

ANALYZING BANKS' PERFORMANCE DURING THE RECENT BREAKDOWNS. WHAT WERE THE MAIN DRIVERS?

VINCENZO PACELLI ^{*,§}, FRANCESCA PAMPURINI ^{†,¶} and ANNA
GRAZIA QUARANTA ^{‡,||}

**Ionian Department in "Legal and Economic Systems of the Mediterranean:
Society, Environment, Cultures"
University of Bari Aldo Moro, Italy*

*†Department of Economics and Business Management Sciences
Catholic University of the Sacred Heart of Milan
Largo Gemelli 1, 20123 Milan, Italy*

*‡Department of Economics and Law
University of Macerata
Via Crescimbeni 14, 62100 Macerata, Italy*

*§vincenzo.pacelli@uniba.it
¶francesca.pampurini@unicatt.it
||annagrazia.quaranta@unimc.it*

Received 13 March 2023

Revised 6 July 2023

Accepted 5 October 2023

Published 9 November 2023

We observe the main efficiency drivers of European Banking Groups after the burst of the Global Financial Crisis. This analysis is a live issue within the studies in the field of intermediation. The observed period (2010–2021) is emblematic of the complexity of the financial market in the last two decades. The efficiency levels derive from a stochastic frontier approach; a k -means cluster analysis distinguishes the units into three homogeneous groups, so that the main determinants of the higher level of efficiency can be identified. They are linked to a particular business model, specific managerial choices, costs rationalization and liquidity optimization.

Keywords: Banking groups; stochastic frontier approach; cluster analysis; efficiency drivers; management.

JEL Classifications: C58, C23, D24, F65, G21

§Corresponding author.

This is an Open Access article published by World Scientific Publishing Company. It is distributed under the terms of the Creative Commons Attribution 4.0 (CC BY) License which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

1. Introduction

Understanding what the main drivers of bank efficiency are is a live issue within the studies in the field of intermediation. Actually, the issue of efficiency has deep roots in financial literature since its evaluation is fundamental almost in judging the effectiveness of the strategies chosen by the manager, in comparing different subjects, as well as in appraising the dynamic of the evolution of each firm's business (among the others, Pagano 2021).

Despite the described importance of the topic, to the best of our knowledge, only a few studies analyzed which managerial aspects had the greatest impact on the efficiency levels achieved by the European Banking System during the different breakdowns that characterized the past two decades (Tsionas *et al.* 2015). This paper therefore aims to contribute to bridging that gap, being convinced that analyzing the response of banks to difficulties from the external environment and evaluating (in terms of efficiency) the effectiveness of their choices can provide useful information for both managers and policymakers. Then, the aim of the paper is also to offer some useful strategic managerial and policy recommendations after identifying the possible drivers of the highest efficiency values obtained by banking groups.

In this study, we deal with the banking groups operating in the major countries of the Euro Area since their banking systems are quite comparable and they suffered the same difficulties caused by the specific breakdowns that hit the whole Eurozone.

On the premise of the homogeneity of the available information and the need to obtain a balanced data set, the observation period spans from 2010 to 2021 to enable the acquisition of important information about the impact of all the breakdowns that took place in the Euro Area after 2008 (i.e. the subprime crisis and the following period, the sovereign debt crisis, the difficulties linked to non-performing loans and to the unusual dynamic of interest rates, and, finally, the recent COVID-19 pandemic crises) on the functioning of the groups.

The evaluation of the levels of efficiency obtained by the banking groups in the observed period is preparatory to the aim of the analysis and it will be based on a technique widely used in previous literature known as Stochastic Frontier Approach (Aigner *et al.* 1977, Meeusen & van den Broeck 1977, Forsund *et al.* 1985, Battese & Coelli 1995, Berger & Humphrey 1997, Beccalli 2004, Coelli *et al.* 2005, Pagano 2021, Pampurini & Quaranta 2018).

Then, through a k -means cluster analysis on the efficiency values previously obtained by each banking group in each year, we will distinguish the units into three homogeneous groups. In this way, we separate the banking groups linked to lower, medium and higher overall efficiency values during the study period.

The work proceeds with an analysis of the drivers deriving from specific strategic choices and/or attributable to the business model, which can explain the achievement of higher levels of efficiency in order to be able to identify useful recommendations in terms of managerial choices and policy strategies.

The study is organized as follows. Section 2 provides a brief literature review of the most important works that focus on the evaluation of bank efficiency and its drivers regardless of the model adopted and the purpose. Section 3 describes the results of the empirical analysis, while Sec. 4 provides some managerial and policy implications. Section 5 concludes.

2. Literature Review

Many studies have focused on the topic of efficiency from a methodological point of view (Allen & Rai 1996, Berger & Mester 1997, Bauer *et al.* 1998, Coelli *et al.* 2005, Beccalli *et al.* 2006, Halkos & Tzeremes 2013, Tsionas *et al.* 2015, McKee & Kagan 2016, Quaranta *et al.* 2018).

In order to quantify the level of efficiency, previous literature suggested different approaches that were changed and improved many times thanks to the gradual introduction of best practices in accounting standards which were able to represent the firm in a more realistic way and also thanks to continuous innovation in mathematical models (Fethi & Pasiouras 2010, Thanassoulis 2001, Avkiran 2011, KPMG 2009, Barnes 1987, Paradi & Zhu 2013, Feldstein 1967, Murphy & Orgler 1982, Boufounou 1995, Berger *et al.* 1993, Berger & Mester 1997, Hensel 2003, Coughlan *et al.* 2010, Hamid *et al.* 2017, Jaiyeoba *et al.* 2018, Aigner *et al.* 1977, Meeusen & van den Broeck 1977, Forsund *et al.* 1985, Battese & Coelli 1995, Coelli *et al.* 2005, Fernández *et al.* 2020, Aigner & Chu 1968, Charnes *et al.* 1994, Banker *et al.* 1984, Deprins *et al.* 1984, Simar & Wilson 2008, Olesen & Petersen 2016).

In the 90s, there were many works that tried to identify the determinants of the efficiency of financial intermediaries. In particular, some studies focused on the banking system in a specific geographical area and on a homogeneous sample within the economic environment. Other works focused on the comparison of different banking systems on an international basis in order to highlight the impact of the differences due to the underlying economic environments (Radić *et al.* 2012, Ferreira 2013, Mirzaei 2013, Kalyvas & Mamatzakis 2014, Kontolaimou 2014, Degl'Innocenti *et al.* 2016 2017). In particular, Radić *et al.* (2012) address the need to assess investment banking efficiency on a global perspective. Specifically, the research assesses both cost and profit efficiency of investment banking industries operating in the G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) and Switzerland. The comparison of banking efficiency across countries is carried out using a global best-practice econometric frontier whereby banks in each country can be compared against the same standard.

This field of literature grew with the process of integration and globalization of the European financial markets and gave birth to two different comparison techniques: the first is based on the construction of different production/cost frontiers (Beccalli 2004, Lozano-Vivas & Pasiouras 2010, Lozano-Vivas & Pastor 2010, Matousek *et al.* 2015) while the second is based on the identification of a single efficient frontier for all the observed units (Pastor 2002)(Casu & Molyneaux 2003,

Girardone *et al.* 2009, Kenjegalieva *et al.* 2009, Delis & Papanikolaou 2009, Casu & Girardone 2010, Chortareas *et al.* 2012). In the first strand of research mentioned above, the paper of Lozano-Vivas & Pastor (2010) identifies barriers to cross-border banking based on bank performance and the objective of the work is to measure the influence of technology and environmental conditions when comparing two countries. Matousek *et al.* (2015), on the other hand, investigate whether the single market initiative for a homogeneous and competitive banking market extended to banks' cost and efficiency structures. This paper contributes to the ongoing empirical research on banking integration. The second strand of research belongs to the works of Casu & Girardone (2010) and Chortareas *et al.* (2012). Casu & Girardone (2010) assess the recent dynamics of bank cost efficiency through Data Envelopment Analysis (DEA). The results seem to provide evidence in support of integration and convergence, which are considered crucial to assess the outcomes of EU deregulation policies and necessary to improve the efficiency and performance of the banking sectors. Chortareas *et al.* (2012) instead analyze the dynamics between key regulatory and supervisory policies and various aspects of commercial bank efficiency and performance. The study focuses on a sample of 22 EU countries over the period 2000–2008 and the results suggest that supervisory powers can improve the efficient operations of banks. Recently Ivan *et al.* (2023) extended the analysis of the impact of the introduction of regulatory changes on bank performance. The empirical analysis was conducted on a sample of 433 European commercial banks over the period 2006–2015 and the results show a varying impact of regulation on bank performance. In large and medium-sized banks, regulation positively affects both efficiency and profitability, while for small banks it affects negatively as the new regulatory framework has imposed additional administrative and regulatory burdens.

Within this strand of literature focused on the international comparison of financial intermediaries, an important share of works examined in depth the drivers of efficiency. The main variables identified include the following: the business model (Doan *et al.* 2018, Stiroh 2004, Stiroh & Rumble 2006, Lepetit *et al.* 2008, Phan *et al.* 2018, Mesa *et al.* 2014, Curi *et al.* 2015, Elyasiani & Wang 2012), private or public ownership (Doan *et al.* 2018, Lozano-Vivas & Pasiouras 2010, Lu *et al.* 2018, Mesa *et al.* 2014), the organizational complexity (Rangan *et al.* 1989, Elyasiani & Mehdiian 1990, van der Venet 2002, Casu & Girardone 2002, 2004, Curi *et al.* 2015) the size of the intermediary (Phan *et al.* 2018, Martins 2018, Lu *et al.* 2018, Andries 2011, Batir *et al.* 2017, Isik & Hassan 2002, Catalbas & Atan 2005, Mesa *et al.* 2014), listing on a regulated market (Phan *et al.* 2018, Girardone *et al.* 2004, Casu & Molyneaux 2003, Beccalli *et al.* 2006, Pasiouras *et al.* 2008, Majid & Sufian 2009, Hadad *et al.* 2011, Pagano 2022), capital robustness (Martins 2018, Batir *et al.* 2017, Quang *et al.* 2022, Catalbas & Atan 2005, Isik & Hassan 2002), the level of internationalization of the business (DeYoung & Roland 2001, Batir *et al.* 2017), the level of credit quality (Lozano-Vivas & Pasiouras 2010), the concentration of the market (Martins 2018) and the supervisory framework (Barth *et al.* 2013, Lozano-Vivas & Pasiouras 2010,

Pasiouras *et al.* 2009, Barra *et al.* 2016). Major changes in the financial scenario, along with the effect of globalization of financial markets in the propagation of the crisis, have rekindled the interest of regulators and scholars in discussing the optimal banking models. Among the few studies on business model and banking performance, the paper of Curi *et al.* (2015) provides empirical evidence of optimal business models adopted by foreign banks operating in a peculiar banking system, i.e. the financial center, and it attempts to analyze whether business models adjusted during the financial crisis. Therefore, Phan *et al.* (2018) analyzed the efficiency variable on the size of the intermediary. This work focuses on measuring the cost efficiency of the Hong Kong banking sector over the period 2004–2014 through a second-stage regression analysis that finds that bank size and GDP growth are positively associated with efficiency, whereas revenue diversification and inflation are associated with lower efficiency. As regards the efficiency factor that is identified with the listing on a regulated market, Pagano (2022) focuses his study on the effect of operational inefficiency on the stock returns of large global financial firms using an approach based on a production function related to capital and labor. Capital robustness is discussed in the study by Quang *et al.* (2022), which examines the impact of non-performing loans on bank efficiency and the mitigating effect of bank capitalization. The evidence shows a negative relationship between non-performing loans and bank efficiency. Banks holding a stronger capitalization or belonging to a banking group could reduce the impact of non-performing loans on banking efficiency.

As just underlined, to the best of our knowledge, only a few studies analyzed which managerial aspects had the greatest impact on the efficiency levels achieved by the European Banking System during the different breakdowns that characterized the past two decades in the Euro Area countries. This paper therefore aims to contribute to bridging the gap.

3. Empirical Results

The set of banking groups considered for the analysis in the period 2010–2021 consists of 76 units operating in the main Euro Area countries characterized by a non-dissimilar socio-economic profile. It includes commercial banks, savings banks, cooperative banks and bank holdings and holding companies.

For reasons of comparability of results, we used a balanced data set^a including nine Austrian banking groups, 3 Belgian, 17 German, 11 Spanish, nine French, 14 Italian, 10 Dutch and three Portuguese.

The values of the efficiency indices of the groups were obtained via a methodology widely used in literature (Berger & Humphrey 1997, Beccalli 2004).^b Briefly, in

^aCfr. Roengpitya *et al.* (2014)

^bThe data used for the construction of banking group efficiency indices, as well as all the other variables employed in this study, are in the Orbis Bank Focus database (Bureau van Dijk) with the exception of the GDP deflator values that we obtained from the World Bank database.

relation to each considered year, we used a stochastic (cost) frontier in a translog, and therefore a parametric procedure belonging to the Stochastic Frontier Approach (SFA — Aigner *et al.* 1977; Meeusen & van den Broeck 1977),^c within which the total production costs were regressed on three outputs (loans, total financial assets and off-balance sheet assets) and four inputs (human, financial, fixed capital and equity) defined coherently with the Intermediation Approach (Berger & Humphrey 1997).

Given this premise, we obtained banking groups' inefficiency values for each year as regression residuals.^d

The obtained values (Table 1) show clearly that, each year, the variability between the average values of the efficiency indices related to each country is very low.

From the analysis of these values, the level of the banking groups' efficiency in the considered period clearly tends to decrease, and therefore to reflect the well-known effects induced on efficiency by the low profitability and the high incidence of costs

Table 1. Average values of the efficiency indices from 2010 to 2021 for banking groups distributed by country.

Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Austria	0.95	0.94	0.90	0.85	0.81	0.74	0.78	0.77	0.80	0.82	0.73	0.82
Belgium	0.99	0.98	0.96	0.93	0.90	0.88	0.82	0.87	0.84	0.84	0.84	0.92
Germany	0.96	0.95	0.93	0.90	0.87	0.80	0.78	0.83	0.79	0.80	0.72	0.81
Spain	0.96	0.95	0.89	0.92	0.77	0.76	0.78	0.79	0.68	0.77	0.64	0.76
France	0.95	0.95	0.94	0.90	0.85	0.84	0.84	0.84	0.79	0.83	0.81	0.88
Italy	0.96	0.95	0.93	0.94	0.94	0.87	0.85	0.85	0.81	0.84	0.71	0.78
Holland	0.98	0.97	0.93	0.89	0.87	0.82	0.84	0.85	0.85	0.82	0.75	0.83
Portugal	0.96	0.96	0.90	0.93	0.92	0.83	0.90	0.89	0.87	0.87	0.84	0.91
Mean	0.96	0.95	0.92	0.91	0.87	0.81	0.82	0.83	0.80	0.82	0.75	0.84

^cWe used stochastic statistical frontiers because, if compared to other parametric non-statistical approaches and, in general, to other non-parametric procedures, they have the undoubted advantage of distinguishing efficiency directly caused by managers' abilities from efficiency resulting from random factors, measurement errors and other particular circumstances. The latter include, for example, any differences in the accounting principles applied in the different countries – which could cause distortions in the measurement of some phenomena – and anything that affects the efficiency of an analyzed unit that accounting data cannot quantify. The effective capacity of these approaches, when measuring efficiency, to incorporate and at the same time distinguish all these factors, enables us not to wholly attribute to structural inefficiency the difference between the values registered by each subject analyzed and the best practice company. This result is achieved by structuring the error term in a particular way. In a nutshell, it results from the sum of two independent components, i.e. (i) random factors, measurement errors and other particular circumstances (distributed as a normal random variable) and (ii) technical inefficiency (which, generally, follows a one-side normal distribution, in a cost function assuming values lower or equal to zero).

^dFor the purposes of calculating the efficiency indices, we used STATA18. All the input coefficients of the cost frontiers related to each considered year show a positive sign and have a significance level of at least 90%.

occurred in the whole financial system as well as those related to the pandemic period.

What has just been said becomes clear by deeply analyzing the trend of the above efficiency values. Indeed, after the first slight recovery that characterized the period immediately following the outbreak of the Global Financial Crisis, we observe a first significant decrease between 2011 and 2012 due to the problems linked to the sovereign debt crisis that hit several continental European countries causing significant widening of the spread.

A second important decrease in the level of efficiency characterized the period 2013–2015. This trend reflected the impact of problems deriving both from the persistence of the residual negative effects of the sovereign debt crisis, and from the emergence of non-performing loans in the balance sheets of many intermediaries.

In 2016 and 2017, there were no significant changes in average efficiency levels, which, on the other hand, underwent a moderate decline in 2018, probably due to the effects of the bail-in rules. In 2019, there was a slight recovery in average values followed by a severe decline in 2020 probably caused by the COVID-19 pandemic. The efficiency increase in 2021 could reflect the favorable effects deriving from the financial support measures adopted by the different European Countries Governments.

An interesting result can also be observed by analyzing the efficiency indices related to groups of different sizes (Table 2). Although the difference between the average values of the efficiency indices in the various years considered reported in Table 2 in relation to the three different size classes may appear small, the tests of differences between averages demonstrated the statistical significance of these spreads.^e Therefore, this allows us to proceed with the considerations that follow.

Throughout the period analyzed, the efficiency level of the large groups is systematically lower than that of the other two size categories. The medium-sized groups overall performed the best in terms of efficiency. This result is not surprising since many studies observed the same evidence (Avramidis *et al.* 2016, Delis *et al.* 2017, Isik & Hassan 2002, Batir *et al.* 2017, Mesa *et al.* 2014, Andries 2011, Berger & Mester 1997, Goddard *et al.* 2007).

Table 2. Average values of the efficiency indices from 2010 to 2021 for banking groups distributed by size.

Size	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Large	0.95	0.94	0.91	0.90	0.85	0.80	0.80	0.82	0.80	0.80	0.93	0.85
Medium	0.96	0.95	0.92	0.91	0.89	0.81	0.85	0.84	0.84	0.85	0.95	0.88
Small	0.96	0.95	0.90	0.90	0.87	0.83	0.82	0.83	0.75	0.80	0.95	0.87

^eData available upon request.

Table 3. Drivers of efficiency and their related proxies resulting after the principal component, factor and multi-collinearity analyses.

Efficiency drivers	Proxies
Size	Total assets
Liquidity	Liquid assets/total assets
Intangible assets	Intangibles/total assets
Profitability	Profit before tax/total assets
	Operating profit/average total equity
	Net interest income/earning assets
Efficiency	Cost to income ratio
Business model	Loans/total assets
	Total financial assets/total assets
Complexity of the group	Number of companies in the group
Listed/unlisted	Dummy variable
Risk/capitalization	Total capital ratio

Table 4. Average values (in percentage) of the considered efficiency drivers in each cluster.

		Cluster 1	Cluster 2	Cluster 3
		Medium		
		High efficiency	efficiency	Low efficiency
Size	Small	16	40	9
	Medium	63	46	20
	Large	21	14	71
Liquidity	Liquid assets/total assets	20.63	31.07	38.51
Intangible assets	Intangibles/total assets	0.26	0.31	0.34
Profitability	Profit before tax/total assets	0.28	0.34	0.20
	Operating profit/average total equity	3.71	4.80	2.39
	Net interest income/earning assets	1.50	1.63	1.47
Efficiency	Cost to income ratio	68.21	71.38	75.11
Business model	Loans/total assets	67.15	58.09	47.18
	Total financial assets/total assets	14.91	18.15	24.42
Complexity of the group	Number of companies in the group	220	411	1042
Listed/unlisted	Listed groups	0.43	0.33	0.41
Risk/capitalization	Total capital ratio	19.55	19.40	19.69

Using the efficiency values of each banking group in each considered year, we ran a non-hierarchical cluster analysis to divide the considered units into three homogeneous groups, that is, by distinguishing the banking groups that showed lower (cluster 3), medium (cluster 2) and higher (cluster 1) overall efficiency values throughout the period of the study.^f

The analysis was then able to shift to what may have been the drivers of the efficiency levels reached by the groups. To this end, we ran both principal component and factor analyses, as well as a final study on residual multi-collinearity between the

^fData available upon request.

most used variables in financial literature as efficiency determinants. As a result, we obtained the efficiency drivers listed in Table 3 together with the proxies used to measure them.

Table 4 shows the average values reached by the mentioned efficiency determinants in each cluster giving, at the same time, a profile for each of them.

4. Discussion

Some important reflections emerge regarding managerial and strategic decisions and their impact on the results in terms of efficiency.

Regarding the issue of size, it can be seen that the best results in terms of overall efficiency (cluster 1) gained over time are attributable to medium-sized banking groups, while the presence of large groups characterizes cluster 3 (which displays the worst overall efficiency levels).

Previous studies (Batir *et al.* 2017, Isik & Hassan 2002, Catalbas & Atan 2005, Mesa *et al.* 2014) had already highlighted that the increase in size also increased the organizational and management complexity of banking and financial groups, thus generating a negative impact on the overall efficiency level of the whole poly-functional group. In our case, this result is also confirmed by the circumstance that the groups that have shown the worst overall results in terms of efficiency (i.e. the groups in cluster 3) are also those for which the complexity level has the highest value, even almost four and three times higher than those, respectively, of the banking groups in the first and in the second cluster.

A further confirmation of this link between the level of efficiency and the size and complexity of banking groups derives from the cost-to-income ratio analysis. The most efficient groups are those for which this indicator registers the lowest levels, emphasizing once again the importance of containing costs at a strategic level. This indicator increases progressively, moving from the first to the third cluster, supporting the hypothesis that the dimensional increase and the resulting management complexity[§] lead to scale diseconomies (Martins 2018, Batir *et al.* 2017).

Another feature that seems to positively influence the overall level of efficiency concerns the choice of business model; a supporting positive link emerges between the effect of traditional lending business on the overall business and the level of efficiency achieved. The groups that have chosen to adopt (or maintain) a traditional business model based on the centrality of lending activities are those that actually have the best overall efficiency levels. On the contrary, the overall less efficient banking groups are characterized by a higher recourse to investment banking and trading. This result is also in line with the main findings of other studies (Doan *et al.* 2018; Batir *et al.* 2017; Mesa *et al.* 2014; BIS 2018).

Another strategic choice that seems to have an impact on efficiency is in the field of liquidity policy. In the analysis conducted, the groups showing the highest levels of

[§]For a better understanding of the complexity role see, among others, Gharajedaghi (2011).

overall efficiency show lower liquidity levels than all the others. This naturally leads us to reflect on liquidity costs and therefore, once the minimum coefficients imposed by the rules recently introduced by the Basel legislator are met, managers should be stimulated to use any liquidity excess on more profitable assets.

As regards the intermediate values of the ratio between operating profit and total equity, as well as the particularly contained values of group complexity reached by the overall most efficient banking groups, since these are variables that cannot be controlled directly by management because surely deriving from the strategic choices discussed above and from the business model adopted, they must be interpreted as a direct consequence of what we previously discussed.

The absence of a well-defined link between efficiency and some of these aspects, such as, for example, the effect of net interest income on earning assets and level of risk, is not surprising. In fact, these indices largely depend on the conditions of the external environment which all banking groups must deal with. Indeed, the effect of net interest income on earning assets was certainly influenced by the exceptionally low level of market interest rates (in some periods even negative) which drastically eroded interest rate spread. Total capital ratio, on the other hand, is an index with a minimum threshold defined by the Supervisory Authorities starting from which each management identifies its own level of compliance trying not to deviate too far from the average of the index levels fixed by competitors.

5. Conclusions

In this final section, we try to summarize the most evident managerial and policy indications deriving from the previous results.

From the obtained results it is clear that the banking groups that reached the highest overall efficiency values over time are those of medium size, consisting of a not particularly high number of companies and characterized by a business model that is more oriented than the others to traditional credit activity. These groups are also distinguished by a greater ability to reduce costs and by a limited weight of both liquidity and financial assets on total assets.

Regarding liquidity, this circumstance is perfectly in line with the opportunity to maintain non-excessive amounts in the portfolio, thus avoiding rather high opportunity costs, but, at the same time, guaranteeing sufficient stock to adequately manage the problems that would be generated in case of a crisis on the markets.

The choice to move towards a more traditional business model is crucial too. Following the outbreak of the crises and the contagion phenomena between different countries and different industrial sectors, many banking groups changed their activity by reducing size of loans — to the detriment of the credit flow in support of the real economy — and thus moving towards the investment bank model, with the aim of countering the reduction in interest margin by increasing revenues from commissions and services. This choice, indeed, only produced an increase in profitability in the first few years and, conversely, simultaneously increased the volatility of the

sources of revenue. In the medium-long term, this strategy therefore proved to be relatively unwise, so many banking groups have gradually returned to a traditional business based on lending to retail customers.


The modulation of the size of financial assets also appears to pose problems. If, on the one hand, lending activity below a certain threshold would inevitably generate problems of low profitability, on the other, its disproportionate increase would lead to adverse selection phenomena with negative impacts, once again, on profitability. Maintaining this delicate balance is probably the reason why the profitability indicators of the most efficient groups are at intermediate levels compared to those of the groups belonging to the other two clusters.


Also, from the point of view of cost containment, the overall most efficient groups over time are those for which the cost-to-income ratio takes on lower values, although the difference from the average value reached in the same index by the medium-efficiency banking groups does not appear particularly marked. The most efficient banking groups also show intermediate values for the ratio between operating profit and average total equity. Moreover, they have the highest profit before tax values and, at the same time, show the lowest level of complexity of the group.


Having stated the above, all the strategic choices in some way linked to the search for an adequate dimension are therefore of primary importance; in any case, this must be achieved by remodeling the complexity of the group towards a more streamlined and, thus, a more effective and efficient structure. To this must be added adequate cost rationalization policies, the optimization of asset liquidity levels as well as the search for a business model that is able to provide the most appropriate calibration of weights to be assigned to credit and to financial activities.

The importance of this last aspect points to the need for greater attention to the identification of indices — different from those generally now used — which is able to efficiently represent the business model. This is because the consolidated data are not always automatically explanatory of the choice of the model adopted within a banking group.

ORCID

Vincenzo Pacelli  <https://orcid.org/0000-0002-8195-2876>

Francesca Pampurini  <https://orcid.org/0000-0001-6624-2772>

Anna Grazia Quaranta  <https://orcid.org/0000-0003-4619-5862>

References

- D. J. Aigner & S. F. Chu (1968) On estimating the industry production function, *American Economic Review* **58** (4), 826–839.
- D. J. Aigner, C. A. K. Lovell & P. Schmidt (1977) Formulation and estimation of stochastic frontier production function models, *Journal of Econometrics* **6** (1), 21–37.
- L. Allen & A. Rai (1996) Operational efficiency in banking: An international comparison, *Journal of Banking and Finance* **20** (4), 655–672.

- A. M. Andries (2011) The determinants of bank efficiency and productivity growth in the central and eastern European banking systems, *Eastern European Economics* **49** (6), 38–59.
- N. K. Avkiran (2011) Association of DEA super-efficiency estimates with financial ratios: Investigating the case for Chinese banks. *Omega* **39** (3), 323–334.
- P. Avramidis, C. Cabolis & K. Serfes (2016) Does one bank size fit all? The role of diversification and monitoring, *LeBow College of Business, Drexel University School of Economics Working Paper Series* 7.
- Bank for International Settlements (2018) Structural changes in banking after the crisis, *CGFS Papers* 60.
- R. D. Banker, A. Charnes & W. W. Cooper (1984) Some models for estimating technical and scale efficiencies in data envelopment analysis, *Management Science* **30** (9), 1078–1092.
- P. Barnes (1987) The analysis and use of financial ratios: A review article, *Journal of Business Finance and Accounting* **14** (4), 449–461.
- C. Barra, S. Destefanis & G. Lubrano Lavadera (2016) Risk and regulation: A difference-in-differences analysis for Italian local banks, *Finance Research Letters* **17**, 25–32.
- J. R. Barth, C. Lin, Y. Ma, J. Seade & F. M. Song (2013) Do bank regulation, supervision and monitoring enhance or impede bank efficiency? *Journal of Banking and Finance* **37**, 2879–2892.
- T. E. Batir, D. A. Volkman & B. Gungor (2017) Determinants of bank efficiency in Turkey: Participation banks versus conventional banks, *Borsa Istanbul Review* **17** (2), 86–96.
- G. E. Battese & T. J. Coelli (1995) A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics* **20**, 325–332.
- P. W. Bauer, A. N. Berger, G. D. Ferrier & D. B. Humphrey (1998) Consistency conditions for regulatory analysis of financial institutions: A comparison of frontier efficiency methods, *Journal of Economics and Business* **50** (2), 85–114.
- E. Beccalli (2004) Cross-country comparisons of efficiency: Evidence from the UK and Italian investment firms, *Journal of Banking and Finance* **28** (6), 1363–1383.
- E. Beccalli, B. Casu & C. Girardone (2006) Efficiency and stock performance in European Banking, *Journal of Business, Finance and Accounting* **33** (1–2), 245–262.
- A. N. Berger, D. Hancock & D. B. Humphrey (1993) Bank efficiency derived from the profit function, *Journal of Banking and Finance* **17** (2), 317–347.
- A. N. Berger & D. B. Humphrey (1997) Efficiency of financial institutions: International survey and directions for future research, *European Journal of Operational Research* **98** (2), 175–212.
- A. N. Berger & L. J. Mester (1997) Inside the black box: What explains differences in the efficiencies of financial institutions, *Journal of Banking and Finance* **21** (7), 895–974.
- P. V. Boufounou (1995) Evaluating bank branch location and performance: A case study, *European Journal of Operational Research* **87** (2), 389–402.
- B. Casu & Girardone (2002) A comparative study of the cost efficiency of Italian bank conglomerates, *Managerial Finance* **28** (9), 3–23.
- B. Casu & C. Girardone (2004) Financial conglomeration: Efficiency, productivity and strategic drive, *Applied Financial Economics* **14**, 687–696.
- B. Casu & C. Girardone (2010) Integration and efficiency convergence in Eu Banking Market, *Omega – The International Journal of Management Science* **38** (5), 260–267.
- B. Casu & P. Molyneaux (2003) A comparative study of efficiency in European banking, *Applied Economics* **35** (17), 1865–1876.
- G. K. Catalbas & M. Atan (2005) Efficiency in banking and the effect of capital structure efficiency in banks, *Journal of Economics Business and Finance* **20** (237), 49–62.

- A. Charnes, W. Cooper & E. Rhodes (1994) *Data Envelopment Analysis: Theory, Methodology and Application*. Boston: Kluwer Academic Publishers.
- G. E. Chortareas, C. Girardone & A. Ventouri (2012) Bank supervision, regulation, and efficiency: Evidence from the European Union, *Journal of Financial Stability* **8** (4), 292–302.
- T. J. Coelli, D. S. P. Rao, C. J. O'Donnell & G. E. Battese (2005) *An Introduction to Efficiency and Productivity Analysis*. Berlin: Springer.
- J. Coughlan, E. Shale & R. Dyson (2010) Including the customer in efficiency analysis, *International Journal of Bank Marketing* **28** (2), 136–149.
- C. Curi, A. Lozano-Vivas & V. Zelenyuk (2015) Foreign bank diversification and efficiency prior to and during the financial crisis: Does one business model fit all? *Journal of Banking and Finance* **61**, S22–S35.
- M. Degl'Innocenti, S. A. Kourtzidis, Z. Sevic and N. G. Tzeremes (2017) Bank productivity growth and convergence in the European Union During the Financial crisis, *Journal of Banking and Finance* **75**, 184–199.
- M. Degl'Innocenti, R. Matousek, Z. Sevic and N. G. Tzeremes (2016) Bank efficiency and financial centres: Does geographical location matter?, *Journal of International Financial Markets, Institutions & Money* **46**, 188–198.
- M. D. Delis, M. Iosifidi & M. G. Tsionas (2017) Endogenous bank risk and efficiency, *European Journal of Operational Research* **260**, 376–387.
- M. D. Delis & N. I. Papanikolaou (2009) Determinants of bank efficiency: Evidence from a semi-parametric methodology, *Managerial Finance* **35** (3), 260–275.
- R. DeYoung & K. P. Roland (2001) Product mix and earnings volatility at commercial banks: Evidence from a degree of total leverage model, *Journal of Financial Intermediation* **10**, 54–84.
- D. Deprins, L. Simar & H. Tulkens (1984) *Measuring Labor-Efficiency in Post Office. The Performance of Public Enterprises: Concepts and Measurement*. Amster: North Holland.
- A. T. Doan, K. L. Lin & S. C. Doong (2018) What drives bank efficiency? The interaction of bank income diversification and ownership, *International Review of Economics and Finance* **55**, 203–219.
- E. Elyasiani & S. Mehdiian (1990) A non-parametric approach to measurement of efficiency and technological change: The case of large US commercial banks, *Journal of Financial Services Research*, 157–168.
- E. Elyasiani & Y. Wang (2012) Bank holding company diversification and production efficiency, *Applied Financial Economics* **22** (17), 1409–1428.
- M. S. Feldstein (1967) *Economic Analysis for Health Service Efficiency*. British National, London: Econometric Studies of the British National.
- X. L. Fernández, D. Paz-Saavedra & P. Coto-Millán (2020) The impact of Brexit on bank efficiency: Evidence from UK and Ireland, *Finance Research Letters* **36**, 101338.
- C. Ferreira (2013) Banking efficiency and European financial integration, *Applied Economics Quarterly (formerly: Konjunkturpolitik)*, **59** (2), 99–124.
- M. D. Fethi & F. Pasiouras (2010) Assessing bank efficiency and performance with operational research and artificial intelligence techniques: A survey. *European Journal of Operational Research* **204** (2), 189–198.
- F. Forsund, C. A. K. Lovell & P. Schmidt (1985) A survey of frontier production functions and of their relationship to efficiency measurement, *Journal of Econometrics* **13** (1), 5–25.
- J. Gharajedaghi (2011) Systems thinking: Managing chaos and complexity, *A Platform for Designing Business Architecture*. Elsevier.

- C. Girardone, P. Molyneux & E. P. M. Gardener (2004) Analysing the determinants of bank efficiency: The case of Italian banks, *Applied Economics* **36** (3), 215–227.
- C. Girardone, J. C. Nankervis & E. Velentza (2009) Efficiency, ownership and financial structure in European banking: A cross-country comparison, *Managerial Finance* **35** (3), 227–245.
- J. Goddard, P. Molyneux, J. O. Wilson & M. Tavakoli (2007) European banking: An overview. *Journal of Banking and Finance* **31**, 1911–1935.
- M. Hadad, M. Hall, K. Kenjegalieva, W. Santoso & R. Simper (2011) Banking efficiency and stock market performance: An analysis of listed Indonesian banks, *Review of Quantitative Finance and Accounting* **37** (1), 1–20.
- G. E. Halkos & N. G. Tzeremes (2013) Estimating the degree of operating efficiency gains from a potential bank merger and acquisition: A DEA bootstrapped approach, *Journal of Banking and Finance* **37** (5), 1658–1668.
- A. Hamid, A. Wahab & R. Haron (2017) Efficiency of Qatari banking industry: An empirical investigation, *International Journal of Bank Marketing* **35** (2), 298–318.
- N. D. Hensel (2003) Strategic management of efficiencies in networks: Cross-country evidence on European branch banking, *European Financial Management* **9**, 333–360.
- I. Isik & M. K. Hassan (2002) Technical, scale and allocative efficiencies of Turkish banking industry. *Journal of Banking and Finance* **26** (4), 719–766.
- H. B. Jaiyeoba, A. A. Adewale & K. Ibrahim (2018) Measuring efficiencies of Bangladeshi and Indonesian microfinance institutions, *International Journal of Bank Marketing* **36** (2), 305–321.
- A. Kalyvas & E. Mamatzakis (2014) Does business regulation matter for banks in the European Union? *Journal of International Financial Markets, Institutions and Money* **32** (C), 278–324.
- K. A. Kenjegalieva, R. Simper & T. G. Weyman -Jones (2009) Efficiency of transition banks: Inter-country banking industry trends, *Applied Financial Economics* **19** (19), 1531–1546.
- A. Kontolaimou (2014) An efficiency analysis of European banks considering hierarchical technologies, *Applied Economics Letters* **21** (10), 692–696.
- KPMG (2009) *Financial Institutions Performance Survey*. Australia.
- L. Lepetit, E. Nys, P. Rous & A. Tarazi (2008) Bank income structure and risk: An empirical analysis of European banks, *Journal of Banking and Finance* **32**, 1452–1467.
- A. Lozano-Vivas & F. Pasiouras (2010) The impact of non-traditional activities on the estimation of bank efficiency: International evidence, *Journal of Banking and Finance* **34**, 1436–1449.
- A. Lozano-Vivas & J. T. Pastor (2010) Do performance and environmental conditions act as barriers for cross-border banking in Europe? *Omega* **38** (5), 275–282.
- Y. F. Lu, C. Gan, B. Hu, M. Y. Toh & D. A. Cohen (2018) Bank efficiency in New Zealand: A stochastic frontier approach, *New Zealand Economic Papers*.
- M. Majid & F. Sufian (2009) Bank efficiency and share prices in China: empirical evidence from a three-stage banking model. *International Journal of Computational Economics and Econometrics* **1** (1), 23–47.
- A. I. Martins. (2018) Efficiency determinants in Portuguese banking industry: An application through fractional regression models, *Tourism and Management Studies* **14** (2), 63–71.
- R. Matousek, A. Rughoo, N. Srantıs & A. G. Assaf (2015) Bank performance and convergence during the financial crisis: Evidence from the ‘old’ European Union and Eurozone, *Journal of Banking and Finance* **52**, 208–216.

- G. J. McKee & A. Kagan (2016) Community bank product design within an asymmetric competitive market, *International Journal of Bank Marketing* **34** (5), 752–772.
- R. B. Mesa, H. M. Sánchez & J. N. R. Sobrino (2014) Main determinants of efficiency and implications on banking concentration in the European Union, *Spanish Accounting Review* **17** (1), 78–87.
- W. Meeusen & J. van den Broeck (1977) Efficiency estimating from Cobb–Douglas Production Function with composed error, *International Economic Review* **18** (2), 435–444.
- A. Mirzaei (2013) Bank performance during the financial crisis 2007–2010, *International Journal of Business and Economics* **12** (1), 27–44.
- N. B. Murphy & Y. E. Orgler (1982) Cost analysis for branching systems: Methodology, test results, and implications for management, *Journal of Financial Research* **5** (2), 181–188.
- O. B. Olesen & N. C. Petersen (2016) Stochastic data envelopment analysis: A review, *European Journal of Operational Research* **251**, 2–21.
- M. S. Pagano (2021) The shrinking role of foreign operations at global financial institutions and its impact on efficiency, *Finance Research Letters* **38**, 101419.
- M. S. Pagano (2022) How do equity investors assess the efficiency of Global Financial Institutions? *Finance Research Letters* **49**, 103144.
- F. Pampurini & A. G. Quaranta (2018) Sustainability and efficiency of the European Banking Market after the global crisis: The impact of some strategic choices, *Sustainability* **10** (1–16), 2237.
- J. C. Paradi & H. Zhu (2013) A survey on bank branch efficiency and performance research with data envelopment analysis, *Omega* **41** (1), 61–79.
- F. Pasiouras, A. Liadaki & C. Zopounidis (2008) Bank efficiency and share performance: Evidence from Greece, *Applied Financial Economics* **18** (14), 1121–1130.
- F. Pasiouras, S. Tanna & C. Zopounidis (2009) The impact of banking regulations on banks' cost and profit efficiency: Cross-country evidence, *International Review of Financial Analysis* **18**, 294–302.
- J. Pastor (2002) Credit risk and efficiency in the European banking system: A three-stage analysis, *Applied Financial Economics* **12** (12), 895–911.
- H. T. Phan, S. Anwar & W. R. J. Alexander (2018) The determinants of banking efficiency in Hong Kong 2004–2014, *Applied Economics Letters* **25** (18), 1323–1326.
- T. P. Quang, V. V. Huong & P. T. Huy (2022) Do non-performing loans impact bank efficiency? *Finance Research Letters* **46**Part B, 102393.
- A. G. Quaranta, A. Raffoni & F. Visani (2018) A multidimensional approach to measuring bank branch efficiency, *European Journal of Operational Research* **266**, 746–760.
- N. Radić, F. Fiordelisi & C. Girardone (2012) Efficiency and risk-taking in pre-crisis investment banks, *Journal of Services Research* **41** (1), 81–101.
- N. Rangan, A. Zardhooki, J. Kolari & D. Fraser (1989) Production costs for consolidated multibank holding companies compared to one-bank organisational form, *Journal of Economics and Business*, 317–325.
- R. Roengpitya, N. Tarashev & K. Tsatsaronis (2014) Bank business models, *BIS Quarterly Review*, 55–65.
- L. Simar & P. W. Wilson (2008) Statistical inference in nonparametric frontier models: Recent developments and perspectives. In *The Measurement of Productive Efficiency* (H. Fried, C. A. K. Lovell & S. S. Schmidt, eds.), 421–521. Oxford University Press.
- K. J. Stiroh (2004) Diversification in banking: Is noninterest income the answer? *Journal of Money, Credit and Banking* **36**, 853–882.
- K. J. Stiroh & A. Rumble (2006) The dark side of diversification: The case of U.S. Financial holding companies, *Journal of Banking and Finance* **30**, 2131–2161.

V. Pacelli, F. Pampurini & A. G. Quaranta

- E. Thanassoulis (2001) *Introduction to the Theory and Application of Data Envelopment Analysis*. Massachusettes: Kluwer Academic Publishers.
- E. M. Tsionas, A. G. Assaf & R. Matousek (2015) Dynamic technical and allocative efficiencies in European banking, *Journal of Banking & Finance* **52**, 130–139.
- R. van der Venet (2002) Cost and profit efficiency of financial conglomerates and universal banks in Europe, *Journal of Money Credit and Banking* **34**, 254–282.