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A global analysis of bank profitability factors

Prosper Lamothe[1], Enrique Delgado[1], Miguel A. Solano[2] & Sergio M. Fernández[3]✉

We analyze the factors that explain banks' profitability globally and by region. With increasing globalization, knowing the different aspects of bank profitability is essential for countries' financial stability and economic growth. This study used a sample of 2,091 commercial banks operating in 110 countries grouped into major world regions. With random effect regression models, the global results show that the internal factors that explain the bank´s profitability are listed entities, impaired loans, efficiency, gross interest margin, and capitalization. For its part, the most significant external factors are related to the position of the countries in the ranking by assets, inflation, unemployment, interest rates, and economic growth. From a regional perspective, the results allow us to deduce with high robustness the existence of variable sets that determine bank profitability in each region and that regional models outperform global models in most cases.

[1] Universidad Autónoma de Madrid, Madrid, Spain. [2] Universidad de Granada, Granada, Spain. [3] Universidad de Málaga, Málaga, Spain.
✉email: sergiofernandezmiguelez@uma.es

Introduction

The financial system is essential in channeling funds to investments efficiently, supporting economic growth in developed and developing countries (Al-Harbi 2019; Luo, Tanna and De Vita 2016). One key element of a financial system is the banks, which perform the intermediation function between suppliers and applicants of funds and collaborate in the implementation of the monetary policy of a country. Therefore, banks can contribute to ensuring the continuity of economic growth and financial system stability (Ofori-Sasu et al. 2022; Feng and Wang 2018). Likewise, with deregulations, technological advances, and global economic integration, the banking sector is more globalized, and understanding the different aspects of banking globalization is essential for the financial stability of countries (Yin 2019). In this context, bank profitability has been the object of study by bank researchers, managers, and supervisors with a high interest in knowing the impact of this process. However, most studies investigating the determinants of bank profitability did not include all regions or did not make a global comparison between a large number of countries (Le and Ngo 2020; Le et al. 2022; Yuan et al. 2022; Sun, Mohamad and Ariff 2017; Rekik and Kalai 2018; Yanikkaya et al. 2018). Therefore, a study across countries and regions at the global level allows us to incorporate more information to form a complete bank data set. Only the study by Ho et al. (2023) has covered many countries (90 countries) from all regions of the world. Thus, previous literature calls for new studies that collect more financial and economic data and include global samples of countries and regions, which would provide more precise research by harmonizing the problem of banks' profit-making (Yuan et al. (2022); Ercegovac et al. 2020).

To cover this gap in research, the present study analyzes the factors that explain banking profitability using a sample of 2,091 conventional commercial banks operating in 110 countries, grouped into the eight central regions of the world. This paper contributes to the field of bank profitability in several significant ways. First, it contributes to the growth of profitability factors analysis by introducing new global and regional models that improve the understanding of the bank profitability´ formation process. As the bank industry embraces global economic integration, providing international empirical evidence from a broad database on the factors that drive bank profitability is essential. This document provides an analysis from 2018 to 2021, covering 110 countries in major regions of the world (Africa, Eastern Europe, Far East and Central Asia, Middle East, North America, Oceania, South and Central America, and Western Europe). Second, this research explains how the current globalization process extends from the internal characteristics of the entities to the external factors of the regions´ macroeconomic environment. It can also be a starting point for future research in this field. Third, this document offers unique sets of variables for global analysis and each of the world´s main regions, allowing you to minimize the cost of building simulation models to improve bank profitability.

The rest of the paper is organized as follows. Section 2 presents a review of the literature. Section 3 describes the data, variables, and methods used. Section 4 presents the results and a discussion of them. Finally, the main conclusions, implications, and suggestions for future research are presented.

Literature review

In recent years, the study of bank profitability has increased due to globalization, the impact of COVID-19, and negative interest rates (Ercegovac et al. 2020; Korytowski 2018; López-Penabad et al. 2022; Yin 2019; Yüksel et al. 2018). Previous studies on banking profitability have focused on a single country or region, with few addressing this problem from a global perspective (Al-Harbi 2019; Ercegovac et al. 2020). Besides, existing studies have generally been conducted only on banks in developing countries, the United States of America, and Europe (Abreu and Mendes 2001; Athanasoglou et al. 2006; Chiorazzo and Milani 2011; Growe et al. 2014; Petria et al. 2015; Menicucci and Paolucci 2016; Korytowski 2018; Yao et al. 2018; Yüksel et al. 2018).

Le and Ngo (2020) investigated the determinants of bank profitability in 23 countries from 2002–2016. Their results confirm a positive relationship between capital market development and bank profitability. Menicucci and Paolucci (2016) analyzed Europe and Hoffmann (2011) for the United States of America. Feng and Wang (2018) studied why European banking is less profitable than American banking. They concluded that European banking has higher financing costs, which implies lower efficiency and, consequently, lower rates of return on assets. For their part, Caterini et al. (2021) and Ercegovac et al. (2020) investigated the relationship between the different models of each banking system in Europe and each country's risk and return profile. They concluded that European banks with the best risk profile and efficiency are also the most profitable. Recently, Kozak (2021) reminded us that, for Central, Eastern, and South European countries, overcoming COVID-19 does not mean that the risk of banks incurring provisions for credit deterioration disappears and that this negatively affects profitability. Çolak and Öztekin (2021) have also analyzed the impact of COVID-19 on the ability of banks in 125 countries to continue generating credit investment. Their results indicate that the countries with the most developed and robust financial systems are the ones that have shown the best resilience despite the crisis in terms of loan growth. Likewise, Le et al. (2022) have investigated the relationship between diversification and profitability in Islamic banking systems under the impact of COVID-19. Using a sample of 24 countries for the period 2013–2020, their results indicate that the performance of Islamic banking systems is positively associated with sectoral diversification of Shari'ah-compliant financing. Furthermore, this diversification has mitigated the adverse effect of the health crisis derived from COVID-19 on the performance of Islamic banking systems. Ho et al. (2023) also confirmed that bank income diversification reduces the adverse effects of COVID-19 using data from 1231 banks in 90 countries. Gazi et al. (2022a) investigated the impact of COVID-19 on the financial performance and profitability of listed private commercial banks in Bangladesh. They found that during the pandemic period, high rates of non-performing loans, holding more liquid assets, large amounts of cover capital, and inadequate size reduced banks' profitability. Gazi et al. (2022b) also found that the financial performance of Islamic banks is superior to that of traditional banks. For its part, Almaqtari et al. (2019) analyzed the factors determining commercial banks´ profitability in India and Pakistan. Their results determined that bank size, operating efficiency, leverage ratio, and inflation rate are the most critical determinants affecting bank profitability. And, Yuan et al. (2022) investigated the impact of profitability determinants on commercial banks of Bangladesh and India in the period 2010–2021. They find that bank size and debt-to-asset ratio are positive and significant.

Previous literature divides the factors affecting bank profitability into internal and external categories. Numerous explanatory variables have been proposed for both classes, depending on the type and objective of each study. The internal factors of profitability can be classified into financial statement variables and non-financial statement variables, both under the control of bank management (Haron 2004). Those that refer to capital adequacy, volumes of deposits and credits, and liquidity stand out

among them. External factors are outside bank management´s control but impact its economic and financial structure. According to Haron (2004), competition, concentration, market share, capitalization, inflation, and the size of banks are the most discussed external variables.

Among the internal factors, several previous studies indicate that banks with a high capital ratio are more flexible in conducting business and taking advantage of new opportunities, so it can be expected that more capitalized banks will achieve higher profitability (Al-Harbi 2019). However, some studies have confirmed a negative relationship between profitability and a high capital index due to the assumption of lower risks, which produces lower returns (Saona 2016). Therefore, although the empirical evidence on the relationship between the capital ratio and profitability is inconclusive, the effect of bank capitalization could be a significant factor in explaining profitability. For their part, deposits represent one of the primary sources of financing for banks, and due to their low cost, they can also positively affect profitability (Chirwa 2003; Saona 2016; Menicucci and Paolucci 2016). However, some studies show evidence of an adverse effect of deposits on profitability in the face of a lack of loan demand or poor liquidity management (Akbas 2012; Tariq et al. 2014), or even an insignificant relationship (Demirgüc-Kunt and Huizinga, 1999; Soyemi et al. 2013). Likewise, a positive effect of the loans granted to clients on bank profitability has been detected since more loans imply new income for the entities (Heffernan and Fu 2008; Sufian 2012; Menicucci and Paolucci 2016). However, other factors can cause an increase in loans to impact profitability negatively. For example, banks are sensitive to macroeconomic conditions, and during periods of crisis, many loans may become uncollectible (Heffernan and Fu 2008). Therefore, there is evidence to expect a significant effect of the loan volume on profitability; consequently, some studies consider impaired loan percentage as another internal factor of bank profitability (Kosmidou et al. 2005).

On the other hand, cost management efficiency has also been highlighted in previous literature as an internal profitability factor. A positive relationship between efficiency and profitability indicates that efficient banks operate at lower costs or that they manage to transfer part of their costs to customers (Al-Harbi 2019; Pasiouras et al. 2009). Yuen et al. (2022) studied the global banking sector. They found that adopting standards of the environment, social, and governance (ESG) activities could increase banking costs and reduce bank profitability. Similarly, entity size has also been related to scale economies. Previous studies have generally found a positive relationship between size and profitability (Yuan et al. 2022; Saona 2016; Athanasoglou et al. 2006; Demirgüc-Kunt and Huizinga, 1999). Finally, another internal factor is liquidity since liquid assets, considered unprofitable investments, have been associated with lower rates of return (Gemar et al. 2019).

Concerning the external factors of bank profitability, firstly, the economic development measured by the Gross Domestic Product (GDP) per capita stands out (Saona 2016). Some studies reported a negative correlation between profitability and GDP growth due to the high competition in periods of economic expansion (Ben Ameur and Mhiri 2013; Ben Naceur and Omran 2011; Yanikkaya et al. 2018). So, the economic cycle fluctuations, measured by the inflation and unemployment rates, have also been considered external indicators with a significant impact on the bank's profitability. During recessions, loan quality deteriorates, leading to lower profitability (Demirgüc-Kunt and Huizinga, 1999; Ben Naceur and Omran 2011). Likewise, economic growth can cause an increase in the demand for loans, causing bank profitability to improve (Bogdan and Roman 2015).

Previous literature also points to interest rates significantly impacting bank profitability. The increase in the interest rate discourages people and companies from taking out new loans, causing a decrease in bank profits in the long term (Staikouras and Wood 2003; Noman et al. 2015; Islam and Nishiyama 2016). However, this effect can be positive in developing countries (Al-Harbi 2019; Feng and Wang 2018). In some studies, the country's stock market has been related to bank profitability (Borroni et al. 2016). A positive effect is expected for this variable because developed stock markets increase the information available to banks, allowing them to assess risks better. Likewise, banks benefit from the commissions from managing their client's portfolios. However, a prominent securities market could negatively affect the banks' profitability since this market can substitute them as a source of financing. It has also been found that the larger a country´s banking sector, the more competition exists between its entities, which leads to lower profitability (Demirgüc-Kunt and Huizinga, 1999). But, a large banking sector can also provide more business and cost reduction opportunities, increasing profitability and margins (Ghosh 2016). Similarly, market concentration can affect returns. In this sense, some studies detect a positive relationship (Demirgüç-Kunt and Huizinga 2000), while others indicate that more concentration does not necessarily imply greater profitability (Ben Ameur and Mhiri 2013).

Table 1 Sample composition (%).

World Region		Year	
Africa (A)	1.00	2018	24.68
Eastern Europe (E)	4.36	2019	26.50
Far East and Central Asia (F)	38.38	2020	27.45
Middle East (M)	1.04	2021	21.37
North America (N)	19.38	Listed in the stock exchange (LIS)	
Oceania (O)	2.03	Yes	29.17
South and Central America (S)	4.89	No	70.83
Western Europe (W)	28.91		
Total Worldwide (WW) $N = 4721$	100.00		

Data, methods, and variables

This study uses data from a sample of 2091 banks from 110 countries. These data are mainly individual financial indicators for each bank and come from the Orbis Bank Focus by Moody´s database. This database covers almost 40,000 institutions across the globe and supplies specific information on Banks, including financials, corporate structure, and rating reports. In addition, macroeconomic data are used, which have been extracted from the World Development Indicators of the World Bank and the Bank of International Settlements.

To achieve the goal of conducting a broad-based international study, we attempted to collect as much data as possible from the banks listed in the cited Orbis Bank Focus database. However, after comparing, cleaning the data, and selecting banks with more than 5000 million euros total assets, we ended up with a sample that includes 2091 banks (equivalent to approximately 8366 observations). Still, the sampling error was less than 1%. Fig. 1 illustrates the allocation of nations to each of the regions considered, and Table 1 reports the bank´s distribution in the sample among the areas of the world. The Far East and Central Asia, North America, and Western Europe are the regions with the most weight within the sample.

Regarding the methodology, this study follows the banking profitability model proposed by Demirgüc-Kunt and Huizinga (1999), which uses Eq. (1) for the regression analysis, where P_{ijt} is the profitability of bank i in country j at time t, B_{ijt} represents the

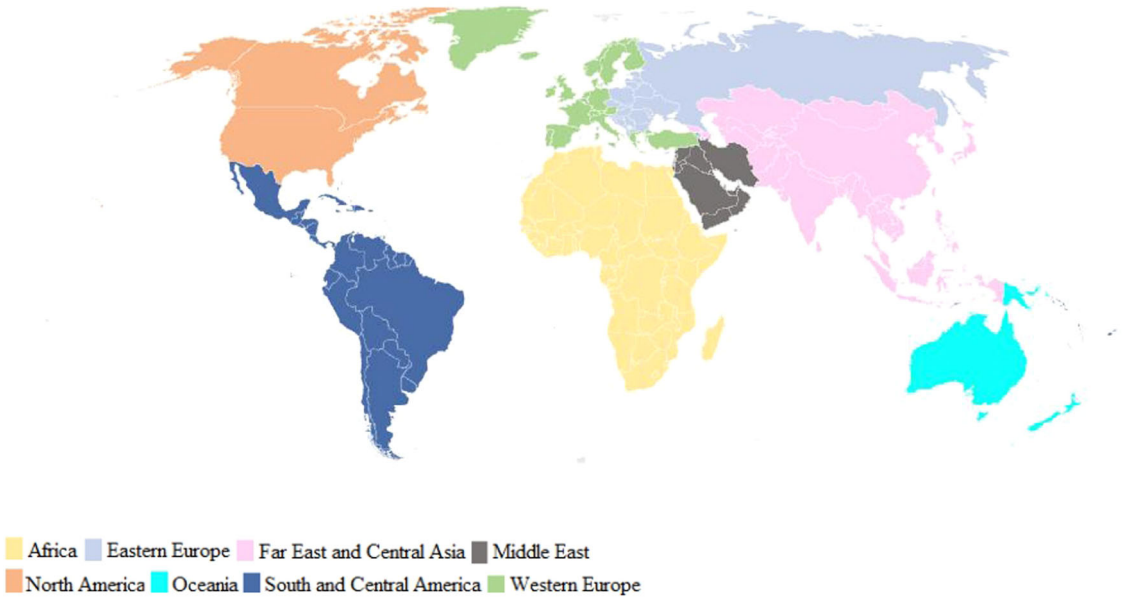

Fig. 1 Sample countries' regional distribution.

Table 2 Econometric variables.

Code	Name	Definition
Dependent variables		
ROAE	Return on Average Equity	Net Income/Average Shareholders' Equity (%)
ROAA	Return on Average Assets	Net Income/Average Total Assets (%)
Independent variables		
a) Internal factors		
LIS	Listed in the stock exchange	1 if the bank is quoted, and 0 otherwise
TALN	Total Assets	Ln of Total Assets
NPL	Non-performing loans	Impaired loans/Gross loans & advances to customers (%)
RSKC	Cost of risk	Net impairment charges on loans & advances/Gross loans & advances to customers (%)
EFR	Efficiency ratio	Total operating expenses/Operating revenues (%)
NIM	Net interest margin	Net interest margin/Gross loans & advances to customers (%)
GRM	Gross margin	Operating revenues/Gross loans & advances to customers (%)
ETAR	Equity to asset ratio	Total Equity/Total Assets (%)
CLR	Cash liabilities ratio	Cash & balances with central banks /Total Liabilities (%)
CDP	Customers' deposits[a]	Total customer Deposits (€)
CLO	Customers' loans[a]	Total customer Loans (€)
CLOC	Customers' loans three largest banks[a]	Total aggregated Loans of the three largest banks (€)
BCR	Bank ranking	Bank country rank by assets
b) External factors		
INF	Inflation	The annual rate of consumer prices increase in a country (%)
UNEM	Unemployment	The labor force without a job in a country (% of the total labor force)
GPC	GDP per capita[a]	Per capita gross domestic product in a country (€)
GDPG	GDP growth	Annual growth of the gross domestic product in a country (%)
CBIR	Central Bank policy rate	Annual policy rate of the Central Bank in a country (%)
DCPS	Domestic credit to the private sector	Domestic credit to the private sector in a country (% of GDP)

[a]Deflated according to the annual price index of each country.

internal variables of bank i in country j at time t, X_{jt} are the external variables corresponding to country j at time t, and $\mathfrak{E}_{ijt}$ is the error term.

$$P_{ijt} = \alpha_0 + \alpha_i B_{ijt} + B_j X_{jt} + \varepsilon_{ijt} \quad (1)$$

We performed several processes and tests to check our regression model´s robustness. First, the detection and filtering of outliers. To do this, the outliers beyond the interval expressed in (2) were deleted.

$$\left(Q_1 - 3P_Q,\ Q_3 + 3P_Q\right) \quad (2)$$

where Q_1 is the quartile 1, Q_3 is the quartile 3, and P_Q represents the interquartile path.

Second, the panel unit root test (Levin, Lin and Chu 2002) to check if a common unit root was present in the variables. Accepting the null hypothesis refers to the existence of a common unit root, while accepting the alternative hypothesis indicates the absence of a common unit root. Third, we used the F and

Hausman tests to identify our study´s best model (Yuan et al. 2022). The F test allowed us to select a model between pooled models and fixed effect models. The Hausman test was used to identify the best model between the fixed effect model and the random effect model. Additionally, tests were also carried out on the assumptions of normality, linearity, homoscedasticity, and autocorrelation of the error terms. To this end, the normal probability plot and the scatterplot of standardized residuals against the predicted standardized value met the assumptions of normality, linearity, and homoscedasticity of the error terms. The Durbin-Watson test ensured the absence of autocorrelation in our models. Finally, the variance inflation factor (VIF) values indicated the lack of multicollinearity.

On the other hand, this study selects the two most commonly used dependent variables as a proxy for bank profitability. On the one hand, the return on average equity (ROAE), defined as the profit after taxes on equity, measures the return on capital. On the other hand, the return on average assets (ROAA) refers to the profit after taxes on total assets. It indicates the profit obtained per monetary unit of assets (Feng and Wang 2018). In addition, and as possible profitability factors, a set of 19 variables selected from previous literature has been available (Al-Harbi 2019; Yanikkaya et al. 2018; Feng and Wang 2018). These independent variables include internal factors of the entities (size, efficiency, margin, and liquidity) and external factors on the macroeconomic situation of the countries (inflation, GDP, interest and unemployment rates, and domestic credit). Table 2 details the definition of all the variables used in the investigation.

Table 3 Panel data unit root test.

Variables	*t* statistic	*p*-value
Internal factors		
LIS	−7.398	0.000
TALN	−5.211	0.000
NPL	−12.587	0.000
RSKC	−15.001	0.000
EFR	−9.244	0.000
NIM	−14.362	0.000
GRM	−9.671	0.000
ETAR	−11.917	0.000
CLR	−8.663	0.000
CDP	−9.810	0.000
CLO	−12.482	0.000
CLOC	−14.868	0.000
BCR	−7.560	0.000
External factors		
INF	−13,740	0.000
UNEM	−8.907	0.000
GPC	−6.398	0.000
GDPG	−11.456	0.000
CBIR	−7.003	0.000
DCPS	−8.219	0.000

Results

Panel data model diagnosis. The results of the data unit root test panel appear in Table 3. All variables present a p-value < 0.05, indicating that the variables were free of a common unit root.

For their part, the results to support the selection of the appropriate panel data regression model appear in Table 4. The F test indicated that the fixed effect model was chosen instead of the pooled model since the null hypothesis was rejected in all cases (p-value < 0.001). For its part, the results of the Hausman test indicate that the null hypothesis was accepted (p-value > 0.05), so we specified that the random effect model was the best to analyze the panel data of the present study.

Descriptive statistics. Table 5 shows the main descriptive statistics of the variables used in the research. Regarding the dependent variables, the average Return on Average Equity (ROAE) of the banks in the sample is 8.08%, with Africa being the region with the highest rate of profitability (17.20%) and Western Europe offering the lowest rate (5.44%). Likewise, the average value of Return on Average Assets (ROAA) of the total sample amounts to 0.78%, with Africa also registering the highest mean value (1.84%) and Western Europe the lowest value (0.61%).

On the other hand, the independent variables corresponding to the sample present a moderate dispersion at a global level. However, some have similar mean values in all regions, such as TALN, RSKC, and ETAR, with values of 17.03, 0.01, and 0.58, respectively. Also, other variables present unequal mean values between regions. For example, NPL has a mean value of 0.03 globally, but in Africa, the value is 0.06, while in North America and Oceania, the average is 0.01. The net interest margin measured by NIM registers a global average value of 0.19%, although, in Western Europe, it amounts to 0.55%, and in Oceania, it is only 0.02%. Other independent variables, such as CDR, CLO, and CLOC, also present a high dispersion in the sample. Finally, the variables that refer to the regions' macroeconomic conditions show an inflation rate (INF) of 1.62% and an unemployment rate (UNEM) of 4.32%. However, with significant differences between regions (for example, Africa has the highest mean values in INF and UNEM while the Middle East has the lowest values). The variables that refer to the GDP (GPC and GDPG), the Central bank policy rate (CBIR), and the Domestic credit to the private sector (DCPS) also present significant differences between the regions.

Table 6 presents Pearson's correlation coefficients of the independent variables about dependent variables such as ROAE and ROAA used in this study. The matrix shows that there is no general concern regarding multicollinearity because the independent variables do not have high correlations and the variance inflation factor (VIF) for all predictor variables is less than 5 (Alharbi 2017).

Regression analysis. This section shows the results of the random effect regression models for the dependent variables ROAE and ROAA. These results are presented globally, considering all the

Table 4 Results of the F-test and Hausman test.

		WW	A	E	F	M	N	O	S	W
F-test[a]	F	2.947	3.102	6.917	5.908	4.515	3.745	6.157	8.472	4.740
	p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test[b]	Chi-square	7.921	8.395	3.813	1.589	7.962	1.821	9.525	3.831	5.402
	p-value	0.518	0.673	0.481	0.389	0.671	0.475	0.351	0.850	0.672

WW Worldwide, *A* Africa, *E* Eastern Europe, *F* Far East and Central Asia, *M* Middle East, *N* North America, *O* Oceania, *S* South and Central America, *W* Western Europe.
[a]H_0 = The pooled model is better than the fixed effect model; H_1 = The fixed effect model is better than the pooled model.
[b]H_0 = The random effect model is better than the fixed effect model; H_1 = The fixed effect model is better than the random effect model.

Table 5 Descriptive statistics.

Variables	Mean	Standard deviation
Dependent variables		
ROAE	WW 8.08, A 17.20, E 11.44, F 7.15, M 9.42, N 11.50, O 8.27, S 12.18, W 5.44	WW 7.64, A 8.95, E 12.21, F 6.22, M 5.40, N 7.14, O 3.70, S 7.66, W 7.47
ROAA	WW 0.78, A 1.84, E 1.32, F 0.63, M 0.86, N 1.28, O 0.61, S 1.29, W 0.46	WW 0.81, A 1.35, E 1.13, F 0.59, M 0.69, N 0.75, O 0.29, S 1.14, W 0.71
Independent variables		
a) Internal factors		
TALN	WW 17.03, A 17.00, E 16.69, F 17.21, M 17.38, N 16.57, O 17.32, S 16.76, W 17.16	WW 1.34, A 1.07, E 0.69, F 1.30, M 1.10, N 1.31, O 1.72, S 1.12, W 1.38
NPL	WW 0.03, A 0.06, E 0.06, F 0.03, M 0.03, N 0.01, O 0.01, S 0.04, W 0.04	WW 0.05, A 0.04, E 0.04, F 0.06, M 0.03, N 0.02, O 0.02, S 0.03, W 0.06
RSKC	WW 0.01, A 0.01, E 0.01, F 0.01, M 0.01, N 0.00, O 0.00, S 0.02, W 0.01	WW 0.10, A 0.01, E 0.01, F 0.01, M 0.01, N 0.01, O 0.00, S 0.03, W 0.18
EFR	WW 0.58, A 0.53, E 0.55, F 0.53, M 0.57, N 0.56, O 0.58, S 0.58, W 0.67	WW 0.30, A 0.15, E 0.16, F 0.24, M 0.16, N 0.13, O 0.15, S 0.17, W 0.43
NIM	WW 0.19, A 0.08, E 0.05, F 0.03, M 0.03, N 0.05, O 0.02, S 0.09, W 0.55	WW 10.39, A 0.05, E 0.03, F 0.06, M 0.01, N 0.03, O 0.00, S 0.13, W 19.32
GRM	WW 0.45, A 0.12, E 0.08, F 0.06, M 0.05, N 0.03, O 0.03, S 0.24, W 1.38	WW 26.32, A 0.07, E 0.05, F 0.22, M 0.01, N 0.00, O 0.00, S 0.69, W 48.94
ETAR	WW 0.09, A 0.10, E 0.11, F 0.08, M 0.09, N 0.08, O 0.07, S 0.10, W 0.08	WW 0.04, A 0.03, E 0.03, F 0.04, M 0.04, N 0.20, O 0.02, S 0.05, W 0.04
CLR	WW 0.09, A 0.13, E 0.08, F 0.11, M 0.20, N 0.08, O 0.03, S 0.06, W 0.09	WW 0.09, A 0.09, E 0.07, F 0.08, M 0.08, N 0.08, O 0.03, S 0.05, W 0.09
CDP	WW 58715793.97, A 27214363.32, E 24014649.05, F 79754100.44, M 44879136.29, N 51575892.08, O 90006689.35, S 17256247.37, W 47207975.32	WW 206868067.78, A 25035255.81, E 45264868.82, F 285934615.47, M 41451511.02, N 190586143.81, O 141031819.18, S 22874865.25, W 109516528.48
CLO	WW 49199780.94, A 22790024.04, E 21781352.52, F 61274133.31, M 36069484.79, N 32871727.42, O 106277214.16, S 18628320.10, W 50794547.02	WW 156988827.71, A 22265775.71, E 45197334.28, F 216518665.84, M 31937208.07, N 104478845.38, O 165788453.63, S 23744866.86, W 111579156.73
CLOC	WW 2010631901.35, A 89942033.92, E 207464083.61, F 3096188933.52, M238824445.06, N 2470488493.66, O 1015774994.57, S 170946610.54, W 1044491975.02	WW 2114356885.22, A 60094838.04, E 198903986.14, F 2872117858.22, M 41212268.01, N 114478473.33, O 422099236.47, S 79449169.96, W 688326361.81
BCR	WW 67.95, A 4.23, E 7.20, F 65.14, M 5.57, N 165.56, O 8.92, S 8.84, W 33.99	WW 80.86, A 2.96, E 5.60, F 60.27, M 3.95, N104.28, O 6.20, S 6.79, W 35.66
b) External factors		
INF	WW 1.62, A 3.76, E 2.55, F 1.17, M 0.29, N 2.09, O 1.55, S 3.14, W 1.48	WW 2.14, A 4.12, E 1.90, F 1.39, M 0.71, N 1.73, O 1.21, S 2.34, W 2.82
UNEM	WW 4.32, A 11.34, E 2.90, F 2.86, M 2.39, N 4.39, O 3.91, S 7.26, W 5.79	WW 3.81, A 12.66, E 2.02, F 2.11, M 2.27, N 2.92, O 2.34, S 5.58, W 4.27
GPC	WW 35161.99, A 4199.37, E 15349.27, F 19684.70, M 43732.49, N 63925.97, O 50877.12, S 8827.15, W 43526.25	WW 23004.85, A 1948.11, E 4619.01, F 15352.85, M 3253.35, N 2386.33, O 6217.64, S 2811.98, W 18269.73
GDPG	WW 1.09, A 0.62, E 1.14, F 1.79, M 1.78, N 1.28, O 1.54, S 0.80, W 0.03	WW 4.44, A 2.91, E 3.59, F 4.19, M 3.59, N 3.40, O 1.53, S 5.36, W 5.24
CBIR	WW 1.35, A 4.60, E 2.15, F 1.88, M 0.08, N 0.65, O 0.51, S 3.48, W 0.63	WW 2.58, A 4.96, E 2.60, F 2.00, M 0.08, N 0.99, O 0.65, S 3.03, W 3.33
DCPS	WW 138.72, A 56.19, E 47.44, F 156.97, M 70.54, N 200.69, O 146.08, S 62,69, W 104.36	WW 55.89, A 47.28, E 10.30, F 46.57, M 5.38, N 15.87, O 8.81, S 27.04, W 26.35

A Africa, *E* Eastern Europe, *F* Far East and Central Asia, *M* Middle East, *N* North America, *O* Oceania, *S* South and Central America, *W* Western Europe.

banks in the sample, and later, through an individual analysis by world region. In turn, and following the proposal of Gazy et al. (2022b), the estimated results are presented in two different models: model 1 includes only the banks´ internal variables, and model 2 adds external variables along with the banks' internal variables to see the joint impact of both factor types.

At a global level, the regression results determine the existence of a variable set with a significant effect on the ROAE and ROAA (Table 7). This set comprises variables that positively affect profitability (LIS, GRM, ETAR, BCR, INF, GDPG, and CBIR) and those whose impact is negative (NPL, EFR, CLOC, UNEM, and GPC). In addition, the results also indicate that the variables TALN, RSKC, and DCPS are significant in explaining the ROAE values but not for ROAA. Similarly, the variable CLR was a determinant for ROAA, but it was not about ROAE. These results show that listed banks have the highest profitability worldwide, with fewer impaired loans and higher efficiency, gross margin, and equity-to-assets ratio. Likewise, the most profitable banks are found in the best-positioned countries in the ranking by assets, with a macroeconomic environment characterized by higher inflation rates, lower levels of unemployment, and GPD per capita, but with higher rates of GDP growth and interest rates.

Table 8 shows the regression results for ROAE in the different regions. The validity tests confirmed that the models are robust. For their part, the results indicate that particular variables significantly affect profitability in practically all areas. Thus, RSKC and EFR are significant in all regions. NPL is a prominent variable in all regions except North America, ETAR except the Middle East and CLOC in Oceania. Other variables are also crucial for a broad set of areas. For example, AIM for all regions except Africa, Oceania, and South and

Table 6 Pearson correlation matrix and VIF.

	ROAE	ROAA	TALN	NPL	RSKC	EFR	NIM	GRM	ETAR	CLR	CDP	CLO	CLOC	BRC	INF	UNEM	GPC	GDPG	CBIR
ROAE	1																		
ROAA	0.856**	1																	
TALN	−0.004	−0.096	1																
NPL	−0.401**	−0.027	−0.023	1															
RSKC	0.019	0.041	−0.015	0.307*	1														
EFR	−0.293*	−0.260*	−0.096	0.057	−0.014	1													
NIM	0.021	0.033	−0.019	0.281**	0.493**	0.005	1												
GRM	0.021	0.034	−0.019	0.281**	0.492**	0.007	0.372**	1											
ETAR	0.146*	0.474**	−0.224*	0.048	0.040	−0.135*	0.027	0.028	1										
CLR	−0.032	−0.036	0.053	0.039	0.006	0.091	0.002	0.003	−0.127*	1									
CDP	0.036	−0.006	0.389**	0.019	−0.003	−0.059	−0.004	−0.004	−0.075	0.053	1								
CLO	0.035	−0.012	0.224**	0.016	−0.004	−0.066	−0.005	−0.005	−0.089	0.029**	0.469**	1							
CLOC	0.031	−0.036	0.099	−0.159*	−0.006	−0.233**	−0.011	−0.011	−0.076	−0.027	0.124	0.119*	1						
BRC	0.049	0.081*	−0.328**	−0.174*	−0.027	0.011	−0.014	−0.012	0.107	−0.018	−0.183	−0.203*	0.334**	1					
INF	0.311**	0.218**	−0.015	0.022	0.012	−0.085	−0.005	−0.005	0.093	0.016	−0.016	−0.019	−0.084	−0.035	1				
UNEM	−0.024	−0.048	0.045	0.078	0.014	0.013	0.003	0.003	−0.023	−0.044	−0.005	0.006	−0.051	−0.074	0.462**	1			
GPC	−0.038	−0.011	−0.097	−0.180*	−0.029	0.154*	0.016	0.016	0.074	0.001	−0.040	−0.046	−0.175*	0.357**	−0.101	−0.028	1		
GDPG	0.216**	0.277**	0.082	−0.027	−0.003	−0.160*	0.003	0.003	0.036	−0.032	0.050	0.051	0.297**	0.005	0.382**	0.027	−0.081	1	
CBIR	0.193*	0.190*	0.023	0.044	0.023	−0.173*	−0.011	−0.011	0.065	−0.017	0.018	0.015	0.159*	−0.118*	0.530**	0.291*	−0.452**	0.336**	1
DCPS	0.034	−0.011	0.014	−0.291**	−0.022	−0.088	0.005	0.005	−0.046	0.013	0.063	0.038	0.200*	0.336**	−0.145*	−0.116*	0.411**	0.049	−0.193*
VIF	1.492	1.907	1.203	2.078	3.350	2.974	1.590	3.898	2.179	2.078	1.964	2.142	3.037	1.092	2.154	3.351	2.413	1.990	1.847

VIF Variance inflation factor.
* Correlation is significant at the 0.05 level; ** Correlation is significant at the 0.01 level.

Table 7 Worldwide random effect regression models for ROAE and ROAA estimation.

	Dep.Var.: ROAE		Dep. Var.: ROAA	
	Model 1	Model 2	Model 1	Model 2
Constant	16.249***	11.274***	0.533**	0.312**
Internal factors				
LIS	1.382***	0.631***	0.103***	0.056**
TALN	−0.105	0.316***	−0.002	0.011
NPL	54.473***	−66.426***	−2.283***	−2.115***
RSKC	−98.109***	−131.736***	−0.479	−1.208
EFR	−10.233***	−8.951***	−0.817***	−0.718***
NIM	−4.230***	−4.260***	−0.010	−0.057
GRM	3.070***	2.647***	0.428***	0.415***
ETAR	10.955***	9.509***	8.152***	7.861***
CLR	−0.291	−0.455	0.303***	0.231**
CDP	0.000	−0.000	0.000	0.000
CLO	0.000	−0.000	0.000	0.000
CLOC	−0.001***	−0.001***	−0.002***	−0.001***
BCR	0.004**	0.014***	0.001***	0.001***
External factors				
INF	-	0.435***	-	0.044***
UNEM	-	−0.161***	-	−0.022***
GPC	-	−0.001***	-	−0.001*
GDPG	-	0.172***	-	0.018***
CBIR	-	0.194***	-	0.019***
DCPS	-	−0.011***	-	0.000
Models' analysis				
F	89.002***	92.123***	151.987***	127.881***
R^2	20.13%	27.63%	29.63%	34.14%
Adj. R^2	19.91%	27.33%	29.43%	33.87%
RMSE	6.24	5.94	0.66	0.64
MAPE	108.44%	93.30%	106.58%	97.68%
AIC	6.50	6.41	2.11	1.95
BIC	6.52	6.44	2.03	1.98

*** Sig. at 0.01; ** Sig. at 0.05; * Sig. at 0.10.

Central America; AGM for all except North America and South and Central America; and INF in all regions except Middle East, Oceania, and Western Europe.

Unlike the previous variables that have substantially impacted ROAE for various regions, some variables have been significant in only one or two regions. For example, BCR is only substantial for Western European banks, and UNEM is only significant for South and Central America. Furthermore, TALN has a negative effect on North America and Western Europe; CLO is only in Africa and South and Central America, and GDPG is only in South and Central America and Western Europe. Therefore, from the comparison between regions, it can be deduced that for each region, there is single variables' set that determines the ROAE levels and that these regional differences improve the estimation of the global model in most cases since the goodness of the regression fit shown in Table 7 is higher for the regional models compared to the global ones.

The random effect regression results for ROAA in the different regions appear in Table 9. In this case, all the models built also present an acceptable fit. The results confirm that the variables affecting ROAA in practically all regions are NPL, RSKC, EFR, ETAR, and CLOC. Likewise, and as for ROAE, other variables are also significant for a broad set of regions, such as the case of GRM, which was significant in all regions except the Middle East and North America. However, certain variables of particular significance in determining the ROAE levels of most regions have not been so for the ROAA model. These variables are NIM (with significance only in the Far East and Central Asia, North America,

Table 8 Random effect regression models for ROAE by world region.

	A		E		F		M		N		O		S		W	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Constant	44.346***	43.068***	74.723***	52.793**	27.734***	21.245***	23.097	10.715***	38.852***	45.395***	22.126***	22.226***	50.393***	39.246**	21.607***	22.029***
Internal factors																
LIS	−0.435	0.387	0.487	0.384	0.960***	0.884***	1.917	0.958	−0.581	−0.658	−0.316	−0.280	2.882***	3.107***	1.596***	1.339***
TALN	n/a	n/a	−2.484**	−0.477	−0.396***	0.040	−0.095	n/a	−1.246***	−0.839**	n/a	n/a	−1.060	−0.106	−0.607***	−0.737***
NPL	−65.926***	−62.053***	−12.387	−23.855*	−35.846***	−39.557***	−129.424***	−143.03***	−10.247	−11.351	−38.772*	−42.589*	−77.306***	−66.733***	−36.512***	−27.598***
RSKC	−369.017***	−341.112***	−396.865***	−383.954***	−461.795***	−470.837***	−325.448***	−192.063	−275.555***	−211.110***	−834.499***	−855.363***	−185.974***	−173.31***	−292.838***	−374.615***
EFR	−39.298***	−37.703***	−45.921***	−45.947***	−21.757***	−20.108***	−34.157***	−30.446	−18.174***	−18.089***	−23.319***	−23.547***	−35.699***	−34.337***	−3.109***	−2.612***
NIM	−34.330	−39.313	−91.123**	−103.342**	65.442***	71.563***	211.047	179.146*	24.429***	19.974***	−138.106	−150.891	5.203	3.673	−22.193***	−27.888***
GRM	118.760***	120.572***	164.727***	160.303***	118.297***	97.341***	59.030	30.555*	−1.124	−0.874	324.930***	334.582***	2.066	0.868	12.211***	13.905***
ETAR	−98.189**	−96.428***	−15.011	−27.055*	−58.100***	−55.820***	−32.751	−41.724	−61.574***	−66.003***	−59.117***	−57.701***	−27.553***	−47.657***	−10.500**	−12.881***
CLR	−2.357	−0.127	5.720	−1.007	0.725	1.888*	−5.319	0.276	−3.409*	−0.056	−11.582**	−12.564**	16.608***	14.284**	−5.574**	−5.695***
CDP	0.002***	−0.001***	n/a	n/a	n/a	n/a	−0.002	−0.001	0.001***	0.003*	0.001	0.001	−0.002***	0.003***	0.001	0.001
CLO	0.003***	0.001***	0.002	0.001	0.001	0.002	n/a	n/a	n/a	n/a	n/a	n/a	0.001***	−0.003*	0.001	0.002
CLOC	0.004***	−0.003***	0.001**	0.001	−0.002***	0.003***	0.003*	n/a	0.004***	0.003***	−0.001	−0.001	0.003***	0.002***	−0.002***	−0.001
BCR	0.430	0.407	−0.546***	−0.000	−0.007***	0.001	−0.185	−0.322	−0.006*	−0.002	0.034	0.036	−0.084	0.046	−0.013*	−0.016**
External factors																
INF	-	−0.328**	-	−0.796*	-	−0.162*	-	2.761	-	0.216**	-	−0.002	-	−0.601*	-	0.215
UNEM	-	0.035	-	0.207	-	−0.097	-	n/a	-	n/a	-	0.027	-	−0.194**	-	−0.063
GPC	-	n/a	-	−0.000	-	−0.007***	-	0.000	-	n/a	-	n/a	-	−0.000	-	−0.000*
GDPG	-	0.325	-	−0.080	-	0.040	-	n/a	-	n/a	-	n/a	-	0.247***	-	0.159***
CBIR	-	n/a	-	0.580*	-	0.176*	-	−12.739	-	n/a	-	−0.103	-	0.408*	-	0.468***
DCPS	-	n/a	-	−0.180**	-	0.002	-	0.388*	-	−0.071***	-	n/a	-	−0.037	-	0.018**
Models' analysis																
F	57.587***	24.681***	41.164***	29.621***	407.709***	293.710***	12.469***	11.552***	52.117***	50.368***	113.465***	86.215***	35.282***	35.946***	22.261***	25.665***
White test	0.521	0.422	7.853***	1.680	66.782***	36.353***	3.402***	4.661***	0.710	0.614	3.070***	3.000***	1.760***	0.870	9.670***	5.520***
R^2	92.98%	94.39%	73.18%	75.29%	73.90%	75.43%	80.60%	82.63%	42.56%	45.57%	93.86%	93.86%	71.37%	79.33%	18.67%	27.98%
Adj. R^2	89.61%	90.57%	71.41%	72.74%	72.72%	75.17%	74.14%	75.48%	41.76%	44.67%	93.00%	92.77%	9.35%	77.12%	17.83%	26.89%
RMSE	2.13	1.91	5.27	5.06	2.92	2.84	2.35	2.23	4.16	4.05	0.91	0.91	3.99	3.39	5.80	5.50
MAPE	15.54%	13.87%	69.74%	72.21%	45.72%	46.13%	19.21%	17.01%	32.91%	28.04%	9.59%	9.73%	36.91%	31.44%	124.30%	103.82%
AIC	5.60	4.94	6.52	6.28	5.00	4.95	5.08	5.05	5.72	5.67	2.91	2.97	5.75	5.48	6.39	6.26
BIC	5.24	5.66	6.38	6.60	5.04	5.00	5.58	5.63	5.79	5.76	3.26	3.38	5.98	5.82	6.45	6.36

Standard errors are given in parentheses.
n/a non-available, *A* Africa, *E* Eastern Europe, *F* Far East and Central Asia, *M* Middle East, *N* North America, *O* Oceania, *S* South and Central America, *W* Western Europe, *RMSE* Root Mean Square Error, *MAPE* Mean Absolute Percentage Error, *AIC* Akaike Information Criteria, *BIC* Bayesian Information Criteria.
*** Sig. at 0.01; ** Sig. at 0.05; * Sig. at 0.10.

and Western Europe) and INF (important in North America and Western Europe). On the other hand, the variables that had been significant for the ROAE model only in one or two regions followed the same behavior in the ROAA model (for example, BCR, UNEM, TALN, and GDPG). These results also confirm that a single set of explanatory variables determines bank profitability for each region.

Discussion

At a global level, our results point to a set of five internal factors that are statistically significant in explaining bank profitability. These factors refer to listed banks (LIS), non-performing loans (NPL), efficiency (EFR), gross margin (GRM), and capitalization (ETAR). Likewise, other external factors have been significant in our global models, indicating that the most profitable banks are located in the countries best positioned in the ranking by assets (BCR), with a macroeconomic environment characterized by higher inflation rates (INF), lower levels of unemployment (UNEM) and GDP per capita (GPC), but with higher GDP growth rates (DGPG) and higher interest rates (CBIR). Some of these factors have already been identified in previous global studies. For example, Ho et al. (2023) confirmed the significance of operational efficiency, the level of capitalization, and the growth of the DGP on bank profitability using a sample of entities belonging to 90 countries.

The variable referring to non-performing loans (NLP) has been significant in the global models for ROAE and ROAA and all regional models except for North America and Eastern Europe. These results highlight the importance of non-performing loans as an internal profitability factor, which aligns with Kosmidou et al. (2005). However, they differ from those obtained by Kozak (2021), who found a significant effect of NPL in banks in Eastern European countries. Possibly, the greater resilience to the increase in loan deterioration in some regions is due, among other things, to the benefits of scale economies (Kozak 2021). For example, North America is characterized by a high position in the bank country rank by assets (BCR) and does not show a particular sensitivity to NPL.

The results obtained on the importance of bank capitalization measured by ETAR indicate that it is significant globally for ROAE and ROAA, and also by region (except the Middle East for ROAE). The latter may be because banks with a high capital ratio can take advantage of new business opportunities, achieving greater profitability (Al-Harbi 2019). Our results are consistent with the findings of Yuan et al. (2022) for commercial banks in South Asian countries. They also detect bank capitalization´s positive and significant effect on ROAE and ROAA. However, our results differ from those obtained by Saona (2016), who found a negative relationship between profitability and capital ratio due to the assumption of lower risks. And with those of Le et al. (2022), referring to the negative influence of bank capitalization on the profitability of Islamic banking systems.

On the other hand, the variables that refer to total customer deposits (CDP) and total customer loans (CLO) have never been significant in our global models. However, at the regional level, the CDP was significant, with a negative impact in Africa and a positive impact in North, South and Central America. These results only partially coincide with the studies of Chirwa (2003), Saona (2016), and Menicucci and Paolucci (2016), which indicated that deposits could positively affect profitability. Our results are also in line with those obtained by Akbas (2012) and Tariq et al. (2014) by showing that, in some regions, customer deposits (CDP) hurt profitability. And also in line with the studies of Demirgüc-Kunt and Huizinga (1999) and Soyemi et al. (2013) by detecting an insignificant relationship between deposits and profitability in certain regions.

Added to the above, our results indicate that the TALN, RSKC, and DCPS variables significantly explain the ROAE values but not for the ROAA. Similarly, the CLR variable was significant for ROAA, but not ROAE. Ercegovac et al. (2020) also obtained different factors for ROAE and ROAA with a sample of European banks. Likewise, Le and Ngo (2020) confirmed a positive relationship between capital market development and bank profitability, which may be consistent with our findings on the significance of the DCPS variable.

From a regional perspective, our models for the Far East and Central Asia region further confirm that the cost of risk (RSKC), the aggregate total loans of the three largest banks (CLOC), and the interest margin (NIM) are also relevant factors. These results have partially coincided with those obtained by Almaqtari et al. (2019) since, in their study on banks in India and Pakistan, they pointed out that only size, operational efficiency, the level of capitalization, and the inflation rate are the factors that most affect profitability. However, our model adds new explanatory variables. For Europe, the study by Ercegovac et al. (2020) concluded that banks with the best risk profile and greater efficiency are also the most profitable. Our results also confirm that the cost of risk (RSKC) and efficiency ratio (EFR) are significant internal factors that explain the ROAE and ROAA levels of Eastern and Western European banks. Even so, our models provide new explanatory variables specific to Europe, including the gross margin (GRM) and capitalization (ETAR). Finally, for the North American region, our results coincide with those of Feng and Wang (2018), who pointed out efficiency (EFR) as one of the essential factors of bank profitability. However, our models detect other variables that are also essential for bank profitability in the region, such as the net interest margin (NIM), the negative effect of the size of the entities (TALN), capitalization (ETAR), the ranking of banks by assets (BCR) and the DGP growth (DGPG).

Conclusions and implications

Banks are part of a financial system by performing the intermediation function and collaborating in implementing monetary policy. In an increasingly globalized environment, understanding the different aspects of banking profitability at a global level is essential for the financial stability of countries. This study adds to the empirical literature on bank profitability by analyzing the global and regional levels.

From a global perspective, the results reveal that certain internal and external factors explain bank profitability. The listed bank (LIS), the incidence of impaired loans (NPL), efficiency (EFR), gross margin (GRM), capitalization (ETAR), and the position of the countries in the ranking by assets (BCR) are the main internal factors. And among the external factors stand out inflation rate (INF), unemployment (UNEM), GDP growth (DGPG), and interest rate (CBIR).

From a regional perspective, certain variables significantly affect profitability in practically all regions, such as the cost derived from impairment charges on loans (RSKC) and efficiency (EFR). And other variables are also significant in all regions with some exceptions, such as non-performing loans (NPL), which is not significant in North America, the level of capitalization measured by the equity to asset ratio (ETAR), which is not in the Middle East, and total aggregated loans of the three largest banks (CLOC), which was not significant in Oceania. However, some variables have been relevant only in one or two regions, such as the case of the bank country rank by assets (BCR), unemployment (UNEM), size (TALN), total customer loans (CLO), and the growth of DGP (GDPG). Therefore, these results have allowed us to know the unique variables that determine bank profitability in each region with robustness. Also, the regional models improve the estimation of the global models in most cases.

Our research has important theoretical and professional implications in bank profitability. From a theoretical perspective,

Table 9 Random effect regression models for ROAA by world region.

	A		E		F		M		N		O		S		W	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Constant	0.314	−0.189	6.157***	5.037***	1.357***	1.002***	−0.391	0.373	−0.251	1.351	1.061***	1.075***	6.164***	5.223**	1.435***	1.427***
Internal factors																
LIS	0.118	−0.027	−0.095	−0.136	0.132***	0.111***	−0.141	−0.121	0.117	0.117	−0.040	−0.039	0.311***	0.363***	0.207***	0.182***
TALN	n/a	n/a	−0.287***	−0.168	−0.016	0.023**	0.095	n/a	−0.068	−0.045	n/a	n/a	−0.259**	−0.180	−0.062***	−0.069***
NPL	−7.183**	−8.332**	−0.754	−1.436	−2.408***	−2.787***	−10.953***	−14.296***	2.707**	2.831**	−1.208**	−1.385**	−6.049***	−5.643***	−1.553***	−0.784**
RSKC	−39.640***	−40.933***	−20.41***	−15.935***	−31.741***	−34.016***	−12.758	−6.475	−3.135	0.027	−66.671***	−69.018***	−8.761***	−7.788***	−12.290***	−18.644***
EFR	−2.739***	−1.639*	−2.523***	−2.509***	−1.672***	−1.583***	−2.924***	−2.57***	−2.098***	−2.103***	−1.614***	−1.653***	−3.218***	−3.101***	−0.269***	−0.228***
NIM	0.030	−3.340	−2.065	−3.012	13.488***	11.325***	9.285	11.003	6.245***	5.569***	−6.547	−9.087	0.603**	0.363	−0.693***	−0.641***
GRM	12.429***	16.803***	11.964***	11.507***	0.308	0.726***	9.883	5.694	0.077	0.100	24.561***	26.597***	0.456***	0.487***	2.369***	2.152***
ETAR	17.384***	18.088***	6.310***	6.289***	3.695***	3.496***	9.227***	6.935*	3.083***	2.852***	1.954**	2.144***	6.731***	4.923***	4.947***	4.989***
CLR	−1.008	−2.378	0.483	−0.089	0.420***	0.469***	0.383	0.607	−0.088	0.063	−1.337***	−1.582***	0.998	0.705	−0.366**	−0.331*
CDP	−0.002**	0.001	n/a	n/a	n/a	n/a	−0.001	−0.002	0.001	0.001	n/a	0.002	0.003***	0.003***	0.001	0.002
CLO	0.003***	n/a	0.004***	0.002**	0.001	−0.002	n/a	n/a	n/a	n/a	0.001	n/a	−0.003*	−0.004**	0.002	0.001
CLOC	−0.002*	0.001	0.003***	0.001	−0.002***	−0.004***	0.001	n/a	0.003***	0.002***	−0.002*	−0.004**	0.003***	0.003***	−0.004***	−0.001
BCR	0.079**	0.047	−0.053***	−0.033*	0.002**	0.002*	−0.027	−0.043	0.000	0.000	−0.001	−0.000	−0.024	−0.010	−0.002***	−0.003***
External factors																
INF		n/a		−0.007		−0.014		0.244		0.064***		0.004		−0.036		0.046***
UNEM		0.005		−0.058		−0.010		n/a		n/a		0.003		−0.024**		−0.017***
GPC		n/a		−0.000		−0.004***		−0.000		n/a		n/a		0.000		−0.004***
GDPG		−0.001		0.019		0.001		n/a		n/a		n/a		0.026***		0.009**
CBIR		−0.020		0.055*		0.021**		−1.213		n/a		−0.021		0.016		0.015
DCPS		n/a		−0.008		−0.001***		0.042		−0.008***		n/a		−0.004		0.002***
Models' analysis																
F	53.990***	29.69***	37.723***	27.141***	342.87***	250.804***	16.501***	14.502***	28.833***	28.202***	114.108***	88.604***	27.885***	24.766***	39.251***	40.367***
White test	1.460	1.650	3.520***	1.200	36.590***	23.891***	3.172***	4.031***	3.687***	3.344***	4.396***	2.492***	2.603***	5.559***	13.732***	9.434***
R^2	95.15%	93.06%	70.77%	72.97%	69.70%	71.69%	84.62%	85.66%	27.72%	30.50%	93.73%	93.87%	63.10%	69.55%	27.58%	36.51%
Adj. R^2	93.39%	89.96%	68.89%	70.28%	69.49%	71.4%	79.49%	79.75%	26.76%	29.41%	92.91%	92.81%	60.84%	66.74%	26.88%	35.60%
RMSE	0.29	0.35	0.49	0.47	0.32	0.31	0.27	0.26	0.64	0.62	0.07	0.07	0.54	0.49	0.52	0.49
MAPE	15.98%	19.50%	69.64%	68.53%	58.49%	57.81%	27.98%	23.68%	44.09%	40.99%	10.41%	10.64%	56.55%	50.41%	119.02%	102.94%
AIC	0.96	1.41	1.53	1.52	0.56	0.50	0.74	0.75	1.96	1.93	−2.18	−2.14	1.71	1.58	1.56	1.44
BIC	1.48	2.00	1.75	1.83	0.61	0.56	1.24	1.33	2.03	2.00	−1.86	−1.74	1.93	1.88	1.61	1.51

Standard errors are given in parentheses.
n/a non-available, *A* Africa, *E* Eastern Europe, *F* Far East and Central Asia, *M* Middle East, *N* North America, *O* Oceania, *S* South and Central America, *W* Western Europe, *RMSE* Root Mean Square Error, *MAPE* Mean Absolute Percentage Error, *AIC* Akaike Information Criteria, *BIC* Bayesian Information Criteria.
*** Sig. at 0.01; ** Sig. at 0.05; * Sig. at 0.10.

our results help to understand the formation process of bank profitability, offering global and specific models for each region. Furthermore, our study contributes to the existing academic literature by providing international empirical evidence from an extensive database on the factors driving bank profitability, covering the 2018–2021 period and 110 countries in significant regions worldwide. Most global studies related to the banking sector´s profitability stopped in 2016 or have considered a maximum of 90 countries. Likewise, our evidence explains how the current globalization process extends from the internal characteristics of the entities to the external factors of the region's macroeconomic environment. From an applied point of view, our findings are essential for bank management and shareholders, as they will allow them to identify critical factors, both internal and external, that influence the maximization of profits and that ultimately contribute to stability of the banking sector. Also, our findings encourage international bank managers to minimize the cost of building models for profitability analysis by offering unique variable sets for each of the world's major regions. However, due to the power of generalization that our global models also demonstrate, we highlight their usefulness for the regulation of the sector, and they can be applied to simulate deposit, solvency, and monetary policy measures. The results also recommend that regulatory authorities increase their efforts to develop securities markets that promote banking profitability and are not substitutes for the banking sector. On the other hand, given that the incidence of impaired loans and efficiency has been essential for bank profitability at the global and regional levels, bank managers must monitor credit risk. In this sense, freeing up the resources used to address impaired loans and strengthening efficiency will be essential to improve banks´ profitability globally. This suggests that strong and rapid policy measures are needed to reduce overall costs through new technological opportunities, thereby achieving the transformation of the banking business model towards sustainable profitability objectives. Finally, because variables referring to customer deposits and loans have never been significant in our global models, governments should encourage individuals and businesses to open bank accounts and facilitate lending. We also consider that our results indicate that the size of the banking sector positively affects the profitability of entities, so regulators should facilitate the development of the industry, especially in certain regions such as Africa and South and Central America., where this effect is most intense.

The study also has certain limitations, indicating the need for additional research in the future. This research has used a set made up of internal and macroeconomic variables. Other studies could incorporate new variables to explain bank profitability. Factors arising from legal enforcement advances in information technology and governance can offer new insights into the analysis and improve the accuracy of the models used. Also, given that the present study has applied the random effects estimation for panel data of bank profitability, this question could be investigated using other analysis techniques, such as the generalized method of moments, artificial neural networks, or qualitative research. Finally, considering the expansion of financial innovations that allows banks to target new customers and market segments, future research could determine how the adoption or digitalization of fintech impacts the profitability of banks and how they moderate their optimization strategies benefits.

Data availability

The data that support the findings of this study are available from Orbis Bank Focus by Moody´s but restrictions apply to the availability of these data, which were used under licence for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Orbis Bank Focus by Moody´s.

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References

Abreu M, Mendes V (2001) Commercial bank interest margins and profitability: evidence for some EU countries. In: Pan-European Conference Jointly. IEFS-UK & University of Macedonia Economic & Social Sciences, Thessaloniki, Greece, pp. 17–20

Akbas H (2012) Determinants of bank profitability: an investigation on Turkish banking sector, Öneri Dergisi. 10(37):103–110

Alharbi AT (2017) Determinant of Islamic Bank's profitability: International evidence. Int J Islamic Middle East Finan Manag 10:331–350. https://doi.org/10.1108/IMEFM-12-2015-0161

Al-Harbi A (2019) The determinants of conventional banks profitability in developing and underdeveloped OIC countries. J Econ Financ Adm Sci 24(47):4–28. https://doi.org/10.1108/JEFAS-05-2018-0043

Almaqtari FA, Al-Homaidi EA, Tabash MI, Farhan NH (2019) The determinants of profitability of Indian commercial banks: A panel data approach. Int J Financ Econ 24(1):168–185. https://doi.org/10.1002/ijfe.1655

Athanasoglou P, Delis M, Staikouras C (2006) Determinants of bank profitability in the South Eastern European region. J Financ Decis Mak 2:1–17. https://doi.org/10.2139/ssrn.4163741

Ben Ameur I, Mhiri S (2013) Explanatory factors of bank performance evidence from Tunisia. Int J Econ Financ Manag 2(1):1–11. https://journalofbusiness.org/index.php/GJMBR/article/view/980

Ben Naceur S, Omran M (2011) The effects of bank regulations, competition, and financial reforms on banks' performance. Emerg Mark Rev 12(1):1–20. https://doi.org/10.1016/j.ememar.2010.08.002

Bogdan F, Roman A (2015) Internal and external determinants of commercial Banks profitability: empirical evidence from Bulgaria and Romania. Ann Fac Econ, Univ Oradea, Fac Econ 1(1):896–904

Borroni M, Piva M, Rossi S (2016) Determinants of Bank Profitability in the Euro Area: Has Anything Changed? (N Dises1619). Università Cattolica del Sacro Cuore, Dipartimentie Istituti di Scienze Economiche (DISCE)

Caterini G, Gaffeo E, Gobbi L (2021) How diverse are national banking systems? An analysis on banking business models, profitability, and riskiness. Economic Notes 49(2):e12156. https://doi.org/10.1111/ecno.12156

Chiorazzo V, Milani C (2011) The impact of taxation on bank profits: Evidence from EU banks. J Bank Financ 35(12):3202–3212. https://doi.org/10.1016/j.jbankfin.2011.05.002

Chirwa W (2003) Determinants of commercial banks' profitability in Malawi: a cointegration approach. Appl Financ Econ 13(8):565–571. https://doi.org/10.1080/0960310022000020933

Çolak G, Öztekin Ö (2021) The impact of COVID-19 pandemic on bank lending around the world. J Bank Financ 133:106207. https://doi.org/10.1016/j.jbankfin.2021.106207

Demirgüc-Kunt A, Huizinga H (1999) Determinants of commercial bank interest margins and profitability: some international evidence. World Bank Econ Rev 13:379–408

Demirgüç-Kunt A, Huizinga H (2000) Financial structure and bank profitability Working Paper series (2430). World Bank, Washington, DC

Ercegovac R, Klinac I, Zdrilić I (2020) Bank specific determinants of EU banks profitability after 2007 financial crisis. J Contemp Manag Issues 25(1):89–102. https://doi.org/10.30924/mjcmi.25.1.5

Feng G, Wang C (2018) Why European banks are less profitable than US banks: A decomposition approach. J Bank Financ 90:1–16. https://doi.org/10.1016/j.jbankfin.2018.02.017

Gazi M, Nahiduzzaman M, Harymawan I, Masud A, Dhar B (2022a) Impact of COVID-19 on financial performance and profitability of banking sector in special reference to private commercial banks: Empirical evidence from Bangladesh. Sustainability 14(10):6260. https://doi.org/10.3390/su14106260

Gazi MAI, Talukder MA, Molla MS, Hossain M, Hossain AI (2022b) Does the financial performance of Islamic banks are higher than the traditional banks in Bangladesh? Panel data analysis. Indian J Bank Financ 9(1):33–46. https://doi.org/10.46281/ijfb.v9i1.1549

Gemar P, Gemar G, Guzman-Parra V (2019) Modeling the Sustainability of Bank Profitability Using Partial Least Squares. Sustainability 11:4950. https://doi.org/10.3390/su11184950

Ghosh A (2016) Banking sector globalisation and bank performance: a comparative analysis of low income countries with emerging markets and advanced

economies. Rev Dev Econ Financ 6(1):58–70. https://hdl.handle.net/10520/EJC193921
Growe G, DeBruine M, Lee JY, Maldonado JFT (2014) The profitability and performance measurement of US regional banks using the predictive focus of the "fundamental analysis research". In: Advances in Management Accounting. Emerald Group Publishing Limited, Leeds, England
Haron S (2004) Determinants of Islamic bank profitability. Glob J Financ Econ 1:11–33. https://hdl.handle.net/1959.11/6691
Heffernan S, Fu M (2008) The determinants of bank performance in China. Working paper series, Cass Business School, City University
Ho TH, Nguyen DT, Luu TB, Le TD, Ngo TD (2023) Bank performance during the COVID-19 pandemic: does income diversification help? J Appl Econ 26(1):2222964. https://doi.org/10.1080/15140326.2023.2222964
Hoffmann PS (2011) Determinants of the Profitability of the US Banking Industry. Int J Bus Soc Sci 2(2):255–269. http://hdl.handle.net/11531/12554
Islam M, Nishiyama S (2016) The determinants of bank profitability: dynamic panel evidence fromSouth Asian countries. J Appl Financ Bank 6(3):77
Korytowski M (2018) Banks' profitability determinants in post-crisis European Union. Int J Financ Bank Stud 7(1):1–12. https://www.ssbfnet.com/ojs/index.php/ijfbs/article/view/14
Kosmidou K, Tanna S, Pasiouras F (2005) Determinants of profitability of domestic UK commercial banks: panel evidence from the period 1995-2002. Money Macro Financ (MMF) Res Group Conf 45:1–27
Kozak S (2021) The Impact of COVID-19 on Bank Equity and Performance: The Case of Central Eastern South European Countries. Sustainability 13(19):11036. https://doi.org/10.3390/su131911036
Le TD, Ho TH, Nguyen DT, Ngo T (2022) A cross-country analysis on diversification, Sukuk investment, and the performance of Islamic banking systems under the COVID-19 pandemic. Heliyon 8(3):e09106. https://doi.org/10.1016/j.heliyon.2022.e09106
Le TD, Ngo T (2020) The determinants of bank profitability: A cross-country analysis. Cent Bank Rev 20(2):265–273. https://doi.org/10.1016/j.cbrev.2020.04.001
Levin A, Lin CF, Chu C-SJ (2002) Unit Root Tests in Panel Data: Asymptotic and Finite Sample Properties. J Econ 108(1):22. https://doi.org/10.1016/S0304-4076(01)00098-7
López-Penabad MC, Iglesias-Casal A, Silva JF (2022) Effects of a negative interest rate policy in bank profitability and risk taking: Evidence from European Banks. Res Int Bus Financ 60:101597. https://doi.org/10.1016/j.ribaf.2021.101597
Luo Y, Tanna S, De Vita G (2016) Financial openness, risk and bank efficiency: Cross-country evidence. J Financial Stab 24:132–148. https://doi.org/10.1016/j.jfs.2016.05.003
Menicucci E, Paolucci G (2016) Factors affecting bank profitability in Europe: An empirical investigation. Afr J Bus Manag 10(17):410–420. https://doi.org/10.5897/AJBM2016.8081
Noman A, Chowdhury M, Chowdhury N, Kabir M, Pervin S (2015) The effect of bank specific and macroeconomic determinants of banking profitability: a study on Bangladesh. Int J Bus Manag 10(6):287. https://doi.org/10.5539/ijbm.v10n6p287
Ofori-Sasu D, Sarpong MO, Tetteh V, Kusi BA (2022) Banking disclosure and banking crises in Africa: does board gender diversity play a role? Humanit Soc Sci Commun 9(1):1–10. https://doi.org/10.1057/s41599-021-01019-x
Pasiouras F, Tanna S, Zopounidis C (2009) The impact of banking regulations on banks' cost and profit efficiency: Cross-country evidence. Int Rev Financial Anal 18(5):294–302. https://doi.org/10.1016/j.irfa.2009.07.003
Petria N, Capraru B, Ihnatov I (2015) Determinants of banks' profitability: evidence from EU 27 banking systems. Procedia Econ Financ 20:518–524. https://doi.org/10.1016/S2212-5671(15)00104-5
Rekik M, Kalai M (2018) Determinants of banks' profitability and efficiency: empirical evidence from a sample of banking systems. J Bank Financ Econ 1:5–23
Saona P (2016) Intra-and extra-bank determinants of Latin American Banks' profitability. Int Rev Econ Financ 45:197–214. https://doi.org/10.1016/j.iref.2016.06.004
Soyemi K, Akinpelu L, Ogunleye O (2013) The determinants of profitability among deposit money banks (DMBs) in Nigeria post consolidation. Glob Adv Res J Econ. Acc Financ 2(5):93–103
Staikouras C, Wood G (2003) The determinants of bank profitability in Europe. Int Bus Econ Res J 3:57–68
Sufian F (2012) Determinants of bank profitability in developing economies: empirical evidence from the South Asian banking sectors. Contemp South Asia 20(3):375–399. https://doi.org/10.1080/09584935.2012.696089
Sun P, Mohamad S, Ariff M (2017) Determinants driving bank performance: a comparison of two types of banks in the OIC. Pac-Basin Financ J 42:193–203. https://doi.org/10.1016/j.pacfin.2016.02.007
Tariq W, Usman M, Mir H, Aman I, Ali I (2014) Determinants of commercial Banks profitability: empirical evidence from Pakistan. Int J Acc Financ Report 4(2):1–22. https://doi.org/10.5296/ijafr.v4i2.5939
Yanikkaya H, Gumus N, Pabuccu Y (2018) How profitability differs between conventional and Islamic banks: a dynamic panel data approach. Pac-Basin Financ J 48:99–111. https://doi.org/10.1016/j.pacfin.2018.01.006
Yao H, Haris M, Tariq G (2018) Profitability determinants of financial institutions: evidence frombanks in Pakistan. Int J Financ Stud 6(2):53. https://doi.org/10.3390/ijfs6020053
Yin H (2019) Bank globalisation and financial stability: International evidence. Res Int Bus Financ 49:207–224
Yuan D, Gazi MAI, Harymawan I, Dhar BK, Hossain AI (2022) Profitability determining factors of banking sector: Panel data analysis of commercial banks in South Asian countries. Front Psychol 13:1000412. https://doi.org/10.3389/fpsyg.2022.1000412
Yuen MK, Ngo T, Le TDQ, Ho TH (2022) The environment, social and governance (ESG) activities and profitability under COVID-19 evidence from the global banking sector. J Econ Dev 24(4):345–364. https://doi.org/10.1108/JED-08-2022-0136
Yüksel S, Mukhtarov S, Mammadov E, Özsarı M (2018) Determinants of profitability in the banking sector: an analysis of post-soviet countries. Economies 6(41):1–15. https://doi.org/10.3390/economies6030041

Author contributions

PL and ED contributed to the design of the study; ED, MAS, and SFM contributed to the data collection and performed the data analysis; ED and SFM wrote the first draft of the manuscript; PL, ED, MAS, and SFM contributed to the manuscript revision, as well as reading and approving the submitted version.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

Additional information

Correspondence and requests for materials should be addressed to Sergio M. Fernández.