

DETERMINANTS OF THE PROFITABILITY OF SAVINGS BANKS IN THE US AND THE MODERATING EFFECT OF THE PANDEMIC CRISIS

DETERMINANTES DE LA RENTABILIDAD DE LAS CAJAS DE AHORRO EN ESTADOS UNIDOS Y EL EFECTO MODERADOR DE LA CRISIS PANDÉMICA

Marco Amaral

mamaral@ipca.pt

Polytechnic Institute of Cávado and Ave

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ABSTRACT

The pandemic crisis that began in 2020 and lasted until 2021 has raised concerns about the impact on banking profitability. As a result, the global banking system suffered a drop in the profitability of its banking business as part of the crisis. Taking into account the problem of profitability in the banking sector, some studies have been increasingly highlighted both in academia and in the financial market. Therefore, this study aims to analyze the determinants of bank profitability for banks operating in the savings segment in the United States, for the periods between 2012 and 2022. To this end, four factors explaining profitability (default rate, liquidity, solvency and productivity) were analyzed for 57 banks. In addition, we wanted to assess the moderating effect that the pandemic crisis had on the banking sector. To obtain the results, a panel data analysis model was used, combining cross-section data (banks) and time-series data (years), and a strongly balanced panel was obtained. Four multiple linear regression models were then used, and it was possible to identify liquidity and solvency as the main positive factors in bank profitability. In contrast, the factors of default rate and productivity have a negative influence on bank profitability. The results also show that banks with high default rates had greater difficulties during the period of the pandemic crisis, that is, the crisis negatively moderated the effect of default on profitability.

Keywords: Profitability, pandemic crisis, banks, US, panel data.

RESUMEN

La crisis pandémica que comenzó en 2020 y duró hasta 2021 ha suscitado preocupación por su impacto en la rentabilidad bancaria. Como consecuencia, el sistema bancario mundial sufrió una caída de la rentabilidad de su negocio bancario en el marco de la crisis. En vista del problema de la rentabilidad en el sector bancario, se ha hecho cada vez más hincapié en algunos estudios tanto en el mundo académico como en el mercado financiero. Por lo tanto, este estudio tiene como objetivo analizar los determinantes de la rentabilidad bancaria para los bancos que operan en el segmento de ahorro en los Estados Unidos de América, para los períodos comprendidos entre 2012 y 2022. Para ello, se han analizado cuatro factores explicativos de la rentabilidad (tasa de morosidad, liquidez, solvencia y productividad) para 57 bancos. Además, se trató de evaluar el efecto moderador que tuvo la crisis pandémica en el sector bancario. Para obtener los resultados, se utilizó un modelo de análisis de datos de panel que combina datos de sección transversal (bancos) y datos de serie temporal (años), obteniendo un panel fuertemente equilibrado. A continuación, se utilizaron cuatro modelos de regresión lineal múltiple y fue posible identificar la liquidez y la solvencia como los principales factores positivos de la rentabilidad bancaria. Por el contrario, los factores de morosidad y productividad influyen negativamente en la rentabilidad bancaria. Los resultados también muestran que los bancos con altas tasas de morosidad tuvieron mayores dificultades durante el periodo de la crisis pandémica, es decir, la crisis moderó negativamente el efecto de la morosidad en la rentabilidad.

Palabras clave: Rentabilidad; crisis pandémica; bancos; datos de panel.

JEL Classification/ Clasificación JEL: G01, G21, G28.

1. INTRODUCTION

Given the recent adverse economic contexts (financial crisis and pandemic crisis) in which banks operate, it is becoming increasingly urgent to understand the factors that may determine their profitability and the explanatory variables that may influence banking performance. Recently, a large number of studies on this subject (Messai *et al.*, 2015; Duraj and Moci, 2015, Titko *et al.*, 2015; Elisa and Guido, 2016; Alshatti, 2016; Le and Ngo, 2020), among others, have shown a set of dominant factors that drive profitability in the banking sector. For the authors Wahdan and Leithy (2017), the factors that affect bank profitability can come from external or internal sources. In the same line of research, Serwadda (2018) states that external factors include the government's macroeconomic policies, central bank interest rates, climate change and the current COVID-19 pandemic. In turn, internal factors include interest income, overdue credit, capital adequacy, asset size and others (Islam *et al.*, 2017). Thus, the study of the determinants of bank profitability proves to be fruitful and timely.

The purpose of this paper is to analyze the determinants of the profitability of savings banks in the US and to assess the moderating effect that the pandemic crisis has had on this sector. To achieve this goal, 57 savings banks in the US banking system were analyzed for the period 2012 to 2022. In order to analyze the profitability of US savings banks, two bank profitability indicators were used and related to a set of management indicators, separated into four categories, namely: level of default, liquidity, solvency and productivity. These indicators make it possible to work with a significant number of variables such as costs, revenues, loans, deposits, assets, capital, employees, among others, and relate them to their respective profitability indicators, measured by RoA (Return on Assets) and RoE (Return on Equity). In addition, in order to measure the functional relationships between the variables in the study, control variables such as interest rates, the consumer price index, the political organization system, and size were considered. Specifically, we strive to answer a set of questions that allow us to validate the level of profitability of savings banks in the US banking system and identify the divergences between profitability and the internal and external characteristics of banks, such as: default rate, liquidity, solvency, productivity, inflation, central bank reference rate, type of government, and size. In addition, for the sample period considered, we looked at whether the pandemic played a moderating role in these effects. In this

sense, in addition to focusing on the relationship between internal and external factors and the profitability of the banking sector, the debate in this research also aims to assess the moderating effect of the pandemic crisis. Thus, it is hoped that this study will make a strong contribution to research in this thematic area, essentially in the analysis of the profitability of US banking institutions, thus making it possible to portray the reality of US banking specializing in the savings segment, as well as contributing to the teachings of bank profitability focused on its internal and external determinants.

The final document of this work is structured as follows: in addition to the first introductory section, a second section on the literature review is presented, highlighting the evidence of similar studies and the formulation of the hypotheses to be tested. This section describes the sample, data collection, study variables, specification of the econometric model and statistical methods, the results obtained and their discussion. Finally, the fourth point, the conclusion of the study, is presented, which reflects on the main conclusions of this research, as well as the main limitations of the study.

2. RELEVANT LITERATURE AND DEVELOPMENT OF HYPOTHESES

This section presents the literature review of this study in order to ensure and substantiate the purposes of the work carried out, as well as the development of the hypotheses to be tested, through the hypotheses formulated for this purpose.

2.1. LITERATURE REVIEW

There are a number of studies that relate measures of bank financial profitability, particularly with regard to the factors that determine the profitability of credit institutions.

Analyzing the literature for the banking market on bank profitability, the works carried out by authors such as Athanasoglou *et al.* (2008), Sanchez *et al.* (2017) and Bikker and Vervliet (2018), use the Return on Assets (RoA) and Return on Equity (RoE) indices as the main indicators to measure results and assess their evaluations. Therefore, to ensure the purposes of this study, a set of data in different environments from various authors was analyzed. In this way, it was possible to distinguish some studies insofar as the results obtained are different, but which, despite presenting mixed associated relationships, have in common combinations of internal and external determinants to explain bank profitability.

In Europe, Athanasoglou *et al.* (2008) analyzed the profitability of Greek commercial banks, measured by RoA and RoE, from 1985 to 2001, in the light of the recent economic recession. These authors carried out the most popular decomposition of the determinants of bank profitability, adopting three categories of factors that explain bank profitability. First, through bank-specific factors, using variables such as size, capital, credit risk, loans, revenue

diversification, type of bank and efficiency, they found a significant positive effect for the capital variable and a significant negative effect for the credit risk variable, while the results for bank size were insignificant. In a second category of determinants of bank profitability, they adopted industry/sector-specific factors such as ownership and bank concentration and concluded that there is no clear relationship between sector concentration and bank profitability. Finally, in the third category of determinants, they looked at the macroeconomic environment (external factors) with a special focus on the variable of economic growth measured by Gross Domestic Product (GDP), with the authors concluding that strong economic growth combined with higher interest rates is likely to increase bank profitability.

In a cross-sectional analysis of 154 financial entities from 22 countries for the period 2005-2010, the study by Sanchez *et al.* (2017) aims to understand the impact of corporate social performance on the financial performance of the banking sector. In this sense, the authors' study consists of verifying which dimensions of corporate social performance (corporate governance, employee relations, community relations and product responsibility) had the greatest impact on banks' financial profitability (measured by RoA and RoE), as well as whether the 2008 financial crisis played a moderating role in these effects. The authors also used control variables such as bank size and leverage to avoid biased results. In order to assess the impact of social performance on financial profitability, the authors used dynamic panel data through the multiple linear regression equation for the fixed effects model. The results showed that banks with better employee relations and corporate governance had better profitability. However, the financial crisis negatively moderated the effect of corporate governance, suggesting flaws in its mechanisms. Product liability, contrary to the authors' expectations, did not positively influence bank profitability. Finally, the authors analyzed the moderating effect of the financial crisis and concluded that the crisis has an interaction effect on the relationship between social performance and banks' financial profitability. This effect flows mainly through the variables of corporate governance and community.

On the other side of the continent, namely in the US banking system, the study by the authors Bikker and Vervliet (2018), for the years 2001 to 2015, made it possible to consider an analysis of the period before and after the financial crisis. The work carried out by the authors aims to explore the relationship between bank profitability and the economic environment of low interest rates. The sample includes a set of panel data for 3,582 commercial and savings banks, using profitability measures such as RoA, RoE, net interest margin and profit. As determinants, the authors selected a set of bank-specific variables (size, loans, capital, credit risk and revenue diversification) and macroeconomic variables (GDP, inflation and interest rates). From the results obtained, the authors concluded that variables such as capital, loans and size have a significant positive effect on bank profitability, in contrast, the credit risk variable has a negative effect and the macroeconomic variables GDP and inflation were considered insignificant in explaining bank profitability. Finally,

the authors confirm that, in part, the low interest rate environment harms bank profitability and crushes net interest income.

Table 1 shows, by author, a number of other studies on the subject of bank profitability.

TABLE 1. STUDIES ON BANK PROFITABILITY, BY AUTHOR

Authors (Year)	Period (Sample)	Profitability Metrics	Determinants	Conclusion
Bourke (1989)	1972-1981 (Banks from 12 countries)	RoA	Liquidity Capital Leverage Ownership Concentration	- The results show that banking concentration has a positive effect on profitability. On the other hand, capital and liquidity show a negative relationship.
Demirguc-Kunt and Huizinga (1999)	1988-1995 (Banks in 80 countries)	Net Interest Margin	Dimension Revenue Capital Liquidity Credit Risk GDP Inflation Interest Rates	- The authors note that determinants such as capital, GDP and inflation show a positive and statistically significant association. In contrast, the liquidity variable shows a negative relationship with bank profitability.
Tregenna (2009)	1994-2005 (EUA)	RoA RoE	Concentration Market Share Size Efficiency	- The study shows that banking concentration increases profitability, even when the largest banks are excluded.
Fronk (2016)	1985-2015 (EUA)	RoA	GDP Unemployment Rate Interest Rate Spread	- Macroeconomic factors are responsible for profitability being so low during and after the financial crisis.
Paroush and Schreiber (2019)	1995-2015 (EUA)	RoA	Capital Risk	The authors found that capital is positively related to profitability, while risk is negatively related.
Mendoza <i>et al.</i> (2020)	1994-2011 (Banks from 134 countries)	RoA Net Interest Margin	Concentration Diversification Risk Liquidity Capital Loans Efficiency GDP Inflation	- Determinants such as banking concentration, GDP, diversification of services and products show a positive and significant relationship with bank profitability. On the other hand, inflation shows a negative relationship with profitability.
Veeramoothoo and Hammoudeh (2022)	2010-2017 (EUA)	RoA RoE	Financing Liquidity Size Capital Risk GDP	- The authors found that small banks are more vulnerable to short-term liquidity risks and large banks are more susceptible to medium and long-term liquidity risks.
Wang (2023)	2008-2016 (Japan and EUA)	RoA	Risk Liquidity Efficiency Capital Size GDP	- The author's study shows that holdings of risky securities in Japan have a positive effect, while in the US it has a negative effect on the profitability of large banks.

Source: Author's own creation.

The following subsections present the determinants that can influence bank profitability, and which therefore relate to bank profitability. Thus, in light of the literature, the following five hypotheses were developed, separated by four specific categories for the sector of activity (default, liquidity, solvency and productivity) and by a category designed to measure the effect of the pandemic crisis on bank profitability, as shown in Table 2.

TABLE 2. SUMMARY OF THE STUDY HYPOTHESES

Factor	Argument	Hypotheses
Default	Default rate on the portfolio of loans granted to customers	H1: The sluggishness of banks, as measured by the default rate on the loan portfolio, negatively affects banks profitability
Liquidity	Transforming customer funds into customer loans	H2: Bank liquidity has a positive (negative) effect on banks profitability
Solvency	Capital adequacy	H3: Bank solvency has a positive (negative) effect on bank profitability
Productivity	Employee production	H4: Bank productivity has a positive effect on bank profitability
Pandemic	Moderating effect of the pandemic crisis - COVID19	H5: The moderating effect of the pandemic crisis has a significant influence on the relationship between the four factors and bank profitability

Source: Author’s own creation.

2.2. DEFAULT

The default variable is intended to reflect the sluggishness of a bank’s customer loan portfolio. In order to analyze the default rate of the loan portfolio, this study used the effect of impairments and loan provisions on the customer loan portfolio, thus making it possible to verify the weight of impairments recorded in each financial year in the loan portfolio, i.e. in total loans. There is a general consensus among the authors, Demircuc-Kunt and Huizinga (1999), DeYoung and Rice (2004), Athanasoglou *et al.* (2008), Kosmidou (2008), Liang *et al.* (2013), Barata (2014), Carvalho and Ribeiro (2016), Sun *et al.* (2017), Bikker and Vervliet (2018), Mota *et al.* (2019), Paroush and Schreiber (2019) and Wang (2023), that a bank’s profitability is directly related to the quality of its loan assets. Thus, a lower quality of the loan portfolio negatively affects bank profitability with the amount of provisioning for expected credit losses. It should also be noted that these authors concluded that this variable is one of those which most influences bank profitability. Thus, on the assumption that a high default rate decreases bank profitability, the following hypothesis is tested: H1: The sluggishness of banks, as measured by the default rate on the loan portfolio, negatively affects banks profitability

2.3. LIQUIDITY

Since liquidity is related to a banking institution’s ability to honor its commitments in relation to depositors’ capital, the level of liquidity of each

banking institution can be expected to have an impact on banks' profitability. The recent Basel III regulatory changes (BCBS, 2013; 2014), introduced two minimum financial liquidity standards such as the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR) which, despite being the best options for measuring bank liquidity, were not used in this study as not all the financial data was available for the period under analysis. Therefore, the ratio of transformation of customer funds into loans granted was adopted for this category of explanatory variable. This variable makes it possible to measure how much customer capital (bank deposits) is used in loans granted to customers of those same banks. This indicator is widely used by regulators to measure banks' liquidity. The higher this indicator, the greater the possibility of a bank generating income, and therefore becoming more profitable, i.e. banks with high value for this indicator will be those with a higher degree of leverage, by converting deposits into loans, thus being appropriate to refer to as factors of greater bank profitability. The studies carried out by various authors on this variable are very ambiguous. In fact, while some studies have concluded a positive relationship between bank profitability and liquidity (Molyneux and Thornton, 1992; Barth *et al.*, 2013; Trujillo-Ponce, 2013), other studies have concluded a negative relationship (Bourke, 1989; Demircuc-Kunt and Huizinga, 1999; Hamdi and Hakimi, 2019). Thus, given the mixed character with different types of positive and negative association, the following hypothesis was developed to be tested:

H2: Bank liquidity has a positive (negative) effect on banks' profitability.

2.4. SOLVENCY

With regard to the solvency of banks, this study highlights the importance of capital ratios, specifically the Tier 1 solvency ratio, which reflects, in accordance with Basel III guidelines, a bank's obligation to maintain certain amounts of capital, known as core capital, to cope with unexpected losses. This ratio is measured by the relationship between Tier 1 capital and the bank's risk-weighted assets (RWA). However, given the difficulty in obtaining the data provided by the banks in the sample, the financial data obtained from the balance sheet resulting from the ratio between equity and total net assets (solvency understood in accounting terms) was used as an indicator. The higher this ratio the better, demonstrating, on the one hand, a greater capacity for banks to cover losses on their assets and, on the other hand, less need to raise external funds, and therefore greater bank profitability. However, some studies do not agree on the relationship between solvency and bank profitability. Bourke (1989), Hoffmann (2011) and Carvalho and Ribeiro (2016) concluded a negative relationship, but the authors' studies (Demircuc-Kunt and Huizinga, 1999; Athanasoglou *et al.*, 2008; Kosmidou, 2008; Trujillo-Ponce, 2013; Bikker and Vervliet, 2018 and Paroush and Schreiber, 2019) point in the opposite direction, confirming the existence of a positive association. Given that there

is no agreement on the relationship between the solvency and profitability of banks, it was pertinent to formulate the following hypothesis to test:

H3: Bank solvency has a positive (negative) effect on bank profitability.

2.5. PRODUCTIVITY

The level of profitability obtained by a banking institution can be influenced by its productivity. The productivity variable in this study is translated by the management indicator called productivity of complementary activity per employee. In general, this indicator is intended to reflect the relationship between the net commissions generated by each employee of a bank, making it possible to establish a comparative evaluation measure of the banking sector. Authors such as Gambacorta and Ibanez (2011) and Trenca *et al.* (2015), consider that the fact that an employee generates a high performance in banking activity will reflect in higher bank profitability. This leads to the following hypothesis to be tested:

H4: Bank productivity has a positive effect on bank profitability.

2.6. MODERATING EFFECT OF THE PANDEMIC CRISIS

The aim of this variable is to analyze how the moderating effect of the pandemic crisis has influenced banks' default, liquidity, solvency and productivity and what effect it may have had on their profitability. To this end, a dummy variable was used for the periods without a pandemic crisis (0 corresponds to the periods from 2012 to 2019 and 2022) and for the periods with a pandemic crisis (1 corresponds to the periods from 2020 and 2021). Studies such as Wu and Shen (2013) and Sanchez *et al.* (2017) analyzed the effects before and after the financial crisis and found mixed effects (positive and negative) between the explanatory variables and bank profitability. In this sense, the following research hypothesis is proposed:

H5: The moderating effect of the pandemic crisis has a significant influence on the relationship between the four factors and bank profitability.

3. METHODOLOGY

This section presents the analysis and description of the data, as well as the sample considered, followed by the variables included in the model and the treatment of the main statistical data, and concludes with the specification of the econometric model.

3.1. SAMPLE AND DATA DESCRIPTION

The sample consists of a portfolio of 57 financial entities operating in the US banking system in the specialized savings segment (see Appendix I), for the period from 2012 to 2022, totaling 627 observations. The total volume of assets and bank deposits of the entities considered in the sample amounts to

921 billion USD in 2022 (representing 71.9% of total assets, which amount to 1,281 billion USD) and 803 billion USD (representing 74.2% of total deposits, which amount to 1,082 billion USD), respectively.

The data was collected using the database provided by BankFocus and Bureau van Dijk, as well as statistical data published by the Federal Deposit Insurance Corporation (FDIC). Macroeconomic data for the years in the sample was obtained from the CountryEconomy database of Alldatanow, S.L.

In order to demonstrate the evolution and size of the US banking system for the savings bank segment, a characterization of the system is given in Table 3.

TABLE 3. CHARACTERIZATION OF THE SAMPLE: EVOLUTION OF SAVINGS BANKS IN THE US

Description	Measure	2012	2019	2020	2021	2022
No. of Institutions	Unit	1,011	659	627	607	579
No. of employees	Unit	148,918	121,746	122,265	119,610	108,648
Total Assets		1,063	1,154	1,378	1,519	1,281
<i>Of which:</i>						
Earning Assets:		983	1,096	1,316	1,458	1,215
- Total Loans	Billion USD	652	655	660	681	641
- Other (*)		331	441	656	777	574
Non-remunerated Assets		80	58	62	61	66
Total Deposits	Billion USD	805	921	1,139	1,287	1,082
% of Assets	%	75.7	79.8	82.6	84.7	84.5
Deposits-to-Loans (Transformation Ratio)	%	81.0	71.1	57.6	52.9	59.2
Equity Capital	Billion USD	127	125	134	147	93
% of Assets	%	11.9	10.8	9.7	9.7	7.3
Net Interest Margin		3.46	3.87	3.09	2.78	3.28
<i>Of which:</i>						
	%					
Yield on Earnings Assets		4.38	4.83	3.65	3.06	3.73
Cost of Funding Earning Assets		0.92	0.96	0.56	0.28	0.45
Income		54	54	52	53	51
<i>Of which:</i>						
Interest Income	Billion USD	33	41	37	38	41
Non-interest Income		21	13	15	15	10
Provisions for Credit Losses	Billion USD	5	5	8	0,3	4
Net Income	Billion USD	11	15	11	16	13

(*) Other Earnings Assets: Securities, Derivatives, Depository Institutions and other financial instruments.

Source: Author's own creation based on publications of FDIC statistical data.

Table 3 shows that in 2022 the FDIC supervised 579 savings banks with 108,648 employees and total assets and deposits of 1,281 billion US dollars and 1,082 billion US dollars, respectively. Although during the sample period total assets grew by more than 20% (from 1,063 in 2012 to 1,281 in 2022) and total deposits by more than 30% (from 805 in 2012 to 1,082 in 2022), the same was not true of the number of institutions and employees, with a sharp reduction of 432 savings institutions (-42.7%) and 40,270 employees

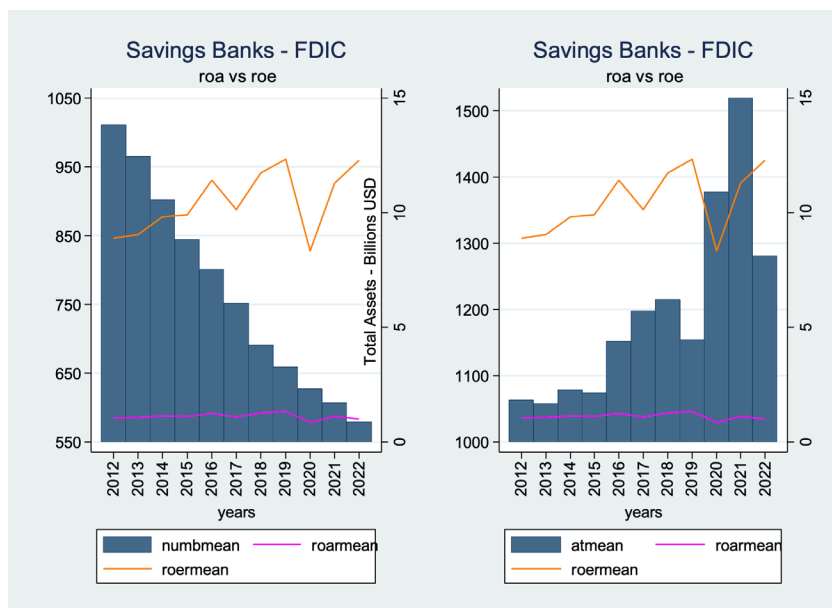
(-27.0%). In turn, the net interest margin rate, which corresponds to the ratio between net interest income and the average balance of total interest-generating assets, has remained stable throughout the analysis period (above 3%), with the exception of the year 2021, when there was a rate of 2.78%, justified by a lower effect of household consumption in the period of the pandemic crisis and greater reinforcement in terms of savings. It should also be noted that there has been a change in the evolution of earning assets, which grew by 23.6% (from 983 in 2012 to 1,215 in 2022). It should be noted that customer loans remain stable in their composition, while there has been a sharp increase in other earning assets such as debt securities and other instruments, which grew from 331 billion US dollars in 2012 to 574 billion US dollars in 2022 (an increase of 73.4%), having reached the highest amount in 2021 of 777 billion US dollars, an amount that for the first time was higher than loans to customers, which amounted to 681 billion US dollars. It can be concluded that, given the change in the type of earning assets, income has remained stable (above 50 billion dollars), although other income (such as commissions and others) has fallen substantially (-52.4%) since 2012 (21 billion dollars) and will only reach 10 billion dollars in 2022. However, despite the fact that income fell slightly in the period under review (in 2012, 54 billion dollars, against 51 billion dollars in 2022), there was a slight improvement in net income (in 2012, 11 billion dollars, against 13 billion dollars in 2022) as a result of tight and strong management in cost containment, namely with a sharp reduction in physical branches and human resources. Lastly, the level of provisioning for credit losses for the year 2021 was significantly reduced (0.3 billion dollars) as 82 financial institutions adopted the new methodologies for accounting for current expected credit losses (CECL), as published in the FDIC's quarterly information report (FDIC, 2022).

3.2. STUDY VARIABLES

The dependent variable of bank profitability is measured in this study by two alternative indicators of bank performance, RoA and RoE, according to the authors' studies (Athanasoglou *et al.*, 2008; Tregenna, 2009; Sanchez *et al.*, 2017; Bikker and Vervliet, 2018 and Veeramoothoo and Hammoudeh, 2022). From the literature reviewed in this paper, it was felt that these are the indicators most commonly adopted by authors who have addressed this issue. They are also indicators widely used by regulators and banks to assess a bank's performance. While return on equity (RoE) measures the relationship between net income and equity, allowing us to assess the performance of the resources placed by investors in the bank, return on assets (RoA) measures the relationship between net income and assets. This ratio assesses the profitability generated by the assets financed by the bank.

The recent evolution of these two indicators in the US banking system, for the savings bank segment supervised by the FDIC, was as follows (see Graph 1).

GRAPH 1 – EVOLUTION OF THE DEPENDENT VARIABLES IN THE US BANKING SYSTEM



Source: Obtained using STATA software.

Over the last 11 years, the North American banking sector in the savings bank segment has shown a trend towards improved bank profitability, both in terms of RoE (more pronounced) and RoA (more stable). However, it can be seen that the number of financial institutions (numbmean) over this period has decreased significantly, as opposed to the volume of assets (atmean) which has increased.

The independent variables used in this study are reflected in the hypotheses previously formulated and are indicators and ratios related to the activity of the banking sector and represent a set of variables that identify five hypotheses to be tested. Thus, the variables included in the model, as well as how they are determined and the source of the data, are as follows (see Table 4).

TABLE 4. VARIABLES INCLUDED IN THE MODEL

Variables	Notation	Form of Determination	Source
Dependent: Return on Assets	RoA	RoA ratio (Return on Assets) = Net Profit / Net Assets	BankFocus
Return on Equity	RoE	RoE ratio (Return on Equity) = Net Profit / Shareholders' Equity	BankFocus

(Continue)

Independent: Default	DEF	Customer Loan and Advances Default Rate = Loan Impairment (year) / Net Loans and Advances to Customers	BankFocus
Liquidity	LIQ	Transformation Ratio = Net Customer Loans / Customer Deposits	BankFocus
Solvency	SOL	Solvency Ratio (in accounting terms) = Equity / Net Assets	BankFocus
Productivity	PRO	Degree of Production of Complementary Activity = Net Commissions / No. of Employees	BankFocus
Moderation: Pandemic Crisis	CRI	Dummy variable (binary) where: 0 - Without Pandemic Crisis (periods from 2012 to 2019 and 2022); 1 - With Pandemic Crisis (2020 and 2021)	Author
Control: Macroeconomic: Inflation	INF	Consumer Price Index (%)	Country Economy
Central Bank Reference Rate	CBR	US Central Bank Interest Rate (%)	Country Economy
Type of Government	TGO	Dummy variable (binary) where: 0 - Democratic Government; 1 - Republican Government	Author
Banks: Dimension	DIM	Logarithm (natural) = of Net Asset Value	BankFocus

Source: Author’s own creation.

3.3. ECONOMETRIC MODEL AND STATISTICAL METHODS

The studies that evaluate the factors that determine the profitability of banking institutions, such as Trujillo-Ponce (2013), Serrano and Pavia (2014), Carvalho and Ribeiro (2016), Bikker and Vervliet (2018), Hamdi and Hakimi (2019), Mota *et al.* (2019), Paroush and Schreiber (2019), Mendoza *et al.* (2020), Otero *et al.* (2021), Veeramoothoo and Hammoudeh (2022) and Wang (2023) basically use linear regression models, which make it possible to describe and assess which independent variables have explanatory power over the dependent variables. Thus, the proposed model, including the control variables for the study of the determinants of profitability and their moderating effects of the pandemic crisis on bank performance can be illustrated in the following Figure 1.

The data in this study includes the descriptive statistics of the study variables, as well as Pearson’s correlation analysis between the variables for the period analyzed between 2012 and 2022 (11 years), as shown in Table 5.

TABLE 5. DESCRIPTIVE STATISTICS AND CORRELATION ANALYSIS

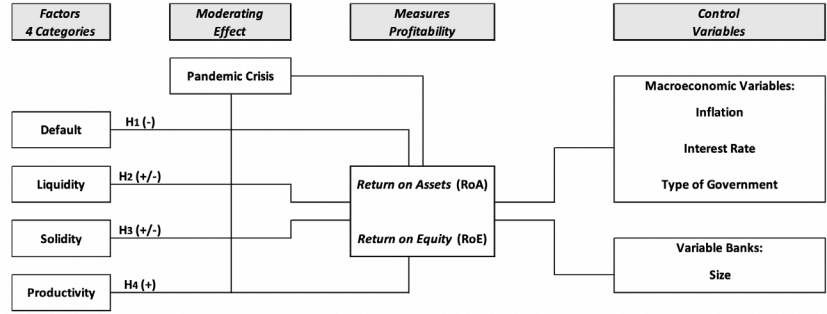
	RoA	RoE	DEF	LIQ	SOL	PRO	INF	CBR	DIM	TGO (a)	CRI (a)
Mean	1.08	9.20	0.19	85.40	12.60	19.35	2.55	0.98	15.37	-	-
S. D.	1.09	6.18	0.49	23.59	9.45	32.13	2.04	1.24	1.18	-	-
Min.	-9.68	-12.41	-1.50	2.52	2.39	-57.68	0.70	0	10.07	-	-
Max.	13.03	45.53	4.67	192.6	96.94	306.23	7.00	4.25	18.60	-	-

(Continue)

No. Obs.	627	627	620	620	627	616	627	627	627	627	627
RoA	1										
RoE	0.73	1									
DEF	-0.03	-0.03	1								
LIQ	0.27	-0.01	-0.05	1							
SOL	0.58	-0.04	-0.05	0.37	1						
PRO	-0.21	-0.10	-0.03	-0.24	-0.17	1					
INF	0.10	0.19	-0.12	-0.13	-0.09	0.12	1				
CBR	0.02	0.15	-0.05	-0.01	-0.09	0.10	0.46	1			
DIM	-0.10	0.01	0.10	0.07	-0.17	0.21	0.23	0.16	1		
TGO	-0.01	-0.03	0.11	0.04	0.02	-0.05	-0.23	0.16	0.10	1	
CRI	0.05	0.03	0.09	-0.12	-0.02	0.01	0.38	-0.37	0.17	0.13	1

(a) Dummy variable.
Source: Author’s own creation.

FIGURE 1 – PROPOSED MODEL



Source: Author’s own creation.

It can be seen that bank profitability, measured by RoA and RoE, for the period under analysis, averaged 1.08% and 9.20%, respectively. On the other hand, the correlation coefficients are generally not significantly high (below or above 75%) to cause concern about multicollinearity problems.

In order to answer the five hypotheses mentioned above, the following four multiple linear regression models were developed, as shown in Table 6.

TABLE 6. LINEAR REGRESSION MODELS

$RoA_{it} = \beta_0 + \beta_1 FAT_{it} + \beta_2 CRI_{it} + \beta_3 VC_{it} + \epsilon_{it}$	Model 1
$RoA_{it} = \beta_0 + \beta_1 FAT_{it} + \beta_2 CRI_{it} + \beta_3 CRI_{it} * INTFAT_{it} + \beta_4 VC_{it} + \epsilon_{it}$	Model 2
$RoE_{it} = \beta_0 + \beta_1 FAT_{it} + \beta_2 CRI_{it} + \beta_3 VC_{it} + \epsilon_{it}$	Model 3
$RoE_{it} = \beta_0 + \beta_1 FAT_{it} + \beta_2 CRI_{it} + \beta_3 CRI_{it} * INTFAT_{it} + \beta_4 VC_{it} + \epsilon_{it}$	Model 4

Where,

(Continue)



RoAit represents the return on assets ratio of institution i at time t;
RoEit represents the return on equity ratio of institution i at time t;
FATit represents the determining factors of institution i at time t; In which there are four determining factors: DEFit represents the default rate on loans to customers of institution i at time t; LIQit represents the ratio of deposits to loans of institution i at time t; SOLit represents the solvency ratio of institution i at time t; PROit represents the production of complementary activity of institution i at time t;
CRIit represents the dummy of pandemic crisis of institution i at time t;
VCit represents the control variables of institution i at time t; They are composed of four control variables: INFit represents the inflation rate for institution i at time t; CBRit represents the central bank reference rate for institution i at time t; TGOit represents the type of government for institution i at time t; DIMit represents the logarithm of the size of net assets institution i at time t;
CRISit * INTFATit represents the moderating effect of the interaction between the crisis and the determining factors of institution i at time t; In which they are constructed by four crossed variables (see Appendix II): DEFit*CRIit represents the interaction between default and the crisis of institution i at time t; LIQit*CRIit represents the interaction between liquidity and the crisis of institution i at time t; SOLit*CRIit represents the interaction between solvency and the crisis of institution i at time t; PROit*CRIit represents the interaction between productivity and crisis of institution i at time t;
β_0 is the constant term;
eit is the statistical error term of institution i at time t.

Source: Author’s own creation.

3.4. RESULTS AND DISCUSSION

The econometric estimation of the model uses the Panel Data technique (Stata - Statistics Data Analysis) which combines cross-section data (banks) and time-series data (years), obtaining a strongly balanced panel.

In order to model the functional relationship between the variables, multiple linear regression models were used, using a panel data model, and the Hausman test was applied in order to assess whether this method best fits the fixed-effects Ordinary Least Square (OLS regression) model or the random-effects Generalized Least Squares (GLS regression) model. The analysis showed that the model with the highest quality is the random effects model. According to Wooldridge (2002), the random effects model is more efficient in large samples because the random effects estimators have smaller standard errors.

3.4.1. ESTIMATION OF THE ECONOMETRIC RESULTS

In order to estimate the model, it is necessary to take into account that the data treatments used in this study are arranged in a longitudinal panel, made up of a set of different entities (N= 57 banks) and over various periods of time (T= 11 years). Therefore, in order to model the functional relationship between the variables, four multivariate linear regression models were adopted, using the generalized least squares random effects model, as shown in Table 7.

TABLE 7. REGRESSION RESULTS

Variable	RoA (Return on Assets)		RoE (Return on Equity)	
	RE (Random Effects)			
	Model 1	Model 2	Model 3	Model 4
DEF	-0.0866*	-0.0128	-0.7276*	-0.3770
LIQ	0.0064***	0.0063***	0.0535***	0.0450***
SOL	0.0620***	0.0590***	-0.4484***	-0.4536***
PRO	-0.0040***	-0.0045***	-0.0321***	-0.0332***
CRI	0.0152	-0.9745***	-0.1735	-9.5107***
INF	0.0616***	0.0434**	0.3775**	0.3000*
CBR	-0.0080	0.0059	0.2116	0.2237
TGO	0.0099	-0.0051	-0.2990	-0.3628
DIM	0.0310	0.0646	0.8993**	1.1974***
DEF * CRI		-0.2357***		-1.2861*
LIQ * CRI		0.0052**		0.0701***
SOL * CRI		0.0569***		0.3558***
PRO * CRI		0.0010		-0.0003
_CONS	-0.7226	-1.1663	-4.0365	-7.6483
No. Observations:	609	609	609	609
No. Banks:	57	57	57	57
R-sq:				
Within	0.1635	0.2241	0.1837	0.2393
Between	0.3937	0.3696	0.0087	0.0140
Overall	0.3338	0.3435	0.0166	0.0253
Rho	0.5824	0.5896	0.5731	0.5776
Hausman:				
chi²	1.55	13.70	29.17	39.41
Prob > chi²	0.9968	0.3954	0.0600	0.0520

(*) (**) (***) Statistically significant results for a significance level of 0.10, 0.05 and 0.01 respectively.
Source: Author's own creation.

Table 7 shows the results obtained when estimating the regression model, which was run four times, based on the profitability of US banks specializing in the savings segment, measured by the RoA (models 1 and 2) and RoE (models 3 and 4). While models 1 and 3 allow us to assess the relationship between bank profitability and the explanatory factors, models 2 and 4 allow us to assess the moderating effects of the pandemic crisis on the influence of the relationship between the factors and bank profitability. Thus, the results indicate that there is an acceptable level of explanation of the determining factors for the RoA indicators with an adjusted R^2 of 33.38% and 34.35%. Regarding the RoE indicator, there is a low adjusted R^2 of 1.66% and 2.53%. As far as the explanatory variables are concerned, the results obtained show statistical significance in explaining bank profitability as measured by RoA and RoE for the four determining factors under study, i.e. the variables of default (DEF), liquidity (LIQ), solvency (SOL) and productivity (PRO). With regard to the control variables, inflation (INF) and bank size (DIM) also show statistical significance.

Finally, it can be seen that the moderating effect of the pandemic crisis, the variables of default (DEF), liquidity (LIQ) and solvency (SOL) were the variables that had an influence on both bank profitability indicators (RoA and RoE). It should also be noted that a complementary analysis to this study was carried out to highlight the sensitivity of the linear regression estimates (see Appendix III). The data was removed for the periods considered during the pandemic crisis (2020 and 2021) and the results show that the default (DEF) variable was not statistically significant. We then analyzed the moderating effect of the interaction between the pandemic crisis and default on bank profitability and found that when the years of the pandemic crisis were included in models 1 and 3, it showed a negative sign and became statistically significant for both indicators (RoA and RoE) at a 10% significance level. Thus, the results show how the crisis negatively moderated the effect of default on the profitability of US banks.

3.4.2. DISCUSSION OF RESULTS

This section first presents the results of the main effects of the dependent variables testing hypotheses 1, 2, 3 and 4. Next, the moderating effects related to hypothesis 5 are presented. Thus, the results of the hypotheses to be tested are as follows:

H1: The sluggishness of banks, as measured by the default rate on the loan portfolio, negatively affects banks' profitability.

The results show that the explanatory variable in the model relating to the default rate (DEF) contributes to the decrease in profitability of savings banks in the USA. The regression coefficients for the RoA and RoE variables in the four models show a negative sign, as expected, and are statistically significant for models 1 and 3. In this case, they show a statistical significance level of 10% for the RoA and RoE indicator. It can therefore be said that when banks' customer defaults increase, their profitability decreases. These results are in line with the empirical evidence of Demirguç-Kunt and Huizinga (1999), Athanasoglou *et al.* (2008), Bikker and Vervliet (2018), Paroush and Schreiber (2019) and Wang (2023). In this way, hypothesis 1 can be validated.

H2: Bank liquidity has a positive (negative) effect on banks' profitability.

Bank profitability varies with bank liquidity, and the results show that the independent variable of liquidity (LIQ) has a positive relationship with the profitability of US savings banks. For the four models tested, there is a statistical significance level of 1% for both profitability indicators (RoA and RoE). Although a mixed association between the variables was expected, it is nevertheless possible to validate hypothesis 2, since it is possible to state that banking institutions can obtain greater bank profitability by increasing their liquidity indicators. These results are in line with studies by Molyneux and Thornton (1992), Barth *et al.* (2013) and Trujillo-Ponce (2013).

H3: Bank solvency has a positive (negative) effect on bank profitability.

In the case of profitability measured by RoA, the sign of the regression coefficient of the two models is positive and statistically significant, with a

statistical significance level of 1%, so an increase in the solvency indicator (SOL) contributes to an increase in bank profitability. In contrast, profitability as measured by RoE shows a negative and statistically significant relationship for both models at a 1% significance level. The results show a positive relationship for the RoA variable and a negative relationship for the RoE variable, as expected. Hypothesis 3 can therefore be validated, since a mixed relationship was predicted between the variables under study. This result is in line with the studies by Bourke (1989) Hoffmann (2011) and Carvalho and Ribeiro (2016), who concluded a negative relationship, and with the studies by Demirguc-Kunt and Huizinga (1999), Athanasoglou *et al.* (2008), Kosmidou (2008), Trujillo-Ponce (2013), Bikker and Vervliet, (2018) and Paroush and Schreiber (2019), who concluded a positive relationship.

H4: Bank productivity has a positive effect on bank profitability.

The estimated results show that the productivity (PRO) of US savings banks in terms of the ratio of complementary activity output, measured by the ratio of commission generated by each employee, has a significant influence on bank profitability. The results obtained for the four estimated models show a statistically significant coefficient of 1%, which validates hypothesis 4. However, the coefficients obtained for this indicator were negative, contrary to the expected sign, which allows us to infer that the profitability of RoA and RoE decreased. This result disagrees with the empirical evidence of Gambacorta and Ibanez (2011) and Trenca *et al.* (2015), who concluded that there is a positive association between productivity and bank profitability. Therefore, this could be a field for further study of the results obtained and a considerable expansion of research on this subject.

H5: The moderating effect of the pandemic crisis has a significant influence on the relationship between the four factors and bank profitability.

The moderating effect of the pandemic crisis has a statistically significant influence on the relationship between three of the four determining factors and on the RoA and RoE profitability measures (Models 2 and 4). According to Hayes (2013), an interaction is the product of the relationship between each of the determining factors and the moderating effect. Thus, by analyzing the interaction of the product of each of the variables under study (DEF*RIS; LIQ*RIS; SOL*CRI; PRO*CRI) with the moderating effect of the pandemic crisis, it can be concluded that the pandemic crisis has a moderating effect on the relationship between the determining factors and profitability. In turn, this effect mainly influences the variables of default (DEF*CRI), liquidity (LIQ*CRI) and solvency (SOL*CRI), with a greater magnitude in default (DEF*CRI), since it flows negatively and has an impact on the profitability indicator measured by RoA (*Coef* = -0.2357) and the profitability indicator measured by RoE (*Coef* = -1.2861). Thus, through the moderating effect, we can see how much the effect of the default variable (DEF*CRI) on the profitability variables (RoA and RoE) varies when we are in a period of crisis. As the default variable (DEF*CRI) shows a level of statistical significance of 1% and 10% for RoA and RoE, respectively, it can be concluded that the crisis negatively moderated the effect of default

(DEF*CRI) on profitability as measured by both RoA and RoE, i.e. banks with higher default rates during the pandemic crisis had greater difficulties in their profitability. On the other hand, the results show that the crisis positively moderated the effect of solvency (SOL*CRI) and liquidity (LIQ*CRI) on profitability. This evidence suggests that US savings banks with better solvency and liquidity had fewer difficulties during the pandemic crisis. In turn, the effect of the crisis is null for the productivity variable (PRO*CRI) as it does not have a significant influence. These results are in line with the studies by Wu and Shen (2013) and Sanchez *et al.* (2017), who found mixed effects (positive and negative) between the explanatory variables and bank profitability.

4. CONCLUSION AND LIMITATIONS OF THE STUDY

Although there has been a sharp decline in the number of savings institutions in the United States in recent years, there continues to be an upward trend in bank profitability.

This paper aims to analyze the impact of some factors specific to the banking sector on the financial profitability of US savings banks for the period from 2012 to 2022 and to assess the moderating effect that the pandemic crisis has had on this sector. To this end, four econometric models were built, which explain and can be used to predict the determinants of bank profitability and the moderating role of the pandemic in these effects.

Thus, several conclusions emerge from this study. Thus, for a total of 609 observations corresponding to 57 savings banks, it can be seen that the banks in the sample did not obtain economic benefits in their financial performance in the four explanatory factors. The liquidity factor (LIQ) and the solvency factor (SOL) have a clear positive effect on bank profitability, with a statistical significance level of 1%. These results mean that a higher degree of leverage, through the transformation of customer deposits into loans and advances to customers (LIQ), together with robust equity capital (SOL), can translate into higher profitability for banks. On the other hand, the default factor (DEF) shows a negative relationship at a significance level of 10% for RoA and RoE, and it can be inferred that poorer credit portfolio quality negatively influences bank profitability. Finally, the results also emphasize the productivity factor (PRO), showing, contrary to the expected sign, a negative association with bank profitability at a statistical significance level of 1%. This unexpected result in terms of revenue generation per employee could be directly related to the sharp loss of commission income by North American banks in the period under analysis, which, together with the sharp reduction in the number of employees, as shown in Table 3, could translate into lower bank profitability. Therefore, this could be a field for further research into, for example, different business models that could lead to a generation of revenue per employee in future research.

Regarding the moderating effect of the pandemic crisis, the results show that the crisis positively moderated the effect of solvency (SOL * CRI) and liquidity (LIQ * CRI) on bank profitability. Thus, banks with better solvency and liquidity

had fewer difficulties during the pandemic period. In contrast, banks with high default rates during the crisis had greater difficulties in their profitability, i.e. the crisis strongly negatively moderated the effect of default ($DEF * CRI$), which was the variable with the greatest magnitude on bank profitability in the USA. Finally, the interaction effect of the pandemic crisis on the relationship between productivity ($PRO * CRI$) and profitability is insignificant.

It is therefore felt that banks should have a contingency plan for the occurrence of similar situations, namely a “buffer” of contingent capital to temporarily strengthen the robustness of banks and that the role of banking regulators and supervisors could also be more proactive in implementing medium and long-term financial instruments to restore profitability.

According to the individual analysis of the $p > |z|$ test, the control variables of the central bank reference rate (CBR) and the type of government in the US (TGO) do not have an impact on bank profitability. However, the bank size variable (DIM) has a positive effect on bank profitability as measured by the RoE indicator at a statistical significance level of 1% and 5%, i.e. an increase in RoE implies an increase in profitability. In turn, the inflation (INF) variable positively influences bank profitability for the four models tested, i.e. when the inflation rate increases, bank profitability also increases.

The results of this study can be useful for bank decision-makers, as well as supervisors and regulators in the banking sector, as they identify valuable guidance on the effect of key financial variables on a bank's profitability. It could also be used to develop a framework for policies and regulations that affect bank profitability.

However, the study has some limitations, since the sample used is small, limited to fifty-seven banks in the North American banking system for the savings segment. In addition, the period of analysis is medium-term (11 years) and some financial indicators, due to the lack of financial data, require regulatory support, so the results obtained should be analyzed taking this limitation into account.

Finally, it is suggested that future research should extend the sample and the period of analysis and consider other indicators, whether of a financial nature (tier 1 solvency ratio, liquidity coverage ratio - LCR, net stable funding ratio - NSFR, technology systems, digital transition, environment, corporate governance or business models) or of a non-financial nature (GDP, active and passive market interest rates or the unemployment rate), which could potentially explain bank profitability.

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APPENDIX I | COMPLETE LIST OF US SAVINGS BANKS CONSIDERED IN THE SAMPLE AND NET ASSET VALUE FOR THE YEAR 2022 IN BILLIONS OF USD

Nº	Sample Savings Banks	Assets	%
1	AMERICAN SAVINGS BANK, FSB	9,5	0.7
2	AMERIPRISE BANK, FSB	19,0	1.5
3	ATLANTIC UNION BANK	20,3	1.6
4	AXOS BANK	17,9	1.4
5	BANGOR SAVINGS BANK	7,4	0.6
6	BEAL BANK	6,7	0.5
7	BROOKELINE BANK	6,1	0.5
8	CAMBRIDGE SAVINGS BANK (MHC)	6,5	0.5
9	CAPITOL FEDERAL SAVINGS BANK (MHC)	10,0	0.8
10	COLUMBIA BANK	10,1	0.8
11	DOLLAR BANK, FSB	11,4	0.9
12	EL DORADO SAVINGS BANK, FSB	2,7	0.2
13	FIDELITY BANK, NATIONAL ASSOCIATION	3,1	0.2
14	FIRST FEDERAL BANK	3,8	0.3
15	FIRST FEDERAL SAVINGS & LOAN ASSOCIATION OF LAKEWOOD	2,5	0.2
16	FIRST FOUNDATION BANK	13,0	1.0
17	FIRSTTRUST SAVINGS BANK	5,2	0.4
18	FLAGSTAR BANK, NATIONAL ASSOCIATION	90,0	7.0
19	GATE CITY BANK	3,4	0.3
20	HOME BANK, NATIONAL ASSOCIATION	3,2	0.3
21	HOME FEDERAL BANK OF TENNESSEE	2,8	0.2
22	HOMETRUST BANK	3,6	0.3
23	JOHN DEERE FINANCIAL, FSB	3,1	0.2
24	LENDINGCLUB BANK, NATIONAL ASSOCIATION	7,6	0.6
25	LIBERTY BANK	6,9	0.5
26	LUTHER BURBANK SAVINGS	8,0	0.6
27	MASCOMA BANK	2,7	0.2
28	MIDDLESEX SAVINGS BANK	6,2	0.5
29	MIDFIRST BANK	34,7	2.7
30	MORGAN STANLEY PRIVATE BANK NATIONAL ASSOCIATION	119,9	9.4
31	NORTH AMERICAN SAVINGS BANK, FSB	2,5	0.2
32	NORTH SHORE BANK	2,6	0.2
33	NORTHEAST BANK	2,8	0.2
34	NORTHWEST BANK	14,2	1.1
35	NORTHWEST BANK SUBSIDIARIES	2,5	0.2
36	OCEANFIRST BANK, NATIONAL ASSOCIATION	13,0	1.0
37	PACIFIC PREMIER BANK	21,7	1.7
38	PATHWARD, NATIONAL ASSOCIATION	6,7	0.5
39	PREMIER BANK	8,4	0.7
40	PRINCIPAL BANK	8,4	0.7
41	PROVIDENT BANK	13,8	1.1
42	RAYMOND JAMES BANK	42,1	3.3
43	RIDGEWOOD SAVINGS BANK	6,8	0.5
44	S & T BANK	9,1	0.7

(Continue)

45	SPENCER SAVINGS BANK, SLA	3,8	0.3
46	STERLING BANK & TRUST, FSB	2,4	0.2
47	TFS FINANCIAL CORP	15,8	1.2
48	THIRD FEDERAL SAVINGS & LOAN ASSOCIATION OF CLEVELAND	16,1	1.3
49	TIAA, FSB	39,4	3.1
50	TRUSTCO BANK	6,0	0.5
51	UNION SAVINGS BANKS	3,3	0.3
52	UNION SAVINGS BANKS SUBSIDIARES	3,0	0.2
53	UNITED FIDELITY BANK, FSB	5,7	0.4
54	USAA FEDERAL SAVINGS BANK	110,9	8.7
55	WASHINGTON FEDERAL BANK	21,6	1.7
56	WEBSTER BANK NA	71,2	5.6
57	WILMINGTON SAVINGS FUND SOCIETY, FSB	19,8	1.5
	TOTAL ASSETS YEAR 2022 - SAMPLE CONSIDERED	920.8	71.9
	SAVINGS BANKS NOT CONSIDERED (522)	360.7	28.1
	TOTAL BANKING SYSTEM IN THE U.S.A. - SAVINGS BANKS	1.281.5	100.0

APPENDIX II | COMPOSITION OF THE FOUR LINEAR REGRESSION MODELS ESTIMATED

Model 1
$RoAit = \beta_0 + \beta_1DEFit + \beta_2LIQit + \beta_3SOLit + \beta_4PROit + DUMMY\beta_5CRIit + \beta_6INFit + \beta_7CBRit + \beta_8TGOit + \beta_9DIMit + \epsilon it$
Model 2
$RoAit = \beta_0 + \beta_1DEFit + \beta_2LIQit + \beta_3SOLit + \beta_4PROit + DUMMY\beta_5CRIit + \beta_6INFit + \beta_7CBRit + \beta_8TGOit + \beta_9DIMit + \beta_{10}DEFit * CRIit + \beta_{11}LIQit * CRIit + \beta_{12}SOLit * CRIit + \beta_{13}PROit * CRIit + \epsilon it$
Model 3
$RoEit = \beta_0 + \beta_1DEFit + \beta_2LIQit + \beta_3SOLit + \beta_4PROit + DUMMY\beta_5CRIit + \beta_6INFit + \beta_7CBRit + \beta_8TGOit + \beta_9DIMit + \epsilon it$
Model 4
$RoEit = \beta_0 + \beta_1DEFit + \beta_2LIQit + \beta_3SOLit + \beta_4PROit + DUMMY\beta_5CRIit + \beta_6INFit + \beta_7CBRit + \beta_8TGOit + \beta_9DIMit + \beta_{10}DEFit * CRIit + \beta_{11}LIQit * CRIit + \beta_{12}SOLit * CRIit + \beta_{13}PROit * CRIit + \epsilon it$
Where,
RoAit represents the return on assets ratio of institution i at time t;
RoEit represents the return on equity ratio of institution i at time t;
DEFit represents the default rate on loans to customers of institution i at time t;
LIQit represents the ratio of deposits to loans of institution i at time t;
SOLit represents the solvency ratio of institution i at time t;
PROit represents the production of complementary activity of institution i at time t;
CRIit represents dummy of the pandemic crisis of institution i at time t;
INFit represents the inflation rate for institution i at time t;
CBRit represents the central bank reference rate for institution i at time t;
TGOit represents the type of government for institution i at time t;
DIMit represents the logarithm of the size of net assets institution i at time t;
DEFit*CRIit represents the interaction between default and the crisis of institution i at time t;
LIQit*CRIit represents the interaction between liquidity and the crisis of institution i at time t;
SOLit*CRIit represents the interaction between solvency and the crisis of institution i at time t;
PROit*CRIit represents the interaction between productivity and crisis of institution i at time t;
β_0 is the constant term;
ϵit is the statistical error term of institution i at time t.

APPENDIX III | SENSITIVITY OF LINEAR REGRESSION ESTIMATIONS CONSIDERING OR NOT THE PERIOD OF THE PANDEMIC CRISIS

Variable	RoA (Return on Assets)		EA (random effects)		RoE (Return on Equity)	
	No Pandemic Crisis (a)	With Pande- mic Crisis (b) (Model 1)	Crisis Effect (c) (Model 2)	No Pandemic Crisis (a)	With Pande- mic Crisis (b) (Model 3)	Crisis Effect (c) (Model 4)
DEF	-0.0155	-0.0866*	-0.0128	-0.6713	-0.7276*	-0.3770
LIQ	0.0048**	0.0064***	0.0063***	0.0296*	0.0535***	0.0450***
SOL	0.0512***	0.0620***	0.0590***	-0.4991***	-0.4484***	-0.4536***
PRO	-0.0055***	-0.0040***	-0.0045***	-0.0457***	-0.0321***	-0.0332***
CRI		0.0152	-0.9745***		-0.1735	-9.5107***
INF	-0.0033	0.0616***	0.0434**	-0.1747	0.3775**	0.3000*
CBR	0.0558	-0.0080	0.0059	0.7200*	0.2116	0.2237
TGO	-0.0352	0.0099	-0.0051	-0.7081	-0.2990	-0.3628
DIM	0.0847*	0.0310	0.0646	1.4638***	0.8993**	1.1974***
DEF * CRI			-0.2357***			-1.2861*
LIQ * CRI			0.0052**			0.0701***
SOL * CRI			0.0569***			0.3558***
PRO * CRI			0.0010			-0.0003
_CONS	-1.1859*	-0.7226	-1.1663	-9.0192	-4.0365	-7.6483
No. Observations:	497	609	609	497	609	609
No. Banks:	57	57	57	57	57	57
R-sq.						
Within	0.1547	0.1635	0.2241	0.2529	0.1837	0.2393
Between	0.3408	0.3937	0.3696	0.0025	0.0087	0.0140
Overall	0.3160	0.3338	0.3435	0.0204	0.0166	0.0253
Rho	0.6526	0.5824	0.5896	0.6332	0.5731	0.5776

(a) Not considering the financial data of the savings bank sample for the pandemic crisis periods (2020 and 2021).

(b) Considering the financial data of the savings bank sample for the pandemic crisis periods (2020 and 2021).

(c) Considering the moderating effect of the pandemic crisis on the explanatory factors of the Default (DEF), Liquidity (LIQ), Solvency (SOL) and Productivity (PRO).

(*) (**) (***) Statistically significant results for a significance level of 0.10, 0.05 and 0.01 respectively.