3. BANK EFFICIENCY AND ECONOMIC GROWTH IN THE OECD COUNTRIES

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Abstract

This study analyzes whether efficiency changes in the banking industry affect economic growth, or vice versa, in the OECD countries for the period 2011-2019. In the first stage, bank efficiency figures are measured over time by using the Malmquist Productivity Index. The results indicate that efficiency decreased until 2015 and thereafter recovered. Efficiency decreases mostly resulted from frontier shift, which represents a disadvantageous macroeconomic environment. The Catch-up component of the index was sharply upward after 2017, showing the adaptation of banks to the new-normal economic conditions. In the second stage, a bidirectional association between bank efficiency and economic growth is investigated using dynamic panel data analysis. The findings suggest a limited positive relationship between bank efficiency and economic growth. On the other hand, efficiency changes in the banking industry do not seem to be associated with GDP changes. The analysis is important for correctly positioning the banking sector within an economy and for a correct evaluation of the role of banking from microeconomic fields to macroeconomic channels.

Keywords: Data Envelopment Analysis; Malmquist Productivity Index; two-step system GMM; bank efficiency.

JEL Classification: C14, C61, G21

1. Introduction

It is believed that financialization boosts consumption and investment first, and then affects the real sector through some transmission mechanisms. However, the new normal of the global financial crisis and pandemic crisis periods raises doubt about this mechanism. Additionally, the role of financial institutions in economic growth is also controversial. Consequently, the assumed relationship between economic improvement and bank efficiency has been always been an important issue for owners, regulators, customers, investors, and the public (Fethi & Pasiouras, 2010).

In this study, we aim to investigate the bidirectional relationship between economic growth and bank efficiency in the OECD countries, which constitute about 63% of the world

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economy. It is expected that this research will enable us to reveal the efficiency development of the banks and to test the interaction between economic growth and bank efficiency; thereby investigating whether there is a path and extending from microeconomics fields to macroeconomics channels.

Efficiency and development are two different concepts in finance. Economic growth is generally associated with quantity. The quantity, in this respect, implies the volume of financial parameters such as loans, loans per employee, credit volume, credit volume to GDP ratio, etc. Efficiency, however, is related to the quality of financial activities (Berger, Hasan, & Klapper, 2004; Hasan, Koetter, & Wedow, 2009; Koetter & Wedow, 2010). This study mainly tackles on the interrelation between quality of intermediation efficiency and economic growth.

The study can be unfolded as follows: The second section deals with the related literature. The third section handles data, variables, and methodology. The results are discussed in the fourth section, and the final section includes concluding remarks.

2. Literature Review

There is a vast literature discussing the relationship between economic growth, financial development and bank efficiency. The first area of literature deals with the association between financial quantity and economic development. Levine (2005) defined financial development as the improvements in ex-ante information for feasible investment alternatives; enhancements in investment monitoring and corporate governance; progress in risk management and diversification; improvements in the movement and the allocation of financial resources; and advancements in exchange of services and goods. He pointed out the different approaches regarding the function of the financial sector and economic growth. One idea is that financialization is not effective on economic growth, it responds to demands from the real economy. Opposite arguments claim that the positive effect of financial markets are obvious. Although both ends have strong and well-supported arguments, he concluded that intermediaries and markets are both effective for growth, while reverse causality is not significant. Additionally, financial development helps some firms, which have some difficulties, to access financial resources more easily. Ang (2008) indicated that although financial development and growth are positively associated, there is no consensus about the direction of causality. Therefore, the positive effect of financial development on economic growth needs further empirical investigations. Because of the significant structural differences among the developing countries, he pointed towards the need for more country-specific analysis with appropriate econometric models. Demirgüç-Kunt and Levine (2008) surveyed studies on the interaction between finance and economic growth, the policy and institutional determinants of financial development. They mainly concluded that countries with a better financial system seem to perform better in growth; the size of the banking sector and the stock market liquidity have positive effects on economic growth. This relationship is sound and does not seem to stem from simultaneity bias. The better financial systems work, the easier constrained industries and firms access alternative financial resources. Conversly, financial development requires a stable macroeconomic environment and strong legal and information systems. Liberalization together with stronger institutions, government interventions as regulators, and facilitating access to financial facilities are the necessary factors for financial development. Arestis *et al.* (2015)'s meta-analysis regarding finance and growth nexus decided that the results of the empirical analysis are affected by how analysis is constructed. In another meta-analysis handling 1334

estimates from 67 studies, Valickova *et al.* (2015) concluded that the results show a significant positive effect. However, because underlying effects and research design differ, the individual estimates vary widely. These effects differ for developed and developing countries over time. The effects that seem to be stronger in the developed countries decreased after the 1980s.

Despite this apparently positive explanatory power of financial development on growth, there are also opposing views claiming that financial sector evacuates scarce resources, like the crowding-out effect, from the economy. Especially when financial conditions get tougher, the real sector may suffer from the lack of liquidity and get exposed to the crisis. For example, the global financial crisis, diminishing profitability and negative interest rates may provoke these vulnerabilities. Hasan *et al.* (2016) argued that the financial development and growth relationship recently attracted more attention. Positive correlation between financialization and growth was most common in the period before the 1990s. Thus, the positive effects of financial quantities on growth are not as certain as before and the interaction is more sophisticated.

Studies searching the link between financialization and growth fail to consider the efficiency of the financial industry (Hasan *et al.*, 2016). Even if efficiency is associated with growth, the link may change over time and differ for various countries. Financial transformation, financial crisis and globalization reshape the economic relations. Additionally, considering the introduction of new econometric techniques, updated new researches seem to be a necessity for investigating the link between economic growth, financial efficiency and financial development. Our study may help to fill in this gap in the related literature.

The second strand of the related literature emphasizes that the efficiency of financial sector positively contributes to economic development. Studies searching the relationship between efficiency and growth are comparatively new and limited (Kale and Eken, 2018; Appendix 1). There are many studies concerning the probable sources of bank efficiency stemming from macroeconomic factors, but here we especially focus on the explanatory power of bank efficiency on economic growth. Koetter and Wedow (2010), Hasan *et al.* (2009), Hasan *et al.* (2016) and Fu *et al.* (2018) refer to efficiency as the quality of the financial sector. Hasan *et al.* (2009) and Hasan *et al.* (2016) argue that efficiency can be much more related to growth as compared to conventional quantity measures such as the credit volume.

We found 20 studies researching the effects of financial efficiency on economic activities. Lucchetti *et al.* (2001) are the first to investigate how the banking system proxied by cost efficiency is important for the economic growth of Italian regions between 1982 and 1994. They concluded that bank efficiency was effective on regional growth. Berger *et al.* (2004) tested the effects of bank efficiency on economic performance by using data from 21 developed and 28 developing countries between 1993 and 2000. Their results suggested that apart from control variables both rank of cost and profit efficiency were positively associated with better economic performance.

In a study searching the quality effects of bank efficiency on 11 European Union countries between 1996 and 2004, Hasan *et al.* (2009) used cost efficiency and profit efficiency as the quality of banking sector. Employing the GMM system they concluded that efficient banks positively affected regional economic growth. Koetter and Wedow (2010) analyzed the effects of cost efficiency of German banks in 97 regions between 1995 and 2005; Ferreira (2013) employed Granger causality to investigate the interaction of GDP per capita and cost efficiency in 27 EU countries between 1999 and 2013; Ferreira (2016) used difference GMM to reveal the cost efficiency – gross national product relationship in European Union between

1999 and 2013; Belke *et al.* (2016) in 12 EU countries between 2000 and 2013 making use of system GMM; Bernini and Brighi (2018) in 101 provinces of Italy between 2006 and 2013; Ferreira (2018) in 28 European Union countries between 1998 and 2012. All these studies conducted in Europe found a significant positive contribution of bank cost efficiency to growth. Mensah *et al.* (2012) examined the quality effects of African banks between 1999 and 2008, Saqib (2013) used data from 50 developing countries between 2005 and 2009, Mirzaei and Moore (2016) used data from Qatar between 2000 and 2006, Hasan *et al*. (2016) employed data from 60 countries for the period 1960-2011, Mirzaei and Moore (2019) used data from 49 countries for the period 2001-2010, Hasan *et al*. (2017) employed data from 30 provinces of China for a period from 1998 to 2008, Diallo (2018) collected and analyzed data from 38 different countries in 2009 and Fu *et al.* (2018) used parameters from 14 Asia-Pacific countries from 2003 to 2005. For non-European regions and as well as developed and developing countries, findings, *i.e*., positive relationships, are similar to the European regional studies. Ayadi *et al.* (2015) collected data from 60 developed and developing countries from the Northern and Southern Mediterranean region over the period 1984-2010. They concluded that for economic growth, in addition to bank efficiency, additional conditions had to be satisfied. Yusifzada and Mammadova (2015) studied data from 118 countries covering the 2004-2011 period and concluded that the influence of efficiency differed depending on the financial development level.

As an overview, we may conclude that the results of bank efficiency-economic growth studies are miscellaneous. While the majority of studies indicate positive relationships, Ayadi *et al.* (2015) fail to find interaction. Yusifzada and Mammadova (2015) indicated that the influence of efficiency differed based on the development levels of the countries. Uncertainty was found almost in all studies related to the developing countries. None of these studies so far researched whether bank efficiency-economic growth relationship changed over time.

In the related literature, the bank efficiency and economic growth relationship have been analyzed in two stages. In the first stage, either Stochastic Frontier Analysis (SFA) or Data Envelopment Analysis (DEA) is used. Ferreira (2013), Ferreira (2016) and Diallo (2018) used DEA to measure bank efficiency, while all others utilize SFA (*Belke et al., 2016; Hasan et al., 2009; Koetter and Wedow, 2010; Lucchetti et al., 2001; Mensah et al*., 2012; Mirzaei and Moore, 2019). Instead of a proxy for bank efficiency they measured it first; and then used it in the second stage. The majority of studies use a dynamic model in the second stage. One of the drawbacks of these studies is that, although the effects of efficiency on growth are studied to some extent, the opposite direction is comparatively untouched and needs further study.

3. Methodology, Variables and Data

3.1. Methodology

3.1.1. Efficiency Measurement

The research process of this article consists of two stages. First, the efficiency scores of each bank are measured; and then, the effect of efficiency on growth is analyzed. To see whether inverse causality exists or not, the opposite possibility is also investigated.

There are two main methods to measure the bank efficiency. First is SFA, which is a parametric method and assumes a pre-defined production function and error term distribution. The second method is non-parametric, and it is based on benchmarking different

units considering the usage of multiple inputs to produce multiple outputs. Best performing units are assumed as 100% efficient and all others are compared to these efficient units accordingly. DEA seems to be more preferred for measuring efficiency in banking as onemay see from the surveys about efficiency (Berger and Humphrey, 1997; Fethi and Pasiouras, 2010; Paradi and Zhu, 2013; Sharma *et al*., 2013).

DEA has two basic models, CCR and BCC. The original CCR model, developed by Charnes *et al*. (1978), measures the technical efficiency of units assuming the Constant Return to Scale (CRS) frontier. Then, Banker *et al.* (1984) introduced the BCC model that uses the Variable Return to Scale (VRS) frontier to measures the pure technical efficiency. Technical efficiency is the compound of scale efficiency and pure technical efficiency, and therefore, by results of both models, scale efficiency is calculated. CCR and BCC models are said to be radial, *i.e*., they suggest a radial proportional input and/or output improvement for the inefficient units. However, they neglect the slack in inputs and/or outputs. Slack Based Model (SBM) introduced by Tone (2001) measures efficiency considering slacks as well. The SBM models can be used as input/output-oriented and non-oriented (*i.e*., both-oriented).

Either the Malmquist Productivity Index (MPI) or Window Analysis (WA) measures efficiency over time in DEA. The Malmquist Productivity Index was first introduced by Malmquist (1953) and it measures Total Factor Productivity (TFP) changes between two time periods (Tone and Tsutsui, 2017). The efficiency index is decomposed into two subcomponents as Frontier-shift (efficiency change stemmed from overall technological changes that affect all units) and Catch-up (efficiency change only because of the success of the individual unit itself). Therefore, this method makes it possible to observe the sources of efficiency changes, whether changes arise from the progress/regress of the bank itself or the operation environment it functions within. Each component of efficiency is evaluated by non-parametric DEA models. Therefore, we may choose both orientations (input, output or non-oriented) and return to scale (constant, variable, etc.). Although MPI is defined between two-period, we can evaluate a cumulative Malmquist index (CMI) for longer time span (Tone and Tsutsui, 2017).

In WA, observations of different years are treated as different banks and all observations are put in a pool. Pooling enables us to compare the performance with previous years. Deciding the number of windows is critical here, because a short period may decrease discrimination power, while a long period may cause the inclusion of many irrelevant changes.

Therefore, based on data availability and restrictions of WA we preferred to use MPI to evaluate the efficiency changes of banks. MPI gives information about different sources of efficiency also. With DEA-based MPI, we used a non-oriented Slack Based Model (SBM) that enables us to evaluate the minimum distance to the VRS frontier (non-oriented SBM). Choosing VRS instead of CRS diminishes the effects of an outlier on the other banks' efficiency scores. After evaluating the score of each bank, the sector efficiency of each country is calculated using a weighted average calculation based on each bank's total assets over that of the industry.

Efficiency in the financial sector has many aspects. It can be assumed as the success of changing liabilities (deposits, equity and other funds) into assets (loans and other earning assets), *i.e*., intermediation efficiency (Berger and Humphrey, 1997), the success of generating deposits and loans with minimum cost (cost efficiency), and success of maximizing profit (profit efficiency); ability to implement a number of operations with minimum assets, personnel and expenses (operational efficiency); success of creating loans, credits, other financial assets, and income with minimum expenses and assets

(production efficiency). The intermediation efficiency seems to be much more related to providing resources for the economy. Therefore, in this study, we preferred to measure the efficiency considering the banks' intermediation role.

There is no perfect approach to fully capture all capabilities and all functions of banks. Therefore, the roles of banks are controversial among researchers. Acording to Berger and Humphrey (1997), intermediation function was a better approach for efficiency of financial institutions as a whole. Interest expenses can be used as a proxy of deposits and interest income as a proxy for loans also in intermediation approach (Athanassopoulos, 1997, Avkiran, 2011). Considering the main role of a bank and definition of intermediation, we found it very reasonable to assume inputs as (1) deposits & short-term funding, (2) equity and (3) other interest-bearing liabilities; and assume (1) loans and (2) other earning assets as outputs.

Data Envelopment Analysis measures efficiency by dividing the weighted average of outputs to inputs. It freely assigns any weights to maximize the ratio. Assuming the liability side constant, by increasing the assets of a bank rises the intermediation efficiency. Intermediation efficiency may be assumed as the capability of the banking sector to provide funds for growth. We expect a positive relationship between efficiency increase of banks and economic improvement of a country.

3.1.2. Efficiency and Growth Relationship

To analzye the relationship between efficiency and growth, the following general equation is formulated:

$$y_{it} = \beta_0 y_{it-1} + \beta_1 F_{it} + \beta' X_{it} + \eta_i + \varepsilon_{it} \quad (1)$$

where:

y_{it}	Dependent variable
y_{it-1}	Lagged dependent variable
F_{it}	Independent variable whose effect is under investigation
X_{it}	A set of explanatory control variables
η_i	Unit specific effect
ε_{it}	Error term

Here at this stage β_1 is the parameter in our focus. To investigate the effects of efficiency on economic growth, Gross Domestic Product (GDP) is used as the dependent variable, while the intermediation efficiency of banks is used as the independent variable. Then, equation 1 can be reconstructed as:

$$gdp_{it} = \beta_0 gdp_{it-1} + \beta_1 eff_{it} + \eta_i + \varepsilon_{it} \quad (2)$$

where:

gdp_{it}	Gross domestic product, volume, 2011=1.00
eff_{it}	Intermediation efficiency measured by MPI.

Including the lagged value of gdp makes the model dynamic in which the effects of efficiency on GDP are under investigation and we do not have a preliminary expectation about the sign and the size of the relationship. Dummy variables for years are also incorporated into the models. Equation 2 is repeated for components of GDP based on the expenditure approach.

The effects of efficiency on growth may not be unidirectional. Thus, the opposite should also be investigated, *i.e*., economic growth may also influence banking efficiency, or causality may exist in both directions. Therefore, bank efficiency is used as the explanatory variable in Equation 3 and the model is formulated as follows:

$$eff_{it} = \beta_0 eff_{it-1} + \beta_1 gdp_{it} + \eta_i + \varepsilon_{it} \quad (3)$$

In Equation 3, β_1 represents whether GDP influences bank efficiency or not. Here β_0 shows the effects of the previous year's efficiency on the efficiency of the present year. Investigating both the direction of effects from economic growth to bank efficiency and transmission effects of previous years to present years may be assumed as this study's contribution to literature.

To estimate both equation 2 and equation 3, a two-step system Generalized Methods of Moments (GMM) estimator is used. It is developed by Arellano and Bover (1995) and Blundell and Bond (1998) first, and implemented by Roodman (2009). System GMM is especially useful for situations where unit dimension is higher than time dimensions, and the dependent variable depends on its past values. It corrects unobserved heterogeneity, a time-invariant component of the measurement error, omitted variable and potential endogeneity biases. Estimator is assumed to be consistent and unbiased when instruments are valid and the error terms in the first-difference equation are not, especially in the second-order, serially correlated. More recent two-step system GMM is more efficient and robust to heteroscedasticity and autocorrelation than one-step system GMM (Roodman, 2009). Validity of instruments as a group is checked with Sargan/Hensen test, and first and second-order serial correlations are tested with AR1 and AR2 (Nayan *et al*., 2013).

In addition of estimating equation 2 and equation 3 for all 29 OECD countries, the results of static panel estimations with fixed effect are also presented.

3.2. Data

After applying some criteria to filter banks with personnel of more than 100, banks with available data for all years, and eliminating inconvenient and blank data, we ended up with 3039 banks' data from 29 OECD countries from 2011 to 2019 (Appendix 2). All data is retrieved from Bureau Van Dijk's Orbis database. Data availability restricted us to use this period. Surely, the effects of the global financial crisis have not completely disappeared and they are transmitted to the following years. Debt crisis affected Greece, Ireland, Italy, Spain, Portugal, Hungary, and the Eurozone. Other OECD countries may undergo some country-specific problems. However, choosing the 2011-2019 period is somewhat reasonable as it discards the global financial crisis and the pandemic crisis, and covers a comparatively stable period. We used years as dummy variables to remove the effects of the years from the relationship.

For the banking sector efficiency, first, efficiency of each bank is measured within the country it belongs to. Then based on asset sizes, the weighted average of efficiency is calculated for each country.

For the relationship between efficiency and growth, efficiency data calculated in the first stage is used in the second stage. Macroeconomic data was gathered from the OECD Main Economic Indicators database. Descriptive statistics of data for the second stage are presented in Appendix 3.

4. Results and Discussion

4.1 Bank efficiency

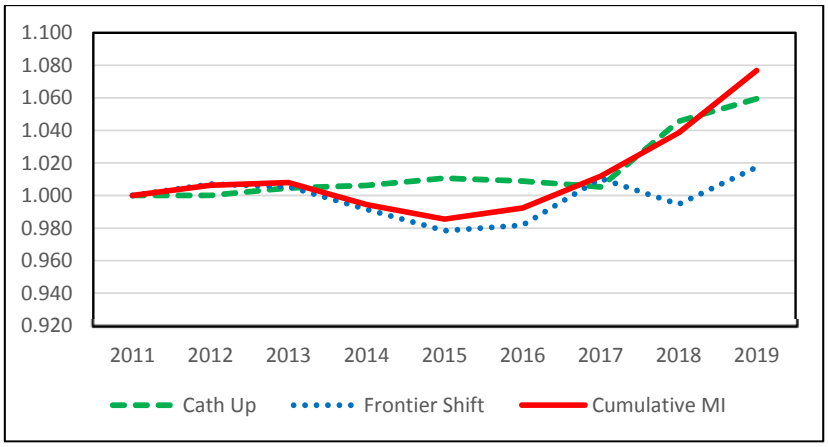
In the first stage, bank efficiency is measured within each country by DEA-based MPI. Slack Based Model of DEA is employed with no orientation assuming the Variable Return to Scale option. Then, the asset-based weighted average of each bank's efficiency is used to calculate the country's banking sector efficiency. The average of the banking sector effciency for each country is presented in Table 1.

Table 1. Cumulative Malmquist Efficiency Index of the banking sectors

Country	2011	2012	2013	2014	2015	2016	2017	2018	2019
Australia	1.000	1.011	0.999	1.014	0.978	0.945	0.941	0.930	0.945
Austria	1.000	0.981	0.972	0.957	0.946	1.007	1.103	1.123	1.097
Belgium	1.000	0.941	0.992	0.964	0.958	0.957	0.999	0.994	1.012
Canada	1.000	1.023	1.048	1.051	1.039	1.041	1.061	1.086	1.110
Switzerland	1.000	0.966	1.013	0.962	0.922	0.903	0.900	0.908	0.897
Chile	1.000	1.038	1.010	1.030	1.070	1.070	1.078	1.155	1.209
Czech Rep.	1.000	1.011	1.005	0.921	0.999	1.078	1.316	1.370	1.348
Germany	1.000	0.980	0.997	0.976	0.935	0.918	0.975	0.957	0.946
Denmark	1.000	1.049	0.974	0.956	0.959	1.002	1.042	1.030	1.236
Spain	1.000	1.004	1.001	1.030	1.007	1.001	1.075	1.102	1.110
France	1.000	0.972	0.961	0.943	0.912	0.887	0.940	0.938	0.950
UK	1.000	1.001	1.002	0.986	0.927	0.915	0.895	0.950	0.984
Hungary	1.000	0.926	1.014	0.961	0.683	0.725	0.820	0.878	0.893
Ireland	1.000	1.085	1.070	1.088	1.191	1.183	1.360	1.284	0.976
Israel	1.000	1.001	1.004	0.977	1.004	1.011	1.058	1.051	1.102
Italy	1.000	1.007	1.010	0.985	0.947	0.947	0.955	1.040	1.042
Japan	1.000	0.958	0.885	0.813	0.826	0.803	0.792	0.819	0.900
Korea	1.000	1.035	1.082	1.091	1.111	1.122	1.182	1.165	1.209
Latvia	1.000	1.017	1.091	1.187	1.166	1.201	1.311	1.237	1.132
Mexico	1.000	1.031	1.065	1.096	1.110	1.065	1.072	1.084	1.049
Netherlands	1.000	0.997	1.044	0.943	0.978	0.863	0.913	0.915	0.959
Norway	1.000	1.035	1.001	0.987	0.952	0.865	0.896	0.883	0.855
Poland	1.000	0.950	1.021	0.963	1.013	1.022	1.053	1.052	1.082
Portugal	1.000	0.949	0.935	0.889	0.868	0.842	0.824	0.801	0.790
Slovakia	1.000	0.957	0.986	0.972	0.971	0.947	1.047	1.205	1.077
Slovenia	1.000	0.972	1.069	0.968	1.142	1.124	1.425	1.301	1.141
Sweden	1.000	1.035	1.037	0.999	0.988	0.983	0.995	1.018	1.007
Türkiye	1.000	0.980	0.987	0.981	0.962	0.962	0.985	0.967	1.002
USA	1.000	1.067	1.092	1.105	1.131	1.192	1.217	1.245	1.302
Average	1.000	1.006	1.008	0.994	0.985	0.992	1.012	1.038	1.077
Maximum	1.000	1.085	1.092	1.187	1.191	1.201	1.425	1.370	1.348
Minimum	1.000	0.926	0.885	0.813	0.683	0.725	0.792	0.801	0.790

The period we cover may be assumed as years of comparative stability and recovery, especially for developed countries that are still lacking low growth rates. A slowdown was experienced from 6.5% to 4.5% in the emerging/developing countries, and a fluctuation between 1% and 2.5% was observed in the developed economies. At the same time with the global slowdown, consumer inflation steadily decreased touching 0 levels for the developed countries, and owing to commodity prices slightly turned up. Alongside the low inflation, advanced countries have experienced low, even negative, real and nominal interest rates (IMF, 2017a, IMF, 2017b).

Figure 1. Cumulative Malmquist Efficiency Index and Its Components



As one may see in Figure 1, in this global macroeconomic environment, a general decrease is observed in bank efficiency until 2015, followed by a sharp recovery after 2016. The overall increase is 7.7% from 2011 to 2019. It is important to underline that efficiency causes decrease in mostly the results from frontier shift, which represents disadvantageous macroeconomic environments for all banks. This environment is not cured as recovery in the frontier component of the index is still steady. However, the catch-up part of the index is sharply upward after 2017, showing the adaptation of banks to the new conditions. In the Czech Republic, USA, and Denmark it increased by 35%, 30% and 25%, respectively, in this period; while Portugal's, Norway's and Hungary's figures decreased by 21%, 14% and 11%.

For the developed countries, the decrease in efficiency is sharper as compared to the developing ones, but recovery is observed after 2016 in all of them. In the non-EU countries, it seems to get more deteriorated than in the EU countries (Table 2). Yet, there may be two main reasons for the recovery in bank efficiency.

Firstly, in the post-global financial crisis period, countries focused on strengthening the banking sector by imposing new regulations, such as Basel III and a higher level of capital requirements. Supervision was strengthened, tighter risk management criteria were imposed and more transparent trading rules for derivatives were implemented. In some countries, such as Italy and Portugal, the banking sector was recapitalized. It is also important to note that banks' short-term wholesale funding decreased during this period as well.

Secondly, in the post-crisis period, smaller banks using deposits as the main source of funding and banks with less diversified sources became more exposed to fluctuations in the financial markets. Low interest rates and low growth in the economies caused negative interest margin, and decreased profitabililty (IMF, 2017b). This jeopardized the intermediation role of banks and forced them to find new profitable alternatives.

Many studies analyze the relationship between bank efficiency and regulations. Some of them found positive relationship between efficiency and deregulations (Barth *et al*., 2013; Gaganis and Pasiouras, 2013; Kale *et al*., 2015). Restrictions compelled by the introduction of new regulations such as increasing capital requirements, tighter regulations and close monitoring after the global financial crisis may prevent banks from increasing their intermediation efficiency, transaction volume and profitability.

Table 1. Average Bank Efficiency for Different Groups of Economies.

	2011	2012	2013	2014	2015	2016	2017	2018	2019
Developed	1.000	1.006	1.008	0.994	0.985	0.992	1.011	1.038	1.076
Developing	1.000	0.995	1.020	1.008	1.018	1.016	1.065	1.086	1.093
Major 7	1.000	1.019	1.031	1.053	1.052	1.055	1.128	1.136	1.146
Others	1.000	1.006	1.007	0.993	0.984	0.991	1.009	1.037	1.076
EU	1.000	1.008	1.008	0.995	0.987	0.998	1.015	1.045	1.085
Non-EU	1.000	0.991	1.007	0.976	0.957	0.926	0.973	0.971	0.987

Note: Weighted average by banks' total assets.

4.2. Bank Efficiency and Economic Growth

To interpret outputs of the two-step system GMM, a couple of diagnostic tests should be applied for consistency, *i.e*., lagged and first differenced values of independent variables should be valid. The overall validity of instruments is tested with the Hensen statistic, in which p-values below 0.1 and higher values indicate potential signs of trouble. There should not be a second-order serial correlation, as well, in residuals, implying that the original error term is not serially correlated and moment conditions are correctly specified. Additionally, the number of instruments should be less than the number of groups; and F-statistics should indicate a joint significance of explanatory variables (Madariaga and Poncet, 2007; Roodman, 2009). All variables are transformed to 2011=1.0 basis and logarithms, and dummy variables for years are incorporated into the models.

The findings in Table 3 illustrate the effects of efficiency on GDP and its components, which are household consumption, investments, government expenditure, exports and imports. All diagnostics show the consistency and validity of the models. The results show that the previous year's GDP is effective in determining the current year's GDP. A percentage change in the previous years GDP is associated with a 1.127% change in the following year's GDP, implying an elastic relationship. The same elasticity is observed in the short run for all components of GDP at a 1% significance level. A limited positive relationship is observed between bank efficiency and economic growth. 1% change in bank efficiency index has explanatory power for a 0.042% change in GDP in the short run at a 5% significance level. Although the effect is minimal, results are in parallel with the findings of Lucchetti *et al*. (2001), Fu *et al.* (2018), Diallo (2018), Hasan *et al*. (2017), Bernini and Brighi (2018), Belke *et al.* (2016), Ferreira (2016), Ferreira (2013), Saqib (2013), Mensah *et al.* (2012), Koetter and Wedow (2010), Hasan *et al.* (2009) and Lucchetti *et al.* (2001) to some extent. The

majority of these studies indicate a positive effect of efficiency on growth. To see and confirm the effects of the cumulative Malmquist index on GDP, fixed effect (FE) estimator regression is employed, and the results are presented in the last column of Table 3. The FE estimator also generated almost the same results.

Considering the GDP components, however, insignificant efficiency coefficients imply that bank efficiency does not have a play in components of growth based on the expenditure approach. Capelle-Blancard and Labonne (2016) also did not find a positive relationship between economic and financial growth in the OECD countries. Ayadi *et al.* (2015), in addition to bank efficiency, suggested better additional conditions for economic growth. However, Hasan *et al.* (2016) pointed out to the more common literature concluding the decreasing and even negative effect of financial development. Rousseau and Wachtel (2011) also draw attention to the positive contribution of financial sector to growth before 1990, but declining in the following years. Hasan *et al.* (2016) pointed to the positive role of financal development up to a certain threshold.

Table 3. Effect of Efficiency on GDP and Its Components

	lgdp	lcons	lcap	exp	imp		FE Estimator
L.lgdp	**1.127*** **						**0.876*** **
	(0.017)						**(0.017)**
lcummi	**0.042** **	0.0133	-0.079	0.023	-0.022		**0.046*** **
	(0.017)	(0.014)	(0.104)	(0.034)	(0.064)		**(0.018)**
L.lcons		**1.146*** **					
		(0.022)					
L.lcap			**1.153*** **				
			(0.063)				
L.lexp				**1.135*** **			
				(0.019)			
L.limp					**1.179*** **		
					(0.048)		
Constant	4.466***	2.598	-3.798	11.150***	8.502**		11.728
	(1.785)	(2.135)	(8.318)	(3.845)	(3.795)		(8.979)
Obs #	232	232	232	232	232		232
Country #	29	29	29	29	29		29
Instr #	23	23	23	23	23		
F p	0.000	0.000	0.000	0.000	0.000		0.000
R^2							0.948
AR1 p	0.238	0.416	0.054	0.036	0.136		
AR2 p	0.666	0.150	0.253	0.174	0.216		
Hansen p	0.117	0.082	0.258	0.107	0.069		

*Notes: Robust standard errors are in parentheses. ***, ** and * indicate significance level of 0.01, 0.05 and 0.10, respectively. p is for probability value. Cons, cap, exp, imp represents GDP components, consumption, capital formation, export and import, respectively. Year dummies are not presented for the sake of brevity.*

The relationship between efficiency and GDP could be investigated for developed-developing and EU-NonEU countries, but unfortunately the number of countries was not enough to apply system GMM. The contribution of finance and insurance sectors to production, which may be assumed as a proxy for financialization, has gradually decreased

for the major countries from 2011 to 2016. Financialization can be defined as the influence of financial markets and financial institutions on economic policy and outcomes. The share of value-added activities of finance and insurance sectors in production decreased from 5.35% to 5.05% in the European Union, from 7.86% to 7.19% in the UK, and from 4.73% to 4.48% in Japan; while it increased from 6.76% to 7.25% in the US. Overall, the 2011-2019 period may be assumed as the era of financialization, and as some researchers (Palley, 2013) note the adverse effects of financialization on real economic growth, the relationship may have decreased in the post-crisis period. The condition of banking sector becoming ineffective in economic growth may be called as efficiency neutrality.

To see whether a relationship exists in opposite direction, a two-step system GMM is implemented using bank efficiency as the dependent variable and the lag of bank efficiency and GDP and its components as independent variables. Dummy variables are used as years. The two-step system GMM results seem consistent.

Table 4. The Effects of GDP and its Components on Bank Efficiency

	GMM Estimator					FE Estimator
L.lcummi	**0.963*** **	**0.956*** **	**1.006*** **	**0.968*** **	**0.993*** **	**0.639*** **
	(0.056)	**(0.053)**	(0.059)	(0.071)	(0.065)	**(0.060)**
lgdp	0.025					-0.068
	(0.070)					(0.103)
lcons		0.073				
		(0.078)				
lcap			-0.049**			
			(0.063)			
lexp				0.017		
				(0.051)		
limp					-0.079*	
					(0.046)	
Constant	-3.196***	-0.952	-5.376*	-3.320	-8.186**	15.161
	(2.778)	(4.062)	(2.966)	(4.470)	(3.992)	(27.938)
Obs #	232	232	232	232	232	232
Country #	29	29	29	29	29	29
Instr #	23	23	23	23	23	
F p	0.000	0.000	0.000	0.000	0.000	0.000
R^2						0.732
AR1 p	0.022	0.023	0.023	0.023	0.023	
AR2 p	0.789	0.794	0.743	0.789	0.766	
Hansen p	0.525	0.349	0.389	0.466	0.548	

Notes: Efficiency (cummi) is the dependent variable. Robust standard errors are in parentheses. ***, ** and * indicate significance level of 0.01, 0.05 and 0.10, respectively. p is for probability value. Cons, cap, exp, imp represents GDP components, consumption, capital formation, export and import, respectively. Year dummies are not presented for the sake of brevity.

The FE estimator results searching bank efficiency and GDP relationship are presented in the last column of Table 4. Previous year's efficiency has explanatory power on efficiency of the following year with more than 95% at a 1% significance level. But the results do not show the effects of GDP on bank efficiency. Only gross capital formation and import are observed to negatively affect bank efficiency at a low significance level. Results are in parallel with

Ferreira's findings (2013) stating that the effect of economic situation to cost efficiency is not clear.

5. Conclusion

This study examines first the intermediation efficiency of 3039 banks in the OECD countries for the period of 2011 to 2019 by using the SBM model of DEA-based Malmquist productivity index. Then, by using the total assets of each country's banking industry the weighted average bank efficiency of each single country is calculated. Finally, a cumulative bank efficiency index is constructed. In general, a decrease is observed in bank efficiency until 2015, and thereafter a recovery is witnessed. Efficiency decreases mostly as results of frontier shift, which represents disadvantageous macroeconomic environment for all banks. However, the catch-up part of the Malmquist index is sharply upward after 2017, showing the adaptation of banks to the new economic conditions.

Having estimated the bank efficiency scores, the relationship between efficiency and growth is investigated by a two-step system GMM estimator of panel data analysis. The results indicate that a percentage change in the previous years GDP is associated with 1.127% change in the following year's GDP, implying an elastic relationship in the short run. However, a limited positive effect is observed between efficiency and economic growth. Only 0.042% of growth is associated with 1% change in efficiency. Although the effect is minimal, the findings are in line with the majority of researches quoted in this study. When GDP components are considered, no relationship is observed between bank efficiency and economic growth components.

There is no relationship in the other direction, *i.e.,* changes in GDP have no explanatory power on changes in bank efficiency. Only gross capital formation and import have negative effects on bank efficiency at a low significance level. Additionally, the previous year's efficiency has explanatory power regarding the efficiency of the following year's with more than 95% at a 1% significance level.

As some researchers point out, the association between efficiency and economic growth might be diminished in the post-crisis period. Efficiency decreases and efficiency neutrality may indicate that monetary expansion has not led to increase in consumption or investment, and then in banking loans. The transmission mechanism from monetary expansion to economic growth has not worked after the crisis. But afterwards, the banking sector seems to adapt to the new conditions and recovered the inefficiencies.

The results are important as they may require to revise the thoughts about the relationship between financial improvement and economic growth. It tries to reveal the link between microeconomic and macroeconomic conditions in the financial industry. However, to confirm the changing role of interaction between financial qaulity and growth, the study needs to be implemented with data of a much longer period. Country-specific researches should also be coducted to see whether the relationship differs from country to country.

References

Ang, J.B., 2008. A Survey of Recent Developments in The Literature of Finance and Growth. *Journal of Economic Surveys,* 22**,** pp.536-576. https://doi.org/10.1111/j.1467-6419.2007.00542.x

Arellano, M. and Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics,* 68**,** pp.29-51. https://doi.org/10.1016/0304-4076(94)01642-D

Arestis, P., Chortareas, G. and Magkonis, G., 2015. The Financial Development and Growth Nexus: A Meta-Analysis. *Journal of Economic Surveys,* 29**,** pp.549-565. https://doi.org/10.1111/joes.12086

Athanassopoulos, A.D., 1997. Service quality and operating efficiency synergies for management control in the provision of financial services: Evidence from Greek bank branches. *European Journal of Operational Research,* 98**,** pp.300-313. https://doi.org/10.1016/S0377-2217(96)00349-9

Avkiran, N.K., 2011. Association of DEA super-efficiency estimates with financial ratios: Investigating the case for Chinese banks. *Omega,* 39**,** pp.323-334. https://doi.org/10.1016/j.omega.2010.08.001

Ayadi, R., Arbak, E., Naceur, S.B. and De Groen, W.P., 2015. Financial Development, Bank Efficiency, and Economic Growth Across the Mediterranean. *In:* Ayadi, R., Dabrowski, M. and De Wulf, L. (eds.) *Economic and Social Development of the Southern and Eastern Mediterranean Countries.* Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-11122-3_14

Banker, R.D., Charnes, A. and Cooper, W.W., 1984. Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management science,* 30**,** pp.1078-1092. https://doi.org/10.1287/mnsc.30.9.1078

Barth, J.R., Lin, C., Ma, Y., Seade, J. and Song, F.M., 2013. Do bank regulation, supervision and monitoring enhance or impede bank efficiency? *Journal of Banking & Finance,* 37**,** pp.2879-2892. https://doi.org/10.1016/j.jbankfin.2013.04.030

Belke, A., Haskamp, U. and Setzer, R., 2016. Regional bank efficiency and its effect on regional growth in "normal" and "bad" times. *Economic Modelling,* 58**,** pp.413-426. https://doi.org/10.1016/j.econmod.2015.12.020

Berger, A.N., Hasan, I. and Klapper, L.F., 2004. Further Evidence on the Link between Finance and Growth: An International Analysis of Community Banking and Economic Performance. *Journal of Financial Services Research,* 25**,** pp.169-202. https://doi.org/10.1023/B:FINA.0000020659.33510.b7

Berger, A.N. and Humphrey, D.B., 1997. Efficiency of Financial Institutions: International Survey and Directions for Future Research. *European Journal of Operational Research,* 98**,** pp.175-212. https://doi.org/10.1016/S0377-2217(96)00342-6

Bernini, C. and Brighi, P., 2018. Bank branches expansion, efficiency and local economic growth. *Regional Studies,* 52**,** pp.1332-1345. https://doi.org/10.1080/00343404.2017.1380304

Blundell, R. and Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics,* 87**,** pp.115-143. https://doi.org/10.1016/S0304-4076(98)00009-8

Capelle-Blancard, G. and Labonne, C., 2016. More Bankers, More Growth? Evidence from OECD Countries. *Economic Notes,* 45**,** pp.37-51. https://doi.org/10.1111/ecno.12051

Charnes, A., Cooper, W.W. and Rhodes, E., 1978. Measuring the efficiency of decision making units. *European Journal of Operational Research,* 2**,** pp.429-444. https://doi.org/https://doi.org/10.1016/0377-2217(78)90138-8

Demirgüç-Kunt, A. and Levine, R., 2008. Finance, Financial Sector Policies, and Long-Run Growth *Policy Research Working Paper.* Washington: The World Bank.

Diallo, B., 2018. Bank efficiency and industry growth during financial crises. *Economic Modelling,* 68**,** pp.11-22. https://doi.org/10.1016/j.econmod.2017.03.011

Ferreira, C., 2013. Bank performance and economic growth: evidence from Granger panel causality estimations. *DE Working papers.* Lisbon: Instututo Superior de Economia e Gestão.

Ferreira, C., 2016. Does Bank Performance Contribute to Economic Growth in the European Union? *Comparative Economic Studies,* 58**,** pp.174-195. https://doi.org/10.1057/ces.2016.4

Ferreira, C., 2018. Financial Crisis, Banking Sector Performance and Economic Growth in the European Union. *Economia Internazionale/International Economics,* 71**,** pp.257-288.

Fethi, M.D., and Pasiouras, F., 2010. Assessing Bank Efficiency and Performance with Operational Research and Artificial Intelligence Techniques: A survey. *European Journal of Operational Research,* 204**,** pp.189-198. https://doi.org/10.1016/j.ejor.2009.08.003

Fu, X., Lin, Y. and Molyneux, P., 2018. The quality and quantity of bank intermediation and economic growth: evidence from Asia Pacific. *Applied Economics,* 50**,** pp.4427-4446. https://doi.org/10.1080/00036846.2018.1450486

Gaganis, C. and Pasiouras, F., 2013. Financial supervision regimes and bank efficiency: International evidence. *Journal of Banking & Finance,* 37**,** pp.5463-5475. https://doi.org/10.1016/j.jbankfin.2013.04.026

Hasan, I., Horvath, R. and Mares, J., 2016. What Type of Finance Matters for Growth? Bayesian Model Averaging Evidence. *Policy Research Working Paper.* Washington: The World Bank.

Hasan, I., Kobeissi, N., Wang, H. and Zhou, M., 2017. Bank financing, institutions and regional entrepreneurial activities: Evidence from China. *International Review of Economics & Finance,* 52**,** pp.257-267. https://doi.org/https://doi.org/10.1016/j.iref.2017.01.013

Hasan, I., Koetter, M. and Wedow, M., 2009. Regional Growth and Finance in Europe: Is There a Quality Effect of Bank Efficiency? *Journal of Banking & Finance,* 33**,** pp.1446-1453. https://doi.org/10.1016/j.jbankfin.2009.02.018

IMF, 2017a. World Economic Outlook, April 2017. Washington: International Monetary Fund.

IMF, 2017b. Global Financial Stability Report, April 2017. Washington: International Monetary Fund.

Kale, S., Eken, M. H. and Selimler, H., 2015. The Effects of Regulations on the Performance of Banks: Evidence from the Turkish Banking Industry. *Journal of Centrum Cathedra: The Business and Economics Research Journal,* 8**,** pp.109-145. https://doi.org/10.1108/JCC-08-02-2015-B003

Koetter, M. and Wedow, M., 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. https://doi.org/10.1016/j.jimonfin.2010.05.015

Levine, R., 2005. Finance and Growth: Theory and Evidence. *Handbook of economic growth,* 1**,** pp.865-934.

Lucchetti, R., Papi, L. and Zazzaro, A., 2001. Banks' Inefficiency and Economic Growth: A Micro-Macro Approach. *Scottish Journal of Political Economy,* 48**,** pp.400-424. https://doi.org/10.1111/1467-9485.00206

Madariaga, N. and Poncet, S., 2007. FDI in Chinese Cities: Spillovers and Impact on Growth. *The World Economy,* 30**,** pp.837-862. https://doi.org/10.1111/j.1467-9701.2007.01025.x

Malmquist, S., 1953. Index numbers and indifference surfaces. *Trabajos de estadística,* 4**,** pp.209-242. https://doi.org/10.1007/BF03006863

Mensah, E., Abor, J., Aboagye, A. Q.Q. and Adjasi, C.K.D., 2012. Enhancing the Economic Growth of Africa: Does Banking Sector Efficiency Matter? In: Tsamenyi, M. and Uddin, S., eds. *Finance and Development in Africa.* Emerald Group Publishing Limited. https://doi.org/10.1108/S1479-3563(2012)000012B005

Mirzaei, A. and Moore, T., 2016. Banking performance and industry growth in an oil-rich economy: Evidence from Qatar. *The Quarterly Review of Economics and Finance,* 60**,** pp.58-69. https://doi.org/10.1016/j.qref.2015.06.001

Mirzaei, A. and Moore, T., 2019. Real Effect of Bank Efficiency: Evidence from Disaggregated Manufacturing Sectors. *Economica,* 86**,** pp.87-115. https://doi.org/10.1111/ecca.12238

Nayan, S., Kadir, N., Ahmad, M. and Abdullah, M.S., 2013. Revisiting Energy Consumption and GDP: Evidence from Dynamic Panel Data Analysis. *Procedia Economics and Finance,* 7**,** 42-47. https://doi.org/10.1016/S2212-5671(13)00216-5

Palley, T.I., 2013. Financialization: What It Is and Why It Matters. *Financialization: The Economics of Finance Capital Domination.* London: Palgrave Macmillan UK. https://doi.org/10.1057/9781137265821_2

Paradi, J.C. and Zhu, H., 2013. A Survey on Bank Branch Efficiency and Performance Research With Data Envelopment Analysis. *Omega,* 41**,** pp.61-79. https://doi.org/10.1016/j.omega.2011.08.010

Roodman, D., 2009. How to do Xtabond2: An Introduction to Difference and System GMM in Stata. *The Stata Journal,* 9**,** pp.86-136. https://doi.org/10.1177/1536867X0900900106

Rousseau, P.L. and Wachtel, P., 2011. What is happening to the impact of financial deepening on economic growth? . *Economic Inquiry,* 49**,** pp.276-288. https://doi.org/10.1111/j.1465-7295.2009.00197.x

Saqib, N., 2013. Impact of development and efficiency of financial sector on economic growth: Empirical evidence from developing countries. *Journal of Knowledge Management, Economics and Information Tecnology,* 3**,** pp.1-9.

Sharma, D., Sharma, A.K. and Barua, M.K., 2013. Efficiency and productivity of banking sector: A critical analysis of literature and design of conceptual model. *Qualitative Research in Financial Markets,* 5**,** pp.195-224. https://doi.org/10.1108/QRFM-10-2011-0025

Tone, K., 2001. A slacks-based measure of efficiency in data envelopment analysis. *European Journal of Operational Research,* 130**,** 498-509. https://doi.org/10.1016/S0377-2217(99)00407-5

Tone, K. and Tsutsui, M., 2017. Malmquist Productivity Index Models. *In:* Tone, K., ed. *Advances in DEA Theory and Applications.* USA: John Wiley & Sons Ltd. https://doi.org/10.1002/9781118946688.ch6

Valickova, P., Havranek, T. and Horvath, R., 2015. Financial Development and Economic Growth: A Meta-Analysis. *Journal of Economic Surveys,* 29**,** pp.506-526. https://doi.org/10.1111/joes.12068

Yusifzada, L. and Mammadova, A., 2015. Financial intermediation and economic growth. *William Davidson Institute Working Paper.* Michigan: William Davidson Institute at the University of Michigan.

Appendix 1

Effect of Bank Efficiency on Economic Growth

Year Author	Sample Period	First Stage	Second Stage		Conclusion
		Mtd/Eff.	Second Stage	Independent	
2018 Ferreira	28 EU 1998-2012	DEA CE	Sys GMM • GDP	• Operational ratios • Capital ratios • Liquidity ratios • Asset quality ratios	Banking sector was considered responsible for the financial crisis, but its performance could also positively contribute to economic growth.
2018 Fu et al.	14 Asia Pasific 2003-2015	SFA SVE, CE, PE	Sys GMM • GDP growth	• Efficiency • Liquidity creation • Control variables	Both financial quantity and quality have positive effect on economic growth.
2018 Diallo	38 2009	DEA IE	Regression • GDP growth	• Bank efficiency • Market capitalization • Tot capitalization • Concentration	For financially dependent industries, bank efficiency increased the growth rate during the crisis.
2019 Mirzaei & Moore	49 2001-2010	SFA CE, PE	Regression • Ind. growth	• Bank CE, PE • Firm size • Share in VA • Financial dependence • Prop. rights • Stock turn. ratio	In countries with efficient banking, industries that rely on external funds grow faster.
2017 Hasan et al	China (30 provinces) 1998-2008	SFA PE	Regression • Regional entrep. act.	• Quantity measures • Quality measures	Bank efficiency plays an important role in funding entrepreneurial firms.
2017 Bernini & Brighi	ITA (101 provinces) 2006-2013	SFA CE	System GMM • GDP	• Bank CE • Credit vol to GDP • Control var (deposit, branches, ATM,	Efficient banks and credit availability positively affect the local economy.
2016 Belke et al	12 EU 2000-2013	SFA CE, PE	System GMM • GDP p. worker	• Fin Q (Efficiency) • Labor Force Growth • Education • HHI, Heritage, Lerner Index • Income/branch • Bank income pc • Fin. volume	Relatively more profit efficient banks increase the economic growth. In normal and bad times, the link between financial quality and growth is valid.

Year Author	Sample Period	First Stage	Second Stage		Conclusion
		Mtd/Eff.	Second Stage	Independent	
2016 Ferreira	EU 1999-2013	DEA CE	Diffa GMM • GNP	• Bank efficiency • Int. rate • Gov. net lending-borr. • Bank concentration • Equity/TA	Bank efficiency positively effects to economic growth.
2016 Hasan et al	60 1960-2011		BMA	• NIM • Bank Z-score • Private credit • Market cap. • Market turnover	Financial development indicators are not clearly related to long-term growth. However, a new indicator such as efficiency is clearly related to long-term growth.
2016 Mirzaei & Moore	QAT 2000-2006		Panel FE • Growth of VA	• Cost to income ratio • Overheads to total assets • Interest rate spread • Credits • GDPgrowth	A competitive, efficient and stable banking system is rquired for financially dependent industries to grow faster.
2015 Yusifzada & Mammadova	118 2004-2011		System GMM • GDP growth p.c.	• NIM and ROA • Gov. expenditure • Trade • Secondary educ.	Depending on the level of financial development, the influence of efficiency differs.
2013 Ferreira	27 EU 1999-2013	DEA CE	Gran. Caus. • GDP per c. • Gr.cap. Grwth	• Cost efficiency • ROE • ROA	Bank performance positively effect economic growth.
2013 Saqip	50 2005-2009		Panel • GDP growth p.c.	• NIM • Investment to GDP • Enrollment • M2/GDP • Priv. Credit to GDP	Financial development and efficiency of sector increases economic growth.
2013 Ayadi et al	11 SEMC 1984-2010		Panel • GDP growth p.c.	• Cost efficiency • Financial dev. • Opennes • FDI	To improve economic growth, an improvement in banking efficiency is not enough; additional conditions are required.
2012 Mensah et al	AFR 1999-2008	SFA CE	Diff GMM • GDP p.c.	• Cost efficiency • Priv. loans. • Pop. growth rate • Investments/gdp • Govt spend. • Econ. Freedom • Corrup. Ind. • Infl. rate • Bank concentration	A positive association between banking sector efficiency and economic growth, confirming the critical role banks play in the economy.
2010 Koetter & Wedow	DEU 1995-2005	SFA CE	System GMM • GDP p. worker	• Cost efficiency • Bank loans and sec./GDP • Growth rate employed • Tertiary ed./total workers • HHI bank assets • Lerner index	Financial quality has a positive effect on economic growth.

Year Author	Sample Period	First Stage	Second Stage		Conclusion
		Mtd/Eff.	Second Stage	Independent	
2009 Hasan et al	11 EU 1996-2004	SFA CE, PE	System GMM • GDP	• Efficiency • Financial volume	Bank efficiency significantly has positive effect on regional economic growth in mature economies.
2004 Berger et al	49 countries 1993-2000	SFA CE, PE	Regression • GDP growth	• Eff rank • Bank share • Market cap. to GDP • Asset concentration	Positive relationship between efficiency and economic growth.
2001 Lucchetti et al	ITA 1982-1994	SFA CE	System GMM • GDP p.c.	• Inefficiency • Loan/gdp • Human capital • Number of bankrupts • Share of loans bys • Share of priv. sector loans	There exists a positive effect of the efficiency of banks on regional growth.

PE: Profit efficiency, CE: Cost efficiency, IE: Intermediation efficiency, p.c.=Per capita.

Appendix 2

Number of Banks and Total Assets

Country	# Bank	Tot. Assets (*)	Country	# Bank	Tot. Assets (*)
Australia	10	2,871	Italy	128	3,474
Austria	16	788	Japan	137	17,083
Belgium	15	1,578	Korea	16	3,001
Canada	20	4,993	Latvia	6	20
Switzerland	32	2,733	Mexico	11	572
Chile	7	311	Netherlands	19	3,133
Czech Rep.	8	222	Norway	19	765
Germany	63	6,320	Poland	14	403
Denmark	19	1,229	Portugal	9	373
Spain	14	3,612	Slovakia	6	57
France	90	17,405	Slovenia	7	36
UK	57	15,738	Sweden	9	1,102
Hungary	9	61	Türkiye	15	561
Ireland	8	391	USA	2268	37,552
Israel	7	490	*Total*	*3039*	*126,873*

Note: (*) Billion USD as of 2019.

Appendix 3

Descriptive Statistics of Data for Panel Data Regression

Variable	Explanation	Obs	Mean	Std. Dev.	Min	Max
cummi	Cumulative MI of efficiency	261	1.0134	0.1066	0.6826	1.4245
gdp	Gross domestic product	261	1.0894	0.1096	0.9506	1.7575
cons	Final consumption expenditure	261	1.0719	0.0851	0.9384	1.3918
cap	Gross capital formation	261	1.1078	0.3466	0.7844	4.8858
exp	Exports of goods and services	261	1.1724	0.1810	0.9830	2.2760
imp	Imports of goods and services	261	1.1453	0.1738	0.8940	2.5145

Source: OECD, authors' calculations.