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Review
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THE PRODUCTIVITY OF EUROPEAN BANKING SECTOR: A REVIEW OF THE POST-2000 LITERATURE

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Abstract
Numerous bank productivity studies indicate rapid changes in the structure of the financial services industry and advances in financial and nonfinancial technologies. Based on the literature review, this paper analyses the theoretical background of two concepts of performance evaluation – the terms efficiency and productivity, and empirically, the performance evaluation of banks, i.e., the measurement of the productivity and research results of previous authors' studies of the European banking sector applying different scientific methods. Non-parametric or parametric techniques, such as DEA with the Malmquist total factor productivity index or SFA method, are increasingly being used to evaluate the productivity of banks and other financial institutions. The measurement of bank productivity is of vital importance from both a microeconomic and a macroeconomic point of view. Therefore, the purpose of this paper is to present productivity literature review of the most relevant studies of the European banking sector published after year 2000. The main results of this research will be the comparative analysis of different empirical scientific studies regarding banking sector productivity evaluation.

Keywords: performance evaluation, productivity growth, efficiency, banks, Malmquist productivity index.

Jel Classification: G21; G34; D24; C61

INTRODUCTION

From the macroeconomic point of view, the fundamental objective of every national economy, including the economic/financial system, is to achieve economic efficiency. Efficiency must be observed from the microeconomic point of view as well, and as such,

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it represents one of the basic indicators of the operation of a modern business subject. Efficiency is also associated with the term productivity, which includes the component of technological advancement whereby change, namely, productivity growth, is one of the basic factors of economic development.

From the microeconomic point of view, the measurement of bank efficiency and productivity is crucial given the enhancement of competition in the banking sector and the improvement in the institutional, regulatory and supervisory framework. From the macro perspective, the efficiency and productivity of the banking sector has an impact on the cost of financial intermediation and the overall stability of the financial system, because of the domination of banking sector in post-transition EU countries. An improvement of banking performance indicates a better allocation of financial resources, and therefore, an increase in investment that favors growth (Koutsomanoli-Filippaki, Margaritis, and Staikouras 2009).

Numerous bank productivity studies indicate rapid changes in the structure of the financial services industry and advances in financial and nonfinancial technologies. An increase in bank productivity is expected to lead to better bank performance, lower prices and improved service quality, as well as to the enhancement of resource allocation and productivity in the economy. Therefore, the purpose of this paper is to present productivity literature review of the most relevant studies of the European banking sector published after year 2000. A theoretical part of the paper analyses two concepts of performance evaluation — the terms efficiency and productivity, as well as their similarities and differences. Previous authors' studies on productivity measurement and research results in the European banking sector are emphasized in the empirical part of this paper. Finally, the main results of this research will be the comparative analysis of different empirical scientific studies regarding banking sector productivity evaluation.

1. PRODUCTIVITY AND EFFICIENCY: TWO CONCEPTS OF PERFORMANCE EVALUATION

In order to understand the efficiency, namely, the productivity that implies numerous "benefits" in business, it is necessary to define the mentioned terms, and to be familiar with, and implement in the process of managing a business subject, different methods of measuring the efficiency and productivity of the observed units. According to the work of Koopmans and Debreu, Farrell (1957) defines and analyses two concepts of efficiency.

The first concept refers to *technical efficiency*, which marks the ability of a business to maximize production from the available level of inputs, while the second concept implies *allocative efficiency* marking the ability of a business to use different inputs in an optimal ratio relative to their prices with a given production technology. If the company is perfectly efficient or if both technical and price efficiency are satisfied, then the *overall (economic) efficiency* is achieved. Likewise, efficiency can indicate the production of a certain level of outputs with minimal input consumption or maximizing output production with existing input consumption.

Although the measurement of efficiency existed in the early 20th century, it was especially intensified in the 1960s. In this early period, the technological changes of business subjects/units were measured by analysing the changes in production and production costs. For example, the measurement of changes in productivity was conducted on the suitability of "output per unit of input" technique. During the 1970s, empirical research of productivity, for example, were based on the effects of ownership structure on efficiency. Recently, among others, methods such as Data Envelopment Analysis (DEA), Stochastic Frontier Analysis (SFA), Corrected Ordinary Least Squares (COLS) are increasingly being used to measure and evaluate the efficiency and productivity of business units.

One of the methodologies widely used to calculate relative efficiency and productivity of numerous business units operating in similar conditions is Data Envelopment Analysis. It is a type of non-parametric, comparative, performance analysis, which assumes that there are *n* business units (or decision-making units – DMUs) in order to evaluate if not all DMUs are efficient. DEA is based on mathematical programming and evaluates the efficiency of a DMU relative to a set of comparable DMUs. DEA is an interdisciplinary scientific method applied in various fields as well as in the evaluation of relative efficiency of various DMUs such as financial institutions, i.e. banks (Jemric and Vujcic 2002; Cerovic, Suljic Nikolaj, and Maradin 2017) or banking sector (Davidovic, Uzelac, and Zelenovic 2019; Maradin, Olgic Drazenovic, and Benkovic 2018), pension funds, insurance companies, investment funds, power plants or energy sector (Vlahinic-Dizdarevic and Segota 2012), schools, higher education institutions, hospitals, shopping facilities, municipal service providers (Hodzic and Muharemovic 2019), business units in forestry, etc.

Although productivity and efficiency are often used as identical terms, they are essentially different economic concepts. Efficiency refers to the operation of a business relative to a refrence set with the current level of technological development, while productivity implies a change in technology over time (Fare, Grosskopf, and Knox Lovell 1994). Equally to efficiency, productivity is defined by the ratio of outputs and inputs. In the beginning of research, productivity change was determined only in the technical units of the measure, while recently, it is widely accepted that a change in efficiency can influence a change in productivity. Therefore, we can say that a change in productivity is observed in technological and efficiency changes. In the cases when there is only one output and one input, the situation is clear. However, in a more realistic situation when a business subject produces multiple products and uses multiple inputs, it is necessary to aggregate the set of outputs and inputs so that the expression in numerator and denominator are scalar values. The same principle is applied for measuring productivity changes emerging due to technological development. Inter-business subject differences in productivity can be caused by factors which may or may not be influenced by the entities, such as inaccurate measurement, differences in production technology, in the scale of production etc.

In economic theory, Total Factor Productivity (TFP) is measured indirectly. It is the output growth not explicable by changes in the amount of inputs (often referred to as Solow residual). On the other hand, in economic practice, TFP is measured by productivity indices or productivity indicators. Indices have a multiplicative form,

whereas indicators have additive form. TFP measures changes in total output relative to inputs and the concept derives from the ideas of Malmquist (1953). In academic literature, the use of primal productivity indices on efficiency and productivity has recently experienced an increase in popularity. As discussed by the review of the non-parametric literature, the Malmquist TFP index is the most commonly used measure of productivity change (Casu, Girardone, and Molyneux 2004).

Among measures based on distance function, we can cite the Malmquist productivity index, the Hicks-Moorsteen productivity index and the Luenberger productivity indicator. These measures require optimization problem solving (Data Envelopment Analysis method) or regression methods measuring the distance from a real, but unknown frontier. Other TFP measures are based on price aggregation, such as the Tornqvist productivity index, the Fisher productivity index or the Bennet-Bowley productivity indicator. These measures require data about input and output prices, but can be derived directly from empirical data (Machek and Hnilica 2012).

The next section presents the results of the research studies of productivity and efficiency in the banking sector of different EU countries.

2. EMPIRICAL REVIEW OF THE PRODUCTIVITY IN THE EUROPEAN BANKING SECTOR

The concept of total productivity was first discussed in the literature of the 1930s and the first explicit calculation of "technical development", obtained by generalizing a Cobb–Douglas production function by adding an exponential time trend, is attributable to Jan Tinbergen (1941) who was the first Nobel prize winner in Economic Sciences (in 1969 along with Ragnar Frisch), and also one of the founder of econometrics. Moreover, one of the first studies to investigate productivity change in the banking industry was by Berg, Forsund, and Jansen (1992). They employed Malmquist index for productivity growth in Norwegian banking system during the deregulation period 1980–1989 and found that productivity fell prior to the period experiencing deregulation but grew rapidly when deregulation took place (Casu, Girardone, and Molyneux 2004).

Many studies and reviews since then have been conducted in evaluating productivity of the banking sector in the European countries. One of the most significant studies are mentioned in this section.

Epure, Kerstens. and Prior (2011) analyse changes in productivity and efficiency of Spanish private and savings banks over the period 1998–2006 by applying the decomposition of the Luenberger productivity indicator. Empirical research is based on three inputs: operating assets (defined as total assets – financial assets), labour (number of employees), other administrative expenses, and three outputs: deposits, loans, fee-generated income (non-traditional output). Empirical results demonstrate that productivity improvements are partially due to technological innovation. Furthermore, while private banks have better efficiency change, savings banks contribute more to technological progress. Consequently, the Luenberger components are used as cluster analysis inputs. Economic interpretations of the resulting performance groups are made via key differences in productivity components.

Kontolaimou and Tsekouras (2010) investigate the productive performance of cooperative banks as compared to commercial and savings banks, taking into account the existence of technology heterogeneity due to different ownership forms in six European banking systems from 1997 to 2004. Inputs used in the empirical research are total expenses, deposits and equity. The constructed output variables include loans, other earning assets and off-balance sheet items. The results show that the type-specific frontier corresponding to cooperative banks lies, to its largest part, away from the European metafrontier. Furthermore, within the cooperative bank type a dichotomy seems to arise. The decomposition results suggest that the cooperatives' technology gap is attributed to output production rather than input use.

Pasiouras and Sifodaskalakis (2010) employ the Malmquist index to examine the TFP change in 13 Greek cooperative banks over the period 2000–2005. Used variables are fixed assets, number of employees, deposits (as inputs) and loans, liquid assets and investments (as outputs). The first model based on the intermediation approach indicates a small decrease (3%) in TFP whereas the second model based on the production approach indicates an increase by 6.6%. Also, the results show that TFP growth is higher for smaller banks than the large ones on average over the entire period of the analysis.

Chortareas, Girardone and Ventouri (2009) analyse cost and profit efficiency as well as productivity change of commercial banks in Greece using the non-parametric DEA method and the TFP Malmquist Index over the period 1998–2003. Empirical research is based on one input (total cost figure) and two outputs (total customer loans and total other earning assets). The results indicate that cost efficiency has risen by 4.3%, profit efficiency by 93% and productivity by 15% and this was mainly driven by the improvements in the performance of best-practice institutions. Moreover, results do not show any role for off-balance sheet activities in Greek banks' efficiency.

Koutsomanoli-Filippaki, Margaritis and Staikouras (2009) investigate the effects of the financial reforms on the efficiency and productivity performance of 186 banks across Central and Eastern European (CEE) countries (Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) over the period 1998–2003. Authors specify two inputs (labour and physical capital) that are used to produce three outputs (loans, other earning assets and borrowed funds). The results demonstrate the strong links of competition and concentration with bank efficiency. They also show that productivity for the whole region initially declined but has improved more recently with further progress on institutional and structural reforms. Finally, productivity change in CEE is driven by technological change rather than efficiency change.

Williams, Peypoch and Barros (2009) employ the Luenberger productivity indicator to estimate productivity growth for savings banks in ten EU countries over the period 1996–2003. Two inputs are used to produce bank outputs: fixed assets and variable costs (defined as the sum of interest expense, personnel cost and other non-interest income expense). Banks are assumed to produce four outputs that cover both on and off-balance sheet activities: total customer loans, interbank loans, securities and off-balance-sheet items. It is found that average productivity growth is 2.79 percent per annum and driven almost entirely by technical change. Whilst the general results confirm earlier findings,

this study is one of the earliest to identify cross-border differences in productivity growth in the savings banks sector.

Kondeas et al. (2008) estimate productivity changes, using SFA method, for commercial banks across 15 countries in the EU to obtain a better understanding of how banks adapted of rapid change in the competitive environment over the 1990s. There are three outputs in the cost function: loans, investments and commissions. The three input prices in the cost function include capital, labour and deposits. The dependent variable is total cost, which is the cost associated with the production of bank output. It is found that the banking systems in all individual countries became more efficient. According to productivity, country rankings changed little (Germany had the most productive banking system in the EU for every year of the time period), and productivity differences between banking systems narrowed.

Guzman and Reverte (2008) analyse productivity change and shareholder value, by verifying whether banks characterised by higher levels of efficiency and productivity change have a higher shareholder value. Outputs used in this empirical research are: total loans, interest income and commissions received. On the input side, three variables are selected: total deposits, interest expenses and commissions paid, and personnel and administration expenses. The results of 14 Spanish banks in the period 2000–2004 confirm that those banks with higher efficiency and productivity changes have a higher shareholder value, even after controlling for the impact of traditional measures of performance, such as return on assets.

Lyroudi and Angelidis (2006) evaluate the productivity change of 994 banks of the ten country members of the European Union for the period before their entry in the EU, 1996–2002. As input variables in the empirical research are characterized: personnel expenses, other operating expenses and total fixed assets. Used outputs are the following: total deposits, total customer loans and investments. The results indicate that the total level of productivity had increased for half of the countries. The decomposition of the Malmquist index revealed that the productivity increase was lower for the best practice banks than the remaining institutions. The relationship between the size of banking institutions and productivity growth was not statistically significant, with the exception of one country.

Rezitis (2006) investigates productivity growth and technical efficiency of the 6 Greek banking institutions over the period 1982–1997. The three input variables are defined as labour (total number of full-time employees), capital expenses (defined as fixed assets, including tangible fixed assets and intangible fixed assets), and value of deposits (bank bonds and site, saving and time deposits). The two output variables are defined as the value of loans and advances (short and long term loans and advances to industry and customers) and the value of investment assets (shares and other variable income securities, participation in companies, investments in fixed income securities and government securities). Productivity growth is higher after 1992, mainly attributed to technical progress, while until 1992 growth is mainly attributed to improvements in efficiency. Furthermore, after 1992, pure efficiency is higher, and scale efficiency is lower, indicating that although banks achieved higher pure technical efficiency, they moved away from optimal scale. Finally, Tobit results show that size and specialization have positive effects on both pure and scale efficiency.

Using the non-parametric Malmquist methodology, Casu and Girardone (2005) analyse the importance of the inclusion of off-balance sheet (OBS) business in the definition of banks output when estimating TFP change indexes. Empirical research is based on three output variables (total loans as lending activity of banks, securities as growing non-lending activities and nominal value of banks' off-balance sheet items as a third output). Input variables are cost of labour (personnel expenses/total assets), deposits (interest expenses/customer and short term funding) and capital (total capital expenses/total fixed assets). The results indicate that the inclusion of OBS items results in an increase in estimated productivity levels, the most on technological change rather than efficiency change. Omitting these non-traditional activities in the definition of bank output understates productivity levels and may lead to biased conclusions.

Casu and Girardone (2004) evaluate the cost characteristics (scale, scope and x-efficiency), profit efficiency and productivity change of Italian financial conglomerates over the period 1996–1999 using both parametric (SFA and Distribution Free Approach (DFA) methods) and non-parametric (DEA method) approaches. The input variables used in this study are the average cost of labour (personnel expenses/average number of personnel), deposits (interest expenses/customer and short-term funding) and capital (total capital expenses/total fixed assets). The output variables are total loans and other earning assets. The results seem to indicate that Italian banking groups have benefited from a consistent improvement in profit efficiency, while they have not experienced a clear increase in cost efficiency. The improvement in overall productivity results mostly from a sharp increase in pure technical efficiency rather than in scale efficiency.

Casu, Girardone and Molyneux (2004) compare parametric and non-parametric estimates of productivity change in European banking sector (2086 banks from France, Germany, Italy, Spain and the UK) between 1994 and 2000. Similarly as in previous research, the authors use the following inputs: the average cost of labour (personnel expenses/total assets), deposits (interest expenses/customer and short-term funding) and capital (total capital expenses/total fixed assets). The output variables capture both the traditional lending activity of banks (total loans) and the growing non-lending activities (securities). The results suggest that productivity growth has mainly reflected in technological improvements. Finally, in this study the two approaches generally do not yield markedly different results in terms of identifying the components of productivity growth.

Tsionas, Lolos and Christopoulos (2003) estimate economic efficiency, TFP change, and technical change of the Greek banking system during the liberalization and deregulation period, i.e. over the period 1993–1998. In empirical research, there are used three output variables (loans, investments and liquid assets) and three input variables (labour, capital and total deposits). The results show that the majority of banks operate close to best market practices, while allocative inefficiency costs seem to be more important than technical inefficiency costs. The positive, but not substantial TFP change of the Greek banking system is associated to efficiency improvement for the medium-sized banks and to technical change improvement for larger institutions.

Kumbhakar et al. (2001) examine the impact of regulatory reform on the performance of Spanish savings banks over the period 1986–1995. Due to the increased mergers and acquisitions during the sample period, there has been a marked reduction in the number

of Spanish savings banks (from 75 in 1986 to 46 in 1995). Empirical research is based on two output variables which are total loans and core deposits, and three input variables: labour (number of employees), variable physical capital (furniture fixtures and materials) and financial input (measured as cost of funds). The focus of this research is whether increased competition brought on by deregulation affected performance of banks over time. Empirical results show declining levels of output technical efficiency along with a significantly high rate of technical progress. In spite of declining technical efficiency during this period, there is evidence of an increasing trend in productivity growth.

CONCLUSION

Based on the literature review, this paper analyses the theoretical background of efficiency and productivity, and empirically, the performance evaluation of banks, i.e., the assessment of the productivity of banking sector applying different scientific methods. Non-parametric or parametric techniques, such as DEA or SFA method, are increasingly being used to evaluate the productivity of banks and other financial institutions. The measurement of bank productivity is of vital importance from both a microeconomic and a macroeconomic point of view in terms of competition during the transition to market economy, especially in post-transition EU countries, and for the development and improvement of the banking financial system and the whole national economy. Therefore, it is necessary to analyse and evaluate banking performance, especially in terms of efficiency and productivity.

Empirical research from a number of authors display different approaches, concepts and methods used in productivity measurement. The research of banking performance can enable important information on efficiency and productivity among the examined subjects in the sample which are of interest for creditors, investors, and other interested stakeholders. According to the analysed literature, the conclusion is that most studies deal with some slight differences in measuring the productivity of banks over a period of time, depending on variable selection and applied methodology.

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