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The direct and indirect effects of financial development on international trade: Evidence from the CEEC-6

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ABSTRACT

This paper analyses the relationship between financial development and international trade in six EU members from Central and Eastern Europe (CEEC-6) using dynamic panel data approaches, specifically the system Generalized Method of Moments (GMM) and pooled mean group (PMG) estimators. The empirical results indicate that financial development affects trade flows and the structure of international trade in the long run; more precisely, it has a positive long-run impact on exports and trade openness. Further, there are indirect long-run effects through the interaction terms between financial development and sectoral value added; these are more pronounced for manufacturing than for agriculture. On the whole, our analysis suggests that the CEEC-6 could benefit in terms of trade from further developing their financial systems.

1. Introduction

This paper aims to provide evidence on the linkages between financial development and international trade in six EU members from Central and Eastern Europe (CEEC-6) using dynamic panel data approaches, specifically the system Generalized Method of Moments (GMM) and pooled mean group (PMG) estimators. In particular, it analyses the impact of financial development on the two components of trade (exports and imports), and also on the trade balance and trade openness. After the fall of their communist regimes the Central and Eastern European countries (CEECs) underwent a transition process with the introduction of free market reforms throughout the economy, including the finance and trade sectors. As a first step, foreign banks were given free access to the domestic banking system and soon acquired a majority share in most CEEC banks; this turned the banking system into a stimulant for economic growth (Caporale et al., 2015). At the same time, the CEECs started to liberalise their trade and exchange rate regimes and underwent a rapid transition from a centrally planned economy based on monopoly of international trade, import and export planning and currency inconvertibility to a market economy. Western Europe soon became one of their most important trade partners. This trade reorientation led to the signing of association agreements with the European Union (EU); this was the first step towards integration, and was soon followed by EU and WTO membership, both of which resulted in a significant increase in trade volumes for the CEECs (see Figs. 1 and 2).

However, in 2009 they experienced a decline in trade. This was part of a general collapse in world trade by 12% in that year which was without precedent in recent history (WTO, 2010). The fall in merchandise export volumes exceeded the world average in the case

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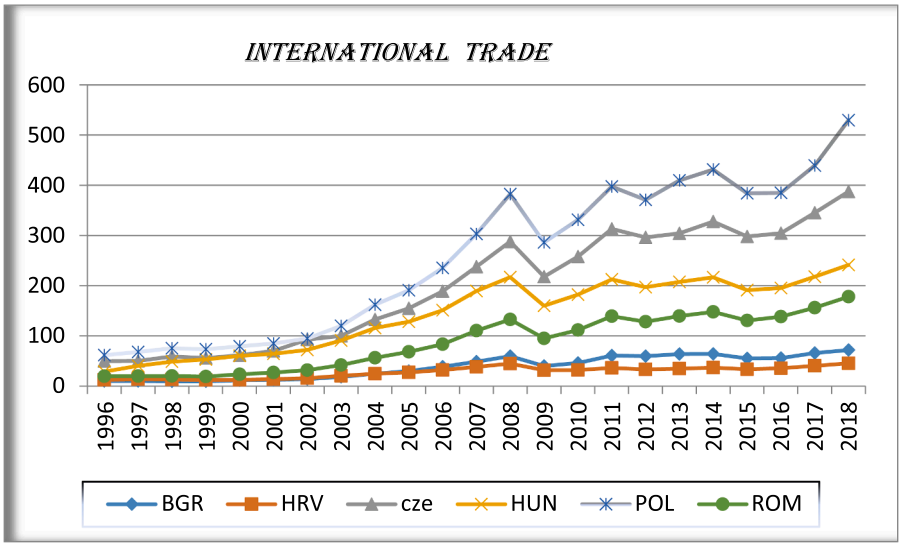

Fig. 1. International Trade of the CEEC-6, 1996–2018, Source: Comtrade.

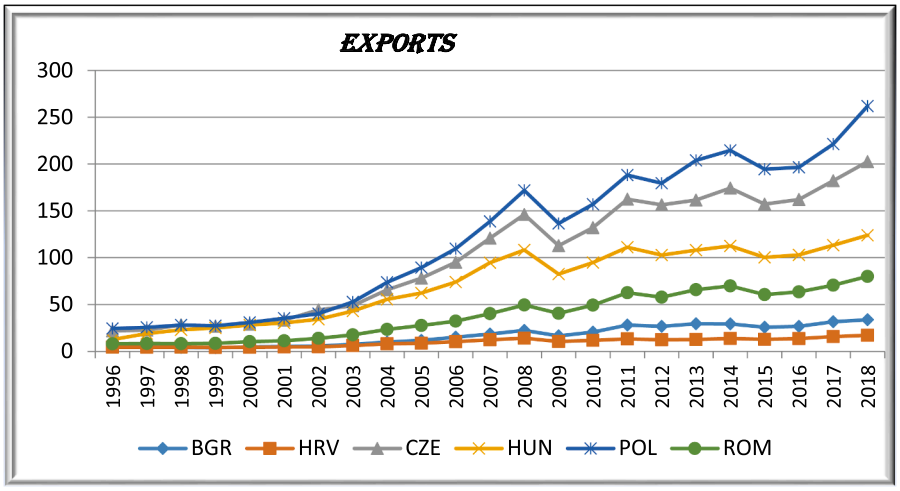

Fig. 2. Exports of the CEEC-6, 1996–2018, Source: Comtrade.

of Europe and North America (14.4%), whilst it was below it in the case of Asia (11%) and Africa (5.6%). The decrease in trade flows was more pronounced for manufactured products (especially industrial machinery, −29% and vehicles, −32%), which led to a deep manufacturing recession and to an even deeper drop in overall trade. An important determinant of the trade collapse of 2009 was the financial crisis of 2007–2008, which affected the financial systems worldwide, with many banks experiencing liquidity and solvency problems. According to Auboin (2009), exporters from Eastern Europe, in addition to encountering difficulties in accessing trade finance facilities, also faced an upward re-pricing of risk, with higher credit and insurance costs resulting in significantly higher trade costs.

The finance-trade nexus might be particularly important for countries trying to catch up with high-income economies by developing their financial sector and adopting trade-led growth strategies. The current study makes a threefold contribution. First, it focuses on a set of Central and Eastern European countries which underwent a transition process from centrally planned to market economies by implementing various reforms in all sectors and gradually liberalising their economies. More specifically, it examines the case of six EU members from Central and Eastern Europe (CEEC-6) which joined the EU but are outside the Eurozone. In these countries the

economic catch-up with the core EU Countries is still ongoing: they have experienced different stages of development over the years, moving from the lower- middle-income to the upper middle-income category (and some of them even to the high-income one)[1] and, although their level of financial development is still relatively low compared to that of the core EU countries, the dynamic process of economic growth has affected the trade-finance nexus. The fact that bottlenecks in/stimulants to financial development may be one of the factors inhibiting/increasing competitiveness and foreign trade also raises important policy issues for these countries. It is noteworthy that all of them have completed the transition process and are currently classified as developed economies by the World Bank (WESP, 2020); thus, they raise a different set of issues in comparison to both countries still at their developing stage (which are also characterised by a much lower level of financial development) and those that have been developed throughout the period under investigation. For all these reasons the selected sample represents a particularly interesting case study.

The second contribution of the present paper is to employ not only a standard proxy for financial development, namely the ratio of private credit to GDP (Beck 2002, 2003), but also a new, more broadly based index constructed by the IMF which takes into account the multidimensional nature of financial development (Svirydzenka, 2016). It is a complex measure that captures various aspects of financial development that might affect trade in the case of the CEEC-6. In particular, it includes both financial institution and financial market indices (depth, access and efficiency) and is therefore more informative about the possible impact of financial development on trade. Such a composite index is particularly useful to shed light on how differences in the level of financial development between countries can create comparative advantages and gains from specialisation and trade, and thus increase trade volumes. In particular, a well-developed financial system enhances international trade by reducing the cost of capital, creating economies of scale and increasing competitiveness. However, knowledge of how various sources of finance may affect trade between countries can only be acquired by analysing the role of its main sub-components corresponding to financial institutions and market participants, as we do in the final part of our analysis investigating causality linkages.

The third contribution of the current study is that, in addition to the direct effects of financial development on trade, it also investigates the indirect ones - more precisely, how financial development affects international trade via sectoral value added (through interaction terms included in the estimated model), an issue which has only been considered by very few studies (in particular, Sare et al., 2019 uses this approach for some African countries), but not in the case of the CEEC-6. State-of-the-art econometric techniques designed for heterogeneous panels are used to analyse both the short- and the long-run relationship between financial development and trade.

The layout of the paper is as follows: Section 2 provides a brief review of the literature on the finance- trade nexus; Section 3 outlines the econometric framework used for the analysis; Section 4 describes the data and presents the empirical results; Section 5 offers some concluding remarks.

2. Literature review

The linkages between financial development and trade are complex and have been explored in numerous studies which have used different proxies for financial development, mostly the ratio of credit to the private sector to GDP (Beck 2002, 2003; Hur et al, 2006; Menyah et al. 2014, Kim et al. 2011;) or stock market capitalization to GDP (Beck 2003, Kim et al. 2011), whilst some others have included instead liquid liabilities (Menyah et al. 2014, Beck 2003) or accounting standards (Becker et al.2013). Different variables have also been used for international trade, for instance exports and imports (Beck, 2002; Becker et al.2013), trade balance (Hur et al, 2006, Beck 2002) or trade openness (Kim et al.2011; Menyah et al. 2014). More details are provided below.

In the theoretical literature the notion of finance dependence was first introduced in the Heckscher-Ohlin-Samuelson (H-O-S) trade model (see Samuelson, 1949 and Heckscher et al., 1991) to show that differences in financial development generate comparative advantages and gains from specialisation. In particular, Kletzer and Bardhan (1987) augmented the H-O-S model and stressed that countries with a relatively well-developed financial system benefit from easier access to external finance and have a comparative advantage that leads them to specialise in industries and sectors relying on external finance. Theirs is a model with two sectors, one producing an intermediate good and the other a final good. Financial development is beneficial for the final good sector whilst the intermediate good sector does not require financing. Thus, countries with more developed financial systems specialise in final goods while those with less developed ones specialise in intermediate goods. Baldwin (1989) highlighted the risk diversification function of financial markets. His model includes two sectors, one which is assumed to face demand shocks and requires access to the financial system to diversify risk, and another one that does not. He found that a relatively high (low) level of financial development leads to specialisation in risky (non-risky) goods. Beck (2002) extended the analysis of Kletzer and Bardhan (1987) by allowing both sectors to use external finance, one being more credit intensive due to increasing returns to scale. He tested the hypotheses developed by Kletzer and Bardhan (1987) and also explored the impact of financial development on the structure of the trade balance. His model includes a manufacturing sector that relies more on external financing and a food sector. He found a positive link between financial development and the specialisation pattern of international trade: sectors that are more dependent on external finance increase faster in countries with better developed financial system; more specifically, a relatively high (low) level of financial development is associated with exporting manufacturing goods (food).

Most empirical studies analysing the effects of financial development on international trade find evidence of a relationship between

[1] According to the World Bank DataBank, World Development Indicators (databank.worldbank.org/source/world-development-indicators), Hungary (2007), Poland (2009), Croatia (2008) and the Czech Republic (2006) have reached the high-income threshold, and Romania (2005) and Bulgaria (2006) the upper middle-income one.".

trade and finance: a well-developed financial system appears to lead to a higher volume of trade and also to have an impact on its structure (Beck 2002, 2003;Svaleryd and Vlachos, 2005; Hur et al., 2006; Kim et al., 2010; Becker et al., 2013; Manova 2013; Bilas et al., 2017). However, a few studies report weak evidence of an effect of finance on trade or find no effect (Menyah et al., 2014; Sare et al., 2019). Svaleryd and Vlachos (2005) examined how financial markets shape industry specialisation patterns and international competitiveness using data for OECD countries. They found a strong causal effect of the financial sector on industrial specialisation, specifically countries with well-functioning financial systems tend to specialise in industries that are highly dependent on external financing. Thus, the financial sector appears to be a source of comparative advantage in a way consistent with the Heckscher–Ohlin–Vanek (HOV) model (see Vanek, 1968). Hur et al. (2006) analysed the link between financial development, asset tangibility, and international trade. They argued that the interplay between the levels of financial development and of asset tangibility affects the pattern of international trade. They used industry-level data on firms' dependence on external finance and firms' asset tangibility for 27 industries in 42 countries. Their results suggest that countries with higher levels of financial development have higher export shares and trade balance in industries with more intangible assets.

Becker et al. (2013) examined the relationship between financial development, fixed costs and international trade using data on bilateral trade flows for a sample of 170 countries between 1970 and 1998. They highlighted the role of financial development when financial dependence is measured by the size of fixed costs. There is evidence that firms incur large fixed costs to enter new export markets and thus exports require significant up-front costs in product design, marketing, and distribution. Financial development is found to be associated with more exports in industries in which up-front fixed costs are high. Kim et al. (2010) studied the short- and long-run relationships between financial development and trade openness for a panel of 87 OECD and non-OECD countries over the period 1960–2005. Their empirical results indicate that in the case of OECD countries financial development has negligible effects on trade. By contrast, in non-OECD countries long-run complementarity between financial development and trade openness coexists with short-run substitutability between the two policy variables considered. Thus, financial development has stronger real effects for developing countries than for developed ones. Sare et al. (2019) examined the relationship between financial development and international trade in 46 African countries over the period 1980–2016. Their findings suggest that in both the long and the short run financial sector development does not have a significant effect on international trade. However, when controlling for the transmission channels they find negative long-run substitutability between finance and trade.

Some studies focus on the links between financial development, economic crises, and international trade, especially on the impact of the global financial crisis of 2007–8 on international trade (Iacovone and Zavacka, 2009; Chor and Manova, 2012; Berman and Martin, 2012). They find that banking crises amplify the adverse effect of external financial dependence on the growth rates of exports by sector. Trade transactions involve some form of credit, insurance or guarantee, thus the supply-side driven shortages of trade finance have the potential to inflict further damage on international trade (Auboin, 2009). Other studies are based on the feedback hypothesis according to which international trade and financial development interact with each other (Bayar et al., 2017, Menyah et al., 2014, Wajda-Lichy et al., 2020); their main conclusion is that the causal linkage between trade and finance is country-specific.

On the whole the empirical evidence on the finance-trade nexus is rather mixed. Moreover, there is hardly any evidence concerning the CEECs that are undergoing a catch-up process and in whose case both financial development and international trade are important drivers of economic growth (Bilas et al., 2017; Bayar et al., 2017, Wajda-Lichy et al., 2020). The present study contributes to the existing literature by investigating the linkages between finance and trade in the specific case of the CEEC-6.

3. Econometric methodology

In order to analyse the finance-trade nexus, we estimate the following regression including financial development variables:.

$$ITRDI_{i,t}^{s} = \alpha_i + \sum_{k=1}^{K} \lambda_{i,k} DF_{i,t}^{k} + \sum_{j=1}^{J} \beta_{i,j} X_{i,t}^{j} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (1)$$

where the dependent variable $ITRDI_{i,t}^{s}$ is an international trade indicator (in turn exports, imports, trade balance and trade openness as a share of GDP); as for the regressors, $DF_{i,t}^{k}$ is a financial development indicator, $X_{i,t}^{j}$ is a set of control variables, μ_t and η_i stand for time-specific and country-specific effects respectively, ε_{it} is a white noise error with zero mean, i (where i = 1,2…,N) and t (where t = 1,2,…, T) denote the country and time period respectively, and α_i is the country-specific intercept that can vary across countries.

Beck et al. (2000) discussed different indicators of financial development capturing the size, activity and efficiency of the financial sector. Most empirical studies use either or both of two standard proxies, namely the ratio of financial depth or stock market capitalization to GDP, or the ratio of credit to the private sector (loans from banks to private enterprises) to GDP. However, the new aggregate index of financial development provided by the IMF (Svirydzenka, 2016) is much more suitable for capturing different aspects of the financial system (see Table A1). Therefore, in our analysis, in addition to the ratio of credit to the private sector to GDP (which is credit issued by banks, as opposed to credit issued by the central bank, and credit to enterprises, as opposed to credit issued to governments – see Levine and Zervos, 1996), we use the IMF index of financial development which is constructed by combining depth (size and liquidity of markets), access (ability of individuals and companies to access financial services) and efficiency (ability of institutions to provide financial services at low cost and with sustainable revenues, and the level of activity of capital markets). This broad, multi-dimensional approach to measuring financial development follows the matrix of financial system characteristics developed by Čihák et al. (2012). All these aspects of financial development are relevant for our analysis and could have a significant impact on trade in the case of the CEEC-6. As already mentioned before, during the transition period these countries typically had

relatively weak institutions and therefore were more vulnerable to economic shocks. Thus, governments had to take action and adopt institutional reforms under the pressure of international competition. This improved the efficiency and quality of institutions, which can be expected to boost financial development and thus trade. For this reason, the IMF index has been included to capture these effects, in addition to the standard proxy used in most previous studies.

In our analysis we follow Beck (2002), who developed a theoretical and empirical model for finance and trade. [2]This a reference model adopted in many empirical studies focusing on the finance-trade nexus, which we adjust to take into account the specific characteristics of the transitions countries. The selection of the variables for our model is therefore based on the existing literature discussed in the previous section. In addition to the two alternative financial development indices already mentioned the model also includes a set of control variables, namely: real GDP per capita (RGDPC), to control for a possible link between the income level and trade (as per capita income increases, the number of product varieties that are traded and the bilateral volume of trade should also increase); total population (POP), whose effect could be either positive or negative, i.e. either trade-enhancing or trade-inhibiting; foreign direct investment (FDI), which in the literature is associated with technology transfers and therefore is expected to have a positive influence on international trade; financial crisis (FCR), which is a dummy for the 2007–2008 global financial crisis and is expected to have a negative impact, since a weakening or collapse of the financial system, in particular the banking system, could weaken a country's export capability and also affect imports and trade in general; EU membership (EU), which is a dummy for full EU membership and is expected to have a positive impact on trade. We employ different measures for international trade, more precisely exports, imports, trade balance and trade openness as a share of GDP, to check the robustness of our results. These variables have already been used in numerous empirical evidence as mentioned in the literature review (Beck, 2002, Becker et al., 2013, Menyah et al., 2014).

We run two separate regressions using each proxy for financial development in turn:.

$$ITRDI^{s}_{i,t} = \alpha_i + \lambda_{i,1} FD_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{it} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (2)$$

$$ITRDI^{s}_{i,t} = \alpha_i + \lambda_{i,1} DCPS_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{it} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (3)$$

where: $ITRDI^{s}_{i,t}$ = international trade as a share of GDP (exports, imports, trade balance[3] and trade openness[4] as a share of GDP in turn), RGDPC = real income per capita, FDI = Foreign Direct Investment as a share of GDP, DCPS = domestic credit to the private sector (as share of GDP), FD = the financial development index developed by the IMF, FCR = financial crisis which is equal to 1 during the global financial crisis (2007–2008) and zero otherwise, EU = EU membership which is a dummy equal to 1 when a country becomes a full EU member and thereafter and to 0 before membership is acquired.

To shed light on the indirect effects of financial development on trade we also re-estimate the two equations above including an additional variable, namely an interaction term between each of the two financial development indicators and sectoral value added for manufacturing and agriculture in turn (FD × AGR, FD × MNF, DCPS × AGR, DCPS × MNF); this type of variable has also been used by Sare et al. (2019) in their study on the finance-trade nexus in Africa.

The expanded model including the interactive term takes the following form:.

$$ITRDI^{s}_{i,t} = \alpha_i + \lambda_{i,1} FDxAGR_{i,t} + \lambda_{i,2} FDxMNF_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (4)$$

$$ITRDI^{s}_{i,t} = \alpha_i + \lambda_{i,1} DCPSxAGR_{i,t} + \lambda_{i,2} DCPSxMNF_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (5)$$

where

DCPSxMNF); (DCPSxAGR) is the credit to the private sector × manufacturing/agriculture value added as a share of GDP.
(FD xMNF); (FD × AGR) is the IMF financial development index × manufacturing / agriculture value added as a share of GDP

The rationale for selecting those two sectors is the following: manufacturing and agriculture are characterised by increasing and constant returns to scale respectively, therefore the former is more reliant on external finance and should be affected more by the level of financial development (Beck, 2002). It is sufficient for our purposes to consider two representative sectors, one of which is more reliant on external financing than the other. Future work will focus on sectoral analysis and include sectors such as services value added (as a share of GDP) or industry value added (as a share of GDP) to gain additional insights.

When investigating the finance-trade nexus it is essential to apply an estimation method that is consistent even in the presence of possible measurement errors, reverse causation and omitted variable bias. Therefore we estimate dynamic panel regressions which weaken the exogeneity assumption for a subset of the regressors and use lagged values of the explanatory endogenous variables as instruments. This approach has several advantages over cross-sectional instrumental variable regressions. In particular, it controls for endogeneity and measurement errors not only of the financial development variables but also of the other explanatory variables. Next we outline the two estimators we use, namely system GMM and PMG.

The dynamic panel regression takes the following form:.

[2] See Beck (2002) for more details about the theoretical model on which our empirical specification is based.
[3] This variable is calculated as (exports - imports)/GDP.
[4] This variable is calculated as (exports + imports)/GDP.

$$ITRDI^{s}_{i,t} = \alpha_i ITRDI^{s}_{i,t-1} + \sum_{k=1}^{K} \lambda_{i,k} DF^{k}_{i,t} + \sum_{j=1}^{J} \beta_{i,j} X^{j}_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (6)$$

More precisely:.

$$ITRDI^{s}_{i,t} = \alpha_i ITRDI^{s}_{i,t-1} + \lambda_{i,1} FD_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (7)$$

$$ITRDI^{s}_{i,t} = \alpha_i ITRDI^{s}_{i,t-1} + \lambda_{i,1} DCPS_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (8)$$

$$ITRDI^{s}_{i,t} = \alpha_i ITRDI^{s}_{i,t-1} + \lambda_{i,1} FD_{i,t} xAGR_{i,t} + \lambda_{i,2} FD_{i,t} xMNF_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (9)$$

$$ITRDI^{s}_{i,t} = \alpha_i ITRDI^{s}_{i,t-1} + \lambda_{i,1} DCPS_{i,t} xAGR_{i,t} + \lambda_{i,2} DCPS_{i,t} xMNF_{i,t} + \beta_{i,1} RGDPC_{i,t} + \beta_{i,2} FDI_{i,t} + \beta_{i,3} POP_{i,t} + \beta_{i,4} FCR_{i,t} + \beta_{i,5} EU_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad (10)$$

where $ITRDI^{s}_{i,t-1}$ is the international trade indicator (ITRDI) lagged 1 year.

Kiviet (1995) argues that in GMM estimation the imposition of homogeneity assumptions on the slope coefficients of the lagged dependent variables could lead to serious biases; [5] this approach is likely to produce inconsistent and misleading long-run coefficients unless the slope coefficients are indeed identical (Pesaran and Shin, 1999). To deal with these issues Pesaran and Shin (1999) proposed the autoregressive distributed lag (ARDL) model in error correction form as a new cointegration test. They showed that panel ARDL can be used even with variables exhibiting different orders of integration, irrespective of whether they are I (0) or I (1) [6]. In addition, both the short-run and long-run effects can be estimated simultaneously from a data set with large cross-section and time dimensions. Finally, the ARDL model yields consistent estimates of the coefficients despite the possible presence of endogeneity because it includes lags of both the dependent and independent variables (Pesaran et al., 1999).

As for the choice of estimator for the ARDL model, there are a number of methods that vary in the extent to which they allow for parameter heterogeneity across countries. The dynamic fixed effects (DFE) estimator allows for different country intercepts but constrains all slope coefficients and error variances to be equal across countries. The mean group (MG) estimator introduced by Pesaran et al. (1996) is based on an un-weighted average of the individual country coefficients. Finally, the pooled mean group (PMG) estimator developed by Pesaran et al. (1999) restricts the long-run slope coefficients to be the same across countries but allows the short-run coefficients and the regression intercept to be country-specific. For our purposes we use the PMG estimation approach since, as shown by Pesaran et al. (1999), it has the advantage of letting the short-run dynamics to be data-determined for each country, taking into account the number of time series observations available in each case. It assumes homogeneous long-run coefficients, and provides a useful intermediate alternative between estimating separate regressions, which allows all coefficients and error variances to differ across the groups, and conventional fixed-effects estimators, which assumes that all slope coefficients and error variances are the same.

To sum up, as a first step we employ the system GMM estimator developed by Arellano and Bover (1995), which combines a regression in differences with one in levels, since the inclusion of the level regression in the estimation reduces the potential bias in finite samples and the asymptotic inaccuracy associated with the difference estimator (see Blundell and Bond, 1998). The consistency of the GMM estimator depends on the error term not exhibiting serial correlation (for which we carry out appropriate tests) and on the validity of the instruments chosen from the lagged endogenous and explanatory variables (which we check by means of the Sargan test of over-identifying restrictions proposed by Arellano and Bond, 1991). Roodman (2009a, b) also points out that in the context of system GMM estimation instrument proliferation can lead to overfitting the endogenous variables and failing to expunge their endogenous components. It is therefore advisable to check the robustness of the results by reducing the number of instruments.[7].

Next, we employ the PMG estimator of Pesaran et al. (1999) in order to analyse both the long- and the short-run relationship between financial development and trade. In its ARDL (p,q,q….q)[8] specification (which allows the dependent variable (trade) to adjust to changes in financial development and other variables by fitting an error correction model) our dynamic heterogeneous panel regression takes the following form:.

$$ITRDI^{s}_{i,t} = \sum_{l=0}^{p-1} \gamma_{i,l} \Delta ITRDI^{s}_{i,t-l} + \sum_{l=0}^{q-1} \left(\sum_{k=1}^{K} \tau_{i,k} DF^{k}_{i,t-l} + \sum_{j=1}^{J} \rho_{i,j} \Delta X_{i,t-l} \right) + \varphi_i \left[ITRDI^{s}_{i,t-1} - \left\{ \beta_{i,0} + \sum_{k=1}^{K} \varrho_{i,k} DF^{k}_{i,t-1} + \sum_{j=1}^{J} \beta_{ij} X_{i,t-1} \right\} \right] + \mu_i + \varepsilon_{i,t} \quad (11)$$

where: γ, τ and ρ are the short-run coefficients of the lagged dependent and independent variables; ϱ and β_i are the long-run

[5] See Bond (2002) for further details about the use of GMM panel estimators in empirical growth studies.

[6] According to Phillips and Hansen (1990) a long-run cointegration relationship can only exist between variables with the same order of integration.

[7] To control for instrument proliferation, the option "collapsing instrument" in Stata is employed.

[8] p is the lag length of the dependent variable, and q of the independent variables.

coefficients, φ_i is the coefficient of the speed of adjustment to the long-run equilibrium, and μ_i stands for the fixed effects. The term in square brackets represents the long-run equilibrium. The subscripts i and t denote country and time, respectively, and l is the lag length. Finally, the term in square brackets represents the long-run equilibrium. The error term $\varepsilon_{i,t}$ is assumed to be independently distributed across i and t, but the variances may be heterogeneous across countries.[9] By making an appropriate choice of the p and q lag lengths consistent estimates of the parameters of equation (11) can be obtained even in the presence of reverse causality between international trade and the measures of financial development used for the analysis.

More precisely, we estimate four equations (see below) to investigate the direct effects of the financial development index (FD) and domestic credit to private sector (DCPS) on international trade (equ. 12 and 13 respectively), and their indirect effects through sectoral value added in agriculture and manufacturing (equ. 14 and 15 respectively):.

$$\Delta \mathrm{ITRDI}^{s}_{i,t} = \sum_{l=1}^{p-1} \gamma_{i,l} \Delta \mathrm{ITRDI}^{s}_{i,t-1} + \sum_{l=0}^{q-1} (\tau_i \Delta FD_{i,t-l} + \rho_{i,1} \Delta RGDPC_{i,t-l} + \rho_{i,2} \Delta FDI_{i,t-l} + \rho_{i,3} \Delta POP_{i,t-l} + \rho_{i,4} \Delta FCR_{i,t-l} + \rho_{i,5} \Delta EU_{i,t-l}) + \varphi_i \Big[\mathrm{ITRDI}^{s}_{i,t-1} - \Big\{ \beta_{i,0} + \varrho_{i,1} FD_{i,t-1} + \beta_{i,1} RGDPC_{i,t-1} + \beta_{i,2} FDI_{i,t-1} + \beta_{i,3} POP_{i,t-1} + \beta_{i,4} FCR_{i,t-1} + \beta_{i,5} EU_{i,t-1} \Big\} \Big] + \mu_i + \varepsilon_{i,t} \tag{12}$$

$$\Delta \mathrm{ITRDI}^{s}_{i,t} = \sum_{l=1}^{p-1} \gamma_{i,l} \Delta \mathrm{ITRDI}^{s}_{i,t-1} + \sum_{l=0}^{q-1} (\tau_i \Delta DCPS_{i,t-l} + \rho_{i,1} \Delta RGDPC_{i,t-l} + \rho_{i,2} \Delta FDI_{i,t-l} + \rho_{i,3} \Delta POP_{i,t-l} + \rho_{i,4} \Delta FCR_{i,t-l} + \rho_{i,5} \Delta EU_{i,t-l}) + \varphi_i \Big[\mathrm{ITRDI}^{s}_{i,t-1} - \Big\{ \beta_{i,0} + \varrho_{i,1} DCPS_{i,t-1} + \beta_{i,1} RGDPC_{i,t-1} + \beta_{i,2} FDI_{i,t-1} + \beta_{i,3} POP_{i,t-1} + \beta_{i,4} FCR_{i,t-1} + \beta_{i,5} EU_{i,t-1} \Big\} \Big] + \mu_i + \varepsilon_{i,t} \tag{13}$$

$$\Delta \mathrm{ITRDI}^{s}_{i,t} = \sum_{l=1}^{p-1} \gamma_{i,l} \Delta \mathrm{ITRDI}^{s}_{i,t-1} + \sum_{l=0}^{q-1} (\tau_{i,1} \Delta FDxAGR_{i,t-l} + \tau_{i,2} \Delta FDxMNF_{i,t-l} + \rho_{i,1} \Delta RGDPC_{i,t-l} + \rho_{i,2} \Delta FDI_{i,t-l} + \rho_{i,3} \Delta POP_{i,t-l} + \rho_{i,4} \Delta \mathrm{FCR}_{i,t-1} + \rho_{i,5} \Delta EU_{i,t-l}) + \varphi_i \Big[\mathrm{ITRDI}^{s}_{i,t-1} - \Big\{ \beta_{i,0} + \varrho_{i,1} FDxAGR_{i,t-1} + \varrho_{i,2} FDxMNF_{i,t-1} + \beta_{i,1} RGDPC_{i,t-1} + \beta_{i,2} FDI_{i,t-1} + \beta_{i,3} POP_{i,t-1} + \beta_{i,4} FCR_{i,t-1} + \beta_{i,5} EU_{i,t-1} \Big\} \Big] + \mu_i + \varepsilon_{i,t} \tag{14}$$

$$\Delta \mathrm{ITRDI}^{s}_{i,t} = \sum_{l=1}^{p-1} \gamma_{i,l} \Delta \mathrm{ITRDI}^{s}_{i,t-1} + \sum_{l=0}^{q-1} (\tau_{i,1} \Delta DCPSxAGR_{i,t-l} + \tau_{i,2} \Delta DCPSxMNF_{i,t-l} + \rho_{i,1} \Delta RGDPC_{i,t-l} + \rho_{i,2} \Delta FDI_{i,t-l} + \rho_{i,3} \Delta POP_{i,t-l} + \rho_{i,4} \Delta \mathrm{FCR}_{i,t-1} + \rho_{i,5} \Delta EU_{i,t-l}) + \varphi_i \Big[\mathrm{ITRDI}^{s}_{i,t-1} - \Big\{ \beta_{i,0} + \varrho_{i,1} DCPSxAGR_{i,t-1} + \varrho_{i,2} DCPSxMNF_{i,t-1} + \beta_{i,1} RGDPC_{i,t-1} + \beta_{i,2} FDI_{i,t-1} + \beta_{i,3} POP_{i,t-1} + \beta_{i,4} FCR_{i,t-1} + \beta_{i,5} EU_{i,t-1} \Big\} \Big] + \mu_i + \varepsilon_{i,t} \tag{15}$$

where: $\gamma_{i,l,}$ is the short-run coefficient on the lagged dependent variable and $\tau_{i,k,}$ and $\rho_{i,j}$ are those on the independent variables, respectively; $\varrho_{i,k}$ and $\beta_{i,j}$ are the long-run coefficients, φ_i is the coefficient of the speed of adjustment to the long-run equilibrium, and i = 1,2,…,N, t = 1,2,…,T, k = 1,2..K and j = 1,2,…..J stand for the country, year, financial development indicator and control variable respectively. The main advantage of using the PMG estimator to analyse the finance-trade nexus is that it allows the level of financial development to have similar effects across the countries considered in the long run while permitting heterogeneous short-run adjustments across groups to changes in the level of financial development.

4. Empirical analysis

Our panel consists of annual data over the period 1996–2018 for 6 countries from Central and Eastern Europe, namely Bulgaria, the Czech Republic, Hungary, Poland, Romania and Croatia. Despite some considerable progress, they are still underdeveloped compared to the Western European ones in terms of both income and financial development (the financial development index for the CEECs-6 is on average 0.30 compared to 0.70 for the EU-15 – see Fig. 3 in the Appendix). The DCPS index also shows differences in financial development between the Western European countries and the CEEC-6. In particular, the average ratio of private credit to GDP is 0.99 in the former, and only 0.45 in the latter (see Fig. 5). These countries are relatively similar in terms of economic or financial development in comparison to the EU-15 countries, though there is some variation across them. In particular, Romania and Hungary have the lowest and highest value of the financial development index, namely 0.30 and 0.48 respectively. As for economic development, the

[9] The assumption of cross-sectional independence of the error term is rather restrictive, as macro time series may exhibit a significant degree of cross-correlation between the countries in the panel as a result of the presence of common shocks and unobserved components that ultimately become part of the error term. The rising degree of economic and financial integration observed internationally during the last few decades has presumably resulted in an increase in the interdependence between cross-sectional units. The impact of cross-sectional dependence on dynamic panel estimators may indeed be quite severe - see Baltagi (2005) for a useful discussion of these issues.

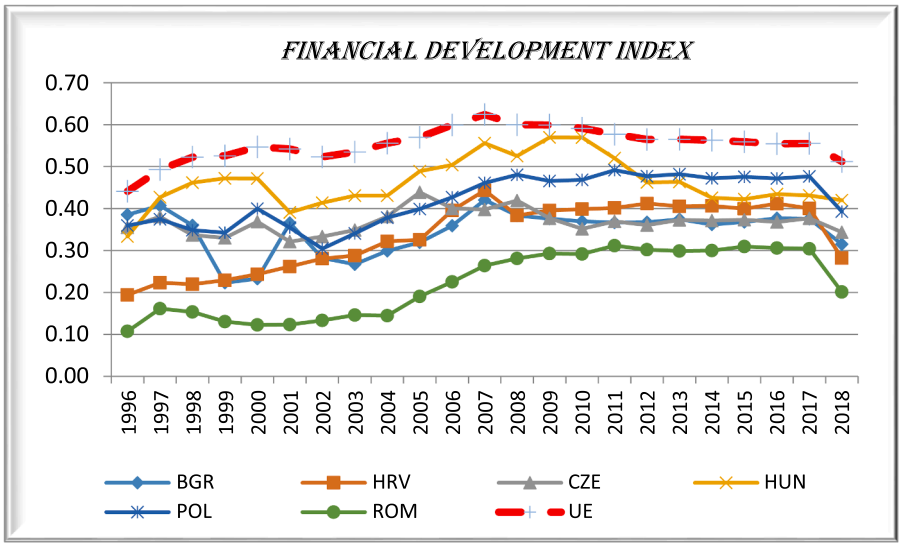

Fig. 3. Financial Development index for the CEEC-6 and the EU, 1996–2018. Source: IMF.

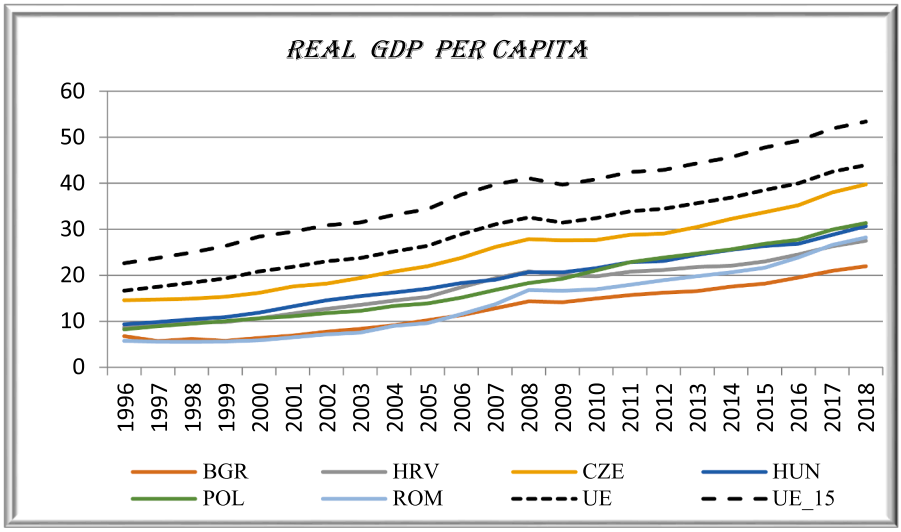

Fig. 4. Real GDP per capita in the CEEC-6 and the EU. Source: World Bank/ WDI database.

Czech Republic and Bulgaria have the highest and lowest GDP per capita (source: IMF, 2018 - see Figs. 3-5 in the Appendix).

The data were obtained from COMTRADE, World Bank (WDI) and the International Monetary Fund (IMF); more details on data sources and definitions are provided in Table A2 in the Appendix.

The estimation results are displayed in Tables 1-4. First, we focus on the direct effects of financial development (see Tables 1-2). As already mentioned, we estimate separately the effects of the two financial indicators on exports and imports, trade balance and trade openness.

The interpretation of the results is based on theoretical arguments and takes into consideration the specific characteristics of CEEC. We find that the ratio of private credit to GDP has a positive and statistically significant effect on exports, but not on imports or the trade balance. According to Beck (2002), countries with higher levels of financial development tend to have higher export shares and higher trade balance. Our findings only partially support this view in the case of the CEEC-6, possibly because for our regressions we use total trade and there are specific sectors that rely more on external finance than others, such as the manufacturing sector, which exhibits increasing returns to scale. Despite the increase in the export share of manufacturing goods in the CEEC-6 over the years, this is still relatively small, which might explain why financial development does not seem to have a strong impact on trade in these countries.

The robustness of these results is confirmed by the estimates obtained using the IMF measure of financial development (see Table 1a), since we detect again a positive and significant impact of financial development on exports only. As already mentioned, although the CEEC-6 have made some progress, their financial systems still remain relatively underdeveloped. The estimated

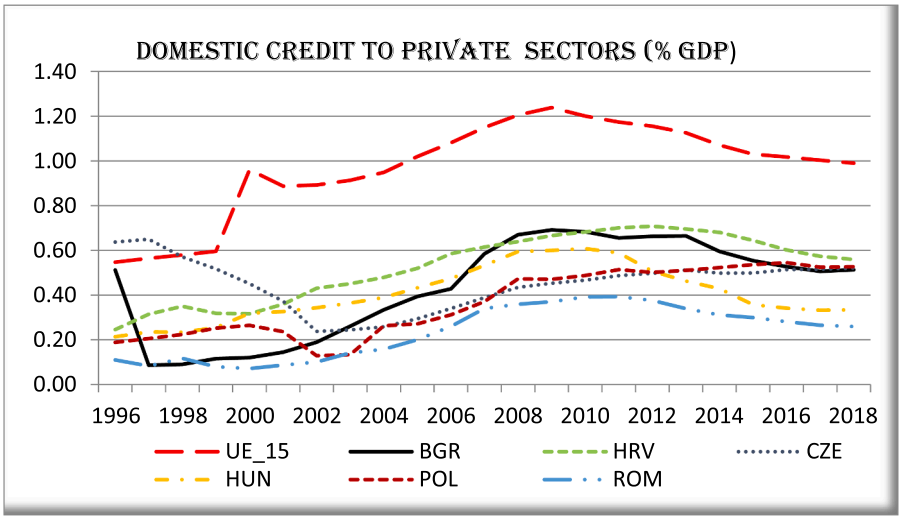

Fig. 5. Domestic credit to the private sector (as a share of GDP) for the CEEC-6 and the EU, 1996–2018, Source: World Bank/ WDI database.

Table 1a
The financial development and international trade nexus: GMM results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TRD_GDP		**EXP_GDP**		**IMP_GDP**		**BAL_GDP**	
L.	0.671	0.701	0.726	0.777	0.655	0.660	0.812	0.849
	(15.49)***	(16.03)***	(20.30)***	(21.52)***	(13.13)***	(13.18)***	(15.75)***	(16.99)***
FD	0.160	–	0.198	–	0.077	–	0.034	–
	(1.71)*	–	(1.83)*	–	(0.66)	–	(0.22)	–
DCPS	–	0.042	–	0.075	–	0.022	–	0.052
	–	(1.70)*	–	(2.40)**	–	(0.83)	–	(1.58)
RGDPC	0.197	0.139	0.168	0.041	0.189	0.169	0.012	−0.001
	(3.18)***	(1.83)*	(2.75)***	(1.67)*	(2.81)***	(2.15)**	(0.61)	(0.05)
FDI	0.000	0.000	0.001	0.001	0.001	0.001	−0.000	−0.002
	(0.13)	(0.12)	(0.25)	(0.19)	(0.41)	(0.37)	(0.04)	(0.29)
POP	−0.131	−0.103	−0.115	−0.067	−0.129	−0.118	0.012	0.039
	(5.19)***	(3.66)***	(4.84)***	(2.47)**	(4.57)***	(3.88)***	(0.39)	(1.06)
FCR	−0.058	−0.059	−0.049	−0.050	−0.062	−0.063	0.073	0.066
	(4.72)***	(4.67)***	(3.79)***	(3.82)***	(4.66)***	(4.68)***	(3.50)***	(3.14)***
EU	0.053	0.054	0.067	0.065	0.042	0.043	0.029	0.010
	(3.14)***	(3.10)***	(3.84)***	(3.67)***	(2.25)**	(2.28)**	(1.48)	(0.51)
Constant	0.746	0.717	0.380	0.449	0.653	0.648	−0.116	−0.257
	(3.62)***	(3.48)***	(1.87)*	(2.14)**	(2.89)***	(2.89)***	(1.10)	(1.83)*
Observations	137	137	137	137	137	137	137	137
Number of un_code	6	6	6	6	6	6	6	6
AR(1)	−4.62	−4.68	−4.47	−4.60	−4.71	−4.70	−4.47	−4.55
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
AR(2)	0.24 (0.809)	0.33 (0.741)	0.38 (0.706)	0.48 (0.63)	0.24 (0.812)	0.30 (0.761)	0.38 (0.704)	0.45 (0.652)
Sargan	147.31	143.84	142.48	147.58	146.53	148.34	149.05	159.57
	(0.221)	(0.306)	(0.306)	(0.235)	(0.233)	(0.222)	(0.210)	(0.123)

Note: TRD_GDP, EXP-GDP, IMP_GDP and BAL_GDP stand for trade openness, exports, imports and trade balance as a share of GDP; RGDPC is real income per capita, FDI is Foreign Direct Investment as a share of GDP, DCPS is domestic credit to the private sector (as share of GDP), FD is the financial development index developed by the IMF, FCR is a dummy equal to 1 during the global financial crisis of 2007–2008 and 0 elsewhere, and EU a dummy for EU membership equal to 1 during the membership period and 0 elsewhere.
Absolute value of t statistics in parentheses.
* Significant at 10%; ** significant at 5%; *** significant at 1%.

coefficients for both financial indicators imply that further financial development would contribute positively to trade openness. The FD index appears to have a more pronounced effect, which suggests that aspects of financial development such as depth, access and efficiency of both financial institutions and markets have a significant impact on trade in the case of the CEEC-6. This is not surprising for economies in transition in which the financial system had to undergo fundamental changes. A higher FD index corresponds to a higher degree of efficiency of financial institutions and markets in providing funding to business at low cost while maintaining

Table 1b
The financial development and international trade nexus: GMM results using additional control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TRD_GDP		**EXP_GDP**		**IMP_GDP**		**BAL_GDP**	
L.	0.621	0.657	0.886	0.940	0.423	0.521	1.045	1.068
	(9.75)***	(10.88)***	(14.94)***	(16.63)***	(4.42)***	(5.12)***	(7.32)***	(12.45)***
FD	0.145		0.187	–	0.068	–	0.029	–
	(1.87)*		(1.94)*		(0.52)		(0.51)	
DCPS	–	0.081	–	0.097	–	0.043	–	0.048
		(1.89)*		(2.69)**		(0.93)		(0.87)
RGDPC	0.238	0.166	0.141	0.097	0.210	0.124	0.044	−0.031
	(4.53)***	(1.94)*	(2.67)**	(1.73)*	(2.67)**	(1.99)*	(0.79)	(0.46)
FDI	0.006	0.002	0.022	0.024	0.018	0.016	−0.013	0.002
	(0.88)	(0.17)	(0.73)	(0.86)	(0.75)	(0.58)	(0.41)	(0.06)
POP	−0.112	−0.134	−0.102	−0.072	−0.065	−0.043	0.014	0.021
	(2.84)***	(2.79)***	(2.56)**	(2.49)**	(2.72)***	(2.55)**	(0.49)	(0.74)
FCR	−0.101	−0.018	−0.055	−0.057	−0.034	−0.045	0.062	0.048
	(5.22)***	(3.64)***	(4.10)***	(4.37)***	(2.45)**	(2.92)***	(1.98)**	(1.88)*
EU	0.039	0.033	0.044	0.061	0.032	0.038	0.021	0.001
	(2.89)***	(2.91)***	(2.37)**	(2.19)**	(2.47)**	(2.39)**	(1.16)	(0.03)
EuroCR	−0.018	−0.024	−0.029	−0.038	0.016	−0.027	−0.004	−0.003
	(0.39)	(1.67)*	(0.29)	(0.51)	(0.27)	(1.65)*	(0.40)	(0.27)
PS	0.034	0.045	0.057	0.049	−0.013	0.022	0.050	0.028
	(1.71)*	(1.95)*	(1.79)*	(1.65)*	(0.51)	(1.72)*	(1.81)*	(1.56)
GOVEF	0.039	0.103	0.041	0.035	−0.041	0.099	0.042	0.074
	(0.47)	(1.72)*	(1.68)*	(0.93)	(0.74)	(1.71)*	(0.99)	(1.66)*
Constant	0.723	0.682	0.233	0.416	−0.648	−0.148	−0.128	−0.261
	(5.53)***	(4.27)***	(1.93)*	(2.08)**	(2.98)***	(2.52)**	(0.62)	(2.27)**
Observations	137	137	137	137	137	137	137	137
AR(1)	−2.79	−3.52	−3.48	−2.93	−2.79	−2.55	−2.45	−3.61
	(0.007)	(0.001)	(0.001)	(0.003)	(0.005)	(0.011)	(0.014)	(0.000)
AR(2)	−1.59	−0.36	−0.56	−1.21	−1.15	0.86	−0.66	0.06
	(0.113)	(0.722)	(0.573)	(0.226)	(0.279)	(0.391)	(0.507)	(0.954)
Sargan	122.01 (0.186)	−120.72	9.62	7.18	14.43	9.73	16.49	26.52
		(0.209)	(0,684)	(0.893)	(0.344)	(0.639)	(0.224)	(0.116)

Note: TRD_GDP, EXP-GDP, IMP_GDP and BAL_GDP stand for trade openness, exports, imports and trade balance as a share of GDP; RGDPC is real income per capita, FDI is Foreign Direct Investment as a share of GDP, DCPS is domestic credit to the private sector (as share of GDP), FD is the financial development index developed by the IMF, FCR is a dummy equal to 1 during the global financial crisis of 2007–2008 and 0 elsewhere, and EU a dummy for EU membership equal to 1 during the membership period and 0 elsewhere; PS stands for political stability, GOVEF for government effectiveness and EuroCR is a dummy equal to 1 during the 2020–2012 Eurozone debt crisis and 0 elsewhere.
Absolute value of t statistics in parentheses
* Significant at 10%; ** significant at 5%; *** significant at 1%.

sustainable profits and sufficient liquidity.

Concerning the control variables, our findings suggest that real income per capita, trade lagged 1 year**,** the global financial crisis, population and EU membership are significant determinants of international trade**.** As expected, real GDP per capita has a positive and significant impact: a higher level of per capita income tends to boost trade by increasing production since it makes consumers demand a greater variety of goods, thus enhancing demand for differentiated products and increasing the level of imports. Total population (POP) has a negative effect. Trade lagged 1 year has a significant and positive impact on all trade indicators; firms that exported in the past (and have credibility on the international market) are more likely to do so in the future. FDI, which is normally found to be an important determinant of trade flows, is not statistically significant across all specifications, i.e. we do not detect the expected impact on trade through positive spillovers of technology and management practices that may enhance competitiveness.

The global financial crisis had instead a significant, negative impact: it affected the financial systems worldwide, with banks facing liquidity problems and tighter credit conditions with reduced access to trade finance resulting in a decrease in trade. Trade finance is a determinant of world trade and an important channel for the transmission of financial shocks. Banking crises in the importing and the exporting countries are harmful to international trade as both the importer' and exporter's banks are involved in the use of letters of credit and insurances. The decrease in trade finance has been particularly pronounced in the emerging countries (Auboin, 2009). The impact of the financial crisis appears to be have been greater on imports than on exports, and thus to have led to an improvement in the trade balance. Finally, becoming full member of the EU had a positive and significant impact on export, imports and trade balance. It is

Table 2
The direct effects of financial development in the short and long run: PMG results.

Financial Development Variable	Dependent Variable	Long-run coefficients	Error correction (PHI)	Short-run coefficients (Δ)	Constant
DCPS	**EXP_GDP**	0.002 (1.75)*	−0.384 (2.03)**	−0.002 (1.20)	2.739 (1.98)**
	BAL_GDP	0.000 (0.02)	−0.487 (3.33)***	0.026 (0.69)	−1.861 (3.37)***
	TRD_GDP	0.004 (2.07)**	−0.465 (4.05)***	−0.021 (1.17)	0.523 (4.84)***
FD	**EXP_GDP**	0.787 (2.59)**	−0.107 (1.11)	0.036 (0.22)	0.734 (1.23)
	BAL_GDP	0.135 (1.10)	−0.399 (2.72)***	−0.246 (0.40)	−1.690 (2.77)***
	TRD_GDP	0.224 (1.87)*	−0.414 (3.09)***	0.089 (0.51)	−2.907 (2.19)**

Absolute value of z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.
No observations: 137. Note: TRD_GDP, EXP-GDP, and BAL_GDP stand for trade openness, exports, imports and trade balance as a share of GDP; DCPS is domestic credit to the private sector (as share of GDP), FD is the financial development index developed by the IMF.

noteworthy that the impact of the control variables is largely the same whichever measure of financial development is used.

As a robustness check we add to the model some control variables, namely political stability (PS)[10] and government effectiveness (GOVEF)[11] as proxies for governance or measures of government quality (Huang 2010), and a dummy variable for the Eurozone debt crisis (EuroCR) which is equal to 1 over the period 2010–2012 and 0 elsewhere. The two proxies of governance are extracted from the World Governance indicators (WGI-World Bank) in their standard normal units which range from approximately −2.5 to 2.5, with higher values corresponding to better outcomes. The results are displayed in Table 1b.

It can be seen that the inclusion of these control variables does not affect significantly the conclusions previously reached about the trade-finance nexus. Concerning their specific impact, both political stability and government effectiveness are found to have a positive, significant effect on trade, which is not surprising since increase the confidence of entrepreneurs and thus benefit trade; the Eurozone debt crisis has instead a negative impact, but this is significant only for trade openness and imports.

As previously pointed out, the GMM estimation approach tackles the endogeneity and measurement error issues and yields consistent estimates. The results of the Sargan test are reported in Table 1a, b and suggest that the lagged endogenous and explanatory variables chosen for this purpose are valid instruments. Besides, the AR(1) and AR(2) Arellano–Bond test statistics imply that the residuals are not autocorrelated. [12]However, the GMM estimation it is not informative about the short- versus the long-run relationships between the variables. To shed light on both of them we estimate an ARDL model using the PMG estimator due to Pesaran et al. (1999). As a first step, we carry out panel unit root tests as in Levine et al. (LLC, 2002), Harris and Tzavalis (1999) and Breitung (2000). The first two types of tests are based on the assumption of a common panel unit root with identical autocorrelation coefficients, whilst the third one eliminates the potential problem of cross-sectional dependence by subtracting the cross-sectional means. All the test results (not reported) provide evidence that the series of interest are stationary in first differences and therefore can be classified as I(1). We also carry out the cross-section dependence (CD) test developed by Pesaran (2004); the results imply that the errors are in fact independent.[13]

Table 2 displays the estimates obtained used the PMG method which, as previously explained, has been chosen because of its advantages over the MG and DEF ones, and also on the basis of the Hausman test (these statistics are not reported). For simplicity we only focus on the effects of the main variables of interest, i.e. the two proxies for financial development. It appears that in the short run neither measure affects exports, the trade balance or openness. This possibly reflects the fact that the CEEC-6 experienced banking crises and general financial and economic instability during the transition years. However, both proxies for financial development have significant, positive long-run effects on exports and trade openness.

The above results concern the direct effects of financial development on international trade. To analyse its possible indirect effects we include in the regressions an interaction term between each of the two financial proxies and sectoral value added for both agriculture and manufacturing. As before we use the GMM and PMG estimators in turn. The findings when employing the former are displayed in Table 3.

As mentioned previously, the GMM estimator yields consistent estimates, the Sargan test indicating that the selected instruments are valid, and the Aurellano-Bond tests impliying the absence of autocorrelation in the errors.[14] These estimates suggest that the

[10] Political stability and Absence of Violence/Terrorism measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism (WGI-World Bank).

[11] Government effectiveness captures perceptions of the quality of public services, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. (WGI-World Bank).

[12] To deal with the issue of the proliferation of instruments in the context of system GMM estimation (Roodman, 2009a,b) we use the "collapse" option of the xtabond2 command in Stata; this automatically applies the Windmeijer (2005) finite-sample correction for the standard errors in the two-step estimation. The endogenous variables used are RGDPC, FDI, DCPS in Table 1a and RGDPC, FDI, DCPS PS in Table 1b.

[13] Here are a few examples of the computed test statistics for Table 1: 0.77 (p-value 0.44) for equ. 1; 0.39 (p-value 0.69) for equ. 2; 1.3 (p-value 0.18) for equ. 3; 1.2 (p-value 0.19) for equ. 4; etc. The corresponding values for Table 3 are the following: − 0.19 (p-value 0.84) for equ. 1; 1.44 (p-value 0.15) for equ. 2; 0.92 (p-value 0.35) for equ. 3; 1.32 (p-value 0.18) for equ. 4; etc. The complete set of results is available on request.

[14] Again we use the "collapse" option in Stata to limit the proliferation of instruments.

Table 3
The financial development (DCPS × sectoral value added; FD index × sectoral value added) and international trade nexus: GMM results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variable	**TRD_GDP**		**EXP_GDP**		**IMP_GDP**		**BAL_GDP**	
L.	0.835	0.779	0.849	0.794	0.803	0.758	0.784	0.782
	(30.22)***	(26.13)***	(35.71)***	(30.16)***	(25.56)***	(23.13)***	(20.86)***	(20.20)***
FD_AGR	–	0.000	–	0.004	–	−0.005	–	0.001
	–	(0.07)	–	(0.57)	–	(0.59)	–	(0.09)
FD_MNF	–	0.020	–	0.023	–	0.019	–	0.001
	–	(5.99)***	–	(6.01)***	–	(5.43)***	–	(0.21)
DCPS_AGR	0.000	–	0.001	–	0.000	–	−0.000	–
	(0.39)	–	(0.34)	–	(0.28)	–	(0.16)	–
DCPS_MNF	0.003	–	0.002	–	0.002	–	0.000	–
	(4.57)***	–	(4.83)***	–	(3.98)***	–	(0.47)	–
RGDPC	0.020	0.009	0.038	0.042	0.002	−0.031	0.013	0.014
	(1.95)*	(2.19)**	(2.54)**	(1.85)*	(1.93)*	(1.68)*	(1.66)*	(0.69)
FDI	0.002	0.000	0.004	0.002	0.001	−0.000	−0.002	−0.002
	(0.77)	(0.14)	(1.23)	(0.55)	(0.28)	(0.12)	(0.44)	(0.42)
POP	−0.103	−0.130	−0.102	−0.124	−0.111	−0.136	0.017	0.015
	(4.04)***	(4.74)***	(4.11)***	(4.65)***	(3.94)***	(4.51)***	(0.49)	(0.42)
FCR	−0.048	−0.056	−0.035	−0.047	−0.059	−0.064	0.073	0.069
	(3.76)***	(4.47)***	(2.74)***	(3.67)***	(4.30)***	(4.70)***	(3.67)***	(3.47)***
EU	0.044	0.049	0.053	0.058	0.043	0.046	0.027	0.031
	(2.80)***	(3.20)***	(3.33)***	(3.86)***	(2.48)**	(2.71)***	(1.54)	(1.81)*
Constant	0.627	0.962	0.360	0.581	0.740	1.086	−0.124	−0.118
	(2.63)***	(4.60)***	(1.53)	(2.95)***	(2.81)***	(4.65)***	(1.20)	(1.19)
Observations	137	137	137	137	137	137	137	137
Number of un_code	6	6	6	6	6	6	6	6
AR(1)	−4.77 (0.000)	−4.58 (0.000)	−4.64	−4.37	−4.73	−4.64	−4.32	−4.33
			(0.000)	(0.000)		(0.000)	(0.000)	(0.000)
					(0.000)			
AR(2)	0.57 (0.567)	0.52 (0.601)	0.60	0.51	0.54 (0.590)	0.56	0.31 (0.758)	0.31
			(0.547)	(0.611)		(0.578)		(0.753)
Sargan - chi2	267.79 (0.210)	270.88 (0.174)	273.86	271.520.168)	271.67	270.13	272.71	274.95 (0.133)
			(0.144)			(0.182)	(0.154)	
					(0.166)			

Note: TRD_GDP, EXP-GDP, IMP_GDP and BAL_GDP stand for trade openness, exports, imports and trade balance as a share of GDP; RGDPC is real income per capita, FDI is Foreign Direct Investment as a share of GDP, DCPS is domestic credit to the private sector (as share of GDP), FD is the financial development index developed by the IMF, FCR is a dummy equal to 1 during the global financial crisis of 2007–2008 and 0 elsewhere, and EU a dummy for EU membership equal to 1 during the membership period and 0 elsewhere.
Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4
The indirect effect of financial development index on trade in CEEC-6 in long and short run: PMG results.

Dependent Variable	Interactive terms of financial development	Long-run coefficients	Error correction (PHI)	Short-run coefficients (Δ)	Constant
Export (EXP_GDP)	**DCPS × AGR**	0.004 (1.84)*	−0.416 (2.13)**	0.007 (0.71)	2.002 (2.42)**
	DCPS × MNF	0.006 (1.97)*		0.003 (1.28)	
	FD × AGR	0.071 (2.01)**	−0.253 (2.25)**	0.154 (0.96)	2.101 (2.20)**
	FD × MNF	0.188 (24.27)**		−0.028 (1.21)	
Trade balance (BAL_GDP)	**DCPS × AGR**	−0.0003 (0.10)	−0.433 (5.27)***	0.006 (1.63)	−0.512 (5.09)
	DCPS × MNF	0.001 (1.13)		−0.002 (1.01)	***
	FD × AGR	0.001 (0.01)	−0.388 (3.61)***	0.043 (1.80)	−1.351 (3.69)
	FD × MNF	0.014 (0.90)		−0.012 (0.76)	***
Trade (TRD_GDP)	**DCPS × AGR**	0.003 (1.95)*	−0.455 (2.31)**	0.004 (0.47)	3.293 (2.16)**
	DCPS × MNF	0.004 (2.16)**		0.0038 (1.31)	
	FD × AGR	0.067 (2.49)**	−0.473 (2.99)***	0.114 (0.78)	0.004 (0.02)
	FD × MNF	0.101 (2.32)**		−0.028 (1.26)	

Absolute value of z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant 1%. No observations: 137.
Note: TRD_GDP, EXP-GDP, and BAL_GDP stand for trade openness, exports, imports and trade balance as a share of GDP; DCPS is domestic credit to the private sector (as share of GDP), FD is the financial development index developed by the IMF.

interaction term between financial development and manufacturing has a positive impact on trade, whilst there is no significant effect in the case of agriculture. This is hardly surprising, since one would expect countries with a sizeable manufacturing sector to have higher exports and trade flows: in a well-developed financial system the cost of capital is lower, which increases returns more

Table 5a
Panel Granger causality test results.

Null Hypothesis	coefficient	Z	Prob > z
Financial Development index (FD)			
TRD_GDP does not Granger-cause FD		2.06	0.027
	0.00999**		
FD does not Granger-cause TRD_GDP		4.40	0.000
	0.57560***		
EXP_GDP does not Granger-cause FD		4.20	0.040
	0.02944**		
FD does not Granger-cause EXP_GDP		3.70	0.000
	0.2694***		
IMP_GDP does not Granger-cause FD		1.20	0.229
	0.08045		
FD does not Granger-cause IMP_GDP		2.14	0.030
	0.14207**		
Domestic credit to private sector (DCPS)			
TRD_GDP does not Granger-cause DCPS		2.67	0.008
	0.13636***		
DCPS does not Granger-cause TRD_GDP		2.27	0.023
	0.14927**		
EXP_GDP does not Granger-cause DCPS		2.20	0.028
	0.25650**		
DCPS does not Granger-cause EXP_GDP		3.67	0.004
	0.03294***		
IMP_GDP does not Granger-cause DCPS		3.44	0.001
	0.29322***		
DCPS does not Granger-cause IMP_GDP		4.09	0.000
	0.08766***		

Absolute value of z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%.

significantly for the manufacturing sector than for agriculture, because of the higher level of external finance and physical capital characterising the former.

Table 4 displays both the short- and long-run estimates from the ARDL model. These results confirm that the indirect effects are more pronounced in the case of the manufacturing sector, which benefits more than the agricultural one from a higher level of financial development, as already explained. This leads in the long run to an increase in the share of manufacturing exports in total trade as a well-developed financial system translates into a comparative advantage for this sector. This finding is consistent with standard theory suggesting that a more efficient financial system will increase exports in long run, especially in the case of finance intensive sectors. Finally, we find also evidence of positive effects of the interaction terms on trade openness, which leads to greater economic integration in the international markets. Our results differ from those reported by Sare et al. (2019), who analyse a sample of developing (low or lower-middle income) African countries with very different features (economic growth, trade, and financial development) compared to the CEEC-6 we examine, the latter having completed their transition to the developed stage (and now being high or upper-middle income countries). In particular, we find that both our financial development measures have an indirect positive long-run effect not only on manufacturing, but also on agriculture, whilst Sare et al. (2019) estimate a corresponding negative impact of domestic credit on the latter sector.

To sum up, it is clear that the level of financial development matters (both directly and indirectly) for international trade in the case of the CEEC-6, especially in the case of manufacturing. This conclusion is supported by the results obtained with both estimations methods (GMM and PMG), and the estimated positive effect is more sizeable when the IMF proxy is used for the analysis.

Finally, we conduct Granger panel causality tests to allow for the possibility of bidirectional causality (i.e., also running from financial development to trade). Specifically, we implement a new test recently developed by Juodis et al., (2021) for the null hypothesis of no Granger causality, which is valid regardless of whether the model coefficients are homogeneous or heterogeneous.[15] This method has superior size and power performance compared to other tests, since it is based on a pooled estimator with a faster $\sqrt{NT}$ convergence rate, and is appropriate for multivariate systems. To carry out these tests, in addition to DCPS and FD, we also use in turn each of the two main sub-components of the FD index, namely financial institutions and financial markets; in this way we shed additional light on the linkages between finance and trade, since the FD composite index, whilst comprehensive, has the disadvantage of not being informative about the specific role played by institutions and market participants respectively. The Panel Granger-causality results are presented in Tables 5a and 5b below.

The results for both DCPS and FD (see Table 5a) imply statistically significant causality running from financial development to trade openness, exports and imports; there is also evidence of causality from trade to finance, more precisely from both exports and trade openness to DCPS and FD, whilst imports do not appear to Granger-cause FD. As for the role played by the two main

[15] The *Xtgranger* command in Stata implements the panel Granger non-causality test developed by Juodis et al. (2021).

Table 5b
Panel Granger causality test results (Financial Markets and Financial Institutions indices).

Null Hypothesis	coefficient	Z	Prob > z
FI (Financial Institutions index)			
TRD-GDP does not Granger-cause FI		2.03	0.044
	0.01615**		
FI does not Granger-cause TRD-GDP		4.46	0.000
	0.49372***		
EXP-GDP does not Granger-cause FI		2.36	0 028
	0.11147**		
FI does not Granger-cause EXP-GDP		4.00	0.000
	0.21099***		
IMP-GDP does not Granger-cause FI		3.31	0.001
	0.27388***		
FI does not Granger-cause IMP-GDP		4.29	0.000
	0.24188***		
FM (Financial Markets index)			
TRD-GDP does not Granger-cause FM		−3.50	0.000
	−0.08513***		
FM does not Granger-cause TRD-GDP		1.11	0.267
	0.15085		
EXP-GDP does not Granger-cause FM		−4.88	0.000
	−0.20787***		
FM does not Granger-cause EXP-GDP		0.75	0.453
	0.05957		
IMP-GDP does not Granger-cause FM		−2.92	0.003
	−0.15188***		
FM does not Granger-cause IMP-GDP		−0.11	0.912
	−0.00760		

Absolute value of z statistics in parenthesis; * significant at 10%; ** significant at 5%; *** significant at 1%.

subcomponents of FD index, the results (see Table 5b) indicate bidirectional causality between financial institutions and exports as well as trade openness and imports, and unidirectional causality from trade openness, exports and imports trade to financial markets, possibly reflecting the fact that the latter are still less developed than in the core EU countries. By contrast, FM is not found to Granger-cause trade openness, exports and imports.

To sum up, international trade and financial development interact with each other. More precisely, there is evidence of reverse causality running in particular from exports and trade openness to both measures of financial development. However, as previously mentioned, the dynamic panel estimators we have used weaken the exogeneity assumption for a subset of regressors, thereby providing consistent estimates even if reverse causality is present, and thus the fact that Granger causality is found in both directions does not affect the validity of our previous results.

5. Conclusions

The aim of this paper has been to explore the linkages between finance and trade in the case of the CEEC-6 using dynamic panel approaches (namely, the system GMM and PMG estimators). More precisely, we have investigated the direct effects of financial development on trade flows, trade balance and trade openness, and also the indirect ones through its interaction with sectoral value added in manufacturing and agriculture. Our key finding is that there exists a positive and significant direct impact of both the financial proxies for financial development used in the analysis on exports and trade openness. This is consistent with theory, which implies that a higher level of financial development should increase exports, especially for sectors with increasing return to scale, and accelerate integration into the international markets.

Concerning the indirect impact of finance on trade via sectoral value added, our results indicate that in the long run the interaction terms between the financial indicators and value added in manufacturing and agriculture have a significant and positive impact on trade, which is more sizeable in the case of the former sector. Thus, a more developed financial system will not only increase the production share of manufactured goods, but also their export share in total trade by producing a comparative advantage for this sector, and will also lead to greater trade openness; in addition, the agriculture sector in long run benefits from higher investment in new technologies. Interestingly, panel Granger causality tests suggest that causality is in fact bidirectional, i.e. it also runs from trade to finance. Future work could further investigate this issue and also extend the analysis to other European countries as well as other sectors such as services or industry value added (as a share of GDP) to gain additional insights.

It is noteworthy that, although the CEEC-6 have already experienced structural changes and implemented comprehensive reforms, economic and monetary integration is still ongoing and catching up with the high-income countries of Western Europe to meet the requirements for joining the eurozone remains a goal yet to be achieved. Our findings represent clear evidence that specific country characteristics such as the income level and financial institutions have affected the finance-trade nexus in the case of the CEEC-6. Despite the transition process they underwent, their financial systems are still undeveloped in comparison to those of the Western countries, and authorities has to continue further reforms. Given the evidence concerning the impact of financial development on trade

(both directly and indirectly) provided by our analysis, financial reforms should be at the core of the policy agenda in these countries so as to increase competitiveness and trade thereby fostering economic growth: it appears that the CEEC-6 can benefit in terms of trade flows from further developing their financial systems,.

Despite the absence of short-run linkages, financial development boosts trade in the long run, where the role of finance is to mobilise savings to remove liquidity constraints and lower the cost of capital, which increases competitiveness. Specifically, the CEEC-6 can benefit from focusing on finance intensive exporting sectors with increasing returns to scale in addition to further developing their financial systems; despite the differences between these economies, such policies should be pursued by these countries with the aim of achieving sustainable economic growth. Finally, financial reforms should be accompanied by other types to support innovation, productivity and diversification of production and deal with the new challenges posed by digitalisation and the need for green energy.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

See Tables A1-A2.

Table A1
IMF financial development index.

Financial Development (FD) index is a relative ranking of countries on the depth, access and efficiency of their financial institutions and financial markets. It is an aggregate of Financial Institutions index and the Financial Markets Index.

Financial Institutions index (FI) is an aggregate of:

- *Financial Institutions Depth index (FID)* which compiles data on bank credit to private sector in percent of GDP, pension fund assets to GDP, mutual fund assets to GDP and insurance premiums life and non-life to GDP.
- *Financial Institutions Access index (FIA)* which compiles data on bank branches per 100.000 adults and ATMs per 100.000 adults.
- *Financial Institutions Efficiency index (FIE)* which compiles data on bank banking sector net interest margin, lending-deposits spread, non-interest income to total income, overhead costs to total assets, return on assets and return on equity

Financial Markets index (FM) is an aggregate of:

- *Financial Markets Depth index (FMD)* which compiles data on stock market capitalization to GDP, stocks traded to GDP, international debt securities of government to GDP, total debt securities of financial corporations to GDP, total debt securities of non-financial corporations to GDP.
- *Financial Markets Access index (FMA)* which compiles data on percent of market capitalization outside of top 10 largest companies and total number issuers of debt (domestic and external, non-financial and financial corporations)
- *Financial Markets Efficiency index (FME)* which compiles data on stock market turnover ratio (stocks traded to capitalization).

Source: see Svirydzenka (2016).

Table A2
List of variables.

Code	Nom	Source
$ITRDI_{i,t}^{s}$	international trade as a share of GDP	World Bank-World Development Indicators (WDI)
EXP_GDP	Export of good and services as a share of GDP	World Bank-World Development Indicators (WDI)
IMP_GDP	Import of good and services as a share of GDP	World Bank-World Development Indicators (WDI)
BAL_GDP	Trade balance as a share of GDP	Authors' calculation using Comtrade database
TRD_GDP	Trade Openness as a share of GDP	World Bank-World Development Indicators (WDI)
FD	Financial Development Index	IMF database
DCPS	Domestic credit to the private sector (as a share of GDP)	World Bank-World Development Indicators (WDI)
RGDPC	Real income per capita, (current international $)	World Bank-World Development Indicators (WDI)
FDI	Foreign Direct Investment, net inflows (as a share of GDP)	World Bank-World Development Indicators (WDI)
POP	Total population	World Bank-World Development Indicators (WDI)
AGR	Agriculture, forestry and fishing value added (as a share of GDP)	World Bank-World Development Indicators (WDI)
MNF	Manufacturing value added (as a share of GDP)	World Bank-World Development Indicators (WDI)
PS	Political Stability index	World Bank-World Governance Indicators (WGI)
GOVEF	Government effectiveness index	World Bank-World Governance Indicators (WGI))

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