School of Economics and Management
TECHNICAL UNIVERSITY OF LISBON

Department of Economics

Cândida Ferreira

Bank performance and economic growth: evidence from Granger panel causality estimations

WP 21/2013/DE/UECE

WORKING PAPERS

ISSN Nº 0874-4548

Bank performance and economic growth: evidence from Granger panel causality estimations

Cândida Ferreira [1]

Abstract

This paper provides empirical evidence on the causality relations between bank performance and economic growth in a panel including 27 European Union member-states from 1996 through to the onset of the 2008 financial crisis. Bank performance is represented not only by the Return on Assets (ROA) and Return on Equity (ROE) ratios but also by bank cost efficiency, measured through Data Envelopment Analysis (DEA). For economic growth, we consider not only the GDP per capita but also the gross fixed capital formation growth. Deploying a panel Granger causality approach, we confirm positive causality running from bank performance to economic growth. However, as regards the opposite causality, running from growth to bank performance, we conclude that economic growth positively contributes to the bank ROA and ROE ratios but not so certainly in the case of the DEA bank cost efficiency.

Keywords: Bank performance, Economic growth, DEA, Panel Granger causality, European Union.

JEL Classification: G21, G31, E44, F43, F36,

[1] ISEG-UTL - Instituto Superior de Economia e Gestão – Technical University of Lisbon and UECE – Research Unit on Complexity and Economics
Rua Miguel Lupi, 20, 1249-078 - LISBON, PORTUGAL
tel: +351 21 392 58 00
fax: +351 21 397 41 53
(candidaf@iseg.utl.pt)

Bank performance and economic growth: evidence from Granger panel causality estimations

1. Introduction

The contribution of financial development to economic growth has been extensively analysed and empirically tested in recent decades and most especially after the King and Levine (1993) contribution.

In spite of controversy over the variables introduced to represent financial development and the appropriate estimation techniques, most empirical studies do conclude that financial development promotes economic growth and advocating that a smoothly functioning financial sector contributes to the mobilization of savings, the diversification of risk and a better allocation of financial resources. Although less analysed, there is also a strand of literature (represented by Greenwood and Bruce, 1997, among others) that studies the inverse relationship and thereby approaching how economic growth fosters financial development because growth in the real economy increases demand for financial services and thus contributes to the sector's development.

Hence, in spite of the fact that many authors concur on the actual importance of the relationship between financial development and economic growth, the direction of causality still remains a controversial issue.

Granger causality tests might prove highly relevant to establishing the direction of this relationship and have recently been applied by Hassan et al. (2011), Bangake and Eggoh (2011), Kar et al. (2011) and Abdelhafidh (2013), among others, to different subsets of developed and/or developing country economies in conjunction with the respective and now to a greater or lesser extent traditional proxies for portraying economic growth (such as bank credits, deposits or bank liabilities). Their conclusions differ whether in terms of the kind of countries, the time interval considered and the variables applied but, generally speaking, they confirm that the causality running from financial development to economic growth proves easier to demonstrate than the opposite causality running from economic growth to financial development.

This paper seeks to contribute to the debate on the causality relationship between finance and growth using a panel Granger causality approach and departing from recent empirical work in order to complement the evidence existing, especially in the following terms:

- We consider a panel including the 27 European Union member states over a relatively long timeframe, from 1996 through to the onset of the 2008 financial crisis;
- We take into account the dominant role of banking institutions in the European financial sector and instead of using traditional proxies for representing financial development, we test the specific relationship between bank performance and economic growth;
- We approach bank performance by the usual Return on Assets (ROA) and Return on Equity (ROE) ratios in addition to measures of bank efficiency obtained by Data Envelopment Analysis (DEA);
- For economic growth, we consider not only the commonly applied per capita Gross Domestic Product (GDP) but also the investment channelled into growth in addition to the gross fixed capital formation.

The results obtained clearly confirm the positive causality of bank performance on economic growth. As regards the opposite causality, from growth to bank performance, whilst there are no doubts that growth positively contributes to bank ROA and ROE ratios there is less certainty about bank DEA efficiency.

This paper is structured as follows: Section 2 presents the relevant literature, section 3 explains the methodological framework and data sample; Section 4 reports the empirical results obtained; Section 5 concludes.

2. **Relevant literature**

The link between economic growth and the quality of financial systems dates back at least as far as Schumpeter (1911), who maintained that the services provided by financial intermediaries prove essential to economic innovation, productive investment and economic growth. Over the last century, this question has been subject to theoretical debates and empirical studies, which rose in particular in the wake of the renowned King and Levine (1993) paper.

According to most studies, financial development plays an important role in economic growth as well-functioning markets and financial institutions are identified as decreasing transaction costs and problems over asymmetric information levels. At the same time, financial institutions act to identify investment opportunities by selecting the most profitable projects, mobilizing savings, facilitating trade and the diversification of risk while also improving corporate governance mechanisms.

In one such study, Levine and Zervos (1998), applying data for 49 countries for the 1976-1990 period, point out a strong correlation between the rates of real per-capita output growth and stock market liquidity. In another work, Demirguç-Kunt and Levine (1999), with data for 150 countries spanning the 1990s, conclude that wealthy countries have better developed financial systems, characterising this development in terms of the size and the efficiency of the financial sector, measured by the assets, liabilities, overhead costs and interest rate margins.

A few years later, Beck et al. (2004) deployed the ratio between credits from financial intermediaries to the private sector divided by GDP as a proxy to capture the depth and breadth of financial intermediation in a panel of 52 countries over the period 1960 to 1999. They conclude that financial development is not only clearly pro-growth but also pro-poor, thus, in countries with better-developed financial intermediation, income inequality declines more rapidly.

Providing a review of the literature and the empirical evidence on the relationship between financial development and economic growth, Khan and Senhadji (2000) conclude that the results of empirical studies analysing the relationship between financial development and economic growth indicate that, while the general effects of financial development on the outputs may be positive, the size of these effects varies not only with the different variables considered, the financial development indicators but also with the estimation method, data frequency or the defined functional form of the relationship. On the other hand, there are authors like Stiglitz (1985), Bhide (1993), Bencivenga *et al.* (1995), who stressed that certain costs may stem from the role of financial intermediaries and correspondingly these intermediaries may also sometimes be subject to adverse selection and moral hazard problems that may constrain real economic growth through inhibiting resource allocation, exaggerating fluctuations in interest rates, or contributing to falls in the saving rates prevailing.

Other authors, including Loayza and Rancière (2006), underline the importance of the time horizon, defending that, in the long term, the literature on economic growth finds a positive relationship between financial development and growth but, in the short term, the literature mostly on bank crises returns a negative relationship and concludes that monetary aggregates may represent good predictors of economic crisis.

More recently, Cecchetti and Kharroubi (2012) apply a sample of developed and emerging economies to analyse how financial development affects aggregate productivity growth and conclude in favour of an inverted U-shaped financial development effect as it exerts a positive influence on productivity growth but only up to a certain point after which the influence on growth turns negative. Furthermore, in focusing on advanced economies, these authors demonstrate that a fast-growing financial sector is detrimental to aggregate productivity growth.

Ayadi et al. (2013) use a sample of northern and southern Mediterranean countries for the 1985-2009 time period and conclude there are deficiencies in bank credit allocation in these countries as credit to the private sector and bank deposits are negatively associated to economic growth; however, on the stock market side, the results indicate that stock market size and liquidity do contribute to growth. Furthermore, these authors conclude both that poorer countries are catching up with richer countries in terms of GDP growth and that low inflation and the quality of institutions are key factors to growth.

Rajan and Zingales (1998) had already pointed out that the positive correlation usually returned by financial development and economic growth might derive from a problem of omitted variables. They argued that there is no clear causality between financial development and economic growth and proposed further tests to analyse the mechanism through which financial development may promote economic growth taking into account both the country and sectorial effects. Thus, rather than adhering to the traditional explanation of economic growth by proxies of financial development, Rajan and Zingales (1998) test the hypothesis that financial markets and banking institutions not only reduce the cost of financing but also help to combat problems provoked by asymmetrical information and correspondingly assuming in their test that those sectors most dependent on external financing represent those growing at the fastest pace and in line with the development of the financial markets and institutions to which these sectors have access.

Recently, Greenwood et al. (2010, 2013) quantitatively analyse the impact of financial development on economic growth, deploying a state cost verification model and conclude that as financial sector efficiency rises, financial resources get redirected from the less productive firms to their more productive peers. This analytical approach was applied to both U.S. and cross-country data (more precisely, to a 45 country sample, first applied in Beck et al., 2000) and one key finding points to the conclusion that world output might increase by 53 per cent if all countries adopt the best global financial practices.

Koetter and Wedow (2010) study the importance of financial intermediation by banks to the economic growth taking place in 97 German economic planning regions between 1993 and 2004 and conclude that the quality of these banks, as reported by bank cost efficiency, robustly contributes to growth, while the quantity of bank credit provided does not clearly correlate with economic growth. The same kind of conclusions are obtained by Hasan et al. (2009) who study whether regional growth in eleven European countries gets influenced by bank costs and profit efficiency over the time period 1996-2005. Their findings indicate how, in these countries, an increase in bank efficiency generates five times more influence on economic growth than the same rise in the level of bank credit provided.

There is also a strand of the literature represented by authors like Robinson (1952), Gurley and Shaw (1967), Goldsmith (1969), Jung (1986), Greenwood and Jovanovic (1990), Berthelemy and Varoudakis (1996), Greenwood and Bruce (1997) who remain unconvinced as to the one-way causality of financial development on economic growth and postulate that there may be a reverse causality between economic growth and financial development. Furthermore, other authors even assume that the relationship between financial development and economic growth represents a two-way causality (among others, Patrick, 1966; Demetriades and Hussein, 1996; Blackburn and Hung, 1998; Luintel and Khan, 1999; Khan, 2001; Shan et al., 2001; Calderon and Liu, 2003).

Applying pooled data from 109 developing and industrial countries, for the period from 1960 to 1994, Calderon and Liu (2003) conclude not only that financial development generally leads to economic growth but also that the Granger causality from financial development to economic growth coexists with the Granger causality between economic growth and financial development. These authors also empirically demonstrate not only how financial deepening contributes greater to the causal relationships in developing countries but also that the longer the sampling interval, the larger the impact of financial development on economic growth thereby positing that the effect of financial sector deepening on the real economy requires time to become evident while furthermore finding that even though financial development may enhance economic growth through both capital accumulation and productivity growth, the productivity channel would seem a stronger influence.

More recently, Hassan et al. (2011) study how financial development links to economic growth through applying Granger causality tests for a sample period between 1980 and 2007, and categorizing low and middle income countries into six geographic regions: East Asia and the Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, South Asia, Sub-Saharan Africa; and also two groups of high-income countries: OECD and non-OECD countries. Their findings point to the conclusion favouring evidence on the role of financial development in economic growth in low and middle income countries. More precisely, in the short run, there is two-way causality between financial development and economic growth, reported in all regions apart from Sub-Saharan Africa and East Asia and the Pacific. However, these latter two regions have causality running from economic growth to financial development supporting the hypothesis that in developing countries growth leads finance because of the increasing demand for financial services.

At the same time, Bangake and Eggoh (2011) deploy panel methods and Granger causality on a dataset of 71 developed and developing countries over the relatively long time period of 1960-2004 and conclude that there is long run bidirectional causality between financial development and economic growth across country groups. Nevertheless, in the short run, the situation is different and contradicts at least some of the Hassan et al. (2011) findings as regards low and middle income countries where there is no short run evidence of causality between finance and growth while in high income countries economic growth significantly affects financial development.

For a panel of fifteen Southern and Eastern Mediterranean countries, and the 1980-2007 time span, Kar et al. (2011) conclude that the causality between finance and economic growth mostly depends on the measurement of financial development and differs from country to country.

Abdelhafidh (2013) returned the same kind of conclusion following analysis on the direction of causality interactions between finance and growth in a sample of North African countries for the 1970-2008 time period. The general conclusion is that Granger economic growth raises domestic savings in these countries even though the findings point to specific country results, with unilateral and sometimes bilateral Granger causality relations between the different proxies for financial development and economic growth. They also underscore the policy implications of different financial sources on economic growth and the merits of a case by case approach.

3. **Methodological framework and data sample**

In order to test the causality relationship between bank performance and economic growth we follow here the Granger causality concept (Granger, 1969) and the approaches developed to analyse the existence of causality relationships among variables in panels (by such authors as Holtz-Eakin et al., 1988; Weinhold, 1996; Nair-Reichert and Weinhold 2001; Kónya, 2006; Hurlin and Venet, 2008; Bangake and Eggoh, 2011), using the general linear panel Granger causality model:

$$y_{i,t} = \alpha + \sum_{k=1}^{K} \gamma_i^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} x_{i,t-k} + \varepsilon_{i,t} \qquad (1)$$

Where: y = dependent variable; x = explanatory variable; i = 1,...,N cross units; t = 1,...,T time periods; α = intercept; k = 1,...K lags; ε = error term (including not only the disturbance term, but also the individual cross-unit specific effects).

To test Granger non-causality from x to y, the null hypothesis is $H_o : \beta_i = 0, \forall i = 1,..., N$

The alternative hypothesis states that there is a causality relationship from x to y for at least one cross-unit of the panel: $H_1 : \beta_i = 0, \forall i = 1,..., N_1; \beta_i \neq 0, \forall i = N_1 + 1, N_1 + 2..., N; (0 \leq \frac{N_1}{N} \leq 1)$.

Our sample comprises a panel in which the cross units are 27 EU countries (i = 1, …, 27) and the timeframe covers a relatively long period, from 1996 to the onset of the 2008 financial crisis (t = 1996, …, 2008).

Over the following pages, we set out the variables chosen to represent bank performance (return on assets, return on equity and bank cost efficiency) and economic growth (considering not only per capita GDP but also gross fixed capital formation). We also report the results of the unit root tests of the series studied.

3.1. Bank performance

We measure bank performance through two of the ratios commonly applied to analyse the banking sector performance: the return on assets (ROA) and the return on equity (ROE); we also consider a measurement for bank efficiency (generated by Data Envelopment Analysis). All data for these three bank performance variables are sourced from the IBCA-BankScope 2008 CD (annual data from the consolidated accounts of commercial and saving banks, all in nominal values and in Euros).

Return on assets

The ROA is the ratio of the net income to the total bank assets and serves to assess the efficiency of bank resource applications and their respective financial strength. Bank net income in itself provides a good indication of the bank's overall performance even while suffering from one important drawback: it does not take into account the bank's size and thereby rendering comparisons among different banking institutions and/or different time periods difficult.

The use of ROA (and also of ROE) adjusts in accordance with the size of banks and thereby making possible those comparisons among institutions for the same or for different time periods. Thus, the ROA is a simple measure of bank profitability providing a good insight into just how well, or otherwise, the bank management is doing its job through reflecting the performance of the bank's assets in terms of the profits returned.

Appendix A presents the ROA obtained for our sample of the 27 EU member state banking institutions countries between 1996 and 2008. The results also demonstrate the clear difficulties faced by banking institutions in some important EU countries in 2008. For the years leading up to 2008, there are few negative results and only in some new EU member states and during some critical years in Germany's reunification process. Nevertheless, generally speaking, for the time period between 1996 and 2007, our ROA results reveal a general tendency towards rising profits generated by bank assets in most EU countries.

Return on equity

In spite of the recognition that the ROA ratio returns a clear measure of bank performance, for the banking industry, most analysts prefer to use return on equity (ROE, thus, the ratio of net income to bank equity) to judge not only the performances of individual banks but also of the entire banking sector. Bank shareholders pay particular attention to the relationship between bank earnings and their equity investment, which is susceptible to measurement by the ROE ratio.

Appendix B contains the results returned for ROE in our sample that confirm the clear difficulties encountered by banking institutions in some leading EU countries in 2008 and a few negative values for banking institutions in some new EU members and the reunified Germany. However, there is no clear trend in the rises and falls in the ROE results for the years before 2008. On the contrary, these ROE results report clear oscillations in the ratio of bank earnings and shareholder equity investment across the 27 EU countries.

Bank cost efficiency

To measure bank efficiency we adopted the Data Envelopment Analysis (DEA), a non-parametric method developed by, among others, Coelli et al. (1998), Thanassoulis (2001) and Thanassoulis et al. (2007). Here, we take the intermediation approach considering that total bank costs depend on three bank outputs: total loans, total securities and other earning assets; and also on three bank inputs: borrowed funds, physical capital and labour. Our sample comprises annual data from the consolidated accounts of commercial and saving banks from 27 EU countries between 1996 and 2008, sourced from the IBCA-BankScope 2008 CD.

Appendix C reports the obtained DEA yearly bank cost efficiency results. In spite of year-on-year oscillations, in many EU countries, there is a clear trend towards decreasing bank cost efficiency levels (particularly for some large countries such as Germany and France alongside other smaller countries including Belgium, Denmark, Finland, Luxembourg, Sweden and the Netherlands). On the other hand, for some of the new EU member states, there is a trend towards increasing bank cost efficiency (and particularly evident for Bulgaria and Romania).

3.2. Economic growth

Economic growth will be represented by the Gross Domestic Product (GDP) but also by the gross fixed capital formation, taking into account the importance of the fixed capital to create necessary conditions to economic growth. The used data were sourced from the Eurostat statistical database and defined in nominal terms (as were also defined the bank performance variables, sourced from the IBCA-BankScope 2008 CD).

Gross domestic product

In our estimations we apply per capita nominal GDP at market prices (Euro per inhabitant) sourced from the Eurostat statistical database. The data reported in Appendix D demonstrate that during the period considered nominal per capita GDP rose throughout the 27 EU countries, and grew at its fastest pace in countries with lower GDP levels (for instance, around five times more in Bulgaria and in the Czech Republic) even though this increased growth did not amount to eliminating the enormous discrepancies still persisting among the 27 countries.

Gross fixed capital formation

Appendix E presents the yearly 27 EU country nominal gross fixed capital formation expenditure levels. With few exceptions, and only for the years 2002 (in countries including Austria, Belgium, Finland, Netherlands, Spain and Portugal) and 2008 (mostly in Greece, Ireland, Spain and the UK), there is a generalised rise in this expenditure in all countries and particularly clearly in the new EU member states.

3.3. Unit root tests

The number of observations in our panel (27 countries x 13 annual observations) does not lend itself to the application of single-unit root tests for time series. Therefore, we opted for panel-unit root tests, which prove more appropriate to this case. These tests not only increase the power of unit root testing due to the observation span but also minimise the risks of structural breaks.

From among the available panel unit root tests, we chose here to use the Levin, Lin and Chu (2002) test and the Im, Pesaran and Shin (2003) test.

The Levin, Lin and Chu (2002) may be viewed as a pooled Dickey-Fuller test, or as an augmented Dickey-Fuller test, which include lags and the null hypothesis stems from the existence of non-stationarity. This test is adequate for moderate size, heterogeneous panels and such as the panels applied in this paper with fixed effects, and assumes there is a common unit root process. The results reported in Appendix F enable us to reject the existence of the null hypothesis.

The Im, Pesaran and Shin (2003) test estimates the t-test for unit roots in heterogeneous panels and allows for individual unit root processes. This involves applying the mean of the individual Dickey-Fuller t-statistics to each panel unit and assumes that all series are non-stationary under the null hypothesis. Appendix G presents the results obtained with this test, and they confirm the rejection of non-stationarity.

4. **Empirical results**

In our estimations, we applied the variables defined in the previous section to test the panel Granger causality relations between economic growth (more precisely, the GDP per capita and also the gross fixed capital formation) and bank performance (represented by the Return on Assets, ROA, and the

Return on Equity, ROE, ratios and also by bank cost efficiency level as measured through Data Envelopment Analysis, DEA).

We opted to deploy both panel ordinary least squares (OLS) estimations and fixed-effects panel estimations, in keeping with Wooldridge (2002) and Baltagi (2008), among others and first present the results obtained for the causality running from bank performance to growth and then the inverse causality running from growth to bank performance.

4.1. Causality running from bank performance to growth

Table 1 feature the obtained results for the causality running from bank performance to economic growth generated by panel ordinary least square (OLS) robust estimations and panel fixed robust estimations.

As regards GDP per capita, Tables 1-A, 1-B and 1-C report the specific influence of the variables representing bank performance (respectively, the ROA and ROE ratios and also DEA bank cost efficiency). In all situations, the results obtained confirm the positive effect of all these variables on GDP growth, and these effects are statistically strong at least for the first lags of bank performance variables.

Simultaneously, and also as expected, as we are dealing with panel estimations, the R-squared values returned are not remarkable. Nevertheless, for the fixed-effects estimations, the R-squared obtained for "between" are not only relatively high but also always much higher than the R-squared "within", revealing how for the panel considered, the cross-section evolution ("between" the countries) is always stronger than the time evolution ("within" the interval considered).

We reach very similar conclusions in the second part of Table 1, which reports the results obtained for growth in gross fixed capital formation.

More precisely, in all situations, there is a clear and positive influence of ROA (Table 1-D), ROE (Table 1-E) and bank cost efficiency (Table 1-F) on the growth of the gross fixed capital formation, and these results are statistically stronger for the first lags of the bank performance variables. Furthermore, and also in line with the previous results, the R-squared values obtained enable us to conclude that the cross-section evolution between the 27 EU countries is more relevant in this panel than the time evolution during the interval considered (1996-2008).

A more careful comparison of the information reported in Table 1 clearly demonstrates that the best results are obtained in Table 1 – F, demonstrating that with both robust OLS and panel-fixed robust estimations, bank cost efficiency exerts a statistically strong positive influence on the growth in gross fixed capital formation.

These results reveal that Granger causality from bank efficiency to growth is particularly strong when growth is represented by gross fixed capital formation, confirming the position that well-functioning banking institutions do play an important role and not only in mobilising savings but also in diversifying risk and identifying the best investment opportunities.

TABLE 1 – CAUSALITY RUNNING FROM BANK PERFORMANCE TO ECONOMIC GROWTH

Table 1 - A - Dependent variable: **Gross domestic product at market prices (Euro per inhabitant);** explanatory variable: **Return on assets (ROA)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
GDP per capita t-1	-.02102	-2.00	0.046	-.0137797	-1.36	0.187
GDP per capita t-2	-.0093003	-1.42	0.156	-.0013958	-0.33	0.744
Return on assets (ROA) t-1	.8580076	1.49	0.137	.8257388	2.31	0.029
Return on assets (ROA) t-2	.030947	0.08	0.934	-.0058706	-0.02	0.986
Constant	.070038	21.49	0.000	.0701304	532.72	0.000
	R-squared: = 0.0730			**R-squared**: within = 0.0757 between = 0.2929 overall = 0.0686		
	F (4, 317) = 3.96 (Prob. > F = 0.0038)			**F**(4, 26) = 27.82 (Prob. > F = 0.0000)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.888955**			**0.819868**		

Table 1 - B - Dependent variable: **Gross domestic product at market prices (Euro per inhabitant);** explanatory variable: **Return on equity (ROE)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
GDP per capita t-1	-.0215765	-2.00	0.046	-.014548	-1.48	0.151
GDP per capita t-2	-.0093493	-1.43	0.153	-.0015179	-0.33	0.742
Return on equity (ROE) t-1	.0769428	1.81	0.072	.0714988	2.49	0.020
Return on equity (ROE) t-2	.0167438	0.59	0.553	.0134006	0.51	0.614
Constant	.0697435	21.26	0.000	.0698698	288.58	0.000
	R-squared: = 0.0752			**R-squared**: within = 0.0756 between = 0.2893 overall = 0.0712		
	F (4, 317) = 4.50 (Prob. > F = 0.0015)			**F** (4, 26) = 49.48 (Prob. > F = 0.0000)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.093687**			**0.084899**		

Table 1 - C - Dependent variable: **Gross domestic product at market prices (Euro per inhabitant);** explanatory variable: **Cost Efficiency (DEA)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
GDP per capita t-1	-.0289362	-2.92	0.004	-.0216277	-2.55	0.017
GDP per capita t-2	-.011864	-1.44	0.152	-.0040334	-0.56	0.582
Cost Efficiency (DEA) t-1	.0500286	2.47	0.014	.0393857	1.71	0.100
Cost Efficiency (DEA) t-2	.0229764	1.36	0.173	.0134193	0.66	0.518
Constant	.0699159	21.88	0.000	.07013	287.42	0.000
	R-squared: = 0.0810			**R-squared**: within = 0.0679 between = 0.2563 overall = 0.0783		
	F (4, 317) = 4.45 (Prob. > F = 0.0016)			**F** (4, 26) = 2.09 (Prob. > F = 0.1114)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.073005**			**0.052805**		

Table 1 - D - Dependent variable: **Gross fixed capital formation;** explanatory variable: **Return on assets (ROA)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Gross fixed capital formation t-1	-.0051933	-0.56	0.576	-.0001781	-0.02	0.986
Gross fixed capital formation t-2	-.0237701	-2.18	0.030	-.0182414	-1.67	0.107
Return on assets (ROA) t-1	1.156915	1.41	0.160	1.054623	1.35	0.190
Return on assets (ROA) t-2	.4841011	0.83	0.409	.4258303	0.82	0.418
Constant	.0822218	15.42	0.000	.0822752	244.77	0.000
	R-squared: = 0.0560			**R-squared**: within = 0.0449 between = 0.3104 overall = 0.0547		
	F (4, 317) = 2.22 (Prob. > F = 0.0662)			**F** (4, 26) = 4.81 (Prob. > F = 0.0040)		
Number of observations	322			322		
GRANGER COEFFICIENT	**1.641016**			**1.480533**		

Table 1 - E - Dependent variable: **Gross fixed capital formation;** explanatory variable: **Return on equity (ROE)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Gross fixed capital formation t-1	-.0054185	-0.57	0.566	-.0005223	-0.05	0.957
Gross fixed capital formation t-2	-.0226198	-2.03	0.043	-.017041	-1.49	0.147
Return on equity (ROE) t-1	.1259699	1.84	0.067	.1132009	1.96	0.061
Return on equity (ROE) t-2	.0793229	1.80	0.073	.0738109	1.34	0.191
Constant	.0816039	15.35	0.000	.0817264	167.77	0.000
	R-squared: = 0.0686			**R-squared**: within = 0.0579 between = 0.3577 overall = 0.0672		
	F (4, 317) = 3.26 (Prob. > F = 0.0121)			**F** (4, 26) = 7.54 (Prob. > F = 0.0004)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.205293**			**0.187012**		

Table 1 - F - Dependent variable: **Gross fixed capital formation;** explanatory variable: **Cost Efficiency (DEA)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Gross fixed capital formation t-1	-.0124428	-2.02	0.044	-.0071564	-0.95	0.353
Gross fixed capital formation t-2	-.0271697	-2.51	0.013	-.0217012	-2.55	0.017
Cost Efficiency (DEA) t-1	.1181437	4.20	0.000	.1068434	3.26	0.003
Cost Efficiency (DEA) t-2	.0637245	2.60	0.010	.0527886	1.94	0.064
Constant	.0815758	15.80	0.000	.0817325	259.91	0.000
	R-squared: = 0.1091			**R-squared**: within = 0.0956 between = 0.2870 overall = 0.1079		
	F (4, 317) = 7.35 (Prob. > F = 0.0000)			**F** (4, 26) = 4.82 (Prob. > F = 0.0048)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.181868**			**0.159632**		

4.2. Causality running from growth to bank performance

The results returned for the causality running from economic growth to bank performance, and also applying panel OLS robust estimations and fixed-effects robust estimations, are detailed in Table 2.

More precisely, in the first half of this table we report the results for the influence of GDP per capita growth on the three bank performance variables: on Return on Assets (Table 2 – A), on Return on Equity (Table 2 – B) and on bank cost efficiency (Table 2 – C). In the final section of Table 2 (that is, Table 2 – D, Table 2 – E and Table 2 – F), we set out the results obtained for the influence of gross fixed capital formation on ROA, ROE and bank efficiency respectively.

In all situations, the resulting R-squared values presented in Table 2 are much higher than those for the causality running from bank performance to growth reported in Table 1. Furthermore, and also contrary to Table 1, for the fixed-effects estimations we obtain a much stronger R-squared "within" result than that for the R-squared "between" and therefore reach the conclusion that for the causality running from growth to bank performance the time evolution ("within" the considered interval, 1996-2008) is much more relevant than the cross-section evolution ("between" the 27 EU countries included in the panel).

In addition, for all the explanatory variables, the results obtained are statistically valid (and much stronger) for the second lags than for the first, confirming the relevance of time delays to this process as the effects of economic growth on bank performance are not immediate.

The information generated allows for the conclusion that in spite of the oscillations between the first and the second lags, economic growth (GDP per capita and gross fixed capital formation) wields a generally positive influence on both the ROA and the ROE ratios as not only are the results of the second lags positive and statistically relevant but also the joint-influence of the two lags under consideration, represented by the correspondent causality Granger coefficients, always proves positive.

On the other hand, for the causality running from economic growth to bank cost efficiency, the results obtained when growth is proxied by GDP per capita (Table 2 – C) and when proxied by gross fixed capital formation (Table 2 – F), while not very strongly in statistical terms, generally turn out negative.

To understand this possible non-alignment between economic growth and bank efficiency, we should recall that DEA efficiency is a relative measure, dependent on the chosen sample and, in our estimations, we considered that bank costs depend on the combinations of three bank outputs (total loans, total securities and other earning assets) and three bank inputs (borrowed funds, physical capital and labour).

Hence, it would not prove difficult to accept that, for our panel of EU countries, over the time period considered, these combinations of outputs and inputs depend on many factors other than economic growth.

TABLE 2 – CAUSALITY RUNNING FROM ECONOMIC GROWTH TO BANK PERFORMANCE

Table 2-A - Dependent variable: **Return on assets (ROA);** explanatory variable: **Gross domestic product at market prices (Euro per inhabitant)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Return on assets (ROA) t-1	-.3484563	-2.56	0.011	-.3473012	-4.00	0.000
Return on assets (ROA) t-2	-.2684678	-3.06	0.002	-.2684267	-10.54	0.000
GDP per capita t-1	-.0038217	-1.46	0.146	-.0035203	-1.27	0.214
GDP per capita t-2	.0088773	2.75	0.006	.0091956	2.84	0.009
Constant	-.0001383	-0.32	0.752	-.0001357	-2.54	0.017
	R-squared: = 0.4224			**R-squared**: within = 0.4285 between = 0.1189 overall = 0.4221		
	F (4, 317) = 5.99 (Prob. > F = 0.0001)			**F** (4, 26) = 28.85 (Prob. > F = 0.0000)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.005056**			**0.005675**		

Table 2-B - Dependent variable: **Return on equity (ROE);** explanatory variable: **Gross domestic product at market prices (Euro per inhabitant)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Return on equity (ROE) t-1	-.3498541	-1.94	0.053	-.3495838	-4.00	0.000
Return on equity (ROE) t-2	-.230413	-2.05	0.041	-.2290209	-9.01	0.000
GDP per capita t-1	-.0222006	-1.06	0.290	-.0180974	-0.96	0.348
GDP per capita t-2	.0895546	2.29	0.023	.0942303	2.50	0.019
Constant	-.0029979	-0.43	0.667	-.0029558	-3.00	0.006
	R-squared: = 0.2805			**R-squared**: within = 0.2874 between = 0.0386 overall = 0.2802		
	F (4, 317) = 4.72 (Prob. > F = 0.0010)			**F** (4, 26) = 22.91 (Prob. > F = 0.0000)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.067354**			**0.076133**		

Table 2 - C - Dependent variable: **Cost Efficiency (DEA);** explanatory variable: **Gross domestic product at market prices (Euro per inhabitant)**

	OLS robust			**Fixed-effects robust**		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Cost Efficiency (DEA) t-1	-.0861809	-1.26	0.210	-.1111668	-2.67	0.013
Cost Efficiency (DEA) t-2	-.1639728	-1.89	0.060	-.1857853	-3.43	0.002
GDP per capita t-1	-.001682	-0.05	0.958	.007362	0.27	0.786
GDP per capita t-2	-.0931096	-1.75	0.082	-.0844469	-1.64	0.112
Constant	-.0051778	-0.61	0.540	-.0047732	-10.53	0.000
	R-squared: = 0.1181			**R-squared**: within = 0.1282 between = 0.0047 overall = 0.1157		
	F (4, 317) = 2.53 (Prob. > F = 0.0408)			**F** (4, 26) = 10.85 (Prob. > F = 0.0000)		
Number of observations	322			322		
GRANGER COEFFICIENT	**-0.094792**			**-0.077085**		

Table 2 - D - Dependent variable: **Return on assets (ROA);** explanatory variable: **Gross fixed capital formation**

	OLS robust			Fixed-effects robust		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Return on assets (ROA) t-1	-.3531667	-2.48	0.014	-.3514223	-3.90	0.001
Return on assets (ROA) t-2	-.3034327	-3.15	0.002	-.3024296	-8.80	0.000
Gross fixed capital formation t-1	-.0017174	-1.27	0.205	-.0014962	-1.01	0.321
Gross fixed capital formation t-2	.0060029	2.73	0.007	.0062315	2.70	0.012
Constant	-.0001518	-0.35	0.730	-.0001523	-3.41	0.002
	R-squared: = 0.4322			**R-squared**: within = 0.4384 between = 0.1598 overall = 0.4319		
	F (4, 317) = 5.58 (Prob. > F = 0.0002)			**F** (4, 26) = 42.96 (Prob. > F = 0.0000)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.004286**			**0.004735**		

Table 2 - E - Dependent variable: **Return on equity (ROE);** explanatory variable: **Gross fixed capital formation**

	OLS robust			Fixed-effects robust		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Return on equity (ROE) t-1	-.3541566	-2.02	0.044	-.3517636	-3.84	0.001
Return on equity (ROE) t-2	-.2484065	-2.25	0.025	-.2452814	-8.67	0.000
Gross fixed capital formation t-1	-.0092782	-0.86	0.391	-.0055061	-0.56	0.579
Gross fixed capital formation t-2	.0665872	2.38	0.018	.0705989	2.46	0.021
Constant	-.00316	-0.46	0.647	-.0031785	-3.61	0.001
	R-squared: = 0.3129			**R-squared**: within = 0.3224 between = 0.0287 overall = 0.3123		
	F (4, 317) = 4.88 (Prob. > F = 0.0008)			**F** (4, 26) = 30.38 (Prob. > F = 0.0000)		
Number of observations	322			322		
GRANGER COEFFICIENT	**0.057309**			**0.065093**		

Table 2 - F - Dependent variable: **Cost Efficiency (DEA);** explanatory variable: **Gross fixed capital formation**

	OLS robust			Fixed-effects robust		
	coef.	**t**	**P>|t|**	**coef.**	**t**	**P-value**
Cost Efficiency (DEA) t-1	-.0866303	-1.26	0.208	-.1144128	-2.68	0.013
Cost Efficiency (DEA) t-2	-.1592579	-1.69	0.091	-.1824269	-2.87	0.008
Gross fixed capital formation t-1	-.0026062	-0.17	0.864	-.0001657	-0.01	0.991
Gross fixed capital formation t-2	-.0414804	-1.35	0.177	-.0396671	-1.30	0.205
Constant	-.00474	-0.54	0.588	-.004398	-9.82	0.000
	R-squared: = 0.0829			**R-squared**: within = 0.1000 between = 0.0584 overall = 0.0818		
	F (4, 317) = 2.39 (Prob. > F = 0.0507)			**F** (4, 26) = 9.02 (Prob. > F = 0.0001)		
Number of observations	322			322		
GRANGER COEFFICIENT	**-0.044087**			**-0.039833**		

4.3. Granger coefficients and F-tests results

In Table 3, we present a summary of the values obtained with OLS robust and fixed-effects robust estimations for the causality Granger coefficients and the F tests (always supposing the joint hypothesis $\beta_1 = \beta_2 = 0$). In Part I of Table 3 we put forward the results for causality running from bank performance to economic growth before the results for inverse causality, from growth to bank performance, in Part II.

The F-test results underpin the conclusion that, in general, our estimations are statistically significant for bi-directional causality relations between growth and bank performance.

The reported values of the Granger coefficients clearly confirm the positive causality between bank performance (here represented by the ROA and ROE ratios and bank cost efficiency) and economic growth. These results are in line with the literature defending how the best financial practices nurture economic growth (for instance, recently, Greenwood et al. 2013) and very particularly with the conclusions from such authors as Koetter and Wedow (2010) or Hasan et al. (2009), who have analysed the importance of bank efficiency to growth in some EU countries for time intervals ranging from the mid-1990s through to the mid-2000s.

On the other hand, for causality running from economic growth to bank performance, the Granger coefficient results presented in the second part of Table 3 are not unanimous. However, there is no doubt that growth enhances the rise in bank ROA (more precisely, the ratio between net bank income and total assets) and also of bank ROE (thus, the ratio between net income and bank equity). Hence, for these two ratios, and also taking into account the results reported in the first section of Table 3, we may conclude in favour of clear and positive bi-directional panel Granger causality between growth and bank performance.

However, as regards the influence of economic growth on bank efficiency, the Granger coefficients presented in Table 3 do not provide for any conclusion as to growth bringing about an increase in bank efficiency.

However, this does not prove unusual when taking into consideration not only the definition of DEA bank cost efficiency but also the variety of conclusions about the levels of importance of economic growth to financial development reported by authors including Hassan et al. (2011), Bangake and Eggoh (2011) and Abdelhafidh (2013) for different kinds of countries and regions.

TABLE 3 – GRANGER COEFFICIENTS AND F-TESTS RESULTS

Part I				Part II		
	OLS robust	Fixed effects robust			OLS robust	Fixed effects robust
1-A Dep. var: **GDP per capita**; expl.var: **Return on assets (ROA)**	**0.888955** F (4, 317) = 3.96 (Prob. > F = 0.0038)	**0.819868** F(4, 26) = 27.82 (Prob. > F = 0.0000)		**2-A** Dep. var: **Return on assets (ROA)**; expl.var: **GDP per capita**	**0.005056** F (4, 317) = 5.99 (Prob. > F = 0.0001)	**0.005675** F (4, 26) = 28.85 (Prob. > F = 0.0000)
1-B Dep. var: **GDP per capita**; expl.var: **Return on equity (ROE)**	**0.093687** F (4, 317) = 4.50 (Prob. > F = 0.0015)	**0.084899** F (4, 26) = 49.48 (Prob. > F = 0.0000)		**2-B** Dep. var: **Return on equity (ROE)**; expl.var: **GDP per capita**	**0.067354** F (4, 317) = 4.72 (Prob. > F = 0.0010)	**0.076133** F (4, 26) = 22.91 (Prob. > F = 0.0000)
1-C Dep. var: **GDP per capita**; expl.var: **Cost Efficiency (DEA)**	**0.073005** F (4, 317) = 4.45 (Prob. > F = 0.0016)	**0.052805** F (4, 26) = 2.09 (Prob. > F = 0.1114)		**2-C** Dep. var: **Cost Efficiency (DEA)**; expl.var: **GDP per capita**	**-0.094792** F (4, 317) = 2.53 (Prob. > F = 0.0408)	**-0.077085** F (4, 26) = 10.85 (Prob. > F = 0.0000)
1-D Dep. var: **Gross fixed capital formation**; expl.var: **Return on assets (ROA)**	**1.641016** F (4, 317) = 2.22 (Prob. > F = 0.0662)	**1.480533** F (4, 26) = 4.81 (Prob. > F = 0.0040)		**2-D** Dep. var: **Return on assets (ROA)**; expl.var: **Gross fixed capital formation**	**0.004286** F (4, 317) = 5.58 (Prob. > F = 0.0002)	**0.004735** F (4, 26) 42.96 (Prob. > F = 0.0000)
1-E Dep. var : **Gross fixed capital formation**; expl.var: **Return on equity (ROE)**	**0.205293** F (4, 317) = 3.26 (Prob. > F = 0.0121)	**0.187012** F (4, 26) = 7.54 (Prob. > F = 0.0004)		**2-E** Dep. var: **Return on equity (ROE)**; expl.var: **Gross fixed capital formation**	**0.057309** F (4, 317) = 4.88 (Prob. > F = 0.0008)	**0.065093** F (4, 26) = 30.38 (Prob. > F = 0.0000)
1-F Dep. var : **Gross fixed capital formation**; expl.var: **Cost Efficiency (DEA)**	**0.181868** F (4, 317) = 7.35 (Prob. > F = 0.0000)	**0.159632** F (4, 26) = 4.82 (Prob. > F = 0.0048)		**2-F** Dep. var: **Cost Efficiency (DEA)**; expl.var: **Gross fixed capital formation**	**-0.044087** F (4, 317) = 2.39 (Prob. > F = 0.0507)	**-0.039833** F (4, 26) = 9.02 (Prob. > F = 0.0001)

5. **Conclusions**

This paper contributes towards the debate on the causality relationship between bank performance and economic growth by applying a panel Granger causality approach to 27 European Union countries for the time period between 1996 and 2008.

The proxies for bank performance are the Return on Assets (ROA) and the Return on Equity (ROE) ratios in conjunction with bank cost efficiency, measured by the Data Envelopment Analysis (DEA) non-parametric approach. Furthermore, to represent economic growth, we opt not only to deploy GDP per capita but also gross fixed capital formation.

The results obtained are in line with the conclusions reached by those defending how good financial practices help foster economic growth (among others, Koetter and Wedow, 2010; Hasan et al., 2009; Hassan et al., 2011; Greenwood et al., 2013). Our evidence clearly supports the causality running from bank performance to economic growth as, in all situations, we report the positive influence of ROA, the ROE and DEA bank cost efficiency on both per capita GDP and on gross fixed capital formation growth.

Additionally, for the opposite causality, running from economic growth to bank performance, there is clear evidence that both GDP per capita and growth in gross fixed capital formation contribute positively to the ROA and ROE ratios. These results underpin the conclusion that, whenever applying these two proxies for bank performance, we obtain positive bi-directional panel Granger causality between economic growth and bank performance.

However, when approaching bank performance according to DEA bank cost efficiency, we are then unable to confirm this positive bi-directional relationship as while there is evidence that bank cost efficiency does enhance economic growth, there is no clear statistic evidence on whether per capita GDP and growth in gross fixed capital formation growth result in an increase in bank cost efficiency levels.

The explanation for these results, on the one hand, stems both from the specific characteristics of DEA bank cost efficiency and also from the fact that bank efficiency always depends not only on the macroeconomic environment prevailing but also on the ongoing management decisions at banking institutions. From another perspective, our results fall within the framework of the controversial factors and levels of contribution of economic growth to financial development identified in different countries and regions and recently underlined by such authors as Hassan et al. (2011), Bangake and Eggoh (2011) and Abdelhafidh (2013).

As policy implications to the conclusions presented, we would underline the important role of bank performance as a condition favourable to the financing of gross fixed capital formation and fostering economic growth in European Union member states from at least the mid-1990s and through to the onset of the recent financial crisis. Furthermore, the subsequent crisis has also clearly demonstrated that problems in the EU banking sector lowered its capacity to finance productive activities and hence acting as a drag on economic recovery and growth.

References

Abdelhafidh, S. (2013), "Potential financing sources of investment and economic growth in North African countries: A causality analysis", *Journal of Policy Modelling*, **35**, pp. 150-169.

Ayadi, R., E. Arbak, S. Ben-Naceur and W.P. De Groen (2013) *Financial Development, Bank Efficiency and Economic Growth across the Mediterranean*, European Commission European Research Area, WP 6 – Financial services and capital markets; MEDPRO Technical Report No 30.

Baltagi, H. B. (2008) *Econometric Analysis of Panel Data*, Forth Edition, John Wiley & Sons Ltd.

Bangake, C. and J. Eggoh (2011) "Further evidence on finance-growth causality: A panel data analysis", *Economic Systems*, **35**, pp. 176-188.

Beck, T., A. Demirgüç-Kunt and R. Levine (2000) "A new database on financial development and structure", *World Bank Economic Review*, **14**, pp. 597–605.

Beck, T., A. Demirgüç-Kunt and R. Levine (2004) *Finance, Inequality and Poverty: Cross-Country Evidence*, World Bank Policy Research Working Paper No. 3338.

Bencivenga, V., B. Smith and R. Starr (1995) "Transaction Costs, Technological Choice and Endogenous Growth", *Journal of Economic Theory*, **67**, pp. 53-117

Berthelemy, J.C. and A. Varoudakis (1996) "Economic growth, convergence clubs, and the role of financial development", *Oxford Economic Papers*, **48**, pp. 300–328.

Bhide, A. (1993) "The Hidden Costs of Stock Market Liquidity", *Journal of Financial Economics*, **34**, pp. 1-51.

Blackburn, K., and V. Hung (1998) "A theory of growth, financial development and trade", *Economica*, **65**, pp. 107–124.

Calderon, C. and L. Liu (2003) "The direction of causality between financial development and economic growth", *Journal of Development Economics*, **72**, pp. 321–334.

Cecchetti, S. and E. Kharroubi (2012) *Reassessing the impact of finance on growth*, Bank for International Settlements, Working Paper No. 381.

Coelli, T.J., D. S. Prasada Rao and G. Battese (1998) *An Introduction to Efficiency and Productivity Analysis*, Norwell, Kluwer Academic Publishers.

Demetriades, P., and K. Hussein (1996) "Does financial development cause economic growth? Time series evidence from 16 countries", *Journal of Development Economics*, **5**, pp. 387–411.

Demirguç-Kunt, A. and R. Levine (1999) *Bank-Based and Market-Based Financial Systems: Cross Country Comparisons*, World Bank Policy Research Working Paper, No 2143.

Goldsmith, R. W. (1969) *Financial structure and development*, New Haven, CT Yale University Press.

Granger, C. W.J.(1969) "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods." *Econometrica*, **37**, pp. 424-438.

Greenwood, J. and S. Bruce (1997) "Financial markets in development, and the development of financial markets", *Journal of Political Economy*, **98**, pp. 1076–1107.

Greenwood, J, and B. Jovanovic (1990) “Financial development, growth and the distribution of income”, *Journal of Economic Dynamic and Control*, **21**, pp. 145–181.

Greenwood, J., C. Wang and J. M. Sanchez (2010) “Financing development: The role of information costs”, *American Economic Review*, **100**, pp. 1875–1891.

Greenwood, J., J.M. Sanchez and C. Wang (2013) “Quantifying the impact of financial development on economic development”, *Review of Economic Dynamics*, **16**, pp. 194-215.

Gurley, J., and E. Shaw (1967) “Financial structure and economic development”, *Economic Development and Cultural Change*, **15**, pp. 257–268.

Hasan, I., M. Koetter and M. Wedow (2009) “Regional growth and finance in Europe: Is there a quality effect of bank efficiency?”, *Journal of Banking and Finance,* **33**, pp. 1446-1453.

Hassan, M., B. Sanchez, and J. Yu. (2011) “Financial development and economic growth: New evidence from panel data”, *The Quarterly Review of Economics and Finance,* **51**, pp. 88-104.

Holtz-Eakin, D., W. Newey and H.S. Rosen (1988) “Estimating Vector Autoregressions with Panel Data”. *Econometrica*, **56**, pp. 1371–95.

Hurlin, C. and B. Venet (2008) “Financial Development and Growth: A Re-Examination using a Panel Granger Causality Test” Working Paper halshs-00319995, version 1.

Im, K., M. Pesaran and Y. Shin (2003) “Testing for Unit Roots In Heterogeneous Panels”, *Journal of Econometrics,* **115**, pp. 53-74.

Jung, W. S. (1986) “Financial development and economic growth: International evidence”, *Economic Development and Cultural Change*, **34**, pp. 336–346.

Kar, M., S. Nazlioglu and H. Agir (2011) “Financial development and economic growth nexus in the MENA countries: Bootstrap panel granger causality analysis”, *Economic Modelling*, **28**, pp. 685-693.

Khan, A. (2001) “Financial development and economic growth”, *Macroeconomics Dynamics*, **5**, pp. 413–433.

Khan, M. S. and A. Senhadji (2000) "Financial Development and Economic Growth: An Overview" IMF Working Paper No 209.

King, R. and R. Levine (1993) “Finance and Growth: Schumpeter Might be Right”, *Quarterly Journal of Economics*, **108** (3), pp. 717-737.

Koetter, M. and M. Wedow (2010) “Finance and growth in a bank-based economy: Is it quantity or quality that matters?”, *Journal of International Money and Finance*, **29**, pp. 1529-1545.

Kónya, L. (2006) “Exports and growth: Granger causality analysis on OECD countries with a panel data approach”, *Economic Modelling*, **23**, pp. 978-992.

Levin, A, C. Lin and C. Chu (2002) “Unit Root Tests in Panel Data: Asymptotic and Finite Sample Properties”, *Journal of Econometrics,* **108**, pp. 1-24.

Levine, R. and S. Zervos (1998) “Stock markets, banks and economic growth”, *American Economic Review,* **88** (3), pp. 537-558.

Loayza, N. V. and R. Rancière, Romain (2006) "Financial Development, Financial Fragility, and Growth", *Journal of Money, Credit and Banking*, **38**(4), pp. 1051-1076.

Luintel, B. K. and M. Khan (1999) "A quantitative re-assessment of the finance-growth nexus: Evidence from amultivariate VAR", *Journal of Development Economics*, **60**, pp. 381–405.

Nair-Reichert, U. and D. Weinhold (2001) "Causality tests for cross-country panels: a look at FDI and economic growth in less developed countries", *Oxford Bulletin of Economics and Statistics*, **63**, pp. 153-171.

Patrick, H.T. (1966) "Financial development and economic growth in underdeveloped countries", *Economic Development and Cultural Change*, **14**, pp. 174–189.

Rajan, R. and L. Zingales (1998) "Financial dependence and growth", *American Economic Review,* **88**, pp.559-587.

Robinson, J. (1952) *The rate of interest and other essays,* Macmillian, London.

Schumpeter, J.A. (1911) *The Theory of Economic Development*, Harvard University Press, Cambridge.

Shan, J., A. Morris, A. and F. Sun (2001) "Financial development and economic growth: An egg-chicken problem?" *Review of International Economics,* **9**, pp. 443–454.

Stiglitz, J. (1985) "Credit markets and the Control of capital", *Journal of Money, Credit and Banking*, **17**, pp. 133-152

Thanassoulis, E. (2001) *Introduction to the Theory and Application of Data Envelopment Analysis - A Foundation Text with Integrated Software*, Kluwer Academic Publishers, USA.

Thanassoulis, E., M.C.S. Portela and O. Despic (2007) "DEA – The Mathematical Programming Approach to Efficiency Analysis" in *The Measurement of Productive Efficiency and Productivity Growth*, H. O. Fried; C. A. K. Lovell, S.S. Schmidt (editors), Oxford University Press.

Weinhold, D. (1996) "Testes de causalité sur donnés de panel: une application à l'étude de la causalité entre l'investissement et la croissance", *Économie et prévision*, **126**, pp. 163-175.

Wooldridge, J. (2002) *Econometric Analysis of Cross Section and Panel Data*, The MIT Press.

Appendix A – Return on assets (ROA)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	0.0026	0.00345	0.00286	0.00403	0.00419	0.00325	0.00252	0.00348	0.00375	0.00462	0.00902	0.00586	-0.00142
Belgium	0.00302	0.00302	0.00287	0.00468	0.0057	0.00555	0.00387	0.00456	0.00431	0.00461	0.00684	0.00334	-0.01741
Bulgaria	0.05388	0.0967	0.00694	0.01875	0.02756	0.0168	0.01766	0.02099	0.01911	0.02024	0.01917	0.02198	0.02267
Cyprus	0.00389	0.00377	0.00541	0.01176	0.01105	0.00705	-0.00211	-0.0002	0.00202	0.00476	0.00888	0.01536	0.0116
Czech Rep.	0.00324	-0.00751	-0.00996	-0.00912	0.00383	0.00149	0.01318	0.01391	0.01344	0.01442	0.01357	0.0137	0.01222
Denmark	0.00834	0.00804	0.0072	0.00615	0.00603	0.00511	0.00455	0.00656	0.00565	0.00669	0.00719	0.00557	-0.00063
Estonia	0.02395	0.02263	-0.01593	0.01879	0.0171	0.02385	0.02386	0.02296	0.02127	0.01772	0.01719	0.02002	0.01383
Finland	0.00365	0.00862	0.00448	0.00815	0.01414	0.01517	0.00474	0.01658	0.00773	0.00868	0.00884	0.00965	0.00502
France	0.00073	0.00165	0.00269	0.00314	0.00481	0.00388	0.00349	0.00386	0.00497	0.00443	0.00571	0.00282	-0.00105
Germany	0.00231	0.00222	0.00377	0.00219	0.00399	-0.00018	-0.0019	-0.00203	0.00051	0.00269	0.00359	0.00388	-0.00223
Greece	0.00559	0.00606	0.00721	0.02243	0.0131	0.00954	0.00489	0.00747	0.00536	0.00921	0.00834	0.01075	0.0043
Hungary	0.01177	0.01083	-0.00029	0.00374	0.0114	0.0136	0.01482	0.01735	0.02394	0.01839	0.01721	0.01623	0.01344
Ireland	0.00687	0.00695	0.00766	0.00733	0.006	0.00464	0.00439	0.00522	0.00548	0.00551	0.0063	0.00611	0.0008
Italy	0.00201	0.00071	0.00462	0.00634	0.00728	0.00536	0.00433	0.00505	0.00608	0.00727	0.00775	0.00641	0.00419
Latvia	0.03149	0.02642	-0.06331	0.00926	0.01632	0.01551	0.01397	0.01374	0.01609	0.01839	0.01712	0.01735	0.00019
Lithuania	-0.00612	0.00592	0.01042	0.01309	0.00778	0.00381	0.00829	0.01133	0.00999	0.00874	0.01178	0.01446	0.00947
Luxembourg	0.00426	0.00419	0.00543	0.00405	0.00469	0.00505	0.00516	0.00544	0.00493	0.00574	0.00857	0.00627	0.00262
Malta	0.00857	0.00941	0.00772	0.00757	0.01091	0.00818	0.00659	0.00876	0.01008	0.01233	0.01164	0.00941	-0.00227
Netherlands	0.00689	0.00675	0.00682	0.0067	0.00834	0.00707	0.00453	0.0061	0.00509	0.00688	0.00686	0.00805	-0.00883
Poland	0.0217	0.01648	0.00751	0.0107	0.01053	0.00763	0.00429	0.00355	0.01339	0.01722	0.0171	0.01973	0.016
Portugal	0.00586	0.00756	0.0075	0.0079	0.00914	0.00725	0.00654	0.00683	0.00509	0.00652	0.00755	0.00721	0.00288
Romania	0.00241	0.00074	-0.009	0.02758	0.02114	0.02552	0.01705	0.01196	0.02172	0.01683	0.01594	0.0131	0.0202
Slovakia	0.00182	-0.00696	-0.02133	0.01443	0.0153	0.01043	0.01232	0.0131	0.01082	0.00999	0.01105	0.0115	0.00873
Slovenia	0.01058	0.00956	0.01151	0.00645	0.01095	0.00511	0.00706	0.00615	0.00767	0.0073	0.00899	0.00929	0.00439
Spain	0.00619	0.00698	0.00783	0.00803	0.00826	0.00808	0.00764	0.00773	0.00747	0.00773	0.0089	0.00978	0.0069
Sweden	0.00945	0.00487	0.00717	0.00674	0.00756	0.00888	0.0045	0.00582	0.00885	0.00683	0.00677	0.00658	0.00454
UK	0.00674	0.00597	0.00834	0.00793	0.00794	0.0071	0.00622	0.00761	0.00744	0.00537	0.00547	0.00592	-0.00009

This appendix presents the obtained yearly EU country returns on assets (ROA = net income/assets). Source: own calculations with data sourced from the IBCA-BankScope 2008 CD (annual data from the consolidated accounts of the commercial and saving banks, all in nominal values and in Euros).

Appendix B – Return on equity (ROE)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	0.07012	0.08268	0.0717	0.10285	0.1149	0.08425	0.06325	0.07434	0.08538	0.09875	0.16321	0.09107	-0.02699
Belgium	0.10145	0.09688	0.08235	0.13048	0.1604	0.17411	0.10844	0.13201	0.13042	0.15421	0.21715	0.07971	-0.52826
Bulgaria	0.43574	0.64501	0.04117	0.10237	0.15356	0.11381	0.12309	0.14553	0.16157	0.17414	0.17626	0.19653	0.18565
Cyprus	0.06761	0.0682	0.0941	0.15086	0.11837	0.08053	-0.02424	-0.00296	0.03704	0.09008	0.11125	0.15764	0.13239
Czech Rep.	0.04608	-0.11873	-0.15207	-0.14085	0.05733	0.02374	0.18834	0.18377	0.16247	0.17876	0.17501	0.20417	0.14958
Denmark	0.13266	0.14013	0.12551	0.11145	0.11017	0.10189	0.09585	0.13581	0.12381	0.13881	0.13917	0.11885	-0.01584
Estonia	0.26234	0.25425	-0.10693	0.12701	0.12888	0.18962	0.18476	0.18313	0.20602	0.20292	0.22375	0.25453	0.14777
Finland	0.07584	0.1886	0.09463	0.16671	0.22149	0.23956	0.07312	0.17018	0.08563	0.1005	0.0965	0.13678	0.09833
France	0.02058	0.0491	0.07574	0.08075	0.12459	0.10213	0.08729	0.09581	0.13134	0.12659	0.15251	0.08743	-0.03695
Germany	0.0647	0.06262	0.10468	0.06207	0.10063	-0.00403	-0.0478	-0.05344	0.0154	0.07803	0.10829	0.11397	-0.07949
Greece	0.12395	0.12592	0.12222	0.21942	0.15107	0.12468	0.07597	0.11189	0.08771	0.13803	0.11176	0.1466	0.0771
Hungary	0.20067	0.14938	-0.00464	0.05168	0.14947	0.17457	0.17517	0.19713	0.2474	0.21231	0.189	0.18294	0.16369
Ireland	0.10778	0.11656	0.12663	0.12916	0.09938	0.09332	0.10073	0.13648	0.13956	0.1512	0.1691	0.16367	0.0252
Italy	0.03248	0.01212	0.07539	0.10621	0.12109	0.08584	0.06809	0.07376	0.09107	0.09731	0.11052	0.07958	0.05588
Latvia	0.2347	0.21165	-0.79227	0.09451	0.18878	0.16992	0.15678	0.15339	0.18947	0.22583	0.21638	0.20573	0.0024
Lithuania	-0.0944	0.06697	0.08455	0.10784	0.06946	0.03556	0.07332	0.1123	0.11137	0.11295	0.16206	0.19346	0.11498
Luxembourg	0.13237	0.13567	0.15398	0.11146	0.12008	0.12174	0.11354	0.12027	0.10508	0.12224	0.17984	0.13193	0.05362
Malta	0.15712	0.16442	0.10927	0.10722	0.1479	0.1102	0.08934	0.05892	0.07043	0.09368	0.08918	0.08777	-0.02371
Netherlands	0.1077	0.11702	0.12257	0.13324	0.14828	0.13617	0.0971	0.13562	0.15143	0.16493	0.166	0.16065	-0.25869
Poland	0.24709	0.1869	0.08864	0.12328	0.11412	0.08001	0.04391	0.03965	0.12701	0.16575	0.16663	0.19204	0.17613
Portugal	0.09731	0.12965	0.11553	0.12514	0.16528	0.13154	0.10931	0.10743	0.08646	0.11704	0.11874	0.11894	0.05323
Romania	0.03886	0.00847	-0.07063	0.17422	0.12891	0.14468	0.10438	0.08074	0.1699	0.15345	0.16463	0.15455	0.22711
Slovakia	0.03798	-0.14916	-0.82112	0.23768	0.21061	0.13332	0.13958	0.14107	0.12162	0.12898	0.15206	0.15506	0.11975
Slovenia	0.09374	0.08089	0.11398	0.06774	0.11554	0.05954	0.08655	0.07417	0.09183	0.09395	0.11265	0.11967	0.05467
Spain	0.10724	0.1181	0.12561	0.12915	0.11746	0.1159	0.1095	0.11587	0.10342	0.11944	0.13925	0.15256	0.11552
Sweden	0.23566	0.12267	0.19192	0.16768	0.20256	0.22153	0.115	0.13852	0.20442	0.16303	0.16075	0.16533	0.1289
UK	0.14577	0.12942	0.16932	0.14853	0.14254	0.12455	0.11284	0.13373	0.15684	0.14866	0.15404	0.15892	-0.00381

This appendix presents the obtained yearly EU country returns on equity (ROE = net income/equity). Source: own calculations with data sourced from the IBCA-BankScope 2008 CD (annual data from the consolidated accounts of the commercial and saving banks, all in nominal values and in Euros).

Appendix C – Yearly Data Envelopment Analysis (DEA) cost efficiency measures of the EU member states

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	0.702	0.629	0.595	0.760	0.720	0.616	0.643	0.694	0.676	0.707	0.662	0.678	0.715
Belgium	0.950	0.887	0.903	0.983	0.826	0.911	0.793	0.958	0.594	0.819	0.672	0.463	0.478
Bulgaria	0.149	0.270	1.000	1.000	1.000	1.000	1.000	0.970	0.937	0.832	1.000	1.000	0.915
Cyprus	1.000	1.000	1.000	1.000	1.000	1.000	0.914	0.725	0.695	0.679	0.837	0.800	0.937
Czech Rep.	0.945	0.803	0.579	0.632	0.859	0.741	0.681	0.716	0.838	0.897	1.000	1.000	1.000
Denmark	0.926	0.853	0.830	0.785	0.668	0.525	0.607	0.776	0.780	0.734	0.928	0.722	0.536
Estonia	1.000	0.864	0.730	0.647	0.717	0.765	0.621	0.587	0.760	0.777	0.893	0.711	0.669
Finland	0.783	1.000	1.000	1.000	0.737	1.000	0.687	0.677	1.000	0.905	1.000	0.845	0.579
France	0.818	0.699	0.687	0.739	0.552	0.547	0.578	0.576	0.531	0.577	0.606	0.597	0.712
Germany	0.948	0.889	1.000	0.981	0.772	0.762	0.887	0.934	0.956	0.776	0.821	0.699	0.606
Greece	0.754	0.685	0.643	0.604	0.734	0.781	0.949	1.000	1.000	1.000	1.000	0.967	0.991
Hungary	0.334	0.298	0.365	0.367	0.539	0.504	0.402	0.485	0.434	0.433	0.523	0.500	0.495
Ireland	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.951	1.000	1.000	0.849	0.959
Italy	1.000	0.872	1.000	1.000	0.975	0.802	0.921	0.924	1.000	0.958	0.984	0.741	0.740
Latvia	1.000	1.000	0.990	1.000	1.000	0.947	0.885	0.910	0.991	0.827	0.839	0.721	0.729
Lithuania	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.900	0.778
Luxembourg	0.879	0.690	0.730	0.696	0.654	0.508	0.564	0.697	0.673	0.757	0.523	0.544	0.524
Malta	1.000	0.911	0.953	0.888	0.932	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Netherlands	1.000	1.000	1.000	0.874	0.764	0.759	0.748	0.852	0.822	0.779	0.821	0.882	0.564
Poland	0.700	0.591	0.708	0.596	0.597	0.604	0.528	0.593	0.616	0.605	0.985	1.000	0.928
Portugal	0.894	0.808	0.836	1.000	0.824	0.638	0.538	0.438	0.512	0.562	0.641	0.599	0.584
Romania	0.612	0.596	1.000	1.000	1.000	1.000	1.000	1.000	0.986	0.925	0.886	0.998	0.855
Slovakia	1.000	0.823	0.596	0.613	0.639	0.658	0.715	0.753	0.833	0.839	0.953	0.902	1.000
Slovenia	0.803	0.732	0.712	0.868	0.856	0.842	0.675	0.620	0.585	0.808	0.855	0.873	0.809
Spain	1.000	1.000	1.000	1.000	1.000	0.997	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Sweden	0.632	0.675	0.708	0.724	0.514	0.638	0.677	0.695	0.589	0.626	0.695	0.509	0.440
UK	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

This Appendix presents the cost efficiency results obtained by DEA.

Following Coelli et al. (1998), Thanassoulis (2001) and Thanassoulis et al. (2007), we can assume that at any time t, there are N decision-making units (DMUs) that consume a set of X inputs ($X = x_1, x_2, ..., x_k$) to produce a set of Y outputs ($Y = y_1, y_2, ..., y_m$), thus obtaining the DEA input-oriented efficiency measure of every *i* DMU, solving the following optimisation problem:

$$\min_{\theta,\lambda} \theta_i$$

$$s.t. \quad \sum_{r=1}^{N} y^{t}_{mr}\lambda^{t}_{r} \geq y^{t}_{mi}\, ; \sum_{r=1}^{N} x^{t}_{kr}\lambda^{t}_{r} \leq \theta_i x^{t}_{ki}\, ; \lambda^{t}_{r} \geq 0; \ \sum_{r=1}^{N} \lambda^{t}_{r} = 1$$

The DEA approach provides, for every *i* decision-making unit (DMU, here every country's banking sector), a scalar efficiency score ($\theta_i \leq 1$). When $\theta_i = 1$, the DMU lies on the efficient frontier and is considered an efficient unit. On the contrary, when $\theta_i < 1$, the DMU lies below the efficient frontier and is considered an inefficient unit; moreover, ($1- \theta_i$) always represents a measurement of the inefficiency of the respective unit.

For the DEA estimates, we apply three variables as outputs: the total loans (natural logarithm of the loans), the total securities (natural logarithm of the total securities) and the other earning assets (natural logarithm of the difference between the total earning assets and the total loans); and three variables as inputs: the price of borrowed funds (natural logarithm of the ratio between interest expense and the sum of deposits), the price of physical capital (natural logarithm of the ratio between non-interest expenses and fixed assets) and the price of labour (natural logarithm of the ratio between personnel expenses and the number of employees).

The data are sourced from the IBCA-BankScope 2008 CD and the sample comprises annual data from the consolidated accounts of the commercial and savings banks of all EU countries between 1996 and 2008.

Appendix D – Gross domestic product (GDP) per capita

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	23200	23000	23900	24900	26000	26600	27300	27700	28700	29800	31300	33000	33900
Belgium	21400	21700	22400	23400	24600	25300	26000	26600	28000	29000	30200	31600	32299
Bulgaria	900	1100	1400	1500	1700	2000	2200	2400	2600	3000	3400	4000	4600
Cyprus	11000	11600	12400	13300	14300	15300	15600	16100	17000	17900	19000	20300	21600
Czech Rep.	5000	5100	5600	5700	6200	7000	8200	8300	9000	10200	11500	12800	14800
Denmark	27600	28500	29300	30700	32500	33500	34400	35000	36500	38300	40200	41700	42500
Estonia	2600	3200	3600	3900	4500	5100	5700	6400	7200	8300	10000	12000	12200
Finland	19700	21100	22500	23700	25500	26800	27600	27900	29100	30000	31500	34000	34900
France	20800	21000	2900	22700	23700	24500	25000	25600	26500	27300	28400	29600	30100
Germany	23400	23200	23700	24400	24900	25500	25900	26000	26600	27000	28100	29500	30100
Greece	10200	11100	11300	12100	12600	13400	14300	15600	16700	17400	18700	19900	20700
Hungary	3500	4000	4200	4400	4900	5800	6900	7300	8100	8800	8900	9900	10500
Ireland	16300	19800	21400	24300	27800	30600	33400	35300	37000	39300	41800	43500	40500
Italy	17400	18500	19100	19800	21000	22000	22800	23300	24000	24500	25300	26200	26300
Latvia	1800	2300	2500	2900	3600	3900	4200	4300	4800	5600	7000	9200	10100
Lithuania	1800	2500	2800	2900	3600	3900	4400	4800	5300	6100	7100	8500	9700
Luxembourg	39200	39000	40700	46200	50400	51100	53800	57200	60000	65200	71800	78100	80800
Malta	7600	8400	8800	9400	11000	11100	11500	11400	11300	11900	12500	13300	14200
Netherlands	21200	21900	22900	24400	26300	27900	28800	29400	30200	31500	33100	34900	36200
Poland	3200	3600	4000	4100	4900	5600	5500	5000	5300	6400	7100	8200	9500
Portugal	9500	10100	10800	11600	12400	13000	13500	13700	14200	14600	15100	16000	16200
Romania	1300	1400	1600	1500	1800	2000	2200	2400	2800	3700	4500	5800	6500
Slovakia	3100	3500	3700	3600	4100	4400	4800	5500	6300	7100	8300	10200	11900
Slovenia	8400	9100	9800	10500	10800	11500	12300	12900	13600	14400	15500	17100	18400
Spain	12400	12800	13500	14500	15600	16700	17700	18600	19700	21000	22400	23500	23900
Sweden	24600	25300	25700	27400	30200	28500	29900	31100	32400	33000	35000	36900	36100
UK	16500	20600	22200	24000	27200	27800	28800	27600	29600	30500	32200	33700	29300

This appendix sets out the yearly EU countries' nominal GDP per capita (market prices, Euro per inhabitant). Source: Eurostat statistical database.

Appendix E – Gross fixed capital formation

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Austria	45057.6	44463.2	46157.2	47216.8	50474.2	50443.9	48583.4	51314.5	52301.9	53737.7	55215.6	58772.4	61141.4
Belgium	43720.6	45300.9	47227.3	49710.0	53469.0	54241.0	51368.0	52185.0	57880.0	62738.0	66923.0	72956.0	77395.0
Bulgaria	1071.6	1011.9	1482.8	1868.3	2215.3	2841.9	3109.1	3492.4	4151.4	5988.0	7310.3	8827.0	11904.4
Cyprus	1454.9	1454.4	1597.0	1616.0	1710.5	1808.3	2019.1	2071.3	2413.2	2637.4	3023.2	3516.1	3936.3
Czech Rep.	16375.5	15713.4	16295.3	16097.0	18323.8	20402.4	22951.6	22629.5	23809.0	27016.1	30349.2	35641.0	41336.6
Denmark	27000.0	29476.3	31718.4	32297.4	35028.6	35430.5	36182.4	36313.9	38030.3	40476.3	47373.4	49485.7	49457.9
Estonia	983.2	1255.2	1519.8	1318.7	1582.7	1842.2	2307.7	2751.9	2989.8	3586.4	4817.4	5710.3	4846.6
Finland	18228.4	20352.8	22627.0	23957.0	26481.0	28095.0	26811.0	27562.0	29439.0	31566.0	33144.0	38338.0	39759.0
France	214026.8	212078.5	227882.9	249333.4	271953.3	282432.5	281088.5	290656.5	309190.8	332318.9	360376.1	394621.6	411879.0
Germany	409481.3	400420.3	411293.5	426980.0	439550.0	421740.0	391800.0	381950.0	381790.0	384450.0	417820.0	447880.0	460740.0
Greece (*)	*23713.1*	*25918.0*	*26360.6*	*28511.0*	29806.1	31665.2	35211.4	40164.8	40788.3	40020.1	49508.4	53444.8	51568.1
Hungary	7896.0	9033.9	9884.0	10813.3	12263.0	13891.7	16461.1	16584.0	18651.2	20218.9	19480.9	21659.8	22901.6
Ireland	11062.4	14484.1	17098.1	21046.8	24439.1	26330.8	28285.5	31590.8	36653.6	43521.6	48253.7	48444.4	39427.7
Italy	187950.7	199096.1	209751.0	221299.1	245518.7	257682.0	274571.1	275257.6	288429.0	300765.5	319061.9	333532.7	330649.4
Latvia	732.9	930.6	1483.5	1566.5	2071.0	2334.2	2378.3	2451.7	3091.7	4011.8	5265.7	7160.8	6787.5
Lithuania	1358.9	1994.9	2391.2	2254.7	2347.0	2767.5	3084.0	3509.8	4089.1	4801.4	6093.0	8085.9	8216.5
Luxembourg	3264.4	3548.3	3770.2	4669.8	4572.7	5109.6	5419.5	5739.4	5904.1	6211.8	6510.8	7775.9	8172.6
Malta	668.8	698.2	778.6	814.0	965.0	881.5	728.6	873.8	885.8	1048.7	1120.6	1181.6	993.7
Netherlands	71216.5	74876.9	79882.7	88383.0	91652.0	94673.0	92862.0	92848.0	92426.0	97016.0	106373.0	114340.0	121849.0
Poland	24448.9	31080.7	36939.1	38429.8	44094.4	43919.6	39267.9	34948.2	36926.3	44538.9	53468.5	67058.4	80836.5
Portugal	22538.2	26311.0	29676.8	32340.8	35238.4	36268.1	35978.1	33846.6	34699.9	35412.8	35890.1	37629.1	38634.4
Romania	6486.7	6698.3	6802.3	5939.1	7652.5	9295.3	10350.8	11317.2	13293.2	18925.3	25036.0	37671.4	44609.6
Slovakia	5288.6	6389.9	7126.2	5661.3	5687.0	6721.2	7108.3	7297.9	8156.6	10216.1	11803.8	14357.4	15973.6
Slovenia	3745.1	4293.9	4834.6	5537.3	5647.6	5711.3	5735.3	6229.9	6805.1	7296.5	8236.1	9603.6	10729.7
Spain	105022.0	110323.1	123739.4	142462.0	162806.0	176967.0	191715.0	213020.0	236051.0	267444.0	301263.0	323216.0	312046.0
Sweden	35227.6	35254.4	37786.7	42442.0	48197.9	45509.6	46289.3	46984.3	49676.2	53403.6	59550.7	66157.6	66749.2
UK	160170.1	200510.3	231166.7	245690.3	274107.4	276239.4	287093.5	269886.8	295332.0	306700.8	333228.7	365368.1	303114.5

(*) *For the period 1996-1999, the Greek data were not available. We assumed that the gross fixed capital formation grew in line with Gross Domestic Product at market prices (millions of ECUs) and calculated the missing values backward.*

This appendix presents the yearly EU countries' nominal gross fixed capital formation, millions of euro (from 1.1.1999)/Millions of ECU (up to 31.12.1998).

Source: Eurostat statistical database.

Appendix F – Panel unit root Levin, Lin and Chu (2002) test

Variables	t-star	P > t
First difference of the return on assets (ROA) ratio	-22.27852	0.0000
First difference of the return on equity (ROE) ratio	-18.01915	0.0000
First difference of the natural logarithm of the DEA bank cost efficiency	-13.66342	0.0000
First difference of the natural logarithm of GDP	-12.73790	0.0000
First difference of the natural logarithm of gross fixed capital formation	-9.74921	0.0000

This appendix presents the results obtained with the Levin, Lin and Chu (2002) test, which may be viewed as a pooled Dickey-Fuller test, or as an augmented Dickey-Fuller test when lags are included, with the null hypothesis being the existence of non-stationarity.

This test basically implements an ADF regression:

$$\Delta y_{it} = \delta_i y_{it-1} + \sum_{L=1}^{P_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it}$$

Where:

i=1,…N = cross-units of the panel

t=1,…T = time series observations

L=1,…,P = lag orders

d_{mt} = vector of deterministic variables , with α_m= corresponding vector of coefficients for a particular model (m = 1,2,3)

Assuming that $\delta=1-\rho$ and $\rho_1 = \ldots = \rho_N$, the null hypothesis is H0: $\delta = 0$ and the alternative, H1: = $\delta < 0$.

Appendix G – Panel unit root Im, Pesaran and Shin (2003) test

Variables	W[t-bar]	P-value
First difference of the return on assets (ROA) ratio	-16.681	0.000
First difference of the return on equity (ROE) ratio	-13.173	0.000
First difference of the natural logarithm of DEA bank cost efficiency	-9.679	0.000
First difference of the natural logarithm of GDP	-9.047	0.000
First difference of the natural logarithm of gross fixed capital formation	-7.365	0.000

This appendix features the results returned by the Im, Pesaran and Shin (2003) test, which allows for individual unit root processes. The core equation, presented with the Levin, Lin and Chu (2002) test, is the following:

$$\Delta y_{it} = \delta_i y_{it-1} + \sum_{L=1}^{P_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mt} + \varepsilon_{it}$$

Where $\delta=1-\rho$ and now ρ_i may vary across cross-sections. The null hypothesis is now H0: $\delta = 0$, for all i. The alternative, H1, considers that at least some of the individual processes might be stationary, thus:

- $\delta_i = 0$, for a sub-sample of the cross units (i = 1, …, N_j)
- $\delta_i < 0$, for the rest of the cross units (i = N_j, N_{j+1}, … N)