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Research article

Is financial development good for economic growth? Empirical insights from emerging European countries

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Abstract: The impact of financial development on economic growth has been extensively debated in the literature since the seminal paper of Schumpeter (1934) considering finance as an engine of economic growth through its effects on innovative investments. However, recent empirical literature casts some doubts on this relationship and repcorts a minor role of financial development in driving economic growth or the existence of a non-monotone linkage between financial development and economic growth. The paper investigates empirically this relationship for 11 Emerging European Countries (EEU) on the period 1995–2016 by using dynamic panel models (such as the Pooled Mean Group estimator of Pesaran et al. 1999). The findings, when imposing a linear relationship, suggest that financial development produces positive effects on economic growth only in the short-run horizon (validating the supply leading channel). When studying the hypothesis of non-linearities related to the finance-growth nexus, the relationship has an inverted U-shaped form (financial development exerts a positive effect on economic activity until a certain threshold and after that, the link becomes negative). The non-linearity hypothesis is true only for the domestic credit to private sector variable. In terms of policy implications, the governments should focus on efficient investment projects to improve economic growth and to efficiently expand the banking sector.

Keywords: financial development; economic growth; (non) linear dynamic panel models; Fieller and Delta confidence intervals; emerging European countries

JEL Codes: O40, E44, E58, F36, P26

1. Introduction

Does financial development stimulate economic growth or does economic growth drive financial development? This controversial issue has been extensively debated in the literature since the seminal paper of Schumpeter (1934) considering finance as an engine of economic growth through its effects on innovative investments. According to Valickova et al. (2015), most studies find a positive and statistically significant effect of financial development on economic growth, which is lower in less developed countries (e.g., Gurley and Shaw (1955), McKinnon (1973) and Shaw (1973), Harvey (1989), King and Levine (1993), Levine (1997, 2005), Beck and Levine (2004); Beck et al. (2013), Fang (2019)). Their findings also report that stock markets foster GDP growth to a greater extent compared to other financial intermediaries. However, to this finding, opposing views were advanced: Robinson (1952) argues that the demand for financial services follows economic growth while Lucas (1988) highlights the overstressed role of finance in the existing literature. Differently, Patrick (1966) thinks that the instability of this relationship is influenced by the stage of development of the country: at the initial stage, financial development involves economic growth while as real growth emerges in the economy this link becomes less significant and growth starts to boost the demand for financial services. Due to the diversity of these points of view, Patrick (1966) formulates four hypotheses: the supply-leading hypothesis (finance accelerates economic growth), the demand-following hypothesis (economic growth drives finance), the feed-back hypothesis (the two dimensions are interdependent) and the neutrality hypothesis (no causal linkage between finance and economic growth). Furthermore, the contributions to the endogenous growth theory (Lucas, 1988; Romer, 1986) involved increasing interest for the role of financial development in promoting economic growth (Bencivenga and Smith, 1991; Barro and Sala-i-Martin, 1992, King and Levine, 1993 and so on).

Given the difficulty to determine the direction of the relationship between finance and economic growth at a theoretical level, the majority of the recent studies focused on the empirical facets of this relationship. Goldsmith's paper (1969) was the first empirical study founding evidence in favour of a positive relationship between financial development and economic growth. Other empirical studies followed to confirm this positive linkage between finance and growth such as: King and Levine (1993), Levine and Zervos (1996), Demetriades and Hussein (1996), Beck et al. (2000), Rioja and Valev (2004), Campos and Kinoshita (2008) etc. Recently, Fang (2019) explores the impact of financial development on economic growth for middle-income countries by adopting an original approach. By using a mix of methods drawn from the previous empirical literature (King and Levine, 1993; Levine and Zervos, 1998; Rousseau and Wachtel, 2000, 2002; Xu, 2000) and by augmenting them with new measures and relations of financial development, he find some interesting results: i) financial development affects significantly economic growth through channels of physical capital stock and total factor productivity, ii) there is Granger causality between equity market development and economic growth in middle-income countries whilst reverse causality between economic growth and equity market expansion in high income countries and iii) a feed-back relationship between banking system development and inflation. Differently, based on an Autoregressive Distributed Lag (ARDL) bound testing and on a nonlinear Autoregressive Distributed Lagged (NARDL) for the 1974Q1 to 2016Q4 period, Md and Wei (2018) question the same relationship for Asian countries and find an asymmetric linkage between financial innovation, banking sector expansion and economic growth. The feedback

hypothesis between financial innovation and economic growth, and banking sector development and economic growth both in short and long run is also supported by their estimations. While these two recent studies support the existence of a relationship between financial sector and economic growth, Opoku et al. (2019) find strong support for the neutrality hypothesis (no link between these two dimensions) by using a frequency-domain spectral causality approach for 47 African countries over the period 1980–2016.

Rather than questioning the existence of a linear relationship between financial sector and real sector, another recent group of studies cast doubts on such results and report a non-monotone linkage between finance and economic growth (Arcand et al., 2015); Ductor and Grechyna, 2015; Md and Wei (2018): finance definitely accelerates economic growth to a threshold, but, after that, this positive effect vanishes. The inverted U-shape relation between financial development and economic growth is also found for a panel of 52 middle-income countries (Samargandi et al., 2015), suggesting that too much finance may negatively impact growth. The finding is in line with those obtained by Deidda and Fattouh (2002) in the case of 119 developed and developing countries by using cross-section methods, Rioja and Valev (2004) for 74 advanced and developing by employing panel data, Huang and Lin (2009) for a sample of 71 high-and low-income countries by using threshold methods as Cechetti and Kharroubi (2012). In this regard, Ductor and Grechyna (2015) argue that a positive effect of financial development on economic growth should be conditioned by a corresponding growth in the real sector; in the case where the real sector drags behind, financial development may trigger economic growth deceleration.

To capture the various dimensions of financial development, the empirical literature employs different indicators. For the financial depth and banking development, the most used indicator is the domestic credit to private sector. Alternative measures are monetary indicators as M2/GDP (Anwar and Cooray, 2012) or M3/GDP. However, the M2 indicator is used less frequently in the empirical studies. The literature considers that this financial indicator is a poor proxy for financial development of countries with an underdeveloped financial system because it mostly measures the capacity of the financial system to provide transaction services rather than to channel savings to investors (Khan and Senhadji, 2003). Conversely, M3 is considered a less liquid monetary aggregate and, therefore, more reliable for financial development (Beck et al., 2000; Samargandi et al., 2015). The stock market capitalization ratio and the liquid liabilities to GDP ratios are among the two indicators used to measure the size of the financial sector. Finally, the interest rate margin (computed as the difference between deposit and lending rates in the banking sector) is often employed to appraise the efficiency of the financial sector. The current paper includes two financial development measures allowing for the effect of financial development on economic growth: the domestic credit to private sector as a share of GDP (the most widely used indicator for financial development) and the financial development index by IMF. These two choices are also guided by the availability of the data on the selected period, for all countries of our panel.

After the fall of the Berlin wall, Emerging European countries putted in place many reforms to build an efficient market mechanism. By reorganizing production and reallocation of resources, the expectation was to provide better incentives, less waste, and finally, economic prosperity. During the transition process, these countries have also rethought their financial systems by deregulating the banking industry at the national level and opening up financial markets to foreign competition. Consequently, many borders breached down such as those between banks and non-bank financial institutions, financial products, and the geographical positions of financial institutions. All these

changes (the founding of many new institutions, privatisation of state-owned banks, mergers and consolidation, the spread of information technology, and a significant increase in the presence of foreign banks) generated growing competitive pressures on banks in the emerging economies, led to deep changes in the structure of the banking industry and on the real sector as well. The accession to the European Union (EU) accelerated the banking reform process and helped for the development of their financial systems. However, despite these positive developments, real convergence in terms of real GDP per capita is still challenging. Hence, questioning whether financial markets have a positive impact on economic growth is key in appraising the success of the previous policy efforts.

The number of empirical studies exploring this topic in the case of EEU is scarce (may be because the lack of data for greater time horizons). The present paper aims to fill this gap by empirically investigating the finance-growth nexus for 11 Emerging European Union Countries (EEU) over the period 1995–2016. It contributes to the existing empirical literature in the following ways. Firstly, the paper employs relatively recent econometric methods: the dynamic panel heterogeneity method of Pesaran et al. (1999) which was applied for the first time to the finance-growth nexus by Loayza and Roncière (2006) for the advanced economies, in particular. Based on the autoregressive distributed lag (ARDL) specification, this method allows exploring both the long-and short-run effects of financial intermediation on economic growth. By assuming that intercept, slope coefficient and error variance can vary across countries; it also tackles heterogeneity among cross-section units of the panel. A candidate panel specification would be the Mean Group (MG) estimator by Pesaran and Smith (1995) where the assumption that a number of economic conditions may be the same across countries in the long run is disregarded. The efficiency gain of PMG model comes from the assumption of heterogeneous short-run dynamics and identical long-run coefficient across countries. A second alternative to PMG would be the Dynamic Fixed Effects estimator (DFE) in which the slope coefficient and error variances are equal across countries in the long-run (as in the PMG model). In the DFE model, the speed of adjustment coefficient and short-run coefficients are similar too. Consequently, the model could be subject to a simultaneous equation bias due to the endogeneity between the error term and the lagged dependent variable for small sample size (Baltagi et al., 2000). At the opposite side, the PMG model is robust to the choice of lag orders and seems to be consistent and efficient even in the presence of endogenous and non-stationary regressors (Pesaran et al., 1999). To the best of my knowledge, the PMG method was never applied for EEU when studying finance-growth nexus.

Secondly, the paper focuses on a panel composed by 11 developing EU countries (some countries panel have meanwhile become members of the eurozone). Most part of the previous empirical literature have focused on the finance-growth nexus in advanced economies because of the nature and the importance of their financial markets, and frequently reported a positive and significant effect of finance on economic growth. But, not much is known regarding the relationship between financial development and growth in the case of middle-income countries of Emerging Europe whose financial system are characterized by lower levels of financial intermediation than those of advanced economies (see Caporale et al., 2009).

Thirdly, the paper aims to additionally consider the recent empirical line of reasoning of Arcand et al. (2015) or Ductor and Grechyna (2015) pointing out the existence of a non-monotone relation between finance and economic growth: finance accelerates growth to a threshold, but, after that, this positive effect vanishes. The resulting inverted U-shape relation between financial development and

economic growth is captured by integrating a quadratic term into the benchmark equation and tested for its significance. To better identify the turning point and its confidence intervals (for the ratio of normally distributed statistics), the paper follows two ways: the classical Delta method or alternatively, the Fieller approach for the approximation of the confidence interval. Many papers have compared these approximations and found that they coincide for cases when the denominator variable is estimated with a low relative variance. However, in some cases the Fieller has been shown superior coverage (see Hirschberg and Lye (2010) and Bernard et al. (2019) for parameter ratios obtained from dynamic panel data models). For robustness purposes, the study estimates the finance-growth nexus by using a new measure of financial development build by IMF, the financial development index. This index embodies the complex multidimensional nature of financial development. It outlines how developed financial institutions and markets are in terms of their depth (size and liquidity), access (ability of companies and households to access financial services) and efficiency (the ability of financial system to offer financial services at low costs and with sustainable revenues).

The estimation results could be synthetized as follows: When imposing a linear relation between financial development and economic growth, it can be observed a positive effect between these two variables only in the short-run horizon (which validates the supply-leading channel). In the long-run, outcomes indicate unclear impact of financial development on economic growth in almost all specifications. When models integrate a quadratic term of financial development to appraise the non-monotone linkage between financial development and economic growth, the study suggests that the relationship between financial development and economic growth need not be linear, either in the long- and-short-run. In other words, this outcome supports the "Too Much Finance" approach of Arcand et al. (2015) and Ductor and Grechyna (2015) arguing that the marginal effect of financial development on GDP growth process may be positive until a certain threshold, and then, it becomes damaging. The robustness checks is conducted by studying the confidence intervals from Delta and Fieller methods and the turning point based on these methods, too. The first one, suits asymptotically normal panel data estimators, provided underlying regularity conditions prevail. The second one, supposes asymmetrical confidence intervals and, according to the very recent empirical literature (Bernard et al., 2019), it is superior to the application of the Delta method in dynamic panel regressions such as the Pooled Mean Group (PMG) estimator. The paper show that the estimated confidence intervals are globally robust with both methods.

The reminder of the paper is structured as follows. The next section presents a brief review of the literature on the EEU countries. The section 3 presents data and methodology on the pooled mean group estimator (PMG). The section 4 is dedicated to the presentation of the results. The last section concludes.

2. The literature review on emerging European countries

As pointed out in the introduction, the relationship between financial development and economic growth has been an active research area at both theoretical and empirical levels. The empirical studies are abundant and were often based on times series analysis, static panel data methods, cross-country growth regressions and industry and firm-level analysis (e.g., Goldsmith's seminal paper (1969), King and Levine (1993), Levine and Zervos (1996), Demetriades and Hussein (1996), Beck et al., (2000); Arestis et al. (2001), Rioja and Valev (2004), Jacquet and Pollin (2012), Campos and Kinoshita (2008),

Arcand et al. (2015); Campos and Dercon (2014), Samargandi et al. (2015), Ductor and Grechyna (2015), Valickova et al. (2015)).

The literature exploring the link between financial development and economic growth in the case of Emerging European countries counts a handful of studies. Hermes and Lensink (2000) outline the role of stock markets in the process of financial intermediation and of the deposit insurance in improving the quality of the banking system. In the same vein, Bonin and Wachtel (2003) provide an analytical study about the effectiveness of financial sector in Central and Eastern European Countries during the transition period and point out the significant progresses in the development of this sector. Their outcomes suggest that Hungarian banking system development is more pronounced than in other countries (such as Poland, Czech Republic, Bulgaria and Croatia) where the participation of foreign strategic investors in banking did not attaint same standards, and consequently, did not affect in the same way the economic activity. On the other hand, the institutional development was not the first financial sector priority during the transition period for the most part of these countries. Using the domestic credit du GDP ratio as a financial indicator, Berglof and Bolton (2003) show little evidence on that financial development stimulates economic growth in the transition countries. Their results also indicate that financial expansion has generate in some countries, soft budget constraints and undermined growth. Fiscal and monetary discipline, at the macro level, and contract enforcement, at the micro level seem to be among factors that affect the finance-growth link. Hermes and Lensink (2003) investigate the importance of financial development in enhancing the link between FDI and economic growth in the case of 67 countries (especially, Latin America and Asia countries). Countries with developed financial system allow FDI to positively contribute to economic growth. Based on cointegration methods, Kenourgios and Samitas (2007) investigate the long-run relation between finance and economic growth for Poland by employing quarterly data from 1994:Q1 to 2004:Q4. Their findings reveal that, in the long run, credits to the private sector have been one of the main forces in Polish economic growth. Fink et al. (2009) investigate the effect of financial sector segments at different stages of development over the period 1996–2000, for nine EU countries. Their findings suggest that transfer mechanisms are not the same over the development cycle (from bond markets to labour participation) and that financial market segments connected to the public sector (but, not stock markets) affect positively economic growth and stability in the transition economies. Zdzienicka (2011) focuses on the credit market of eleven European transition economies in the aftermath of the 2008 global financial crisis. By using filtering methods and dynamic panel models, she finds that the countries with a larger and more protracted excessive credit before the 2018 crises, have experienced the largest credit contraction. Adarov and Tchaidze (2011) analyse the financial markets of four emerging European countries (Poland, Czech Republic, Hungary and Slovakia) by including in the estimations four financial indicators: domestic credit to private sector, private bond market capitalization and stock market capitalization on the period 1994–2008. Their outcomes show evidence that EU4 countries are significantly shallower than what one would expect given their stage of economic development and controlling for different other macroeconomic variables. One possible explanation would be the underdevelopment of institutions and the access to external funding which discourage, to some extent, the development of their financial markets. Also, better results are obtained in the case of the equity and the private credit markets. Based on a dynamic panel model over the period 1994–2007, Caporale et al. (2009) find that credit and stock markets are still underdeveloped

in the economies of ten new EU Members, and that their contribution to economic growth is constrained by a lack of financial depth. Furthermore, they emphasize that a more efficient banking system stimulates economic growth of these economies. Using cointegration methods (such as FOLS and DOLS models) on the period 1995–2014 for 16 South-Eastern and Central European Countries, Stojkoski and Popova (2016) find a statistically significant and positive effect of financial development (M2/GDP ratio) on economic growth. Kilinc et al. (2017) explore whether the banking and the stock market measures among EU countries have been subject to a convergence process to verify the degree of integration of financial markets. Their results favour an accelerated integration of financial markets rather than a slowdown in this integration process. Finally, Asanovic (2020) provide an analytical presentation of the finance-growth nexus and argue that there is still enough room for finance to contribute to economic growth in Southeast European Countries.

Based on this succinct overview of the empirical literature and of the theoretical approaches on the relationship between financial development and economic growth, the paper formulates two main hypothesis that will be tested in next sections:

H1: The financial development may have positive or negative effects on economic growth

H2: The relationship between finance and economic growth can be also non-monotone: finance accelerates growth to a threshold, but, after that, this positive effect vanishes.

3. Data and methodology

3.1. Empirical method

To study the relationship between financial development and economic growth, I employ the linear Pooled Mean Group (PMG) estimator for heterogeneous dynamic panels developed by Pesaran et al. (1999). This model is likely to provide better consistent results than traditional dynamic panel models such as Arrelano and Bond (1991) for some reasons: data cover a small number of countries (N = 11 countries) compared to the selected period (T = 22 years), a longer time interval means an increasing number of instruments that may affect the validity of the Sargan test, and thus, the null hypothesis of instrument exogeneity, the GMM captures only the short-term dynamics of the data.

The PMG model is written as follows for the periods t = 1, 2,..,T and the countries i = 1, 2,..,N:

$$lnGDP_{it} = \mu_i + \sum_{j=1}^{p} \Lambda_{ij} lnGDP_{i,t-j} + \sum_{j=0}^{q} \gamma_{ij} lnX_{i,t-j} + \varepsilon_{it} \quad (1)$$

where the dependent variable GDP is the real GDP per capita growth (GDP_{it}) and X_{it} is the vector of our explanatory variables having the dimension k × 1 (it includes variables such as: the trade openness variable (TO_{it}), the fixed brut capital formation (Inv_{it}), the population growth (POP_{it}), the domestic credit to private sector (DC_{it}), the initial level of GDP per capita ($GDP\ initial_{it}$), the financial development (FD_{it}), the school enrolment ratio ($School_{it}$), the inflation (Inf_{it}), country fixed effects, Λ_{ij}'s are the lag coefficients of the dependent variable, γ_{ij}'s are the coefficients of the explicative variables. Thus, the Equation (1) is:

$$\Delta lnGDP_{it} = \varphi_i \left[lnGDP_{i,t-1} - \theta_i ln\ GDP_{i,t-1}\right] + \sum_{j=1}^{p-1} \Lambda'_{ij} \Delta lnGDP_{i,t-j} +$$

$$+ \sum_{\mathrm{j}=0}^{\mathrm{q}-1} \gamma'_{ij} \Delta lnX_{i,t-j} + u_{it} \quad (2)$$

where u_{it} are the errors independently distributed for the country *i* and the time *t*, zero mean and the variance $\sigma_i^2 > 0$.

$$\varphi_i = -\left(1 - \sum_{\mathrm{j}=1}^{\mathrm{p}} \Lambda_{\mathrm{ij}}\right);\ \theta_i = \frac{\sum_{j=0}^{q} \gamma_{ij}}{1 - \sum_k \Lambda_{ik}};\ \Lambda'_{ij} = -\sum_{m=j+1}^{p} \Lambda_{i,m};\ \mathrm{j} = 1,2,\ldots,\ \mathrm{p} - 1 \quad (3)$$

$$\text{and } \gamma'_{ij} = -\sum_{m=j+1}^{q} \gamma_{i,m} \text{ with } \mathrm{j} = 1, 2,\ldots,\ \mathrm{q} - 1 \quad (4)$$

The PMG (2) model identifies to forms of causality in the panel data: a short-term causality by testing the significance of the coefficients related to the lagged differences of the economic variables (Λ'_{ij} and γ'_{ij} in the Equation (2)) and a long-term causality measured by the speed of adjustment coefficient (the error correction term (φ_i) which must have a negative sign to see explanatory variables converging to a long-run equilibrium. There are two other candidates' models for the PMG: the Mean Group estimator (MG) and the Dynamic Fixed effects estimator (DFE). The efficiency gain between these three models is given by the well-known Hausman test. In the paper, these alternative models will be tested only for the benchmark model.

3.2. Data and variables

The study considers for both, time and cross-country variation in the data. The data sample covers 11 EEC countries including Bulgaria, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. I employ yearly data over the period 1995–2016. In the estimated models the dependent variable is economic growth measured as the growth of real per capita GDP. The vector of independent variables includes the initial real GDP per capita (for the tendency of economic growth rates to converge across countries over time), the gross fixed capital formation (for the investment in physical capital), the trade openness to GDP (for the impact of the international factors on economic growth), the population growth (as a proxy for the growth of labour force), the government expenditure as a share of GDP (for the various effects of public spending and taxation), the inflation based on consumer prices (to appraise the stability of the macroeconomic and business conditions) and the secondary school enrolment ratio (as proxy for human capital). The *initial level of GDP per capita* is measured by the value of GDP per capita every five years and aims to capture the convergence process highlighted by Solow (1956). Countries with a lower initial capital stock per head (or similarly, a lower initial level of production per capita) grow faster than countries with having a higher capital stock per head. The expected sign of this variable is therefore negative as suggested by the literature. To all these explanatory variables, two measures of financial development are added: the domestic credit to private sector and the financial development index. The second measure of financial development is provided by IMF database and explains the characteristics of the financial systems in terms of the depth (size and liquidity), access (ability of companies and individuals to access financial services) and efficiency (the ability of financial institutions to provide financial services at low costs and with sustainable revenues). However, it does not consider their underlying drivers (the

institutional, regulatory, and legal frameworks) or outcomes (financial stability measures). Furthermore, as highlighted by IMF, a higher FD ranking may not necessarily be a good thing, but may instead show that a country's financial system is expanded beyond it structural and regulatory capabilities, with negative repercussions for growth and stability (IMF, 2020). All models use variables converted in natural logarithms. Accordingly, each estimated coefficient should be read as a constant elasticity of the dependent variable with respect to the independent variable. Data are provided by World Bank Development Indicators, Unesco and Eurostat databases.

Table 1 displays the matrix correlation of explanatory variables. It shows that school enrolment ratio and inflation are relatively highly correlated (−0.54) as well as the initial level of GDP per capita with the trade openness variable (0.59). Consequently, these variables enter alternatively into the estimates.

Table 1. Matrix correlation of explanatory variables.

	Initial GDP	Inv	GOVEX	TO	Inf	POP	School	FD	DC
Initial GDP	1								
Inv	0.28	1							
GOVEX	0.18	0.07	1						
TO	*0.59*	0.18	0.22	1					
Inf	−0.48	−0.02	−0.13	−0.40	1				
POP	0.50	0.15	0.07	0.16	−0.08	1			
School	0.50	−0.04	−0.06	0.44	−0.53	−0.05	1		
FD	0.42	−0.01	0.01	0.22	−0.30	0.33	0.36	1	
DC	0.29	0.20	0.17	0.34	−0.31	−0.04	0.34	0.10	1

Note: Initial GDP is the initial GDP per capita, Inv—Gross fixed capital formation, GOVEX—Government expenditure, TO—trade openness, Inf—inflation, POP—population growth, School—secondary school enrolment ratio, FD—Financial development index and DC—domestic credit to private sector.

Table 2 provides some descriptive statistics of our dependent and explanatory variables. Looking at the financial variables, it can be observed that the mean of domestic credit to private sector (% GDP) is 49.35% with a maximum of 168.84 % for Latvia, during the transition period.

The expansion of credit has been a characteristic of transition economies, foreign bank being the main channel of credit for these countries. From the Figure 2, it can be observed the evolution of the banking system credit to the private sector which is still a relevant component of financial development. It has a weight between 0.19% and 168.8% reflecting the role of banks in many financial systems; But, it is far from being the most significant financial driver in all selected emerging EU countries. The most important level of domestic credit to private sector can be identified in the case of Baltic Countries such as Estonia and Latvia, during the studied period.

The second measure of financial sector, the financial development index, has a mean equal to 0.32. From the Figure 1, it can be observed that some emerging countries, such as Bulgaria, Hungary, Czech Rep., Poland and Croatia have higher levels of financial development (higher than 0.32) than other countries such as Estonia, Romania, Slovakia and Slovenia (lower than 0.32) suggesting that foreign banking sources were more active in the first group of countries.

Table 2. Summary descriptive statistics of explanatory variables.

	Nb. Obs	Mean	Std. Dev.	Min	Max
GDP	242	12265.84	5009.36	3756.751	25447.43
Initial GDP	242	11431.54	4921.36	3781.90	23735.24
Inv	242	23.92	4.85	4.49	37.29
Gov. Exp.	242	19.01	2.36	11.68	25.88
TO	242	108.55	33.84	43.68	183.99
Inf	242	11.85	69.22	−1.55	154.76
POP	242	−0.42	0.61	−3.85	0.91
School	242	53.88	18.2	13.39	89.25
FD	242	0.32	0.11	0.10	0.58
DC	242	49.35	23.31	0.19	168.84

Note: author's computation.

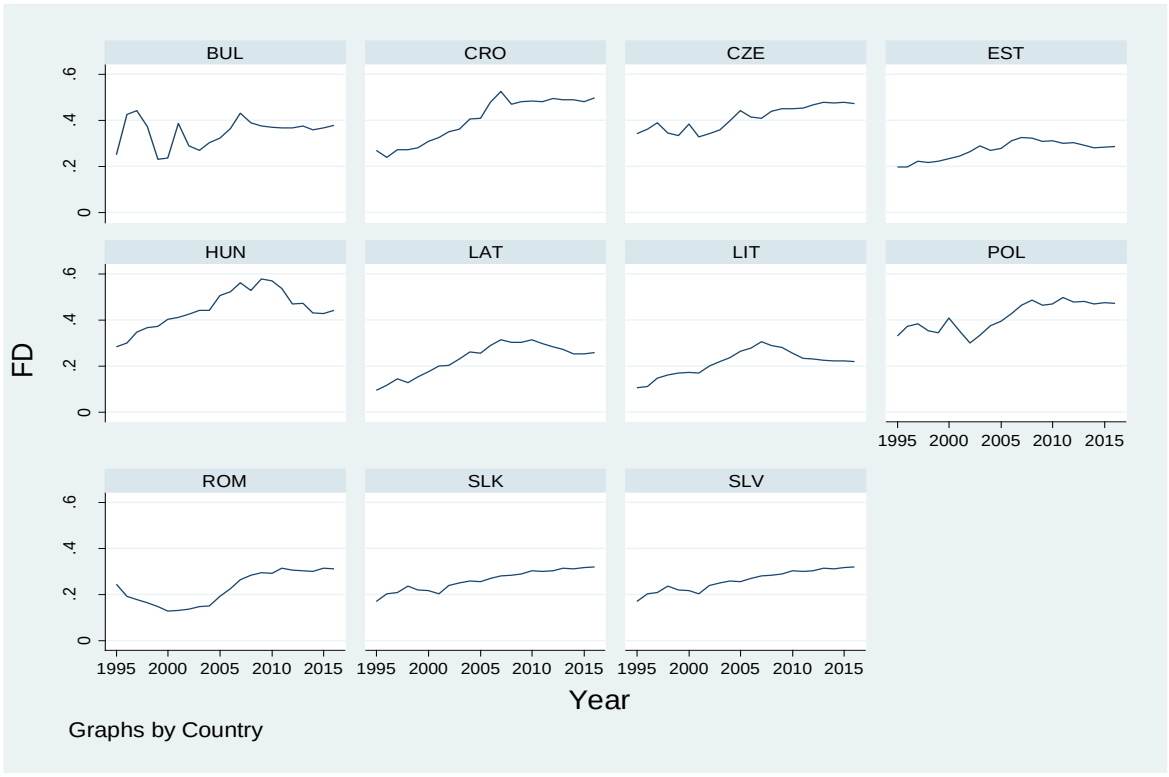
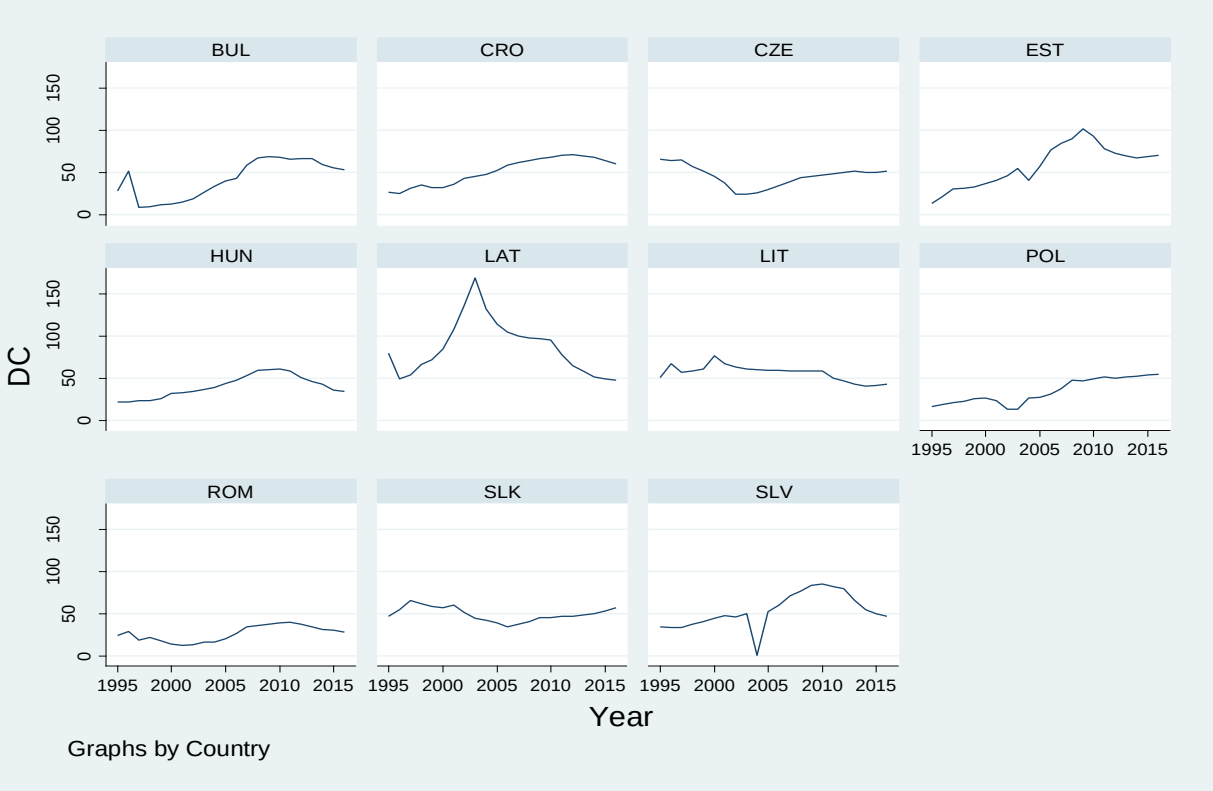


Figure 1. The evolution of domestic credit to private sector in EEU_11 countries: 1995–2016.



Note: author computation.

Figure 2. The evolution of financial development index in EEU_11 countries: 1995–2016.

4. Results

4.1. Panel unit root test

The database spans 22 years and includes 11 emerging EU countries. Because of this coverage, it is expected that some explanatory variables follow a unit root process (Nelson and Plosser, 1982; Samargandi et al., 2015). To this end, I apply second-generation unit root test by Pesaran (2007) after testing for the cross-section dependence hypothesis by Pesaran (2004). Looking at the cross-section dependence test (Table 3), Pesaran (2004) results show that the null hypothesis of no-cross section dependence is rejected at 1% significance level for all variables (except for the population growth). This is an indication to apply second-generation panel unit root test. Table 4 displays the results of Pesaran (2007) panel unit test for variables in level and in first differences. It can be observed that data embodies stationary and non-stationary series in level (I(0) and I(1)). Furthermore, all variables seem to be stationary in first-differences (I(1)). Because no series goes beyond I(1), the ARDL models can be safely applied.

Table 3. Cross-section dependence test by Pesaran (2004).

Variables (in levels)	Pesaran CD stats
GDPpc growth	18.243*** (0.000)
Initial GDP	33.500*** (0.000)
Inv	10.707*** (0.000)
Govexp	5.074*** (0.000)
To	26.944*** (0.000)
Inf	26.533*** (0.000)
Pop	1.896 (0.236)
School	20.415*** (0.000)
FD	24.960*** (0.000)
DC	3.656*** (0.000)

Note: i) p-values are in parenthesis; ii) ***, ** and * - significance at 1%, 5% and 10% levels, respectively

Table 4. Panel unit root test by Pesaran (2007).

Variables/CIPS stats	CIPS stats (var. in levels)	CIPS stats (var. in first differences)
GDPpc growth	−2.455*** (0.007)	−7.175*** (0.000)
Initial GDP	1.080(0.860)	−7.175*** (0.00)
Inv	−3.141*** (0.001)	−6.022*** (0.000)
Govexp	−6.086*** (0.000)	−9.670*** (0.000)
To	−2.755*** (0.003)	−5.097*** (0.000)
Inf	−2.565*** (0.005)	−7.647*** (0.000)
Pop	−1.209 (0.113)	−3.053*** (0.001)
School	−1.858** (0.032)	−3.479*** (0.000)
FD	−1.553* (0.060)	−5.990 *** (0.000)
DC	−0.390 (0.348)	−4.476*** (0.000)

Note: i) estimates are shown only for models with constant with lags equal to 1; ii) results with constant and trend are qualitatively similar; iii) p-values are in parenthesis; iv) the standard errors are reported in parenthesis. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

4.2. Results of PMG, MG and DFE

The Table 5 reports the results of the PMG, MG and DFE estimators for the benchmark model. The efficiency and consistency gains between these three models are explained by the Hausman test. As expected, the Hausman statistics acknowledge the null hypothesis of the homogeneity restriction on the explanatory variables in the long run. This is an indication that the PMG estimator is more preferred than its candidates (MG and DFE) and that the simultaneous equation bias is minimal for these data (Pesaran et al., 1999).

Table 5A. Long-run PMG, MG and DFE estimations for EEC countries (without/with FD linear effect).

Long-run coeff.									
Models	Model 1: Benchmark			Model 2: Including DC			Model 3: Including FD		
Indep. Var. /PMG	PMG	MG	DFE	PMG	MG	DFE	PMG	MG	DFE
Initial GDPpc	−0.016	0.536	−0.433	−0.116	2.825***	−0.249	0.398	2.133	2.133
	(0.134)	(0.751)	(0.287)	(0.184)	(0.919)	(0.414)	(0.262)	(1.502)	(1.502)
Population growth	−0.534***	−1.566***	−1.229***	−0.381**	−0.668	−1.118***	−0.299	−1.464**	−1.464**
	(0.213)	(0.528)	(0.259)	(0.199)	(0.573)	(0.284)	(0.206)	(0.678)	(0.722)
Fixed capital	−0.102	−0.566	−0.501	−0.060	0.813	−0.294	0.544	1.135*	1.135*
	(0.372)	(1.062)	(0.622)	(0.370)	(1.056)	(0.636)	(0.367)	(0.678)	(0.678)
Gov. Expenditure	0.214***	0.364***	−0.252***	0.191	0.338***	0.237***	0.218***	0.349***	0.349***
	(0.048)	(0.093)	(0.090)	(0.040)	(0.106)	(0.092)	(0.042)	(0.094)	(0.094)
DC/FD	-	-	-	−0.076	−1.403*	−0.252	−0.611*	−2.231	−2.231
				(0.106)	(0.799)	(0.229)	(0.370)	(1.420)	(1.420)
Error Correction Term	−0.843***	−0.944***	−0.758***	−0.863***	−1.099***	−0.769***	−0.887***	−0.742*	−1.001***
	(0.057)	(0.064)	(0.052)	(0.051)	(0.086)	(0.054)	(0.050)	(0.079)	(0.080)

Table 5B. Short-run PMG, MG and DFE estimations for EEC countries (without/with FD linear effect).

Short-run coeff.									
Models	Model 1: Benchmark			Model 2: Including DC			Model 3: Including FD		
Indep. Var. /PMG	PMG	MG	DFE	PMG	MG	DFE	PMG	MG	DFE
Δ Initial GDPpc	2.500***	1.827*	−2.765***	2.095***	−0.789	2.502***	2.181***	0.063	−1.851
	(0.787)	(1.058)	(0.859)	(0.812)	(1.153)	(0.887)	(0.859)	(0.074)	(1.270)
Δ Population growth	0.787	1.524**	0.016	−0.568	0.838	−0.030	0.802	−0.079	1.452
	(0.567)	(0.734)	(0.279)	(0.603)	(0.530)	(0.299)	(0.559)	(0.139)	(0.927)
Δ Fixed capital	7.463***	7.706***	2.946	7.755***	7.525***	2.868	7.161***	0.054	6.463***
	(1.867)	(2.218)	(2.648)	(1.819)	(1.440)	(2.570)	(1.845)	(0.112)	(2.395)
Δ Gov. Expenditure	−0.020	−0.087	0.025	−0.018	−0.077	0.031	−0.033	−0.344	−0.126**
	(0.059)	(0.080)	(0.073)	(0.063)	(0.090)	(0.073)	(0.062)	(0.246)	(0.062)
ΔDC/FD	-	-	-	0.975	2.225***	3.917	2.131***	0.019	1.772
				(0.680)	(0.812)	(3.115)	(0.743)	(0.176)	(1.420)
Constant	1.414***	−2.465	4.879**	0.573	−25.884***	3.917***	−4.371	8.065***	−22.567**
	(0.104)	(5.983)	(2.307)	(0.128)	(8.885)	(3.115)	(0.241)	(3.752)	(0.215)
No. Obs.(N x T)	231	231	231	231	231	231	231	231	231
No. Countries	11	11	11	11	11	11	11	11	11
Hausman test-chi2(8) (p-value)	4.30 (0.367)	-	0.26 (0.992)	5.63 (0.344)		3.29 (0.655)	-	27.13 (0.0)	4.68 (0.46)

Note: i) the test of difference between PMG and MG was performed using Hausman test. ii) DC means the domestic credit to private sector (% GDP) and FD is the financial development index by IMF; the selected model is ARDL (1,1,1,1,1,1,1,1,1,1) using Stata program and according to AIC criterion.

4.3. Linear and non-linear PMG models

The results of the PMG estimates are provided in Tables 6 and 7. The Table 6 reports the results including the domestic credit to private sector. The IMF's financial development index is integrated in the Table 7, for robustness checks.

Looking to the Table 6 (models from (3) to (5)), it can be observed that domestic credit to private sector exerts unclear effects on GDP growth (negative or positive effects) in the long-run and positive effects in the short-run. All these findings are statistically non-significant in the linear specifications (except for the model 3 where it can be viewed a statistically significant and positive effect of CD on the GDP growth, in the short-run). Consequently, the supply-leading channel hypothesis (finance generates economic growth) is not validated in the case of the linear relation between finance-growth (except for the short-run, in the model (3)).

Regarding the non-linear effect of finance on growth (i.e., the models (4) to (9) including a quadratic term), results clearly indicate an inverted U-shaped relationship (a positive impact of financial development on economic activity followed by a negative effect after a certain threshold). This finding is validated only in the long-run horizon. In the short-run, the DC effect on economic growth is statistically non-significant. In other words, this outcome supports the "Too Much Finance" approach of Arcand et al. (2015) and Ductor and Grechyna (2015) arguing that the marginal effect of financial sector on GDP growth may be positive until a certain threshold, and then, it becomes negative. According to Samargandi et al. (2015) or Caporale et al. (2009), the long-run depressed effect of financial sector on economic growth may be explained by a still immature functioning financial system. From their point of view, this form of disequilibrium occurs when financial systems stand facing excessive government interferences through interest rate ceiling measures, a variety of credit programs for special sectors or higher reserve requirements or when the size of the financial sector becomes too large with respect to the socially optimal level.

In other words, the current paper find evidence in favour of a non-monotone and significant linkage between finance and GDP growth, in the long-run horizon only. This result supports partially that of Loayza and Rancière (2006) for the advanced EU economies pointed out a positive effect of finance on economic growth.

Almost all control variables have the expected sign and are on the whole significant, whatever the specification. The initial level of economic development of an economy is a key driver of economic growth in the long-run estimations suggesting that conditional convergence takes place. Its negative sign indicates that countries with a lower initial capital stock per head/production per capita grow faster than countries with higher capital stock per head (Solow, 1956). The positive coefficient of population growth translates the beneficial effect of savings on the economic growth, in the short-run. In the long-run, the negative coefficient of population growth reminds, in the spirit of Solow, the adverse effect of overpopulation on the economic growth. The government expenditure fasters economic growth in the long-run specifications. The positive effect of expansionary fiscal policies may be in line with modern monetary theory arguing that these policies may be efficient as long as the inflation is kept within a sustainable target. The fact that government expenditures inhibit economic growth in the short-run and signal, to a certain extent, a government burden (Eggoh and Khan, 2014) does not support the Keynesian view. The coefficient associated with the trade openness is positive in the short-run enriched

specifications, which is in line with both the neoclassical approach and the endogenous growth theory. In the neoclassical framework, the positive effects of trade on growth pass through comparative advantages (i.e. production factors endowments, technology differences). In the endogenous growth theory, trade impacts positively economic growth due to the technological diffusion between countries (Lopez-Villavicencio and Mignon, 2011). The negative sign of inflation on growth suggests an overall adverse effect of inflation on GDP growth of the analysed countries (as in Eggoh and Khan, 2014). As expected, the physical capital impact is positive on both horizons, but, it is stronger in the short-run estimates than in that of long-run. This could be a sign of a lack of appropriate market incentives in EEU, which makes physical capital slighter productive in the long-run. Finally, human capital (highly skilled workforce) exerts a positive effect on the growth process in the long-run horizon. High level of skills and training goes hand in hand with an intensification of R&D activities and an acceleration of technological progress, and thus, with economic growth. It can be noted that human capital is subject to a sort of diminishing return meaning that educated workforce would benefit from higher incomes in the long run, but not necessarily in the short-run.

The linear specifications including the second measure of financial development (FD) are qualitatively similar with those previously presented. To summarize, there is evidence that financial development has a linear negative effect on growth process in the long-run. However, it can be also observed positive and statistically significant effects of financial development in the short-run growth process, in the EEU (models 4 and 5).

Differently, the PMG models including the quadratic term of "financial development" do not confirm the existence of a U-shaped form of financial development; but, rather a long-run positive effect. A possible explanation would be that the financial development index embodies more information on the financial sector. It is a broader indicator because it focuses on both, financial markets and financial intermediaries in terms of their depth (size and liquidity), access (ability of companies and individuals to access financial services) and efficiency (the ability of financial institutions to provide financial services at low costs).

These models aim also to appraise the impact of financial sector on GDP growth in the aftermath of the 2008–2009 financial crisis, too. To this end, the specification (9) integrates an interaction term between a dummy variable named "2008 Crisis" and our financial indicators (DC or FD). Estimates show that financial development deters economic growth during the 2008 global financial crisis, the estimated coefficients being statistically significant in the long-run models at 1% level of significance.

Table 6A. Long-run and short-run PMG estimations for EEU countries: *linear and non-linear effects of DC on economic growth.*

	Long-run coeff.									
Models	Model 1: Not including DC			Model 2: Linear effect of DC			Model 3: Non−linear effect of DC			
DC = Domestic Credit to private										
Indep. Var. /PMG	Benchmark	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Initial GDPpc	−0.706***	−0.113	-	−0.463***	0.157**	-	−0.419*	−0.099	-	-
	(0.189)	(0.269)		(0.234)	(0.299)		(0.244)	(0.292)		
Inflation	−0.204***	-	-	−0.167***	-	-	−0.209**	-	-	-
	(0.049)			(0.046)			(0.050)			
Population growth	−0.605***	−0.418**	−0.235	−0.681***	−0.366	−0.090***	−0.826***	−0.494**	0.330	−0.713***
	(0.211)	(0.219)	(0.222)	(0.230)	(0.232)	(0.225)	(0.243)	(0.225)	(0.212)	(0.142)
Fixed capital	0.287	−0.103	0.214	0.019	−0.380***	−0.035	0.006	−0.162	0.186	1.092***
	(0.352)	(0.339)	(0.329)	(0.399)	(1.393)	(0.410)	(0.382)	(0.353)	(0.397)	(0.272)
Gov. Expenditure	0.135***	0.565***	0.534***	0.169***	0.535***	0.495***	0.207***	0.557***	0.579***	0.384***
	(0.049)	(0.055)	(0.052)	(0.049)	(0.052)	(0.048)	(0.054)	(0.047)	(0.047)	(0.035)
School enrol, secondary	-	0.090	0.215	-	1.162	1.224	-	3.713***	3.381***	1.248*
		(1.266)	(1.010)		(1.337)	(1.028)		(1.182)	(0.950)	(0.667)
Trade openess	-	-	0.052			0.056	-	-	−0.049	−0.092
			(0.295)			(0.333)			(0.333)	(0.223)
DC	-	-	-	−0.050	−0.043	0.008	0.116	0.469**	0.512***	0.238*
				(0.116)	(0.157)	(0.146)	(0.325)	(0.219)	(0.204)	(0.169)
DC^2	-	-	-	-	-	-	−0.040	−0.113***	−0.119***	−0.056*
							(0.053)	(0.045)	(0.041)	(0.030)
DC*2008 Crisis	-	-	-	-	-	-				−0.117***
										(0.010)
Error Corr. Term	−0.889***	−0.888***	−0.873***	−0.888***	−0.894***	−0.865***	−0.945***	−0.921***	−0.885***	−1.107**
	(0.063)	(0.062)	(0.058)	(0.057)	(0.058)	(0.058)	(0.060)	(0.073)	(0.075)	(0.010)

Note: The selected model is ARDL (1,1,1,1,1,1,1,1,1,1) with constant and trend (according to the AIC criterion). The standard errors are reported in parenthesis. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

Table 6B. Short-run PMG estimations for EEU countries: *linear and non-linear effects of DC on economic growth*

	Short-run coeff.									
Models	Model 1: Not including DC			Model 2: Linear effect of DC			Model 3: Non-linear effect of DC			
DC = Domestic Credit to private Indep. Var. /PMG	Benchmark	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Initial GDPpc	2.297***	1.002	-	1.908**	0.599**	-	1.696*	0.338	-	
	(0.795)	(0.822)		(0.815)	(0.989)		(0.902)	(0.338)		
Δ Inflation	0.225*	-	-	0.157	-	-	0.155	-	-	
	(0.123)			(0.128)			(0.112)			
Δ Population growth	1.324**	0.724*	0.991**	1.016*	−0.496	0.937*	0.915	0.232	0.573*	0.965
	(0.641)	(0.431)	(0.490)	(0.573)	(0.450)	(0.510)	(0.593)	(0.346)	(0.327)	(0.599)
Δ Fixed capital	7.179***	3.040***	2.981***	7.604***	3.737**	3.593***	7.391***	3.844***	3.506***	1.359
	(1.710)	(0.968)	(1.078)	(1.664)	(0.915)	(1.113)	(1.599)	(0.972)	(1.093)	(1.017)
Δ Gov. Expenditure	0.021	−15.794***	−13.071***	−0.014	−15.737***	3.593***	−0.010	−16.312***	−13.786***	−8.136***
	(0.054)	(2.507)	(2.489)	(0.064)	(2.467)	(1.113)	(0.068)	(2.438)	(2.456)	(2.178)
ΔSchool enrol, secondary	-	1.143	−0.622	-	−0.116	−1.983	-	−0.678	−1.899	−5.422
		(3.351)	(3.378)		(3.847)	(3.514)		(4.200)	(3.819)	(5.165)
ΔTrade openess	-	-	2.811**	-	-	3.042***	-	-	2.776**	1.542
			(1.299)			(1.211)			(1.323)	(1.189)
Δ DC	-	-	-	1.122*	0.813	0.481	10.722*	2.341	2.520	−0.250
				(0.668)	(0.635)	(0.481)	(5.805)	(4.013)	(5.821)	(7.569)
Δ DC^2	-	-	-	-	-	-	−1.215	−0.073	−0.141	0.460
							(0.775)	(0.595)	(0.806)	(1.038)
ΔDC2 * 2008 Crisis	-	-	-	-	-	-	-	-	-	0.085**
										(0.02)
Constant	6.511***	−0.229**	−0.871***	5.256***	−3.978***	−4.128***	5.183***	−15.318***	−13.443***	−8.490***
	(0.544)	(0.114)	(0.111)	(0.411)	(0.261)	(0.268)	(0.399)	(1.219)	(1.136)	(1.004)
No. Obs.(N x T)	231	231	231	231	231	231	231	231	231	231
No. Countries	11	11	11	11	11	11	11	11	11	11
Log Likelihood	−238.77	−220.50	−205.47	−206.55	−217.52	−192.71	−217.42	−187.356	−174.494	−139.637
ARDL(p,q)	ARDL(1,1,1,1,1,1,1,1)			ARDL(1,1,1,1,1,1,1,1,1)			ARDL(1,1,1,1,1,1,1,1,1)			

Note: The selected model is ARDL (1,1,1,1,1,1,1,1,1,1) with constant (according to the AIC criterion). The standard errors are reported in parenthesis. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. The estimations results were obtained with Stata program.

Table 7A. Long-run PMG estimations for EEU countries: *linear and non-linear effects of FD on economic growth.*

	Long-run coeff.									
Models	Model 1: Not including FD			Model 2: Linear effect of FD			Model 3: Non-linear effect of FD			
FD =Financial development										
Indep. Var. /PMG	Benchmark	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Initial GDPpc	−0.706***	−0.113	-	−0.279	−0.525	-	−0.509	−0.249	-	-
	(0.189)	(0.269)		(0.329)	(0.340)		(0.333)	(0.337)		
Inflation	−0.204***	-	-	−0.217***	-	-	−0.264***	-	-	-
	(0.049)			(0.050)			(0.053)			
Population growth	−0.605***	−0.418**	−0.235	−0.731***	−0.424**	−0.296	−0.944***	−0.389*	−0.250	−0.411**
	(0.211)	(0.219)	(0.222)	(0.217)	(0.210)	(0.206)	(0.229)	(0.212)	(0.210)	(0.186)
Fixed capital	0.287	−0.103	0.214	0.677*	0.366	0.756**	0.502	0.401	0.686**	0.802***
	(0.352)	(0.339)	(0.329)	(0.406)	(0.350)	(0.347)	(0.417)	(0.343)	(0.330)	(0.273)
Gov. Expenditure	0.135***	0.565***	0.534***	0.194***	0.586***	0.525***	0.253***	0.57**	0.517***	0.406***
	(0.049)	(0.055)	(0.052)	(0.053)	(0.049)	(0.046)	(0.059)	(0.051)	(0.049)	(0.042)
School enrol. Ratio, secondary	-	0.090	0.215	-	-	3.247***	-	2.152*	3.370***	2.781***
		(1.266)	(1.010)			(1.114)		(1.274)	(1.128)	(1.081)
Trade openess	-	-	0.052	-	1.538	0.245	-	-	0.147	−0.149
			(0.295)		(1.277)	(0.346)			(0.362)	(0.293)
FD	-	-	-	−0.628	−1.338***	−1.347***	1.022	1.402	1.652	2.481**
				(0.403)	(0.402)	(0.347)	(0.981)	(1.264)	(1.302)	(1.080)
FD^2	-	-	-	-	-	-	0.589*	0.929**	1.020**	1.038***
							(0.315)	(0.432)	(0.437)	(0.354)
FD2* 2008 Crisis		-	-						-	−0.853***
										(0.195)
Error Corr. Term	−0.889***	−0.888***	−0.873***	−0.924***	−0.912***	−0.892***	−0.900***	−0.882***	−0.876***	−0.924***
	(0.063)	(0.062)	(0.058)	(0.063)	(0.062)	(0.069)	(0.779)	(0.067)	(0.073)	(0.195)

Table 7B. Short-run PMG estimations for EEU countries: *linear and non-linear effects of FD on economic growth.*

Short-run coeff.										
Models	Model 1: Not including FD			Model 2: Linear effect of FD			Model 3: Non-linear effect of FD			
FD =Financial Development Index										
Indep. Var. /PMG	Benchmark	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Δ Initial GDPpc	2.297***	1.002	-	2.052***	0.720	-	2.363**	1.580	-	-
	(0.795)	(0.822)		(0.026)	(0.758)		(1.076)	(1.064)		
Δ Inflation	0.225*	-	-	0.243**	-	-	0.227*	-	-	-
	(0.123)			(0127)			(0.141)			
Δ Population growth	1.324**	0.724*	0.991**	1.314**	0.652*	0.979**	2.044*	1.363*	1.573**	1.719**
	(0.641)	(0.431)	(0.490)	(0.564)	(0.392)	(0.421)	(1.125)	(0.760)	(0.658)	(0.833)
Δ Fixed capital	7.179***	3.040***	2.981***	6.942***	2.432***	2.588**	5.871***	1.386	2.133*	2.228**
	(1.710)	(0.968)	(1.078)	(1.649)	(0.852)	(1.094)	(2.104)	(1.230)	(1.175)	(1.092)
Δ Gov. Expenditure	0.021	−15.794***	−13.071***	−0.014	−15.853***	−12.451***	0.079	−15.129***	−12.400***	−9.264***
	(0.054)	(2.507)	(2.489)	(0.059)	(2.829)	(2.427)	(0.057)	(2.878)	(2.609)	(2.617)
ΔSchool enrol. Ratio, tertiary	-	1.143	−0.622	-	-	−1.861	-	−0.033	−2.382	−2.825
		(3.351)	(3.378)			(3.442)		(3.836)	(3.799)	(3.550)
ΔTrade openess	-	-	2.811**	-	0.297	2.740**	-	-	2.918**	2.136*
			(1.299)		(3.446)	(1.430)			(1.378)	(1.264)
Δ FD	-	-	-	−0.629	1.566**	1.302**	−6.053	−8.676	−9.315	−8.222
				(0.403)	(0.740)	(0.675)	(11.030)	(10.405)	(6.576)	(5.933)
Δ FD^2	-	-	-	-	-	-	−4.835	−5.659	−4.907*	−4.559*
							(4.505)	(4.925)	(2.910)	(2.848)
Δ FD2* 2008 Crisis	-	-	-	-	-	-	-	-	-	0.366
										(0.274)
Constant	6.511***	−0.229**	−0.871***	1.126***	−12.650***	−17.121***	4.366***	−10.921***	−14.906***	−11.179***
	(0.544)	(0.114)	(0.111)	(0.154)	(0.929)	(1.396)	(0.407)	(0.863)	(1.271)	(0.957)
No. Obs.(N x T)	231	231	231	231	231	231	231	231	231	231
No. Countries	11	11	11	11	11	11	11	11	11	11
Log Likelihood	−238.77	−220.50	−205.47	−225.61	−204.99	−188.22	−212.828	−192.175	−178.223	−158.58
ARDL(p,q)	ARDL(1,1,1,1,1,1,1,1,1)			ARDL(1,1,1,1,1,1,1,1,1)			ARDL(1,1,1,1,1,1,1,1,1,1)			

Note: The selected model is ARDL (1,1,1,1,1,1,1,1,1,1) with constant (according to the AIC criterion). The standard errors are reported in parenthesis. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively. The estimations results were obtained with Stata program.

4.4. Delta and Fieller Confidence Intervals

Turning out to our estimated financial variables of interest (domestic credit to private sector and financial development index), it can be noted that the paper questions the robustness of the confidence intervals, too. This is an important topic in new applied econometrics, especially when estimating parameter ratios obtained from dynamic panel data models (GMM or PMG). More precisely, the estimation implies to evaluate the confidence intervals for the ratios of normally distributed statistics by using two basic approaches: the Delta method (based on a Wald-type specification) and the Fieller method. The first one, suits asymptotically normal panel data estimators, provided, of course, underlying regularity conditions prevail. But, the recent literature emphasizes more and more frequently that Delta method raises identification problems even when a ratio's numerator and denominator are correctly identified. The problems that arise is that, when the ratio's denominator tends to zero, the ratio is not well defined; the distribution of standard test statistics is irregular, and as a result, usual tests and confidence intervals are incorrectly sized, or (said differently) usual asymptotic standard errors understate sampling uncertainty. Bernard et al. (2019) show that the second method (that is the Fieller (1954) method) is superior to the application of the Delta method in both dynamic panel regressions: the Pooled Mean Group (PMG) estimator and Arellano and Bond's (1991) estimator (GMM). The authors argue that the Fieller's method is efficient in small samples, even in some persistent contexts. Another feature is that, contrary to the Delta intervals, the Fieller intervals are not forced to be symmetric. To determine the location of the turning point in the non-linear PMG specifications (i.e., in the models including the quadratic terms of financial indicators), I conduct an extensive simulation to compare the two approaches and to verify the usefulness of the Fieller's result. The Table 8 displays the Delta Intervals of the non-linear model including the domestic credit given that only this financial variable exerts a statistically significant and non-monotone impact on the growth process. It can be observed, according to Delta method, the turning point corresponds to 2.074 (for model 7) and 2.153 (for model 8). For the model 7, the confidence interval is between 1.055976 and 3.09293 whilst for the model 8, the confidence interval is between 1.256704 and 3.049526.

Table 8. Delta Intervals for non-linear PMG model.

Model7: GDPG = *f* (Initial GDP, Pop, Inv, GovEx., Ses, DC, DC2)			95% CI	
Variable	Coefficient (Std. Error)	P > |z|	Low	High
DC	2.074453*** (0.51964)	0.000	1.055976	3.09293
Model8: GDPG = *f* (Pop, Inv, GovEx., Ses, To DC, DC2)			95% CI	
Variable	Coefficient (Std. Error)	P > |z|	Low	High
DC	2.153115*** (0.457361)	0.000	1.256704	3.049526

Note: The standard errors are reported in parenthesis. ***, ** and * - significance at 1%, 5% and 10% levels.

The Fieller's confidence intervals are graphically shown in the Figure 3 (for model 7) and Figure 4 (for model 8) and allow to appreciate the robustness of the previous results.

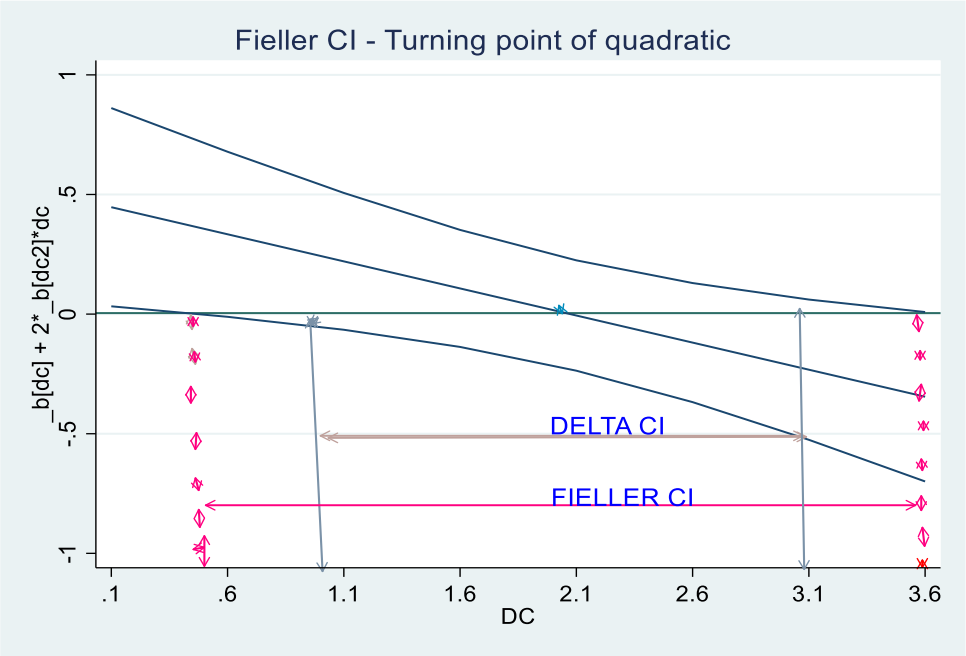


Figure 3. Delta and Fieller Confidence Intervals for the Model 7.

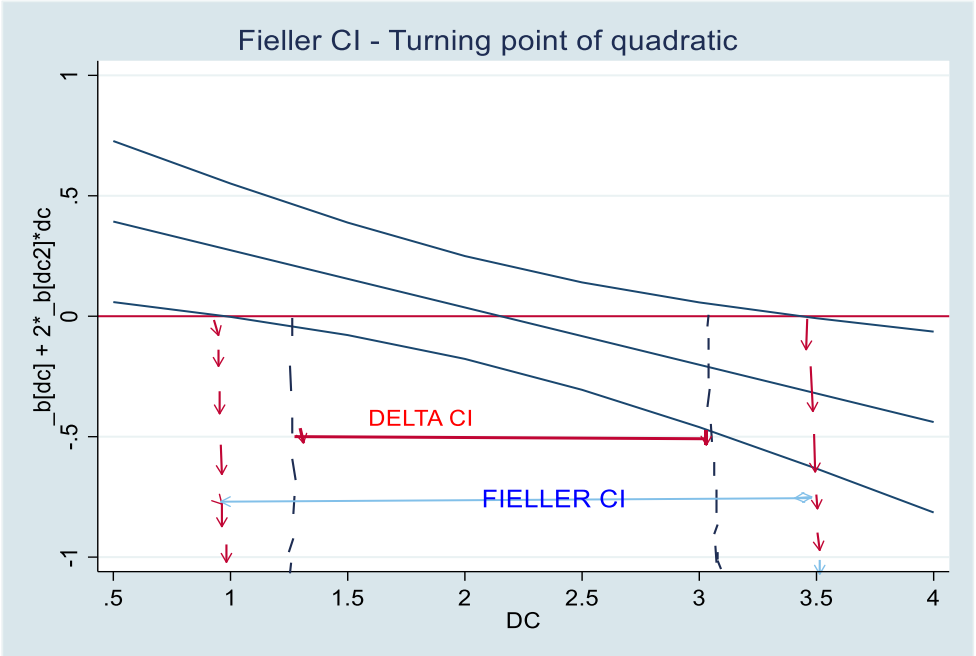


Figure 4. Delta and Fieller Confidence Intervals for the Model 8.

5. Conclusions

The article examines the impact of financial development on economic growth in eleven emerging European countries. The analysis is carried out over the period 1995–2016 and uses dynamic panel

models, including the PMG estimator of Pesaran et al. (1999). The results, when imposing a linear relationship, suggest that domestic credit to private sector has unclear long-term effects (positive or negative) on economic growth, but, a short-run positive effect (model (3)). The last result validates the supply-leading channel by Schumpeter (1934) theory for the model (3). Furthermore, the financial development index (FD) is found to have a significant contracting effect on GDP growth process in the long-run and a positive significant effect, in the short-run (models 4 and 5). This finding joins partially that of Loayza and Rancière (2006) who identified a long-run positive effect of FD on growth, in the advanced EU.

The inclusion of a quadratic term related to FD (domestic credit) in the PMG demonstrates the existence of a non-monotone, inverted U-shape relationship between the financial sector and the real sector of the economy. Finance stimulates economic growth until a certain level and then, if funding becomes excessive in the economy, economic activity slows down. This outcome is robust when using the domestic credit to private sector only. A possible explanation of this result would be that the financial development index is a broader indicator than domestic credit. It focuses on both, financial markets (the bond markets and stock markets) and financial intermediaries (mainly, banks) whilst domestic credit to private sector is a specific measure of the development of the banking sector. In terms of economic policies, the result suggests that expansion of the banking sector itself could stimulate long-term economic growth only if it is followed by corresponding growth in the real sector.

The other explanatory variables (such as the initial level of GDP, inflation, fixed investment, government expenditure, educated people and population growth) are statistically significant in almost all models and have the expected sign in the long-run estimations. In the short-run, the estimates indicate opposite signs for inflation, initial level of GDP and population growth.

Although the effect of financial development is found to be different across the time horizons (due to the transformations in the nature of economic structures, financial markets and so on), the results could be of potential importance to policymakers in terms of optimizing the financial deepening to stimulate growth in the real sector.

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Conflict of interest

The author declares no conflicts of interest in this paper.

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