UNIVERSIDAD NACIONAL DE MISIONES

Facultad de Ciencias Económicas

SECRETARÍA DE CIENCIA Y TECNOLOGÍA
Facultad de Ciencias Económicas - Universidad Nacional de Misiones
Documentos de Trabajo - ISSN 2953-5107

UNRAVELLING THE DETERMINANTS OF BANKING EFFICIENCY IN ARGENTINA: A TWO-STAGE ANALYSIS OF THE ARGENTINE BANKING SECTOR

Documento de Trabajo N° 23
Abril de 2025

Costa de Arguibel, Facundo Eduardo
Dip, Juan Antonio
Stvass, Gerardo Orlando

SECRETARÍA DE CIENCIA Y TECNOLOGÍA - FCE · UNaM

https://cyt.fce.unam.edu.ar/

Unravelling the Determinants of Banking Efficiency in Argentina: A two-stage analysis of the Argentine banking sector

Costa de Arguibel, Facundo *

Dip, Juan Antonio*

Stvass, Gerardo Orlando*

*Facultad de Ciencias Económicas. Universidad Nacional de Misiones

DOCUMENTO DE TRABAJO N° 23

Abril de 2025

Cita sugerida:
Costa de Arguibel, F.E., Dip, J.A., Stvass, G.O. (2025). Unravelling the Determinants of Banking Efficiency in Argentina: A two-stage analysis of the Argentine banking sector. Documento de Trabajo FCE-UNaM N° 23.

Unravelling the Determinants of Banking Efficiency in Argentina: A two-stage analysis of the Argentine banking sector

Costa de Arguibel, Facundo *

facundo.costa@fce.unam.edu.ar

Dip, Juan Antonio*

juan.dip@fce.unam.edu.ar

Stvass, Gerardo Orlando*

gerardostrass@gmail.com

*Facultad de Ciencias Económicas. Universidad Nacional de Misiones

Abstract

In this paper, we apply a two-stage data envelopment analysis to study the effect of the interrelation between banking activities, the ownership structure, and the technical efficiency of Argentine banks (2012-2019). The first stage involves a Bootstrapped DEA to estimate the banks' technical efficiency with and without service revenues. The second stage estimates a truncated regression with Bootstrap to examine the effect of non-traditional activities and the origin of assets on the technical efficiency of banks. Besides, we control for differences in the entities' financial risk and the influence of environmental variables. Our robust results show that non-traditional activities are positively related to bank efficiency. Those banks that have a greater presence in non-traditional activities are more efficient. On the other hand, foreign banks with a greater weight in non-traditional activities are more efficient than their local peers. Foreign banks better exploit the advantages of diversification of activities compared to/over their local peers. Finally, public banks are more inefficient than private ones. The results are robust to changes in the selection and specification of certain variables.

Keywords: Banking diversification; Non-traditional activities; Efficiency; Double Bootstrap Regression DEA; Argentina.

1. Introduction

The beneficial relationship between financial development and economic growth is a topic widely documented in the economic literature. Since King and Levine's (1993) paper, various studies have reported empirical evidence indicating the favourable effect of financial development on countries' growth capacity (Guiso et al., 2004). As financial intermediaries, banks have a central place in financial systems. Furthermore, in those countries with little financial development, banking institutions are the primary channel of access to credit in the economy (Ariss, 2010; Levine, 2002). The banking sector worldwide has undergone profound transformations in recent years that affect the entities´ functioning. Deregulation, technological change, and increasing financial integration radically changed the scope of banking business. At the same time, competitive pressures increased in the countries' banking industries. These factors have directly affected the ownership structure, performance, and primary activities of banks (Delis and Papanikolaou, 2009; Fiordelisi et al., 2011; Doan et al., 2018).

A large body of literature has documented that an efficient banking sector is more prepared to face negative shocks and contribute to the financial system's stability in developed and developing countries (Schaeck and Cihák, 2014; Kasman and Carvallo, 2014). Thus, it is important to understand the factors that affect the efficiency of banks. In this sense, the international empirical literature on banking efficiency has explored a variety of determinants related to own and systemic financial risk, namely: capitalization levels, size, market structure, institutional characteristics, and macroeconomic conditions of countries (Sufian et al., 2016; Jiménez-Hernández et al., 2019; Banya and Biekpe, 2018; Althassan and Tetteh, 2017; Fukuyama and Mataousek, 2017; Jelassi and Delhoumi, 2021). However, one of the factors that has received little attention in the literature is the banks´ non-traditional activities. The competitive environment has driven banks to pursue strategies for diversifying their sources of income. Thus, Alhassan and Tetteh (2017) highlight that commission-based services (charges for banking services, commissions for commercial activities, and other income) have increased their relevance in the operational activities of banks, especially in the developing countries' banking sector. Despite this trend, the banking efficiency literature has typically focused on the traditional activities that appear on banks' balance sheets. However, other studies, such as Rogers (1998) for the United States, Lieu et al. (2005) for Taiwan, and Alhassan and Tetteh (2017) for Ghana, have documented that models excluding fee-based services penalize banks' efficiency.

Regardless of these articles' contributions, the literature has not reported conclusive results on the effect of these activities on efficiency. On the one hand, diversifying the bank's activities into different products could help to reduce the expected financial costs associated with the bankruptcy of the firm (Boot and Schmeits, 2000). In this sense, banks specializing in the selection and monitoring of borrowers' credits could reduce costs associated with information monitoring by engaging in more diversified intermediation activities. In some way, diversifying activities (e.g., card granting, insurance, and financial guarantees) could allow for better information collection, leading to improved loan allocation. These larger loans would serve to meet the deposit demands of their clients, thereby reducing the chances of financial stress events occurring. However, a variety of studies have highlighted that banks' expansion into less traditional activities is associated with higher risks and lower returns (Stiroh and Rumble, 2006). In a way, banks that venture into less traditional activities require investments in infrastructure and human capital to develop new activities. This could increase the entities' leverage (i.e., greater capital risk) and income volatility. In addition, banks could face greater difficulties in competing for customers due to high switching costs in these segments.

These different strategies undertaken by banks could be driven by differences in the ownership structure of banks. Pennathur et al. (2012) recognise that public and private banks, both local and foreign, employ different strategies to diversify income sources and gain competitiveness.

Furthermore, most studies have documented that public banks tend to be considerably more inefficient than private banks and have a higher proportion of non-performing loans (Dewenter and Malatesta, 2001; Barth et al., 2004; Beck et al., 2004). Despite this regularity (i.e., public banks tend to perform worse than private ones). Pennathur et al. (2012) found positive effects associated with a decrease in risk from the expansion of non-traditional activities in public banks in India during 2001-2009. On the other hand, the literature has documented that foreign banks have competitive advantages over their local peers. Typically, foreign banks have advantages in the use of more complex communication and information technologies (Frame et al., 2004; Berger and Udell, 2006). These improved skills and technologies could allow for better operational and financial management in diversifying into non-traditional activities (Doan et al., 2018).

This paper aims to contribute to the study of the diversification strategies and ownership structures that banks employ to ensure the proper functioning of the banking system. We focus on Argentina for several reasons. Firstly, Argentina is a country that has historically presented a tiny financial development (Campos et al., 2012; Prados de la Escosura and Sanz-Villarroya, 2009; Taylor, 2003). Besides, the banking entities concentrate a large proportion of financial assets in their balance sheet. According to data from the World Bank, in the 1980s, credit to the private sector represented an average of 26% of GDP. Currently, it does not exceed 16%. It makes the country with the least financial depth in the region. Thus, Liendo and Sturzenegger (2022) have pointed out that the size of the country's financial system resembles that of impoverished African nations.

Secondly, in recent decades the Argentine banking sector has undergone serious transformations that affected the ownership structure and market concentration. The banking landscape at the beginning of the 21st century was shaped by the expansion of foreign banks and the decline of local public banks. On the other hand, the strong regulations that the banking system has suffered, and the macroeconomic deterioration of the last decade have expanded the scope of activities in Argentine banks. Liendo and Sturzenegger (2022) also highlighted the role of non-traditional activities as a survival strategy for banks in the face of rising inflation and strict price regulations on banking products. Despite this new consolidation of the banking sector, the literature on banking efficiency in Argentina has ignored the role of these activities and their possible interaction with the ownership structure (Costa de Arguibel et al., 2024; Seffino y Maldonado, 2021; Peretto et al., 2021; Seffino y Maldonado, 2016; Peretto, 2016; Ybarra, 2016; Delfino, 2003)

Therefore, in this paper, we use the methodology of Simar and Wilson (2007) to analyse the determinants of banking efficiency (mainly non-traditional activities and ownership structure) through a robust semi-parametric model. Typically, the banking efficiency literature has applied two-stage analysis to examine different determinants of efficiency. In these models, the efficiency estimated in the first stage is regressed (i.e., from censored models) on different covariates not included in this stage. The seminal contribution of Simar and Wilson (2007) suggests that the results of the second stage are statistically invalid, mainly because these models suffer from serial correlation. As a solution, the authors propose using a double Bootstrap procedure to enable inferences about the parameters of interest. Using data envelopment analysis (DEA), we apply a double bootstrap truncated regression procedure to study the influence of two closely linked determinants (non-traditional activities and ownership structure) on the technical efficiency of Argentine banks during the period 2012-2019.

Our paper contributes to the literature in different ways. First, most of the articles have studied the relationship between efficiency and non-traditional activities through parametric methods and have focused on efficiency measures related to costs. Besides, our article is pioneering in its examination of this distinctive relationship, taking into account the technical efficiency of banking entities through non-parametric approaches. Second, in previous studies, researchers have used Tobit regressions to examine the connection between non-traditional activities, ownership

structure, and efficiency. To address the limitations of Tobit regression, we apply the truncated bootstrap regression method suggested by Simar and Wilson (2007). This allows us to correct the efficiency scores´ bias and consistently estimate the parameters. Third, the article is a pioneer in exploring the factors that influence the efficient behaviour of Argentine banks for the period 2012-2019. Furthermore, no previous papers have considered the role of non-traditional activities in the Argentine banking efficiency literature. Thus, we contribute to the international literature on income diversification, ownership structure and its influence on banks' efficiency levels from the context of a developing economy with the characteristics of Argentina. Ultimately, our research dialogues with the literature that studies Argentine exceptionalism focused on the hypothesis of poor financial development as a limitation to growth (Campos et al., 2012; Prados de la Escosura and Sanz-Villarroya, 2009; Taylor, 2003).

The paper is structured as follows. In section 2 we present the methodology to estimate the determinants of banking efficiency meticulously. In section 3 we present the results and section 4 presents the robustness exercises. Finally, section 5 presents the conclusions.

2. Methodology and data

2.1 Selection of Variables

The selection of variables for input and output vectors is a key issue in banking efficiency literature. This is connected to the debate about the role of deposits in the production process of banks. Most studies have focused on two approaches - intermediation and production - each representing different functions of banking entities. Despite this controversy, Berger and Humphrey (1997) have highlighted that neither approach is capable of fully capturing the dual role of banking institutions, both as service producers and as financial intermediaries. However, recent studies have underlined the sensitivity of bank efficiency scores to the banks' operational activities (Tortosa and Ausina, 2002; Holod and Lewis, 2011; Boďa and Piklová, 2018; Costa de Arguibel et al., 2024).

In our paper, we follow the intermediation approach to characterize Argentina's banking entities' production function. Under this approach, banking operations are characterized by the collection of deposits and funds from savers for their corresponding conversion into different types of loans and assets that are demanded by investors. Therefore, operating expenses and those expenses related to interest –i.e. deposits– are considered here as inputs, while the product is determined by the amount of loans and other assets. In this sense, we consider that this approach is valid because we understand that more efficient intermediation would contribute to better performance of the country's economy. We selected as inputs the number of employees (number of people), the value of deposits totals (non-financial public sector + financial sector + non-financial private sector) and fixed capital which is captured by the number of bank branches enabled. We follow the literature that uses this method (Stewart et al., 2016; Sufian et al., 2016). In turn, we specify the bank's product based on the value of total loans (including those destined for the non-financial Public Sector + Financial Sector + Non-financial Private Sector), the bank's investments made up of the nominal holding of public and private securities (includes securities in pesos and foreign currency such as shares of other non-controlled companies, negotiable obligations, common investment funds, debt securities of financial trusts, bills and notes of the BCRA), and income from services which correspond to the commission income, portfolio management service and rental of safe deposit boxes. Table 1 shows the input and output variables with their descriptive statistics.

Table 1. Descriptive statistics of the input and output variables

Variable	N	Mean	Sd	Min	Max
Outputs **(in billions of AR$ in 2012)**					
Investments	442	4,028.76	14,365.81	0.03	148,958.80

Total Loans	474	8,371.97	16,077.17	0.88	99,844.50
Non-Interest income	474	621.86	1,100.51	0.05	5,970.81
Inputs					
Deposits (in billions of AR$ in 2012)	474	13,551.86	32,080.62	0.47	268,659.70
Branches (quantity)	474	369.12	602.71	1.00	3,486.00
Staffing (quantity)	474	1,760.31	3,052.75	1.00	18,592.00

Source: Author

We are focusing on examining how non-traditional activities impact the efficiency of banks in Argentina. We establish two models with different combinations of banking products. In model I, the bank's product consists of the bank's loans, investments, and non-interest income value. In contrast, Model II uses only loans and investments as a product. In this sense, as Althassan and Tetteh (2016) demonstrate, non-interest income, representing income from activities such as commissions, portfolio management, securities, granting of guarantees and rentals, is a good proxy to measure non-traditional activity.

2.2 First stage: Estimation of efficiency through DEA

Different methods have been implemented to study the efficiency of productive units (Debreu, 1951; Farrell, 1957) in the industry, among which the banking sector stands out. These methods include parametric frontier methods (stochastic frontier) and non-parametric methods such as DEA. Thus, DEA allows us to calculate the efficiency scores of Argentine banks through a production frontier that uses linear programming techniques. Its composition arises from the data of the selected firms and the production frontier results in a linear combination of those observations that have the best practices. Consequently, the efficiency estimate of each banking entity is relative to the other units within the dataset.

When estimating the production frontier, an important aspect lies in the returns to scale that characterize technology. The literature has highlighted the difficulty of sustaining the constant returns` assumptions to scale in the banking sector since it considers that firms are operating at their optimal scale (Assaf et al., 2011; Henriques et al., 2020). In this sense, there are reasons such as imperfect competition, government regulations and restrictions, to assume that firms do not operate at the optimal scale level (Coelli et al., 2005).

Therefore, we apply DEA with variable returns to scale –commonly known as BBC DEA– and product orientation. In our context, it is reasonable to consider the assumptions about banks' technology. The Argentine banking system is highly regulated and has different restrictions that make it difficult for banks to operate on an optimal scale. On the other hand, considering an input orientation is closely related to the possibility that banks can easily expand or contract their inputs. For countries such as Argentina, it is unrealistic to consider that banks could improve their efficiency by reducing deposits, staffing or fixed capital in the short term. Deposits are influenced by market conditions and the trust that a bank establishes with its depositors. Regarding staffing, the labour market regulations introduce institutional inertia, making it difficult to make short-term modifications. In conclusion, this paper suggests that banking institutions have limited control over their inputs.

Within this framework, estimating the efficiency score for a banking firm (x_i, y_i), which has N inputs and M products, involves solving the following linear program with variable returns to scale for the $i=1,\ldots,L$ banks:

$$\hat{\lambda}_{DEA}(x_i, y_i) = max\left\{\lambda \vee \lambda\, y_{jm} \leq \sum_{i=1}^{n} \gamma_i\, y_{jm}\, m=1,\ldots,M\right.$$

$$x_i \geq \sum_{i=1}^{n} \gamma_i x_{jn}, n=1,\ldots,N$$

$$\left.\sum_{i=1}^{n} \gamma_i = 1; \gamma_i \geq 0; i=1,\ldots,L\right\} (1)$$

Where $\gamma_i = (\gamma_1, \gamma_2, \ldots, \gamma_L)$ is a vector of weights that determines the convex combination of the observed firms and serves as a reference set to evaluate the firm´s efficiency i. On the other hand, $\hat{\lambda}_{DEA}(x_i, y_i)$ measures the proportional increase that the firm i makes, to reach the efficiency frontier. In this sense, if $\hat{\lambda}_{DEA}(x_i, y_i) > 1$, the banks would be considered inefficient since, with the level of inputs it has, they could produce a higher level of output. Therefore, the greater $\hat{\lambda}_{DEA}(x_i, y_i)$ the more inefficient the entity would be.

Traditional DEA often produces biased efficiency score estimates, posing a challenge for accurately estimating efficiency. As a solution, Simar and Wilson (2000) have proposed a bootstrap approach that implements a bias correction on the estimated efficiency. In this sense, the bias can be determined by:

$$\widehat{BIAS}_B\left(\hat{\lambda}_{DEA}(x_0, y_0)\right) = B^{-1}\sum_{b=1}^{B} \hat{\lambda}_{ib}^{¿}(x_0, y_0) - \hat{\lambda}_{DEA}(x_0, y_0) (2)$$

Where $\hat{\lambda}_{ib}^{¿}(x_0, y_0)$ is the bootstrap efficiency score. B represents the bootstrap replications. Thus, the bias-corrected efficiency scores can be obtained by:

$$\tilde{\lambda}_{DEA}(x_0, y_0) = 2\hat{\lambda}_{DEA}(x_0, y_0) - B^{-1}\sum_{b=1}^{B} \hat{\lambda}_{ib}^{¿}(x_0, y_0) (3)$$

2.3 Second stage: Double Bootstrap procedure

As highlighted above, the two-stage approach has been widely applied in the banking efficiency literature of developing countries. Using censored regressions in the second stage of the analysis poses problems as noted by Simar and Wilson (2007). The authors have demonstrated that the environmental factors in the second stage are related to the inputs and outputs applied in the first stage. As a result, the explanatory variables are correlated with the error term in the truncated regressions. Then, the outcome leads to inconsistent and biased estimates in the second stage. The Simar and Wilson methodology enables us to include environmental variables that account for the variations in efficiency scores among different entities. Additionally, it helps us address the issue of serial correlation by employing truncated regressions with bootstrap procedures. Thus, they propose a double bootstrap procedure that enables valid statistical inference by generating standard errors and confidence intervals to estimate efficiency. This methodology has two algorithms[1] –Algorithm 1 and Algorithm 2– whose main difference is that the second allows the efficiency and determinants of the banking units to be jointly estimated[2]. Hence, the model is specified as follows:

$$\hat{\lambda}_{¿} = \beta z_i + \epsilon_i \; i=1,\ldots,L \; (4)$$

[1]For small samples (less than 400 DMUs), Simar and Wilson (2007) recommend adjusting Algorithm 1.

[2] Steps one and two in Algorithm 2 are identical to Algorithm 1. However, steps three and four add a parametric bootstrap procedure to produce better estimates in terms of statistical significance and bias (Dip et al., 2019; Fernández et al., 2018).

Where the bank's efficiency score $i(\hat{\lambda}_{¿})$, obtained in the first stage, is regressed on a set of environmental variables (z_i) in the second stage[3]. Moreover, β is a vector of parameters and ϵ_i is the error term. As we refer before, Simar and Wilson (2007) criticize traditional regression models for having problems with the estimates. They pointed out that the efficiency scores estimated in the first stage are not independent and are correlated, which violates the classic assumption of exogeneity. Put another way, and following Jiménez-Hernández et al. (2019):

$$\hat{\lambda}_i = \beta z_i + \epsilon_i \; con \; \epsilon_i = \varepsilon_i + \xi_i \; y \; \xi_i \equiv \hat{\lambda}_i - \lambda_i \quad (5)$$

Here $\xi_i \equiv \hat{\lambda}_i - \lambda_i$ is the bias of the efficiency scores estimated in the first stage. Thus, the Simar and Wilson (2007) methodology produces estimates of λ_i corrected for bias which allows valid estimates of the parameters in the regression model.

To utilize the procedure outlined above, we assume it is feasible to replicate the data generation process using a dataset derived from the original data. Subsequently, we re-estimated the DEA model using the new data and repeated this process 1000 times. Following this, 1500 replications are employed to assess the bias of the bank's efficiency score. Finally, we regress the bank's efficiency score with the explanatory variables of the second stage using algorithm #1.

2.3.1 Selection of environmental variables and empirical model

Following the empirical literature (Jiménez-Hernández et al., 2019; Sufian et al., 2016; Fernández et al., 2018) our base specification is formed as follows:

$$Eff_{¿} = \alpha + \beta_1 DIVER + \beta_2^{'} X_{¿}^{'} + \delta^{'} Y_{¿}^{'} + \epsilon_{¿}^{'} \quad (6)$$

Where $Eff_{¿}$ indicates the bank's bias-corrected efficiency score i in the period t calculated in the first stage; α is the constant term; $DIVER$ is a measure of the functional diversification of the bank's activities; $X_{¿}^{'}$ is a vector of financial variables that captures the impact of financial risk on the bank's efficiency; $Y_{¿}^{'}$ is a vector that incorporates firm-specific control variables and macroeconomic variables. Finally, $\epsilon_{¿}^{'}$ is an error term that includes the unobserved bank-specific effect and idiosyncratic error.

To study the relationship between non-traditional activities and the efficiency of Argentine banks, it is necessary to determine how they will be measured and captured. In line with the previous studies by Sufian et al. (2016), Hunjra et al. (2020), Adem (2022) and Mehzabin et al. (2022), the paper uses the share of service income in total operating income (*non-share*) as a measure of the bank's non-traditional activity. Income from services includes commissions for credit cards, insurance, financial guarantees granted, obligations, commissions linked to the granting of credit and those linked to securities and collection management. Besides, it includes portfolio management services and the rental of safe deposit boxes. Therefore, we believe the ratio of service income to total operating income is a good measure of the bank's non-traditional activity.

[3]If algorithm 2 is used it must be replaced $\hat{\lambda}_{¿}$ by $\hat{\hat{\lambda}}_{¿}$ which is estimated jointly. For more detail see Simar and Wilson (2007) and the appendix.

Table 2. Description of environmental variables and measurement

Variable	Name	Description
nonshare	Non-traditional activity	Share of income from services in the total operating income of the banking entity
r_liquidity	Liquidity risk	The ratio of total loans to the total assets of the banking entity
r_credit	Credit risk	Ratio of forecasts for possible lost loans over the bank's total loans
r_capital	Capital risk	The ratio of total liabilities to total assets of the bank
roa	Profitability risk	Return on bank assets
lta	Bank size	Natural logarithm of total assets at 2012 prices
pub	Public banks	pub = 1 when the entity is a public bank
extra	Foreign banks	extr = 1 when the bank has foreign national capital or is a branch of foreign financial entities
lninf	Inflation	natural logarithm of the consumer price index
lnpib	GDP	natural logarithm of gross domestic product
ln_c3	Market concentration	natural logarithm of the asset concentration index of the three largest entities

Source: Author

On the other hand, we include several control variables in the vector ($X_{¿}^{'}$) to control for systematic differences in bank efficiency related to financial risk. This vector includes four types of risk – capital, liquidity, profit, and credit risk – that according to the literature are likely to affect the efficiency of banks (Fernández et al., 2018; Banya and Biekpe, 2016). This includes the ratio of loan provisions to total loans (Rcredit), the ratio between total loans and total assets (Rliquidity), the ratio between the bank's liabilities and total assets (Rcapital) and the Return on Assets (Income). In this sense, those banks with greater risk preferences could have more leverage with a greater volume of risky loans and lower profitability. This is due to the negative relationship between credit risk and bank efficiency (Brissimis et al., 2008; Sufian and Habibullah, 2009; Banya and Biekpe, 2016). The description of all the environmental variables is in Table 2.

We also include the bank size in the vector $Y_{¿}^{'}$. It is measured as the natural logarithm of real total assets (LNTA) to control for systematic differences in efficiency due to the degree of economies of scale and specialization. Finally, we incorporate binary variables that allow us to identify the banks' capital origins: PUBL which assumes the value 1 if the bank is Public and EXTR if the bank's capital has a foreign origin. On the other hand, banks' performance could be affected by macroeconomic conditions. We incorporate the logarithm of the gross real product growth rate to control for variations in the economic cycle. We also consider the effect of macroeconomic risk controlling for inflation. In this aspect, the empirical literature does not show clear results (Fernández et al., 2018). Given the motivation described above, our base model is specified as follows:

$$\hat{\lambda}_{¿}=\alpha+\gamma_1 nonshare_{¿}+\gamma_2 EXT\ R_{¿}+\gamma_3 PUB\ L_{¿}+\beta_1 Rcredito_{¿}+\beta_2 Rliquidez_{¿}+\beta_3 Rcapital_{¿}+\beta_4 Rrent\ a_{¿}+\beta_5 LNT$$

(7)

Where $\hat{\lambda}_{¿}$ is the technical efficiency of the bank i in the period t, α is the constant term, β and γ are variables´ coefficient vectors; ϵ is the error term. Besides, γ_1 measures the direct impact of a change in the bank's strategy from activities that generate interest income to those activities that generate services. At the same time, γ_2 and γ_3 measure the differential effect on the efficiency of public and foreign banks concerning private and local banks. Because our interest also lies in the dimension of ownership and its relationship with non-traditional activities, we specify the following empirical relationship:

$$\hat{\lambda}_{¿}=\alpha+\gamma_1 nonshare_{¿}+\gamma_3 EXT\ R_{¿}+\gamma_5 PUB\ L_{¿}+\gamma_6 nonshare_{¿}*EXTR+\gamma_7 nonshare_{¿}*PUBL+\beta_1 Rcredito_{¿}+\beta_2 R$$

(8)

In addition to the previous equation (7), we introduce the interaction between the type of bank structure and the variables measuring income diversification. This addition aims to determine whether income diversification might enhance or decrease the efficiency of different ownership structures. The coefficients γ_6 and γ_7 measure the effects of public and foreign banks expressed as the difference in the greater exposure to non-traditional activities of private and local banks.

Table 3. Descriptive statistics of the environmental variables

Variable	Mean	Sd	Min	Max
nonshare	0.178	0.109	0.000	0.697
lta	8,238	1,898	3,882	12,692
r_credit	0.038	0.041	0.004	0.418
r_liquidity	0.465	0.194	0.006	0.949
r_capital	0.824	0.150	0.063	0.953
roa	4,637	5,418	-22,910	42,010
pub	0.219	0.414	0.000	1
extra	0.257	0.438	0.000	1
lninf	4,438	0.560	3,707	5,450
lnpib	6,565	0.015	6,541	6,588
ln_c3	3,789	0.195	3,484	3,996
N	474			

Note: nonshare = ratio of service income over total operating income; r_credit = ratio of forecasts of possible lost loans over total loans; r_liquidity = total loans over total assets; r_capital = total liabilities over total assets; roa = return on assets; lta = natural logarithm of real total assets; pub=1 if the bank is public; extr = 1 if the bank is foreign-owned; infla = annual inflation rate; gdp = gross real annual growth rate of GDP; ln_cr3 is the logarithm of the largest three entities' asset concentration ratio.

Source: Author

Table 3 shows the main descriptive statistics of the explanatory variables. Table 3 indicates that the three largest banks hold over 45% of the banking system's assets. Additionally, it shows that Argentine banks predominantly finance their assets through their liabilities. This is evident from the average capital risk for the period considered (0.824). Additionally, a large part of the assets is concentrated in loans (r_liquidity = 0.465) of which the credit risk is relatively low (0.038). Finally, the return on capital (roa) has been on average 4.6%, which is below the average annual inflation of the period (26.9%).

2.3 Source of information

The data is extracted from the balance sheets of each bank, which were published in December by the Superintendency of Financial and Exchange Entities (SEFyC), an organization under the Central Bank of the Argentine Republic (BCRA). In this report, the balance sheets of each entity within the financial system are presented, and each of our variables corresponds to the account number of the respective account plan for each bank. To select the banks' sample, we consider only those entities that do not have any missing values in the chosen variables - inputs and output - across all periods. Table 4 presents the sample for each period.

Table 4. Composition of the sample of Argentine banks

Period	Public banks	Private local banks	Foreign banks	Total
2012	13	31	17	61
2013	13	30	16	59
2014	13	31	16	60
2015	13	31	16	60
2016	13	31	16	60
2017	13	31	15	59
2018	13	31	13	57
2019	13	32	13	58

Source: Authors

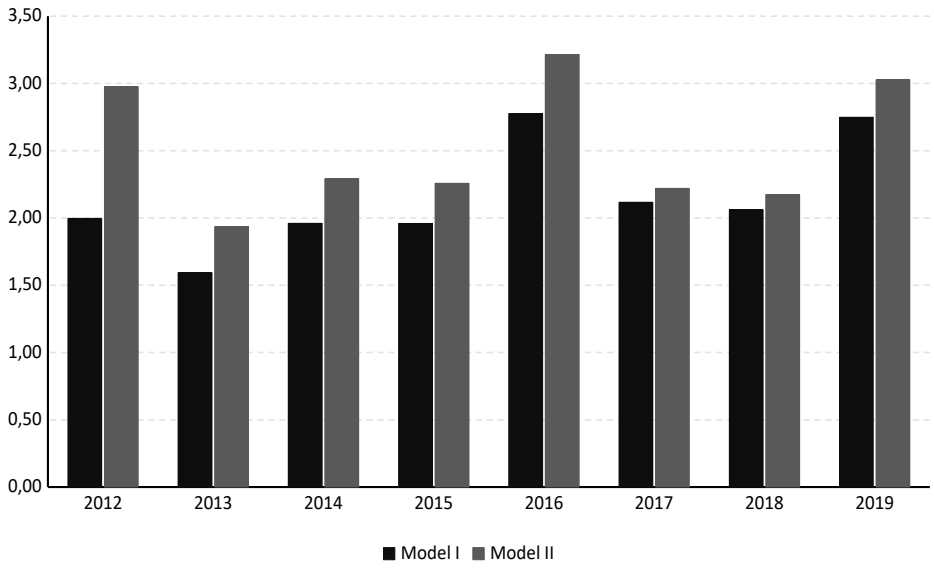
Our sample consists of an unbalanced panel of financial entities representative of the Argentine banking sector. On average, they represent 99% of the assets of the banking system and 98% of the assets of the financial system throughout the period. Finally, to carry out our analysis we express the monetary variables in constant AR$ 2012 pesos.

3. Results

3.1 Efficiency in the first stage

In Figure 1, we illustrate the evolution of inefficiency for the two models under consideration throughout the study period. It should be noted that values close to 1 signify more efficient banking entities, whereas deviations from this value indicate increased inefficiency. Remarkably, we identified distinct patterns of banking inefficiency: during the period from 2013 to 2016, there was a consistent increase in inefficiency levels across both models. Conversely, during the period from 2016 to 2018, we observe an enhancement in the average technical efficiency of banks, which is followed by a subsequent increase in inefficiency.

Figure 1. Average corrected inefficiency scores of the Argentine banking sector



Source: Authors

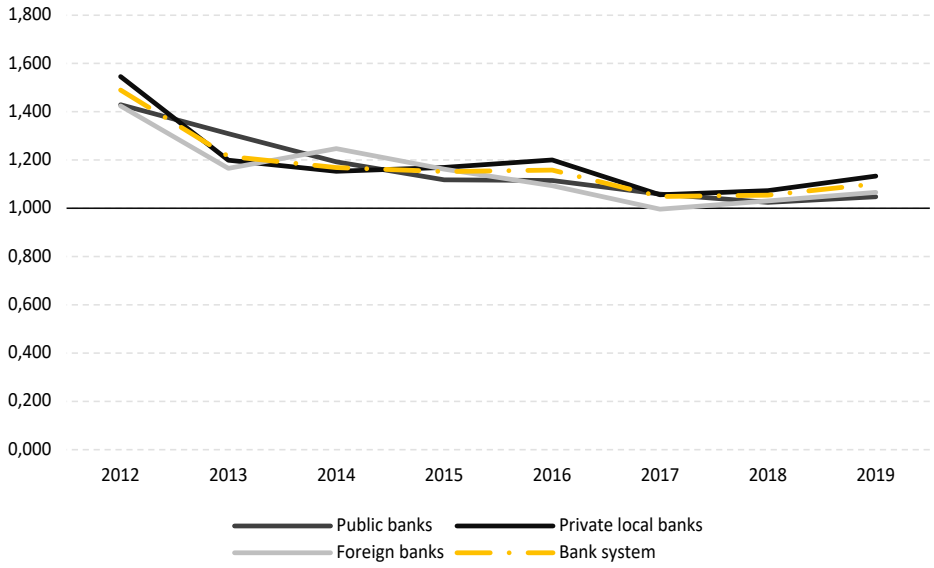
This result is interesting since, as Liendo and Sturzenegger (2020) highlight, the period 2012-2015 is characterized by strong regulation and financial repression in the Argentine banking system. On the other hand, the period 2016-2019 is characterized by a deregulation of the banking system. Furthermore, according to Figure 1, including service income (a proxy for non-traditional activity) improves the efficiency of Argentine banks, resulting in a lower technical inefficiency score. These results indicate that banks with a greater focus on non-traditional activities enjoy

more efficient resource utilization compared to the rest of the banks. The results are consistent with Tortosa-Ausina (2003), Lieu et al. (2005) and Althassan and Tetteh (2016) who demonstrated that the consideration of non-traditional activities in efficiency models improves the average efficiency of banking entities.

Figure 1 also shows that the average improvement in bank efficiency is even greater during 2012-2015 when non-traditional activities are included as part of a bank's product (model I). This finding indicates that under model I, banks enhance their efficiency. This may be linked to the findings of Liendo and Sturzenegger (2020), who emphasized that 2012-2015 was marked by financial repression policies that resulted in a reduction in banking profits from traditional activities. Faced with these pressures, banks have undertaken strategies –i.e. charging commissions, insurance, and credit cards, among others – that reduced their dependence on traditional activities and increased their product from the investments in capital and human resources they have made.

The above can also be visualized in Figure 2. It represents the ratio between the inefficiency scores of Model II concerning Model I, which is a good way to represent the penalty in efficiency due to the exclusion of non-traditional activities. The larger the deviation from 1 in the ratio, the wider the inefficiency gap between models that do not encompass non-traditional activities as a product. In essence, a ratio exceeding 1 denotes that the inclusion of non-traditional activities enhances the operational efficiency of banks.

Figure 2. Ratio of inefficiency scores Model II-Model I



Source: Authors

Figure 2 reflects an interesting perspective. In the period under study, the importance of non-traditional activities in the efficiency of banks has faded over time. Regardless of the ownership structure, the gap in the inefficiency of both models has been reduced and with it the relevance of non-traditional activities in the composition of the banking product. As highlighted previously, a possible explanation would be close to the arguments of Liendo and Sturzenegger (2020) and focused on the deregulation of the banking sector.

3.2 Determinants of Banking Efficiency

Table 5 shows the estimation of equation (7). Please bear in mind that when interpreting Table 5, the sign of the coefficients indicates the relationship between the variables and the bank's inefficiency. A positive coefficient value increases inefficiency, while a negative value decreases inefficiency. (that is, there is an improvement in banking efficiency). Therefore, in this second

stage, the dependent variable is the inefficiency score of Argentine banks and is estimated only for model I which includes income from services (non-traditional activities).

Table 5. Determinants of technical inefficiency, truncated bootstrap regression

Independent variables	Technical inefficiency ($\hat{\lambda}$)			
	Model I	**Model II**	**Model III**	**Model IV**
Constant	635.8***	603.6***	634.6***	593.3***
	(210.9)	(194.4)	(208.6)	(190.5)
nonshared	-7,960**	-8,575**	-7,942**	-8,435**
	(3,615)	(3,700)	(3,675)	(3,441)
Lta	-4,321***	-4,631***	-4,309***	-4,517***
	(0.679)	(0.702)	(0.702)	(0.675)
r_credit	16.69**	17.71***	16.54**	16.72***
	(6,667)	(6,463)	(6,794)	(6,352)
r_liquidity	-4,200**	-4,183**	-4,158**	-3,858**
	(2,070)	(1933)	(2,045)	(1920)
r_capital	21.82***	21.81***	21.93***	22.43***
	(4,630)	(4,607)	(4,991)	(4,448)
roa	-0.0247	-0.0217	-0.0239	-0.0160
	(0.0526)	(0.0496)	(0.0528)	(0.0513)
lninf	-0.00168	0.0531	0.00493	0.0898
	(1,012)	(0.917)	(0.925)	(0.914)
lnpib	-98.72***	-93.56***	-98.55***	-92.01***
	(32.74)	(30.28)	(32.35)	(29.56)
ln_c3	6,501**	6,416**	6,450**	6,054**
	(2,770)	(2,637)	(2,742)	(2,579)
pub		4,724***		4,644***
		(1,139)		(1,082)
extra			0.118	0.850
			(1,132)	(1,073)
Observations	442	442	442	442
No. Iterations	1000	1000	1000	1000

Note: Truncated double bootstrap regression with an unbalanced panel of banks. Estimation for the entire sample and the 2012-2015 and 2016-2019 subperiods.
***, ** and * indicate significance level at 1%, 5% and 10% respectively.
Bootstrap standard errors in parentheses.

The negative and significant nonshare coefficient in all specifications indicates that a bank is more efficient when it has a higher share of service revenue. This is consistent with findings from Sufian et al. (2016), Doan et al. (2018), Sufian (2010), and Stiroh and Rumble (2006). Therefore, our results suggest that a greater diversity in income structure is associated with a more effective allocation of resources. In some sense, this suggests that more diversified banks have an advantage over more specialized competitors. As pointed out by Elsas et al. (2010), banks with more diversified activities could exploit the information collected from their clients to a greater extent and obtain a cost advantage over their competitors.

Table 5 also shows the results for different ownership groups. We find that public banks are systematically more inefficient than their private peers. Thus, banks characterized by public ownership present greater incompetence and are more inefficient than those managed by the private sector. These results align with previous literature for developing countries (Doan et al., 2018; Garcia-Cestona and Surroca, 2008, Ariff and Can, 2008; Berger et al., 2009; Bonin et al., 2005). However, there are differences from some of the literature on banking efficiency in Argentina. It has been pointed out that public and private banks are similar in terms of efficiency (Costa de Arguibel et al. 2024; Peretto et al., 2021; Ferro et al., 2013). This difference may be due to the fact that the works of these authors did not include non-traditional activities in their estimation models. On the other hand, we did not find significant and robust evidence indicating that foreign banks are more efficient than their domestic peers. These results reflect that the idiosyncratic differences in the banking sector – i.e. between domestic banks and their foreign peers – are not large enough concerning their country of origin; or that there are no superlative

differences in the technology used by both types of entities. In this framework, our results are in line with those of Peretto et al. (2021) for Argentine banks in 2018 and differ from Costa de Arguibel et al. (2024) for Argentina and Sufian (2005) for Malaysia.

Meanwhile, we discovered a positive and statistically significant impact of credit risk on bank inefficiency, which is in line with the findings of Sufian (2010), Alhassan and Tetteh (2016), and Delis and Papanikoloua (2009). This suggests that a decline in loan performance is connected to reduced levels of efficiency. Additionally, our results consistently demonstrate a significant and positive influence of capital risk on bank inefficiency. This suggests that a rise in capital risk leads to an increase in the banks´ inefficiency. This relationship aligns with the literature that studies the relationship between financial leverage and firm performance (Mumtaz et al., 2013; Banya and Biekpe; 2016; Fernández et al., 2018; Sufian and Habibullah, 2014). Finally, our specification detects a statistically significant negative relationship between liquidity risk (r_liquidity) and technical inefficiency. This suggests that a higher level of loans relative to total assets is associated with lower bank inefficiency.

Concerning bank-specific factors, we find that bank size, measured by the logarithm of total assets (lta), is statistically significant and is negatively associated with inefficiency – positively with efficiency. This indicates that larger banks are more efficient, which is in line with the theory that shows that larger banks reduce the costs of gathering and processing information to a greater extent (Staub et al., 2010). This is in line with the empirical findings of Sufian et al. (2016), Stewart et al. (2016) and Fernández et al. (2018). However, our results differ from the results of Peretto et al. (2021) for 2018 in Argentina, who did not find significant results that the growth of bank size is positively associated with efficiency. These conflicting results may be because the authors perform inference from a Tobit model which can be associated with invalid standard errors as specified by Simar and Wilson (2007).

3.2.1 The role of ownership structure

Different ownership structures could lead to differences in banks' operating strategies due to differences in terms of their consumers' preferences, information quality, and production methods (Luu et al., 2020). In this sense, Pennathur et al. (2012) highlight that local private banks and foreign banks are more likely to get involved in non-traditional activities as they have a disadvantage in collecting soft information necessary for a correct allocation of credit in the local market. On the other hand, banks with greater government involvement in their governance may not benefit from diversifying their activities. Table 6 shows the results of the truncated bootstrap regression.

Table 6. Interaction between income diversification and ownership

Independent variables	Technical inefficiency		
	Model I	Model II	Model III
Constant	600.7 ***	597.8 ***	548.9 ***
	(196.5)	(206.4)	(181.6)
nonshare	-7,287 **	-5,482	-25.96 ***
	(3,374)	(3,677)	(7,711)
lta	-4,656 ***	-4,355 ***	-4,116 ***
	(0.718)	(0.711)	(0.573)
r_credit	17.91 ***	21.87 ***	17.72 ***
	(6,355)	(7,062)	(5,989)
r_liquidity	-4,382 **	-4,669 **	-3,621 **
	(1945)	(2,143)	(1,777)
r_capital	22.71 ***	24.43 ***	27.15 ***
	(4,617)	(5,523)	(5,042)
roa	-0.0218	-0.0237	0.00203
	(0.0514)	(0.0560)	(0.0486)
lninf	-0.0874	0.0852	0.0391
	(0.910)	(0.985)	(0.816)
lnpib	-92.94 ***	-93.30 ***	-84.48 ***
	(30.58)	(32.03)	(28.17)
ln_c3	6,109 **	6,363 **	4,660 **
	(2,733)	(2,812)	(2,311)
pub	6,942 ***		
	(2,137)		
pub#nonshare	-13.83		
	(10.32)		
extra		5,414 **	
		(2,484)	
extr#nonshare		-34.52 **	
		(15.37)	
obs	442	442	442
No. Iterations	1000	1000	1000

Note: Truncated double bootstrap regression with an unbalanced panel of banks.
***, ** and * indicate significance level at 1%, 5% and 10% respectively.
Bootstrap standard errors in parentheses.

Finally, we are interested in studying whether the effect of non-traditional activities varies with the ownership structure. Thus, Table 6 shows that the interaction term *extr#nonshare* shows a negative and significant relationship with technical inefficiency. This indicates that foreign banks perform better in exploiting the benefits of diversifying their activities than their local peers. The findings mirror those revealed by Berger et al. (2009) and Doan et al. (2018) for developing countries. Foreign banks in developing countries face significant challenges in understanding the local market, but they also possess advantages in terms of skilled human resources, soft technologies, and information monitoring. These advantages could favour foreign banks in the business of non-traditional activities (Claessens et al., 2001). In this way, foreign-owned banks, to mitigate the disadvantages of the local market, are more prepared to exploit activities that generate income from non-traditional activities.

4. Robustness

We perform a robustness exercise for a balanced panel of 54 banks. By estimating the previous equations – (7) and (8) – for a balanced panel of banks we seek to ensure that the effect of our results is not driven by the incorporation of banking entities with atypical results in the selected variables. Table 7 presents the results.

Table 7. Determinants of efficiency, balanced panel of 54 banking entities

Independent variables	Technical inefficiency				
	Model I	**Model II**	**Model III**	**Model IV**	**Model V**
Constant	587.7**	552.1**	578.4***	551.7***	464.8**
	(236.3)	(218.4)	(219.8)	(212.4)	(224.8)
nonshare	-10.19***	-10.71***	-10.17***	-9,625**	-6,813*
	(3,915)	(3,938)	(3,913)	(4,106)	(3,846)
lta	-4,544***	-4,889***	-4,429***	-4,928***	-4,364***
	(0.759)	(0.794)	(0.722)	(0.795)	(0.718)
r_credit	12.60*	14.36**	11.46	14.51**	20.20***
	(6,925)	(6,818)	(7,261)	(6,670)	(7,389)
r_liquidity	-3,679	-3,850*	-3,301	-4,039*	-3,487
	(2,293)	(2,159)	(2,172)	(2,220)	(2,209)
r_capital	22.92***	22.99***	23.53***	23.86***	27.07***
	(5,138)	(5,079)	(5,307)	(5.103)	(5,800)
roa	-0.0235	-0.0194	-0.0173	-0.0204	-0.00573
	(0.0583)	(0.0560)	(0.0588)	(0.0568)	(0.0603)
lninf	0.580	0.594	0.597	0.488	0.603
	(1,104)	(1,007)	(1,025)	(0.995)	(1,070)
lnpib	-91.49**	-85.73**	-90.08***	-85.54***	-73.40**
	(36.70)	(33.89)	(34.19)	(33.00)	(34.95)
ln_c3	6,135*	6,004**	5,804*	5,744**	5,754*
	(3,154)	(2,897)	(3,011)	(2,882)	(3,062)
pub		5,097***		6,818***	
		(1,159)		(2,168)	
pub=1 # nonshare				-10.72	
				(10.14)	
extra			0.867		10.99***
			(1,206)		(3,179)
extr=1 # nonshare					-62.39***
					(19.09)
Observations	410	410	410	410	410
No. Iterations	1000	1000	1000	1000	1000

Note: DEA-Double Bootstrap applied to a balanced panel of 54 banking entities that presented observations on the selected variables for the 8 periods considered (2012-2019).

The main findings remain consistent even when considering a balanced panel of banks. This suggests that our results are reliable regardless of the sample composition, and that the observed effects are not due to how the sample was chosen. However, conflicting evidence on the factors influencing banking efficiency has emphasized the importance of how variables are selected. Boďa and Piklová (2018), Tortosa-Ausina (2002), and Drake, Hall, and Simper (2009) have shown differing efficiency scores based on whether production or intermediation approaches are used to select the variables. For banks in Argentina, Costa de Arguibel et al. (2024) show the low congruence of efficiency scores under the intermediation and production approach.

In this way, we estimate efficiency models I and II considering deposits as a variable of the bank's product. Thus, model I considers deposits, loans, and income from services as products, while inputs correspond to staffing and bank branches. Model II considers the same variables excluding the non-interest income of the banking product. For reasons of space, we do not present a visualization like Figure 1 in the production model, however it is available upon request.

Our results show that excluding service income in the bank's product vector penalizes the efficiency of banking entities throughout the period. These results are identical to those observed in Figure 1. Furthermore, the results presented in Table 8 indicate that non-traditional activities significantly affect Argentine banks' efficiency. Additionally, our results remain valid even when considering the inefficiency of banks under public ownership. Finally, foreign banks with a greater focus on non-traditional activities outperform their local counterparts.

Table 8. Determinants of inefficiency under the production approach in Argentine banks

Independent variables	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
nonshare	-36.83***	-37.20***	-31.67***	-35.32***	-38.66***	-21.44**	-55.90**
	(11.86)	(12.08)	(9,342)	(11.18)	(11.93)	(9,898)	(26.91)
pub		14.77***					
		(5,007)					
pub=1 # nonshare					39.06		
					(45.02)		
extra			-13.31***				
			(3,160)				
extr=1 # nonshare						-91.31***	
						(34.78)	
Observations	474	474	474	474	474	474	474
No. Iterations	1000	1000	1000	1000	1000	1000	1000

Note: Truncated double bootstrap regression with an unbalanced panel of banks. The variable selection approach corresponds to the production approach. The bank's product consists of deposits, loans, service revenues, and inputs through staffing and branches.
***, ** and * indicate significance level at 1%, 5% and 10% respectively.
Bootstrap standard errors in parentheses.

5. Conclusions

The financial sector of Argentina is relatively small compared to other countries in the region and is similar in size to that of some impoverished African nations. Banks play a significant role in the country's financial sector. The lack of depth in the financial sector has been an important factor in Argentina's poor economic performance. The Argentine banking system has undergone various reforms and structural changes, which have influenced the behaviour of these financial institutions. This study aims to enhance our comprehension of the factors that influence the performance of banking entities. We specifically aim to understand the impact of non-traditional activities on the behaviour of banks. To achieve this, we employ a two-stage DEA Bootstrap approach, as suggested by Simar and Wilson (2007), to investigate the effect of non-traditional activities on the efficiency of Argentine banks from 2012 to 2019.

The findings highlight the importance of taking into account non-traditional activities when evaluating the performance of Argentine banks. Not considering these activities leads to an underestimation of the technical efficiency of Argentine banks and suggests that they have a competitive edge in non-traditional activities. Additionally, the evidence indicates that foreign banks are better at capitalizing on the benefits of diversifying their activities compared to local banks in the Argentine banking industry. Finally, our results indicate public banks have worse performance than privately managed entities. The findings remain reliable regardless of which variables are chosen and how they are defined. Overall, the results suggest that traditional banking activities have played a significant role in empowering Argentine banks to operate efficiently and remain competitive.

References

Adem , M. (2023). Impact of income diversification on bank stability: a cross-country analysis. Asian Journal of Accounting Research, 8(2), 133-144.

Alhassan, A. L., & Tetteh, M. L. (2016). Non-Interest Income and Bank Efficiency in Ghana: A Two-Stage DEA Bootstrapping Approach. Journal of African Business, 124-142.

Ariff, M., & Luc, C. (2008). Cost and profit efficiency of Chinese banks: A non-parametric analysis. China economic review, 19(2), 260-273.

Ariss, R. (2010). On the implications of market power in banking: Evidence from developing countries. Journal of banking & Finance, 34(4), 765-775.

Assaf, A. G., Barros, C. P., & Matousek, R. (2011). Technical efficiency in Saudi banks. Expert Systems with Applications, 5781-5786.

Banya, R., & Biekpe, N. (2018). Banking Efficiency and its determinants in selected Frontier African Markets. Economic Change and Restructuring, 51, 69-95.

Barth, J. R., Caprio Jr, G., & Levine, R. (2004). Bank regulation and supervision: what works best?. Journal of Financial intermediation, 13(2), 205-248.

Beck, T., Demirgüç-Kunt, A., & Maksimovic, V. (2004). Bank competition and access to finance: International evidence. Journal of Money, Credit and banking, 627-648.

Berger, A. N., & DeYoung, R. (1997). Problem loans and cost efficiency in commercial banks. Journal of banking & finance, 21(6), 849-870.

Berger, A. N., Hasan, I., & Zhou, M. (2009). Bank ownership and efficiency in China: What will happen in the world's largest nation?. Journal of Banking & Finance, 33(1), 113-130.

Berger, A., & Humphrey, D. (1997). Efficiency of financial institutions: International survey and directions for future research. European journal of operational research, 98(2), 175-212.

Berger, A. N., & Udell, G. F. (2006). A more complete conceptual framework for SME finance. Journal of Banking & Finance, 30(11), 2945-2966.

Brissimis, S. N., Delis, M. D., & Papanikolaou, N. I. (2008). Exploring the nexus between banking sector reform and performance: Evidence from newly acceded EU countries. Journal of Banking & Finance, 32(12), 2674-2683.

Boďa, M., & Piklová, Z. (2018). The production or intermediation approach?: It matters. In Contemporary Trends and Challenges in Finance (pp. 111-120). Springer, Cham.

Bonin, J. P., Hasan, I., & Wachtel, P. (2005). Bank performance, efficiency and ownership in transition countries. Journal of banking & finance, 29(1), 31-53.

Boot, A. W., & Schmeits, A. (2000). Market discipline and incentive problems in conglomerate firms with applications to banking. Journal of financial intermediation, 9(3), 240-273.

Campos, N. F., Karanasos, M. G., & Tan, B. (2012). Two to tangle: Financial development, political instability and economic growth in Argentina. Journal of Banking & Finance, 36(1), 290-304.

Claessens, S., Demirgüç-Kunt, A., & Huizinga, H. (2001). How does foreign entry affect domestic banking markets?. Journal of banking & finance, 25(5), 891-911.

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). An introduction to efficiency and productivity analysis. springer science & business media.

Costa de Arguibel, F., Wittig, C. y Dip, J.A. 2024. Estructura de propiedad, origen de capital y eficiencia bancaria: evidencia para Argentina en el periodo 2010-2018. *Revista de Economía Institucional*. 26, 51, 165–191. DOI: https://doi.org/10.18601/01245996.v26n51.08.

Debreu, G. (1951). The coefficient of resource utilization. Econometrica: Journal of the Econometric Society, 273-292.

Delfino, M. (2003). Ownership and Efficiency in the Banking Industry. Empirical evidence for Argentina. Recuperado de: https://www.diw.de/documents/dokumentenarchiv/17/42115/2004-333-V01.pdf.

Delis, M. D., & Papanikolaou, N. I. (2009). Determinants of bank efficiency: evidence from a semi-parametric methodology. Managerial finance, 35(3), 260-275.

Dip, J. A., Costa de Arguibel, F., & Wittig, C. P. (2019). La eficiencia de las universidades públicas en argentina mediante el análisis envolvente de datos con bootstrap. Cuadernos del Cimbage, 1-26.

Doan, A. T., Lin, K. L., & Doong, S. C. (2018). What drives bank efficiency? The interaction of bank income diversification and ownership. International Review of Economics & Finance, 55, 203-219.
Drake, L., Hall, M., & Simper, R. (2009). Bank modelling methodologies: A comparative non-parametric analysis of efficiency in the Japanese banking sector. Journal of International Financial Markets, Institutions and Money, 19(1), 1-15.
Farrell, M. (1957). The measurement of productive efficiency. Journal of the Royal Statistical Society, 120(3):253–290.
Fernandes Da Silva, F., Stasinakis, C., & Bardarova, V. (2018). Two-stage DEA-Truncated Regression: Application in banking efficiency and financial development. Expert Systems with Applications, 284-301. doi:https://doi.org/10.1016/j.eswa.2017.12.010.
Ferro, G., León, S., Romero, C., & Wilson, D. (2013). Eficiencia del sistema bancario argentino (2005-2011). Anales XLVIII Reunión Anual de la Asociación Argentina de Economía Política. Universidad Nacional de Rosario, Rosario, Argentina. Recuperado de: https://bd.aaep.org.ar/anales/works/works2013/ferro_leon.pdf.
Frame, W. S., & Woosley, L. (2004). Credit scoring and the availability of small business credit in low-and moderate-income areas. Financial Review, 39(1), 35-54.
Fiordelisi, F., Marques-Ibanez, D., & Molyneux, P. (2011). Efficiency and risk in European banking. Journal of banking & finance, 35(5), 1315-1326.
Fukuyama, H., & Matousek, R. (2017). Modelling bank performance: A network DEA approach. European Journal of Operational Research, 259(2), 721-732.
García-Cestona, M., & Surroca, J. (2008). Multiple goals and ownership structure: Effects on the performance of Spanish savings banks. European Journal of Operational Research, 187(2), 582-599.
Guiso, L., Sapienza, P., & Zingales, L. (2009). Does local financial development matter? (pp. 31-66). Physica-verlag HD.
Henriques, I. C., Sobreiro, V. A., Kimura, H., & Barberio Mariano, E. (2020). Two-stage DEA in banks: Terminological controversies and future directions. Expert Systems with Applications. doi:https://doi.org/10.1016/j.eswa.2020.113632.
Holod, D., & Lewis, H. F. (2011). Resolving the deposit dilemma: A new DEA bank efficiency model. Journal of banking & finance, 35(11), 2801-2810.
Jelassi, M. M., & Delhoumi, E. (2021). What explains the technical efficiency of banks inTunisia? Evidence from a two-stage data envelopment analysis. Financial Innovation, https://doi.org/10.1186/s40854 021 00282 w.
Jiménez-Hernández, I., Palazzo, G., & Sáez-Fernández, F. J. (2019). Determinants of bank efficiency: evidence from the Latin American banking industry. Applied Economic Analysis, 27(81), 184-206.
Kasman, A., & Carvallo, O. (2014). Financial stability, competition and efficiency in Latin American and Caribbean banking. Journal of Applied Economics, 17(2), 301-324.
King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. The quarterly journal of economics, 108(3), 717-737.
Levine, R. (2002). Bank-based or market-based financial systems: Which is better? Journal of Financial Intermediation, 11., 398-428.
Liendo, H., & Sturzenegger, F. (2020). A Practitioner's Guide to Efficiency and Competition Policies in Banking-Based on Argentina's experience 2015-2019 (No. 142). Recuperado de: https://webacademicos.udesa.edu.ar/pub/econ/doc142.pdf.
Lieu, P. T., Yeh, T. L., & Chiu, Y. H. (2005). Off-balance sheet activities and cost inefficiency in Taiwan's banks. The Service Industries Journal, 25(7), 925-944.
Luu, H. N., Nguyen, L. Q. T., Vu, Q. H., & Tuan, L. Q. (2020). Income diversification and financial performance of commercial banks in Vietnam: do experience and ownership structure matter?. Review of Behavioral Finance, 12(3), 185-199.
Mumtaz, R., Rauf, S. A., Ahmed, B., & Noreen, U. (2013). Capital structure and financial performance: Evidence from Pakistan (Kse 100 Index). Journal of basic and applied scientific research, 3(4), 113-119.

Pennathur, A. K., Subrahmanyam, V., & Vishwasrao, S. (2012). Income diversification and risk: Does ownership matter? An empirical examination of Indian banks. Journal of Banking & Finance, 36(8), 2203-2215.
Peretto, C. B., Quiroga Martínez, F., & Alberto, C. L. (2021). Análisis de los factores que determinan la eficiencia de los bancos en Argentina. Un análisis DEA en dos etapas. Contaduría y Administración. doi:ttp://dx.doi.org/10.22201/fca.24488410e.2022.2646.
Prados de la Escosura, L., & Sanz-Villarroya, I. (2009). Contract enforcement, capital accumulation, and Argentina's long-run decline. Cliometrica, 3, 1-26.
Rogers, K. E. (1998). Nontraditional activities and the efficiency of US commercial banks. Journal of Banking & Finance, 22(4), 467-482.
Sawada, M. (2013). How does the stock market value bank diversification? Empirical evidence from Japanese banks. Pacific-Basin Finance Journal, 25, 40-61.
Schaeck, K., & Cihák, M. (2014). Competition, efficiency, and stability in banking. Financial management, 43(1), 215-241.
Seffino, M., & Hoyos Maldonado, D. (2016). Eficiencia bancaria en la Argentina. Comportamiento de los bancos entre 2005 y 2013. Estudios Gerenciales, 32(138), 44-50.
Seffino, M., & Maldonado, D. H. (2021). Eficiencia en entidades bancarios. El caso argentino 2004–2016. Economica, 67, 021-021.
Simar, L. and Wilson, P. (2000). A general methodology for bootstrapping in nonparametric frontier models. Journal of Applied Statistics, 27(6):779–802.
Simar, L., & Wilson, P. W. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. Journal of Econometrics. doi:doi:10.1016/j.jeconom.2005.07.009.
Staub, R. B., e Souza, G. D. S., & Tabak, B. M. (2010). Evolution of bank efficiency in Brazil: A DEA approach. European journal of operational research, 202(1), 204-213.
Stewart, C., Matousek, R., & Nguyen, T. N. (2016). Efficiency in the Vietnamese banking system: A DEA double bootstrap approach. Research in International Business and Finance, 36, 96-111.
Stiroh, K. J., & Rumble, A. (2006). The dark side of diversification: The case of US financial holding companies. Journal of banking & finance, 30(8), 2131-2161.
Sufian, F., & Habibullah, M. S. (2009). Asian financial crisis and the evolution of Korean banks efficiency: A DEA approach. Global economic review, 38(4), 335-369.
Sufian, F., & Habibullah, M. S. (2014). Banks'total factor productivity growth in a developing economy: does globalisation matter?. Journal of International Development, 26(6), 821-852.
Surfian, F., Kamarudin, F., & Nassir, A. m. (2016). Determinants of efficiency in the malaysian banking sector: Does bank origins matter? Intellectual Economics, 38-54. doi:http://dx.doi.org/10.1016/j.intele.2016.04.002.
Taylor, A. M. (1998). Argentina and the world capital market: saving, investment, and international capital mobility in the twentieth century. Journal of Development Economics, 57(1), 147-184.
Tortosa-Ausina, E. (2002). Bank cost efficiency and output specification. Journal of Productivity Analysis, 18, 199-222.
Tortosa-Ausina, E. (2003). Nontraditional activities and bank efficiency revisited: a distributional analysis for Spanish financial institutions. Journal of Economics and Business, 55(4), 371-395.
Ybarra, J. P. (2016). Eficiencia y productividad en la industria bancaria de Argentina. Recuperado en: http://hdl.handle.net/10908/12010.