which have huge assets, reduce risks through diversification and this leads to low capital adequacy in large banks. Fonseca and González (2010) stated that there is negative association between bank size and capital adequacy. It might imply that large banks maintain low capital adequacy so that they may obtain government support during financial distress.

Liquidity

Liquidity is regarded as another important determinant of capital adequacy. Indeed, as a mechanism to create a stable financial system, the current financial authorities encourage banks to raise their capital adequacy. For this reason, banks have attempted to have high levels of liquidity; this leads to high capital adequacy (Fungáčová et al., 2010). There are two opposing views regarding the relationship between capital adequacy and creation of liquidity.

On the one hand, Berger and Bouwman (2009) conclude that banks can have high capital adequacy by attracting depositors. Consequently, high deposit levels increases liquidity, and this has a positive influence on capital adequacy. Hakenes and Schnable (2011a) supported this view and stressed that liquidity might have a positive effect on capital adequacy.

Moreover, Matz and Neu (2006) indicated that high liquidity creates high capital adequacy. This is because high liquidity implies a rise in the number of depositors. However, this might result in the inability of banks to meet unexpected withdrawals. In such a scenario, banks may either sell some assets at 'fire-sale prices' or face unexpected withdrawals from customers. Therefore, rather than selling assets, banks increase capital adequacy to counteract any unexpected risk of withdrawals (Distinguin et al., 2013). Ahmad et al. (2008) found a positive relationship between liquidity and capital adequacy because of the risk of leverage. Moreover, Imbierowicz and Rauch (2014) regarded liquidity as a source of risk in banks, and a factor that increases the likelihood of their defaulting. Thus, banks need high capital adequacy as a hedge against risk.

On the other hand, by using a 'simultaneous equations framework', Distinguin et al. (2013) investigated a bank's relationship between liquidity and capital adequacy They found that banks with high liquidity decrease capital buffers, especially a bank that has implemented a deposit insurance system. Consequently, rather than capital adequacy, a bank may rely more on deposit insurance to counteract any risk of withdrawals.

Profitability

Basel III proposes some new standards for creating a high-quality buffer for banks (BIS, 2015). This proposal reveals the significance of the relationship between bank's profitability, risk, and capital adequacy' be an acceptable revision (Lee and Hsieh, 2013). There is widespread debate over the impact of profitability on capital adequacy. Therefore, it is possibly not surprising that profitability has positive influences on capital requirement. Berger (1995) highlighted the positive relationship between profitability and capital buffer. Thus, an increase in profitability ratio leads to an increase in capital adequacy, where higher returns would mean higher risk taking by banks. Moreover, Rime (2001) mentioned that profit positively impacts capital adequacy, and it is attributed to the possibility that , by increasing earnings, the CAR might increase when a bank takes more risk. Flannery and Rangan (2008) provided further explanation by pointing out that a bank with information asymmetries might have fluctuations in earnings. Consequently, banks hold these funds as retained earnings because an increase in retained earnings may also lead to an increase in capital adequacy.

Contrarily, some of the literature hypothesized that increased profits induce adverse changes in capital adequacy. As a result of an increase in capital requirement, there may be a reduced risk from investments due to investment diversity (Berger, 1995). Fonseca and González (2010) found that, in a perfectly competitive banking market, profit has a negative influence on capital adequacy. Ahmad et al. (2008) highlighted the fact that high gains might lead managers to reduce capital adequacy to provide liquidity for new investments.

Risk to Assets

Risk to assets is another important determinant of capital adequacy; however, the explicit relationship between risky assets and capital adequacy within banks remains ambiguous. Avery and Berger (1991), Blum (1999), Rime (2001), and Fonseca and González (2010) investigated whether a change in the level of risk to assets increases or decreases the capital adequacy of banks. Avery and Berger (1991) pointed out that banks can control the level of risk to assets by controlling moral hazard. Therefore, a bank may hold low capital adequacy. Furthermore, Rime (2001) found that controlling the risk to assets by diversification led banks to reduce their capital buffers. Contrarily, Fonseca and González (2010) measured the relationship between risk to assets and capital adequacy from a different perspective. They indicated that it is not essential for banks to have a limited level of risk to assets to have low capital adequacy. They suggested that 'banks that opt to take greater risks with their assets also opt to hold smaller capital buffers'.

However, others disagreed with the previous approach that risk to assets reduced the capital adequacy. Blum (1999) emphasized that increased risk to assets results in an increase in capital buffers in future. He pointed out that although there are possibilities of banks taking greater risks to assets for increasing immediate profits, it would still be essential for these banks to improve their capital buffers in future to counteract the high level of risk taken. Ahmad et al. (2008) supported Blum's perspective by indicating that managers and shareholders, who were less risk-averse, look for high earnings with high levels of risk; this may incentivise banks to have strong capital adequacy to meet the created level of risk .

Leverage

Leverage is an important determinant of capital adequacy, which reflects the level of risk to the bank. In the United States of America, the Federal Deposit Insurance Corporation (FDIC)

leverages rules to determine the adequacy of capital requirements (Jarrow, 2013). The relationship between leverage and capital adequacy is determined by the cost of equity leverage and the cost of debt leverage. Consequently, many scholars have indicated a positive relationship between leverage and capital adequacy. However, due to the high cost of equity, banks may face difficulties in increasing leverage by issuing new equity. Therefore, the bank may increase leverage by debts; this increases the level of risk and incentivises the bank to have a strong capital adequacy (Blum and Hellwig, 1995).

Contrarily, others studies, such as Rime (2001), pointed out that banks might use liquidity to meet capital adequacy requirements, especially due to high cost of debt. It might lead to a reduction in leverage. Thus, the bank may have high capital adequacy with low leverage. Similarly, while Ahmad et al. (2008) found a negative relationship between leverage and capital adequacy, they analysed the negative relationship from a different perspective. Banks with low levels of liquidity may finance their operations and may increase leverage to raise earnings instead of having high capital adequacy. Thus, banks may maintain low capital adequacy with high leverage.

Deposits

Deposits are necessary for capital adequacy; similarly, capital adequacy aims to protect the banks and their depositors against any insolvency or losses (Abdul Karim et al., 2014). Consequently, banks maintain a high optimal level of capital adequacy to increase their depositors' confidence. This means that banks must reinforce their capital adequacy to become more attractive to depositors. Thus, banks can raise their capital adequacy by increasing deposits (Blum and Hellwig, 1995).

However, Yeyati and Micco (2007) pointed out that an increase in deposits may lead to reduced reliance on risky financial sources, such as loans and bonds, which might lead banks to generate low optimal levels of capital adequacy due to low levels of risk. Therefore, larger banks with high deposit ratios have low capital adequacy.

2.2.2. Capital adequacy requirements: Moving from micro- to macroeconomics

Over the last three decades, there have been major transformations in the banking environment. In the past, financial authorities focused on 'internal factors' to measure bank-specific risks and

neglected the ‘external factors. However, global financial stocks around the world have increasingly attracted attention of financial authorities towards external risks (Rime, 2001). Blum and Hellwig (1995) investigated the relationship between macroeconomic indicators and capital adequacy requirements. They stated that macroeconomic indicators affected the abilities of banks to meet their obligations. This might increase the probability of insolvency of banks and lead to lower bank equity. Thus, to counteract the greater risk of bad debts and low equity, banks may reinforce their capital adequacy by linking capital adequacy to macroeconomic indicators. Additionally, considering that macroeconomic factors influence the behaviour of capital adequacy, Blum and Hellwig (1995) explain further that these bank lending behaviours influence ‘capital adequacy fluctuations.

Saunders (2002) supported the perspective that macroeconomic risk incentivised banks to increase their capital adequacy. He highlighted the fact that banks could improve their capital adequacy by increasing their levels of investment. Therefore, the expected earnings may meet any increase in capital adequacy requirement, which means ‘higher capital adequacy is met with more earnings’. In this case, the profits from the loan may cover any increase in the bank’s capital adequacy.

Additionally, Shaw et al. (2013) built a macroeconomic model to examine the impact of macroeconomic indicators on capital adequacy. They pointed out that loans are not only tools but also good macroeconomic indicators that might have a strong influence on capital adequacy. It indicates that banks can meet their capital adequacy by ‘accumulating more equity’ instead of reducing lending. This implies that good economic conditions may incentivise banks to enhance their capital adequacy levels.

Other researchers provided a combination model by integrating micro- and macroeconomic indicators. Choi (2000) investigated the impact of micro- and macroeconomic data on capital adequacy in emerging economies. He found that macroeconomic data had a strong influence on capital adequacy, particularly in the aftermath of the Asian financial crisis.

Akhter and Daly (2009) stated that, due to increased risk, a combination of macroeconomic factors and bank-specific factors might influence capital adequacy. However, Ali and Daly (2010) provided different categories of macro risk that might impact capital adequacy; this is

where some macro factors have a high level of risk and others have a low degree of risk. They concluded that, compared to others, banks ought to consider the high levels of risk in macro factors.

Therefore, the following variables aim to show the impact of either external indicators or market risk on capital adequacy.

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) is one of the important factors, which assists in determining capital adequacy. Heid (2007) provided a good explanation of the relationship between economic growth and capital adequacy requirements. Pointing out previous research, he showed that during an economic downturn, when credit rating becomes an important requirement for obtaining capital, reduction in lending and access to capital contributes towards an increase in capital adequacy. However, under the Basel regulation and during an economic downturn, there may be a reduction in capital adequacy because of low risk, which is considered to compensate for reduced lending. Gambacorta and Mistrulli (2004) investigated the relationship between GDP and banks' lending behaviours. They found that GDP affected high-risk banks more than well-capitalized banks. Akhter and Daly (2009) indicated that during downturns and because of the reduction in the quality of bank assets banks had more capital adequacy as a precautionary measure. Therefore, greater capital adequacy assists banks in obtaining high credit ratings, and consequently makes it easier to gain access to capital. Ali and Daly (2010) even considered GDP to be a major factor that influenced the default rates of American and Australian banks. It implies that bad economic growth leads to an increase in default rates, which may increase the levels of capital adequacy.

However, other researchers had a different perspective. Ayuso et al. (2004) used the annual data for Spanish banks from 1986 to 2000 to examine the relationship between capital buffers and economic cycles. They indicated a negative relationship between capital buffers and economic cycles during either an upturn or a recession. This may be because, during an upturn or recession, banks wrongly anticipate the economic conditions. Recently, Hoenig (2013) put forward the idea that a high level of capital requirement results in lower lending during slower

economic growth. He stated, 'banks may enhance their capital adequacy via maintaining lending during a crisis—a key factor influencing the speed of the recovery'.

Inflation

The rate of inflation is one of the important factors affecting capital adequacy and reflects the increase in the price of goods and services. As with other macroeconomic factors, there is widespread debate on the effect of inflation on capital adequacy. Lackman (1986) stated that inflation ought to be considered a major issue that affects liabilities, capital, and assets, and that increased inflation does not necessarily lead to an increase in capital adequacy. This means that, under inflationary conditions, banks may suffer from low levels of income, which, in turn, would lead to low capital adequacy.

Babihuga (2007) pointed out that there is a negative relationship between high inflation and capital adequacy ratios. The high cost of capital during inflation adversely impacts the profits. Consequently, under inflationary conditions, fewer earnings create low capital adequacy.

Furthermore, Akhter and Daly (2009) considers inflation rate, with other macro factors, to be one of the primary determinants of capital adequacy and bank profits. They stated that, under high levels of inflation, investors seek high levels of return that might lead to increased costs of capital. Thus, low capital adequacy is due to low earnings. However, banks may also meet investors' expectations by having high levels of capital adequacy. Männasoo and Mayes (2009) stated that high levels of inflation might lead to increased bank distress as a result of 'increasing vulnerability', such as limited loans. Thus, such loans result in lower levels of risk and reduce the capital adequacy ratio.

Gonzalez-Hermosillo (1999) presented another view by pointing out that a high rate of inflation rate enhances financial stability. Therefore, if an inflationary slowdown leads to increased credit risk and reduced profits through increased real interest rates, then debt default may rise and impact capital adequacy positively.

Additionally, Athanasoglou et al. (2008) indicated that there was a positive relationship between high inflation, bank profits, and capital adequacy. They stated that a high level of inflation might

reinforce capital adequacy by 'shifting the burden of increased expenses to lending rate' and covering the extra expenses from surplus profits.

Exchange rates

Exchange rates have a significant impact on capital adequacy. The influence of this indicator is based on the size of overseas business, currencies, shares, and assets that a bank holds abroad. Chamberlain et al. (1997) explained the impacts of high exchange rates on the levels of bank risk. They stated that high exchange rate fluctuations of foreign currencies might influence banks directly through foreign operations and foreign currency transactions and indirectly through increased foreign competition and demands for foreign loans. Moreover, they supported the Basel Accord that considered exchange rates to be a source of bank risk, and hence a factor that may impact on capital adequacy.

In addition, Choi et al. (1992) found a strong link between high exchange rates of foreign currencies and capital adequacy. Particularly, this relationship becomes clear when large-sized banks 'aggregate their returns' such that the high levels of profits earned through a high exchange rate may increase capital adequacy However, they pointed out that the level of risk depended on the bank's characteristics.

Stiglitz (1999) went further than this and stated that even a low exchange value of domestic currency might create risk for banks. Depreciation in the value of domestic currency makes it difficult for some banks to import their loans; this affects their operations and profits and may influence their capital adequacy. It implies that, owing to low gains, a low domestic exchange rate may create low capital adequacy.

Contrarily, Akhter and Daly (2009) measured the real impact of effective exchange rates on capital adequacy in more than 50 countries. They found a positive relationship between high exchange rates and capital adequacy. They highlighted the fact that large banks with large foreign obligations might lose more when the local currency losses value against a foreign currency; thus, losses may influence the capital adequacy ratio.

Other scholars played down the influence of currency fluctuations on capital adequacy. Wetmore and Brick (1994), Chamberlain et al. (1997), Choi and Elyasiani (1997), and Gounopoulos et al.

(2013) stressed that banks can avoid any profit, losses, and risks, which might have an impact on capital adequacy, by hedging against the potential decline or increase in the value of a local currency.

Interest rate

The interest rate is an important determinant of capital adequacy. Traditionally, the link between interest rates and bank capital adequacy is considered a debatable subject; this is because the interest rate may influence capital adequacy through either profits or the risk levels.

Ho and Saunders (1981), Berger and Udell (1992), and Neumark and Sharpe (1992) investigated the relationship between interest rates and capital adequacy through risk lending to determine the impact of interest rates on capital adequacy. Based on the findings, they suggested that banks must enhance capital adequacy to counteract the possibility of lending default arising from an increase in interest rates.

Blum and Hellwig (1995) supported this perspective by stating that, through an increased probability that borrowers from the bank might be unable to service their debts, increased interest rates affect capital adequacy. Consequently, non-performing loans may increase, thereby inducing changes in the capital adequacy ratio.

Akhter and Daly (2009) examined this relationship from a profit perspective and found a positive relationship between capital adequacy and interest rates. They indicate that a high lending rate leads to an increase in profit, and hence banks might be able to increase their capital adequacy.

Contrarily, Cecchetti and Li (2008) found a negative relationship between interest rates and capital adequacy. They stated that, depending on the economic situation, either an increase or a reduction in lending capacities might have a negative influence on the relationship between interest rates and capital adequacy. Therefore, an increase in the interest rate may induce a decline in lending capacities, which, in turn, would reduce risk and banks may hold lower capital adequacy. Additionally, a reduction in the interest rate may lead to an increase in lending capacities. Consequently, banks may take high risks, which would incentivise them to have higher capital adequacy. Moreover, Delis and Kouretas (2011) investigated the relationship between low-interest rates and risk-taking in major European banks. They concluded that there is

a negative relationship between low-interest rates and bank risk-taking. A low-interest rate may incentivise banks to invest more to offset any losses created by high risk-taking. Thus, to counteract this high level of risk, banks must enhance capital adequacy.

Money supply

Money supply, which reflects the total liquidity of the country's economy, may also have an influence on capital adequacy. This variable has a strong link with either surplus or deficit in the government budget; this may affect the rate of inflation, interest rates, and the business cycle. Therefore, money supply may influence capital adequacy through other macroeconomic indicators. Thakor (1996) provided critical support for this perspective by investigating the impacts of money supply on banks' capital adequacy. He pointed out that money supply might influence capital adequacy through other macroeconomic indicators. Therefore, an increase in money supply induces a reduction in short-term interest rates. The probability of credit denial[5] increases, which, in turn, leads to a reduction in bank lending; it implies that a reduction in lending risks may lead banks to have low capital adequacy.

However, if an increase in money supply leads to reduced long-term interest rates, then it may induce a decline in the denial of credit. Consequently, banks' lending may increase under low long-term interest rates, and, owing to high credit risk, the banks may have high capital adequacy. In other words, the impact of an increase in money supply on capital depends on either an increase or a reduction in bank lending and 'term structure of interest rate'. This means that an increase in money supply may reduce lending and incentivise banks to have low capital adequacy due to the low risk associated with a low-interest rate in the short-term, while the opposite would be true in the long-term (Thakor, 1996).

2.2.3. Market contestability and bank capital requirement behaviour

Competition in the financial industry has increased rapidly in the wake of globalization. This competitive environment produces both benefits and challenges for financial institutions. Therefore, Dickens and Philippatos (1994) indicated that more competition may lead to either lower profits or greater risks in the banking industry, depending on the level of control for market power. Consequently, this scenario may influence capital adequacy. Specifically, high

[5] Credit denial refers to the rejection of a credit application by a prospective lender.

competition may affect the banks by deteriorating profits to a certain extent. However, during a period of economic downturn, deterioration of profits may result in banks having low levels of capital adequacy due to weak liquidity. Conversely, during an economic upturn, high competition might incentivise the banks to take a greater amount of risk and, consequently, the banks might enhance their capital adequacy to counteract high risk.

Moreover, Allen et al. (2011) examined the influence of the contestable environment on capital adequacy. They highlighted that excessive competition produces high capital adequacy because of higher risks, whereby banks seek to 'attract normal borrowers'. However, with a free competition environment, banks have an opportunity to 'attract creditworthy borrowers'. This may motivate banks to have low capital adequacy due to low levels of risk.

Other researchers tried to link competition with capital requirements through deposit rates. Matutes and Vives (2000) pointed out that there was a relationship between contestability in the deposit market and the risk-taking incentive. In this case, the appropriateness of capital regulation depends on the level of competition. Moreover, by using the 'dynamic model of imperfect competition', Repullo (2004) re-examined the relationship between risk-taking, market power, deposit rate, and capital requirement. He stated that, particularly in a highly competitive environment with high level of deposits, a high amount capital adequacy might be more effective in controlling the risks to depositors.

Considered as market contestability indicators, Barth et al. (2001) presented the following variables to evaluate the global competition level in the banking industry. Therefore, the following sub-section aims to investigate the influence of market contestability variables in capital adequacy.

Banks' activity restrictions

This indicator reflects banks' non-lending activities, such as securities, real estate, and insurance. As mentioned earlier, by examining 1337 banks in 70 countries, Fonseca and González (2010) clarified the impact of banks' activity restrictions on capital buffers. They found a negative relationship between the activity restrictions of banks and capital buffers when an increase in activity restriction led banks to reduce their capital buffer by reducing the level of risk. In other

words, tighter restrictions induce a reduction in the incentives of depositors to monitor banks and the ability of managers to 'undertake risky investments'.

However, Claessens and Laeven (2004) stated that, by increasing the risk of market power and limiting the banks' abilities to reduce risk levels through diversification, restrictions on activities had a positive influence on capital adequacy. Thus, greater restrictions on activities may reduce the abilities of banks to reduce their risks, and may thereby lead the banks to have high capital adequacy.

Furthermore, Gonzalez (2005) stated that, by relaxing restrictions on activities, sometimes banks might reduce their risks through increased diversification, and thus reduce their capital adequacy. Moreover, Beck et al. (2006a) indicated that tighter restrictions on activities increasing risk-taking due to less diversification, and thereby lead to a weakening of the financial system. Moreover, Laeven and Levine (2009) pointed out that risks might increase with tighter capital adequacy, owing to the desire of banks to offset the loss in profits. It has a positive impact on capital adequacy. They also stated that tighter restrictions on activities might reduce the banks' abilities to 'diversify', and, because of a higher risk level, this may lead to high capital adequacy.

Financial conglomerates

The traditional work of banks includes selling insurance, underwriting securities, and providing loans for clients. However, recently there has been a rapidly occurring change in the financial landscape, wherein financial institutions are diversifying into the non-financial sectors. Financial institutions that undertake such diversification are referred to as 'financial conglomerates' (Vander Vennet, 2002). According to data provided by the Basel'Committee (2013), the Committee is looking to work with other standard-setting bodies to engage with the challenges faced by the diversified financial conglomerates. Thereby, by defining the risks faced by these conglomerates, the Committee aims to enhance the amount of capital adequacy.

Few studies attempted to investigate the influence of financial conglomerates on capital adequacy. Nonetheless, a large debate has emerged about whether conglomerates create higher or lower levels of risk. Rime (2001) stated that highly diversified banks have low capital adequacy because diversification leads to increased profits and reduces the level of risk. Thus, due to their highly diversified financial conglomerate portfolios, universal banks may maintain

low amounts of capital adequacy. Furthermore, Ahmad et al. (2008) provided a clear explanation on the impact of financial conglomerates on capital adequacy. They explain that banks, which are highly diversified financial conglomerates, can reduce their risk levels by earning more profits and reducing the cost of capital. Accordingly, due to their low levels of risk from diversification, banks may maintain low capital adequacy. Using a similar argument, van Lelyveld and Knot (2009) found that more diversification leads to a lower level of risk and results in banks having low capital adequacy.

Conversely, Flannery (1999) indicated that sometimes banks might not achieve any benefit from conglomerate diversification because there might be an increase in the risk levels. Since earning high returns would need high risk-taking, it might be essential for banks to increase capital adequacy. Additionally, Morrison (2003) examined the financial conglomerates' influence on capital requirements. He found that, due to an increase in systemic risk and market risk, banks' diversification had a negative impact on capital requirement. This means that banks, which hold highly diversified portfolios, may face high levels of risk, and 'too big to fail' banks may have high capital adequacy. van Lelyveld and Knot (2009) highlighted the perverse effect of diversification on banks. The shareholders seek high profits, and this may increase the level of risk and motivate the bank to maintain a tighter capital buffer.

Foreign banks and entry requirements

Although no significant study examined the direct relationship between foreign banks and capital adequacy ratio, a few studies provided some indication about this relationship. Goldberg and Saunders (1981) tried to find a link between capital requirement and foreign banks' activities and regulations. They stated that foreign financial agencies had limitations on their activities under which they were unable to accept deposits. Certain foreign financial branches and agencies provide 'wholesale banking services'. However, these services are extended only to banks and international businesses, and do not include the public; consequently, limiting the scope of services may influence their capital requirements. Specifically, foreign banks provide lending to 'creditworthy borrowers'; this may motivate banks to hold a low amount of capital because of the low risk of non-performance loans.

However, Walter and Gray (1983) and Levine (2001) examined the impact of foreign banks and regulations on the banking industry and capital ratios. They pointed out that, compared to domestic banks, although foreign banks were more affected by the market power risk, they are likely to make more profits. Therefore, this high level of earnings might help foreign banks to enhance their capital adequacy to counteract market risks.

Moreover, Claessens et al. (2001) supported this perspective, stressing that foreign banks tended to earn high profits, have high-interest margins, and pay high taxes. These are all greater than domestic banks in developing countries due to different procedures, customers, and regulations. Concerning foreign banks, it implies that greater profits with higher risks may produce tighter capital adequacy.

However, Lensink and Hermes (2004) re-examined the findings of Claessens et al.(2001). They emphasized that, in less developed markets, the entry of foreign banks might increase the costs and margins for financing the domestic banks' operations in the short-term due to less competition. This means that an increase in the costs and margins may affect the banks' profits and thus, because of a lack of liquidity, the banks might be unable to offset any shortage in capital adequacy.

By using macroeconomic indicators, other studies investigated the influence of the entry of foreign banks on capital adequacy. Unite and Sullivan (2003) investigated the impact of the entry of foreign banks in the banking industry the Philippines. They concluded that, due to increased foreign competition, an increase in the number of foreign banks had led to a decline in interest rates. It implies that the lending activities may increase due to a fall in interest rates and this may create an incentive for the banks to enhance their capital adequacy (as indicated by Blum and Hellwig (1995) and Cecchetti and Li (2008)).

2.2.4. Capital adequacy requirement in foreign financial market: The case of GCC countries

In the last two decades, the global financial system has witnessed a rapid change in either the credit system or regulations. However, a series of financial crises, such as the Latin American

crisis, East Asian financial crisis, and the recent Eurozone crisis, raised concerns. Consequently, some emerging and developing countries adopted the rules of ‘minimum capital requirement.

Concetta Chiuri et al. (2002) provided a critical opinion regarding the capital adequacy requirement in developing countries. They stated that the capital adequacy requirement have less influence in developing countries. Owing to weak regulatory frameworks, macroeconomic indicators have a considerably greater effect on bank lending in developing countries than in developed countries. Besides, they indicate that, since developing countries have ineffective 'alternative financing channels' and strong impact of market powers on capital adequacy, an emergent financial system must increase the capital adequacy requirement more than the minimum level.

In the case of GCC countries, the banking industry is relatively young when compared to the developed banking systems; therefore, the banks in GCC countries are more likely to experience financial insolvency (Al-Muharrami et al., 2006). Recently, Maghyereh and Awartani (2014) studied this phenomenon in GCC countries’ banks by examining distressed and non-distressed banks from 1993 to 2002. Their study concluded that less profitable, poorly capitalized, and banks heavily involved in lending were more likely to be distressed. They also pointed out that banks with less government ownership were riskier than the banks whose stability was maintained by the government; additionally, when compared to banks in developed countries, banks in GCC countries tend to be riskier. Therefore, GCC countries’ banks must enhance the amount of capital adequacy instead of relying on government support to counteract any high risks. Maghyereh and Awartani (2014) supported the previous perspective by pointing out that a majority of banks experienced distress between 1993 and 2002; this period was marked by government deficit and low oil prices. Consequently, and, especially, after the failure of the Dubai Government to manage the 2009 Dubai Debt Crisis, the banks in GCC countries attempted to enhance their capital buffers against risks and to reduce dependence on government support.

The fact that GCC countries are oil-based economies and these countries facilitated the exposure of their banking sector to the oil market and extensive reforms in their banking system might increase the appeal of studies on these countries. The major reform was in compliance with the ‘Basel Accord for capital adequacy’ (Maghyereh and Awartani, 2014).

However, to the best of our knowledge, few qualified studies have attempted to identify the determinants of capital adequacy ratios in oil exporting countries by applying a dynamic panel model, taking into account the influence of oil price volatility on capital adequacy.

Price of Oil

Although research on the concept of the price of oil and capital adequacy is still non-existent, many scholars have examined the influence of oil prices on the banking industry through government expenditures. In fact, the economic sectors of most GCC countries are almost driven by government spending that has a significant correlation with the price of oil. This means that the price of oil is a significant indicator of the credit default risk.

In this context, Szegö (1983) found that there was a link between the price of oil and banking stability achieved through government expenditures. He demonstrated that, because of the high price of oil, the oil exporting countries were more likely to create a surplus than other countries. However, the banking system may become less efficient in its diversification of the financing channels because of its dependence on government spending. This may increase risk and motivate banks to hold high amounts of capital adequacy, particularly, with the existence of high liquidity.

However, by estimating the impact of the price of oil on interest rates and inflation, DiGiammerino et al. (2006) provided further explanation regarding the influence of the volatility of the price of oil on the banking stability. They proved an indirect relationship between the price of oil, inflation, and interest rates in developed economies. In other words, the high price of oil may lead to increased government spending, which may influence inflation. Therefore, with inflationary conditions, investors may seek high earnings, which, in turn, might have a negative effect on the amount of capital adequacy due to lack of liquidity that may compensate for any shortage in capital adequacy.

A recent trend in oil literature attempted to estimate the effects of the oil price on the banking system and financial markets. Morana (2013) investigated the influences of speculation on the price of oil and examined its impacts on financial stability. Based on his findings, he suggested that banks needed to enhance their capital buffers to counteract any risks.

Recently, Turhan et al. (2014) studied the oil price-exchange rate in the G20 countries. They provided new evidence that, when the price of oil increases, there are opportunities for risk diversification due to the exchange rate. This means that banks may have high amounts of capital adequacy because of the risk of exchange rate volatility.

To sum up, the global economy has witnessed many crises, which have affected the price of oil and financial stability in many countries. For this reason, globally, the financial authorities have attempted to reform their banking regulations by enhancing capital adequacy to counteract any financial crisis (Maghyereh and Awartani, 2014).

2.2.5. Financial crisis and capital adequacy ratio (Historical perspective)

Financial crisis and development of capital adequacy ratio

There has been rapid development in various aspects, including regulation and credit risk, of the global financial system; however, concerns about the system emerged after the recent global credit crunch. The financial crisis provided an opportunity to re-evaluate the approach to risk and credit, especially in financial institutions (Harrington, 2009).

In the mid-1980s, after the Latin American debt crisis, the Basel Committee introduced the capital measurement system related to the Basel Capital Accord. This measure, known as the Capital Adequacy Ratio (CAR), was used to measure credit risk. Moreover, it was used to assess the health of the banking sector (Wade and Veneroso, 1998). Since 1988, the ratio has been introduced progressively not only in the G20 countries, 'the members of the Basel committee', but also virtually worldwide (Altman and Saunders, 2001).

Many financial institutions went bankrupt during the 1997–198 Asian financial crisis. These bankruptcies demonstrated the link between macroeconomics (such as GDP, exchange rate, interest rate) and capital requirements in financial institutions (Corsetti et al., 1999). Thereafter, in 1999, the new Capital Accord 'Basel II' provided another approach for the calculation of CAR and it was implemented in 2004. This new approach was more sensitive to risk and included the following three complementary pillars that were considered to be the basis of the CAR: minimum capital requirements (credit, market and operational risk); a supervisory review process; and market discipline (Decamps et al., 2004).

In 2007, as a result of a downturn in the housing and mortgage markets, the world, generally, and America, particularly, suffered financial crises that led to recessions in most economic sectors and had repercussions for various credit systems (Lang and Jagtiani, 2010). Therefore, it became necessary to introduce new financial regulations to the world, and this need resulted in a new set of regulations in the form of Basel 2.5; this regulation requires the banks to increase capital adequacy requirement to offset any credit risks (Wilkens et al., 2013).

In December 2010, the third update of the Basel Accord (Basel III) was issued. According to the Basel Committee, 'Basel III is a comprehensive set of reform measures, developed by the Basel Committee, to strengthen the regulation, supervision, and risk management of the banking sector' (BIS, 2015).

Basel III was intended to improve banks' abilities to absorb any shocks in the financial and economic systems, to improve governance and risk management, and to increase disclosures and transparency within banks. The Committee went further than improving governance and transparency; it also raised the capital adequacy requirement from 8% to 10.5% by 2015 (Slovik and Cournède, 2011).

Influences of financial crisis on capital adequacy

Numerous empirical studies attempted to measure the impacts of financial crises on capital adequacy. For example, Kim et al. (2002) provided clear identification of the influence of the Asian crisis on the capital adequacy requirement. They demonstrated that, during the credit crunch in Asia, Small and Medium-sized Enterprises (SMEs) faced difficulties meeting their banks' financial obligations. Consequently, the banks enhanced their capital adequacy requirements to counteract the risk of non-performing loans. In the context of the Asian crisis, Brana and Lahet (2009) pointed out that the crisis induced Japanese banks to reduce their foreign assets portfolios, which led to reduced risks and enhanced CARs .

With regards to the recent global financial crisis, Angkinand (2009) stated that this crisis requires banks to have sufficient capital adequacy by mitigating excessive risk-taking. In addition , Ho and Hsu (2010) highlighted the fact that the global financial crisis encouraged financial authorities to reform their financial regulations; these reforms influenced banks' risky investment strategies and led to the creation of tighter capital adequacy requirements. It implies that the

financial crisis had a positive effect on the CAR. However, recently, Teixeira et al. (2014) found that the global financial crisis had a negative impact on capital adequacy. They suggested that the crisis influenced the banks' abilities to access equity easily, and thus limited their abilities to offset any shortages in capital adequacy.

2.3. Methodology, hypotheses on determinants of capital adequacy, and database

In this section, the researcher introduces the models used in the study that are based on Akhter and Daly (2009) and Fonseca and González (2010). The dependent variables of financial institutions' capital adequacy are described below. For explanatory variables, the researcher classifies the determinants of capital adequacy into three groups: bank indicators, country indicators, and market contestability indicators (Mirzaei and Moore, 2014). The aim of classification was to measure the influence of each group on capital adequacy. The section concludes by explaining the data sources and giving data descriptive analyses.

2.3.1. Variables

Table 2-1: Variable Definitions and Sources

Variables	Definition	Notation	Expected effect	Source
Dependent variable: Capital Adequacy ratio	It is also referred to as risk-based capital ratio; this is the ratio of total risk-based capital to risk-weighted assets. The total risk-based capital ratio is the total of the core capital (Tier 1), supplementary capital (Tier 2), and Tier 3.	CAR	?	BankScope
Capital buffer of bank	Difference between capital and capital requirement/capital requirement	RBUF	?	Authors' calculation
Bank capital above minimum levels	Capital adequacy ratio excluding the capital requirement	CAMR	?	Authors' calculation
Independent Regulation:				
First lag of dependent	First lag of dependent variables	CAR t-1	+/−	Authors' calculation
Bank variables:				
Bank size	Natural logarithms of a bank's total assets	$\log(size)$	−	BankScope
Loan losses provision	Loan impairment charge; it is a periodic expense for possible future loan losses.	$log(LLP)$	+	BankScope
Current ratio	The ratio of liquid assets to total current liabilities	$Curr$	+	BankScope
Return on average assets	The ratio of net income to total average assets	$ROAA$	+	BankScope
Leverage	It is also known as Debt/Equity Ratio; it is calculated by dividing total liabilities by total equity	$Lver$	+	BankScope
Deposits	A ratio of total deposits to total assets	$Dops$	−	BankScope
Risk-weighted assets	The ratio of credit risk, market risk, operation risk, and other types of bank risk to total assets	$RWAA$	−	BankScope
Bank macro variables			?	
GDP growth	Annual percentage growth rate of GDP (at constant 2005 prices)	GDP	-	World Bank
Price of oil	Natural logarithms of Crude oil price (yearly basket price of OPEC)	log(OP)	+	OPIC

Inflation	The annual percentage change in the consumer price index	Inf	−	dataset World Bank
Interest rate	The repo rate of interest; central banks use it to control the money supply in the financial market.	$int\ r$	+	Trading Economics dataset
Real Effective Exchange rate	The value of currency to the weighted average of the basket from several foreign currencies divided by a price deflator	$reer$		World Bank
Money supply	Money supply reflects the total liquidity in the country's economy outside the banking system	$M2$		World Bank
Market contestability:				
Activity restriction	It includes securities, insurance, and real estate activities. It ranges between zero and twelve	$Act\ rest$	?	
Financial conglomerate	A bank may control a non-financial firm, a non-financial firm may control a bank, and a non-bank financial firm may control a bank. It ranges from zero to twelve	$fin\ Con$	?	World bank survey
Limit on foreign bank	Foreign banks may own domestic banks; foreign banks may enter a country's banking system. It ranges from zero to four	lim	?	Barth et al.
Entry requirement	It measures whether various types of legal submissions are required to obtain a banking license. It ranges between zero and eight	$en\ req$	?	
Supervision:				
Official supervisory power	It determines whether the supervisory authorities have the authority to take specific action to prevent and correct problems.	$super$	+	World bank survey. Barth et al.

Along with the definition and sources, Table 2-1 shows the variables that may influence the CAR. The following section provides an explanation on each variable:

Dependent variables

All the countries included in this study implemented the Basel II guidelines, but differences in requirements are basically lie in the percentage of general capital adequacy ratio (CAR). Moreover, this ratio might not take into account each country's minimum capital requirement. Therefore, we measure capital adequacy in absolute terms (the institution's capital adequacy less the capital requirement to which it is subject, bank capital above the minimum level(CAMR)), and in relative terms (the difference between capital adequacy and the capital requirement is divided by the requirement, (RBUF)) (Fonseca and González, 2010).

Capital Adequacy Ratio (CAR):

Although a majority of the GCC countries naturally follow Sharia law, there is no distinction between the regulations of the Islamic banks and conventional banks (Ariss and Sarieddine, 2007). Some of the central banks in GCC countries have fully implemented the Basel II Capital Standards while others are planning for full implementation. Moreover, progress is being made on the implementation of Basel III (Khamis and Rasmussen, 2012). Therefore, the researcher adopts CAR as a dependent variable in this study, where:

$$CAR = (Tier\ 1\ capital + Tier\ 2\ capital + Tier\ 3)/(Total\ risk\text{-}weighted\ assets) \times 100 \quad (1)$$

In banks, Tier 1 capital is the core capital; it includes the primary element of capital, which is equity capital and disclosed capital. Contrarily, Tier 2 capital is supplementary capital; it includes undisclosed reserves, revaluation reserves, loan-loss reserves, hybrid debt capital instruments, and subordinated term debt (bis, 2006). At present, the CAR also includes short-term subordination debt covering market risk (Tier 3). The total risk-weighted assets are represented by 'the sum of the products of the book value of each capital asset and its corresponding risk weights' (Ahmad et al., 2008). The credit risks follow the Basel standard credit risk weightings of 0%, 20%, 50%, 100%, and 150%, respectively (bis, 2006).

The capital buffer of the bank (RBUF):

The capital buffer of the bank refers to the difference between the capital adequacy and the capital requirement divided by the capital requirement. This ratio takes into account each country's minimum capital requirement (Fonseca and González, 2010).

Bank capital above the minimum level (CAMR):

This ratio refers to the difference between the capital adequacy and the minimum capital requirement. Less stressed banks may have capital adequacy above the minimum level while high stressed banks may have capital adequacy below the minimum requirement (Hirtle, 2010).

Explanatory variables

In addition to the regulation and supervision variables discussed in the previous literature, in this study we distributed the independent variables into three groups. Consequently, the first group represents accounting-based indicators, the second group displays the country indicators, and the third group represents market contestability indicators. This distribution is intended to assist in determining which group has the strongest influences on the CAR.

Bank regulation:

First lag of CAR:

Since banks adjust CAR to meet any change in economic and policy factors, any change to the CAR might prove to be expensive for some banks. Therefore, banks may maintain tight capital adequacy if they anticipate a high cost of change. Akhter and Daly (2009) and Fonseca and González (2010) used the first lag of capital as a proxy for change in policy, especially the CAR requirement that control for time-invariant variables and collinearity. Consequently, the researcher devised the following hypothesis of regulation:

H1: Costs of adjustment have a positive impact on GCC countries' banks' CARs.

Market contestability indicators:

Activity restrictions:

Restrictions on bank activities refer to banks' non-lending activities or non-interest income, such as securities, real estate, and insurance. Although the previous literature tried to link activity

restrictions with profits or risk (Gonzalez, 2005), the previous studies have not attempted to examine clearly the relationship between activity restrictions and CAR. However, Fonseca and González (2010) found some impacts of activity restrictions on bank capital; these impacts are accounted to reduce d market discipline due to more activity restrictions. Therefore, banks need to maintain high capital adequacy to increase the confidence of their depositors. Accordingly, we devised the following hypothesis:

H2: Activity restrictions have a positive impact on GCC countries' banks' capital adequacy.

Financial conglomerates:
This indicator reflects the relationship between banks and non-financial firms and vice versa. Under this factor, banks may maintain low capital adequacy due to diversification (Ahmad et al., (2008). Thus, the study devised the following hypothesis to concur with recent studies showing that:

H3: Financial conglomerates have a negative impact on GCC countries' banks' capital adequacy.

Limitations on foreign banks and entry requirements:
'Limitations on foreign banks' refer to whether foreign financial institutions can be allowed to enter a country's banking industry and own domestic banks by means of subsidiaries, acquisition, agencies, and branches.

In this regard, 'entry requirements' refer to the documents required to issue licenses. Previous literature linked these indicators with bank profit and market discipline (Lensink and Hermes, 2004). In this study, the researcher assumed a positive relationship between foreign bank entry and capital adequacy. This is because the entry of more foreign banks may induce high competition and, in turn, might lead to high levels of risk. Accordingly, this study devised the following hypotheses:

H4: foreign bank entry has a positive impact on GCC countries' banks' capital adequacy.

H5: Entry requirements have a positive impact on GCC countries' banks' capital adequacy.

Supervision:

Official supervisory power:

Stringent official supervision creates better market power that might reduce risks. Consequently, banks might maintain low capital adequacy. Accordingly, we devised the following hypothesis:

H6: Stringent official supervision has a positive impact on GCC countries' banks' capital adequacy.

Energy prices

Price of Oil:

The price of oil price is regarded as an important economic indicator in oil-exporting countries, such as the GCC countries. This is because it can influence economic and financial systems (DiGiammerino et al., (2006). In this study, the researcher used the natural logarithms of oil price to reduce the serial correlation between the price of oil and other country indicators (Baillie and Bollerslev, 1994). Indeed, while few studies discussed this relationship, with particular regard to the GCC countries, some studies highlighted the fact that high oil prices induced an economic boom in the oil-exporting countries. Consequently, this study expects to find a negative relationship between the price of oil and capital adequacy. A high oil price may motivate banks to maintain a low capital adequacy, since the government may provide support and good economic conditions. The study devised the following hypothesis on the price of oil:

H7: The price of oil has a negative impact on the GCC countries' banks' capital adequacy.

Bank indicators (control variables):

Size:

Bank size is determined by using the natural logarithms of total assets as a proxy log (size) (Fonseca and González, 2010). In this sub-section, the influence of bank size on the CAR may facilitate determination of whether the amount of total net assets has a positive or a negative impact on capital adequacy; this is based on the consideration that 'bigger is not necessarily better'.

Loan Loss Provisions (LLP):

The researcher applied the natural logarithms of LLP as a proxy of risk (Anandarajan et al.,(2005). He used this ratio to reflect on future on bank loan losses. High LLP may lead to high CAR.

Current ratio:

The researcher applied the current ratio here as a proxy of liquidity; this is estimated by dividing current assets by current liabilities (Richards and Laughlin, 1980). An increase in liquidity increases capital adequacy (Berger and Bouwman, 2009).

Profitability ratio:

The researcher used the Return on Average Assets (ROAA) as a proxy of profitability. Based on the literature, a high ROAA induces high capital because the bank can offset from its profits any decline that may occur in capital adequacy (Rime, 2001) and (Flannery and Rangan, 2008). However, other studies, such as (Fonseca & González, 2010), produced contrasting results.

Leverage ratio:

Leverage reflects banks' riskiness. The total debt is divided by total equity as a proxy of leverage (levr) (Bodie et al. (2007). Leverage is a proxy of risk, and thus capital adequacy may rise if the risk is high (Fonseca and González, 2010).

Risk-weighted assets:

Risk-Weighted Assets (RWA) are determined by dividing risk-weighted assets by total assets as a proxy of risk assets (Das and Sy, 2012). A RWA is another source of risk that may have either a positive or a negative influence on capital adequacy. Indeed, previous studies proved that there was a negative relationship between RWA and CAR (Rime, 2001).

Country indicators (country control variables):

GDP:

The real annual percentage growth is referred to as GDP per capita, and is based on constant local currency. This rate assists in examining the impacts of either an economic upturn or a

downturn on the CAR. During an economic upturn, there is a negative relationship between GDP growth and capital adequacy. This may be because banks anticipate better economic conditions during an upturn and may consequently have low capital adequacy (Akhter and Daly, 2009).

Inflation:

Inflation reflects the annual percentage change in the Consumer Price Index. This ratio may assist in examining what happens to banks' capital adequacy under high or low inflationary conditions. Previous literature mainly showed a negative impact on capital adequacy; however, some studies, such as (Akhter and Daly, 2009), indicate the contrary.

Exchange rate:

This rate helps to examine the influences of business, projects, and shares that are held by the banks in foreign countries and denominated by foreign currencies. The link between exchange rate and capital adequacy depends on banks' foreign obligations and investments, which are pegged to the exchange rate and hedging. However, a positive effect is expected when GCC banks invest in foreign countries. This might occur as a result of an appreciation in foreign exchange leading to banks earning more and offsetting any losses in capital adequacy (Akhter and Daly, 2009). The study used the real effective exchange rate as a proxy of the exchange rate.

Interest rate:

Through interest rates, banks can increase their earnings as well as their levels of risk. Thus, in both cases, there is an effect on the rate of capital adequacy (Blum and Hellwig, 1995) and (Rajan, 2006). The study used the repo interest rate as a proxy because GCC countries' central banks used it to influence daily liquidity in the financial system.

Money supply (monetary policy):

Money supply has strong links with other macroeconomic indicators. Therefore, to reduce this correlation, the researcher used M2 as a proxy of the money supply. M2 is the average annual growth rate of money supply and quasi-money outside the bank, savings deposit, money in

mutual funds, and other time deposits' (Thakor, 1996). Therefore, more money supply may reduce the lending risk, which may lead banks to have low capital adequacy (Thakor, 1996).

2.3.2. Capital adequacy empirical model

The current study used GMM. This estimator was created by Arellano and Bond (1991) for dynamic panel data and developed by Blundell and Bond (1998). Thus, the estimator now possesses better asymptotic and finite properties, especially with highly persistent data (Cameron and Trivedi, 2009). Recently, several researchers, such as Ayuso et al. (2004), Jokipii and Milne (2008), and Akhter and Daly (2009) adopted this estimator.

This model is designed to address the following three main econometric issues. First, the estimator handles the issue of unobserved bank-specific effects by using the first-differences of all variables. Second, the estimator treats the dynamic nature of capital adequacy by using a 'lagged dependent variable model' (Fonseca and González, 2010). Third, it deals with the likely endogeneity of the independent variables. To tackle this issue, the estimator controls endogeneity by applying 'instruments based on the lagged value of the independent variables' (Fonseca and González, 2010).

Moreover, there are two popular versions of the GMM estimator, namely the one-step and two-step. The former is assumed to be independent and homoscedastic of error term; while the latter is more efficient asymptotically (Akhter and Daly, 2009). As suggested by Arellano and Bond (1991), the asymptotic bias may influence the model by using an entire set of lagged values of capital adequacy. Therefore, the use of an entire set of lagged values may lead to weak instruments; these will be asymptotically inefficient. However, this study dealt with this problem by using lagged differences of capital adequacy, as suggested by Blundell and Bond (1998), (Stolz and Wedow, 2005). Furthermore, while the model seemed over-identified, the two-step estimator might deal with this issue by using an optimal weighting matrix (Cameron and Trivedi, 2009).

Therefore, the study applied both one and two-step GMM estimators, as suggested by Blundell and Bond (1998). The model for estimation was as follows:

$$CAR_{i,t} = a_1 + \beta_1 CAR_{i,t-1} + \beta_2 size_{i,t} + \beta_3 LLP_{i,t} + \beta_4 Curr_{i,t} + \beta_5 ROAA_{i,t} + \beta_6 Lver_{i,t} + \beta_7 RWAA_{i,t} +$$

$$\beta_8 GDP_{i,t} + \beta \quad OP_{i,t} + \beta_{10} Inf_{i,t} + \beta_{11} reer_{i,t} + \beta_{12} \; int\, r_{i,t} + \beta_{13} M2_{i,t} + \beta_{14} Act\, rest_{i,t} + \beta_{15} fin\, Con_{i,t} +$$

$$\beta_{16} lim_{i,t} + \beta_{17} en\, req_{i,t} + \beta_{18} super_{i,t} + u_i + \varepsilon_{i,t} \qquad (2) \text{Where } 0 \leq \beta \leq 1.$$

The dependent variable $CAR_{i,t}$ was the capital adequacy ratio for bank i at the time t. On the side of explanatory variables, the researcher applied $CAR_{i,t-1}$ for one period lagged for regulation as independent the variable. Concerning the bank variables, $(size)$ represented the size of the financial institution, (LLP) denoted loan loss provisions, and $(Curr)$ indicated current ratio, $ROAA$ expressed return on average assets, Leverage ratio was denoted as $(Lver)$, and $(RWAA)$ represented risk weight assets to assets. With respect to the country indicators, GDP growth was represented by(GDP), (OP) stood for oil price, inflation was represented by (Inf), real efficient exchange rate was expressed as $(reer)$, interest rate was represented by $(int\, r)$, and $(M2)$ stood for money supply. In case of market contestability, activity restrictions were represented by$(Act\, rest)$, $(fin\, Con)$ stood for financial conglomerates, (lim) represented limitations on foreign banks, and $(en\, req)$ expressed entry requirement. The official supervisory power was expressed as $(super)$. Finally, concerning error terms,(u_i) represented time invariant heterogeneity across banks and ($\varepsilon_{i,t}$) expressed the time variant error term.

For consistency in the GMM estimator, the researcher applied two specification tests developed by Arellano and Bond (1991) and Blundell and Bond (1998). The first test was the Sargan test that was conducted for over-identifying restrictions in GMM. By measuring the sampled analog of moment condition, the test could measure the overall validity of the instruments. The second test was the Arellano-Bond test for no serial correlation; it was computed only with the two-step GMM. The test examined the hypothesis that a differenced error term has no second-order serial correlation because it is expected to be rejected by the first-order, but not with higher orders. Therefore, a failure to reject the null hypotheses of both tests provides support to our model (Akhter and Daly, 2009).

Panel data included some issues, and the researcher took account of the problem of non-stationary data and outlier data. Although non-stationary data was unnecessary with a low period sample (small T), the study applied the Fisher test, as shown in Table A2-1, in the Appendix. This unit root test was performed on unbalanced panel data (Maddala and Wu, 1999).

For robustness check, the study applied one-step GMM to control error term in the model. In addition, the researcher applied the capital buffer of the bank (RBUF) as a dependent variable; it reflects the difference between capital adequacy and capital requirement divided by capital requirement (Fonseca and González, 2010). Moreover, the study applied bank capital above minimum ratio (CAMR) by isolating capital requirement from capital adequacy.

In order to double check, the study applied the random effect model (RE) over the fixed effect (FE) model. Our model included time-invariant variables, and hence random effect was considered more appropriate (Greene, 2008).

However, the fixed effect model omitted the variables that had zero value for 'within standard deviation', it implies that the characteristics of each entity will not have a significant influence on the variables (see Table 2-3) (Cameron and Trivedi, 2009). The primary assumption of the fixed effect model is that something within the individual entities may influence or may bias the outcomes of the variables. Consequently, while this bias needs to be controlled, it is difficult to control the bias with a zero value for 'within standard deviation'. Moreover, another issue with the fixed effect model is that it is unsuitable for time-invariant variables where the entity's error term is correlated. The error term for each entity should not be correlated with each other; however, an RE model would become more suitable if correlation is detected in the FE models.

Therefore, the random effect model may deal with this issue by taking into account between-entity error and within-entity error. The main advantage of the random effect model is that it is more efficient with time-invariant variables. Moreover, random effect can control any unequal variances of the error term or 'heteroskedasticity' that might have occurred with the GMM two-step estimator(Cameron and Trivedi, 2009).

2.3.3. Data and Descriptive Analysis

Data

As shown in Table 2-1, the study used four different datasets for the panel. The first dataset of bank indicators relied on the BankScope Database and the Bloomberg Database; these provided all the banks' published financial statements. In addition, the World Bank's datasets were used for procuring information related to country indicators. The World Bank's bank regulation and

supervision survey databases were used for collecting information on market contestability. Finally, OPEC basket databases were used to obtain information related to the price of oil.

The data was based on annual observations of six oil-exporting countries (GCC) during the period from 1998 to 2013. There were 89 banks (see Table A2-2 in the Appendix). The sample includes active banks identified by BankScope. For extreme values within the bank's financial statements, the researcher applied the 'inner and outer fences'[6] outlier method suggested by Tukey (1977). Consequently, the study excluded any extreme value due to a possible error in BankScope. Moreover, the study excluded banks with less than three years of financial statements and banks without any information about total assets and CAR. In addition, a few years were dropped due to missing data, and therefore the panel data consists of unbalanced panel data.

In addition, the study excluded Islamic banks in GCC, where Islamic banking is different from conventional banking because interest (riba) is prohibited in Islam. In other words, Islamic banks are not allowed to offer a fixed rate of return on deposits and are not allowed to charge interest on loans. Therefore, A unique feature of Islamic banking is its profit-and-loss sharing (PLS) paradigm, while, commercial banks are based on interest (Chong and Liu, 2009).

Table 2-2: Descriptive statistics

	Total					Per-crisis			Post-crisis		
VARIABLES	Mean	Std.Dev	Min.	Max.	Obs	Mean	Min.	Max.	Mean	M in.	Max
Independent											
capital adequacy ratio	21.13	9.064	7.8	84.9	977	21.197	7.8	84.9	21.064	8.7	81.6
Bank indicators											
Bank size	3.78	0.859	1.435	5.647	1,175	3.6367	1.4345	5.404	3.9559	1.7427	5.64688
Loan loss provision	1.499	0.914	-0.699	3.817	941	1.2663	-0.698	3.817	1.7556	-0.6989	3.67649
Current ratio	36.29	25.28	0.229	203	1,119	39.464	0.229	191.76	32.166	0.855	202.963
ROAA	2.151	3.102	-28.41	20.67	1,159	2.8066	-11.92	20.667	1.3457	-28.41	20.207
Leverage	2.326	1.422	-4.885	9.742	1,146	2.4087	-4.884	9.7418	2.224	1.0001	7.97318
Deposit	0.612	0.187	0.02	0.96	1,122	0.6116	0.04	0.89	0.6118	0.02	0.96
Risk-weight assets	0.822	0.266	0.35	3.15	765	0.7563	0.38	2	0.8570	0.35	3.15
Country indicators											
GDP Growth	5.132	4.291	-7.076	19.22	1,151	5.6389	-1.789	19.218	4.5345	-7.0761	17.663
Price of oil	1.731	0.259	1.233	2.039	1,176	1.5454	1.232	1.8393	1.9578	1.7857	2.03922
Inflation	3.093	3.505	-4.863	15.05	1,157	2.8475	-1.347	13.758	3.3850	-4.8632	15.0502

[6] By interquartile range

Real effective exchange rate	0.383	5.128	-22.98	31.81	1,143	0.8619	-14.42	31.808	-0.173	-22.975	3.05559
Interest rate	0.798	10.37	-18.3	41.25	964	1.086	-18.30	31.479	0.5606	-16.666	41.2542
Money supply	0.136	0.101	-0.08	0.43	1,176	0.1632	-0.01	0.43	0.1023	-0.08	0.23
Market Contestability											
Activities restricted	61.11	13.85	33.33	75	1,176	61.496	33.333	75	60.637	33.333	75
Financial conglomerates	62.09	7.442	50	66.67	1,176	61.831	50	66.666	62.405	50	66.6667
Limited on foreign bank	3.049	0.947	1	4	1,176	3.0123	1	4	3.0947	1	4
Enter requirement	0.887	0.317	0	1	1,176	0.8935	0	1	0.8787	0	1

See table 2-1 for variables' definitions

Descriptive Analysis

Table 2-2 presents the descriptive statistics analysis for variables and distinguishes between the sample period, pre-crisis period, and post-crisis period. The mean for *CAR* is considerably higher when compared to other regions in the world. Figure 2-1 in the Appendix compares *CAR* in the GCC countries with regions across the globe; it is around 21.13% in GCC, while the *CAR* is around 16% in the ASEAN region. The *CAR* is around 14% in the OECD countries and 14.5% in the G8 countries. Table 2-2 also does not show any essential difference between the total mean of CAR for the whole period when compared to the pre-crisis or post-crisis periods. Furthermore, concerning the pre-crisis period, some banks maintained less than the minimum *CAR* percentage prescribed in the Basel Accord, which is 7.8%. Contrarily, this percentage increases slightly over the crisis period to 8.7% to meet the Basel Accord percentage. The maximum *CAR* percentage is around 80%, which reflects capital adequacy requirement for new banks. The increase in bank *size* after the crisis was around 4.0 points, while it was around 3.6 points in the pre-crisis period. In addition, *ROAA* was %2.806 during the period of pre-crisis period compared to about %1.345 after the crisis.

Country indicators seem to be stable during the whole period; however, the consequences of the financial crisis influenced the economic indicators. While the *GDP* was considerable at 4.534 points after the crisis, certain decline was observed during this period when compared to *GDP* at 5.638 points in the pre-crisis period. Contrarily, inflation increased to %3.385 after the crisis compared to %2.847 in the pre-crisis period. There was also a decline in the *real interest rate* of 0.560 after the crisis. There was a sharp drop in the *real effective exchange rate*, which was negative, at −0.173, after the crisis due to high *inflation* and a weak US dollar exchange rate

during this period. The relative stability in country indicators may be explained by log (OP) or *oil price*, which jumped to 3.385% after the crisis from 2.847% in the pre-crisis period and led to increased government spending.

Table 2-2 does not show any essential difference between the market contestability indicators during the whole sample, pre-crisis, and post-crisis periods. For *activity restrictions* and *financial conglomerates*, there is some flexibility with %60 or 6 out of 12 points. Contrarily, greater stringency is observed in entry requirements at around %90 when compared to other indicators. In contrast to *entry requirements*, the indicator for *limitations on foreign banks* is more flexible at close to 4 points.

Table 2- 3: Descriptive Statistics within and between

Variable		Mean (1)	Std. Dev. (2)	Min (3)	Max (4)	Observations (5)
Dependent						
Capital adequacy ratio	Overall	21.13019	9.06354	7.8	84.9	N = 977
	Between		8.555715	14.06857	52.3025	n = 87
	Within		6.20934	-8.23344	68.9927	T-bar = 11.2299
Independent						
Bank indicators						
Bank size	Overall	3.780156	0.859257	1.434569	5.64688	N = 1175
	Between		0.836807	2.096176	5.402593	n = 89
	Within		0.32874	2.26786	4.692616	T-bar = 13.2022
Loan loss provision	Overall	1.498785	0.914131	-0.69897	3.817413	N = 941
	Between		0.840872	-0.69897	3.405252	n = 87
	Within		0.512098	-0.15482	2.761931	T-bar = 10.8161
Current ratio	Overall	36.28848	25.27528	0.229	202.963	N = 1119
	Between		25.58884	4.029111	164.765	n = 85
	Within		18.79519	-32.1738	171.0925	T-bar = 13.1647
ROAA	Overall	2.151165	3.101754	-28.41	20.667	N = 1159
	Between		1.630291	-5.78417	8.012857	n = 89
	Within		2.814956	-31.2217	19.60733	T-bar = 13.0225
Leverage	Overall	2.326234	1.422031	-4.88489	9.74186	N = 1146
	Between		1.103531	1.003364	6.391081	n = 88
	Within		0.877408	-4.86849	9.143717	T-bar = 13.0227
Deposit	Overall	0.611756	0.186812	0.02	0.96	N = 1122
	Between		0.186271	0.054	0.814546	n = 86
	Within		0.086107	0.054256	0.938422	T-bar = 13.0465
Risk- weight assets	Overall	0.822314	0.266022	0.35	3.15	N = 765
	Between		0.228168	0.468667	1.758571	n = 89
	Within		0.164558	0.047314	2.467314	T-bar = 8.59551
Country Indicators						
GDP growth	Overall	5.132318	4.291096	-7.0761	19.2185	N = 1151
	Between		2.251471	2.033954	12.46211	n = 89
	Within		3.829174	-6.48063	17.91547	T-bar = 12.9326
Price of oil	Overall	1.730634	0.258934	1.232996	2.039216	N = 1176
	Between		0.112168	1.687509	2.031745	n = 89

	Within		0.243315	1.256066	2.082341	T-bar = 13.2135
Inflation	Overall	3.092882	3.504882	-4.86328	15.05015	N = 1157
	Between		1.117496	-0.0748	5.415723	n = 89
	Within		3.344274	-6.37499	14.08098	T-bar = 13
Real effective exchange rate	Overall	0.383481	5.127857	-22.9751	31.8081	N = 1143
	Between		1.694645	-3.57688	3.627314	n = 89
	Within		4.832215	-22.7619	29.49786	T-bar = 12.8427
Interest rate	Overall	0.798269	10.3696	-18.3013	41.2542	N = 964
	Between		2.515694	-5.85597	5.81285	n = 89
	Within		10.14434	-18.4165	43.25164	T-bar = 10.8315
Money supply	Overall	0.13591	0.100843	-0.08	0.43	N = 1176
	Between		0.038215	0.066	0.242308	n = 89
	Within		0.09396	-0.06409	0.41341	T-bar = 13.2135
Market contestability						
Activity restrictions	Overall	61.11111	13.84508	33.33333	75	N = 1176
	Between		13.84939	33.33333	75	n = 89
	Within		0	61.11111	61.11111	T-bar = 13.2135
Financial conglomerates	Overall	62.089	7.442209	50	66.66666	N = 1176
	Between		7.337502	50	66.66666	n = 89
	Within		0	62.089	62.089	T-bar = 13.2135
Limitation on foreign bank	Overall	3.04932	0.946725	1	4	N = 1176
	Between		0.937119	1	4	n = 89
	Within		0	3.04932	3.04932	T-bar = 13.2135
Entry requirement	Overall	0.886905	0.316844	0	1	N = 1176
	Between		0.330984	0	1	n = 89
	Within		0	0.886905	0.886905	T-bar = 13.2135

See Table 2-1 for variables definition. Between standard reflects individual-variant and within reflects time-variant.

Table 2-3 shows the overall, between, and within standard deviations for the sample. These assist us in choosing the appropriate estimators for the sample by identifying the within and between variations. For instance, zero between standard deviation reflects individual-invariant, while zero within standard deviation represents time-invariant (Cameron and Trivedi, 2009). The *CAR* seems to be a dynamic variable with individual variation 8.555 and time variation 6.209. Thus, the study applies dynamic estimators to measure *CAR* since it is a dependent variable. With the exception of *ROAA*, bank indicators tend to be individual variations with a significant value of standard deviation when compared to 'within standard deviation'. These might be because of the financial crisis. Contrary to the bank indicators, the country indicators tend to be time variations where most variations are 'within variations'. However, market contestability indicators are time-invariant variables[7] that appear with 'zero within standard deviation'. Consequently, with

[7] Time-invariant reflects variables with correlated error term.

zero within standard variation, it is inappropriate to apply some estimators, such as the fixed effect model (Cameron and Trivedi, 2009). In addition, in the last column, 'N' represents the number of observations and 'n' shows the number of individuals, while the T-bar represents the average number of time-points.

Table 2-4: Correlation among variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1)CAR	1										
(2)size	-0.1481	1									
(3)LLP	-0.1083	0.8056	1								
(4)Curr	0.2454	-0.3795	-0.382	1							
(5)ROAA	0.1728	0.1711	0.0016	0.0677	1						
(6)Lver	-0.2369	-0.0211	-0.0347	0.0831	-0.1385	1					
(7)Dops	-0.1314	0.24	0.259	-0.5419	0.1171	-0.4405	1				
(8)RWAA	-0.1505	-0.0412	-0.0086	0.1548	-0.2034	-0.125	-0.106	1			
(9)GDP	-0.0978	0.1149	-0.0826	0.0149	0.2096	0.0049	0.0276	-0.0537	1		
(10)OP	0.01	0.1254	0.1553	-0.0797	-0.0785	-0.2678	0.0754	0.1814	-0.0209	1	
(11)Inf	-0.0571	0.0606	-0.006	-0.03	0.1156	-0.0397	0.034	0.1244	0.1163	0.1715	1
(12)reer	0.0252	-0.0499	-0.0066	-0.0194	0.0808	-0.0745	0.0986	-0.0644	0.0982	-0.1105	0.0834
(13)r int r	-0.046	-0.1041	-0.0431	0.1034	-0.1787	0.1061	-0.0703	0.0254	-0.2213	-0.2245	-0.4295
(14)M2	-0.0022	0.0383	-0.1117	0.0873	0.2962	0.0487	-0.0706	0.0195	0.3243	-0.1418	0.4941
(15)Act rest	0.0342	0.4948	0.3169	-0.1489	0.1606	-0.3151	0.2524	0.2329	0.0216	0.098	0.0187
(16)fin Con	0.0819	-0.2402	-0.3	0.2296	-0.0909	0.0188	-0.1979	0.187	-0.0559	0.0966	-0.1185
(17)lim	0.0674	0.3689	0.2354	0.0376	-0.0236	0.1663	-0.1411	0.0052	0.1113	-0.0753	-0.0929
(18)en req	0.0791	-0.1806	-0.0056	0.0336	-0.1317	0.0752	-0.0197	0.0332	-0.4743	-0.0477	-0.011

	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(12)reer	1						
(13)r int r	-0.0357	1					
(14)M2	0.0833	-0.1996	1				
(15)Act rest	-0.0002	-0.0668	0.0724	1			
(16)fin Con	-0.1002	0.0935	0.0765	0.3833	1		
(17)lim	-0.2769	0.0469	-0.0333	0.1261	-0.1012	1	
(18)en req	0.0252	-0.0353	-0.3221	-0.1322	-0.2395	0.0341	1

See Table 2-1 for variables definition.

Table 2-4 presents the correlation matrix among the explanatory variables. The outcomes show that with around 0.805 there is a high correlation between (*size*) and (*LLP*). The positive association between (*LLP*) and (*size*) indicates that banks with higher assets tend to engage in lending rather than other banking activities. Accordingly, we ran regression individually for each variable. Moreover, the matrix indicates that deposit ratio (*Deps*) has collinearity with other bank indicators, especially the Current Ratio (*curr*), Leverage (*Lver*), and Loan Loss Provisions (LLP). Consequently, we may drop this ratio from its original model and add it to the financial crisis model where split data may reduce the collinearity between the variables.

There is a little concern about the correlation between country indicators where the highest correlation is 0.4941. This is between money supply (*M2*) and inflation (*inf*). The matrix shows that the market contestability indicators tend to have a positive correlation with *CAR*. Contrarily,

with the exception of the current ratio (Curr) and *ROAA*, most bank indicators have a negative relationship with *CAR*. In the next section, the current study investigates statistically the relationship between *CAR* and the explanatory variables within a dynamic linear framework.

2.4. Empirical results

The study adopted a panel dynamic model (an autoregressive process in data for the behaviour of capital adequacy) as the dependent variables are dynamic by nature and because of the endogeneity in explanatory variables, where bank indicators, country indicators, and market contestability indicators interact with each other. The researcher applied Equation (2) for the GMM one-step and two-step estimators, developed by Blundell and Bond (1998); in addition, taking in account the correlation between size and loan loss provisions, the researcher applied the equation over the period from 1998 to 2013. In addition, the current study extended our model by taking into account banks that met minimum capital requirements. Moreover, the researcher also used banks with capital ratios above the minimum levels to identify the less stressed banks. Also, along with other macro- and microeconomic, and market contestability indicators, this model examined the influence of regulation and supervision on capital adequacy.

Table 2-5: Estimation Results for Capital Adequacy, Capital buffer of Bank and Bank Capital above minimum

VARIABLES	(1) CAR (Two-step)	(2) CAR (Two-step)	(3) CAR (One step)	(4) CAR (One step)	(5) RBUF (Two step)	(6) RBUF (Two step)	(7) CAMR (Two step)	(8) CAMR (Two step)	(9) CAR (Two step)	(10) CAR (Two step)
Independent										
Regulation										
Frist lag of Dependent		0.241***	0.241***	0.359***		0.137***		0.118***		0.234***
		(0.00938)	(0.0257)	(0.0271)		(0.00818)		(0.0073)		(0.00927)
Bank indicators										
Bank size	-1.014*	-0.372***	-0.395***		-0.349***	-0.458***	-0.436***	-0.495***	-0.201***	-0.388***
	(0.590)	(0.594)	(0.819)		(0.0461)	(0.0481)	(0.396)	(0.528)	(0.531)	(0.770)
Loan loss provision				0.849**						
				(0.394)						
Current ratio	0.0666***	0.0576***	0.0644***	0.0737***	0.0114***	0.0123***	0.121***	0.133***	0.0664***	0.0578***
	(0.00446)	(0.00569)	(0.0118)	(0.0142)	(0.000558)	(0.000659)	(0.00369)	(0.0065)	(0.00593)	(0.00644)
ROAA	0.0961***	0.157***	0.149**	0.105	0.0139***	0.0129***	0.106***	0.124***	0.102***	0.146***
	(0.0300)	(0.0354)	(0.0639)	(0.0651)	(0.00246)	(0.00440)	(0.0206)	(0.0359)	(0.0307)	(0.0316)
Leverage	-1.842***	-1.640***	-1.634***	-1.008***	-0.120***	-0.0965***	-1.403***	-1.346***	-1.531***	-1.684***
	(0.197)	(0.163)	(0.222)	(0.253)	(0.0110)	(0.0134)	(0.113)	(0.0888)	(0.111)	(0.158)
Risk- weight assets	-0.543***	-0.662***	-0.662***	-0.420***	-0.632***	-0.660***	-0.544***	-0.659***	-0.576***	-0.673***
	(0.848)	(0.748)	(1.033)	(1.051)	(0.0631)	(0.0701)	(0.508)	(0.8576)	(1.039)	(0.795)
Country Indicators										
GDP Growth	-0.0696***	-0.101***	-0.0990**	-0.192***	-0.00916***	-0.0208***	-0.101***	-0.181***	-0.0594***	-0.103***
	(0.0118)	(0.0167)	(0.0428)	(0.0489)	(0.00133)	(0.00202)	(0.0154)	(0.0184)	(0.0123)	(0.0155)
Price of oil	-0.249***	0.183	0.136	0.780	-0.105***	0.0416	-0.745***	-0.001	-0.539***	0.210
	(0.372)	(0.212)	(0.739)	(0.759)	(0.0157)	(0.0240)	(0.268)	(0.0231)	(0.174)	(0.247)
Inflation	-0.183***	-0.204***	-0.201***	-0.219***	-0.0203***	-0.0231***	-0.195***	-0.2105***	-0.216***	-0.201***
	(0.0218)	(0.0189)	(0.0442)	(0.0479)	(0.00178)	(0.00162)	(0.00933)	(0.0128)	(0.0219)	(0.0188)
Real effective exchange rate	0.0312***	0.0343***	0.0380	0.0700**	0.00573***	0.00540***	0.0538***	0.042***	0.0421***	0.0306***
	(0.00707)	(0.00639)	(0.0286)	(0.0305)	(0.000905)	(0.00104)	(0.00580)	(0.0101)	(0.00843)	(0.00961)
Interest rate	-0.0339***	-0.0461***	-0.0471**	-0.0623***	-0.00650***	-0.00749***	-0.0633***	-0.075***	-0.0404***	-0.0439***
	(0.00486)	(0.00441)	(0.0188)	(0.0185)	(0.000500)	(0.000491)	(0.00519)	(0.0050)	(0.00480)	(0.00378)
Money supply	-0.495***	-0.521	-0.441	-0.344	-0.269***	-0.106*	-1.972***	-1.827***	-0.400***	-0.372
	(0.707)	(0.657)	(1.628)	(1.923)	(0.0621)	(0.0608)	(0.532)	(0.6691)	(0.643)	(0.619)
Market Contestability										
Activity restrictions	0.0671*	0.663***	0.953***	0.809***	1.128***	1.573***	0.650***	0.500***	0.880***	0.726***
	(0.0391)	(1.498)	(2.158)	(1.608)	(0.200)	(0.171)	(0.867)	(0.0558)	(1.078)	(1.656)
financial conglomerates	-0.293***	-0.373***	-0.520***	0.591	-0.628***	-0.893***	-0.444***	-0.8544***	-0.139***	-0.584***
	(0.0948)	(4.039)	(3.418)	(3.189)	(0.498)	(0.347)	(1.605)	(0.1022)	(2.639)	(4.513)
Limitation on foreign bank	0.199	1.776**	1.337*	0.476***	0.159***	0.194**	1.626***	0.682***	0.569	1.661*
	(0.588)	(0.871)	(0.778)	(0.817)	(0.0525)	(0.0847)	(0.518)	(0.6862)	(0.635)	(0.899)

Entry requirement	0.645***	0.643***	0.826***	0.916***	0.398***	0.428***	0.313***	0.834***	0.684***	0.793***
	(1.517)	(1.327)	(2.493)	(2.502)	(0.138)	(0.113)	(1.011)	(1.6241)	(1.312)	(1.492)
Supervision										
Official supervision power									-0.103	0.115
									(0.105)	(0.147)
Constant	3.434***	4.238***	4.506***	6.743	5.464***	5.509***	3.378***	4.207***	3.655***	4.579***
	(7.611)	(10.73)	(10.61)	(8.786)	(0.824)	(0.870)	(5.143)	(5.8629)	(7.963)	(13.01)
Observations	618	618	618	531	617	617	617	617	618	618
Number of id	84	84	84	80	84	84	84	84	84	84
R										
Sigma_u										
Sigma_e										
Rho										
Wald test	28008.25***	112557.5***	552.32***	586.91***	3.92000000***	3.6800000***	438600.9***	61067.96***	34891.07***	82144.6***
Sargan test(p-value)	0.9994	0.9984	-	-	0.9991	0.9994	0.9993	0.9993	0.9991	0.9988
AR-1 (p-value)	0.0000	0.0003	-	-	0.0005	0.0621	0.0002	0.0514	0.0000	0.0005
AR-2 (p-value)	0.3316	0.2033	-	-	0.1394	0.3179	0.2831	0.2793	0.4039	0.1905
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
Country NO	6	6	6	6	6	6	6	6	6	6

The dependent variables are Capital Adequacy ratios (CAR), Capital buffer of the bank (RBUF), and Bank capital above the minimum levels (CAMR). The researcher estimated all regressions using the one-step and two-step GMM estimators. Standard errors are in parentheses*** p<0.01, ** p<0.05, and * p<0.1, respectively. Sargan test is the test for over-identifying restrictions in GMM. Arellano-Bond test for AR1 and AR2 that averaged auto-covariance in residuals of order 1 and 2, respectively, were 0 (H0: no autocorrelation). The researcher added first lag of CAR t-1 and RBUF t-1 as a proxy of regulation to respond to r a change in economic and policy factors. Official supervisory power is used as a proxy of supervision.

2.4.1. Base Models: Determinants of banks' capital adequacy

Table 2-5 presents the main models of the determinants of capital adequacy. The regressions for all models reveal that, with the exception of model 4, the capital adequacy models, which include size as an explanatory variable, are highly significant. The *capital adequacy* models with *loan loss provisions* show that, with the exception of some market contestability indicators, model 4 is significant, while models 9 and 10 report the insignificant influence of supervisory power on capital adequacy.

The key finding in this study is that GCC countries' banks reaped the benefits of diversification by the positive effect of liquidity and profit on capital adequacy, which enhance the soundness of financial system. Moreover, GCC countries' banks take advantage of higher growth and high government spending due to high oil price, thus, banks anticipate low risks.

Regulations:

Table 2-5 shows that, by means of capital set at a certain time-invariant percentage (points) above minimum requirements across countries, the use of the first lag of dependent variable may assist in adjusting capital adequacy. Indeed, owing to the costs of adjusting the *CAR*, banks may hold high *capital adequacy* in the near future. The models 2, 3, 4, 6, 8, and 10 show the positive and significant influence of regulations on *capital adequacy*. The first lags of dependent variables reflect a change in economic and policy factors. Therefore, banks may anticipate the high cost of change in policy in the near future, and, consequently, maintain strong capital adequacy (Akhter and Daly, 2009).

Bank specific indicators:

The study found that bank-specific indicators had a significant influence on the *CAR*. Table 2-5 shows that the directions of most bank specific indicators are consistent with the diversification strategy. Therefore, through diversification, GCC banks can counteract any unsystematic risks and reap high profits. In Model 1, the positive coefficient of *current ratio* and *ROAA* and the negative coefficient of the *risk-weighted assets* provide strong support for the previous perspective that GCC banks reap the benefits of diversification (Elton and Gruber, 1997).

Size:

The Table 2-5 and the results show that bank *size* has a negative coefficient with the *CAR* and is significant at the level of 10% in Model 1 and 1% in all the models, with the exception of Model 4. The significant negative relationship between *size* and *capital adequacy* means that large banks have lower *capital adequacy* than small banks and face less pressure to increase their *capital adequacy* due to their high asset portfolios and greater diversification. These factors lead to low risks and low capital buffers. This result is consistent with Shrieves and Dahl (1992), Rime (2001), and Akhter and Daly (2009). It is also consistent with the 'too-big-to-fail' theory; this means that governments provide support to large banks during financial distress to enable these banks to maintain low *capital adequacy* (Fonseca and González, 2010).

LLP:

As shown in Model 4, (*LLP*) is statistically significant at a level of 0.05, with a positive sign; this means that an increase in *LLP* leads to an increase in the *CAR*, while there are no large coefficient differences between the one-lag and two-lag models. The results are consistent with Wahlen (1994), Kim and Kross (1998), and Ahmad et al. (2008), and reflect the high risks and poor management of GCC banks. However, the results are inconsistent with Rime (2001) and Fonseca and González (2010). This suggests a negative relationship between *LLP and capital adequacy* in circumstances where banks opt for greater risk with small *capital adequacy* due to *leverage*.

current ratio:

The *current ratio* has a significant positive association with *CAR* in all models where banks need to increase their capital buffer to meet liquidity risk or short term financial demands. This outcome is similar to the view of Ahmad et al. (2008) and Berger and Bouwman (2009). It is also consistent with the perspective of Imbierowicz and Rauch (2014), who considered liquidity as a source of risk. However, this result is inconsistent with Distinguin et al. (2013) who suggest that a negative relationship is established between liquidity and capital buffer as a result of banks paying higher illiquidity and deposit insurance premium, but deposit insurance is not exist in case of GCC banks.

ROAA:

Table 2-5 presents a positive statistically significant association between *CAR* and *ROAA* where, with the exception of Model 4, the significance is at 1% level for all models that include *LLP* as the independent variable. To increase their profits, banks may become more susceptible to risk due to risky investments. In addition, management may hold some profits to enhance the soundness of bank's stability and financial solvency. This result is consistent with Berger (1995) and Rime (2001).

Leverage ratio:

The study found strong and highly significant negative coefficients between *leverage ratio* and *CAR*. The significance is at the level of 0.01 in all the models. According to Rime (2001), high *leverage* reflects a low *capital buffer* due to the weak liquidity of banks. The outcome is consistent with the previous view and with the findings of Ahmad et al. (2008), who considered that banks with weak liquidity had low *capital adequacy* and a high *leverage ratio*. It enabled banks to finance their investments by means of liquidity rather than by issuing new equity that can be expensive. This result shows that banks may reap the benefits of diversification by counteracting the risk of *leverage*.

risk-weighted assets:

It is evident that *risk-weighted assets* have strong and negative coefficient with *CAR*. Thus, high-risk weighted assets bring down the *CAR*. According to Fonseca and González (2010), 'banks that opt to take greater risk with their assets also opt to hold smaller capital buffer'. The result is consistent with Avery and Berger (1991) and Rime (2001) who stated that, an increase in risk leads to a decline in capital adequacy in the case of banks that finance their investments.

Country indicators:

The macroeconomic indicators are found to be significant, especially when bank *size* is included as one of the explanatory variables. Consequently, banks in GCC countries have acquired the benefits of government spending; this is primarily due to the reduction in market risk and anticipated low risk. Contrarily, high government spending in GCC countries has influenced

macroeconomic conditions by improving *GDP*, controlling inflation, and affecting interest rates (Infante and Stein, 1976).

GDP:

Table 2-5 shows that the growth of *GDP* has a robust and negative effect on the significant coefficients in all the models. Upturns in economic conditions, resulting from high oil prices, have increased the flexibility of banks in GCC countries to have capital adequacy. It implies that expectation of good economic conditions may lead banks to maintain low capital adequacy. While this is consistent with the view of Akhter and Daly (2009), Gambacorta and Mistrulli (2004) considered that, during better economic conditions, banks held high capital adequacy as a result of increased lending.

Inflation:

Moreover, *inflation* has a statistically significant and negative relationship with *capital adequacy* in all Models. This relationship depends on the banks' income during a period of high *inflation*, and therefore high inflationary conditions lead to an increase in the expectation of investors to get additional income. Therefore, high *inflation* may force banks to meet investors' expectations instead of maintaining high *capital adequacy* This result is consistent with (Akhter and Daly, 2009). Additionally, the study did not find a significant distinction between coefficients in size models and LLP. This means that *inflation* may have an influence on *capital adequacy* in both small- and large-sized banks.

Real effective exchange rate:

The *real effective exchange rate* has a positive coefficient with *CAR*, with the exception of Model 3; the relationship is significant in all the models under the one-step GMM. The positive sign means that appreciation of the *foreign exchange*[8] *rate* leads banks to earn more and offset any losses in *capital adequacy*. It implies that banks in GCC countries with foreign shares and assets may gain more as result of foreign investments, and thus high profits may lead to an

[8] International currency becomes more valuable (more expensive). GCC currencies are tied to a fixed exchange rate with the US dollar. Therefore, GCC banks with an international diversification strategy are able to reap the benefits of depreciation in the value of the US dollar.

increased *CAR*. However, it is inconsistent with the view that banks that have foreign obligations are not sufficiently hedged (Akhter and Daly, 2009).

interest rate:

The parameter estimates *of interest rate* have negative and significant effects on *capital adequacy* in all the models. An increase in *interest rates* may trigger a decline in lending capacities; this would reduce risk and incentivise banks to maintain low *capital adequacy*. Contrarily, a decline in *interest rates* may increase lending capacities, and banks may maintain tighter *capital adequacy* owing to the high risk in lending (Cecchetti and Li, 2008). Additionally, Table 2-5 indicates an adverse relationship between *M2* and capital in Models 1, 5, 6, 7, 8, and 9. This relationship disappears under the one-step estimator in Models 3 and 4. Table 2-6 may support the perspective that *M2* is associated with size that will result in *M2* to have a significantly negative impact on banks' *CAR*'. This means that banks may maintain low *capital adequacy* as a result of an increase in *money supply*. Thus, an increase in *money supply* may reduce public's incentive to borrow from banks and subsequently cause a decline in banks' lending. Moreover, an increase in *money supply* might prove to be an alternative source of funding for the public and reduce their dependency on banks, and, in turn, this might contribute towards reducing risk and creating a *capital buffer* that is less tight (Thakor, 1996).

Oil prices:

Oil prices have significant negative impacts on *capital adequacy* in Models 1, 5, 7, and 9, which exclude regulations as an explanatory variable. Although other models do not reveal a significant relationship, Models 1, 5, 7, and 9 may assist in understanding this relationship. The price of oil is correlated with government spending. High *oil prices* may increase the money supply and contribute towards boosting the economy; accordingly, banks may anticipate a low level of risk and maintain low *capital*. However, the oil-importing countries might experience a contrary effect. Moreover, the GCC countries rely on oil exports to fund national budgets. Therefore, owing to government spending, an increase in *oil prices* may motivate banks to maintain *capital adequacy* that is less tight (Szegö, 1983).

Market contestability indicators:

Table 2-5 shows that market contestability indicators are highly significant in all models, especially when we include bank size as an explanatory variable. Contrarily, they are less important in Models 4 and 9 in which LLP and supervision are included as explanatory variables.

Activity restrictions:

Activity restrictions have significant positive coefficients with *capital adequacy* in all models. Fonseca and González (2010) found positive coefficients between *activity restrictions* and *capital adequacy*. This result is consistent with our finding that banks in GCC countries have positive coefficients with capital buffers. Therefore, greater restrictions and reduced market discipline on bank activities may lead banks to increase their *capital adequacy*. Furthermore, fewer restrictions may increase diversification and, in turn, banks may maintain *capital adequacy* that is less tight because of low risk (Gonzalez, 2005).

Financial conglomerates:

Table 2-5 shows that, unlike the *activity restrictions*, *financial conglomerates* have a negative impact on *capital adequacy*. The negative sign indicates that an increase in diversification may lead GCC countries' banks to have less *capital adequacy*; this would reduce the risk levels of banks (van Lelyveld and Knot, 2009).

Limitations on foreign banks and entry requirements:

With regards to the *limitations on foreign* banks and *entry requirements* indicators, Table A2-2 in the Appendix shows that the total number of banks increased by 65%, from 58 active banks in 1998 to around 90 banks in 2013. It implies that the GCC countries are less stringent regarding foreign banks and *entry requirements*. Table 2-5 indicates that, with the exception of Models 1 and 9, there is a positive and significant relationship between *limitations on foreign banks* and *CAR* in all models. Moreover, in all models, there is a positive and significant relationship between *entry requirements* and *CAR*. This result reflects the high competition of foreign banks in the GCC countries' banking industries. Strong competition leads to an increase in lending activities and consequently increases risk-taking due to high *LLP* (Unite and Sullivan, 2003). Accordingly, banks may increase their *capital adequacy* because of a high lending risk.

Furthermore, banks may increase their margins to achieve higher profits than their competitors. It shows that banks enhance their *capital adequacy* to counteract marginal risk. Additionally, Models 9 and 10 do not show any evidence of the influence of supervision on the *CAR* of banks in GCC countries.

Table 2-6: Estimation results, capital adequacy determinants.(one & two lag)

	Dynamic model (GMM)				Random effect
	(1)	(2)	(3)	(4)	(5)
VARIABLES	GMM(One-lag)	GMM(One-lag)	GMM(Two-lag)	GMM(Two-lag)	RE(robust)
Independent					
Regulation					
CAR t-1	0.424***	0.416***	0.419***	0.503***	
	(0.0162)	(0.0156)	(0.0196)	(0.0176)	
CAR t-2			-0.0894***	-0.0515***	
			(0.00989)	(0.0100)	
Bank indicators					
Bank size	-1.014*		-1.414***		-1.544***
	(0.590)		(0.604)		(2.190)
Loan loss provision		0.638***		0.617**	
		(0.189)		(0.295)	
Current ratio	0.0666***	0.0696***	0.0765***	0.0870***	0.0790**
	(0.00446)	(0.00502)	(0.00625)	(0.00534)	(0.0381)
ROAA	0.0961***	0.0660***	0.315***	0.405***	0.316*
	(0.0300)	(0.0250)	(0.0417)	(0.0410)	(0.175)
Leverage	-1.842***	-1.011***	-1.544***	-0.673***	-1.834***
	(0.197)	(0.153)	(0.151)	(0.157)	(0.376)
Risk- weight assets	-0.543***	-0.453***	-0.802***	-0.494***	-0.788**
	(0.848)	(0.711)	(1.050)	(0.875)	(3.243)
Country Indicators					
GDP Growth	-0.0696***	-0.130***	-0.0999***	-0.142***	-0.0895*
	(0.0118)	(0.0115)	(0.0141)	(0.0190)	(0.0787)
Price of oil	-0.249***	-0.0984	-0.340	-1.249***	1.777
	(0.372)	(0.322)	(0.528)	(0.456)	(2.395)
Inflation	-0.183***	-0.201***	-0.142***	-0.160***	-0.235***
	(0.0218)	(0.0300)	(0.0201)	(0.0264)	(0.0705)
Real effective exchange rate	0.0312***	0.0523***	0.0323***	0.0552***	0.0889**
	(0.00707)	(0.00394)	(0.00826)	(0.0110)	(0.0360)
Interest rate	-0.0339***	-0.0611***	-0.0115***	-0.0419***	-0.0365**
	(0.00486)	(0.00501)	(0.00430)	(0.00516)	(0.0176)
Money supply	-0.495***	-0.594	-0.843***	-0.816***	0.442
	(0.707)	(0.751)	(0.694)	(0.811)	(3.169)
Market Contestability					
Activities restricted	0.0671*	-0.0720	0.304***	-0.0812	0.185*
	(0.0391)	(0.0608)	(0.0784)	(0.0563)	(0.140)
financial conglomerates	-0.293***	-0.0831	-0.563***	0.0478	-0.302*
	(0.0948)	(0.147)	(0.166)	(0.128)	(0.173)
Limited on foreign bank	0.199	1.326*	1.362**	1.696***	1.589**
	(0.588)	(0.742)	(0.612)	(0.641)	(1.075)
Enter requirement	0.645***	0.976***	0.237***	0.844***	-1.336
	(1.517)	(1.792)	(1.756)	(1.972)	(2.312)
Constant	3.434***	1.282	4.138***	4.501	5.292***
	(7.611)	(8.244)	(9.299)	(5.789)	(10.89)
Observations	618	531	583	504	645
Number of id	84	80	82	79	85
R					0.37
Sigma_u					7.7219297
Sigma_e					4.1858881
Rho					0.77288799
Wald test	28008.25***	8943.03***	121020.66***	1310000***	138.53***
Sargan test(p-value)	0.9994	0.9998	0.9991	0.9987	
AR-1 (p-value)	0.0000	0.0002	0.0000	0.0000	
AR-2 (p-value)	0.3316	0.5534	0.2357	0.0638	
Cluster	Bank	Bank	Bank	Bank	Bank
Country NO	6	6	6	6	6

The dependent variables CAR, the first lag (CAR t-1), and second lag (CAR t-2) capture the dynamic nature of the CAR. The researcher estimates all regressions using the two-step GMM. Standard errors are in parentheses*** p<0.01, ** p<0.05, and * p<0.1, respectively .Sargan test is the test for over-identifying restrictions in GMM. Arellano-Bond test for AR1 and AR2 that averaged auto-covariance in residuals of order 1 and 2, respectively are 0 (H0: no autocorrelation). The researcher tested the robustness of the result by using loan loss provision and RE, instead of bank size,

2.4.2. One- and two-lag models

Following Fonseca and González (2010), the current study used GMM one-period and two-period lags to control endogeneity in regulation. Moreover, the researcher applied Random Effect (RE) estimators to test the robustness of his results, especially to check, as Table 2-6 shows, whether regulation is absent from Model 5.

Table 2-6 demonstrates the response to change in regulation. The outcomes of including one-lag in Models 1 and 2 indicate that, in the near future, banks may incur a high cost in meeting changes in the *capital adequacy* requirements. This explains the positive relationship between regulation and *capital adequacy*. On the contrary, as the two-lag models show, the cost of changes in capital requirements might reduce, thereby resulting in a negative relationship between regulation and capital adequacy, if banks have time to manage the change in regulation (Akhter and Daly, 2009). Three and four lags support the previous perspective.

Moreover, Table 2-6 shows the difference between coefficients when bank *size* is presented as an explanatory variables in Models 1 and 3. The coefficients tend to be higher with a two-period lag when compared to a one-period lag. This provides evidence of the time lag effect on the relationship between dependent and independent variables.

The results in Tables 2-5 and 2-6 suggest that banks in GCC countries are mostly diversified, and they reap the benefits of diversification by reducing risk levels and increasing profits. Moreover, GCC countries' banks obtain the benefits of government expenditure, and hence are capable of offsetting market risk. Furthermore, GCC countries' banks successfully apply a diversified international strategy of increasing profits from international investments by means of depreciation of local currencies and appreciation of foreign currencies.

Table 2-7: Estimation results, Capital adequacy groups' determinants

	(1)		(2)		(3)		(4)		(5)		(6)	
Independent	(GMM) One-lag	(GMM) Two-lag	(GMM) One-lag	(GMM) Two-lag	(GMM) One-lag	(GMM) Two-lag	(GMM) One-lag	(GMM) Two-lag	(GMM) One-lag	(GMM) Two-lag	(GMM) One-lag	(GMM) Two-lag
regulation												
CAR t-1	0.463***	0.481***	0.465***	0.483***	0.539***	0.566***	0.435***	0.471***	0.536***	0.525***	0.539***	0.587***
	(0.00258)	(0.00660)	(0.0121)	(0.0163)	(0.00574)	(0.0114)	(0.00738)	(0.0135)	(0.0118)	(0.0139)	(0.00573)	(0.00380)
CAR t-2		-0.0668***		-0.0657***		-0.0635***		-0.0914***		-0.0535***		-0.0607***
		(0.00259)		(0.00606)		(0.00575)		(0.00772)		(0.00680)		(0.00364)
Bank indicators												
Bank size	-0.923***	-1.079***	-0.229	-0.680***			-1.315***	-2.071***				
	(0.139)	(0.168)	(0.242)	(0.245)			(0.234)	(0.237)				
Current ratio	0.0597***	0.0578***	0.0585***	0.0621***			0.0607***	0.0580***				
	(0.00234)	(0.00150)	(0.00326)	(0.00436)			(0.00338)	(0.00236)				
ROAA	0.0391***	0.195***	0.0970***	0.285***			0.0744***	0.202***				
	(0.0118)	(0.00707)	(0.0248)	(0.0221)			(0.0217)	(0.0251)				
Leverage	-1.814***	-1.705***	-1.527***	-1.311***			-1.827***	-1.698***				
	(0.0397)	(0.0228)	(0.0947)	(0.0996)			(0.0657)	(0.0942)				
Risk- weight assets	-0.647***	-0.498***	-0.091***	-0.881***			-0.809***	-0.487***				
	(0.158)	(0.427)	(0.344)	(0.313)			(0.370)	(0.715)				
Country indicators												
GDP growth			-0.0510***	-0.0961***	-0.0817***	-0.0788***			-0.0731***	-0.0743***		
			(0.00866)	(0.00702)	(0.00615)	(0.00784)			(0.0101)	(0.00813)		
Price of oil			-0.824***	-0.276***	-0.729***	0.232			-0.876***	0.503*		
			(0.276)	(0.265)	(0.134)	(0.166)			(0.165)	(0.266)		
inflation			-0.201***	-0.139***	-0.284***	-0.237***			-0.279***	-0.262***		
			(0.0159)	(0.0101)	(0.00550)	(0.0103)			(0.00981)	(0.0149)		
Real effective exchange rate			0.0215***	0.0265***	0.0364***	0.0459***			0.0334***	0.0448***		
			(0.00517)	(0.00389)	(0.00274)	(0.00340)			(0.00414)	(0.00427)		
Interest rate			-0.0337***	-0.0173***	-0.0480***	-0.0266***			-0.0486***	-0.0337***		
			(0.00319)	(0.00207)	(0.00150)	(0.00242)			(0.00255)	(0.00370)		
Money supply			-1.842***	-1.296***	-1.614***	-1.072***			-2.005***	-0.335		
			(0.624)	(0.763)	(0.292)	(0.344)			(0.510)	(0.626)		
Market Contestability												
Activity restrictions							0.0641***	0.105***	0.00288	0.0324	0.0104	-0.0208
							(0.0187)	(0.0224)	(0.0432)	(0.0697)	(0.0185)	(0.0146)
financial conglomerates							-0.147***	-0.153***	0.122	0.0309	-0.0190	0.0659**
							(0.0502)	(0.0472)	(0.0962)	(0.308)	(0.0446)	(0.0303)
Limitation on foreign bank							1.796***	0.627***	0.173	1.136	0.144***	0.716***
							(0.522)	(0.796)	(0.599)	(2.691)	(0.487)	(0.181)
Entry requirement							1.435**	0.286	0.295***	0.539**	0.435***	0.560***
							(0.716)	(0.800)	(1.547)	(2.936)	(0.459)	(0.614)
Constant	2.203***	2.212***	2.371***	2.527***	1.184***	1.043***	2.257***	2.254***	-3.524	-3.612	-0.777	-4.119*
	(0.662)	(0.727)	(1.303)	(1.352)	(0.238)	(0.373)	(4.189)	(3.812)	(3.194)	(5.160)	(2.452)	(2.163)
Observations	660	622	618	583	764	695	660	622	764	695	877	782
Number of id	84	82	84	82	86	85	84	82	86	85	86	85

Wald test	306931***	244309***	17706.43***	42249***	32946.47***	14693.26***	252751.28***	241372***	60624.36***	32582.35***	6688.74***	188687.38***
Sargan test	0.9981	0.9984	0.9990	0.9993	0.9960	0.9962	0.9988	0.9983	0.9958	0.9976	0.9909	0.9959
AR-1	0.0042	0.0051	0.0000	0.0002	0.0000	0.0000	0.0048	0.0041	0.0000	0.0002	0.0002	0.0009
AR-2	0.6860	0.0793	0.4899	0.2737	0.4265	0.2085	0.7968	0.0429	0.4144	0.2815	0.2639	0.2601
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
Country NO	6	6	6	6	6	6	6	6	6	6	6	6

The dependent variables are Capital Adequacy ratios. First lag (CAR t-1) and second lag (CAR t-2) capture the dynamic nature of the CAR. The researcher estimated all regressions using the two-step GMM. Standard errors are in parentheses*** p<0.01, ** p<0.05, and * p<0.1 respectively .Sargan test is the test for over-identifying restrictions in GMM. Arellano-Bond test for AR1 and AR2 that averaged auto-covariance in residuals of order 1 and 2, respectively, are 0 (H0: no autocorrelation).

2.4.3. Group of indicators

In this section, as shown in Table 2-7, the study re-estimated the model by isolating each group of indicators. The study used three groups bank specific indicator models, country indicator models, and market contestability models to identify the overall impact of groups and individual impact of each group on capital adequacy. The study found that the significance and direction of most coefficients were consistent with the base models in Table 2-5, and thus verified the robustness of initial results. However, there are still some discrepancies. For bank-specific indicators, all the variables in Model 1 exhibit a significant relationship with *CAR*. Moreover, there are no significant differences in coefficients between one-lag and two-lag models, and therefore the impact of time is limited within the group of bank specific variables.

In Model 2, the study isolated the market contestability variables and examined the effect of both country indicators and bank-specific indicators on *capital adequacy*. The results found a statistically significant relationship between the indicators of both the groups and *capital adequacy ratios* in one-lag and two-lag. However, size in lag-one failed to explain its influence on *CAR*. This might reduce the significance of bank *size* in influencing GCC countries' banks' *capital adequacy*.

In Model 3, the study excluded bank indicators and market contestability indicators. The finding showed a statistically significant relationship between country indicators and *capital adequacy* in both one-lag and two-lag. These results are consistent with the primary findings in Table 2-5.

Moreover, Model 4 displays the impact of both bank indicators and market contestability indicators on *capital adequacy*. The current study found that, when country indicators were absent, both groups together had a statistically significant influence on *CAR*. This might reflect the role of well-diversified banks in GCC countries in reducing the riskiness of either financial activities or non-financial activities.

Contrary to Model 4, the study isolated the bank indicators in Model 5. The results showed that a change in model specification makes *CAR* sensitive to the impact of market. However, country indicators play a significant role in interpreting *capital adequacy*. In addition, market contestability's impact on *CAR* became clear to a certain extent in Model 6.

Table 2- 8: Estimation results, pre- and post-financial crisis periods

	Pre- crisis (1998-2006)		(GMM)		Post-crisis (2007-2013)		(GMM)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	One-lag	One-lag	Two-lag	Two-lag	One-lag	One-lag	Two-lag	Two-lag
Independent								
Regulation								
CAR t-1	0.635***	0.638***	0.526***	0.554***	0.277***	0.288***	0.297***	0.217***
	(0.0888)	(0.164)	(0.0854)	(0.1.3)	(0.00692)	(0.0101)	(0.0189)	(0.0154)
CAR t-2			-0.195***	-0.380*			-0.104***	-0.0223**
			(0.0440)	(0.204)			(0.00802)	(0.00901)
Bank indicators								
Bank size	0.743		-1.445		-0.601***		-0.736***	
	(5.631)		(6.021)		(0.9000)		(1.195)	
Loan loss provision		-2.866		-1.550		1.054***		0.895***
		(4.455)		(4.180)		(0.223)		(0.270)
Current ratio	0.135***	0.0314	0.114***	0.0481	0.00552	-0.0119	0.0124***	-0.0135*
	(0.0473)	(0.0944)	(0.0419)	(0.0812)	(0.00480)	(0.00881)	(0.00482)	(0.00808)
ROAA	0.970***	1.219***	1.189***	1.111***	-0.0151	-0.0366	0.271***	-0.278
	(0.147)	(0.417)	(0.0886)	(0.450)	(0.0194)	(0.0311)	(0.0424)	(0.0578)
Leverage	-0.616	-2.373	0.143	-1.350	-2.424***	-2.332***	-2.036***	-1.939***
	(0.545)	(1.548)	(0.855)	(1.083)	(0.0682)	(0.285)	(0.137)	(0.138)
Deposit	-2.422	-2.423	0.159	-1.967	-2.203***	-2.943	-1.608***	-2.599***
	(0.880)	(0.294)	(0.326)	(0.508)	(0.514)	(0.995)	(0.977)	(0.677)
Risk- weight assets	-0.387	-0.353*	-0.454***	-0.471**	-0.324***	-0.395***	-0.143***	-0.333***
	(0.742)	(0.187)	(0.462)	(0.462)	(0.517)	(1.021)	(0.641)	(0.052)
Country indicators								
GDP growth	0.146	-0.366*	0.198*	-0.0959	-0.0760***	-0.0716***	-0.0967***	-0.0947***
	(0.100)	(0.211)	(0.119)	(0.193)	(0.00842)	(0.00796)	(0.00721)	(0.00866)
Price of oil	-0.509	-0.901	-0.272	-0.337	-0.439***	-1.702***	-1.703**	1.005
	(3.608)	(7.144)	(3.846)	(6.619)	(0.395)	(0.628)	(0.745)	(0.714)
Inflation	0.136	-0.303	0.252	-0.0498	-0.267***	-0.259***	-0.193***	-0.279***
	(0.316)	(0.447)	(0.198)	(0.479)	(0.0159)	(0.0238)	(0.0247)	(0.0240)
Real effective exchange rate	-0.0121	-0.00778	-0.0153	0.0120	0.0340***	0.0539***	0.0662***	0.0671***
	(0.0204)	(0.0354)	(0.0284)	(0.0356)	(0.00495)	(0.0141)	(0.0143)	(0.0156)
Interest rate	0.0114	-0.0513	0.0364	0.0146	-0.0634***	-0.0652***	-0.0470***	-0.0585***
	(0.0399)	(0.0657)	(0.0376)	(0.0627)	(0.00351)	(0.00668)	(0.00567)	(0.00619)
Money supply	0.338	0.569	0.910	0.437	0.214	-1.407	-0.454***	-1.316
	(4.179)	(8.817)	(3.601)	(9.030)	(0.477)	(1.109)	(0.688)	(0.865)
Market Contestability								
Activity restrictions	0.843	-0.0686	-0.0912	-0.0204	1.054**	0.121	0.463***	0.00911
	(0.730)	(0.468)	(0.748)	(0.419)	(0.512)	(0.0997)	(0.154)	(0.0985)
financial conglomerates	-0.783	0.611	0.0904	0.618*	-2.075*	-0.241	0.724*	0.0447
	(1.183)	(0.379)	(1.232)	(0.375)	(1.215)	(0.209)	(0.392)	(0.207)
Limitation on foreign bank	0.797	0.896**	1.850	0.444	0.454	1.169	0.831**	0.819**
	(2.629)	(3.959)	(3.678)	(4.294)	(4.478)	(1.127)	(1.956)	(1.236)
Entry requirement	0.968**	0.862**	0.551	0.177	0.284**	0.617***	0.186**	0.770***
	(9.894)	(8.954)	(18.89)	(12.16)	(10.06)	(2.409)	(4.820)	(2.270)
Constant	0.631**	0.642*	0.254**	0.244	0.101***	0.452***	0.554***	0.242***
	(0.631)	(0.271)	(0.718)	(0.286)	(0.331)	(0.692)	(0.130)	(0.791)
Observations	179	132	163	121	429	352	373	341
Number of id	59	50	49	43	82	72	75	71
Wald test	19892.41***	8298.59***	39290.09***	7545.09***	64583.41***	67061***	74046.56***	79247.65***
Sargan test	0.9934	0.9987	0.9681	0.9988	0.6104	0.8648	0.7576	0.9436
AR-1	0.0563	0.0062	0.0220	0.0270	0.0035	0.0004	0.00012	0.0015
AR-2	0.9805	0.7806	0.4794	0.4548	0.1996	0.8555	0.0718	0.1683
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
Country NO	6	6	6	6	6	6	6	6

The dependent variables are Capital Adequacy ratios, the first lag (CAR t-1) and Second lag(CAR t-2) to capture the dynamic nature of Capital Adequacy ratio. The researcher estimates all regressions using two-step GMM. Standard errors are in parentheses*** p<0.01, ** p<0.05, * p<0.1 respectively .Sargan test: the test for over-identifying restrictions in GMM. AR-1 and AR-2: an Arellano-Bond tests that average auto-covariance in residuals of order 1 and 2, respectively are 0(H0: no autocorrelation).

2.4.4. Pre- and post-financial crisis periods

In Table 2-8, the study re-estimated the initial model of researcher by using separate data for the pre- and post-financial crisis periods. The results on the post-crisis period are consistent with the researcher's initial Model, as shown in Table 2-5; these results verify the robustness of the initial model's results. However, the current study added the deposit ratio to the financial crisis models to examine the hypothesis that the deposit ratio had a statistically significant negative impact on GCC countries' banks' capital adequacy after the financial crisis.

The pre-crisis Models 1, 2, 3, and 4 show that, with the exception of current ratio and *ROAA*, most indicators did not have significant statistical effects on *CAR*. Therefore, GCC countries' banks relied on profits and liquidity to determine their capital adequacy during the pre-crisis period, without taking into account the sources of risk.

The results of all the pre-crisis models show a statistically significant positive relationship between *ROAA* and *CAR*. Furthermore, in Models 1 and 3, the findings show a significant positive association between current ratio and *CAR*. This result implies that, based on liquidity, GCC countries' banks may be able to finance capital adequacy. However, during the pre-crisis period, there was an insignificant relationship between deposit ratio and *CAR*.

Contrarily, Models 5, 6, 7, and 8 show that current ratio and *ROAA* had a weak influence on *CAR* during the post-crisis period. The results indicate that most bank indicators, country indicators, and market contestability indicators have a statistically significant impact on the *CAR*, particularly on the deposit ratio. This provides substantial evidence on the effect of riskiness during financial crisis and the corresponding behaviour of *CAR*.

Concerning the post-crisis period models, the study also found that the *deposit ratio* had a significant negative effect on the *CAR*. This means that high deposits might lead GCC countries' banks to maintain low capital adequacy by reducing their lending risk and risky financial sources, such as loans and bonds (Yeyati and Micco, 2007).

The influence of *oil price* is stronger in the post-crisis period Models 5, 6, and 7 when compared to the pre-crisis models. It may be due to the continual increase in the price of oil, which experienced some fluctuations, in the post-financial crisis period. This provides support for the

opinion that increasing government spending enhances the financial soundness of GCC countries' banks. It is better to be aware that the non-oil sectors in GCC countries thrive on government spending. It implies that high government spending may enhance the performance of non-oil sectors, whereas low government spending may increase the risk of default.

Table 2-9: Results Summary

Explanatory Variables	Significant	Effect direction	Explanation
Bank regulation			
CAR_{t-1}	√	Positive	The bank may predict high capital adequacy, which explains the positive relationship between capital adequacy ratio and first lag of capital adequacy.
Bank indicators			
Bank size	√	Negative	High asset portfolio and greater diversification lead to low risk and low capital buffer in large banks.
Loan loss provision	√	Positive	It reflects high risk and poor management in GCC countries' banks. Thus, banks maintain strong capital adequacy.
Current ratio	√	Positive	Banks need to increase capital buffer to meet liquidity risk or short term financial demands.
ROAA	√	Positive	By increasing profits, banks become more susceptible to riskier investments. Therefore, banks may have high capital adequacy.
Leverage	√	Negative	High leverage reflects low capital buffer due to poor liquidity of banks.
Risk-weighted assets	√	Negative	Fonseca and González (2010) suggest that 'banks that opt to take greater risk with their assets also opt to hold smaller capital buffer'.
Country Indicators			
GDP Growth	√	Negative	The anticipated upturn in economic conditions leads banks to maintain low capital adequacy.
Price of oil	×	Negative	High oil price may increase money supply and boost the economy; in view of this, banks may anticipate low risk and maintain low capital; however, these circumstances do not exist in GCC countries' banks.
Inflation	√	Negative	A high inflationary condition increases the expectations of investors to earn more, which leads them to increase the cost of capital. Therefore, high inflation may force banks to have low capital adequacy.
Real effective exchange rate	√	Positive	Large banks with foreign shares and assets may gain more as a result of appreciation in the exchange rate of foreign investments; thus, high profits result in high liquidity that lead to an increase in CAR.
Interest rate	√	Negative	Banks with large obligations are likely to suffer due to high-interest rate. The earnings of such banks may reduce because of servicing debts, thereby leading to a decline in capital adequacy.
Money supply	×	Negative	With high money supply, banks' lending may reduce; this would lead to reduced risk and create a less tight capital buffer; however, these circumstances do not exist in GCC countries'

			banks.
Market contestability indicators			
Activity restrictions	√	Positive	Greater restrictions on bank activities with low market discipline may lead banks to raise capital adequacy.
Financial conglomerates	√	Negative	Greater diversification is enabling GCC countries' banks to maintain less capital adequacy; this reduces risk levels.
Limitation on foreign banks	×	Positive	There is high competition among foreign banks in GCC countries' financial sectors; it leads to increased lending activities, thereby increasing risk due to high loan loss provision.
Entry requirements	√	Positive	Banks may maintain strong capital adequacy with an aim of obtaining high credit risk and increasing the costs and margins of financing domestic banks.
Supervision			
Official supervision power	×	Positive/Negative	An increase in official supervisory power may improve market power; this would lead to a decline in the risk levels; however, these circumstances do not exist in GCC countries' banks.
Financial crisis effect			
Deposit ratio	√	Negative	With high deposits, banks may maintain low capital adequacy to reduce lending risk it reflects the amount of capital that returned to the banks in GCC countries post the global financial crisis.

These results are based on Table 5.

2.5. Conclusion

This study analysed the determinants of capital adequacy ratio in banks by using a panel data for 89 banks in 6 GCC countries for the period between 1998 and 2013. The study applied the one-step and two-step GMM estimator to control unobservable heterogeneity and used the RE estimator to make the results robust.

Table 2-9 summarizes the findings. The results suggest that market contestability and loans are considered the primary sources of risk in GCC countries' banks. This reflects banks' poor risk management. However, GCC countries' banks reap the benefits of diversification well diversified. One of the key findings is the positive effect of profits that appear to assist the banks in offsetting any losses in their CAR. Moreover, the findings of the study prove that an increase in government spending contributes towards reducing the risk of country indicators, such as GDP, inflation, and interest rate. Thus, GCC countries' banks may anticipate low risk and counteract the risk of macroeconomic variables by maintaining less tight capital adequacy. This explains the negative direction of most country variables examined in the context of the banks in GCC countries. Another key finding is that, when the researcher excluded country indicators from the model, a strong impact of market contestability indicators and bank specific indicators was observed on capital adequacy. However, especially when there is a change in model specification, capital adequacy is very sensitive to the impact of market contestability. This may explain the weakness in the relationship between market contestability indicators and capital adequacy in the absence of bank variables.

Furthermore, splitting the sample into the pre- and post-crisis periods showed that ROAA and the current ratio made a significant impact on the interpretation of capital adequacy. Contrarily, the pre-crisis period models show a marginal impact of risk-weighted assets on capital adequacy. However, the post-crisis period models show a marginal influence of current ratio and ROAA had on capital adequacy. The study found that market contestability explained its influence on CAR in a robust manner.

As mentioned earlier, GCC countries have oil-based economies, and government spending in these countries particularly focuses on the oil sector. Therefore, by enhancing the performance of non-oil sectors during the global financial crisis, high oil prices and government spending proved

to be advantageous for GCC countries' banks. Although they were strongly associated with western banks, GCC countries' banks did not suffer during the global financial crisis.

Appendix

Figure 1-1: A comparison of capital Adequacy in GCC countries with other regions across the globe

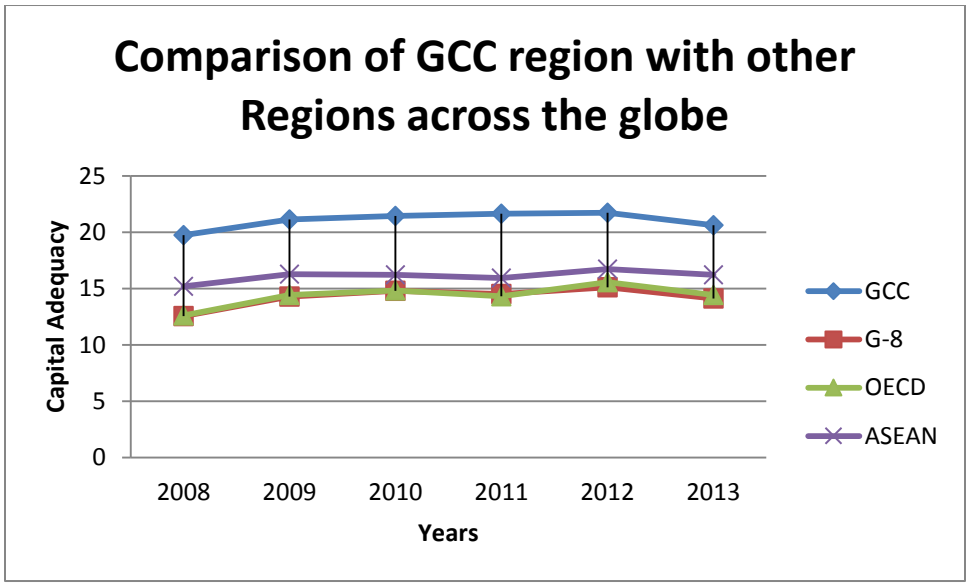


Table A2-1: Fisher-type unit-root test

VARIABLES	Inverse chi-squared**	Inverse normal**	Inverse log it**	Modified inv. chi-squared**
Dependent				
CAR	987.0464***	-21.2749***	-29.3551***	44.6826***
Independent				
Bank indicators				
Bank size	951.2461***	-18.0268***	-26.7438***	41.3208***
Loan loss provision	332.7843***	-3.1613***	-5.9567***	9.8324***
Current ratio	480.9273***	-7.0664***	-11.3057***	17.2839***
ROAA	451.1932***	-8.1487***	-10.7677***	14.6678***
Leverage ratio	398.8501***	-6.2575***	-8.6803***	12.0532***
Deposit	534.6533***	-9.5007***	-13.8164***	20.2325***
Risk weight assets to assets	421.5781***	-5.5707***	-8.5882***	12.9096***
Country indicators				
GDP Growth	431.1824***	-11.1408***	-11.3391***	13.4186***
Price of oil	1113.0625***	-26.0936***	-32.3064***	49.9456***
Inflation	386.4688***	-4.9823***	-8.5527***	11.0488***
Real exchange	456.8232***	-10.4286***	-11.8406***	14.7776***
Interest rate	1084.795***	-19.9913***	-30.354***	48.06***
Money supply	719.7096***	-12.3233***	-19.5779***	28.7106***
Market contestability (dummies)*				
Activity restriction	457.1458***	-13.3189***	-13.1708***	15.5727***
Financial conglomerates	439.8006***	-13.017***	-12.6902***	14.632***
Limitation on foreign banks	443.4563***	-12.045***	-12.001***	13.8769***
Entry requirements	404.8675***	-13.6574***	-13.0017***	14.8674***

Ho: All panels contain unit roots

Ha: At least one panel is stationary

*Cross-sectional means removed for dummies

P-value *** p<0.01, ** p<0.05, * p<0.1

** All four of the tests strongly reject the null hypothesis

Table A2-2: Numbers of banks in GCC

	Pre-crisis		Post-crisis		
Country	**1998**	**2002**	**2007**	**2010**	**2013**
Sultanate of Oman	6	8	8	8	8
Kingdom of Bahrain	9	9	22	23	23
State of Kuwait	8	8	10	10	11
United Arab Emirates	19	19	21	24	24
State of Qatar	6	7	9	11	11
Kingdom of Saudi Arabia	10	10	11	12	12
Total	58	61	81	88	89

Number of banks in GCC. Every four years.

Chapter Three

Do financial regulations enhance or impede Semi-Oriented Radial Measure operational efficiency banks? Evidence across countries and economic blocs

Abstract

This article applies the Semi-Oriented Radial Measure (SORM) by using a DEA (Data Envelopment Analysis) to measure bank operational efficiency based on bank-level data. This is coupled with a rich dataset that builds on four recent worldwide surveys on bank regulation. We contribute to this study by investigating whether financial regulations enhance or impede SORM operational efficiency in banks across regional economic blocs, income groups, and other national entities. This study relies on an unbalanced panel analysis of 7,853 banks in 102 countries collected over the period 2000–2014. We find that a few fuel-exporting countries with reasonable governance practices have reaped the benefits of high oil prices and hold high-efficiency scores. We also find that the capital requirement stringency, coupled with good governance practices, tends to enhance bank efficiency. Contrarily, less stringent capital requirement impedes bank efficiency in less-developed countries. In addition, it is positive and marginally significantly related to bank efficiency in fuel-exporting countries. Moreover, the results show that the strengthening of supervisory power is negatively significant in explaining bank efficiency in countries having disconnected supervisory authorities. Contrarily, supervisory independence, coupled with highly experienced authority, tends to enhance bank efficiency in more developed countries. Finally, our results demonstrate that although governance indicators enhance bank efficiency, the inclusion of the financial crisis period reveals the weakness of governance practices during the period.

Keywords:

Semi-Oriented Radial Measure; operational efficiency; financial regulations; economic blocs; financial crisis; capital requirements; governance; supervisory power; and tenure supervisors

3.1. Introduction:

A well-functioning financial system plays a vital role in promoting sustainable economic growth and supporting financial deepening. This occurs when financial institutions operate in a financial system that is effective, resilient, and fair. Moreover, trust and confidence in a system is enhanced when all the participants of the financial system fulfil their roles. Financial regulations are the cornerstones and key elements of a well-functioning financial system. Therefore, financial authorities should concentrate primarily on the efficiency, quality, resilience, and fairness of the financial regulations system rather than on the size of the system.

The worldwide financial crisis tested financial environmental regulations in the global financial system but the financial regulations largely failed, particularly in the largest financial systems. Therefore, after the onset of the financial crisis, the financial regulators in the USA and across the globe pushed through the much-needed reforms. However, these reforms raised some fundamental questions like the following: whether these reforms are appropriate, especially at a global level; whether the reforms considered the variations between different regions; and whether the government must take on the roles of a supervisor and regulator in the financial system. Despite extensive studies like Berger and Humphrey (1997) and Berger and Di Patti (2006), which focused on the degree of bank efficiency, few studies attempted to shed light on bank efficiency and regulations (Barth et al., 2013b). However, the study conducted by Barth et al. did not consider the important differences across regions and income groups and the onset and aftermath of the financial crisis. In addition, it did not consider some key elements in financial regulations. For example, the strong international competition among economic blocs contributed to national regulators and supervisors being reluctant to take unilateral action for improve bank efficiency.

Hence, the purpose of this study is to contribute to the investigation of whether the financial regulations and reforms to financial systems can work better to enhance bank efficiency. We concentrate specifically on a comprehensive study to determine whether capital adequacy requirement, market contestability, supervision, transparency, governance, and diversification enhance or impede bank efficiency. Furthermore, this study takes into consideration the variations across regional economic blocs and income groups, and the behaviour of financial regulators and regulations associated with a global financial crisis. We achieved this purpose by

using rich datasets and unique measurement tools like the Semi-Oriented Radial Measure (SORM), which are appropriate to our bank efficiency data.

Nonetheless, the theoretical predictions about the influence of financial regulations on banks are unclear. Therefore, before conducting the quantitative analyses of financial regulations and bank efficiency, we identified the theoretical perspective to understand the influence of financial regulations on bank efficiency. In this regard, Barth et al. (2005) and Barth et al. (2013b) provide two general views. The public interest view shows that 'governments act in the interests of the public and regulate banks to enhance bank efficiency and ameliorate market failures'. Contrarily, the private interest view indicates that regulations impede bank efficiency when governments use it to promote the private benefits of the few and not for the public's general interests. Thus, we examine this opposing view and other regulation theories that relate to capital adequacy requirement as per example[9]. This analysis may provide valuable information to regulatory decisions makers.

The rest of the paper is structured as follows. Section 2 presents the relevant literature about bank efficiency and financial regulation. Section 3 describes the variables and methodology coupled with an explanation of our datasets. Section 4 discusses the results and Section 5 concludes our empirical paper.

3.2. The relevant literature

In this section, we discuss the relevant theoretical and empirical literature about the influence of capital regulations, market contestability, supervision, and transparency on bank efficiency; additionally, we consider the variations in economic blocs and outcomes of financial crises.

3.2.1. Bank efficiency

Background on bank efficiency

Existing studies have provided evidence of the significant importance of bank efficiency by concentrating mainly on the regional variations in bank efficiency emerging due to disparities between different types of banks and their approaches.(Chiu et al., 2008).

[9] This empirical study is based on various theoretical models, such as capital adequacy, market contestability, and governance; please see Section 2 for the theoretical discussion.

Using a scale and scope efficiency approach, Mester (1987) estimated an average practice cost function by describing the relationship between average costs, outputs, and input prices. Thus, the indicator cost relies on quantities of output variables, the price of input variables, error term, any fixed output or input, and environmental factors. Clark (1988) went further by applying an average incremental cost[10] or marginal cost as an estimator of efficiency. Hence, banks can determine proper efficiency levels by reaping the benefits of additional production at low incremental costs.

By utilizing a non-parametric programming frontier approach, Aly et al. (1990) provided an empirical investigation of scale, technical, and allocative efficiencies in 322 independent American banks. This approach was based on the assumption of banks using two inputs to produce one output. Consequently, the results showed that the level of overall efficiency was low due to the inefficient nature of technology rather than allocative efficiency. Furthermore, Grabowski et al. (1993) explored this concept by using non-parametric programming with five outputs and three inputs to compare the efficiency of branch banking organizations and bank holding companies. The findings indicated that of branch banking organizations were more efficient than bank holding companies. Equally importantly, Favero and Papi (1995) developed econometric measures of scale and technical efficiencies by utilizing non-parametric Data Envelopment Analysis (DEA) in 174 Italian banks. The results provide strong evidence that concentrating on non-traditional activities leads to productive specialisation that enhances bank efficiency.

In a similar manner, Schaffnit et al. (1997) introduced the DEA model with output multiplier constraints to examine the influence of external indicators on personal efficiency in 5 large Canadian banks' 8000 branches. They concluded that efficient branches delivered high-quality services by dint of high profits. Moreover, by investigating the level of efficiency within publicly-owned, foreign-owned, and privately-owned banks during the period of liberalisation in India, Bhattacharyya et al. (1997) found that bank ownership had a significant impact on bank efficiency. The results suggested that, owing to the extent of their small branches in metropolitan areas, foreign-owned banks were more efficient. Contrarily, privately owned banks were less efficient and publicly owned moderately efficient. Additionally, for the same reasons, Fukuyama

[10] 'Encompassing change in banks' balance sheets due to additional unit of goods or services'.

et al. (1999) examined the effect of ownership on efficiency in Japanese credit cooperatives. The findings showed that, when compared to Japanese-cooperatives, foreign-owned credit cooperatives were more efficient as foreign managerial policies required these cooperatives to focus on reallocating inputs and creating more outputs at the same or lower costs.

Resti (1998) highlighted that, banks that operate in the same local market and are not too large may deliver better performance when they come together in a merger after a merger, banks seem to be more efficient, especially if both banks were operating in the same local market and both banks were not too big. Thus, cost savings can arise through the closure of overlapping branches. However, Garden and Ralston (1999) opposed Resti's view and suggested that a merger might reduce a bank's efficiency because integration of data might increase costs and differences in cultures of the merged banks might cause a conflict among employees, especially among employees who lost their positions.

Additionally, several studies, such as those by Ferrier and Lovell (1990) and Bhattacharyya et al. (1997), compared econometric and non-econometric techniques with an aim of revealing their advantages and disadvantages. They indicated that both techniques had strengths and weaknesses, but non-econometric techniques were more flexible. Berger and Humphrey (1997) provided substantial evidence concerning the use of different efficiency methods, although a different efficiency technique did not necessarily provide consistent outcomes.

Similarly, some researchers have predominantly focused on a new approach to efficiency by investigating the relationship between risk and bank efficiency; studies conducted by Cebenoyan et al. (1993) and Barr et al. (1994) can be considered as examples of the new approach.

3.2.2. Bank efficiency and risk

Indeed, traditional bank efficiency views have failed to take into account risk as an essential ingredient in bank efficiency. Risk factors are ignored since it is assumed that banks are risk neutral. Such assumptions result in bank efficiency models may be ineffective and yield incorrect empirical results (Sun and Chang, 2011).

Therefore, some researchers attempted to adopt risk factors to create 'risk-adjusted efficiency models'. For instance, Cebenoyan et al. (1993) pointed out that risk had a positive and significant relationship with banks' inefficiency scores. This means that risky loans may impede banks'

efficiency, and hence banks may lose their flexibility of being more lenient during crisis and become more prone to insolvency. Barr et al. (1994) developed a Failure Prediction Model based on the five CAMEL risk factors, by utilizing DEA. The CAMEL rating system assists in re-evaluating a bank's soundness and relies on the following five risk factors: capital adequacy, asset quality, management quality, earnings ability, and liquidity position.

Berger and DeYoung (1997) examined the influence of risk indicators on banks' efficiency by incorporating risk effects, including risky assets, non-performing loans, and allowance for loan losses. They applied a two-stage approach with the findings showing that risk factors correlated strongly with efficiency levels. In a similar manner, Chang (1999) used the three risk factors with a non-parametric approach to measure the level of technical efficiency in Taiwan. The results provide strong evidence that incorporating risk influences the level of efficiency performance. In fact, existing studies concentrate on incorporating risk factors or 'credit risk', for example, a study on Japanese banking by Altunbas et al. (2000), study on the European banking industry by Iannotta et al. (2007), and study on the Greek commercial banks by Pasiouras (2008). However, Sun and Chang (2011) extended their model to include credit risk, operational risk, and market risk during crisis. The results show that risk measures influence both the variability and level of bank efficiency across countries and over the financial crisis.

3.2.3. Bank efficiency and financial crisis

The financial crisis became a global phenomenon that revealed the substantial vulnerabilities in the banking industry, in terms of either poor management or weak control of risks. Many existing studies have mentioned the effects of this phenomenon on bank efficiency. For instance, Sufian (2010) investigated the impact of the 1997 Asian financial crisis on bank efficiency. He indicated that a financial crisis negatively influenced the level of bank technical efficiency across Asian countries, especially in the year following the crisis. Sun and Chang (2011) provided further explanation on the impact of global financial crisis on bank efficiency in Asian countries. The results indicated that, during the crisis, risk-averse banks, which funded their loans based on deposits rather than capital, might be less efficient when compared to risk-neutral banks. Furthermore, risk-averse banks provide their output in 'an allocatively inefficient manner' to manage 'the differences in risk performances'. By the same token, Luo et al. (2011) discussed the influence of a financial crisis on one of largest economies in Asia and the world—the

Chinese banking industry by examining the effects of the global credit crunch on the efficiency of the share prices in Chinese banks. The outcomes revealed sluggishness in the Chinese capital market and deterioration of foreign demand for goods; these factors led to a drop in interest rates and a decline in the net income of Chinese banks.

However, the effects of a global credit crisis impose a greater pressure on developed financial markets. Fahlenbrach et al. (2012) supported the previous perspective pertaining to the influence of a financial crisis on developed economies by re-evaluating the performance of American banks during a financial crisis. They found that high leveraged and concentrated mortgage lending and weak governances reduced the efficiency of American banks during a financial crisis.

The recent focus of most researchers has been the euro debt crisis and its effects on banks and the world economy. Although the shortage of liquidity is considered a cause of weak efficiency in some banks in the Eurozone, credit risk is the primary cause of weakness in bank efficiency during a debt crisis. Battistini et al. (2014) provided a critical opinion about the Eurozone sovereign debt crisis and bank efficiency. They highlighted that an increase in credit default swap and a surging home bias in banks' sovereign debt during the Eurozone crisis influenced the banks. Therefore, banks raised their risks in response to increased country risks, and this negatively influenced the bank efficiency. At the same time, owing to an increased systemic risk, banks' sovereign debt portfolios tended to be home biased. This created a highly fragmented Eurozone sovereign debt market and had a negative influence on bank efficiency.

It must be noted that some studies focused on bank efficiency during crises and others concentrated on efficiency across countries and economic blocs.

3.2.4. Bank efficiency across countries and economic blocs

The relationship between bank efficiency and regional scope or economic blocs creates an incentive for many researchers. Berger and DeYoung (2001) emphasized that geographic scope might enhance bank efficiency by spreading their risks, developing managerial skills, being accessible to affiliates; exploiting the benefits of network economies; and reaping the advantage of diversification. Similarly, Valverde et al. (2007) showed that Europe's single market is representative of the influences of economic blocs on bank efficiency, by pointing out that a

single market might create cross-border competition and facilitate cross-border acquisitions and as a result expand a bank's market share and operational scale, respectively. These advantages may reinforce efficiency in banks that move to operate a regional scope strategy.

Furthermore, researchers have provided extensive evidence that bank efficiency is geographically dependent. Akhigbe and McNulty (2003) indicated that banks operating in the metropolitan areas were less efficient than non-metropolitan banks. It implies that banks operating across states might to be more efficient. In a similar manner, Tirtiroglu et al. (2011) re-evaluated the efficiency level of the American commercial banks and found that these banks were geographically dependent among other banks in the states. Additionally, Tabak et al. (2013) stated that geographical distance played a significant role in analysing bank efficiency. It implies that banks that operate across the country are more efficient than local banks.

Despite the fact that a majority of existing studies concentrated on developed economies, some researchers are interested in measuring efficiency across developing and less developing economies. Literature shows that there is little doubt that low-income countries have less efficient banks. For instance, Asongu (2010) studied 29 low and middle-income African countries and emphasized that banks in low-income countries experienced poor performance due to low deposits, and it consequently reduced government spending and foreign investments. Contrarily, owing to economic openness, middle-income countries had greater levels of efficiency, which encouraged more deposits. Moreover, Spulbăr and Niţoi (2014) measured the degree of efficiency across Latin America, South-East Asia, and Central and Eastern Europe. The results indicated that the variations in economic regulations among economic blocs might have an influence on the level of bank efficiency.

I. Maghyereh and Awartani (2014) determined the bank efficiency in wealthy developing countries by measuring efficiency in the GCC countries. The findings revealed an association between the variations in bank regulation and level of efficiency among the GCC countries. Moreover, Barth et al. (2013b) highlighted an interesting conclusion; they revealed that changes in bank regulations might play an essential role in improving bank efficiency levels. Therefore, measuring bank efficiency, based on economic blocs, may control this variance across countries and enhance the homogenisation of the sample.

3.2.5. Financial regulation and bank efficiency

the heavily regulated environment in which banks operate and banking regulations, which is an essential determinant of banking efficiency, are the two factors that can be accounted for attracting researchers towards examining the influence of financial regulations on banking efficiency (Pasiouras et al., 2009). For example, Sun and Chang (2011) investigated the impact of regulations on banking efficiency in the emerging Asian markets. They pointed out that regulations may influence managers, and tight regulations may result in weak management decisions and hinder banking efficiency. Similarly, Chortareas et al. (2012), Berger and Bouwman (2013), Tan and Floros (2013), Lee and Hsieh (2013), and Lee and Chih (2013) provide strong evidence that, besides capital adequacy requirement, bank regulation, governance, monitoring, and supervision exert a heavy impact on banking efficiency through the elements of financial regulation that are imposed on owners and managers who may take less risky investment decisions, and thus lead banks to earn less profits (Gale, 2010).

Theoretically, the influence of financial regulations on banking efficiency is unclear. However, Barth et al. (2013b) provided two general conflicting views for amplifying this perspective. The first 'public interest view holds that the government acts in the interest of the public and regulates banks to promote efficient banking and ameliorate market failures'. The 'private interest view holds that regulation is often used to promote the special interests of the few, not public, thus impeding banking efficiency'.

This theoretical framework is based on various models that have investigated the role of government in regulating the banking industry. Therefore, under public view, a government concentrates on maximizing social welfare, reducing costs of information, and having well-defined public rights. Contrarily, under a more secretive view, regulation may enhance the well-being and power of bankers and well-connected politicians. Thus, a small group of people may reap the benefits of regulations (Barth et al., 2005).

Relationship between capital regulation and bank efficiency

Capital requirement

Financial jurisdictions across countries seek to apply tougher capital requirement as a result of its role in providing a buffer against bank losses and as a tool that enhances the soundness of the financial system (Lee and Chih, 2013). This capital requirement function provides incentives for

researchers to study this relationship between capital regulation and bank efficiency. For instance, Berger and Di Patti (2006) produced interesting results by emphasizing that lower capital requirement is associated with higher bank efficiency and Chortareas et al. (2011) found contradictory results that high capital requirement levels may reinforce bank efficiency.

As mentioned already, there are two opposing perspectives about the effects of capital requirements on bank efficiency. Pasiouras et al. (2009) stated that the determinants of the relationship between capital requirement and bank efficiency were based on lending quality and quantity, portfolio decisions, asset allocation, and funding channels of banks. These elements might be associated with moral hazards, poor management, mishap, and skimping, and hence might contribute towards identifying the relationship between capital requirement and bank efficiency. In the same context, Pessarossi and Weill (2014) provided a comprehensive discussion on this conflict based on agency costs hypotheses. On the one hand, the conflict of interest between managers and shareholders may waste banks' resources, instead of enhancing their efficiency due to their moral hazard behaviours. To meet shareholders' needs, managers might finance a bank's operations via greater debt. However, to avoid bankruptcy, managers have to maintain higher capital adequacy. Consequently, greater capital adequacy might cause a decline in free cash flow and have a negative effect on bank efficiency. On the other hand, the conflict of interest between shareholders and debt holders may create an incentive for banks to invest in high-risk projects. Therefore, financial authorities compel banks to provide explicit or implicit guarantees for deposits, such as capital requirements. In other words, holding high levels of capital as a requirement may reduce agency costs and make banks more attractive to depositors; this is associated positively with bank efficiency.

Furthermore, Barth et al. (2013b) pointed out that the impact of capital adequacy on bank efficiency was a point of argument. Under the public view, a higher risk can compensate for any loss in capital adequacy by facilitating higher gains. However, the private view states that owners tend to refuse stringent capital requirements, especially if the costs exceed the benefits. Lee and Hsieh (2013) explored this controversial relationship further and other factors that determined the influence of capital adequacy on a bank's efficiency, for example, activity restrictiveness, supervisory power, and governance.

Therefore, the impact of capital requirement on bank efficiency is an empirical question that needs to be explored further.

Relationship between market contestability and bank efficiency

Activity restrictions and fewer entries, coupled with foreign bank entry, are considered to form the basis of contestability market theory (Bikker and Spierdijk, 2009) and (Mirzaei and Moore, 2014). Accordingly, utilizing these indicators may assist in investigating the driving forces of market contestability on bank efficiency.

Bank activity restriction:

Recently, numerous banks broadened their portfolios to provide non-traditional services. However, financial authorities may impose restrictions on non-traditional banking activities. For instance, there are restrictions on real estate activities, securities activities, and insurance activities; besides, these activities prohibit banks to own non-financial firms (Lozano-Vivas and Pasiouras, 2010).

Therefore, some studies attempted to investigate the importance of the influence of non-traditional activities on bank efficiency. Pasiouras et al. (2009) pointed out that lesser restrictions on non-traditional activities allow banks to reap the benefits of diversification and advantages of economies of scale and scope. These advantages increase the efficiency of banks. Nevertheless, there is a possibility of a bank failing to manage its diverse activities, and, by losing the advantages of expertise and specialization on a specific activity, this may impede its efficiency.

Chortareas et al. (2012) stated that restrictions on bank activities would influence bankers' business conduct that might result in hindering bank operational efficiency. Furthermore, imposing restrictions on non-traditional banking activities might reduce the incentives for managers to make future investments, which, in turn, would reduce the number of customers (Barakat and Hussainey, 2013). Moreover, Barth et al. (2013b) concluded that although limited restrictions on bank activities might create complex entities that might be difficult to manage or 'too big to discipline', fewer restrictions would enhance a bank's reputation of serving various customers and ability to diversify sources of income and increase the bank's franchise value; hence, fewer restrictions will contribute towards increasing a bank's efficiency.

It implies that high restrictions on non-traditional banking activities may be negatively associated with bank efficiency.

Financial conglomerate:

Operationally, every financial institution seeks to expand the scale and scope of economies. Therefore, besides traditional banking operations, some financial institutions may hold equity not only in financial institutions but also in non-financial firms. In addition, non-financial firms may hold equity in banks (Vander Vennet, 2002).

Empirically, there are conflicting predictions about whether financial conglomerates can provide economies of scope through financial and non-financial activities. The traditional perspective indicates that financial conglomerates may produce diversification for banks. Thus, banks may enhance efficiency by lowering risk. Nevertheless, Laeven and Levine (2007) highlighted that the 'economies of scope are not sufficiently large to produce a diversification premium', by finding that the market value of financial conglomerates is lower in comparison to financial institutions that specialized in individual activities. Moreover, they pointed out large financial conglomerates might face difficulties in aligning management interests with those of small shareholders; this might lead to agency problems between financial conglomerates' small shareholders and management.

Additionally, Freixas et al. (2007) raised the question on whether diversification through financial conglomerates reduced risk-taking incentive. The answer to this question challenged a few researchers. This is notwithstanding the fact that (Freixas et al.) showed that financial conglomerate diversification might enhance risk-taking incentives, and hence might impede bank efficiency. It may also lead to a reduction in the efficient allocation of resources and increase the level of risk for the conglomerate's financial arm.

In terms of issuing higher risk, van Lelyveld and Knot (2009) highlighted the flaws of financial conglomerates. For example, the expansion of corporate activities may drive managers to gain private benefits or agency problems can trigger between managers and small shareholders. Financial conglomerates may also create bargaining issues between staff and managers or lead to bureaucratic rigidity. These issues in financial conglomerates may negatively influence bank efficiency.

Moreover, diversification in financial conglomerates may cause cross-subsidization issues between business lines that may lead to inefficient allocation of capital and may impede bank efficiency. In addition, it may drive managers to invest in overinvestment projects. Additionally, financial conglomerates may increase exposure to reputational risk due to the conflict of interests between activity areas of financial conglomerates and clients. These may lead to higher costs of debt and reduced share price, which negatively influence bank efficiency (Schmid and Walter, 2009).

Openness in the banking industry:

The indirect effect of financial openness on bank efficiency that operates through bank risk may also be positive or negative. A portfolio management theory perspective would suggest a positive effects, particularly for larger banks, warranted by new opportunities for risk spreading and international portfolio diversification in terms of both income and asset diversity. However, the indirect effect through the risk channel could be negative given the new opportunities for banks to incur more risks under a more liberalized and deregulated financial regime as banks expand their operations into foreign markets or in non-traditional activities (Luo et al., 2016).

It is good to know that the international banking strategy has forced some banks to expand their presence across continents and in many countries. Consequently, many foreign entities have access to many emerging markets, but the influences on banking efficiency varies across countries (Zhu, 2011).

Thus, numerous studies have concentrated on the advantages and disadvantages yielded by the openness of the banking industry. Claessens et al. (2001) and Agénor (2003) highlighted the positive influence of foreign entrants on domestic banks through direct and indirect effects. Domestic banks must become more efficient if they wish to survive the competitive pressures from foreign entrants. Hence, competitive pressures have a direct influence on bank efficiency. The prospects of collaborating with the foreign entrants drive domestic banks to upgrade personnel through training; utilize competitive technologies; and enhance risk management skills. Moreover, foreign banks may provide domestic banks a better access to global financial markets.

However, there are costs associated with openness in the banking industry, owing to 'cherry picking'. Foreign banks may engage in illicit lending practices. This may be associated with the desire of domestic banks to deal with the pressures of competition, and consequently, banks may take additional risks that may hinder their efficiency. Furthermore, foreign banks, via mergers and acquisitions, may contribute towards an increase in financial system concentration. Additionally, foreign banks may create 'crowding out', which may cause survival difficulties for small domestic banks (Vives, 2001).

Both the aforementioned discussions lead to a re-evaluation of the effects of openness in the banking industry across different economies. Sturm and Williams (2004) found that foreign banks were more efficient when compared to Australian banks, especially after deregulation. This may be because Australian banks utilize bank size as a barrier to new entrants. Contrarily, Sengupta (2007) pointed out that firms in emerging markets have easier access to credit via foreign banks and this might hinder the efficiency of domestic banks. However, Li et al. (2016) concluded that foreign entrants improve efficiency in domestic Chinese banks by improving technologies.

Relationship between supervision and bank efficiency

The rapid worldwide growth of the financial system made it necessary for financial authorities to enhance financial supervision regimes. Financial supervision can equip financial authorities to create a safety net for the banking system against crises (Raz et al., 2014). The financial supervision regime is multi-dimensional. Nevertheless, the literature focuses on three specific aspects—supervisory power, supervisory independence, and the stability of supervisors.

Supervisory power

The role of supervisory authorities in the management of the banking system, and, particularly, whether supervisory authorities can take specific actions to prevent and correct problems is considered a conflicting topic. As argued in Barth et al. (2013b), they point out that a powerful supervisory agency can enhance corporate governance by exercising direct monitory controls and higher expertise. These initiatives can offset market failures by being sources of imperfect competition and boosting bank efficiency of imperfect information and boosting bank efficiency. Under this public interest view, supervisory power may be associated positively with bank efficiency. Contrarily, the private interest view states that powerful supervisors may sometimes

concentrate on ‘promoting their private interests’ instead of focusing on means of overcoming market failures. In other words, regulators may also utilise their power to discipline non-compliant financial institutions for allocating credit and reaping political and private benefits (Barth et al., 2013b).

Concerning other adverse effects of supervisory power, Beck et al. (2006a) reveals that supervisory authorities might use their power to provide larger subsidies through implicit policies that are ‘too important to fail’ and enable banks to overcome market failures. Therefore, banks had increased incentives to take on risky investments and create a fragile banking system. Concerning this, supervisory power has a negative impact on banks’ efficiency.

Moreover, Chortareas et al. (2012) stated that although supervisory power improved corporate governance, which might reduce corruption in bank lending, ‘excessive government involvement’ might tarnish the integrity of bank lending and create issues with credit allocation; this might have an adverse impact on bank efficiency.

Due to empirical conflict and policy debates, the influence of supervisory power on bank efficiency remains an empirical question.

Supervisory independence:
Isolation of supervision may assist financial authorities to resist any pressures or influences with a view to catering to either private business interests or narrow political interests. Consequently, supervisory independence may facilitate strict bank monitoring and a system for collecting banks’ feedback; it will also guide and advise the banks without exercising any pressures (Barth et al., 2013b). This means that greater supervisory independence can enhance efficiency in the banking sector owing to reduced effects of favouritism from either governments or politicians. Thus, this perspective tends to be consistent with the public interest view. However, empirical results of study (Barth et al.) did not show a significant relationship between supervisory independence and bank efficiency.

Contrarily, higher supervisory independence is expected to limit the powers of participating government officials by reducing nepotism and controlling corruption. It suggests that the supervisory agencies may seek to benefit private interests in the absence of government intervention. Furthermore, Gaganis and Pasiouras (2013) indicated that higher supervisory

independence would diminish bank efficiency since supervisory independence might lead officials to focus on monetary policies instead of promoting governance practices. Therefore, this conflict of interest would reduce bank efficiency.

According to the above argument, the impact of supervisory independence on bank efficiency remains an ambiguous question that we will explore later.

Supervisory tenure:

Although supervisors with long tenure have good work experience, those with a relatively shorter tenure are open to advise from outside and inside an organization and have information channels that offer more diversity. Likewise, supervisors with shorter tenures are more capable of providing diversified opinions, challenging ideas, considering available alternatives, and applying creative strategies (Richard et al., 2009). Thus, these features specifically enhance access to various sources of information and may enhance monitoring and bank efficiency. Contrarily, supervisors with a longer tenure are more prone to lack information on internal and external environments and restricted by a narrow choice of information sources. Additionally, supervisors with a longer tenure are less likely to be creative and are less capable of exploiting diverse ideas (Richard et al., 2009). Hence, supervisors with longer tenures may encounter difficulties in monitoring banks due to information restrictions; this has a negative influence on bank efficiency.

Moreover, Barth et al. (2013b) investigated the effects of supervisor tenure on bank efficiency in circumstances when supervisors' tenure was positive and significant in explaining bank efficiency. The results showed a relationship between supervisory independence and tenure of supervision and demonstrated the absence of the effects of supervisory power on bank efficiency. The fact is that long supervisory tenure is associated negatively with bank efficiency. Thus, the positive relationship between supervisory tenure and efficiency may be due to either a utilized heterogeneous sample or an issue with quantifying the degree of supervisor tenure.

Ultimately, the relationship between supervisor tenure and bank efficiency is still a controversial question that requires further study.

Relationship between transparency and bank efficiency

The transparency approach takes a very important place in financial literature. In classic financial literature, transparency contributes towards reducing asymmetric information issues in the banking industry, and hence enhances bank efficiency (Diamond, 1984). Additionally, other theoretical research, for example, Boyd and Prescott (1986), Petersen and Rajan (1994), and Winton (1995), have found similar results about the influence of transparency on bank performance. Furthermore, Pasiouras et al. (2009) highlighted that bank transparency might enhance governance in banks, and, consequently banks might be able to boost their efficiency.

However, based on the following reasons, there are still remarkable variations in the impact of transparency on bank efficiency. First, most, if not all financial studies, emphasize that transparency is expensive. James (1987), Lummer and McConnell (1989), and Billett et al. (1995) assumed that, even if the costs of enhancing transparency exceed the benefits of transparency, banks might devote more resources towards enhancing transparency for reaping superior financial performance. This view is elucidated by indicating that devoting resources, for creating good loans, reducing loan losses, and enhancing revenues is beneficial when compared to devoting resources for increasing transparency. Second, providing sensitive information to competitors negatively influences the measures taken to increase transparency (Pasiouras et al., 2009). Thus, releasing sensitive information may assist competitors to obtain private information about borrowers and a bank's commercial lending business model. Consequently, the risks associated with releasing sensitive information and the additional costs borne by banks to achieve transparency have a negative impact on bank efficiency.

Moreover, Cordella and Yeyati (1998) studied the possibility of complete transparency leading to bank failure. They showed that increased transparency might reveal negative information, which might lead to an increase in the deposit interest rate. Thus, banks have to pay higher deposit rate due to their riskier states. Moreover, high transparency levels may increase banks' risk-taking incentives because of a decline in their franchise values, and hence hinder bank efficiency (Chen and Hasan, 2006).

Furthermore, improvement in transparency may cause an inefficient bank to have a run on funds. It implies that the bank may face shortages in liquidity owing to an increase in the incentive of depositors to withdraw their money.

Relationship between governance and bank efficiency

Corporate governance can be viewed as the 'model of structure and power that determines the rights and responsibilities of various groups involved in running an organization'(Alkhafaji, 1989). This narrow approach to corporate governance focuses on the essential role of governance as the organizer of interests between shareholders as capital providers, staff as labour providers, and managers who maximize profits through their provided skills. A broader approach to corporate governance would include societal, environmental, and governmental dimensions (Alkhafaji, 2007). Therefore, effective corporate governance practices can boost efficiency by reducing the internal conflict between managers and shareholders and enhancing the healthy relationship between the bank and its external environment.

There is no denying that corporate governance is important to the financial industry and banking efficiency, where the primary function of a bank is intermediation between depositors and borrowers. Accordingly, banks are considered channels that move funds from surplus areas to deficit areas. In order to reinforce this function and boost trust and confidence between them and the public, banks may promote corporate governance practices. On the contrary, poor corporate governance practices may hinder bank efficiency by creating confidence issues. These may lead to a liquidity crisis (Johnson et al., 2000).

Furthermore, Barth et al. (2013b) emphasized that effective corporate governance practices were conducive to a better institutional environment, which contributes towards enhancing bank efficiency. Moreover, Qian and Yeung (2015) found a positive association between efficiency and corporate governance. It is easy for banks to provide either non-disciplinary loans or bad loans when there is poor environmental governance. It implies that banks are less likely to be concerned about their reputations and the need to access equity with higher costs. However, banks having effective environmental governance are capable of boosting their reputations, and thus reinforcing their levels of efficiency.

Relationship between diversification and bank efficiency

Despite the benefits that banks may reap from diversification, extending the banking business model may simultaneously bring new types of risk, such as new market risk, operational risk, liquidity risk, and credit risk, besides legal risk (DeYoung and Roland, 2001). Further, Stiroh and Rumble (2006) demonstrated a negative effect of diversification by pointing out that the probability of default might increase if the extended banking business model included highly volatile activities. Hence, managers may face wide swings in revenue owing to an ineffective diversified portfolio.

Moreover, Berger et al. (2010) utilized the four dimensions of diversification—loans diversification, deposits diversification, assets diversification, and geographical diversification. The results show that all the four dimensions of diversification are associated with higher costs and reduced profits; these hinder banks' efficiency.

However, Boot and Schmeits (2000) concluded that diversification reduces risk and financial distress by spreading risk and enhancing profits. Moreover, Drucker and Puri (2009) pointed out that diversification might enable banks to gain economies of scope by diversifying fixed costs; thus, banks may be able to enhance efficiency.

This debate about the effects of diversification on bank efficiency remains an empirical question that needs to be studied.

Therefore, and to the best of our knowledge, this study takes a different approach from previous studies by innovating SORM-DEA for utilising it in investigating whether financial regulations and reforms in financial systems can work better to enhance bank efficiency. Moreover, most previous studies do not take into account the sizeable variation in financial regulations and supervision across countries and economies. Accordingly, in addition to considering the impact of the recent worldwide financial crisis, this study investigates the influence of financial regulations and supervision across seven major regional economic blocs, developed countries, less developed countries, and fuel-exporting countries. Most importantly, this study attempts to discover the influence of new dimensions of financial regulation like capital adequacy ratio or market contestability indicators on banking efficiency.

3.3. Variables, methodology, and data

Firstly, this study utilized a SORM of DEA to deal with negative data and find efficiency scores. Subsequently, we used the instrumental variable IV, together with the OLS method, to study the influences of financial regulation on bank efficiency. Our rich datasets have assisted us to create variables with high-frequency historical information. Therefore, this section sheds light on this study's variables, hypotheses, methodologies, and data.

3.3.1. Variables

Bank efficiency (dependent variable):

Predominantly, there are two main approaches widely used in financial literature to evaluate the efficiency of financial institutions. The first approach is based on the parametric method that is the Stochastic Frontier Approach (SFA). This method attempts to account for the influences of statistical noise or errors such as either omitted variables or data errors. However, this approach is not capable of dealing with long-term operational issues and inflexibility within the model specification (Lee and Chih, 2013). Furthermore, the other disadvantages of SFA relate to the selection of a functional form and it being less capable of accommodating multiple inputs and outputs; it is also considered weak in treating negative values (Coelli, 2003).

By utilising distance to the efficient frontier, a non-parametric approach like the Data Envelopment Analysis (DEA) can be used for obtaining bank efficiency scores (Pessarossi and Weill, 2014). There are several advantages of using linear programming methods as the DEA that identify frontiers via the best practice banks, and subsequently identify the banks that can deviate from this frontier. The primary advantage in using DEA is that it may reduce the issue of function from dependency by accommodating multiple inputs/outputs (Drake et al., 2006). Second, DEA can enhance individual Decision-Making Units (DMUs) by focussing on individual observations rather than on a population average (Banker and Natarajan, 2008). Third, DEA corrects the bias in decision-making units by utilizing a bootstrap procedure (Simar and Wilson, 2007). In addition to these advantages, DEA is more flexible in handling some statistical problems like homogeneity, the number of DMUs, and negative values.

This study adopted on standard financial intermediation approach that developed by Sealey and Lindley (1977). Based on this approach physical capital, labor and deposits treated as inputs, while deal with loans as output. The intermediation model has been widely adopted and developed by many researchers (Casu et al. (2004) and Drake et al. (2006)). Therefore, we used recent intermediation model that has four inputs and three outputs in order to capture efficiency scores. The three basic inputs are total deposits, personnel expenses, and fixed assets. However, Barth et al. (2013b) add loan loss provision as fourth input in order to capture the risk/potential costs in making loan decisions. Moreover, this model besides loans as first output, it take into account the relatively large share of non-traditional bank activities. Thus, treating other earning assets as second output and other operating income as third output.

Homogeneity and number of DMUs:

The DEA assumes that all DMUs are homogeneous. Thus if DMUs are not homogeneous, then the efficiency scores may suffer from the DEA's discriminatory power and may reflect the differences in environments rather than inefficiencies. Nevertheless, the following strategies can overcome this problem: (i) adjusting for non-homogeneity by separating DMUs into homogeneous groups; or (ii) increasing the number of DMUs (Haas and Murphy, 2003).

As a third strategy, the number of DMUs can have a major impact on the efficiency scores. Staat (2001) re-examined the data of Banker and Morey (1986) and the results showed that their reported efficiency scores were impacted significantly by the variation in the number of DMUs. However, in order to obtain a reasonable level of DEA discrimination between the best and the worst performing DMUs, the rule of thumb is that the number of DMUs should be at least twice the total number of input and output variables.

Table 3-1: Variable and data sources

Variable	Definition	Sources
Dependent variables: ***Semi-Oriented Radial Measure (SORM) of efficiency***	The SORM model is a special measurement of non-parametric method, data envelopment analysis (DEA), which handles the issues of negative values in input and output variables.	**Authors' calculation**
Outputs		
Loans	Total loans (mil$)	**BankScope**

Other earning assets	Total other earning assets(mil$)	**BankScope**
Other operation income	Total other operating income(mil$)	**BankScope**
Inputs		
Deposits	Total deposits (mil$)	**BankScope**
Labour	Personnel expenses (mil$)	**BankScope**
Capital	Fixed assets (mil$)	**BankScope**
Loan loss provision	Loan loss provision and other provision (mil$)	**BankScope**
Independent variables:		
Capital regulation		
Capital adequacy ratio	$CAR = \frac{Tier\ 1\ capital + Tier\ 2\ capital + Tier\ 3}{Total\ risk\ weighted\ assets} \times 100$	**BankScope**
Tier 1 capital ratio	Tier 1 capital to risk-weighted assets	**BankScope**
Market contestability:		
Bank activity restrictions	It refers to regulations that specify which banks may engage in development, investment, and management of real estate. Moreover, this indicator may reflect the ability of a bank to engage in underwriting and selling insurance. This variable ranges between 0 and 12—a higher value reflects more restriction.	**World Bank Survey. Barth et al. (1999, 2003, 2007, 2012)**
Financial Conglomerate	It indicates that a bank may control a non-financial firm and vice-versa, and a non-bank financial firm may control a bank. It ranges between 0 and 12, where higher values indicate greater restriction.	**World Bank Survey. Barth et al. (1999, 2003, 2007, 2012)**
Openness in banking industry	it refers to (i) limitations on foreign bank entry and regulations that specify whether foreign banks may own domestic banks, also refers to whether foreign banks may enter a country's banking industry. With regards to (ii) entry requirements, this indicates whether various types of legal requirements are needed to obtain a banking license. The variables range between 0 and 32, with higher values indicating greater stringency.	**World Bank Survey. Barth et al. (1999, 2003, 2007, 2012)**
Supervision indictors:		
Official supervisory power	It refers to whether the supervisory authorities have the authority to take specific actions to prevent and correct problems. This variable ranges between 0 and 16, where higher values reflect greater power.	**World Bank Survey. Barth et al. (1999, 2003, 2007, 2012)**
Supervisory independence	It refers to the degree to which the supervisory authority is independent of the government and is legally protected from the banking industry. The indicator ranges between 0 and 3, where a higher value indicates more independence.	**World Bank Survey. Barth et al. (1999, 2003, 2007, 2012)**
Average tenure of supervisors	It refers to the average number of years that the current supervisors have been appointed.	**World Bank Survey. Barth et al. (1999, 2003, 2007, 2012)**
Transparency		
Transparency index	Transparency index refers to obtaining credit; this reflects the strength of credit reporting and the effectiveness of	**World Bank, Doing Business, 2014**

	collateral and bankruptcy laws in facilitating lending. It also includes protecting minority investors and resolving insolvency. The former measures the level of transparency requirements, while the latter identifies the degree of transparency in insolvency laws and the transparency in procedural and administrative processes in insolvency matters. The variable ranges between zero and 1, where 1 indicates greater transparency.	
Governance Index:	It refers to the indicators that aggregate a simple average of the following six topics in worldwide governance:	
Voice and accountability	The indicator measures the extent to which a country's citizens can participate in selecting their government as well as their freedom of expression, freedom of association, and free media.	**The Worldwide Governance Indicators (WGI)**
Government effectiveness	The indicator measures the quality of public services, quality of the civil service and the degree of its independence from political pressures, quality of policy formulation and implementation, and credibility of the government's commitment to such policies.	**The Worldwide Governance Indicators (WGI)**
The rule of law	The indicator measures the extent to which agents have confidence in and abide by the rules of society, and it particularly measures the quality of contract enforcement, the police, and the courts as well as the likelihood of crime and violence.	**The Worldwide Governance Indicators (WGI)**
Political stability	The indicator measures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including political violence and terrorism.	**The Worldwide Governance Indicators (WGI)**
Quality of regulation	The indicator measures the ability of the government to formulate and implement sound policies and regulations that permit and promote market competition and private-sector development.	**The Worldwide Governance Indicators (WGI)**
Control of corruption	The indicator measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, and the extent to which the state is 'captured' by elites and private interests.	**The Worldwide Governance Indicators (WGI)**
Diversification		
Diversification Index	It refers to asset diversification and whether the banks can make loans abroad. It ranges Between 0 and 1, where 1 indicates greater diversification.	**World Bank Survey. Barth et al. (1999, 2003, 2007, 2012)**
Other control indicator:		
Inflation	The annual change in the consumer price index	**World Development**
GDP	Gross domestic product	**World Development**
Bank size	Natural logarithm of total assets	**BankScope**

Negative value with DEA:

The traditional DEA assumes that all input and output values should be positive. In many real applications, non-positive inputs and outputs may appear. In our case, we have three outputs besides the four inputs that are apparent in Table 1; additionally, some variables may include a negative value, such as a loss of profit, when it is displayed as an output variable (Emrouznejad et al., 2008). Therefore, many researchers, such as Pastor (1994) and Seiford and Zhu (2002), used transformation with the intention of handling non-positive values in DEA. This changed the negative data to positive data. Hence, we applied a (SORM) DEA, developed by Emrouznejad et al. (2010), to deal with issues of the target and overcome the problems associated with negative data (Matin et al., 2014).

These issues required us to apply SORM to capture efficient performance scores as dependent variables, with consideration of issues of non-homogeneous data and the number of DMUs, besides negative data. As far as we know, this s is the first study to have applied this measure to the banking industry across countries and economic blocs.

Explanatory Variables

Capital requirement:

This variable indicates the strength of the financial system and is utilized to reduce bank risk by acting as a buffer against any losses (Lee and Chih, 2013). Theoretically, the relationship between capital requirement and bank efficiency remains an empirical question. This matter needs to be explored owing to the influences of high capital requirement on bank cash flow. However, Pasiouras et al. (2009), Chortareas et al. (2011), Barth et al. (2013b), and Pessarossi and Weill (2014) highlighted a positive association between capital requirement and bank efficiency owing to capital requirement's essential role in reinforcing financial stability and reducing bank risk incentives. Thus, this study uses Tier 1 capital to risk-weighted assets ratio (Tier 1) in addition to Capital Adequacy Ratio (CAR) as proxies of capital requirement. CAR is measured as:

$$CAR = \frac{Tier\ 1\ capital + Tier\ 2\ capital + Tier\ 3}{Total\ risk\ weighted\ assets} \times 100 \qquad (1)$$

Market contestability

Bank activity restrictions:

As Table 3-1 shows, this indicator reflects the extent to which banks may engage in underwriting, brokering, and dealing in securities, along with being involved in all the aspects of the mutual fund industry. Additionally, it refers to which banks may engage in development, investment, and management of real estate. Moreover, this indicator may reflect the ability of banks to engage in underwriting and selling insurance (Barth et al., 2013a). This variable ranges between 0 and 12, where a higher value reflects more restrictions.

The relationship between bank activity restrictions and bank efficiency is still a controversial matter among financial researchers. While some studies indicated that banks with lesser restrictions might increase bank risk incentives and some banks might lose the advantage of expertise and specialization in specific activities (Pasiouras et al., 2009), Barakat and Hussainey (2013) and Barth et al. (2013b) highlighted that less tight bank restrictions allow banks to obtain the benefits of diversification and increase the incentives of managers to make investments in non-traditional financial services.

Financial conglomerate:

This variable indicates the extent to which banks may own and control firms. Moreover, this indicator may reflect which non-financial firms might own and control banks. Finally, the variable shows whether non-bank financial firms may own shares in banks. The variable ranges between 0 and 12, with higher values indicating greater restrictions (Barth et al., 2013a).

Banks may reap the benefits of diversification as a financial conglomerate (Laeven and Levine, 2007); however, financial conglomerates may create agency problems where managers may gain private benefits through the expansion of activities. Moreover, Freixas et al. (2007), van Lelyveld and Knot (2009), and Schmid and Walter (2009) indicated that financial conglomerates may enhance risk-taking incentives owing to poor diversification.

Openness in banking industry:

In order to measure this indicator, we utilised limitations on foreign bank entry and regulations that specify whether foreign banks may own domestic banks; it also refers to whether foreign banks may enter a country's banking industry. Additionally, this indicator includes bank entry requirements, which indicate whether various types of legal requirements are needed to obtain a banking license (Barth et al., 2013a).

Table 3-2: Hypotheses and related literature

Expository Variables	Hypothesis	Description	Related literature
Capital requirement	H1	The capital adequacy ratio has a **positive effect** on the operational efficiency of a bank.	Pasiouras et al. (2009), Chortareas et al. (2011), Barth et al. (2013b), and Pessarossi and Weill (2014)
	H2	The Tier 1 capital ratio has a **positive effect** on the operational efficiency of a bank.	
Bank activity restrictions	H3	The bank activity restriction has a **positive/negative effect** on the operational efficiency of a bank.	Pasiouras et al. (2009), Barakat and Hussainey (2013), and Barth et al. (2013b)
Financial conglomerate	H4	The financial conglomeration has a **positive/negative effect** on the operational efficiency of a bank.	Laeven and Levine (2007), Freixas et al. (2007), van Lelyveld and Knot (2009), and Schmid and Walter (2009)
Openness in banking industry	H5	The openness in the banking industry has a **positive/negative effect** on the operational efficiency of a bank.	Zhu (2011), Vives (2001), Agénor (2003), and Barakat and Hussainey (2013).
Supervisory power	H6	The supervisory power has a **positive/negative** effect on the operational efficiency of a bank.	Beck et al. (2006a), Barth et al. (2013b).
Supervisory independence	H7	The supervisory independence has a **positive/negative effect** on the operational efficiency of a bank.	Barth et al. (2013b), Gaganis and Pasiouras (2013)

Supervisor's tenure	H8	The supervisory tenure has a **positive/negative effect** on the operational efficiency of a bank.	Richard et al. (2009) and Barth et al. (2013b)
Transparency index	H9	The transparency has a **positive/negative effect** on the operational efficiency of a bank.	Winton (1995), Pasiouras et al. (2009), Chen and Hasan (2006).
Governance Index	H10	corporate governance has a **positive effect** on the operational efficiency of a bank.	Johnson et al. (2000) and Alkhafaji (2007)
Diversification Index	H11	Diversification has a **positive/negative effect** on the operational efficiency of a bank.	Boot and Schmeits (2000), DeYoung and Roland (2001), and Drucker and Puri (2009)
Size	H12	Size has a **positive effect** on the operational efficiency of a bank.	Wheelock and Wilson (2009), Feng and Serletis (2010), and Barth et al. (2013b)
Inflation	H13	Inflation has a **positive/ negative effect** on the operational efficiency of a bank.	Athanasoglou et al. (2008) and Tan and Floros (2012)
Growth	H14	Growth has a **positive effect** on the operational efficiency of a bank.	Drake et al. (2006), Cuaresma et al. (2014), and Belke et al. (2016)

Indeed, both foreign bank entry and entry requirements refer to openness in the banking industry. Consequently, by interacting both variables, we explored if the impact of openness in the banking industry has an effect on bank efficiency. Hence, the new indicator ranges between 0 and 32, with higher values indicating greater stringency.

The effects of the entry of one foreign bank and entry requirements limitations on bank efficiency varies between countries (Zhu, 2011). Numerous studies found advantages and disadvantages of openness in the banking industry. Openness in the banking industry may create benefits for domestic banks by facilitating technology transfer, enhancing training, and developing risk management skills. In addition, domestic banks may have ease of access to international financial markets (Agénor, 2003). On the contrary, openness in the banking industry may require domestic banks to take additional risks and aggravate the problem of concentration in the financial system (Vives, 2001).

Supervision

Official Supervisory power:

We used supervisory power variables to investigate whether the supervisory authorities have the right to take specific actions to prevent and correct issues in the banking industry. Barth et al. (2013a) constructed these variables from 14 dummy indicators. These refer to the following: (i) Can supervisors meet external auditors to discuss their report without bank approval? (ii) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (iii) Can supervisors take legal action against external auditors for negligence? (iv) Can supervisors force banks to change the internal organizational structure? (v) Are off-balance sheet items disclosed to supervisors? (vi) Can the supervisory agency order directors/management to constitute provisions to cover actual/potential losses? Moreover, this indicator reflects whether the supervisory agency can suspend directors' decisions to distribute dividends, bonuses, management fees, and whether the supervisory agency can supersede bank shareholder rights and declare a bank insolvent. This variable also shows (whether banking law allows a supervisory agency to suspend some or all ownership rights of a problem bank and regard bank restructuring and reorganization. Additionally, the indicator reveals whether or not a supervisory agency can supersede shareholder rights, and remove and replace management and directors. This variable ranges between 0 and 16, with higher values reflecting greater power.

Besides promoting supervisors' private benefits, supervisory power may have a negative influence on bank efficiency by a 'too important to fail' policy (Beck et al., 2006a). However, supervisory power may enhance corporate governance, and subsequently reinforce bank efficiency (Barth et al., 2013b).

Owing to previous different views, the effects of supervisory power on bank efficiency may need to be re-evaluated across different economic blocs.

Supervisory independence:

This variable relies on the following three subjects: (i) whether the supervisory authority is independent of political influence within the government, (ii) whether the supervisory authority is protected by the legal system from the banking industry, and (iii) whether the supervisory

authority can make decisions independently of political consideration (Barth et al., 2013a). The indicator ranges between 0 and 3, with a higher value indicating greater independence.

Higher supervisory independence may reduce the influence of favouritism from politicians, and hence may enhance bank efficiency (Barth et al., 2013b). Nevertheless, greater independence may impede bank efficiency by limiting the role of government officials in controlling corruption in a supervisory agency (Gaganis and Pasiouras, 2013).

Consequently, the impact of supervisory independence on bank efficiency is based on supervisory agency experience and other supervisory indicators. These need further investigation.

Supervisors' tenure:

This indicator reflects the average number of years of supervisors in their current positions. This indicator may have either a positive or a negative influence on bank efficiency. The supervisors with a longer tenure may have a positive effect on bank efficiency owing to their experience. Contrarily, supervisors with a shorter tenure may have a negative influence on bank efficiency due to the lack of information and poor monitoring (Richard et al. (2009) and Barth et al. (2013b)).

Therefore, we attempted to study this controversial question and examined the effects of supervisors' tenure on bank efficiency.

Transparency index:

We tried to determine whether transparency reinforces or hinders bank efficiency. Therefore, we amalgamated the following three business regulation dimensions to create a transparency index: (i) the first dimension of obtaining credit reflects the strength of credit reporting and the effectiveness of collateral and bankruptcy laws in facilitating lending, (ii) the second dimension of protecting minority investors measures the level of transparency requirements, and (iii) the third dimension of resolving insolvency identifies the degree of transparency in insolvency law and the transparency in procedural and administrative processes in insolvency matters (Besley et al., 2015). By taking a simple average of countries being studied in each of the three dimensions, we normalized the index to a value between 0 and 1, where 1 indicates greater transparency.

Although transparency has benefits of reducing asymmetric information issues and boosting governance (Winton (1995) and Pasiouras et al. (2009)), transparency may lead to fragility in a financial system because of the higher cost of transparency, thereby reducing reputation values and shortages in liquidity (Chen and Hasan, 2006).

The aforementioned controversial opinions show that the question about the impact of an improvement in transparency on bank efficiency remains unanswered and needs to be examined further.

Governance Index:

We developed a governance index by aggregating simple averages of the following six topics from a worldwide governance indicators' database: (i) voice and accountability, (ii) political stability, (iii) government effectiveness, (iv) regulation quality, (v) rule of law, and (vi) control corruption (Kaufmann et al., 2011). Following this, we normalized the simple average of all the six dimensions of governance to an index between 0 and 1. Higher value indicators indicate better governance practices.

Indeed, governance is considered to be a cornerstone of financial stability because of the former's role in creating the best investment environment and reinforcing the trust between financial institutions and the public (Alkhafaji, 2007). Consequently, best governance practices may support bank efficiency.

Diversification Index:

This variable investigates whether there are guidelines for asset diversification, i.e. whether banks can make loans abroad (Barth et al., 2013a). We created this index by summing the percentage values for both the indicators, and subsequently minimizing the values to 0 and 1, where 1 indicates greater diversification.

In banking literature, there is an argument about whether diversification assists in spreading risk and thereby contributes towards boosting bank efficiency (Boot and Schmeits (2000) and Drucker and Puri (2009)) or it brings new type of risks, such as new market risk, liquidity risk, and credit risk, and hence impedes bank efficiency (DeYoung and Roland, 2001).

Other control variables

Size:

The majority of the literature emphasises the importance of size effect on bank efficiency. Despite the sometimes ambiguous and subtle results in respect of the possible direction of size effects on bank efficiency, most studies stated positive associations between larger banks and bank efficiency. Berger et al. (1987), Mester (1992), and Drake and Hall (2003) provided empirical evidence on the positive relationship between size and bank efficiency. Thus, by developing financial, human, technical, and material aspects, larger banks can enhance their efficiency. While, Berger and DeYoung (1997) found that the larger banks appeared slightly more efficient when compared to small banks in terms of cost efficiency, small banks showed higher efficiency in terms of profit efficiency.

Intuitively, as Wheelock and Wilson (2009), Feng and Serletis (2010), and Barth et al. (2013b) found, we assume a positive relationship between size and bank efficiency owing to the scale or scope of economies. We utilised the logarithm of total bank assets in millions of US dollars as a proxy to capture and control the effects of banks' size on bank efficiency.

Inflation:

We control the impacts of inflation owing to the importance of inflation in determining bank efficiency. Inflation can influence bank efficiency through two different aspects—bank lending and bank revenue. Broadly, the inflationary environment may raise a bank's incentive to increase loan interest rates; this would lead to an increase in a bank's income (Tan and Floros, 2012).

However, the impact of inflation on efficiency relies on whether banks' expenses increased faster than inflation. Hence, if a bank can anticipate inflation, then it has a chance to manage its expenses (Revell, 1979). In this vein, correct forecasting helps banks adjust interest rates depending on the level of change in the inflation rate. Thus, banks have opportunities to increase their revenues faster than their expenses (Perry, 1992). Incorrect anticipation leads to shortages in cash flow; these shortages reinforce loan losses and have negative influences on bank efficiency (Tan and Floros, 2012).

Most existing literature tend to show the positive effect of inflation on bank efficiency due to the developments that have occurred in inflation rate forecasting mechanisms (Athanasoglou et al.,

2008). Therefore, we used the annual change in the consumer price index as a proxy for inflation and assumed a positive association with bank efficiency.

Growth:

There is a significant divergence in economic growth between countries and economic blocs. Some countries and economic blocs have been witnessing steady economic growth, while the economies of others face anaemic growth (Cuaresma et al., 2014). These divergences may influence the quality of the financial system through Non-Performing Loans (NPL). Drake et al. (2006) and Belke et al. (2016) pointed out the link between bank efficiency, growth, and NPL whereby, during bad times of growth, a bank may face high NPL and limits on deposits. However, during normal times of growth, banks may be more resilient to treat high NPL and more efficient due to the low risk of NPL.

We utilized the natural logarithm of annual percentage growth rate of GDP to control the growth's impact on bank efficiency. In addition, we suggested that there is a positive relationship between economic growth and bank efficiency. Thus, high economic growth leads to high efficiency.

In summary, Table 3-2 shows the expected direction of the explanatory variables with the independent variable. We have built those hypotheses based on previous literature.

3.3.2. Model specification and methodological issues

Estimating operational efficiency:

This study contributes towards the application of SORM. The SORM model is a special measurement of a non-parametric method, DEA, developed by Emrouznejad et al. (2010) to handle the issues of negative values in input and output variables. Owing to this problem, SORM creates two new variables for each input and output variable that includes positive and negative values, where 1 is assigned to positive values and 1 to negative values. Thus, negative input values are treated as positive outputs and negative output are handled as positive inputs.

It must be noted that the division of one variable into two variables allowed us to use one as an input and the other as an output, which occurs when the variables include negative values. Contrarily, the rest of the variables are treated as normal.

The other issue is the number of DMUs. In order to address this problem, we followed Staat (2001) and Dyson et al. (2001), where they emphasised that the number of DMUs should be at least twice the total number of input and output variables, as shown in equation(2) and (3):

$$DMUs \geq 3(x + y) \tag{2}$$

Or

$$DMUs \geq (2x * y) \tag{3}$$

Where, $DMUs$ refer to decision-making units or (number of banks), x is the total number of inputs, and y is total the number of outputs.

Finally, heterogeneity of $DMUs$ is another issue that needs to be addressed. Therefore, we dealt with those snags by dividing our sample into homogeneous groups based on economic blocs (Haas and Murphy, 2003).

Therefore, banking efficiency score e_k can be specified by SORM-DEA in the following manner:

$$\begin{aligned}
&Min \quad h \\
&s.t. \quad \sum_j \lambda_j x_{ij} \leq h x_{ij0}\,; \quad \forall i \in I \\
&\qquad \sum_j \lambda_j x^1_{\ell j} \leq h x^1_{\ell j0}\,; \quad \forall \ell \in L \\
&\qquad \sum_j \lambda_j x^2_{\ell j} \geq h x^2_{\ell j0}\,; \quad \forall \ell \in L \\
&\qquad \sum_j \lambda_j y_{rj} \geq y_{rj0}\,; \quad \forall r \in R \\
&\qquad \sum_j \lambda_j y^1_{kj} \geq y^1_{kj0}\,; \quad \forall k \in K \\
&\qquad \sum_j \lambda_j y^2_{kj} \leq y^2_{kj0}\,; \quad \forall k \in K \\
&\qquad \sum_j \lambda_j = 1 \\
&\qquad \lambda_j \geq 0;\ \forall j
\end{aligned} \tag{4}$$

Thus, equation (4) represents the input oriented SORM-DEA model. This is used for DMUs that include negative and positive values in output and input variables, where the efficiency of DMU_{J0} is the optimal value of h, j refers to bank, x is a normal input, and y is a normal output variable. Contrarily, I is the positive input and L is the negative input. Additionally, R and K refer to positive and negative output. $i, \ell, r,$ and k are the actual values of $I, L, R,$ and $k,$ respectively.

This model relies on the standard financial intermediation approach developed by Sealey and Lindley (1977). It has been widely used and adopted in many studies for example by Casu et al. (2004), Drake et al. (2006), Chortareas et al. (2012), and Barth et al. (2013b). The model posits four inputs and three outputs. The four essential dimensions of inputs (x_i) are as follows: x_1 refers to total deposits, which is the sum of total deposits, short term funding, and money market funding; x_2 is labour input and we used personnel expenses as a proxy of labour; x_3 represents physical input through total fixed assets; and x_4 captures the risk in loan decisions by utilizing loan loss provisions as a proxy. Concerning the three outputs (y_i), y_1 is total loans; y_2 refers to other earning assets, which represents other interest generating assets, such as securities and bonds; and y_3 reflects other operating income. We noted that both loan loss provision from the inputs side and other operating income from the outputs side included negative values. Hence, we chose to apply the SORM-DEA model to overcome this issue and to obtain bank efficiency scores.

Econometric model:

This study adopts the two-stage least squares (2SLS) estimator, aside from ordinary least squares (OLS). The 2SLS estimator is a special approach to the theory of instrumental-variables (IV) that is widely used in much financial literature, such as those by Berger and Di Patti (2006), Belkhir (2009), Gonzalez (2009), and Barth et al. (2013b). Econometrically, 2SLS can overcome some econometric issues that are inherent in our sample of panel structures. These are as follows: (i) the unobserved bank-specific effects (La Porta et al. (2000) and (ii) the problem of potential endogeneity of bank efficiency owing to reverse causality, by which bank efficiency affects regulatory policies, and thus the 'regulatory framework may be endogenous to the structure of the banking system in each country' (Beck et al. (2006a) and Barth et al. (2013b)).

Therefore, we use the following equations to investigate the influence of financial regulation on banking efficiency:

$$e_{it} = \beta_0 + \beta_1 x_{it-1} + \beta_2 x_{it} + \cdots + u_{it} \qquad (i = 1, \ldots, N) \tag{5}$$

Where e_{it} is the efficiency score of bank i in year t; x_{it} is a vector of explanatory variables, as discussed in section 3.2. While, u_{it} refers to the random error term.

The equation (5) is based on the assumption that error term u is unrelated to the regressors$x$, as equation (6) shows:

$$E(u|x) = 0 \tag{6}$$

However, it is uncertain if this assumption is valid[11]; thus, we enhance our estimation by utilizing strong assumptions that valid instruments exist, which gives:

$$E(u|z) = 0 \tag{7}$$

where z is an instrument variable correlated to regressor x, as equation (9) shows. Consequently, the models utilizing two-stage least squares are:

$$e_{it} = \beta_0 + \beta_1 x_{it-1} + \beta_2 \hat{x}_{it-1} + \cdots + \beta_k x_k + v_{it} \tag{8}$$

Where $\hat{x}$ in equation (8) is a vector of fitted values of explanatory variables that are obtained in equation (9), and v is a composite error term, which is not correlated with $x_{it-1}, \hat{x}_{it-1}, \ldots . x_k$; β gives equation (10):

$$\hat{x}_{it} = \pi_0 + \mu_1 x_{it-1} + \pi_2 z + \cdots + \pi_k x_k + v_{it} \tag{9}$$

$$\beta_{2sls} = \{x'z(z'z)^{-1}z'x\}^{-1}x'z(z'z)^{-1}z'y \tag{10}$$

Thus, the errors v are homoscedastic and independent.

Furthermore, coupled with the problem of endogeneity, there is a need to address other econometric issues. Indeed, autocorrelation, heteroskedasticity, heterogeneity, and weak instruments are problems that are inherent in our sample and estimator.

[11] There may be an endogeneity bias due to the direct effect of u on x.

First, the issue of autocorrelation arises when explanatory variables and dependent variables are 'instantaneous' (when explanatory and dependent variables come from the same time period). In our analysis, the dependent variable relies on seven bank accounting indicators, and hence there is a chance that the cause and effect occur at the same time. We deal with this matter through lagged bank independent variables x_{it-1}, as equation (8) shows, by which there is an increased length of time between cause and effect (Chen et al., 2011). Moreover, the use of lagged independent variables may assist in solving the endogeneity issue (Hasan et al., 2009).

Second, there is the heteroskedasticity issue, which occurs when the variance of the error term is inconsistent across observations. Thus, to correct the bias and enhance the consistency in the error term, we applied a heteroskedasticity-robust estimator[12] (White (1980), Cameron and Trivedi (2009), and Thompson (2011)).

Third, the large sample may lead to heterogeneity in the sample. Therefore, reducing the heterogeneity in the sample by dividing the sample either based on economic blocs or based on economic development may assist in overcoming this issue (Haas and Murphy (2003) and Thompson et al. (2006)).

Fourth, the use of an instrument variable approach imposes the use of appropriate instrument variables. Accordingly, we follow the existing literature in law and finance to select adequate instrument variables (e.g. Easterly and Levine (1997), López de Silanes et al. (1998), Beck et al. (2003), and Acemoglu and Johnson (2003)). By following previous literature, we found that legal origins might assist in explaining the development of today's financial industry, while the geographical environment may play an essential role in shaping the financial institution system. Therefore, we use legal origins, ethnics, regions, religions, and financial regulation as instrumental variables. Currently, these indicators would not have a direct influence on bank efficiency, but these factors may influence bank efficiency through financial regulation (Barth et al. (2009), Houston et al. (2011), and Barth et al. (2013b)).

Moreover, to assess the appropriateness of the instruments, we conducted an over identified model (Beck et al., 2006a). Hence, if 'F-statistic or minimum eigenvalue statistics greatly exceed

[12] Used heteroskedasticity-robust estimator instead of cluster estimation because the residuals are correlated across both banks and time, while the cluster estimation is valid only if residuals are correlated either across banks or across time (Thompson, 2011).

the critical value of 2SLS relative bias, then we can comfortably to reject the null hypothesis of weak instruments' (Cameron and Trivedi, 2009).

3.3.3. Data and descriptive analysis

The sample:

This study relied on the compilation of the following four rich datasets: BankScope, Bank Regulation and Supervision, Worldwide Governance Indicators (WGI), and Doing Business. BankScope's database is a global and comprehensive intelligence database of banks that is developed by Van Dijk and Fitch, and has a comprehensive coverage of over 32,000 banks worldwide. The information on each bank comprises the balance sheet, an income statement next to interim reports for up to 16 years, 36 financial ratios, and 200 items. The Bank Regulation and Supervision dataset, developed by Barth et al. (2013a), is a unique source that provides data on bank regulatory, supervisory policies, and monitoring across 180 countries, and the surveys covered data for 1999, 2003, 2007 and 2012. This version includes new data and measurements for bank activities, competition regulatory authority, capital regulatory authority, official supervisory action, monitoring, and market structure. The WGI was compiled by Kaufmann et al. (2006). This dataset aggregated six governance dimensions for 215 economies from the period 1996–2014. Doing Business is a dataset that offers a variety of useful indicators to measure business regulations for 189 worldwide economies (Business and Design, 2012).

In addition, other than the four aforementioned main datasets, the study uses variables from the World Development Indicators dataset to control the variation in macroeconomic factors across countries. These may affect bank efficiency (Bank, 2010), as Table 1 shows.

With the rich datasets and through an unbalanced panel of 7897 commercial banks (76.611 observations) in 102 countries over the time period 2000-2014, we aimed to investigate whether financial regulation may be able to enhance or impede bank efficiency. The sample constructing by first considering all the commercial banks in the Bankscope database for 102 countries, and the sample has been refined by excluding: (i) banks not report the values of total assets or capital adequacy ratio; (ii) international banks operating in countries of sample; (iii) banks with fewer than three of consecutive observations and (iv) banks for which other country-specific variables

were not available. For extreme values and unobservable input errors, we applied 'Winsorization' of all bank-level data at the top and bottom 1 percentiles

Furthermore, the sample represents seven major economic blocs, including the Africa blocs[13] (AF). It includes the Asia-Pacific Economic Cooperation (APEC), the European Union (EU), and the Union of South American countries (USAN), the Economic Community of West African States (ECOWAS), the Common Market for Eastern and Southern Africa (COMESA), the Southern African Development Community (SADC), and the Council of Arab Economic Unity (CAEU). Moreover, the sample helps to show the variations between developed economies (DEEC) and developing economies (DIEC), next to fuel-exporting countries (FEC).

Summary of statistic for variables:

Before undertaking a complex analysis of whether financial regulation enhances or impedes bank efficiency, the descriptive statistics attempts to understand the implication of the data that has been analysed. In particular, we had to inspect the dependent variables, *bank efficiency*, explanatory variables, and financial regulation variables. Typically, we concentrated on the features of distribution, such as mean, standard deviation, and the range of values to assess how values lie and spread out. Therefore, Table 3-3 indicates a summary of statistics for the whole sample, while table A3-1 in the Appendix shows the descriptive analyses across economic blocs and economic development.

For average *efficiency*, we utilised a weighted average by dividing *efficiency* scores by total assets. Thus, the weighted average of *efficiency* across the sample is 85.66%. However, as Appendix 1 shows, some variations in efficiency scores appear across economic blocs; the scores are 82%, 90%, 91%, 67%, and 93% for APEC, EU, USAN, AF, and CAEU, respectively. *Capital adequacy* is 16.4% and *Tier 1* around 13% for the whole sample; this reflects high financial stability. However, APEC, EU, and CAEU seem to be somewhat higher compared to other blocs, which scored 17%, 18%, and 16% respectively. Indeed, the CAEU sample includes the rich Middle Eastern oil states, which represent more than 50% of the sample, and hence, CAEU's inductors may reflect the good performance of banks in the Middle Eastern oil states. In general, not surprisingly, as Appendix Table A3-1 shows, developed countries have a more

[13] We have integrated Africa blocs to increase the number of observations

stable financial system, with a score of around 17% compared to 14% in less-developed countries.

Table 3-3: Summary statistic

Variable	N	Mean	Sd	Min	Max
Efficiency	94395	85.66677	26.98422	1.25	98.01
Capital adequacy	94396	16.40009	7.495076	0	34.7
Tier 1	87721	13.90133	7.0098	0	30.89
Bank activities	94385	8.238836	1.238087	3	12
Financial conglomerate	94385	8.26491	1.448014	3	12
Openness in banking industry	94397	30.54891	3.407674	0	32
Supervisory power	94385	12.84706	1.444764	5	16
Supervisory independence	94385	1.70561	0.552661	0	3
Tenure supervisors	90385	11.33019	3.490854	0	22.5
Transparency index	94385	0.95566	0.20585	0	1
Governance index	94384	0.922317	0.267673	0	1
Diversification index	94397	0.334216	0.471718	0	1
Size	94396	2.422507	0.756852	1.39794	4.234972
Inflation	94385	2.595576	3.036955	-5.41530	9.094110
GDP	83912	0.392755	0.244168	-1.96833	1.733661

Table 3-3 gives, also, an overview of market contestability indicators, where *bank activities*, *financial conglomerates*, and *openness in the banking industry* tend to be stringent, with a value of 8 out of 12, 8.2 out of 12, and 30 out of 32, respectively. Nevertheless, the EU is less stringent regarding *bank activities* and *financial conglomerates*, with a value of 6 out of 12 and 5.9 out of 12, respectively. In terms of *openness in the banking industry*, AF and CAEU are less restrictive compared to other economic blocs, with a value of around 26 out of 32. Therefore, the banking industry in emerging markets seems to be more open, with a value of 26.8 out of 32 compared to developed markets that, on average, have a value of around 31 out of 32. See Table A3-1 in Appendix, which summarises the statistics based on the economic blocs and economic development.

The *supervision* seems more powerful and independent across the whole sample, with a value of 12.8 out of 16 for *supervisory power* and 1.7 out of 3 for *supervisory independence*. However,

with the exception of APEC, all economic blocs appear below the *supervisory power* average. Contrarily, as Appendix table A3-1 shows; unlike other economic blocs that have *supervisory independence,* the EU is above average at 1.8 out of 3. The average *tenure of a supervisor* is around 11 years for the whole sample. However, on the opposite side of the whole sample, *tenure supervision* in the EU is below the total average of around 7 years and above the total average in APEC at around 13 years.

Table 3-3 indicates the high practice for the principles of *transparency* that averages at around 95% across the whole sample. In this regard, the best practice is concentrated in developed economies; for example, the EU has around 92% average *transparency* compared to APEC that has around 99%.

Table 3-4: Correlation Matrix among variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Efficiency (1)	1											
Capital adequacy (2)	-0.1761	1										
Tier 1 (3)	0.0047	0.9709	1									
Size (4)	0.5442	-0.2792	-0.1408	1								
Bank activities (5)	-0.2978	0.1746	0.0523	-0.3094	1							
Financial conglomerate (6)	-0.3465	0.1761	0.0652	-0.257	0.6758	1						
Openness in banking industry (7)	-0.3035	0.0732	0.0095	-0.0768	0.0415	0.0554	1					
Transparency index (8)	-0.4221	0.0844	0.0807	-0.2262	0.0883	0.1257	0.1766	1				
Supervisory power (9)	-0.3578	0.1634	0.0417	-0.311	0.4085	0.2337	0.2678	0.1465	1			
Supervisory independence (10)	0.004	0.0285	0.0042	0.0609	0.1951	0.2918	-0.0692	0.1001	0.0933	1		
Tenure supervisors (11)	-0.3077	0.1001	0.0325	-0.0204	0.2469	0.4119	0.3824	0.1257	0.2492	-0.013	1	
Governance index (12)	-0.3938	0.0951	0.0609	-0.2374	0.0133	0.146	0.2377	0.5952	0.0841	0.0859	0.0523	1
Diversification index (13)	0.0123	-0.0492	-0.0153	0.0257	-0.3963	-0.3862	0.1808	-0.0983	-0.138	-0.6466	-0.073	-0.0361
Inflation (14)	0.2702	-0.0301	-0.0214	0.0576	0.0077	-0.114	-0.1333	-0.3036	-0.0314	-0.1043	-0.1072	-0.3863
GDP (15)	0.1883	0.0292	0.0135	0.0169	-0.0338	-0.1142	0.0054	-0.2194	0.0494	-0.2495	0.0419	-0.2566
	(13)	**(14)**	**(15)**									
Diversification index (13)	1											
Inflation (14)	0.0804	1										
GDP (15)	0.2684	0.1605	1									

However, less developed countries have a poor practice of *transparency* principles. For instance, AF has around 31% and CAEU has about 50%. Contrarily, as shown in Appendix Table A3-1, USAN seems good at implementing *transparency* principles, at around 71%. Furthermore, rich oil states suffer from poor *transparency* practice at about 47%; this is consistent with developing economies that have around 50%.

In this regards, Table 3-3 shows best *governance* practice across sample, at around 92%. Contrarily, when compared to the EU at 99% and APEC at 95%, AF with 19%, CAEU at 44%, and USAN at 46% present weak *governance* practices. However, both CAEU and USAN are not far from the stability point that is 50%.

For *diversification*, Table 3-3 indicates the low levels of *diversification* in overall samples at around 33%, whereas CAEU seems to reap some benefits of *diversification* at around 65%. In general, both developed and developing countries are suffering from a low level of *diversification*. This may be either due to the worldwide economic recession or due to the repercussions of the financial crisis, along with political conflicts in some regions.

We used *size*, *inflation*, and *growth* as the control variables. We enhanced the symmetry of *size* and *growth* by using a logarithm. *Size* varies considerably from bank to bank; it has a range between 1.4 and 4.3 and a mean of around 2.5. In a similar manner, there are variations in *GDP* from country to country; the minimum *GDP* is around −2, while the maximum *GDP* is at around 1.8. Finally, the average *inflation* is around 2.6 % across the sample and, as Appendix table A3-1 shows, AF and USAN indicate high rates of *inflation* at 5.6% and 7.2% respectively. These preliminary descriptive statistics provide a good understanding of the relationship between efficiency and financial regulation and show the variations across the sample. The next section demonstrates how the correlation matrix is performing and explains the relationship between *efficiency* scores as a dependent variable and other explanatory indicators.

Correlation matrix:

To examine further the relationship between *bank efficiency* and financial regulation, Table 3-4 reports the matrix of correlation. It must be noted that correlation does not imply causality;

however, most explanatory variables coincide with our expectations. The results seem to suggest that there is a positive correlation between *capital adequacy*, *Tier 1*, *size*, *inflation*, *GDP*, and *bank efficiency*. Contrarily, there is a negative correlation sign between bank *activities' restrictions*, *financial conglomerates*, *transparency*, *supervisory power*, and *tenure supervisors*. In addition, the results show a strong positive correlation between capital adequacy and Tier 1 that is around 0.97.

Contrary to our hypotheses, there is a negative correlation between average *governance* indicator and *bank efficiency*. Even more interestingly and unlike other supervisory indicators, there is a positive correlation between *supervisory independence* and *bank efficiency*. However, not all previous results take into account the influences of the interrelationship between explanatory and control variables. We explore these in our econometric model.

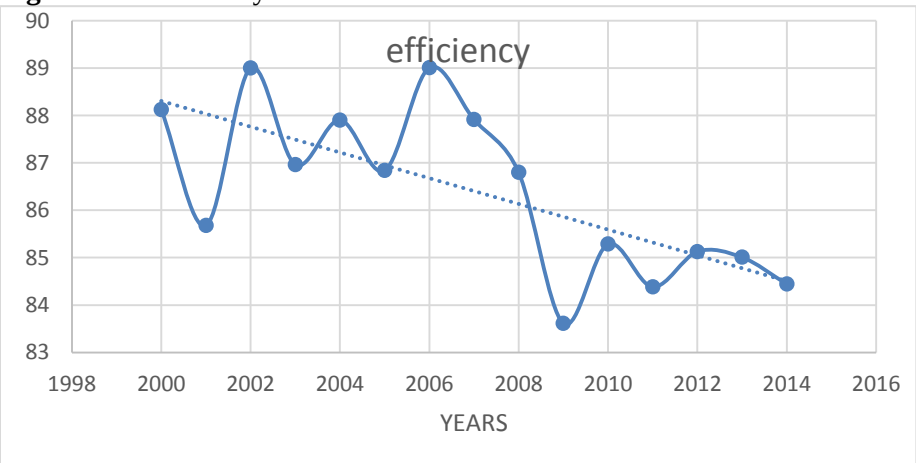
Table 3-5: Weighted mean of efficiency scores across countries

Countries	Mean	Bank No	Countries	Mean	Bank No
ALGERIA	87.11	5	MALAWI	79.75	5
ARGENTINA	88.06	10	MALAYSIA	74.19	27
AUSTRALIA	94.83	17	MALTA	47.35	7
AUSTRIA	68.67	41	MAURITIUS	90.06	15
BAHRAIN	91.59	9	MEXICO	82.01	41
BELGIUM	74.70	16	MOROCCO	88.49	5
BENIN	76.02	1	MYANMAR	76.78	2
BOLIVIA	52.00	5	NAMIBIA	77.77	5
BOTSWANA	86.48	7	NETHERLANDS	94.50	25
BRAZIL	92.94	87	NEW ZEALAND	86.04	17
BULGARIA	28.49	16	NIGER	70.98	1
BURKINA FASO	78.76	1	NIGERIA	88.98	16
BURUNDI	90.35	1	OMAN	89.48	6
CAMBODIA	9.46	11	PALESTINIAN TERRITORIES	75.14	2
CANADA	88.78	37	PAPUA NEW GUINEA	20.58	2
CHILE	93.32	22	PARAGUAY	60.36	2
CHINA	79.53	152	PERU	80.79	14
COLOMBIA	88.40	10	PHILIPPINES	42.20	36
COTE D'IVOIRE	70.18	1	POLAND	52.06	34
CROATIA	41.68	26	PORTUGAL	66.20	16
CYPRUS	40.02	10	QATAR	90.95	6
CZECH REPUBLIC	52.82	17	REPUBLIC OF KOREA	68.96	13
D. REPUBLIC OF CONGO	60.94	1	ROMANIA	34.20	20
DENMARK	93.34	32	RUSSIAN FEDERATION	41.40	99

ECUADOR	54.37	15	RWANDA	68.23	4
EGYPT	88.03	22	SAUDI ARABIA	91.82	8
ESTONIA	66.69	6	SENEGAL	81.57	3
ETHIOPIA	88.61	2	SEYCHELLES	84.95	2
FINLAND	91.56	22	SIERRA LEONE	72.36	6
FRANCE	92.00	37	SINGAPORE	82.91	9
GAMBIA	75.46	3	SLOVAKIA	38.84	8
GERMANY	92.37	86	SLOVENIA	36.94	14
GHANA	79.44	17	SOUTH AFRICA	90.86	13
GREECE	41.59	8	SPAIN	88.15	20
GUYANA	45.99	3	SUDAN	78.45	1
HONG KONG	80.45	29	SURINAME	33.89	3
HUNGARY	50.70	16	SWAZILAND	84.38	3
INDONESIA	44.86	67	SWEDEN	98.69	25
IRAQ	81.82	2	SYRIAN ARAB REPUBLIC	70.03	9
IRELAND	72.54	8	THAILAND	50.73	19
ITALY	88.75	71	TUNISIA	83.67	2
JAPAN	92.98	137	UGANDA	83.41	16
JORDAN	86.00	11	UNITED ARAB EMIRATES	91.86	16
KENYA	87.55	28	UNITED KINGDOM	95.82	57
KUWAIT	86.12	5	UNITED STATES OF AMERICA	73.59	5905
LAO PEOPLE'S DEMOCRATIC REPUBLIC..	9.44	4	URUGUAY	46.88	3
LATVIA	37.35	17	VENEZUELA	71.14	23
LEBANON	82.38	33	VIETNAM	34.90	22
LESOTHO	83.62	1	YEMEN	73.52	4
LITHUANIA	45.77	8	ZAMBIA	71.49	10
LUXEMBOURG	81.88	30	ZIMBABWE	70.96	9
Total			102 Countries	85.67	7853 Banks

Scores based on economic blocs

Figure 3-1: Efficiency across time



3.4. Empirical results

3.4.1. Efficiency scores:

Table 3-5 summarizes the weighted mean of *efficiency* scores across countries. The second and fifth columns give the weighted mean (via total assets) of individual banks in each country. Although the overall sample size is too large to provide accurate scores in detail for each bank, it is worth noting that more developed countries tend to have higher bank *efficiency*. For instance, developed countries, such as Australia, Denmark, France, Germany, Sweden, the United Kingdom, and Japan, have higher *efficiency* scores that are up to 90%. However, and at a more general level, other developed countries, such as New Zealand, Canada, Swaziland, Spain, and Italy coupled with some developing countries, such as Argentina, Hong Kong, Singapore, Mexico, Morocco, Oman, and Jordan, tend to have efficiency scores close to the total mean level that is around 86%. Heavily indebted countries, such as Bolivia, Guyana, Papua New Guinea, Lao People's Democratic Republic, and Vietnam, have poor efficiency scores that are between 52% and 9%.

Furthermore, the effects of a financial crisis had an impact on the USA's *efficiency* score that is at around 74%. Contrarily, some EU countries, such as Greece, have poor *efficiency* scores; this may be due to the debt crisis. However, some Latin American and African countries, such as Brazil and Chile, and South Africa, benefit from high degrees of political and economic stability and sustained growth. Thus, those countries achieve higher *efficiency* scores that are up to 90%. Moreover, it is interesting, but not surprising, that some oil exporting countries reap the benefits of the high price of oil. Bahrain, Qatar, Saudi Arabia, and the United Arab Emirates are interesting examples of such countries. Hence, these countries achieved higher *efficiency* scores of up to 90%, owing to a reasonable degree of control of corruption (that is between 60% and 85%). However, although it had the largest amount of exported oil, the Russian Federation achieved a low-efficiency score of 41%; this may be due to heavy levels of corruption with a poor degree of corruption control[14].

[14] All percentages are based on The Worldwide Governance Indicators (WGI)

Moreover, Figure 3-1 gives an overview of the *efficiency* over time. The average *efficiency* score drops to around 3.5% between 2000 and 2014. The sharpest decline occurred between 2007 and 2009 when the *efficiency* score reached its lowest level of 83.5%. Hence, the influences of the global financial crisis were evident, particularly when the overall efficiency deteriorated in 2009. Figure 3-1 also indicates that the overall *efficiency* improved considerably in 2010 up to 85% and that there was some stability between 85% and 84% after 2010.

Additionally, Figure A3-1 in the Appendix shows the average *efficiency* across economic blocs. The AF is an interesting example of a weak *efficiency* score that might be due to poor *governance practices*. Contrarily, USAN shows high average *efficiency* at around 90%. Indeed, the democratic regimes in some large economies in Latin American have shown remarkable financial stability. Countries, such as Chile and Brazil, have sustainable economic growth and considerable governance practices. The EU has an average *efficiency* of around 90% coupled with high governance practices; this is despite the presence of pressure from some countries, such as Greece, with governments' debt crises.

In the APEC region, following poor governance in some socialist countries, the 2008 financial crisis has influenced efficiency scores that are at around 80%; these are lower than the scores of the EU region. Contrarily, although CAEU has weak governance practices, this region reaps the benefits of a high oil price, especially with more than 50% of data representing GCC[15] countries.

Finally, Figure A3-2 in the Appendix gives the general picture about bank efficiency and income level. We noted that when compared with less developed countries, developed countries tended to have higher *efficiency* scores. This might reflect the high degree of governance practice. Although the oil exporting countries (FEC) seem to have a low efficiency that may have been due to poor governance in some oil economies, other countries, such as GCC countries, have high-*efficiency* scores; additionally, banks in GCC countries reap the benefits of higher oil prices.

[15] Gulf Cooperation Council (GCC) that includes Saudi Arabia, Arab Emirates, Qatar, Bahrain, and Oman

Table 3-6: Estimation results for banks' efficiency across countries with crisis period

	(1)	(2)	(3)	(4)	(5)
			Crisis		
VARIABLES	IV	IV	IV(Before)	IV(During)	IV(After)
Capital requirement					
Capital adequacy t-1	0.262***		0.194***	1.276***	0.216***
	(0.0158)		(0.0206)	(0.174)	(0.0223)
Tier 1 t-1		0.121***			
		(0.0167)			
Market contestability					
Bank activities	-0.712***	-0.682***	0.494	-1.429*	0.632***
	(0.165)	(0.132)	(0.399)	(0.751)	(0.219)
Financial conglomerate	-0.628***	-0.890***	-0.723***	-1.135	-0.732***
	(0.117)	(0.0952)	(0.361)	(0.863)	(0.161)
Openness in banking industry	-0.424***	-0.695***	-1.256***	0.0496	-0.139*
	(0.0545)	(0.0454)	(0.101)	(0.230)	(0.0717)
Supervision					
Supervisory power	-1.966***	-1.379***	0.492**	-0.277***	-1.521***
	(0.111)	(0.0896)	(0.233)	(0.414)	(0.153)
Supervisory independence	-0.384***	-0.570***	-0.341***	-0.636***	-0.423***
	(0.301)	(0.245)	(0.692)	(1.510)	(0.457)
Tenure supervisors	-0.812***	-0.971***	-0.660***	0.163	-0.822***
	(0.0385)	(0.0316)	(0.129)	(0.217)	(0.0961)
Transparency					
Transparency index	-0.779***	-0.767***	-1.067***	-0.430***	-0.604***
	(0.0215)	(0.0175)	(0.0430)	(0.0936)	(0.0309)
Governance indicators					
Governance index	0.210***	0.0923***	0.674***	-0.135*	-0.0178
	(0.0178)	(0.0144)	(0.0373)	(0.0735)	(0.0239)
Diversification					
Diversification index	-1.467***	-1.388***	-1.516***	0.0994	1.853***
	(0.353)	(0.282)	(0.749)	(2.352)	(0.785)
Size t-1	0.513***	0.401***	0.433***	0.320***	0.322***
	(0.158)	(0.142)	(0.242)	(1.371)	(0.221)
Inflation	1.415***	0.908***	1.149***	1.950***	1.321***
	(0.0781)	(0.0665)	(0.0951)	(0.383)	(0.164)
Log GDP	1.710***	1.275***	1.823***	0.555	-0.626
	(0.541)	(0.471)	(0.746)	(3.927)	(0.883)
Constant	8.511***	1.103***	7.982***	3.619**	7.794***
	(2.571)	(1.994)	(4.619)	(16.59)	(3.683)
Observations	76,611	79,093	39,936	1,659	34,142
R-squared	0.564	0.564	0.588	0.534	0.613
Chi2	0.0000	0.0000	0.0000	0.0000	0.0000
1st –stage F test (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000
Number of banks	7853	7853	5706	5706	6829
Countries	102	102	99	99	102

The dependent variable is bank efficiency that is computed by the Semi-Oriented Radial Measure (SORM) DEA. We capture the dynamic nature of capital adequacy, Tier 1 and size via first lagged. We estimate regressions based on Instrumental-Variables (IV). Instrumental variables of bank regulations are regions, ethnics, legal origins, religions and second lagged of capital adequacy. P-values are calculated through the heteroscedasticity-robust and with robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Crisis: before 2000-2006; during 2007-2009; after 2010-2014

3.4.2. Main results

Table 3-6 presents our main regression results for the unbalanced panel of 7,897 banks across 102 countries in the period from 2000 to 2014. The dependent variable is DEA bank efficiency, where scores are based on SORM estimation. The explanatory variables are financial regulations, supervision, governance and macroeconomic indicators.

The primary finding of this research seems to be that there are variations in the impact of financial regulation and supervision on bank efficiency across time, economics blocs, and economic development. This might emphasize that macro-events like intergovernmental trade agreements (economics blocs), financial crises, and economic development may affect the relationship between financial regulation, supervision, and bank efficiency, which appears below in detail.

Other key finding in this study is that capital requirement stringency, coupled with good governance practices, tends to enhance bank efficiency. Contrarily, less stringent capital requirement impedes bank efficiency in less-developed countries. In addition, it is positive and marginally significantly related to bank efficiency in fuel-exporting countries. Moreover, the results show that the strengthening of supervisory power is negatively significant in explaining bank efficiency in countries having disconnected supervisory authorities. Contrarily, supervisory independence, coupled with highly experienced authority, tends to enhance bank efficiency in more developed countries.

Capital requirement:

As indicated by its positive and significant at the 1% level coefficient, the (1) column reveals that more stringent *capital requirement* is associated with high bank *efficiency*. This positive relationship shows the essential role of capital requirement as a buffer against bank risk and as a tool; this enhances bank *efficiency*. This result is consistent with the public interest view that stringency of capital regulation tends to ameliorate market failures (Barth et al. (2013b), and Pessarossi and Weill (2014)). Additionally, the results, as revealed in columns (3), (4), and (5), depict a positive influence on bank efficiency before, during, and after the crisis.

Activity restrictions:

As shown in Table 3-6 columns (1) and (2), more stringent bank *activity restrictions* are associated with lower bank *efficiency*, with a negative significance at the 1% level. Hence, the result suggests that although high restrictions on *bank activities* may assist in reducing bank risk, it may impede banks from reaping the gains of diversification and reducing the incentives for managers for further investments (Pasiouras et al. (2009) and Barakat and Hussainey (2013)). Moreover, column (4) reveals that, during the financial crisis, more restrictions on *bank activities* are negative and marginally significant at the 10% level related to *bank efficiency*. Contrarily, and as seen in column (5), after the mortgage crisis, more stringent bank *activity restrictions* enhanced *bank efficiency*. The finding shows that, due to the financial crisis, the reforms in financial institutions led to the creation of new regulations, which drive to improve bank efficiency. Also, enhanced monitoring and supervision provisions (Lozano-Vivas and Pasiouras, 2010).

Financial conglomerates:

About the impact of *financial conglomerates* on *bank efficiency*, columns (1) and (2) indicate that there is a negative association between a *financial conglomerate* and *bank efficiency*. This finding suggests that it is the type of activity, rather than the size, that might influence bank efficiency. Thus, although expansion activities may enhance bank efficiency due to lower levels of risk, expansion activities with weak macro- and micro-supervision may enhance the levels of risk and impede bank efficiency (Wehinger, 2012). In addition to the third market contestability dimension in this study, we find, as shown in columns (1) and (2), that there is a highly significant negative coefficient of *openness in the banking industry* concerning *bank efficiency*. Contrarily, as shown in column (5), it became marginally significant after the financial crisis. This finding reveals that, in practice, new entrants to the banking industry may contribute towards increasing the pressures of competition and weakening efficiency, owing to a poor monitoring and supervision environment (Vives, 2001). However, this picture has changed slightly owing to the reforms in the financial system, which followed the financial crisis.

Supervisory:

Furthermore, columns (1) and (2) in Table 3-6 present regressions of *bank efficiency* with *supervisory power* and *supervisory independence* that are negatively significant in explaining bank efficiency. This suggests that powerful and isolated supervisors other supervisors to focus on promoting their private interests rather than focusing on overcoming market failures (Barth et al., 2013b). Therefore, *supervision* may impede *banking efficiency* if supervisors focus on their private benefits. Moreover, *supervisory power* not only negatively influences efficiency but a highly *independent supervisory* may also impede *banking efficiency* because the acceptable role of a government may create acceptable powers of supervision that assist in controlling corruption. However, the absence of a governmental role may encourage financial officials to use their power to gain private benefits. Moreover, it is clear that long supervisory tenure is associated negatively with bank efficiency. Hence, besides supervisory independence, *a longer tenure* may attract *supervisors* to get private benefits.

Transparency and corporate governance:

Moreover, Table 3-6 reveals that *transparency* has a negative influence on *bank efficiency*. This result may indicate that *banking efficiency* is reduced due to the release of certain sensitive information such as low *transparency* of insolvency, conflict between minority and majority investors, and conflict between investors and managers. Furthermore, the release of sensitive information may enhance competitors' positions (Pasiouras et al., 2009), while releasing bad information may cause a surge in the deposit interest rates because of riskier states and banks' lowered franchise values (Chen and Hasan, 2006). It is understood that effective *corporate governance* practices are conducive to a better financial institutional environment, and, as can be seen in columns (1) and (2), *governance* reinforces bank efficiency as result of an effective environment. Additionally, as columns (3), (4) and (5) show, the result is consistent before, during, and after the financial crisis ((Barth et al., 2013b), and (Qian and Yeung, 2015). Moreover, as shown in Table 3-6, columns (1) and (2), the influence of *diversification* is negative and significant at the 1% level. This result indicates that loan *diversification* has a negative effect on *bank efficiency* due to the high cost of loans (Berger et al., 2010), while asset *diversification* has a negative influence on bank efficiency owing to high volatility in some assets

(Stiroh and Rumble, 2006). However, the reform[16] in the financial system due to the financial crisis was imposed on the banks to ensure that banks adopt regulations that introduce a riskier treatment for their assets. Therefore, after a financial crisis, the *diversification* had a positive influence on *bank efficiency*.

Concerning the impact of other control variables on *bank efficiency* (Table 3-6), the results indicate that the macroeconomic environment conditions, *inflation*, and *GDP* are positively associated with bank efficiency. Hence, the correct anticipation of *inflation* helps banks to manage their expenses and, depending on the change in the *inflation rate*, assists banks in adjusting interest rates ((Perry, 1992)and (Tan and Floros, 2012)). Moreover, high *GDP* reflects high economic growth. Thus, during good or normal times of growth, banks may be more reluctant to deal with non-performing loans. However, banks may be more flexible in providing loans that enhance bank efficiency ((Cuaresma et al., 2014) and (Belke et al., 2016)). Likewise, large banks are associated positively with bank efficiency. This result may be due to the scale or scope of the economies in banking (Barth et al., 2013b).

[16] 'Basel iii introduces a leverage ratio such that the amount of assets and commitments do not represent more than 33 times the regulatory capital, regardless of the level of their risk-weighting'. GREENLEE et al. (2011)

Table 3-7: Estimation results for banks efficiency across economic blocs

	(1)	(2)	(3)	(4)	(5)
	IV	IV	IV	IV	IV
	APEC	EU	USAN	AF	CAEU
Dependent					
SORM EFFICIENCY- DEA					
Independent					
Capital regulation					
Capital adequacy t-1	0.127***	0.744***	-0.0561	0.172	-0.138
	(0.0102)	(0.181)	(0.118)	(0.159)	(0.169)
Market contestability					
Bank activities	1.531***	0.251	1.265***	-0.148	-0.145
	(0.260)	(0.275)	(0.410)	(0.347)	(0.206)
Financial conglomerate	-2.450***	-2.856***	-1.982***	-0.320	0.985***
	(0.189)	(0.437)	(0.300)	(0.366)	(0.293)
Openness in banking industry	-0.508***	-0.325***	1.474***	-0.0587	0.0149
	(0.0772)	(0.108)	(0.258)	(0.0651)	(0.0520)
Supervision					
Supervisory power	-1.793***	-1.672***	-0.928**	0.364	0.777***
	(0.217)	(0.204)	(0.407)	(0.228)	(0.195)
Supervisory independence	1.857***	-1.452***	1.565***	-0.937	-0.146
	(0.505)	(0.499)	(1.033)	(0.819)	(0.407)
Tenure supervisors	-0.762***	-0.246**	-0.754***	-0.232**	-0.140
	(0.0489)	(0.105)	(0.182)	(0.101)	(0.0949)
Transparency					
Transparency index	-0.603***	-0.240***	0.818***	-0.0503	0.106**
	(0.0718)	(0.0444)	(0.0943)	(0.0576)	(0.0528)
Governance indicators					
Governance index	0.601***	0.342***	-0.0483	0.115***	0.151***
	(0.0397)	(0.0314)	(0.0476)	(0.0356)	(0.0379)
Diversification					
Diversification index	-1.570***	1.219***	-1.438***	-0.865	1.677***
	(0.670)	(0.804)	(1.925)	(1.330)	(1.056)
Size t-1	1.274***	1.579***	1.422***	1.917***	1.189***
	(0.107)	(0.521)	(0.858)	(1.016)	(0.853)
Inflation	0.342***	0.178***	-0.145*	0.0905	0.00649
	(0.0653)	(0.0609)	(0.0768)	(0.0854)	(0.114)
Log GDP	2.605***	1.937***	-2.334	-0.00699	1.122***
	(0.429)	(0.989)	(1.581)	(1.464)	(1.135)
Constant	2.313***	2.907**	-1.738*	5.865***	3.535***
	(3.880)	(8.503)	(10.02)	(9.766)	(7.012)
Observations	76,362	4,556	2,144	1,205	1,299
R-squared	0.437	0.322	0.133	0.149	0.291
Chi2	0.0000	0.0000	0.0000	0.0000	0.0000
1st –stage F test (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000
Number of banks	6648	694	197	194	166
Countries	20	28	12	26	16

The dependent variable is bank efficiency that is computed by a semi-oriented radial measure (SORM). We capture the dynamic nature of capital adequacy and size via first lagged. We estimate regressions based on instrumental variables (IV). Instrumental variables of bank regulations are regions, ethnics, legal origins, religions and second lagged of capital adequacy. P-values are calculated through the heteroskedasticity-robust with robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Blocs: APEC is Asia-Pacific Economic Cooperation; EU is the European Union; USAN is Union of South American; AF-blocs are Economic Community of West African States (ECOWAS), Common Market for Eastern and Southern Africa (COMESA) and Southern African Development Community (SADC), while CAEU is Council of Arab Economic Unity (Arab League).

3.4.3. Bank efficiency and regional economic blocs

In Table 3-7, we address the influence of financial regulations across regional economic blocs. Overall, the results indicate some variations across different regional economic blocs. For instance, *capital adequacy* is associated positively with bank efficiency in APEC and the EU. On the contrary, this impact is absent in USAN, AF, and CAEU. This result shows the degree of a bank's financial soundness in APEC and the EU, which is at around 17% and 18%, respectively. However, as can be seen in Appendix Table A3-1, it is at around 13% in and 12% in USAN.

Interestingly, the economic blocs that faced the financial crisis, such as the Latin American crisis in USAN, Asian Financial crisis, and subprime mortgage crisis in APEC, have learned lessons from the crises by managing the conflict of interest between financial authorities and government. Hence, *supervisory independence* has a positive effect on *bank efficiency* in APEC and USAN. Additionally, managers tend to be risk averse in economic blocs where *bank activities* have positive influences on bank efficiency.

In column (4), we find that both *supervisory power* and *supervisory independence*, coupled with the transparency index, are not significant in explaining *bank efficiency* in AF. Contrarily, column (5) shows that *supervisory power* is statistically and positively significant in CAEU. However, 'strengthening *supervisory power* itself does not necessarily lead to higher bank efficiency', specifically, when *supervisory independence* fails to explain bank efficiency (Barth et al., 2013b).

3.4.4. Bank efficiency and income development

Table 3-8 presents the impact of financial regulations on bank efficiency across developed, developing, and oil exporting countries. In general, in developed economies, banks tend to be more efficient when compared to banks in less developed economies. The developed banks' incentives for this higher performance are strength and soundness of the financial system in their countries. As shown in column (1), this view is supported by the positive and significant relationships between *capital adequacy* and *bank efficiency*. However, stringent *capital adequacy* has a negative influence on bank efficiency in less developed countries, while, as

shown in columns (9), (10), (11), and (12), the impacts of *capital adequacy* in fuel-exporting countries are either absent or are marginal.

Another interesting result is the positive effect of *supervisory independence* on bank efficiency in developed economies. This result may reflect the ability and the experience of developed countries in managing conflicts of interest, especially when *official supervisory power* is high. In addition, an efficient governance environment may be the other reason that helps developed countries to manage conflicts of interests. However, there is exception for EU (Table 3-7) where " in EU regulators and supervisors focused on the micro-prudential supervision of individual financial institutions and not sufficiently on the macro-systemic risks of a contagion of correlated horizontal shocks". Thus, EU not consistent with results of developed countries.

Also, as can be seen in column (5), in less developed countries, the lack of experience and a weak governance environment impedes bank efficiency through the negative influence of *supervisory independence* and lack of the influences of *supervisory power*. In exporting oil countries, governance has a marginal influence on efficiency and, as can be seen in columns (9), (10), (11) and (12), *both supervisory power* and *supervisory independence* are negatively significant in explaining *bank efficiency*.

3.4.5. Robustness test: Ordinary Least-Squares (OLS)

Ordinary Least-Squares (OLS) is a widely used method and forms the basis of other unique techniques such as the ANOVA and GLS. We tested our results robustly by using OLS. The major usefulness of OLS is flexibility with dummy variables coding (Hutcheson and Moutinho, 2008). Another advantage of OLS is that it can be utilised for robust to potential endogeneity concerns; hence, the little differences between IV and OLS estimators may dispel this concern ((Cameron and Trivedi, 2009) and (Barth et al., 2013b)).

Our main empirical results in Table 3-6 are robust, as shown by the OLS regression analysis in Appendix Table A3-2. Consequently, *capital requirement, market contestability, supervision, transparency, governance, and diversification* are all statistically significant and consistent with the results in Table A3-2. In a similar manner, the robustness test in Appendix Table A3-3 is consistent with our empirical results in Table 3-7. The tests show that *capital adequacy* is

significant in explaining *bank efficiency* in USAN and AF. Likewise, Table A3-4 in the Appendix is consistent with our empirical results in Table 3-8.

3.5. Conclusion

In the aftermath of the global financial crisis, the world became more concerned about the quality of financial regulations. Hence, significant efforts were made to assess and reform regulations to mitigate, if not prevent, any future financial crises. We contribute to those efforts by investigating whether financial regulations enhance or impede SORM efficiency in 7852 banks across 102 countries over the period 2000–2014. Furthermore, considering the financial crisis, we extend our investigations to cover seven major regional economic blocs, developed countries, less developed countries, and fuel-exporting countries. In addition, we present a new measure of bank efficiency, SORM, to handle negative values in our data.

The key finding in this chapter is that macroeconomic events such as intergovernmental agreement (economic blocs), financial crises, and economic development may lead to variations in the influence of financial regulation and supervision on bank efficiency. A global financial crisis also influences all the regional economic blocs; however, the degree of influence is different from region to region.

Moreover, we find that more-developed countries tend to have higher *bank efficiency*, while, generally, less developed countries, and, particularly, heavily indebted countries have poor efficiency scores. Likewise, some fuel-exporting countries with reasonable governance practices have obtained the benefits of high oil prices and hold higher bank efficiency scores due to the high liquidity levels in their banking industries. Overall, bank efficiency deteriorated in the aftermath of the global financial crisis. Additionally, the remarkable financial stability in some Latin American countries may enhance bank efficiency in this region.

We also find that more stringent *capital requirement* is associated with high *bank efficiency*. This result is absent in regions such as Latin American, Africa, and the Middle Eastern countries where being less developed depicts a negative relationship between *capital requirement* and *bank efficiency*.

Moreover, while positively significant in APEC, our results indicate that *supervisory power* is negatively significant in explaining *bank efficiency* across most economic blocs. This result is associated with a level of *supervisory independence*, especially in the EU region, where both are negatively significant in expounding *bank efficiency*. However, *supervisory independence* in APEC and USAN positively explains *bank efficiency*.

Furthermore, the results of the economic development analysis are consistent with APEC, where in developed economies' *supervisory power* has a negative impact in interpreting coefficients, but has a positive influence concerning *supervision independence*. Contrarily, in the EU, the absence of an acceptable role of government may lead powerful supervisors to obtain some private benefits or may be because supervisors focused on the micro-prudential supervision of individual financial institutions and not sufficiently on the macro-systemic risks. However, *supervisory independence* has a positive effect on *bank efficiency* in APEC countries, which have efficient governance environments and supervisors who are highly experienced in managing the conflicts of interest.

Finally, governance has a positive impact on *bank efficiency*, with the exception being the crisis period when governance has a negative impact on bank efficiency. However, these influences are absent in fuel-exporting countries.

Table 3-8: Instrument variables results, during crisis period, cross economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	DEEC				DIEC				FEC			
		crisis period				*crisis period*				*crisis period*		
VARIABLES	ALL	BEFORE	DURING	AFTER	ALL	BEFORE	DURING	AFTER	ALL	BEFORE	DURING	AFTER
Dependent												
SORM												
EFFICIENCY- DEA												
Independent												
Capital regulation												
Capital adequacy t-1	0.164***	0.127***	0.981***	0.127***	-0.470***	-0.910***	-0.0378	-0.223***	0.0941	0.416*	1.398*	0.252
	(0.0119)	(0.0165)	(0.135)	(0.0154)	(0.0588)	(0.112)	(0.191)	(0.0838)	(0.145)	(0.232)	(0.830)	(0.203)
Market contestability												
Bank activities	-1.537***	-0.516	0.725	0.641**	-0.110	-0.445	-1.112	1.412***	-1.446***	-2.139***	-1.806***	-2.019***
	(0.222)	(0.568)	(0.841)	(0.256)	(0.205)	(0.446)	(0.847)	(0.284)	(0.248)	(0.446)	(1.458)	(0.559)
Financial conglomerate	-0.646***	-1.296***	-1.648	-2.488***	-1.656***	-2.476***	0.0405	-2.941***	-1.254***	2.649***	-1.101***	-1.742***
	(0.140)	(0.598)	(1.049)	(0.190)	(0.216)	(0.492)	(0.887)	(0.302)	(0.416)	(0.974)	(1.972)	(0.510)
Openness in banking industry	-0.847***	-0.583***	-0.459	0.0944	-0.0438	-0.201	1.082***	0.0734	-0.708***	0.194	-2.476	0.469***
	(0.106)	(0.184)	(0.356)	(0.193)	(0.0617)	(0.144)	(0.258)	(0.0746)	(0.0715)	(0.162)	(2.925)	(0.174)
Supervision												
Supervisory power	-2.543***	-0.743**	-2.284***	-2.221***	-0.238	1.781***	-0.564***	-0.692***	-1.041***	-1.472***	-2.286**	-2.250***
	(0.123)	(0.322)	(0.329)	(0.165)	(0.183)	(0.352)	(1.148)	(0.223)	(0.304)	(0.608)	(2.589)	(0.591)
Supervisory independence	1.976***	-1.621	-2.846*	0.241	-1.544***	-1.045	-1.451*	-2.350***	-1.903***	-2.438***	-1.501**	-1.101***
	(0.404)	(0.987)	(1.555)	(0.545)	(0.452)	(0.846)	(2.470)	(0.596)	(0.684)	(1.161)	(5.925)	(1.044)
Tenure supervisors	-0.615***	-0.648***	-0.0523	0.0684	-0.168**	0.750***	0.620**	-1.491***	-0.526***	1.404***	0.866	-2.158***
	(0.0584)	(0.229)	(0.208)	(0.123)	(0.0750)	(0.153)	(0.266)	(0.0989)	(0.100)	(0.197)	(0.864)	(0.228)
Transparency												
Transparency index	-0.261***	-0.293***	-0.0353	-0.112***	-0.780***	-0.818***	-0.307*	-0.664***	-0.130*	-0.174**	1.329*	0.568***
	(0.0229)	(0.0502)	(0.0825)	(0.0288)	(0.0356)	(0.0637)	(0.164)	(0.0473)	(0.0679)	(0.0874)	(0.693)	(0.149)
Governance indicators												
Governance index	0.791***	1.200***	0.266***	0.486***	0.270***	0.231***	-0.109	0.164***	0.0897*	0.143	-0.630	-0.0985
	(0.0255)	(0.0457)	(0.0760)	(0.0332)	(0.0289)	(0.0694)	(0.154)	(0.0319)	(0.0443)	(0.0884)	(0.506)	(0.0590)
Diversification												
Diversification index	-1.906***	-1.454***	1.125	2.774***	1.864***	2.502***	-1.330***	1.112***	1.861***	1.640***	-1.857	1.768***
	(0.446)	(1.225)	(2.138)	(0.853)	(0.809)	(1.695)	(3.528)	(0.972)	(1.752)	(3.936)	(7.695)	(2.369)
Size t-1	1.345***	1.317***	2.554***	1.180***	2.561***	0.335	1.620***	2.491***	1.292***	1.602***	1.222***	1.377***

	(0.127)	(0.190)	(1.165)	(0.175)	(0.490)	(0.929)	(1.820)	(0.597)	(0.956)	(1.643)	(2.926)	(1.342)
Inflation	2.701***	1.502***	1.240***	2.373***	0.407***	0.237**	2.517***	0.204	0.396***	0.416**	-1.483**	-0.0136
	(0.137)	(0.124)	(0.476)	(0.135)	(0.0793)	(0.0950)	(0.511)	(0.138)	(0.103)	(0.189)	(1.415)	(0.173)
Log GDP	2.542***	4.544***	-1.262	-2.172***	-2.606**	-1.237	-1.378	-1.271***	-2.890***	-2.212***	-2.609***	0.356
	(0.578)	(0.600)	(3.087)	(0.902)	(1.075)	(2.290)	(9.243)	(1.427)	(1.840)	(1.912)	(16.75)	(3.603)
Constant	5.242	-3.828***	-3.121*	-1.571	9.702***	5.792***	8.294***	1.904***	1.545***	5.868***	4.918***	8.928***
	(4.393)	(8.278)	(17.27)	(7.052)	(4.454)	(9.658)	(23.85)	(5.662)	(9.565)	(15.33)	(70.63)	(17.10)
Observations	70,346	37,684	1,309	31,130	7,269	2,678	459	3,301	1,706	614	92	799
R-squared	0.503	0.595	0.570	0.483	0.129	0.113	0.329	0.269	0.712	0.703	0.844	0.808
Chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1st –stage F test (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Banks	6809				1089				357			
Countries	33	33	33	33	69	69	69	69	22	22	22	22

The dependent variable is bank efficiency that is computed by (SORM) DEA. We capture the dynamic nature of capital adequacy, Tier 1, and size via first lagged of capital adequacy. We estimate regressions based on instrumental variables (IV). Instrumental variables of bank regulations are regions, ethnics, legal origins, religions, and second lagged of capital adequacy. P-values are calculated through the heteroskedasticity-robust and with robust standard errors in parentheses *** p<0.01, and ** p<0.05, * p<0.1. Economies are DEEC Developed Economies, DIEC is Developing Economies, and FEC is Fuel- Exporting Countries.

Crises: Before2000-2006; during2007-2009; after2010-2014.

Appendix

Table A3-1: Summary Statistics of Economic blocs and economic levels

Panel A

Blocs		**Efficiency**	**Capital adequacy**	**Tier 1**	**Bank activities**	**Financial conglomerate**	**Openness in banking industry**	**Transparency index**	**Super- power**	**Supervisory independence**	**Tenure supervisors**	**Diversification index**	**Governance index**	**Size**	**Inflation**	**GDP**
APEC	*Obs*	8161	8161	8161	8159	8159	8161	8159	8159	8159	7759	8161	8159	8161	8159	8161
	Mean	82.10	17.04	15.62	8.464	8.537	30.75	0.996	13.13	1.714	11.77	0.317	0.953	2.308	2.378	0.350
	Std. Dev.	18.15	6.773	6.795	0.848	1.196	2.895	0.058	0.966	0.485	2.928	0.465	0.211	0.713	1.647	0.218
	Min	0.01	0	0	3	3	0	0	6	0	2	0	0	1.255	-1.710	-1.113
	Max	69.83	34.78	32.7	12	10.5	32	1	16	3	21	1	1	4.495	24.99	1.182
AF	*Obs*	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923	1923
	Mean	67.55	13.89	9.057	8.381	7.654	26.05	0.312	12.04	1.557	9.249	0.419	0.189	2.654	8.467	0.634
	Std. Dev.	6.201	11.50	10.73	1.706	1.379	8.267	0.463	2.360	0.685	5.890	0.493	0.392	0.773	5.663	0.306
	Min	12.82	0	0	6	4	0	0	5	0	0	0	0	1.255	-8.237	-1
	Max	69.83	34.78	32.7	12	11	32	1	15	3	22.5	1	1	4.495	44.39	1.419
EU	*Obs*	7329	7330	7330	7330	7330	7330	7330	7330	7330	7330	7330	7330	7330	7330	7330
	Mean	90.14	18.16	6.920	6.023	5.930	30.01	0.922	10.27	1.882	7.477	0.473	0.998	3.315	2.058	0.188
	Std. Dev.	21.65	12.41	8.262	1.803	1.194	3.926	0.267	2.116	0.800	4.582	0.499	0.043	0.819	4.869	0.431
	Min	0.33	0	0	3	3	0	0	5	0	0	0	0	1.255	-59.41	-1.968
	Max	69.83	34.78	32.7	11	9	32	1	14.5	3	20	1	1	4.495	45.66	1.065
USAN	*Obs*	2145	2145	2145	2145	2145	2145	2145	2145	2145	2145	2145	2144	2145	2145	2145
	Mean	91.82	12.53	6.438	7.449	6.919	30.27	0.710	12.60	1.289	12.15	0.204	0.463	3.043	7.228	0.460
	Std. Dev.	16.70	11.26	9.761	2.223	2.227	4.240	0.453	1.853	0.824	4.618	0.403	0.498	0.800	11.07	0.426
	Min	2.24	0	0	4	3	12	0	5	0	4	0	0	1.255	-0.162	-1.300
	Max	69.83	34.78	32.7	12	12	32	1	15	3	21	1	1	4.495	96.09	1.262
CAEU	*Obs*	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388	1388
	Mean	93.63	16.31	10.416	7.692	7.484	27.91	0.507	11.01	1.099	8.577	0.652	0.439	3.489	2.901	0.554
	Std. Dev.	6.558	8.962	9.149	1.683	1.896	7.353	0.133	2.505	1.001	4.289	0.476	0.496	0.710	4.807	0.359
	Min	13.06	0	0	3	4	0	0	5	0	0	0	0	1.477	-10.06	-0.893
	Max	69.83	34.78	32.7	12	12	32	1	14.5	3	15	1	1	4.495	53.23	1.733

Panel B

income level	Variable	Efficiency	Capital adequacy	Tier 1	Bank activities	Financial conglomerate	Openness in banking	Transparency index	Supervisory power	Supervisory independence	Tenure supervisors	Diversification index	Governance index	Size	Inflation	GDP
DIEC	*Obs*	9910	9910	9909	9898	9898	9910	9898	9898	9898	7699	9909	9896	9910	9897	9285
	Mean	79.89	14.39	8.978	7.839	7.379	26.81	50.03	11.70	1.431	10.59	0.435	40.60	3.229	6.107	0.639
	Std. Dev.	31.67	11.34	9.726	2.341	1.806	7.724	11.66	2.367	0.839	5.271	0.495	16.55	0.878	6.877	0.344
	Min	11.12	0	0	3	3	0	0	5	0	0	0	0	1.579	-10.06	-1.300
	Max	100	40.9	31.8	12	12	32	78.89	16	3	22.5	1	89.23	4.989	96.09	1.733
DEEC	*Obs*	84486	84488	84488	84488	8448	8448	8448	8448	8448	8268	8448	8448	8448	8448	7462
	Mean	88.67	16.96	15.40	8.285	8.368	30.98	81.69	12.98	1.737	11.39	0.322	85.03	2.336	2.184	0.362
	Std. Dev.	17.22	6.370	6.659	1.024	1.362	2.03	6.362	1.227	0.498	3.268	0.467	4.666	0.726	1.774	0.209
	Min	1.84	9.62	4.78	3	3	0	35	5	0	0	0	43.95	1.278	-59.41	-1.968
	Max	57.95	34.06	32.6	11	10	32	84.41	14.5	3	20	1	99.66	4.417	45.66	1.065
FEC	*Obs*	3758	3758	3758	3758	3758	3758	3758	3758	3758	2542	3758	3758	3758	3758	3508
	Mean	72.26	13.39	6.8576	7.994	7.555	26.46	47.00	11.68	1.537	10.6	0.406	33.51	3.229	8.252	0.650
	Std. Dev.	35.29	10.86	8.297	2.406	1.835	8.171	9.220	2.756	0.867	6.231	0.491	14.22	0.761	9.032	0.276
	Min	7.11	0	0	3	4	0	15.83	7	0	0	0	1.95	1.662	-10.06	-0.915
	Max	100	37.4	24.13	12	12	32	78.89	16	3	22.5	1	73.68	4.642	96.09	1.733

Figure A3-1: Efficiency across economic blocs

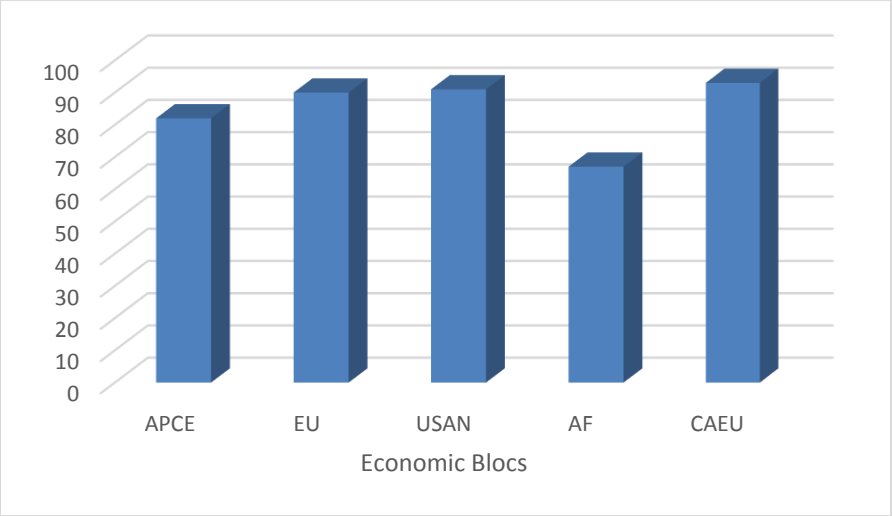


Figure A3-2: Efficiency across economic development

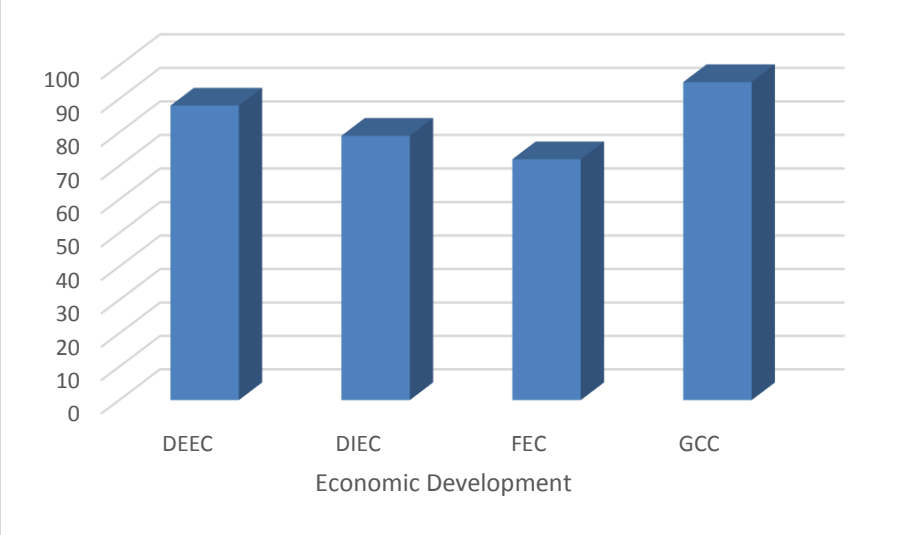


Table A3-2: Estimation results for banks' efficiency across countries, with the crisis period

	(1)	(2)	(3)	(4)	(5)
			Crisis		
VARIABLES	OLS	OLS	OLS(Before)	OLS(During)	OLS(After)
Independent					
Capital requirement					
Capital adequacy t-1	0.265***		0.242***	1.205***	0.167***
	(0.0116)		(0.0148)	(0.130)	(0.0173)
Tier 1 t-1		0.109***			
		(0.0112)			
Market contestability					
Bank activities	-0.711***	-0.679***	0.514	-1.478**	0.612***
	(0.165)	(0.132)	(0.399)	(0.744)	(0.219)
Financial conglomerate	-0.629***	-0.882***	-0.699***	-1.121	-0.711***
	(0.117)	(0.0951)	(0.360)	(0.865)	(0.161)
Openness in banking	-0.424***	-0.696***	-1.255***	0.0496	-0.142**
industry	(0.0545)	(0.0454)	(0.100)	(0.231)	(0.0718)
Supervision					
Supervisory power	-1.965***	-1.374***	0.482**	-2.272***	-1.529***
	(0.111)	(0.0894)	(0.233)	(0.416)	(0.154)
Supervisory independence	-0.385***	-0.570***	-0.344***	-0.568***	-0.400***
	(0.301)	(0.245)	(0.692)	(1.518)	(0.457)
Tenure supervisors	-0.810***	-0.970***	-0.661***	0.160	-0.827***
	(0.0385)	(0.0316)	(0.129)	(0.217)	(0.0961)
Transparency					
Transparency index	-0.779***	-0.766***	-1.063***	-0.435***	-0.606***
	(0.0215)	(0.0174)	(0.0429)	(0.0934)	(0.0310)
Governance indicators					
Governance index	0.211***	0.0927***	0.674***	-0.140*	-0.0192
	(0.0178)	(0.0144)	(0.0372)	(0.0729)	(0.0239)
Diversification					
Diversification index	-1.466***	-1.383***	-1.463***	0.0421	2.905***
	(0.353)	(0.282)	(0.748)	(2.357)	(0.785)
Size t-1	0.554***	0.403***	0.451***	0.390***	0.309***
	(0.152)	(0.138)	(0.235)	(1.251)	(0.214)
Inflation	1.415***	0.907***	1.144***	1.922***	1.322***
	(0.0781)	(0.0665)	(0.0949)	(0.380)	(0.164)
Log GDP	1.710***	1.277***	1.812***	0.735	-0.571
	(0.541)	(0.472)	(0.746)	(3.928)	(0.884)
Constant	8.500***	1.103***	7.797***	3.919**	7.960***
	(2.522)	(1.994)	(4.559)	(15.59)	(3.627)
Observations	76,611	79,093	39,936	1,659	34,142
R-squared	0.564	0.564	0.588	0.535	0.614
Chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Number of banks	7853	7853	5706		6829
Countries	102	102	99	99	102

The dependent variable is bank efficiency that is computed by using the Semi-Oriented Radial Measure (SORM) DEA. We capture the dynamic nature of capital adequacy, Tier 1 and size via first lagged. We estimate regressions based on Ordinary Least-Squares (OLS). P-values are calculated through the heteroscedasticity-robust and with robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Crisis: before 2000-2006; during 2007-2009; after 2010-2014

Table A3-3: Estimation of results for banks' efficiency across economic blocs

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	OLS	OLS
	APEC	EU	USAN	AF	CAEU
Dependent					
SORM EFFICIENCY- DEA					
Independent					
Capital regulation					
Capital adequacy t-1	0.122***	0.650***	0.177***	0.391***	0.0779
	(0.00772)	(0.0825)	(0.0654)	(0.0640)	(0.0773)
Market contestability					
Bank activities	1.529***	0.229	1.364***	-0.0140	-0.142
	(0.260)	(0.275)	(0.407)	(0.340)	(0.203)
Financial conglomerate	-2.450***	-2.870***	-1.899***	-0.318	0.970***
	(0.189)	(0.438)	(0.297)	(0.372)	(0.293)
Openness in banking industry	-0.508***	-0.318***	1.443***	-0.0567	0.00821
	(0.0772)	(0.107)	(0.252)	(0.0652)	(0.0512)
Supervision					
Supervisory power	-1.796***	-1.669***	-1.114***	0.406*	0.750***
	(0.217)	(0.204)	(0.398)	(0.225)	(0.194)
Supervisory independence	1.865***	-1.464***	1.687***	-1.147	-0.360
	(0.505)	(0.502)	(1.038)	(0.819)	(0.402)
Tenure supervisors	-0.762***	-0.258**	-0.808***	-0.283***	-0.0787
	(0.0489)	(0.103)	(0.181)	(0.0997)	(0.0861)
Transparency					
Transparency index	-0.603***	-0.240***	0.833***	-0.0449	0.0873
	(0.0718)	(0.0446)	(0.0929)	(0.0570)	(0.0534)
Governance indicators					
Governance index	0.600***	0.341***	-0.0705	0.130***	0.152***
	(0.0397)	(0.0314)	(0.0465)	(0.0338)	(0.0379)
Diversification					
Diversification index	-1.570***	1.212***	-2.552***	-0.198	2.527***
	(0.670)	(0.805)	(1.775)	(1.250)	(1.065)
Size t-1	1.272***	1.562***	1.575***	2.876***	1.943***
	(0.105)	(0.408)	(0.853)	(0.773)	(0.659)
Inflation	0.343***	0.178***	-0.140*	0.0832	0.00945
	(0.0654)	(0.0614)	(0.0780)	(0.0867)	(0.113)
Log GDP	2.606***	1.917***	-2.262	-0.212	2.560**
	(0.429)	(0.989)	(1.574)	(1.445)	(1.041)
Constant	3.235***	3.218***	-8.155*	4.980***	2.998***
	(3.879)	(7.719)	(9.791)	(7.626)	(5.607)
Observations	76,362	4,556	2,145	1,205	1,299
R-squared	0.437	0.322	0.138	0.157	0.297
Chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Number of banks					
Countries	20	28	12	27	17

The dependent variable is bank efficiency that is computed by using the semi-oriented radial measure (SORM). We capture the dynamic nature of capital adequacy and size via first lagged. We estimate regressions based on ordinary least-squares (OLS). P-values are calculated through the heteroscedasticity-robust with robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Blocs: APEC is Asia-Pacific Economic Cooperation; EU is the European Union; USAN is Union of South American; AF-blocs are Economic Community of West African States (ECOWAS), Common Market for Eastern and Southern Africa (COMESA) and Southern African Development Community (SADC), while CAEU is Council of Arab Economic Unity (Arab League).

Table A3-4: Estimation results for banks efficiency, during a crisis period, across economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	DEEC				DIEC				FEC			
		Crisis period				*Crisis period*				*Crisis period*		
VARIABLES	ALL	BEFORE	DURING	AFTER	ALL	BEFORE	DURING	AFTER	ALL	BEFORE	DURING	AFTER
Dependent												
SORM EFFICIENCY-DEA												
Independent												
Capital regulation												
Capital adequacy t-1	0.162***	0.173***	1.041***	0.0806***	-0.109***	-0.296***	0.0489	-0.0349	0.213***	0.170*	0.404	0.171**
	(0.00887)	(0.0114)	(0.103)	(0.0129)	(0.0387)	(0.0680)	(0.146)	(0.0574)	(0.0623)	(0.101)	(0.297)	(0.0858)
Market contestability												
Bank activities	-1.538***	-0.496	0.786	0.617**	-0.148	-0.515	-1.127	1.379***	-0.182	-1.160**	-1.294	1.219***
	(0.222)	(0.568)	(0.840)	(0.256)	(0.204)	(0.437)	(0.861)	(0.285)	(0.213)	(0.472)	(1.152)	(0.305)
Financial conglomerate	-0.646***	-1.293***	-1.681	-2.454***	-1.520***	-1.814***	0.0929	-1.883***	-2.052***	-1.140***	-2.370*	-1.255***
	(0.140)	(0.598)	(1.058)	(0.190)	(0.212)	(0.468)	(0.893)	(0.301)	(0.221)	(0.461)	(1.300)	(0.365)
Openness in banking industry	-0.847***	-0.586***	-0.462	0.0951	-0.0344	-0.159	1.088***	0.0895	-0.0915	-0.999***	0.984***	0.194**
	(0.106)	(0.183)	(0.358)	(0.193)	(0.0619)	(0.144)	(0.263)	(0.0750)	(0.0632)	(0.119)	(0.332)	(0.0789)
Supervision												
Supervisory power	-2.544***	-0.741**	-2.290***	-2.231***	-0.294	1.391***	-0.612***	-0.726***	-0.994***	-0.180	-1.792***	-1.181***
	(0.123)	(0.322)	(0.331)	(0.165)	(0.182)	(0.346)	(1.169)	(0.222)	(0.173)	(0.339)	(1.445)	(0.236)
Supervisory independence	1.977***	-1.614	-2.928*	0.239	-1.182***	-1.923**	-1.686*	-1.539***	-1.875***	-1.431***	-1.863**	-3.836***
	(0.404)	(0.985)	(1.573)	(0.545)	(0.445)	(0.825)	(2.458)	(0.598)	(0.432)	(0.762)	(2.876)	(0.651)
Tenure supervisors	-0.615***	-0.643***	-0.0413	0.0589	-0.168**	0.853***	0.620**	-1.498***	-0.666***	0.603***	0.0649	-1.587***
	(0.0584)	(0.229)	(0.208)	(0.123)	(0.0757)	(0.155)	(0.270)	(0.0990)	(0.0743)	(0.124)	(0.317)	(0.110)
Transparency												
Transparency index	-0.261***	-0.290***	-0.0296	-0.114***	-0.766***	-0.782***	-0.295*	-0.661***	-0.688***	-0.741***	0.0589	-0.648***
	(0.0229)	(0.0502)	(0.0828)	(0.0289)	(0.0356)	(0.0623)	(0.164)	(0.0477)	(0.0374)	(0.0657)	(0.207)	(0.0527)
Governance indicators												
Governance index	0.791***	1.200***	0.269***	0.485***	0.237***	0.168**	-0.125	0.147***	0.236***	0.186***	-0.0745	0.106***
	(0.0255)	(0.0457)	(0.0766)	(0.0332)	(0.0280)	(0.0664)	(0.154)	(0.0313)	(0.0264)	(0.0696)	(0.173)	(0.0326)
Diversification												
Diversification index	-1.907***	-1.448***	1.260	1.815***	2.772***	1.178***	-2.988**	2.232***	2.862***	1.158***	-1.620	2.148***
	(0.446)	(1.222)	(2.146)	(0.854)	(0.798)	(1.622)	(3.517)	(0.970)	(0.821)	(1.539)	(5.007)	(1.043)
Size t-1	1.345***	1.336***	2.586***	1.168***	2.692***	0.175	1.611***	2.823***	2.695***	1.339***	2.885***	1.501***
	(0.124)	(0.185)	(1.027)	(0.172)	(0.486)	(0.911)	(1.849)	(0.587)	(0.517)	(0.966)	(2.410)	(0.657)

Inflation	2.701***	1.482***	1.277***	2.353***	0.424***	0.251***	2.521***	0.200	0.609***	0.451***	1.565**	0.296*
	(0.137)	(0.123)	(0.479)	(0.135)	(0.0783)	(0.0954)	(0.518)	(0.137)	(0.0840)	(0.131)	(0.677)	(0.156)
Log GDP	2.542***	1.534***	-1.269	-1.164***	-1.226***	-1.549**	-1.442	-1.215***	-2.687**	-2.827***	-1.606	-1.079***
	(0.577)	(0.599)	(3.099)	(0.900)	(1.065)	(2.218)	(9.356)	(1.420)	(1.055)	(2.090)	(9.900)	(1.452)
Constant	5.285	-3.974***	-3.841**	-4.055	2.963***	9.003***	8.935***	1.401***	1.509***	1.738***	1.317***	1.804***
	(4.382)	(8.251)	(16.41)	(7.047)	(4.399)	(9.613)	(24.21)	(5.464)	(4.996)	(10.24)	(33.97)	(6.249)
Observations	70,346	37,684	1,309	31,130	7,270	2,679	459	3,301	5,009	1,404	289	2,742
R-squared	0.503	0.595	0.571	0.483	0.340	0.442	0.329	0.272	0.259	0.320	0.259	0.317
Chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Banks	6809				1089				357			
Countries	33	33	33	33	69	69	69	69	22	22	22	22

The dependent variable is bank efficiency that is computed by using the Semi-Oriented Radial Measure (SORM) DEA. We capture the dynamic nature of capital adequacy and size via first lagged. We estimate regressions based on Ordinary Least-Squares (OLS). P-values are calculated through the heteroskedasticity-robust and with robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. Economics are DEEC Developed Economies, DIEC is Developing Economies, and FEC is Fuel- Exporting Countries.

Crisis: Before 2000-2006, during 2007-2009, and after 2010-2014

Chapter Four

Which banks are less stable? The influence of bank regulation, business models, and size on risk-taking incentives: a quantile approach

Abstract

The effects of financial regulation and supervision on bank stability have been the subjects of debate. We re-examine the multifaceted concepts of financial regulation and supervision on bank stability using five rich data sets based on an unbalanced panel of 2210 banks in 47 countries over the period 2000–2016. In this regard, we use an innovative rating system combined with a quantile regression approach. Our empirical results show that bank holding companies tend to be stable compared with commercial banks and investment banks. We also find that greater capital regulation and higher profit are positively associated with bank stability, while tighter restrictions on banking activities and higher deposit insurance are negatively associated with bank stability. Further, we find a negative impact of both private monitoring and supervisory power when expounding stability across emerging economies. In turn, this influence becomes positive when interpreting stability across advanced economies.

Keywords: bank stability, financial regulation, supervision, business model, quantile approach, and economic development.

4.1. Introduction

Stability in financial institutions in general, and in the banking industry in particular, is of crucial importance. The health and soundness of the financial system is a fundamental pillar for the improvement of economic development, and in order to achieve this, banks must enhance their stability. Moreover, improving stability in the banking industry is of great concern for financial policymakers. Unstable macroeconomic conditions, coupled with the onset of the global financial crisis, have obliged regulators to enact numerous regulations in order to reduce the

fragility of the financial system and restore confidence in the banking system. Nonetheless, these interventions may lead to extraordinary policies.

The controversy about the relation between regulation and stability has created theoretical questions, which are yet to be answered. These concern whether burdensome regulation besides strict supervision is necessary and appropriate for all financial markets and institutions, and the type of regulation that can be pursued. For example, Barth et al. (2004), Pasiouras et al. (2006), Pasiouras et al. (2009), Barakat and Hussainey (2013), and Delis (2015) highlighted the need for tighter financial regulation to promote financial stability and the importance of building stable buffers to meet any financial distress. However, some researchers have argued that stricter regulation may destabilise the financial system. Hakenes and Schnabel (2011b) stated that onerous regulation may attenuate the ability of banks to provide financial resources for other economic sectors. Such regulation may also have an adverse effect on banking competition because of higher loan rates, thus leading to more risk-taking by companies and the higher probability of loan defaults. Further, in some worst case scenarios, banks' losses can exceed the capital buffers which have been proposed by regulators (Arnold et al., 2012). In addition, Demirgüç-Kunt and Detragiache (2011) could not find any significant impact of better regulation and supervision on financial stability. Overall, and with reference to the aforementioned controversy, regulation and supervision are multifaceted concepts.

Therefore, the general objective of this chapter is to re-evaluate the stability across countries together with examine the effect of financial regulation and supervision on bank stability taking into consideration bank business models, bank size, and economic development.

To the best of our knowledge, no studies have considered the multifaceted influences of the concepts of regulation and supervision because of the significant variation in bank size, business models, and economic development. Moreover, most financial stability research has suffered from inadequate measurement of stability scores (Wanke et al., 2016). Thus, the current study contributes to investigations of the multifaceted influences of regulation and supervision on financial stability through an innovative CAMELS-DEA rating system, where CAMELS is an acronym for categories of financial variables that are encountered in the financial literature. Thus, CAMELS refers to capital adequacy (C), asset quality (A), management efficiency (M), earnings (E), liquidity (L) and sensitivity to market risk (S), and DEA is data envelopment

analysis. The study combines this system with a quantile technique that is used with respect to bank size, business models, and economic development. In practical terms, the importance of this study is to provide guidelines for financial policymakers, managers, investors, and researchers.

The study concludes that financial policymakers in each country must consider not only legal or historical variations but also institutional variations regarding banks' business models, bank size, and economic development. This conclusion obliges each country to innovate its own financial regulation framework in order to enhance the stability of the banking system.

The rest of this paper proceeds as follows. The next section presents the relevant literature. In section 3, we describe the variables, methodology, and data. The empirical results are presented in section 4, and we summarise our main findings in section 5.

4.2. The relevant literature

4.2.1. Financial stability

The background of financial stability

Stability in the financial industry has been a subject of scientific discussion among researchers and practitioners. The recent global financial crisis obliged researchers to develop an action method to avoid the risk of financial instability and thereby to prevent any possibility of contagion and spread of the crisis (Akhigbe et al., 2012). This obligation requires a comprehensive analysis of all the dimensions that constitute the global economic environment, coupled with enhancement of prudential rules and regulation (Uhde and Heimeshoff, 2009). A further issue regarding financial instability is the role of the banking industry as a primary conduit which may transmit instability to other economic sectors through a reduction in credit, disruption of the lending mechanism, and the freezing of deposits (Berger et al., 2009). Thus, concerns about an unstable financial system have motivated researchers and regulators to concentrate on developing rules and tools that may enhance stability in the banking industry.

Several studies have investigated the concept of financial stability; however, debate regarding the precise definition of financial stability continues. In his definition, Crockett (1997) considered stability in institutions and stability in markets. In other words, stability in financial institutions may refer to the absence of stress, which leads to occasional losses in larger financial

institutions or even failure in smaller financial institutions; hence, the most stable financial institutions can meet their obligations without external assistance. In addition, stability in the financial system may refer to the absence of aggressive price movements that damage the system; thus, prices should reflect normal changes in economic fundamentals.

Further, Issing (2003) defined financial stability as a system which can guarantee an efficient allocation of savings in order to enhance investment opportunities. In a similar vein, European Central (2005) interpreted financial stability as a system which can provide continued support for an economy, besides reinforcing the performance of the economy. Borio (2003) expounded financial stability based on two main paradigms, the micro-prudential and macro-prudential. For example, the micro-prudential attempts to reduce the probability of bankruptcy in each financial institution, whereas the macro-prudential concentrates on the economic system overall in order to limit any harmful effects of a financial crisis on economic welfare. These paradigms have been discussed further by Garry and Schinasi (2004) by adding new dimensions for a theoretical financial stability framework. Consequently, in a micro-domain, the degree of concentration coupled with the business model may constitute a new micro-domain, whilst supervisory authorities and payment systems may shape the macro-domain. Thus, any failure in a system of payment or supervision may produce financial instability (Creel et al., 2015).

The complexity of identifying financial stability conceptually leads to complex ways of quantifying such stability empirically. Traditionally, the approach which is widely used at the micro-level to capture financial stability is the Z-score (Altman (1968), Altman et al. (1977), Boyd and Graham (1986), Hannan and Hanweck (1988), and Uhde and Heimeshoff (2009)). This reflects the probability of default in the banking system. However, besides its advantages, this indicator suffers from several limitations. The Z-score is based purely on an accounting and auditing framework; thus, a highly positive assessment of accounting information may produce an accurate score. A further limitation of this approach is that the Z-score does not take into account other sources of risk; for example, the sensitivity of market risk or management risk (Čihák et al., 2012) (Creel et al., 2015). Further, Loayza and Ranciere (2006) utilised the standard deviation of private credit to GDP so as to capture financial fragility. In addition, Hollo et al. (2012) developed a financial stability measurement based on the macro-level through a composite indicator of systemic stress (CISS). Iannotta (2007) offered a more explicit result by

using loan loss provision (LLP) to total loans as a proxy for banking credit risk. He concluded that riskier loans lead to higher interest income, which means a positive influence on income.

Männasoo and Mayes (2009) provided a comprehensive review of this subject. They proposed that although no efficacious indicators have been utilised across prior literature, CAMELS indicators appear to have a significant ability to detect any financial distress

(Wanke et al., 2016). The related financial variables of the CAMELS acronym have been adopted in several studies as an appropriate standard for detecting financial distress; for example, in Cole and Gunther (1995), DeYoung (1998), Kumar and Ravi (2007), and Poghosyan and Čihák (2009). Avkiran and Cai (2012) presented empirical evidence which emulated the CAMELS rating system in Australian bank holding companies through the use of a non-parametric technique, DEA. They emphasised that DEA can be utilised as a forward-looking substitute method that assists in detecting financial distress in the near future. More recently, Wanke et al. (2015) and Wanke et al. (2016) examined the CAMELS rating system in Brazilian and Malaysian banks by using DEA with a dynamic slacks approach. They proved that the CAMELS rating system with DEA may be an appropriate method to discover any financial distress.

Financial stability and banks' business models

The view regarding the foundation of banks' business models is that some banking activities may contribute to enhancing a bank's risk and increase the likelihood of financial distress (Prabha and Wihlborg, 2014). Thus, the reasons underlying significant activities are less likely to cause financial distress. Moreover, the features of banks' business models imposed on policymakers lead to the development of appropriate regulation and rules by considering the behaviour of each business model.

Many studies have examined the influence of banks' business models on financial stability. Demirgüç-Kunt and Huizinga (2010) found the benefits of risk diversification at a low level of non-interest income; namely, a high degree of different activities may produce more risks. Altunbas et al. (2011) stated that banks' business models that shape cross-flow capital, aggressive credit growth, and large balance sheets may face distress; conversely, any bank business model which is based on high deposits coupled with significant diversification is less

likely to face any financial distress. Likewise, Ayadi et al. (2012) used banks' business models to compare the performance and stability of banks before, during, and after the global financial crisis. They indicated that retail-oriented banks are more stable compared with different types of financial institutions.

Additionally, Köhler (2015) pointed out that retail-oriented banks tend to be more profitable and stable because of high non-interest income and the benefits of diversification. In contrast, increasing the share of non-deposit funding may lead to enhanced stability in investment banks.

Mergaerts and Vander Vennet (2016) examined the influence of the short- and long-term effects of banks' business models on bank stability for more than 500 banks across 30 European countries. They detected that retail-oriented banks had reaped the benefits of diversification; hence, retail-oriented banks are less likely to face financial distress. They added that each bank has their own risk types, which based on its business model so that may affect prudential regulation and methods of supervision. Accordingly, supervisors should assess related business model choices so as to reinforce the viability of the banking industry.

Financial stability: developed economies vs emerging economies

Enhancing bank stability and preventing any financial distress in the financial system remain substantial challenges for developed and developing countries. However, in order to overcome these challenges, it is necessary to consider economic, financial, and regulatory variations between such countries (Bakker and Chapple, 2003).

Demirg et al. (1998) studied the determinants of banking distress across developing and developed countries. They discovered that weak macroeconomic environmental factors are key elements of fragility in the banking sector. Moreover, these weak factors lead to systemic financial distress. Nonetheless, weak macroeconomic factors are not the sole causes of financial distress in some countries. For example, structural characteristics of the financial system, together with a weak macroeconomic environment, play a vital role in increasing the probability of financial distress, especially in less developed countries.

Further, Čihák et al. (2012) and Wen and Yu (2013) illustrated the relation between financial depth and financial stability. In other words, an important function of private credit is to improve

financial stability by promoting liquidity in the banking sector. Nonetheless, there are significant variations in this role between high-income countries and low-income countries. For example, the banking industry is considered an economic cornerstone in developed countries, while the banking sector has no clear influence on the economies of less developed countries. In other words, banks not efficient to funding other economic sectors, while should be more efficient especially with less efficient stock markets. .

Another important difference between emerging and developed economies is the propagation of financial distress and the sources of stress. This may be because of the different structure of debt contracts and the various levels of financial development in developed and emerging economies. Moreover, differences in currency may have a different impact on financial stability across developed and emerging economies. Weak early warning indicators in emerging economies compared with advanced economies is a further substantial difference which reflects the significant variations between advanced and emerging economies (Babecký et al., 2014).

Financial stability and bank size

The debate about the effect of optimal bank size on improving financial stability has gained much prominence since the global financial crisis. This is because the financial crisis has provided substantial evidence that global banks began the crisis and were the source of financial distress across many countries.

Thus, we can understand the link between bank size and financial stability from different perspectives. The traditional perspective concentrates on the crux of the agency theory whereby managers who run large banks can reap private benefits and obtain more compensation, but these financial empires may suffer from weak governance (Murphy (1985), Jensen (1986), and Gabaix and Landier (2008)). By extrapolating this perspective, it is possible to see that a negative relation between bank size and financial stability may exist.

Another perspective that presents an explanation for the possible influence of bank size on financial stability is the stewardship theory. This perspective, unlike agency theory, presents a manager as an inherently trustworthy person; hence, there is no likelihood of such a person misappropriating a bank's resources (Davis et al., 1997). In a nutshell, a large bank may reflect structural convenience, which may reinforce financial stability (Donaldson and Davis, 1991).

Uhde and Heimeshoff (2009) also viewed the relation between bank size and stability from two broad perspectives of concentration–fragility and concentration–stability. The concentration–stability perspective proposes that large banks can build significant capital buffers by benefiting from high profits coupled with the advantages of diversifying risk. Moreover, large banks tend to boost confidence by resorting to credit rationing and enabling easier monitoring of moral hazard issues. Conversely, from the concentration–fragility perspective, the concept of 'too big to fail' may enhance the moral hazard problem because of explicit and implicit government guarantees. Further, because a large bank has the power to charge higher interest on loans, borrowers may take greater risks to compensate for such high interest rates, which in turn may lead to an increase in defaults.

4.2.2. Financial stability and profitability

The banking sector needs to be profitable to enable banks to play their key role as primary instruments that finance various economic activities. Thus, profitable banking sectors contribute significantly to enhancing stability in the financial system (Athanasoglou et al., 2008). This fact has attracted academics, financial managers, and financial supervisors to study the link between banks' profits and financial stability from different perspectives.

Bikker and Hu (2002), Goddard et al. (2004), Uhde and Heimeshoff (2009), and Vives (2011) illustrated the relation between profit and financial stability via the perspective of size. Hence, large banks, by obtaining greater profits, can build a substantial capital buffer so as to absorb any financial shock. Additionally, higher profits boost liquidity. Thus, large banks are less prone to experience financial distress.

Other channels that explain the link between profit and financial stability are the diversification of investments and financing. Greater profit helps to create banks with multiple activities and assists banks in achieving economies of scale. Thus, banks become less sensitive to financial distress (Williamson (1987), Beck (2007), and Stever (2007)).

Moreover, the risky nature of the banking business has obliged banks to develop risk management systems. Thus, greater profits lead to enhanced efficiency in risk management by attracting expertise and competencies. An expert manager can improve asset quality and promote the level of liquidity in order to resist any financial distress (Molyneux and Thornton, 1992).

By deduction, it is clear that despite the different mediators that explain the link between profit and financial stability, profitability has a positive influence on financial stability. Consequently, we expect profits to have a positive relation with financial stability.

4.2.3. Financial stability, bank regulation, supervision, and internal monitoring

Capital stringency and financial stability

There is an ongoing discussion among academics, regulators, and practitioners about the role of capital requirement regulation. This debate has increased since the global financial crisis because of the role of capital requirement regulation as one of the key instruments to enhance financial stability.

Boot and Greenbaum (1992) and Besanko and Kanatas (1993) pointed out that a strict capital requirement decreases monitoring power, which leads to unsatisfactory bank portfolios. Moreover, Hakenes and Schnabel (2011b) evaluated the relation between capital requirement and financial instability in terms of its impact on banking competition. A more detailed explanation is as follows. A stringent capital requirement attenuates competition for loans, thereby obliging banks to raise loan rates, which may increase the probability of bank default among borrowers. Consequently, banks may take greater risks because of the higher correlation with risky loans.

Nonetheless, most authors and practitioners in the banking sector demonstrate that an effective capital requirement is considered a useful instrument to absorb losses and act as a buffer, which ensures banks meet their liabilities after any shock. Kim and Santomero (1988)showed the way in which a capital requirement can redress the bias towards risk. It is known that managers have an incentive to take greater risks in order to meet shareholders' demands; however, managers who need to meet a capital requirement may use this motivation to take greater risks. Furlong and Keeley (1989) added that besides the role of capital requirement regulation to reduce risk-taking incentives, adequate capital requirements may maximise banks' values by enhancing investors' confidence. Further, strict capital requirement regulation may oblige banks to fund their capital requirements by new share issues, which may prove too costly; nonetheless, strict capital requirements could prompt banks to reduce risky lending with a view to meeting such regulation (Gambacorta and Mistrulli, 2004). Finally, it should be noted that effective capital

requirements have been utilised by managers as a way to boost banks' reputations and reinforce their franchise values by reducing the incentive to take greater risks (Repullo, 2004).

Activity restrictions and financial stability

There are conflicting propositions regarding the influence of restrictions in non-traditional financial activities such as insurance, securities, and property on financial stability.

Restriction supporters argue that tight restrictions may boost monitoring because of low complex banking activities coupled with a reduction in informational asymmetries. Further, they think that relaxing restrictions may enhance market power for some financial institutions and hence impede competition, as well as having an adverse impact on financial policies.

Other researchers and practitioners have argued the opposite by stressing that the competition issue and informational asymmetries are insufficient reasons to warrant a high level of restrictions, while relaxing restrictions enables banks to gain the benefits of economies of scale and scope. This may affect financial services and assist banks to provide more efficient services and enhance bank stability (Barth et al., 2004). Moreover, fewer tight restrictions help banks to build reputational capital by providing different types of service (Laeven and Levine, 2007). Conversely, tight restrictions may destroy bank stability by reducing the banks' ability to diversify, thereby diminishing franchise values (Barth et al., 2013b). Further, regulators may apply tight restrictions in order to reinforce their bargaining ability to obtain benefits (Djankov et al., 2002). Finally, it is important to recognise that each non-financial activity has a different risk weight and production process (DeYoung and Torna, 2013).

Supervision and financial stability

As a response to the global financial crisis, regulators and academics have started to pay attention to the influence of quality of financial supervision on financial stability. Thus, they have begun working on the revision of some supervisory policies. Nonetheless, there is a debate about whether these reforms can significantly affect financial stability.

Official supervision could overcome market failure caused by imperfect information. Such supervision, together with enhanced monitoring and the disciplining of banks, could consequently boost the governance of bank lending and reduce corruption (Beck et al., 2006b).

In other words, active supervisory agencies have the experiences and incentive to improve banks' efficiency and the banks' ability to face any financial distress (Barth et al. (2004) and Barth et al. (2013b)).

Nonetheless, other academics have argued that official supervision may not necessarily concentrate on overcoming market failures; rather, supervisors may concentrate on promoting self-interest. For example, supervisors, who have the power to discipline non-compliant financial institutions, may utilise this power to gain political or private benefits. Hence, official supervisory power may impede financial stability (Beck et al. (2006b) and Barth et al. (2013b)). Further, a self-interest model may enable supervisors to conceal some supervisory information and thereby leave financial stability committees uninformed. It is difficult to manipulate inspection and audit information, but it is easy to hide it and to exchange it for private benefits (Boyer and Ponce, 2012). Additionally, powerful and more independent supervisors working in a weak governance environment may impede prudential supervision, thus creating a financial system which is less resistant to financial shocks (Melecky and Podpiera, 2013). Indeed, supervision has impacts which differ from country to country and from one financial environment to another (Ben Bouheni, 2014). Thus, powerful and independent supervisory authorities in a well-developed financial system with an adequate internal system are less prone to financial shocks, while supervisory authorities in poor financial governance environments could be more sensitive to financial distress (Chortareas et al., 2012).

In addition, the degree of unification of power is an important element in relation between official supervision and bank stability. Not surprisingly, there is again a debate on the advantages and disadvantages of integrated supervision. The benefits of integrated supervision including: (i) increased transparency and accountability; (ii) increase efficiency in the resolution of conflicts that may arise due to different aims of supervision; and (iii) economies of scale and scope, due to elimination of overlaps. however, the disadvantages are included:(i) moral hazard problems due to implicit contracts; (ii) diseconomies of scale and scope; and (iii) issues that may arise due to heterogeneous objectives (Doumpos et al., 2015).

Banks' internal monitoring and financial stability

Monitoring occupies a very important place in a financial system because of its role in reducing credit risk. Indeed, the essential value of monitoring is apparent through the reduction of asymmetric information problems and the regulation of the relation between banks and borrowers (Winton, 1995). Another vital role of internal monitoring is to enhance internal governance and thereby boost stability in financial institutions.

Despite the foregoing, most if not all empirical studies have found that monitoring is costly. These studies have provided an accurate description of the mechanism of costly monitoring by assuming that financial institutions consume more resources by monitoring. In other words, the resources that are devoted to avoiding loan losses and creating good loans may be utilised to maximise revenue. Moreover, in some circumstances, the cost of monitoring may exceed the revenues of some loans or may motivate managers to shift credit risks to depositors with the hope of covering any risk of losses via deposit insurance (Billett et al. (1995) and Akhigbe and McNulty (2011)). Further, costly bank monitoring has a negative impact on borrowers' earnings management behaviour because of the high price of loans (Ahn and Choi, 2009). In addition, strong bank monitoring may influence the transparency of borrowers' earnings management, especially when borrowers have direct deposit relations with lending banks. Hence, borrowers hide or do not reveal some sensitive information, including their cash flows (Qi, 1998). The impacts of costly monitoring are also stronger on small banks, which rely on borrowers' characters and have less robust capital buffers. In contrast, a large bank uses standard criteria coupled with an adequate capital buffer (Cole et al., 2004).

This controversial relation may mean that the influence of private monitoring on financial stability is ultimately an empirical question.

Deposit insurance and financial stability

Despite voluminous studies on the effect of deposit insurance on financial stability, this effect and other closely related issues remain controversial.

In classic works, deposit insurance is deemed to offer a safety buffer in the financial system in order to improve financial stability. This guarantee can boost depositors' confidence and reduce

the role of government with regard to banks' obligations in terms of financial shocks (Anginer et al. (2014) and Constantinescu (2015)).

However, it is important to know that deposit insurance has negative side effects on financial stability. Santomero (1997) and Demirgüç-Kunt and Detragiache (2002) highlighted that deposit insurance may increase the incentive of banks to take risks and reduce the incentive for depositors to control the risk of moral damage. This moral risk can influence market discipline, decrease the stability of the financial system, and increase financial fragility. The moral hazard regarding deposit insurance is explicit: it prompts banks to attract deposits that do not reflect their portfolio risk and encourages banks to finance their projects through high-risk channels. Besides the moral hazard, deposit insurance may cause a lack of liquidity and thus a reduction in banks' ability to meet their obligations to depositors (Chari and Jagannathan (1988) and Bhattacharya et al. (1998)). Further, as pointed out by Constantinescu (2015), deposit insurance is expensive and represents a high consumption of banks' resources compared with a modest impact on financial stability. Moreover, achieving an optimal deposit insurance scheme with an appropriate structure is an arduous task, with governments potentially absorbing all losses. For this reason, banks may take more risks, which makes them more vulnerable to financial shocks (Cull et al. (2005), Demirgüç-Kunt et al. (2008), and Chernykh and Cole (2011)).

4.2.4. Financial stability and the financial environment

Concentration and financial stability

The relation between concentration, competition, and financial stability is fuelling an active debate among academics and regulators. Indeed, there are two conflicting views which adopt different perspectives (Uhde and Heimeshoff (2009) and Fu et al. (2014)).

The traditional view adopts the concentration–fragility perspective. This states that highly concentrated banking systems may boost market power. Thus, banks may be able to increase their interest rates, which encourages companies to take greater risks and increases loan defaults (Beck et al., 2006a). Moreover, the supporters of this view point out that concentration in the banking system leads to reduce competition to access financial services and increased political impact of financial conglomerates, thereby, influence on bank stability (Fu et al., 2014).

Alternatively, the concentration–stability perspective emphasises that high concentration produces greater competition in an optimal market structure. This optimal structure forces interest rates down, thus reducing the probability of loan defaults. Further, concentration in the financial system may tend to have larger, better-diversified banks, which enhance stability in banking. In turn, a less concentrated banking system suffers from credit problems such as less credit rationing and the granting of risky loans, factors which may destroy bank stability (Kasman and Kasman, 2015). Moreover, banks in a concentrated financial system are less prone to lack liquidity and financial distress because of a strong capital buffer. In addition, a concentrated banking system motivates banks to achieve more profits because of economies of scale and scope (Mirzaei and Moore, 2014). Finally, regulators in the concentrated banking sector are more concerned about bank failures. Accordingly, policymakers provide greater subsidies for large banks through the implicit policy of 'too-big-to-fail'. Regulators also find that fewer market players can improve effective supervision, enhance monitoring, and reduce the risk of financial distress contagion (Beck et al., 2006a).

Governance and financial stability

The global financial crisis has increased the awareness of researchers and policymakers about the role of sound governance for the reinforcement of financial stability. Indeed, there is almost a consensus about the active role of governance in enhancing stability in the financial system. However, in spite of this consensus, the problems of weak governance and inadequate codes are still a source of debate (Lupu, 2015).

The primary function of corporate governance is to ensure reliability and credibility for borrowers, depositors, managers, supervisors, investors, and even general stakeholders. This principle is highly important for economic growth and financial stability (Ananchotikul and Eichengreen, 2009).

Kirkpatrick (2009) provided substantial evidence that weaknesses in the implementation of governance principles have contributed significantly to the failures of banks and poor risk management because of inaccuracies in conveying information and the inadequate disclosure of predicted risk. Finally, John et al. (2016) mentioned that equity governance may lead to increased agency costs because of the conflict of interest between debt holders and shareholders

in highly leveraged banks. However, by restricting such leverage, banks may be able to decrease agency costs and maximise social objectives, equity value, and enterprise value.

Government ownership and financial stability

In the 1970s, a wave of privatisation swept across the banking industry in order to improve the health of the financial system. Nonetheless, this approach became somewhat questionable, especially after the global financial crisis. For example, during the financial crisis in countries where government-owned banks were almost non-existent, governments took majority stakes in most of the affected financial institutions through bailouts. This circumstance returned to the forefront the debate about whether government-owned banks enhance financial soundness (Nsengiyumva, 2016).

Indeed, three alternative theories can explain the relation between government ownership and financial stability: the social, political, and agency theories. Each perspective has a positive or negative effect on the relation between government ownership and financial stability. The classical view is based on the social perspective, which suggests that the role of government ownership is to act as an instrument to address market failures. Thus, a government may seek to improve public welfare besides boosting economic development (Stiglitz, 1993). In contrast, the political perspective considers government-owned banks as a tool for implementing the individual goals of politicians (Shleifer and Vishny, 1994); for example, providing financial support for favoured enterprises or increasing employment for their supporters (Shleifer, 1998). The agency perspective shares with the social perspective the element of improving social welfare; however, this perspective can generate weak management, misallocation, and corruption as a result of government bureaucracy (Banerjee, 1997). Briefly, a government can improve social welfare without taking stakes in banks by improving governance practice, enhancing supervision, and regulating the relation between banks and other beneficiaries (Sapienza, 2004). Moreover, privatisation leads to improvements in bank efficiency by limiting government intervention, enhancing competition, maximising profits, and minimising costs (Clarke et al., 2005).

Economic freedom and financial stability

The liberty of individuals and institutions is one of the most important pillars of economic development that has been pursued to achieve economic goals and improve financial stability. The rationale for the relation between economic freedom and financial stability is straightforward. Financial institutions, through the reduction of constraints about how to manage their businesses and improve resource allocation, can control their costs and reduce risk (Chortareas et al., 2013).

The influence of economic freedom on economic stability is extensive and extends to various aspects of the economy, especially the financial aspect. However, the common threads for this relation rely on the following. First, government reforms or changes in government policies: a government, by enhancing transparency and improving governance, can affect the level of economic freedom and hence increase confidence, and can decrease uncertainty in the financial system (Graeff and Mehlkop, 2003). Second, political stability: a high level of economic freedom creates greater political stability and thus reduces uncertainty in the financial system (Blau et al., 2014). Third, economic growth: economic freedom is a non-conventional determinant for economic growth (Hussain and Haque, 2016). A high level of economic freedom contributes to the creation of greater financial intermediary development, which engenders strong economic growth and advances financial stability (Hafer, 2013).

4.2.5. Financial stability and country-specific variables

Significant academic efforts have aimed to identify the link between macroeconomic indicators and financial stability. These efforts have been undertaken because of the role of some macroeconomic indicators such as economic growth and inflation on the level of bank capitalisation and the quality of banks' assets (Schaeck and Cihak, 2012).

Despite this, with regard to economic growth, it is difficult to identify cause and effect in the relation between economic growth and financial stability. In other words, it is not clear whether an increase in financial stability may affect economic growth or whether an enhancement of economic growth may lead to greater financial soundness (Jokipii and Monnin, 2013). Nonetheless, Boyd et al. (2005) provided strong evidence that unstable economic growth

increases uncertainty about a financial system's future; thus, stable economic growth produces a stable financial system. In addition, Ayuso et al. (2004) and Jokipii and Milne (2008) mentioned the need for steady economic growth to enhance banks' capital buffers and improve financial soundness.

With regard to inflation, there is no doubt of the need for inflation targeting in order to promote stability in a financial system. Indeed, a healthy financial system can facilitate the relation between borrowers and lenders, coupled with the diversification of risk (Akram and Eitrheim, 2008). Nonetheless, although an inflationary environment may raise a bank's incentive to increase loan interest rates, which leads to an increase in a bank's income, such an inflationary environment may impede financial soundness by increasing the probability of borrowers defaulting (Tan and Floros, 2012).

4.3. Variables, methodology, and data

In this section, we shed light on variables, methodologies, and data sets that have been used in this study. First, the study utilises the CAMELS-DEA model coupled with a quantile technique. Further, it uses a core profitability model (CPM) together with regulation and supervision dimensions to investigate the multifaceted effects on financial stability.

4.3.1. Variable definitions

Financial stability—CAMELS (dependent variable):

Bank behaviour studies usually rely on a one-dimensional risk indicator; for example, a Z-score, non-performing loans, credit ratings, return on equity, or even capital ratios. However, there is doubt about the ability of these indicators to capture banking risk. Moreover, these indicators do not reflect bank-specific characteristics and may contain some measurement errors because of differences in measurement for on- and off-balance issues (Klomp and De Haan, 2012).

Thus, because a non-unique set of indicators exists, the CAMELS indicators appear to have a significant capacity to assess banks' soundness. Further, this combination of indicators is useful for capturing the financial vulnerability of banks (Wanke et al., 2016).

We adopt the CAMELS combination as a proxy of financial stability. The financial dimensions of this combination are employed by regulators, supervisors, and researchers to assess banks' overall health (Avkiran and Cai (2012), Klomp and De Haan (2012), Wanke et al. (2015), Wanke et al. (2016), Buch et al. (2016), and Calabrese et al. (2017)). However, it is important to explain that because the original criteria of the categories of CAMELS ratings are undisclosed and unavailable to the public, the proxy of each category is selected based on data availability and prior studies (Jin et al. (2011), Avkiran and Cai (2012), and Wanke et al. (2016)). Table 4-1 contains the proxy for each category of CAMELS, with a definition of each proxy.

Table 4-1: Variables' definitions and sources of data

Variables	Definitions	Sources
Dependent variables:		
CAMELS	This combination is applied as a proxy of financial stability, with two inputs and four outputs as follows:	**Authors' calculation**
Inputs:		
Asset quality	Loan loss provision (million/USD)	**BankScope**
Management	Total expenses (million/USD)	**BankScope**
Outputs:		
Capital adequacy	Total equity (million/USD)	**BankScope**
Earnings quality	Total net income (million/USD)	**BankScope**
Liquidity	Liquid assets (million/USD)	**BankScope**
Sensitivity of market risk (size)	Total assets (million/USD)	**BankScope**
Independent		

variables:

CPM	The CPM consists of two cost inputs and two profit outputs as follows:		**Authors' calculation**
Inputs:			
Cost1	Total interest expenses	(million/USD)	**BankScope**
Cost2	Non-interest expenses	(million/USD)	**BankScope**
Outputs:			
Profit1	Gross interest dividend income	(million/USD)	**BankScope**
Profit2	Non-interest operating income	(million/USD)	**BankScope**

Capital regulation index	This index is used to determine whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy is determined. Further, certain funds, official or otherwise, may initially be used to capitalise a bank. The index has a range of 0–10, with higher values indicating greater stringency.	**World Bank Survey (Barth et al., 1999, 2003, 2007, 2012)**
Activity restrictions	Overall restrictions on banking activities such as securities, insurance, and property activities. The restrictions have a range of 0–12, with higher values indicating greater restrictiveness.	**World Bank Survey (Barth et al., 1999, 2003, 2007, 2012)**
Deposit insurance	This variable is used to determine whether a deposit insurance authority has the power to make a decision to intervene in a bank and take legal action against a bank's directors or officials. The variable is also used to establish whether a deposit insurance authority has ever taken any legal action against bank directors or officers. The range is 0–4, with higher values indicating greater power.	**World Bank Survey (Barth et al., 1999, 2003, 2007, 2012)**
Private monitoring index	This index measures whether there are incentives/ability to privately monitor companies. The index has a range of 0–12, with higher values indicating greater private monitoring.	**World Bank Survey (Barth et al., 1999, 2003, 2007, 2012)**
Official supervisory power	This variable is used to determine whether the supervisory authorities have the power to take specific actions to prevent and correct problems. The range is 0–16, with higher values indicating greater power.	**World Bank Survey (Barth et al., 1999, 2003, 2007, 2012)**
Independence of supervisory	The degree to which a supervisory authority is independent of government and legally	**World Bank Survey (Barth et**

authority	protected from the banking industry. The values are 1–3, with higher values indicating greater independence.	**al., 1999, 2003, 2007, 2012)**
Government-owned banks	The extent to which banking system's assets are government owned.	**World Bank Survey (Barth et al., 1999, 2003, 2007, 2012)**
Herfindahl-Hirschman Index (HHI)	A concentration index via the HHI	**Authors' calculation**
Governance index		
V*oice and accountability*	This indicator measures the extent to which a country's citizens can participate in selecting their government, and also measures freedom of expression, freedom of association, and freedom of the media.	**Worldwide governance indicators (WGI)**
Government effectiveness	This indicator measures the quality of public services, the quality of the civil service and the degree of its independence from political pressure, the quality of policy formulation and implementation, and the credibility of a government's commitment to such policies.	**WGI**
The rule of law	This indicator measures the extent to which agents have confidence in, and abide by, the rules of society, particularly regarding the quality of contract enforcement, the police, and the courts. This indicator also measures the likelihood of crime and violence.	**WGI**
Political stability	This indicator measures perceptions of the likelihood that a government will be destabilised or overthrown by unconstitutional or violent means, including	**WGI**

	political violence and terrorism.	
Quality of regulation	This indicator measures the ability of a government to formulate and implement sound policies and regulation that permit and promote market competition and private sector development.	**WGI**
Control of corruption	This indicator measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the 'capturing' of a state by an elite or private interests.	**WGI**
Economic freedom index	This index relies on 10 factors grouped into four categories: (1) the rule of law (*property rights, freedom from corruption*); (2) limited government *(fiscal freedom, government spending*); (3) regulatory efficiency *(business freedom, labour freedom, monetary freedom*); and (4) open markets (*trade freedom, investment freedom, and financial freedom*).	**Index of Economic Freedom**
Log of gross domestic product (GDP)	The natural logarithm of GDP.	**World Development Indicators (WDI)**
Inflation	The annual change in the consumer price index.	**WDI**

Explanatory variables

CPM:

Efficient banks which maximise profitability are more likely to build strong capital buffers and are less liable to be exposed to financial distress (Athanasoglou et al. (2008), Uhde and Heimeshoff (2009) and Vives (2011)). However, most research approaches to maximising profits rely on one dimension without considering the absence of reliable pricing information or the limited role of one dimension in terms of reflecting costs and prices for profitability maximisation. Hence, this study opts for the input-output technical efficiency approach by employing the *CPM* as a proxy for maximising profits and minimising costs (Avkiran (2011) and Avkiran and Cai (2012)). *CPM* consists of two cost inputs (total interest expenses and total non-interest expenses) coupled with two profit outputs (gross interest and dividend income, and total non-interest operating income), as presented in Table 4-1.

Capital regulation index:

No matter what level of stringency exists in capital regulation, most if not all practitioners and researchers emphasise the need for capital regulation to absorb financial shocks (Repullo, 2004). This study uses the *capital regulatory index* (*CRI*) as a measurement of capital stringency. The index consists of: (i) overall capital stringency, which evaluates the amount of capital which banks should hold, besides measuring whether capital regulation reflects certain risks and deducts certain losses from capital; and (ii) initial capital stringency (ICS,) which measures whether certain funds may be utilised to capitalise a bank initially (Barth et al., 2004).

Activity restrictions:

Restrictions of non-traditional financial activities have multifaceted influences on financial stability because of the questionable role of these activities in increasing or diversifying risks (Laeven and Levine (2007); Barth et al. (2013b). This variable indicates whether banks are able to: (i) handle and underwrite securities, (ii) sell and underwrite insurance, and (iii) invest in property (Barth et al., 2004).

Deposit insurance:

Deposit insurance is another controversial subject because of the various impacts it may have on financial stability. For example, deposit insurance may be responsible for enhancing confidence in banks; however, it may lead to an increase in incentives for banks to take risks (Anginer et al. (2014) and Demirgüç-Kunt and Detragiache (2002)). We use the *deposit insurance* variable to

measure whether deposit insurance authorities have the power to: (i) make a decision to intervene in a bank and (ii) take legal action against a bank's officers or directors. The variable is also used to (iii) determine whether deposit insurance authorities have ever taken any legal action against a bank's officers or directors (Barth et al., 2013a).

Private monitoring index:

Another key determinant of financial stability is private monitoring. Monitoring may enhance stability by reducing asymmetric information (Winton, 1995); alternatively, it may impede stability because of the cost of monitoring (Akhigbe and McNulty, 2011). This controversial relation may mean that the influence of private monitoring on financial stability is ultimately an empirical question. The *private monitoring index* is composed of information on: (I) compulsory external audits undertaken by certified or licensed auditors, (ii) the percentage of the 10 biggest banks that are rated by international rating agencies, (iii) the percentage of the 10 biggest banks that are rated by domestic rating agencies, (iv) whether depositors were fully compensated the last time a bank failed by using a deposit insurance scheme, and (v) whether income statements include accrued or principal amounts for non-performing loans and whether banks should provide consolidated financial statements (Barth et al., 2013a).

Official supervisory power:

A theoretical debate exists between public interests which highlight the role of active supervision in overcoming market failure due to imperfect information, and private interests which emphasise that supervisors may concentrate on gaining private benefits rather than focusing on overcoming market failures (Barth et al., 2013b). This debate indicates that official supervisory power is a multifaceted concept. Hence, official supervisory power may have a positive or negative influence on financial stability. The *official supervisory power* variable is constructed from 16 dummy indicators[17]. Briefly, these indicators evaluate whether official supervisory

[17] Official supervisory power refers to: (i) whether or not supervisors can meet external auditors to discuss their report without bank approval. (ii) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (iii) Can supervisors take legal action against external auditors for negligence? (iv) Can supervisors force banks to change the internal organizational structure? (v) Are off-balance sheet items disclosed to supervisors? (vi) Can the supervisory agency order directors/management to constitute provisions to cover actual/potential losses? Moreover, this indicator reflects whether the supervisory agency can suspend directors' decisions to distribute: (vii) dividends, (viii) bonuses, (ix) management fees, and (x) if the supervisory agency can supersede bank shareholder rights and declare a bank insolvent. In addition, this variable shows (xi) whether or not banking law allows a supervisory agency to suspend some or all ownership rights of a problem bank; coupled with regarding

power has the power to take concrete actions to correct and prevent problems (Barth et al., 2013a). Further, this study investigates the interaction between official supervisory power and supervisory independence and the impact on financial stability.

Government-owned banks:

Government ownership of banks may help to achieve social objectives; however, private and political objectives may overcome social objectives, which leads to the hindering of financial development (La Porta et al., 2002). This variable reflects the percentages of a banking system's assets or equity which are owned or controlled by a government (Barth et al., 2013a).

HHI:

The debate between concentration–fragility and concentration–stability means that the influence of market concentration and financial stability is an empirical question that needs to be explored. However, this study adopts the assumption of concentration–stability because of the need to concentrate on a supporting mechanism for the selection of borrowers, enhance liquidity and capital adequacy, and improve economies of scale and scope for banks. These are coupled with the implicit government policy which supports banks because they are 'too-big-to-fail' (Beck et al., 2006a). The *HHI* utilises a proxy of concentration in the banking sector. It captures, through squaring, the market share (deposits) for each bank competing in the banking sector in each country, and has a range from zero to 10.000 points (Al-Muharrami et al., 2006).

Governance index:

With regard to financial institutions which work in a healthy financial environment, there is almost a consensus that governance is conducive to greater financial soundness (Lupu, 2015). Thus, this study relies on the worldwide governance indicators (WGI) to investigate the impact of governance on financial stability. These indicators reflect six dimensions of governance: *voice and accountability*, *government effectiveness*, *the rule of law*, *political stability*, *quality of regulation*, and *control of corruption* (Kaufmann et al., 2011). The definitions of each indicator are presented in Table 1. We develop the *governance index* by calculating the average value of all governance dimensions.

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bank restructuring and reorganization and whether or not a supervisory agency can do the following: (xii) supersede shareholder rights; (xiii) remove and replace management; and (xiv) remove and replace directors. This variable ranges from zero to sixteen with higher values reflect greater power.

Economic freedom index:

While the *governance index* reflects only the quality of the legal and regulatory environment, the *economic freedom index* is more comprehensive. The latter is based on 10 essential dimensions grouped into four broad pillars: (i) the rule of law, which includes property rights and freedom from corruption; (ii) limited government, which combines fiscal freedom and government spending; (iii) regulatory efficiency, which refers to business freedom, labour freedom, and monetary freedom; and (iv) the open market, which reflects trade freedom, investment freedom, and financial freedom. We expect financial institutions tend to be more stable in countries with a high level of economic freedom.

Gross domestic product (GDP):

Stable economic growth reflects a stable financial system and is conducive to decreasing uncertainty about the future of the financial system. This study includes the natural logarithm of GDP to capture the influence of an economic growth rate on financial stability.

Inflation:

Although some links between inflation and financial stability are not obvious, this relation may make sense when focusing on the interest rate. Indeed, inflation and interest rates work in tandem. This may help to explain the effect of the cost of loans on financial stability. Hence, in other words, when inflation increases, interest rates tend to rise and banks may gain more income; however, they may face more loan defaults (Tan and Floros, 2012). We assume an adverse effect of inflation on financial stability and control inflation by using the consumer price index as a proxy for inflation.

4.3.2. Research methodology

In this section, we first propose a CAMELS-DEA technique and then test it by using quantile regression (QR) to examine the multifaceted influences of regulation and supervision on risk-taking in banks. Because this study includes a large number of banks from various countries, with significant variations in business models, these heterogeneous characteristics are imposed on our adopted model so as to test the heterogeneous impacts of regulation and supervision on banks' risks. QR coupled with DEA can overcome some econometric issues, for example, simultaneity and endogeneity problems, and heterogeneity and heteroskedasticity issues.

DEA and CAMELS rates

DEA is an efficient frontier technique which calculates comparative ratios of multi-weighted inputs to multi-weighted outputs by using linear programming for each decision-making unit (DMU) (Avkiran, 2011). Further, unlike one-dimensional risk factors such as the Z-factor or capital ratios, indeed CAMELS indicators are multi-dimensional risk indicators, which makes them useful for assessing the financial vulnerability of banks (Klomp and De Haan, 2012). Accordingly, CAMELS and DEA integration share a common motivation; namely, they are able to deal with, and interact among, multi-inputs and multi-outputs, which gives them a distinct advantage over traditional risk ratios. Moreover, CAMELS-DEA achieves our aim of capturing successful banks by minimising inputs and maximising outputs. This reflects the rational perspective of CAMELS-DEA, which not only relies on a shortage of desirable outputs but also a surplus of undesirable inputs. Thus, selection should consider whether an input/output is desirable or undesirable, taking into account data availability (Wanke et al., 2016).

Capital adequacy (C) is captured by total equity and treated as a desirable output. It should be maximised when more equity is conducive to less financial distress. Asset quality (A) is captured by LLP, which is an undesirable input and should be minimised because a greater amount of LLP means that there is greater risk. In a similar manner, management efficiency (M) has a proxy in the form of total expenses (personnel and operating) and is regarded as an undesirable input. However, earnings quality (E) has a proxy in the form of total net income and is maximised as a desirable output. In addition, liquidity (L) is another desirable output that has a proxy in the form of total liquid assets. Finally, sensitivity to market risk (S) is measured by total assets and treated as a desirable output because of the role of total assets in impeding default risk (Wanke et al., 2016).

Note that a DEA model may suffer from some econometric problems; for instance, negative values (Emrouznejad et al., 2010) and the number of DMUs, which should be at least twice the total number of output and input indicators (Dyson et al., 2001). Overcoming these problems can be achieved by excluding DMUs with negative values. The number of DMUs can be expressed as:

$$DMUs \geq 3(2x * y) \tag{4}$$

where x is the total number of inputs and y is the total number of outputs. $DMUs$ is the number of banks (the decision-making units).

Subsequently, we build a combination model relying on CAMELS rates and standard output-oriented DEA, using a return-to-scale technique as represented in equation (2). This equation was developed by Thanassoulis (2001) and has been adopted by many researchers such as Emrouznejad et al. (2010). Thus, the stability model can be written as:

$$\begin{aligned} &Max\ h \\ &s.t.\ \sum_j \lambda_j x_{ij}\ \le x_{ij_0};\ \ \forall i \\ &\sum_j \lambda_j y_{rj}\ \ge h y_{rj_o};\ \ \forall r \\ &\sum_j \lambda_j = 1 \\ &\lambda_j\ \ge 0;\ \ \forall j, h\ free \end{aligned} \tag{2}$$

Hence, based on equation (2), the efficiency of $DMUs$ is the optimal value of h, which reflects the stability level for each bank, j. x refers to input and y refers to output, while i is the actual value of inputs $\{x_{ij}; i = 1, \dots, m\}$ and r is the actual value of outputs $\{y_r; r = 1, \dots, s\}$.

Empirical model

The empirical model we adopt to examine the impact of bank regulation and supervision is QR. The questionable homogeneous relation between our explanatory variables and bank stability is used with this technique (Klomp and De Haan, 2012). This approach was introduced by Koenker and Bassett (1978). Moreover, our sample includes a large number of banks from different countries, with different business models and different sizes; hence, such heterogeneity reinforces our need for this model. The unique abilities of QR help to provide alternative approaches to treat the potential heterogeneity problem in our sample by exploring a range of conditions related to quantile functions (Koutsomanoli-Filippaki and Mamatzakis, 2011). In addition, traditional inference methods such as least absolute deviations (LAD) and ordinary least squares (OLS) are developed to describe average behaviour in the sample; however, they are too weak to handle heterogeneity in the sample (Lee and Li, 2012). In the OLS model, QR is designed to estimate the median of conditional distribution. It is robust with outliers and avoids the assumption that 'error terms are identically distributed at all points of the conditional

distribution' (Klomp and De Haan, 2012). Thus, the model is a suitable approach to discover whether *bank stability* (a dependent variable) is related to our explanatory indicators at different points of bank stability distribution. We use a multiplicative model, which is particularly designed to take into account generated heteroscedasticity and simultaneity data (Cameron and Trivedi (2009); Klomp and De Haan (2012). Thus, the baseline of our QR can be written as:

$$Q_{\tau ijt}\left(CAMELS_{ijt}|X_{jt}\right) = \alpha_{\tau ijt} + \beta_{\tau 1} CAMELS_{ijt-1} + \beta_{\tau k} X_{kijt-1} + \varepsilon_{i.t} + \varepsilon_{j.t} \quad (3)$$

Where the $CAMELS_{ijt}$ dependent variable refers to bank stability for bank i in country j at time t.

$CAMELS_{ijt-1}$ is a lagged dependent variable that accounts for autoregression and endogeneity. X is a lagged explanatory variable of type k (*CPM*, *capital regulation index*, *activity restrictions*, *deposit insurance*, *private monitoring index*, *official supervisory power*, *government-owned banks*, *HHI*, *economic freedom index*, *GDP*, and *inflation*). The final two error terms, $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$, reflect bank and country respectively. The regression is estimated for $\tau - quantiles$, where:

$$Quantiles = 0 < \tau < 1 \quad (4)$$

Thus, our quantiles τ are the tenth, twenty-fifth, fiftieth, seventy-fifth, and ninetieth. We ensure the robustness of our results by quantile-varying estimates with an increment of 0.05 per quantile, which reflects 19 quantiles from 0.05 to 0.95, coupled with OLS (Lee and Li, 2012). The standard OLS regression model is given by:

$$E(y_i|x_i) = \beta_0 + \beta_1 x_i \quad (5)$$

For example, equation (5) can be written as:

$$y_i = \beta_1 + \beta_2 x_i + u_i \quad (6)$$

Where the error u_i is satisfied $by\ E(y_i|x_i) = 0$.

Hence, in our quantile model, $Q_q(y_i|x_i)$ is analogous to $E(y_i|x_i)$ in equation (5) but does not take into account the distribution function of u_i; thus, the quantile model treats this as:

$$Q_q(y_i|x_i) = \beta_1 + \beta_2 x_i + F_{u_i}^{-1}(q) \quad (7)$$

where F_{u_i} is the distribution function of u_i and conditional or dependent on x_i; however, this may lead to heteroskedasticity in error terms (Cameron and Trivedi, 2009). This problem is overcome by applying 1000 bootstrap replications so as to enhance the adequacy of the standard error and increase the construction of the confidence intervals (Hahn, 1995).

Moreover, other econometric problems that need to be addressed are simultaneity and endogeneity. We lag all explanatory variables (x_{ijt-1}) to avoid these issues and include the lagged independent variable ($CAMELS_{ijt-1}$) as an explanatory variable (Klomp and De Haan, 2012). With regard to the potential endogeneity of some contemporaneous dependent variables such as *financial regulation and supervision*, we re-estimate the effect of these explanatory variables on bank stability using a two-stage least squares (2SLS) instrumental regression model (Lee and Li (2012); Klomp and De Haan (2012). Finally, we resolve the potential heterogeneity of the data by re-examining our quantile model using business model, bank size, and even economic development (Haas and Murphy (2003); Thompson et al. (2006).

4.3.3. Data and descriptive analysis

The data

This study relies on unbalanced panel data of 2210 different banks over 17 years from 2000 to 2016. The sample includes commercial banks, investment banks, and bank holding companies in 47 European countries. Unlike most financial literature, which has concentrated on listed banks (e.g. Demirgüç-Kunt and Huizinga (2010) and Altunbas et al. (2011)), our sample includes listed and unlisted banks. This is important because unlisted banks typically have a different business model such as that of bank holding companies. Moreover, unlisted banks usually reflect significant numbers of small banks (Köhler, 2015). Thus, considering unlisted banks enhances the data's ability to identify the effect of variation in business models and bank size on financial stability (Demsetz and Strahan, 1997), as our analysis will show.

This data set has been refined by excluding the following: (i) banks that do not report the values of total assets or LLP, thereby using the average stability of each bank as a weight; (ii) banks with headquarters outside European countries; (iii) banks with fewer than three years of

consecutive observations; and (iv) banks with unusual values, which may reflect errors in measurement and hence may influence the stability score, specifically when utilising the DEA technique.

Furthermore, the study focus on European data, which has some interesting aspects: (i) most studies focus on US banks or UK banks; (ii) increased homogeneous in sample; (iii) the European sovereign debt crisis, leads to increase the role of credit rating agencies in Europe; and (vi) European banks face different economic and business conditions and operate out of a single country, which unlike US banks.

Moreover, this sample uses rich data sets that are predicated on a combination of five unique databases. First, the BankScope database provides rich, comprehensive data about bank-specific variables. Such data have been used to build the CAMELS model, the CPM, and the HHI (Van Dijk and Fitch, 2000). Second, a unique database provided by Barth et al. (2001) reflects comprehensive information about financial regulation, official supervision, and monitoring.[18] Third, WGI offer a combination of six effective dimensions of governance: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, the rule of law, and control of corruption (Kaufmann et al., 2011). Fourth, an index of economic freedom is another fundamental dimension which influences financial stability by documenting the positive relation between financial soundness and various positive economic goals (Miller et al., 2015). Finally, world development indicators (WDI) provide macroeconomic indicators across countries.

Data description statistics

In this section, we present the summary statistics of the indicators used in this analysis for 2000 to 2016 (see Table 4-2). Notably, winsorising is used for the *CAMELS* modelling and *CPM* modelling. In general, the outcomes of our descriptive analysis seem reasonable, except for *CAMELS* with an average of 52.33%, which is not citable. This is interesting because a normal average may lead to an underestimated value of *CAMELS* because of a large number of banks coupled with significant variations in the sample. Moreover, a large standard deviation suggests that *CAMELS* varies widely among the sample. Thus, we adopt a weighted average (e.g. total

[18] The World Bank Survey (Barth et al., 1999, 2003, 2007, 2012) has been used in this study.

assets and LLP (Barth et al., 2013b). In a similar manner, the average *CPM* of approximately 53% reflects underestimated value.[19] Further, the average of the *capital regulation index* is approximately 6.4 out of 10. Although this is a reasonable level, the emerging European markets have had a significant negative impact on the overall average level. For example, countries such as Serbia, Albania, and Russia have below-average levels of 5 points, while advanced European countries such as the UK, Germany, and France have banks that have built stringent capital buffers that are above the average level. Moreover, European countries have fewer restrictions regarding non-traditional bank activities, which results in an average of 5.8 out of 12. Additionally, *deposit insurance* seems weak with 1.1 out of 4. *Private monitoring index* and *official supervisory power* show reasonable levels of control with averages of 7.7 out of 12 and 10.5 out of 16 respectively.

Table 4-2: Summary Statistics

Variables	Obs	Mean	Std Dev.	Min.	Max.
CAMELS	12444	52.33364	23.8521	16.6	100
CPM	12444	52.65107	14.99185	0	100
Capital regulation index	12444	6.391562	1.664366	2	10
Activity restrictions	12294	5.837156	1.244642	0	10
Deposit Insurance	12294	1.103492	0.917938	0	4
Private monitoring index	12294	7.73746	1.405605	0	11
Official supervisory power	12294	10.4834	2.428872	2	15.5
Government-owned banks	12267	17.67928	17.71378	0	75.2
HHI	12444	1801.504	1376.576	153.6785	38261.89
Governance index	12411	69.88822	26.05861	14.13228	108.9846
Business freedom index	12302	65.00772	9.832645	36.6	82.6
GDP	11508	3.130077	3.575696	-5.37699	9.9605
Inflation	11204	4.613046	4.291899	-0.69254	15.792

More interestingly, on average, *government-owned banks* is approximately 17.8%, which indicates a remarkable change in some European emerging markets[20] in the context of the liberalisation of financial systems. Further, the considerable competition levels in the European banking system, as indicated by 1801 points out of 10000 average HHI points, are unsurprising.

[19] This value reflects the overall average for all countries in the sample. However, the panel data structure is able to control these significant variations across the sample of countries.

[20] Countries that have a history of a socialist economic system, such as Russia and countries in Eastern Europe.

Moreover, poor governance and limited business freedom in some emerging European markets have led to overall averages for the *governance index* and the *business freedom index* of 69.88% and 65% respectively. In addition, a figure of 3.13% *GDP* suggests stable economic growth in most European countries. Finally, an average high inflation rate of 4.6% may reflect monetary stimulus policies[21] in some European countries or may be due to fast growth in some advanced European countries.

The cross-correlation matrix between the variables utilised in this study is presented in Table 4-3. The matrix does not show significant correlations between most of the variables except for the correlation coefficient between the *governance index* and the *business freedom index,* which at approximately 0.89 is the highest figure. Indeed, a higher correlation coefficient between these variables is unsurprising, particularly with variables of similar behaviour. Accordingly, we have addressed this matter by adopting the *business freedom index* in the main analysis and the *governance index* in the robustness analysis. Moreover, the correlation matrix indicates that *CPM*, *capital regulation*, the *private monitoring index*, *HHI*, *governance*, and the *business freedom index* have positive significant correlation coefficients with CAMELS. In contrast, *activity restrictions*, *deposit insurance*, *official supervisory power*, *government-owned banks*, *GDP*, and *inflation* have negative correlation coefficients with CAMELS.

[21] A fall in the interest rate may stimulate demand for money.

Table 4-3: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
CAMELS (1)	1												
CPM (2)	0.1872	1											
Capital regulation index (3)	0.0139	0.0161	1										
Activity restrictions (4)	-0.0745	0.0002	-0.0326	1									
Deposit insurance (5)	-0.0631	-0.0833	0.2593	-0.0521	1								
Private monitoring index (6)	0.0749	-0.011	-0.065	0.0312	-0.0792	1							
Official supervisory power (7)	-0.0014	-0.0506	0.1313	-0.0138	0.0627	0.0963	1						
Government-owned banks (8)	-0.2247	-0.0836	0.0687	-0.0666	0.0238	-0.1365	-0.0309	1					
HHI (9)	0.1463	0.0956	-0.093	-0.0022	-0.2261	-0.0486	0.0056	-0.2842	1				
Governance index (10)	0.3339	0.1673	-0.08	-0.1054	-0.1309	0.153	-0.0234	-0.5998	0.3872	1			
Business freedom index (11)	0.3412	0.1528	-0.0455	-0.1338	-0.1367	0.2382	0.1132	-0.5113	0.2921	0.8872	1		
GDP (12)	-0.1219	-0.23	0.0316	-0.031	0.0635	-0.0068	0.0772	0.4711	-0.1967	-0.4057	-0.333	1	
Inflation (13)	-0.1955	-0.1128	0.1205	-0.0276	0.0639	-0.0924	-0.0539	0.5752	-0.1818	-0.6303	-0.5732	0.3969	1

Table 4-4: Stability levels across countries

Country	Weighted LLP	Weighted assets	Banks	Country	Weighted LLP	Weighted assets	Banks
ALBANIA	41.377401	50.811143	13	LITHUANIA	45.181303	59.849125	9
ANDORRA	54.230713	73.015855	3	LUXEMBOURG	67.256635	81.311362	57
AUSTRIA	75.043948	77.92923	68	MACEDONIA (FYROM)	36.352738	40.222889	15
BELARUS	39.92251	43.90297	21	MALTA	57.602939	62.492898	12
BELGIUM	88.589944	92.588812	23	MONACO	91.877094	90.56771	1
BOSNIA AND HERZEGOV.	34.112604	36.596172	27	MONTENEGRO	32.436133	34.073215	8
BULGARIA	43.518474	48.610087	20	NETHERLANDS	77.233194	88.269231	33
CROATIA	49.361948	54.515342	30	NORWAY	95.635747	96.851744	23
CYPRUS	55.155956	61.96766	19	POLAND	52.406747	63.24623	39
CZECH REPUBLIC	75.228476	81.670169	17	PORTUGAL	60.255478	62.58268	33
DENMARK	69.559981	80.936644	40	MOLDOVA	45.250426	50.902889	12
ESTONIA	68.075541	80.271688	9	ROMANIA	46.036195	49.145004	21
FINLAND	65.543853	75.817031	26	RUSSIAN FEDERATION	54.021116	66.191027	702
FRANCE	80.744329	85.314026	121	SAN MARINO	58.917257	61.707899	4
GERMANY	77.548706	83.254206	155	SERBIA	40.461296	42.878519	27
GIBRALTAR	88.014999	88.014999	1	SLOVAKIA	46.670465	49.464732	14
GREECE	67.516485	70.229284	9	SLOVENIA	42.558726	44.397704	17
HUNGARY	43.077491	46.973926	17	SPAIN	85.995769	88.919448	51
ICELAND	57.583868	67.635691	11	SWEDEN	82.914954	93.626741	38
IRELAND	89.398343	92.282333	15	SWITZERLAND	76.376287	88.175124	139
ITALY	64.249773	73.596774	89	TURKEY	72.023599	79.077725	38
KOSOVO	35.768596	40.881686	4	UKRAINE	32.280932	32.222542	23
LATVIA	45.113216	52.341827	19	UNITED KINGDOM	82.603987	91.018238	136
LIECHTENSTEIN	93.821701	95.466343	1				
				Totals	71.227924	82.593242	2210

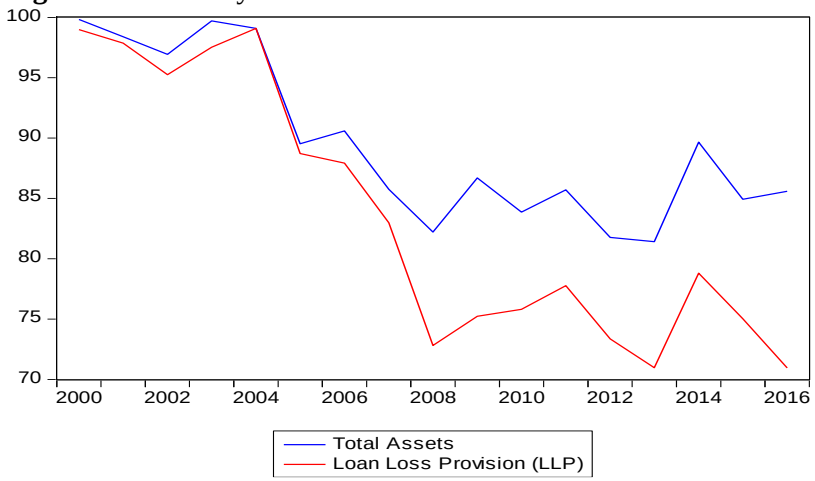
4.4. Empirical results

4.4.1. Stability scores

The bank stability scores are presented in Table 4-4. The second and sixth columns give weighted averages by LLP, while the third and seventh columns provide the weighted averages of each country based on total assets. Unsurprisingly, the results indicate that the more advanced European countries have high *stability levels*. For instance, one of the richest European nations, Norway, contains the most stable banking system in Europe with an average of almost 96%. Additionally, other developed nations such as the UK, France, Sweden, and Belgium have stability scores higher than 80%. Less developed European countries, in contrast, show lower *stability levels*. For example, Ukraine, a highly corrupt country,[22] has the lowest and most unstable banking system with an average of approximately 32%. Similarly, post-Soviet states such as Latvia and Lithuania, as well as some Eastern European countries such as Albania, Bosnia, Kosovo, Slovakia, and Slovenia, tend to have scores that are much lower than the average level. Further, the total average *stability* percentage based on LLP is almost 12% lower than the overall average based on total assets. This finding may suggest the influence of asset size on the enhancement of *bank stability*. In contrast, loan risks may jeopardise stability in the banking system. Figure 4-1 provides clues about the substantial variation between the ways in which LLP and assets influence *stability levels*. While LLP places pressure on levels of *stability*, particularly during a financial crisis, assets tend to be a buffer against financial distress. On other words, large banks have ability to funding their buffer tools such as capital adequacy, which provide protection against any financial distress (Demirguc-Kunt et al., 2013).

[22] Based on Transparency International's Corruption Perceptions Index, 2015. Ukraine ranked 130 out of 160 nations.

Figure 4-1: Stability across time



Indeed, substantial differences may appear when levels of *stability* are grouped by business model, economic development, and bank size (see Figure 4-2). Present *stability* grouped by business models Fig. 2-1-A and Fig. 2-1-B. Interestingly, stability tends to be substantially lower in investment banks and moderately higher in commercial banks, while bank holding companies reflect the highest levels of *stability*. This may suggest that bank holding companies have strong and significant assets coupled with the ability to diversify risk because of non-traditional financial activities and non-financial activities. Thus, they are unlike investment banks, which concentrate on risky financial activities. With regard to economic development classification, Fig. 2-2-A and Fig. 2-2-B show that banks in advanced countries tend to present higher *stability levels* compared with banks in emerging economies. One may consider here that in practice, high governance and effective supervision reinforce stability levels in advanced economies. In addition, it is unsurprising that large banks are less sensitive to financial distress because of their larger capital buffers and higher liquidity compared with small banks, which are more prone to financial distress (see Fig. 2-3-A and Fig. 2-3-B).

Figure 4-3 presents levels of stability across time, particularly *stability levels* during the global financial crisis. Stability and bank business models are presented in Fig. 3-1-A and Fig. 3-1-B. These show that *stability* over the first six years is consistent in all the banks. In 2007, the time of the financial crisis, a moderate drop occurs for bank holding companies and commercial banks; however, investment banks experience a sharp drop in the *level of stability*. This indicates the capability of bank holding companies to resist financial distress,

unlike investment banks, which are more sensitive to financial distress. Further, banks in advanced economies tend to resist financial distress compared with banks in emerging economies because of the solvency of the banking system in advanced economies, which explains the speed of recovery in advanced markets of the consequences of the crisis compared to the emerging markets (see Fig. 3-2-A and Fig. 3-2-B). Similarly, strong capital buffers in large banks enhance *stability* during financial crises. In contrast, small banks appear less resistant to financial distress.

Figure 4-2: Stability grouped by business model, economic development, and bank size

Fig. 2-1-A: Business model based on LLP

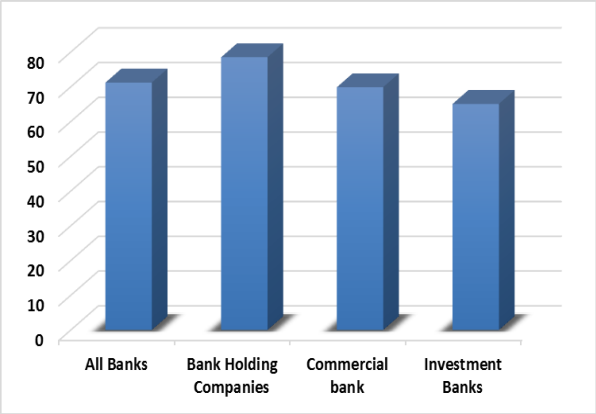


Fig. 2-1-B: Business model based on total assets

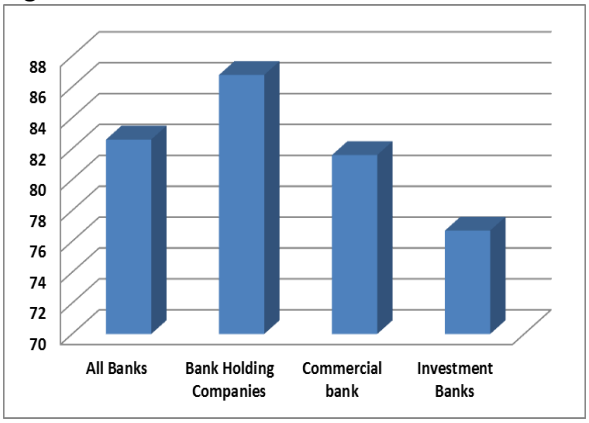


Fig. 2-2-A: Economic development based on LLP

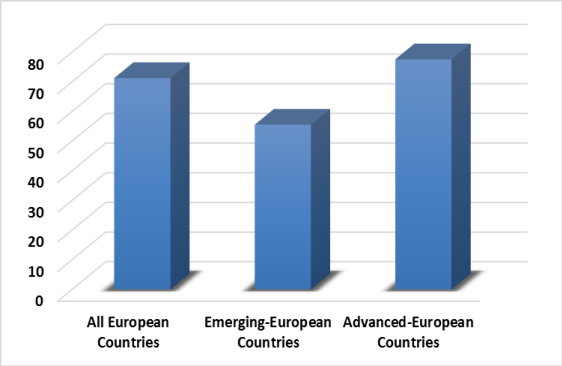


Fig. 2-2-B: Economic development based on total assets

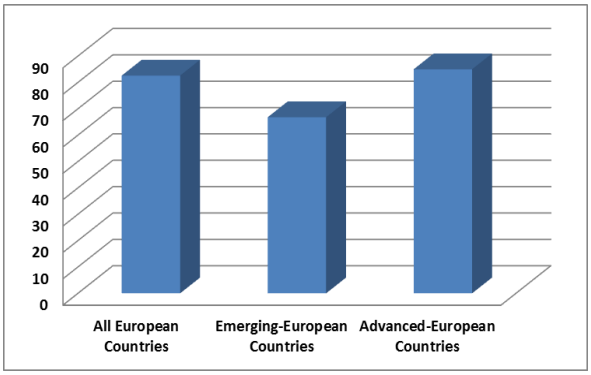


Fig. 2-3-A: Bank size based on LLP

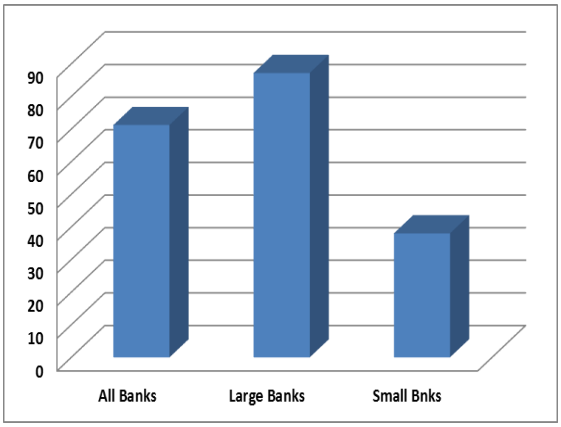


Fig. 2-3-B: Bank size based on total assets

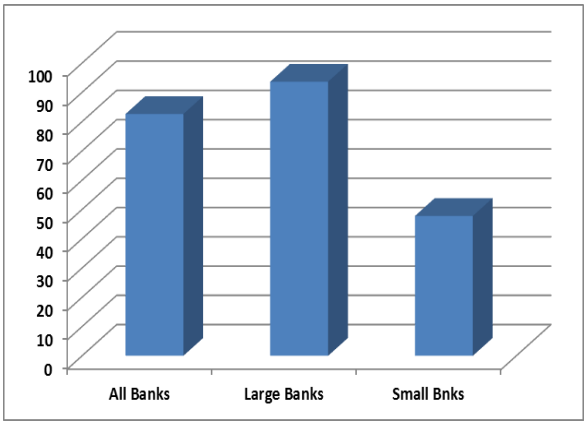


Figure 4-3: Stability across time grouped by business model, economic development, and bank size

Fig. 3-1-A: Business model based on LLP

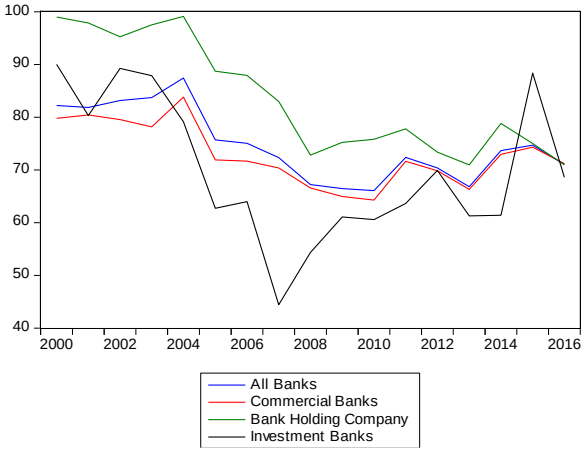


Fig. 3-1-B: Business model based on total assets

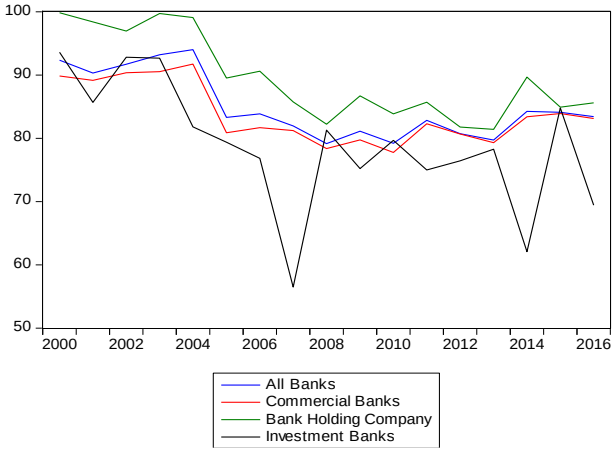


Fig. 3-2-A: Economic development based on LLP

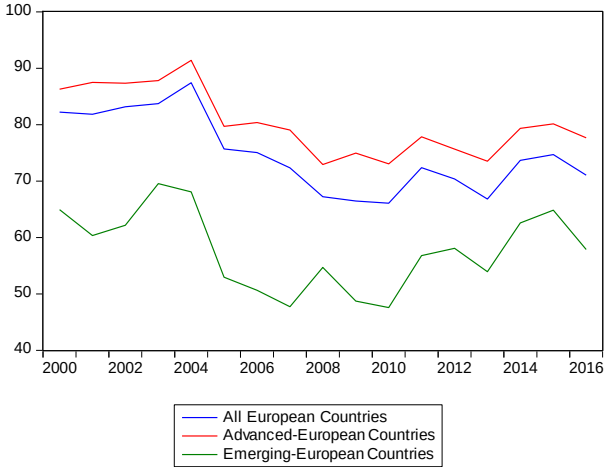


Fig. 3-2-B: Economic development based on total assets

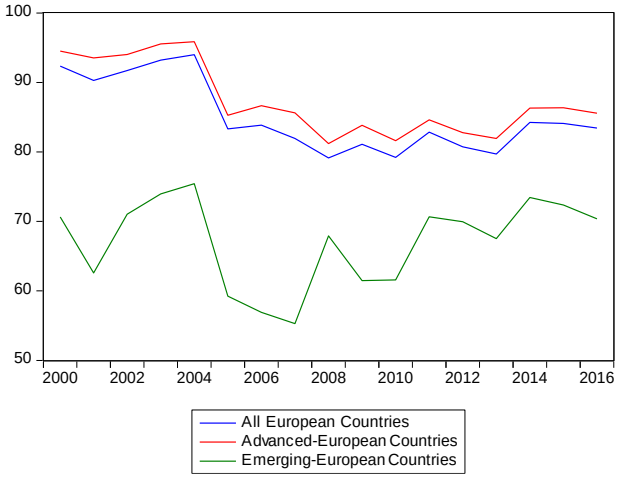


Fig. 3-3-A: Bank size based on LLP

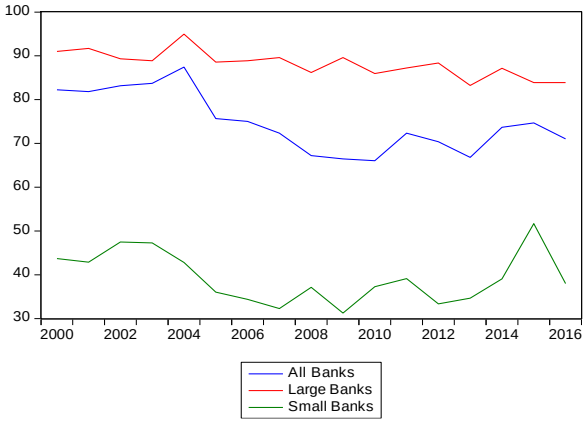
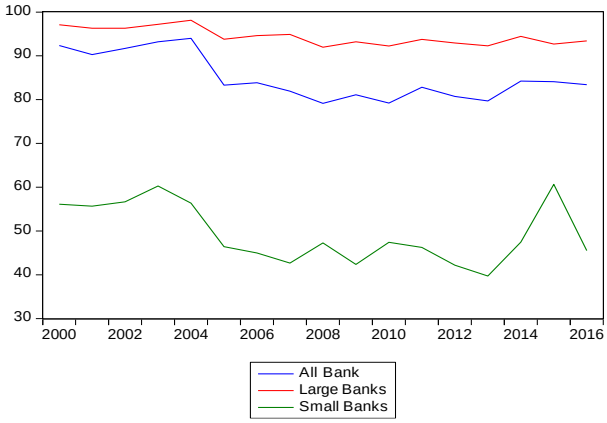


Fig. 3-3-B: Bank size based on total assets



4.4.2. Main model: stability and quantile regression

In this section, the estimated parameters of eq. (3) are presented in Table 4-5 in order to investigate the impact of various quantiles on bank stability. Accordingly, the table includes five pairs of quantile results, Q0.10, Q0.25, Q0.50, Q0.75, and Q0.90, coupled with OLS. As highlighted, OLS depends on the approximation of the mean function of conditional distribution, which does not provide a complete picture of the influence of explanatory variables on stability dispersion across banks. In order to achieve a more detailed explanation, quantiles can deliver a clear picture about the influence of explanatory variables on high-stability and low-stability banks.

Table 4-5: Main model

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Q10	Q25	Q50	Q75	Q90	OLS
Lagged dependent	0.267***	0.475***	0.825***	0.824***	0.622***	0.6083***
	(0.0104)	(0.0128)	(0.0148)	(0.00650)	(0.0174)	(0.0090)
CPM	0.0199**	0.0123	-0.0214*	0.0390***	0.134***	0.0307**
	(0.00907)	(0.00975)	(0.0120)	(0.0140)	(0.0315)	(0.0140)
Capital regulation index	0.174**	0.428***	0.686***	0.650***	0.955***	0.6029***
	(0.0755)	(0.0798)	(0.0961)	(0.110)	(0.290)	(0.1108)
Activity restrictions	-0.201*	-0.123	-0.219*	-0.584***	-0.867**	-0.4658***
	(0.113)	(0.107)	(0.125)	(0.142)	(0.433)	(0.1523)
Deposit insurance	-0.237*	-0.434***	-0.592***	-0.649***	-1.619***	-0.7275***
	(0.142)	(0.154)	(0.169)	(0.205)	(0.513)	(0.1955)
Private monitoring index	-0.196**	-0.296***	-0.339***	-0.563***	-0.671*	0.0517
	(0.0845)	(0.0844)	(0.0890)	(0.136)	(0.389)	(0.1274)
Official supervisory power	-0.0461	-0.174***	-0.337***	-0.390***	-0.732***	-0.1588**
	(0.0513)	(0.0504)	(0.0614)	(0.0854)	(0.190)	(0.0728)
Government-owned banks	-0.0273***	-0.0355***	-0.0438***	-0.0281*	-0.0673*	-0.0479***
	(0.00897)	(0.00849)	(0.0111)	(0.0160)	(0.0381)	(0.0131)
HHI	0.000477***	0.000460**	0.000353**	0.000575***	0.000840	0.0004**
	(0.000119)	(0.000187)	(0.000159)	(0.000152)	(0.000555)	(0.0002)
Business freedom index	0.161***	0.200***	0.222***	0.197***	0.462***	0.2914***
	(0.0184)	(0.0202)	(0.0222)	(0.0249)	(0.0752)	(0.0250)
GDP	0.0862***	0.212***	0.266***	0.210***	0.192	0.2439***
	(0.0298)	(0.0328)	(0.0459)	(0.0643)	(0.169)	(0.0552)
Inflation	-0.0492*	-0.0357	-0.0514	-0.105***	0.229	-0.0239
	(0.0251)	(0.0341)	(0.0373)	(0.0397)	(0.150)	(0.0414)
Constant	9.925***	3.991**	-1.603	9.849***	16.21**	0.6939
	(1.633)	(1.559)	(1.909)	(2.401)	(7.205)	(2.2333)
Observations	10,998	10,998	10,998	10,998	10,998	10,998
R^2						0.452

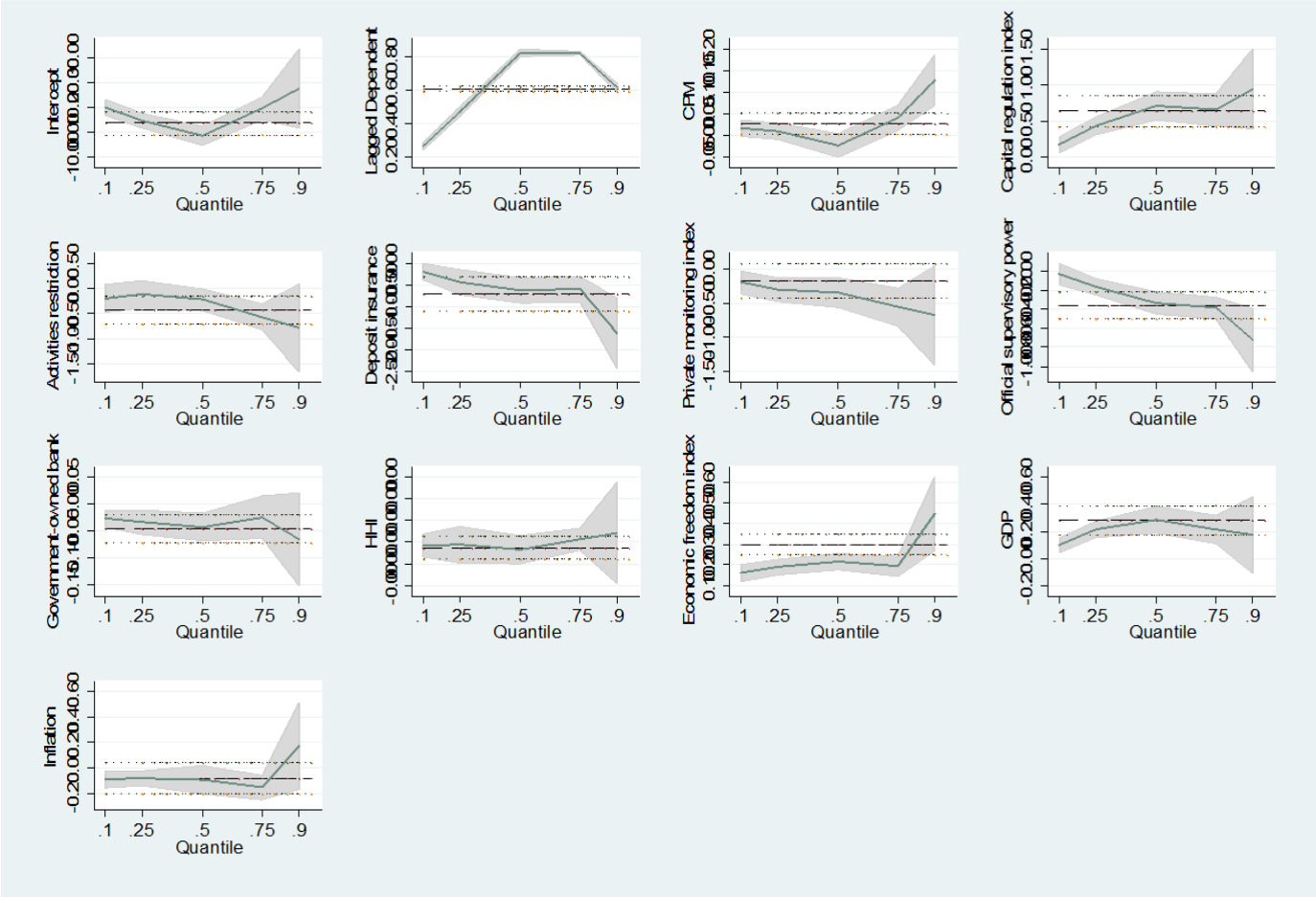
This table presents the QR estimates for our main sample. The dependent variable is *bank stability* based on CAMELS-DEA. The quantiles are reported from columns 1 to 5. Bootstrapped standard errors are based on 1000 replications and are reported in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1 across all quantiles. OLS regression is reported in column 6 with heteroscedasticity-robust standard errors for OLS. ± F tests for the equality of the slope coefficient across various quantiles have been undertaken and are significant at the 5% level for most quantiles; however, they are not reported in order to save space. The details are available upon request.

First Foremost, the key finding in this chapter is emphasizing that financial regulations in general and supervision in particularly are multifaceted concepts. In other words, the financial regulation and supervision have either positive or negative impact in financial stability. This not just due to the variations in history, and legal across countries or culture of financial institution; but also, because of the variation in bank business models, banks size, and economics development. For example, the financial regulation and *supervision* influence negatively on *stability* in emerging markets, while both have positive impact on stability in advanced markets. Greater capital regulation and higher profit are positively associated with bank stability, while tighter restrictions on banking activities and higher deposit insurance are negatively associated with bank stability. Further, we find a negative impact of both private monitoring and supervisory power when expounding stability across emerging economies. In turn, this influence becomes positive when interpreting stability across advanced economies. The rest of this section has shown the results in details.

Regarding *CPM*, it is unsurprising that the results indicate the significant positive impact of most *CPM* quartiles on financial *stability*, except for quantile 0.50.[23] However, interestingly, the unsystematic pattern of *CPM* for interpreting stability across quartiles is presented in Fig. 4-4, which shows the distribution of explanatory variables. Specifically, *CPM* has estimated at around 0.0199 in quantile 0.10. It then declines to 0.0123 at quantile 0.25, but *CPM* is marginal negative impact at median 0.5. While it increases positively at quantile 0.75 and increases further to 0.134 at quantile 0.90. This may provide clarity about the unsystematic impact of profit on bank stability. Further, we observe a significant variation in the *capital regulation index* estimates across quantiles with regard to their influence on bank stability. This situation is particularly evident with the tails of the distribution, with quantile 0.10 at approximately 0.176 compared with 0.955 at quantile 0.9. More importantly, the *capital regulation index* tends to have a systematic pattern of influence on bank stability (see Figure 4-4).

[23] Here, there is negative but not significant impact, as shown in Table 4-5.

Figure 4-4: The distribution of explanatory variables



The figures represent the distribution of explanatory variables at Q10, Q25, Q50, Q75, and Q90. The horizontal line represents the quantile at the 0 scale and the grey area represents a confidence band at 95% for QR.
The OLS estimator is represented by the broken line.

Greater activity restrictions have a significant negative influence on bank stability across most quantiles. The results suggest that a greater restriction in number of non-traditional financial activities may reduce the ability of the banks to diversify risk, thus impeding their stability. For the purpose of comparison, Figure 4-4, regarding *activity restrictions*, has a confidence interval of QR and a confidence interval of OLS that are consistent with each other. This finding suggests that there is no significant difference of the activity restrictions between the results of quantile and OLS in terms of any influence on bank stability.

The impact of *deposit insurance* on bank stability is significantly negative across various quantiles. This relation requires further explanation, particularly for quantile 0.90. We observe that the confidence intervals of different *deposit insurance* quantiles are almost consistent with the OLS confidence interval across quantile 0.10 to quantile 0.75, while at quantile 0.90 the coefficient of deposit insurance decreases the OLS confidence interval

(Figure 4-4). This result highlights the negative impact of deposit insurance on high-stability banks because deposit insurance increases the incentive of banks to take risks. For example, in order to achieve a high-stability level, a bank must minimise the essential input pillar of LLP. In addition, deposit insurance may motivate a bank to relax its restrictions on lending, which may lead to the maximisation of LLP and impede stability. Similarly, deposit insurance may disrupt the ability of banks to maximise liquidity, hence impairing bank stability.

Regarding the *private monitoring index*, we observe a significant negative systematic impact on bank stability across different quantiles. However, this impact differs substantially from the OLS, which shows a positive but not significant impact on bank stability. This finding provides clear evidence about the capability of QR to give a comprehensive picture of the relation between the *private monitoring index* and bank stability. More importantly, Figure 4-4 demonstrates that the departure point of the quantile estimates (median) and OLS (mean) is similar, while the gap becomes greater after this point. This suggests that the reliability of QR is higher compared to the OLS estimator and may indicate the high cost of private monitoring for limiting stability.

Moreover, we find that *official supervisory power* has a significant negative effect on bank stability across different quantiles. We observe a systematic pattern in the effect of different quantiles on stability, whereby high-stability levels are affected to a greater extent compared with low-stability levels. This result highlights the influence of self-interest promotion among some supervisors on decreasing bank stability (Barth et al., 2013b).

Further, the analysis shows that the variable *government-owned banks* has a negative significant impact on the explanation of bank stability across all quantiles. We observe no systematic pattern because of the disparity of coefficients for explaining stability across various quantiles. This finding may demonstrate that bureaucracy in government agencies generates weak management, corruption, and misallocation, thereby decreasing stability in the banking system.

In contrast, *HHI* has a positive significant influence on stability from quantile 0.10 to quantile 0.75, with an unsystematic pattern. This result is consistent with the concentration-stability approach (Uhde and Heimeshoff, 2009). The possible explanation is that concentration may generate fewer market players, a situation which enhances supervision and stability in the banking industry.

In a similar vein, we observe a significant positive effect on the *economic freedom index* regarding the interpretation of bank stability. Figure 4-4 demonstrates an unsystematic pattern for the *economic freedom index* with the coefficients of most quantiles differing substantially from OLS. The reasonable explanation for this finding is that it demonstrates the effect of economic freedom in forcing a government to conduct economic reforms as requirement of market liberalization, thereby enhancing transparency and political stability, removing government control, boosting economic growth, and opening up the markets.

With regard to macroeconomic factors, the empirical results reveal that *GDP* has a positive significant impact on stability across most quantiles. We observe an unsystematic coefficient pattern; however, the coefficient is more pronounced at the median level (quantile 0.50). This positive influence can be attributed to the decreasing probability of uncertainty because of stable economic growth rates.

Finally, our findings indicate that *inflation* is negative but insignificant in terms of providing an explanation of bank stability, except for quantile 0.75, which is positive significant. This indicates that an inflationary environment may increase the probability of borrowers defaulting and hence impede stability.

4.4.3. Business models and bank stability

In this section, we extend our empirical analysis to different types of bank business model as Table 4-6 shows. We group our sample based on the different business models. In order to achieve this, we split the sample into three main business model categories: (i) commercial banks, (ii) investment banks, and (iii) bank holding companies. We believe that this division is important because traditional bank models that transfer funds from depositors to borrowers have reduced in number. Moreover, banks tend to perform more complicated functions; such as risk management, in a modern financial system.

Our results highlight that *CPM* is generally consistent with our main results and that commercial banks, in particular, have a significant positive impact on bank stability. This suggests the importance of profits for the enhancement of stability within commercial banks, while, for instance, *CPM* is absent for interpretations of bank stability within bank holding companies. This finding may reveal a lack of dependence on profits as a buffer in bank holding companies.

Moreover, Table 4-6 shows that the estimated coefficients of the *capital regulation index* are positive and significant across different quantiles in commercial banks. However, the *capital regulation index* has a marginal impact on investment banks and bank holding companies. The cause of this result may be the nature of risk in commercial banks. This risk refers to lending activities that are part of the banks' core operations. In contrast, the nature of risk in investment banks and bank holding companies reflects investment activities. It is important to know that commercial banks need to obtain adequate capital as a cushion against non-performing loans (Chateau and Wu, 2007). However, investment banks have multifaceted businesses; e.g. brokering, trading, core investments, fund management, and interest spreads. Thus, capital adequacy alone is unable to boost stability in investment banks and even in bank holding companies (Radić et al., 2012).

Activity restrictions are significantly negative for the median and higher quantiles in commercial banks and bank holding companies; however, this impact is absent in investment banks. This finding indicates that higher quantiles in commercial banks and bank holding companies are affected to a greater extent by a tightening of activity restrictions.

Deposit insurance is consistent with our main result, specifically for commercial banks where there is a significant negative impact on stability. This impact becomes marginal in investment banks and disappears for bank holding companies. Similarly, the *private monitoring index* mostly has a significantly adverse effect on stability in commercial banks.

Table 4-6: Banks' business models and financial stability

Variables	*Lagged dependent*	*CPM*	*Capital regulation index*	*Activity restrictions*	*Deposit insurance*	*Private monitoring index*	*Official supervisory power*	*Governmen t-own banks*	*HHI*	*Business freedom index*	*GDP*	*Inflation*
Commercial banks (1747 banks)												
Q10	0.257***	0.0197*	0.210***	-0.194	-0.252	-0.169*	-0.0546	-0.0180*	0.000490***	0.170***	0.0619**	-0.0526**
Q25	0.454***	0.0221**	0.487***	-0.0604	-0.376**	-0.309***	-0.185***	-0.0226**	0.000671***	0.201***	0.241***	-0.0640*
Q50	0.789***	-0.00517	0.806***	-0.0974	-0.570***	-0.392***	-0.352***	-0.0350***	0.000443***	0.247***	0.339***	-0.056
Q75	0.826***	0.0441***	0.754***	-0.518***	-0.669***	-0.623***	-0.410***	-0.0169	0.000562***	0.221***	0.241***	-0.0985**
Q90	0.661***	0.132***	1.063***	-0.710*	-1.524***	-0.768**	-0.817***	-0.0344	0.000554	0.535***	0.307*	0.267*
OLS	0.602***	0.0368**	0.695***	-0.252*	-0.600***	-0.224*	-0.379***	-0.0325**	0.000422**	0.323***	0.317***	-0.0491
Investment banks (269 banks)												
Q10	0.191***	0.0453**	0.286**	0.736	0.197	-0.913*	-0.209	-0.0627**	0.000456	0.103	0.193**	-0.00711
Q25	0.392***	0.0434	-0.155	0.785	0.0316	-0.700	-0.332	-0.0949**	-0.00053	0.0952	0.240**	-0.0869
Q50	0.782***	-0.0425	0.0631*	1.035	-1.526*	-0.801	-0.18	-0.0958*	0.000117	0.085	-0.0253	-0.0733
Q75	0.754***	0.046	-0.714	-0.634	-1.609	-0.293	0.583	-0.270***	0.000626	-0.126	-0.113	-0.00522
Q90	0.563***	0.088	-0.145	-1.56	-1.467*	2.174	1.255	-0.348*	0.0022	-0.936**	-0.923	-0.482
OLS	0.534***	0.0397	-0.496	0.138	-1.757*	0.224	0.264	-0.189***	6.52E-05	-0.0984	-0.121	0.00189
Bank holding companies (194 banks)												
Q10	0.493***	-0.00847	-0.409	-2.377	-1.12	-0.74	-0.558	-0.137	0.000548	0.384	-0.3	0.171
Q25	0.780***	0.043	0.0779	-2.412*	-0.298	-0.0442	-0.492	-0.128*	0.000841	0.091	0.533	-0.186
Q50	0.895***	0.01	0.121**	-0.420**	0.572	0.157	-0.256	-0.0364*	0.000531	0.0453	0.234	-0.265*
Q75	0.652***	0.0453	0.209	-2.494*	0.996	-0.107	-0.68	-0.0703	0.00228**	0.0492	0.371	-0.364
OLS	0.580***	0.0507	0.762	-3.906***	0.537	-0.201	-0.501	-0.154**	0.00182***	0.0656	0.650**	-0.425***

This table presents the QR estimates based on banks' business models. The dependent variable is *bank stability* based on CAMELS-DEA. The quantiles at Q10, Q25, Q50, Q75, and Q90 for each bank business model are reported in the above table. Bootstrapped standard errors are based on 1000 replications and are reported in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1 across all quantiles. OLS regression is reported for each business model, and heteroskedasticity-robust standard errors are applied for OLS. ± F tests for the equality of the slope coefficient across various quantiles have been undertaken and are significant at the 5% level for most quantiles; however, they are not reported in order to save space. The details are available upon request. ***Note: the observations*** are: commercial banks: 9,789 banks; Investment banks:624 banks; bank holding companies :585 banks.

Interestingly, supervisors are more concerned with stability in commercial banks within the banking system. This finding can be observed through the significant negative impact of strict *official supervisory power* on stability in commercial banks. In addition, multifaceted business activities may prevent excessive *official supervisory power* regarding investment banks and bank holding companies. This situation can be observed through the insignificant influence of *official supervisory power* on stability within the investment bank and bank holding company business models. Further, the estimates of the coefficients of government-owned banks are significantly negative in most quantiles and across different business models, though modest influence on bank holding companies.

In similar manner, the *private monitoring index* has a negative effect in explaining stability. For instance, the *private monitoring index* has a negative and significant effect on explanations of stability in commercial banks, while this effect is almost absent for interpretations of stability in investment banks and bank holding companies.

As with commercial banks, the estimates of the coefficients of *HHI* are positive and significant in most quantiles. However, compared with commercial banks, the impact of *HHI* is absent in investment banks and almost disappears in most quantiles for bank holding companies. This finding may suggest that commercial banks are more sensitive to competition compared with investment banks or bank holding companies. Correspondingly, the *economic freedom index* has a significant positive effect on stability in commercial banks across all quantiles; conversely, the *economic freedom index* for investment banks and bank holding companies is insignificant for explaining stability. Moreover, the findings for *government-owned banks* are consistent with our main results, indicating that banks with greater government ownership are more likely to be influenced by financial distress across different types of business model.

With regard to other macroeconomic variables, *GDP* significantly contributes to the stability of commercial banks; however, there is almost no significant impact across most quantiles for investment banks and bank holding companies. This finding indicates that commercial banks are more sensitive to a change in economic growth and that investment banks and bank holding companies are less prone to such a change. Further, *inflation* appears to have a modest effect for expounding stability in commercial banks and is almost absent for investment banks and bank holding companies.

In sum, the empirical findings in Table 4-6 show that all the business models of banks in general, and the business model of commercial banks in particular, are almost consistent with our main results in Table 5. However, the results seem weak for explaining the effect of some explanatory variables on the stability of investment banks and bank holding companies. The similarity of these results for commercial banks with our primary results may be due to the large number of commercial banks compared with investment banks and bank holding companies. Thus, the following robustness tests take into account the significant variation across the sub-samples.

Table 4-7: Bank size and financial stability

	Large Banks						***Small Banks***					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	Q10	Q25	Q50	Q75	Q90	OLS	Q10	Q25	Q50	Q75	Q90	OLS
Lagged dependent	0.386***	0.648***	0.916***	0.806***	0.477***	0.669***	0.139***	0.247***	0.431***	0.667***	0.684***	0.385***
CPM	0.0389**	-0.0174	0.00901	0.0557**	0.115***	0.0581***	0.0236**	0.0239*	0.0453***	0.0403	0.0810*	0.0490***
Capital regulation index	0.472***	0.475***	0.384***	0.158	0.52	0.509***	-0.000484	0.151	0.462***	1.178***	2.069***	0.563***
Activity restrictions	0.194	-0.131	-0.0842	-0.236	-1.333***	-0.373*	-0.617***	-0.884***	-1.113***	-1.628***	-2.254***	-1.377***
Deposit insurance	-0.493***	-0.730***	-0.421**	-0.542**	-1.467**	-0.949***	-0.401*	0.139	-0.199	-0.854**	-2.160*	-0.648**
Private monitoring index	0.00113	0.0455	-0.0741	-0.132	0.28	0.0955	-0.333**	-0.494**	-0.725***	-1.382***	-1.597***	-0.647***
Official supervisory power	-0.077	-0.0871	-0.0993	-0.0434	-0.254	-0.155	0.0886*	-0.0288	-0.174**	-0.174**	-0.783***	-0.105*
Government-owned banks	-0.024	-0.0205	-0.0234*	-0.00736	-0.0914*	-0.0307	-0.0183	-0.0344***	-0.0578***	-0.0722**	-0.0677	-0.0555***
HHI	0.000315**	0.000234	0.000315**	0.000551***	0.000542	0.000519**	0.000405**	0.000867***	0.000988***	0.000731**	0.00108	0.000645**
Business freedom index	0.0979***	0.135***	0.161***	0.144***	0.285***	0.290***	0.160***	0.212***	0.252***	0.252***	0.266***	0.287***
GDP	0.166***	0.258***	0.237***	0.286***	0.517**	0.419***	0.0611	0.237***	0.378***	0.497***	0.361	0.366***
Inflation	0.00833	-0.0749	-0.0457	-0.0779	0.275	0.0354	-0.00394	-0.0281	-0.00281	-0.0664	0.0381	-0.0134
Constant	4.183	0.748	-5.676**	8.201**	35.91***	-2.457	16.82***	14.85***	12.56***	17.20***	32.96***	16.54***
Observations	5,590	5,590	5,590	5,590	5,590	5,590	5,408	5,408	5,408	5,408	5,408	5,408
banks	1126	1126	1126	1126	1126	1126	1084	1084	1084	1084	1084	1084
R-squared						0.50						0.28

This table presents the QR estimates based on bank size. The dependent variable is *bank stability* based on CAMELS-DEA. The quantiles are reported in columns 1 to 5 and 7 to 11. Bootstrapped standard errors are based on 1000 replications and are reported in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1 across all quantiles. OLS regression is reported in columns 6 and 12 with heteroscedasticity-robust standard errors for OLS. The quantiles at Q10, Q25, Q50, Q75, and Q90 are applied across large banks and small banks. ± F tests for the equality of the slope coefficient across various quantiles have been undertaken and are significant at the 5% level for most quantiles; however, they are not reported in order to save space. The details are available upon request.

¥ The sample grouped based on a median point of total assets that USD 1212.011 million.

4.4.4. Bank size and financial stability

In this section, we attempt to verify whether the estimation results of our business models' analysis are driven by commercial banks. Accordingly, we group our sample into large and small banks based on a median point[24] in order to avoid bias in sample. The estimation results of bank size are presented in Table 4-7.

In general, the results are consistent with our primary findings. Thus, Table 4-7 indicates that banks are affected positively by *CPM*, which suggests the effect of profit on boosting bank stability. With regard to the *capital regulation index*, the estimation results for large banks reveal that this is positively significant across median and lower quantiles. In contrast, the *capital regulation index* for small banks is positively significant across median and higher quantiles.

Interestingly, small banks are more sensitive to *activity restrictions*. In addition, there is an almost insignificant impact of *activity restrictions* across most quantiles for large banks. The possible explanation for this finding is that large banks may have benefits of economies of scale and scope. Thus, if there is a greater restriction for one activity, large banks can cover this loss with other activities. However, small banks tend to concentrate on one activity; hence, any restrictions may directly and negatively affect stability.

Conversely, size may prove costly for large banks in terms of *deposit insurance*. This is evident from the significant negative influence of *deposit insurance* across all quantiles for large banks. However, this effect is modest for small banks.

The empirical findings in Table 4-7 reveal that the absence of effects in the *private monitoring index* and *official supervisory power* may lead to the absence of influence for both in terms of explaining stability in large banks. If one of them is significant for explaining bank stability, the other is significant, as shown, for small banks.

With regard to the *government-owned banks* indicator, large banks do not reveal a robustly significant link between government ownership and bank stability. This may suggest that large banks with multi-ownership can impede the role of government in controlling banks. However, the picture is different for small banks. The *government-owned banks* indicator has

[24] based on a median point of total assets that $1212.011 million

a significant negative impact on stability across most quantiles in small banks, a result consistent with our main findings.

Further, *HHI*, the *economic freedom index*, and *GDP* are almost consistent with our main results across large and small banks. In addition, *inflation* contradicts our main findings and does not explain stability within large and small banks.

In sum, the estimation results are almost consistent with our main results for large and small banks, although the significance levels of the explanatory variables are slightly higher across small banks. Moreover, the results shed greater light on the impacts of private monitoring and supervisory power for expounding bank stability. However, the following estimation may provide an even clearer picture regarding this relation. .

Table 4-8: Economic development and financial stability

	Emerging European Countries						***Advanced European Countries***					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	Q10	Q25	Q50	Q75	Q90	OLS	Q10	Q25	Q50	Q75	Q90	OLS
Lagged dependent	0.194***	0.321***	0.518***	0.791***	0.784***	0.508***	0.305***	0.575***	0.899***	0.823***	0.520***	0.643***
CPM	0.0137	0.0589***	0.0876***	0.0845***	0.103*	0.0755***	0.0204	-0.00793	-0.0254	0.0154*	0.0974***	0.0144
Capital regulation index	0.0272	0.254**	0.602***	1.061***	1.870***	0.635***	0.257**	0.249**	0.436***	0.0965	0.33	0.335**
Activity restrictions	0.0645	-0.00338	-0.0363	-0.301	0.0275	-0.256	-0.158	-0.0745	0.0792	-0.332**	-0.954**	-0.248
Deposit insurance	-0.198	-0.472**	-0.712***	-0.880**	-1.985***	-1.053***	-0.162	-0.510**	-0.876***	-0.624**	-1.575***	-0.934***
Private monitoring index	-0.448***	-0.561***	-0.570***	-0.745**	-1.544**	-0.771***	0.277	0.461***	0.492***	0.146**	0.84*	0.818***
Official supervisory power	-0.0479	-0.245***	-0.598***	-0.953***	-1.452***	-0.477***	0.0179	0.115**	0.179*	0.241***	0.162	0.178**
Government-owned banks	0.00433	0.00154	0.012	0.0511*	0.0795	0.0432**	-0.0463***	-0.0592***	-0.0991***	-0.0415**	-0.171***	-0.118***
HHI	0.000326**	0.000176	0.00049	0.000761*	0.00198**	0.000184	0.000804***	0.000833***	0.000352**	0.000458**	0.000577	0.000581**
Business freedom index	0.209***	0.324***	0.484***	0.496***	0.669***	0.513***	0.120***	0.0692*	0.101**	0.103***	0.15	0.162***
GDP	0.0327	0.235***	0.406***	0.432***	0.502**	0.298***	0.345***	0.439***	0.534***	0.258***	0.733***	0.643***
Inflation	-0.0169	-0.0267	-0.0337	-0.00684	0.318**	0.00166	-0.270**	-0.224**	-0.236***	-0.199***	-0.304*	-0.253***
Constant	10.80***	2.841	-8.611***	-8.806*	-6.541	-4.245	5.643	1.473	-7.355**	8.207**	33.35***	0.421
Observations	4,666	4,666	4,666	4,666	4,666	4,666	6,332	6,332	6,332	6,332	6,332	6,332
banks	1154	1154	1154	1154	1154	1154	1056	1056	1056	1056	1056	1056
Countries	30	30	30	30	30	30	17	17	17	17	17	17
R-squared						0.344						0.445

This table presents the QR estimates based on economic development. The dependent variable is *bank stability* based on CAMELS-DEA. The quantiles are reported in columns 1 to 5 and from 7 to 11, Bootstrapped standard errors are based on 1000 replications and are reported in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1 across all quantiles. OLS regression is reported in columns 6 and 12 with heteroscedasticity-robust standard errors for OLS. The quantiles at Q10, Q25, Q50, Q75, and Q90 are applied across emerging economies and advanced economies. ± F tests for the equality of the slope coefficient across various quantiles have been undertaken and are significant at the 5% level for most quantiles; however, they are not reported in order to save space. The details are available upon request.

¥ Note: Advanced countries are AUSTRIA, BELGIUM, DENMARK, FINLAND, FRANCE, GERMANY, GREECE, IRELAND, ITALY, LUXEMBOURG, NETHERLANDS, NORWAY, PORTUGAL, SPAIN, SWEDEN, SWITZERLAND, and UNITED KINGDOM, while other countries are emerging markets (see Table 4-1) & (Table A4-3).

4.4.5. Economic development and financial stability

The new global financial system increases the depth of links between advanced and emerging economies. Thus, the crises in advanced economies pass rapidly and significantly to emerging economies (Balakrishnan et al., 2011). Nonetheless, the higher application of governance and supervision, and greater internal monitoring, may enhance the resistance of advanced economies against crises. In contrast, poor governance coupled with weak supervision and a lack of internal monitoring may lead to elevated financial stress in emerging economies. Indeed, some economies may face unprecedented financial stress. Accordingly, in this section, we group our sample in terms of advanced European countries and emerging European countries in order to estimate the impact of financial regulation and supervisory power across different stages of economic development.

The empirical results in Table 4-8 show the effect of the *private monitoring index* and *official supervisory power* on interpreting stability across advanced and emerging economies. This finding reveals the negative influence of both private *monitoring index* and *official supervisory power* for expounding bank stability across emerging European economies. Conversely, the result shows that the *private monitoring index* and *official supervisory power* have positive impacts for explaining stability across advanced European economies. The possible explanation is that powerful supervisory agencies can enhance private monitoring by reducing the barriers to the conveyance of information, thereby boosting bank stability in advanced economies. While, supervisors in emerging economies may use this power to generate private benefits by weakening private monitoring, thereby reducing stability in emerging economies (Barth et al., 2005).

With regard to the other variables, the results are consistent with our main findings. Consequently, *CPM*, the *capital regulation index*, *government-owned banks*, *HHI*, the *economic* f*reedom index*, and *GDP* have a positive impact on stability. In contrast, *activity restrictions*, *deposit insurance*, and *inflation* have a negative influence on stability. However, some significance levels are different across quantiles for advanced and emerging economies.

Table 4-9: Governance and independent supervision

	Governance and stability						***Independent supervision and stability***					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	Q10	Q25	Q50	Q75	Q90	OLS	Q10	Q25	Q50	Q75	Q90	OLS
Lagged dependent	0.263***	0.479***	0.832***	0.824***	0.619***	0.613***	0.267***	0.473***	0.824***	0.826***	0.624***	0.609***
CPM	0.0219**	0.0137	-0.0194	0.0389***	0.131***	0.0280**	0.0201**	0.0113	-0.0151	0.0407***	0.125***	0.0300**
Capital regulation index	0.213***	0.480***	0.688***	0.540***	1.047***	0.663***	0.163**	0.391***	0.680***	0.567***	0.855***	0.569***
Activity restrictions	-0.224*	-0.145	-0.24	-0.556***	-0.872**	-0.504***	-0.242**	-0.094	-0.274*	-0.553***	-1.109***	-0.438***
Deposit insurance	-0.350**	-0.502***	-0.676***	-0.768***	-1.860***	-0.846***	-0.224*	-0.451***	-0.705***	-0.664***	-1.432***	-0.770***
Private monitoring index	-0.107	-0.195**	-0.256***	-0.432***	-0.533	0.00406	-0.170**	-0.335***	-0.432***	-0.592***	-1.093***	-0.266**
Official supervisory power	0.025	-0.0777	-0.199***	-0.242***	-0.485***	-0.200***						
Official supervisory power*independent supervision							0.0197**	0.00478	-0.0327**	-0.00627**	-0.05	-0.0256*
Government-owned banks	-0.0291***	-0.0296***	-0.0419***	-0.0238	-0.015	-0.0403***	-0.0212**	-0.0328***	-0.0468***	-0.0233	-0.0880**	-0.0520***
HHI	0.000378***	0.000485**	0.000295*	0.000450***	0.000342	0.000242	0.000496***	0.000480**	0.000323**	0.000465***	0.000804	0.000360**
Governance index	0.0556***	0.0614***	0.0659***	0.0686***	0.215***	0.107***						
Business freedom index							0.164***	0.201***	0.216***	0.199***	0.402***	0.301***
GDP	0.103***	0.206***	0.273***	0.162**	0.315*	0.274***	0.0955***	0.196***	0.212***	0.173***	0.109	0.232***
Inflation	-0.04	-0.0605	-0.064	-0.0687	0.250*	-0.0328	-0.0528**	-0.0499	-0.0525	-0.0895**	0.179	-0.0189
Constant	15.20***	10.44***	5.996***	16.01***	26.98***	12.96***	8.812***	2.511*	-2.865	6.314***	19.72***	1.679
Observations	11,014	11,014	11,014	11,014	11,014	11,014	10,998	10,998	10,998	10,998	10,998	10,998
R-squared						0.451						0.452

This table presents the QR estimates based on governance and independent supervision. The dependent variable is *bank stability* based on CAMELS-DEA. The quantiles of governance and stability are reported in columns 1 to 5. The quantiles of independent supervision and stability are reported in columns 7 to 11. Bootstrapped standard errors are based on 1000 replications and are reported in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1 across all quantiles. OLS regression is reported in columns 6 and 12 with heteroskedasticity-robust standard errors for OLS. The quantiles at Q10, Q25, Q50, Q75, and Q90 are applied for governance and stability estimates, and also for independent supervision and stability estimates. ± F tests for the equality of the slope coefficient across various quantiles have been undertaken and are significant at the 5% level for most quantiles; however, they are not reported in order to save space. The details are available upon request.

4.4.6. Robustness check: governance and stability

There is no doubt about the responsibility of financial regulation and supervision to improve a bank's individual stability; however, this approach is insufficient for overall financial stability. In order to achieve comprehensive financial stability, one keystone is a governance mechanism. Governance is the main pillar in any financial system and an essential instrument for improving stability.

Thus, we include six dimensions of the WGI to control for the effects of a country's governance levels on bank stability (see table 4-1 for six dimensions). In general, the estimation findings are consistent with our main results. As Table 4-9 shows, all explanatory variables almost maintain their significance and signs in accordance with the main findings. With regard to the *governance index*, the empirical results indicate that a better governance environment helps to increase stability significantly in the banking system. Moreover, the results reflect the systematic effect of governance on stability, a situation that occurs across quantiles 0.10 to 0.90. These results suggest that better governance is conducive to more stable banks, specifically banks with high-level stability.

4.4.7. Robustness check: independent supervision and stability

The new approach of supervision is a trend towards more independent supervision, thereby aiming to reduce conflicts of interest. Thus, more independent supervision may help to oppose any private interest or narrow political interest.

Nonetheless, this is a questionable approach because greater supervisory independence may not limit a government’s participation in nepotism. Moreover, this approach does not consider some qualitative issues. For example, the significant variations between developed and less developed countries regarding legal, historical, and institutional backgrounds, coupled with supervisory quality, skills, and independence from external pressures. These variations may oblige each country to form its own appropriate supervisory framework. Thus, in this section, we re-estimate our main results in general, and the official supervisory power dimension specifically, by interacting official supervisory power with the independence of supervision.

Broadly speaking, the empirical results in Table 4-9 are consistent with our main results. However, we are concerned about official supervisory power and the independence of supervision. The findings show that the estimated coefficient for the interactive variable (official supervisory power* independence of supervision) is negatively significant across some quantiles. This result tend to support the private interests view, and show strong overlap between supervisory power and independence supervision. The possible explanation of this result is that powerful supervision coupled with greater independence may lead supervisors to obtain private benefits, thus impairment of stability because of high levels of nepotism.

4.4.8. Robustness check: quantile estimates for all explanatory variables across the whole sample

This section reports the estimates of all variables across the whole sample based on 19 quantiles with an increment of 0.05 per quantile from 0.05 to 0.95. In general, the estimation results in Table A4-1 in the appendix are consistent with our main findings. However, the findings reveal that *inflation* is insignificant for most of the 19 quantiles. This result suggests that no systematic pattern exists for *inflation* for explaining stability. Moreover, the findings show that the *private monitoring index* and *government-owned banks* are invalid for interpreting stability in the higher quantile (Q95). In contrast, the *capital regulation index*, *activity restrictions*, and *official supervisory power* are insignificant for expounding bank stability in the lower quantile (Q5). This may indicate that banks within the lower quantile of stability are unable to build sufficient capital adequacy and have weak management regarding their risk-oriented activities. Interestingly, *deposit insurance* and *GDP* fail to influence stability in the higher and lower quantiles but are significant across other quantiles (i.e. from Q10 to Q90).

Further, we group the estimation results based on the levels of the 19 quantiles (i.e. Q5 VS Q95, Q45 VS Q55 and Q50 VS OLS). Thus, Table A4-1 in the appendix shows that the levels of significance tend to be higher in the mid-range quantiles across most variables compared with the high- and low-range quantiles. This result may indicate that quantiles near the median point of stability (Q50) are highly significant for expounding stability.

4.4.9. Robustness check: the endogeneity issue

In this section, we re-examine our main results in order to address the possibility of the endogeneity problem. Indeed, two common causes exist for endogeneity: (i) reverse causality between the dependent variable and the explanatory variables, and (ii) the correlation

between the explanatory variables and the error term. In order to address this issue, we use an instrumental variable (IV) technique.

We selected IVs by using the literature on financial regulation. Thus, we use ethnic fractionalisation and legal origins, which help to interpret the development in financial institutions (Barth et al., 2013b). Moreover, we include *independence of supervision* as an instrumental variable which measures the differences across supervisory authorities (Klomp and De Haan, 2012). Table A4-2 in the appendix indicates that the results of 2SLS regression are consistent with our primary findings. In order to confirm the validity of our IVs, we apply an over-identified model. The model's outcomes[25] reject the null hypothesis if the IVs are weak.

4.5. Conclusion

Whether financial regulation coupled with supervisory enhancement impedes bank stability is an issue that researchers have studied, although the empirical results are mixed. In order to provide further insight into this theoretical issue, we assumed that financial regulation and supervision are multifaceted concepts because of the significant variation in business models, bank size, and economic development across banks and countries. Moreover, this study sheds light on a technical issue of stability measurement. In this regard, we adopted the CAMELS risk-rating system. Accordingly, this study is one of the first to investigate the influence of financial regulation and supervision on stability by taking into account variations of business models, bank size, and countries' economic development through an innovative CAMELS-DEA rating system combined with a quantile technique. Moreover, we use rich data sets built on five unique databases that cover 17 years from 2000 to 2016 for 2210 different banks.

With regard to the results in terms of stability, we find that advanced economies tend to be stable compared with emerging economies. Further, we find that bank holding companies have the highest levels of stability, while investment lowers the level of stability across investment banks. Unsurprisingly, large banks show the highest levels of stability compared with small banks. During the period of the global financial crisis, we find that a moderate drop in stability occurred for bank holding companies, while a sharp drop occurred for investment banks.

[25] The results of the weak instrumental variables are not reported in order to save space but are available upon request.

We also find that the *CPM* and *capital regulation index* variables have a positive influence on stability. However, the *capital regulation index* shows a systematic pattern for explaining stability across all quantiles unlike *CPM*, which has an unsystematic pattern. The empirical results also show the adverse impact of *activity restrictions* on stability. This result suggests that restrict in non-traditional financial activity may impede bank stability because of lower degrees of diversification. Moreover, the results show clear variations across different banking business models. The explanatory variables for commercial banks tend to be significant for expounding stability. In addition, they do not explain stability across investment banks and bank holding companies. With regard to bank size, the results indicate that the significance levels are slightly higher for small banks compared with large banks. This suggests the importance of financial regulation for small banks to help provide a buffer against financial distress.

We further find substantial evidence that the *private monitoring index* and *official supervisory power* are similar in the way in which they explain stability. Thus, the results reveal negative effects of both the *private monitoring index* and *official supervisory power* for interpreting stability across emerging economies. In contrast, this influence becomes positive across advanced economies. Further, governance is still the cornerstone of financial stability and has a positive impact on stability across the whole sample. Moreover, it is not only the *private monitoring index* and *official supervisory power* that have an influence for expounding stability; *independent supervision* is also a dimension that may be effect on stability like *private monitoring index* and *official supervisory power*.

In sum, financial regulation and supervision may enhance or impede stability. Indeed, financial policymakers should take into account this significant variation not only from the perspectives of legal and historical backgrounds across countries but also from the perspectives of institutional backgrounds related to issues such as banks' business models and bank size. These perspectives should be considered in addition to economic development.

Appendix

Table A4-1: Quantile estimates for all explanatory variables

Variables		*Lagged dependent*	*CPM*	*Capital regulation index*	*Activity restrictions*	*Deposit insurance*	*Private monitoring index*	*Official supervisory power*	*Government-owned banks*	*HHI*	*Business freedom index*	*GDP*	*Inflation*
Q5 VS Q95	Q5	0.171***	0.0182*	0.101	-0.075	-0.0357	-0.231***	0.0143	-0.0270***	0.000401***	0.120***	0.0172	-0.0232
	Q95	0.371***	0.0778**	1.055***	-1.144**	-0.644	0.0962	-0.378*	-0.0766	0.000777*	0.473***	0.123	0.203
Q10 VS Q90	Q10	0.267***	0.0199**	0.174**	-0.201*	-0.237*	-0.196**	-0.0461	-0.0273***	0.000477***	0.161***	0.0862***	-0.0492*
	Q90	0.622***	0.134***	0.955***	-0.867**	-1.619***	-0.671*	-0.732***	-0.0673*	0.00084	0.462***	0.192	0.229
Q15 VS Q85	Q15	0.341***	0.0134	0.247***	-0.212*	-0.204	-0.210***	-0.0965*	-0.0211**	0.000425***	0.177***	0.129***	-0.0729**
	Q85	0.722***	0.103***	0.879***	-0.999***	-1.428***	-0.895***	-0.551***	-0.0633**	0.000582*	0.337***	0.292**	0.0156
Q20 VS Q80	Q20	0.410***	0.0137	0.325***	-0.143	-0.333**	-0.245***	-0.154***	-0.0259***	0.000551***	0.187***	0.171***	-0.0398
	Q80	0.786***	0.0675***	0.695***	-0.668***	-1.096***	-0.643***	-0.423***	-0.0297	0.000437**	0.234***	0.218**	-0.083
Q25 VS Q75	Q25	0.475***	0.0123	0.428***	-0.123	-0.434***	-0.296***	-0.174***	-0.0355***	0.000460**	0.200***	0.212***	-0.0357
	Q75	0.824***	0.0390***	0.650***	-0.584***	-0.649***	-0.563***	-0.390***	-0.0281*	0.000575***	0.197***	0.210***	-0.105**
Q30 VS Q70	Q30	0.551***	0.00499	0.461***	-0.125	-0.464***	-0.347***	-0.209***	-0.0362***	0.000461***	0.198***	0.239***	-0.0575*
	Q70	0.846***	0.0286***	0.542***	-0.355***	-0.450**	-0.447***	-0.303***	-0.0241**	0.000473***	0.195***	0.166***	-0.0825**
Q35 VS Q65	Q35	0.607***	-0.00272	0.550***	-0.177	-0.474***	-0.339***	-0.251***	-0.0448***	0.000529***	0.203***	0.267***	-0.0515*
	Q65	0.862***	0.0183*	0.536***	-0.285***	-0.434***	-0.412***	-0.316***	-0.0260***	0.000465***	0.215***	0.183***	-0.0537
Q40 VS Q60	Q40	0.678***	-0.0194	0.693***	-0.118	-0.532***	-0.389***	-0.267***	-0.0501***	0.000483***	0.213***	0.271***	-0.0480*
	Q60	0.876***	0.00773	0.580***	-0.257***	-0.453***	-0.375***	-0.329***	-0.0274***	0.000435***	0.222***	0.248***	-0.0620*
Q45 VS Q55	Q45	0.753***	-0.0240*	0.666***	-0.116	-0.526***	-0.380***	-0.316***	-0.0460***	0.000374**	0.222***	0.272***	-0.049
	Q55	0.874***	-0.0172	0.695***	-0.253**	-0.581***	-0.335***	-0.337***	-0.0368***	0.000357**	0.229***	0.264***	-0.0438
Q50 VS OLS	Q50	0.825***	-0.0214*	0.686***	-0.219*	-0.592***	-0.339***	-0.337***	-0.0438***	0.000353**	0.222***	0.266***	-0.0514
	OLS	0.6083***	0.0307**	0.6029***	-0.4658***	-0.7275***	0.0517	-0.1588**	-0.0479***	0.0004**	0.2914***	0.2439***	-0.0239

This table presents the QR estimates based on an increment of 0.05 per quantile. The dependent variable is *bank stability* based on CAMELS-DEA. The quantiles are reported from Q5 to Q95 and compare the lower quantile and higher quantile. Bootstrapped standard errors are based on 1000 replications and are given in parentheses, *** represents p<0.01, ** represents p<0.05, and * represents p<0.1 across all quantiles. The heteroskedasticity-robust standard errors for OLS are applied. ± F tests for the equality of the slope coefficient across various quantiles have been undertaken and are significant at the 5% level for most quantiles; however, they are not reported in order to save space. The details are available upon request.

Table A4-2: instrumental variable estimates

Variables	(1) 2SLS
Lagged dependent	1.514**
	(0.669)
CPM	0.609***
	(0.00906)
Capital regulation index	0.0248*
	(0.0145)
Activity restrictions	-0.496***
	(0.154)
Deposit insurance	-1.119***
	(0.350)
Private monitoring index	0.121
	(0.130)
Official supervisory power	-0.252***
	(0.0945)
Government-owned banks	-0.0449***
	(0.0136)
HHI	0.000470***
	(0.000179)
Business freedom index	0.267***
	(0.0293)
GDP	0.291***
	(0.0642)
Inflation	-0.151*
	(0.0871)
Constant	-1.957
	(3.271)
Observations	10,980
R-squared	0.449

This table presents the instrumental variable (IV) estimates based on 2SLS. The dependent variable is *bank stability* based on CAMELS-DEA. The instrumental variables are *ethnic fractionalisation*, *legal origins*, and *independence of supervision*. Heteroscedasticity-robust standard errors are in parentheses. *** represents p<0.01, ** represents p<0.05, and * represents p<0.1. ± weak instrumental variables are applied; however, they are not reported in order to save space. The details are available upon request.

Table A4-3: Number of banks across advanced and emerging economies

Emerging Country	No. Banks	Advanced Country	No. Banks
ALBANIA	13	AUSTRIA	68
ANDORRA	3	BELGIUM	23
BELARUS	21	DENMARK	40
BOSNIA AND HERZEGOVINA	27	FINLAND	26
BULGARIA	20	FRANCE	121
CROATIA	30	GERMANY	155
CYPRUS	19	GREECE	9
CZECH REPUBLIC	17	IRELAND	15
ESTONIA	9	ITALY	89
GIBRALTAR	1	LUXEMBOURG	57
HUNGARY	17	NETHERLANDS	33
ICELAND	11	NORWAY	23
KOSOVO	4	PORTUGAL	33
LATVIA	19	SPAIN	51
LIECHTENSTEIN	1	SWEDEN	38
LITHUANIA	9	SWITZERLAND	139
MACEDONIA (FYROM)	15	UNITED KINGDOM	136
MALTA	12		
MONACO	1		
MONTENEGRO	8		
POLAND	39		
REPUBLIC OF MOLDOVA	12		
ROMANIA	21		
RUSSIAN FEDERATION	702		
SAN MARINO	4		
SERBIA	27		
SLOVAKIA	14		
SLOVENIA	17		
TURKEY	38		
UKRAINE	23		
Total	1154		1056
Total			2210

Chapter Five

Concluding remarks:

5.1. Summary and findings

The unique and central responsibility of banks in financial markets and other economic sectors, through deposit, lending, and other banking activities, encourages financial policy makers to impose restrictions on some financial activities to guarantee the soundness of the financial system. A banking organisation can expand within new financial services and markets by providing a wide range of services, such as insurance, mortgage, leasing, securities brokerage, mutual funds, and financial information. However, this wide range of non-traditional financial activities might create new sources of risks. Therefore, financial systems across countries may face a wide range of difficult challenges, including financial crises. In response to these challenges, some international financial institutions, such as the Bank for International Settlements (BIS) and the Basel Committee on Banking Supervision (BCBS), established a comprehensive international financial regulatory framework to address the major sources of risk in the banking industry.

Although it is generally understood that the core function of financial regulations and supervision is to protect the public and improve the stability and efficiency of the banking system, the actual concern relates to whether these legislations can represent the particular characteristics of each financial system for each financial organisation, especially during crises. Indeed, financial crises are often an amalgam of events, which differs from one economy to another. For example, the recent global financial crisis was triggered by a mortgage crisis. The Asian financial crisis was mainly attributed to currency devaluations, whereas large-scale government balance sheet problems sparked the Greek debt crisis. The different sources of financial crises provide clear evidence about the influences of variations across economies and financial institutions on stability and efficiency in the banking industry. Accordingly, the core

objective of this thesis is to re-evaluate the efficiency and stability across countries and to examine the influence that financial regulations and supervision have on them.

Chapter 2 contributes to the existing studies regarding capital adequacy by investigating the determinants of the capital adequacy ratio in oil-exporting countries. Specifically, this chapter investigates how the GCC oil-rich countries' banks set their capital adequacy ratios, taking into account the impact of micro- and macro-economic and market contestability indicators. We extended this research by comparing the capital adequacy levels in GCC countries with international benchmarks and by comparing our models with the western models (Akhter and Daly (2009) and Fonseca and González (2010)). Indeed, controversy still exists in banking literature about whether this imposes excessive levels of capital adequacy ratio help to enhance or impede bank soundness, and the unique sample on GCC countries serves as an example of this debate. It may not be surprising that GCC's oil-rich countries maintain high levels of capital adequacy ratios (see Fig 2-1), although banking industries of these countries have an implicit government guarantee (Ghosh, 2014). This motivates investigation of the determinants of capital adequacy ratios in GCC countries. To achieve our aim of examining the response of capital adequacy ratios to changes in macro- and micro-economic and market contestability variables, we employed a GMM across six GCC countries between 1998 and 2013.

The key findings in Chapter 2 show that most market-contestability indicators and loans are considered the main sources of risk in GCC banks, and therefore influence positively on the capital adequacy level. This result indicates that GCC banks suffer from weak risk management (Arnold et al., 2012), which explains the excessive levels of capital adequacy ratios in GCC banks. It is also interesting to find that most country indicators are statistically significant to explain the level of CARs in GCC banks. This can possibly be attributed to increased general government expenditures due to high oil prices, which may contribute towards impeding the risk of other macro-economic indicators. This factor may cause GCC banks to anticipate a lesser risk from macro indicators.

Chapter 3 contributes towards examining whether financial regulations and supervision enhance or impede efficiency in the banking industry. The public view emphasises that government initiatives are directed towards enhancing banking efficiency and promoting public interests. Conversely, the private interest view indicates that financial regulation and supervision might

impede banking efficiency if it is used to obtain private interests or benefits (Barth et al., 2005). This view provides motivation to examine whether financial regulation and supervision can better work towards improving banking efficiency, taking into consideration the variations across regional economic blocs, income groups, and crisis periods. This chapter applied SORM by using a DEA to measure bank efficiency for 7853 banks in 102 countries from 2000 to 2014.

The primary finding of this chapter is that macro-events, such as intergovernmental agreement (economic blocs), country's income level, and financial crisis might contribute towards different influences of financial regulation and supervision on banking efficiency. Evidence also reveals that more stringent bank activity restrictions negatively affect banking efficiency. This chapter reveals that supervisory power is negative in explaining bank efficiency across most economic blocs, though it is negative in the Middle Eastern countries and is absent in African countries.

Chapter 4 investigates the links between financial regulation and banking stability. Theoretically, restrictions in financial regulation and supervision may improve stability in the banking industry (Pasiouras et al., 2006). However, tighter restrictions may affect the ability of banking systems to fund other economic sectors (Hakenes and Schnabel, 2011b). In this context, this chapter contributes towards re-evaluating the stability level for 2210 in 47 countries from 2000 to 2016 by innovative CAMELS-DEA. This is further strengthened by the use of the quantile technique.

The main empirical findings in this chapter reveal that financial regulation and supervision are multifaceted concepts. In other words, the relationship between financial regulation, supervision, and stability may not be affected only by differences in the historical and legal backgrounds in countries, but also by the variations in the bank business model, bank size, and economic development. This is evident through the negative influences of private monitoring and supervision for banking stability in emerging countries, whereas these influences become positive in advanced countries.

5.2. Research implications

The findings of this research are of great interest to risk managers and regulators, providing valuable information about the levels of efficiency and stability across countries. The useful

implications for each country to set the framework of its own financial regulations and supervisions. The main implications drawn from this research are as follows:

The findings in **chapter 2** reveal that risky loans compel banks to maintain high capital adequacy, thus preventing banks from maximising profits. This is because banks may prefer to maintain liquidity as a buffer against any risk, rather than investing profits derived from risky loans. This result reflects the weaknesses of GCC banks in risk management; therefore, financial policy makers and bank managers in the GCC should undertake the necessary measures to control loan loss provisions and to enhance the procedures for granting loans by creating an efficient early warning system. Also, bank managers in GCC should work to improve the role of the capital adequacy ratio and to create efficient cost control. Therefore, managers have to determine a fair capital adequacy ratio and avoid lack of capital adequacy ratio or even excessive levels of capital adequacy ratios. Moreover, GCC regulators should realise that imposing excessive capital requirements for banks may eventually lead to inefficient capital allocation in banks. Market contestability indicators also seem to have a positive influence on capital adequacy. It is not surprising that the policy makers generally set market contestability indicators. Therefore, the increase in restrictions in entry and activities within banking sector should force the holding of excessive capital adequacy ratios.

The findings in **chapter 3** also reveal several implications for banking policy makers. The study reveals that the use of appropriate tools for measuring efficiency could help to build a clear picture of efficiency levels in the banking industry. For instance, based on our measurement, the US banking industry (the largest banking industry in the world) shows medium levels of efficiency, indicating that the size of the banking industry is not an important factor in measuring the levels of efficiency. The research shows that the financial regulation and supervision effects on efficiency are multifaceted concepts. Therefore, financial policy makers should take into account the different effects of financial regulations and supervision when setting financial policies. The empirical study also reveals sizeable variations in the influence of financial regulation and supervision across economic blocs or income groups. Consequently, understanding these variations might help financial policy makers set suitable policies and shape an appropriate financial regulation framework for each country.

Finally, the findings in **chapter 4** indicate that the CAMELS rating system and DEA have proved to be efficient instruments for measuring stability levels across banks. The CAMELS risk-rating system was able to provide a clear picture of the stability levels of banks by including different risk dimensions. This chapter emphasises that financial regulations and supervision are multifaceted concepts, as shown in chapter 3, and that central banks should focus on financial regulation and supervision for enhancing stability and soundness in the banking industry. Also, there are evidence exists that stability is not only influenced by macro events, such as financial crises, economic blocs, and economic development, but also by the micro characteristics of bank-specific factors, such as the bank business model and bank size. Therefore, central banks should set appropriate financial policies with consideration to macro events and micro characteristics of bank-specific factors.

5.3. Limitations of the research and future research interest

One major obstacle in this thesis is data availability; in fact, we found it difficult to collect data for some developing and emerging economies. In particular, in chapter 2, the limitation of data availability makes it impossible to analyse the impact of supervision indicators on capital adequacy. This is because the GCC countries do not have sizeable variations in supervision indicators. Moreover, In chapter 2, the limitation of data availability makes it impossible to analyse the impact of supervision indicators on capital adequacy. This is because the GCC countries do not have sizeable variations in supervision indicators. Moreover, we suggest considering measuring cost, revenue and profit efficiency of GCC commercial banks if the price data are available. In addition, we suggest to employ the Malmquist Productivity Index for further investigation of changes of productivity in Islamic banks over the time and HII Index if data available.

Regarding the limitations of chapter 3, we suggest apply Core Profitability Model (CPM) in order to measuring the profitability if data available across countries in sample. Moreover, other limitations in this chapter is the lack of consensus on how the efficiency of banking institutions ought to be measured, and this problem is stretched even more when cross country comparison is pursued, and applicable to both developed and developing economies.

For chapter 4, we suggest extending the business model of banks to include other banking business model such as real estate banks or Islamic banks, also, include other countries around the world. Moreover, we suggest to distinguish the sample based on Development and Research in Banking Technology (IDRBT), if data available. The banks that focus on the training, research and development activities in the field of information technology may stable more than less IDRBT.

The research might be extended by taking into account other aspects of the financial system, such as banking depth and banking access. For example, future research would examine whether banking-system depth improves or impedes banking stability. Furthermore, the stability of the banking system before and after the oil price drop, in the case of GCC countries, could provide a scope for future research. The third empirical study (chapter 4) that focused on European countries could expand to examine the financial stability for other advanced and emerging economies. This would make a unique contribution to the field.

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