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Ecuador's Banking Sector: How Intrinsic and Extrinsic Factors Shape Productivity?

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Abstract - This article investigates how intrinsic and extrinsic factors related to bank management affect bank production in the short and long run. Currently, research on banking productivity tends to focus on identifying influencing variables; however, the literature does not discriminate between temporary and long-term effects, nor does it demonstrate the mechanisms by which these variables exercise their effects. An error correction model is used to determine how interest-related variables affect banking productivity. In addition, the Malmquist Index, as expanded in the context of Data Envelopment Analysis (DEA) is applied to calculate the productivity. The findings demonstrate that bank productivity is unaffected by levels of international uncertainty, either short or long term. The impact of exogenous variables on banking productivity in Ecuador was also investigated. The results revealed that risk management emerges as a critical element, with a detrimental impact in both the short and long term. A negative association was also found between the delinquency rate and bank productivity, the main mechanism of influence being the fall in technical efficiency. Finally, policy recommendations and strategies that could be implemented to improve banking productivity are presented.

JEL Classification: E5; G2

Keywords-- Bank productivity, Malmquist Index, Panel ECM, Ecuador, Efficiency.

I. Introduction

The Ecuadorian banking system has undergone profound transformations in recent decades, especially after the financial crisis experienced at the end of the 1990s. This crisis caused the need to stabilize the country's financial situation. Thus, at the beginning of 2000, the U.S. dollar was officially adopted as legal tender, which, although this measure achieved a slight stability following the crisis, it represented a loss of autonomy in monetary policy decisions. Since then, the bank sector has been subject to strict regulations and more rigorous financial supervision. For years, this sector has been subject to stringent restrictions and increased financial supervision. For instance, the state is barred from utilizing public funds to bail out banks, as well as limiting the maximum commissions banks can charge for their services. As a result, banks had to look for new methods to enhance operations, diversify revenue streams, and tighten risk management.

Despite more intensive supervision and less state intervention in cases of crisis, in subsequent years, within a dollarized economy and with new regulatory reforms, Ecuador has faced a series of economic and social challenges completely beyond the control of financial institutions. These challenges include political and economic instability, along with recurrent episodes of social protests, which have added to the country's pre-existing structural challenges. At the same time, the country has experienced repercussions derived from the global context, such as international economic crises and significant political events, which may generate instability in international markets and affect investment and consumption decisions towards emerging countries.

According to the literature, there is not a study which analyses the bank efficiency in Ecuador. Moreover, existing papers related to bank productivity focus on identifying the variables that influence it. However, the studies do not discriminate between temporal effects, nor do they define the processes by which these variables have such an effect. This analysis is critical for bank managers to be able to implement timely adjustments. On the other hand, controlling operational risk management has the potential to improve banks' ratings over time, reducing uncertainty and generating confidence among depositors.

Based on the above, there is a need to address these gaps in the literature, which have not been reviewed in depth, namely, the analysis of how bank productivity is influenced by intrinsic and extrinsic factors to bank management. Understanding the dynamics of these factors allows banks to develop more effective mitigation strategies, strengthen their resilience and adaptability to adverse situations, and ensure prudent management of capital and resources. In addition, this understanding contributes to the protection of depositors' interests and the maintenance of confidence in the banking system.

This study is divided into five sections: the first section is the introduction which describe the context, objectives and motivation of the study, the second section explain the existing gaps in the literature, the third section describe the methodology and strategies used for the analysis, the fourth section presents the results and the mechanisms affecting the variables analyzed and the fifth section show the conclusions and recommendations.

II. Literature Review

Bank productivity [1] has been the subject of extensive analysis due to its importance in the efficient operation of financial institutions, as well as its impact on the country's economy. Thus, several studies have focused on analyzing how bank management components can directly or indirectly affect their productivity or efficiency. For instance, risk management can affect the profitability and stability of banks through their operational efficiency [1]. In addition, it has been shown that distinctive characteristics, such as ownership structure and technology, can exert a positive impact on productivity [26; 30]. However, there has been no in-depth examination of the impact of these fundamental characteristics on banking operations, both short and long term.

In addition, the international setting appears to be an important aspect to consider. This unpredictable environment has far-reaching consequences for the economy, politics, and society, promoting enormous volatility in global financial markets. This alters the investment environment and encourages caution among both consumers and businesses. Thus, the link between global uncertainty and its direct effect on banking has been discussed in impact channels such as credit growth dynamics. For instance, reference [2] finds a negative influence on this channel, implying that the underlying mechanism is associated with an increase in default risk. As a result, households may be more likely to default, making it more difficult for them to apply for new loans. In such cases, the authors contend that banks prefer to raise risk premium as a preventative step.

On the other hand, reference [3] analyzed the default ratio and loan size issued to banks. The findings indicated a favorable link between uncertainty and loan performance. This increases credit risk and has a negative impact on loan size. It was also discovered that the amount of marketability moderates these impacts, whereas financial depth enhances the effect on credit risk and strengthens its influence on lending decisions. According to reference [4], uncertainty raises the financial risk of emerging economies while also affecting bank performance and volatility. This effect is determined by whether banks choose to limit the availability of credit. In addition, the authors found an opposite relationship between economic uncertainty and banking stability. This is ascribed to banks' risk decisions (supply-side impacts) rather than deterioration of asset quality caused by borrower distress (demand-side effects).

Reference [5] discovered an inverse link between economic uncertainty and banking stability. However, this is particularly common in countries with a small financial sector and strong levels of competition. Similarly, it has been demonstrated that, while this impact is pronounced in highly liquid and/or profitable banking systems, it is exacerbated in banks that are well capitalized or have a higher level of risk [6], and when disaggregated by banking institution, the largest impact falls on the credits of the largest and riskiest banks [7].

Additionally, reference [8] discovered that the negative association between economic uncertainty and bank productivity is constant both nationally and internationally. That is, as economic policy uncertainty rises in both domestic and foreign markets, lending growth slows for banks. These findings are consistent when utilizing a different method of measurement, such as the global uncertainty index [9] Likewise, there have been studies that indicate the effect of uncertainty on banking productivity, as well as how it is compromised during financial crises, such as the US subprime crisis (2007-2008), sovereign debt (2010-2012), and global financial crisis (2009-2010) [10; 11; 12; 13; 14].

Finally, this study contributes to the literature by examining bank efficiency and the factors influencing it in Ecuador. The latter can serve as proxies for operational risk, such as the delinquency rate and solvency ratio. In addition, external factors that reflect macroeconomic stability, such as GDP growth and inflation, are examined with local uncertainty. Similarly, global market dynamics and international uncertainty will be investigated to better understand their impact on the financial environment in which banks operate.

III. Methodology

The data consists of quarterly financial statements from foreign and local commercial banks operating between 2008 and 2023. These were collected from the Superintendency of Banks (SB) and the Central Bank of Ecuador (BCE) database, as shown in Table I. This study employs unbalanced planel data since several banks went bankrupt or merged during the study period, and banks with a small number of observations were excluded to avoid producing a saturated model.

The panel sample size is an important component in influencing the consistency of estimates in dynamic models [15;16] As a result, our study employs 22 banks for analysis, totaling 1222 records with a minimum of 34 and a maximum of 58 temporal observations per bank, making it a reasonably large and suitable panel for our model [17].

[1] Defined as the efficiency with which a bank uses all its resources, including labor, financial resources and fixed assets, to generate the maximum possible return.

TABLE I
ECUADORIAN BANKS

Name	Start Data
Amazonas	2008q3
Amibank	2008q3
Austro	2008q3
Bolivariano	2008q3
Capital	2008q3
Citibank	2008q3
Coopnacional	2012q2
Delbank	2008q3
Codesarrollo	2014q3
D-miro	2012q3
General Rumiñahui	2008q3
Guayaquil	2008q3
Internacional	2008q3
Litoral	2008q3
Loja	2008q3
Machala	2008q3
Comercial Manabí	2008q3
Pacifico	2008q3
Pichincha	2008q3
Procredit	2008q3
Produbanco	2008q3
Solidario	2008q3

In addition, this study applies to [18], which [19] modified in the context of data envelopment analysis (DEA). This indicator measures production efficiency over time by comparing multiple points in time for a single production unit. DEA model was employed with a production orientation and constant returns to scale (CRS). This methodology constructs a nonparametric empirical production frontier using mathematical programming, which represents the maximum potential output, y^t, for a given set of inputs, x^t, i.e. it seeks to maximize output production with the given inputs. This index uses production technology, represented by an efficient frontier, to calculate the relative productivity of a decision-making unit between time periods. Specifically, it compares a bank's distance to the technological frontier at two different points in time, which allows determination whether the bank has become productive.

Following references [20;21] we define the distance function of the output orientation as follows:

$$D_O^k(x^t, y^t) = \inf\left\{\theta : \left(x^t, \frac{y^t}{\theta}\right) \in S^k\right\} \quad (1)$$

Where S^k, is the production set of all possible input/output vectors, so that the relative technology distance is evaluated in the period k, of the vector (x^t, y^t) occurring in period t. Moreover particularly $\forall (x^t, y^t) \in S^k : D_I^k(x^t, y^t) \leq 1$, y $D_I^k(x^t, y^t) = 1 \leftrightarrow (x^t, y^t)$ belongs to the technology frontier.

This methodology does not require the prescription of a specific functional form, as is common in traditional approaches [22]. Also, it offers flexibility to work with diverse unit systems which does not impose restrictions on the specification of inputs and outputs [23]. Finally, this method provides a comprehensive and systemic perspective for analyzing the performance of the production units under study [24].

Furthermore, reference [25] decomposition was employed to analyze productivity growth (TFPCH) and divide it into three distinct components: technological changes (TECCH), changes in technical efficiency (TECH), and scale efficiency (SECH). This methodology is the most generally used to estimate production technology [26;23] which makes it easier to specify the Malmquist productivity increase as the geometric mean of two time periods:

$$M_O(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)}\right)\left(\frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)}\right)\right]^{1/2} \quad (2)$$

$$M_O(x^{t+1}, y^{t+1}, x^t, y^t) = TFPCH = TECH \times TECCH \times SECH \quad (3)$$

In contrast, the factors employed in this study were chosen based on existing literature. Financial intermediation, in which banks gather deposits and lend them to other economic agents, was considered [27; 28] Furthermore, it was combined with the production method, which views banks as organizations that generate financial services by employing labor and physical capital to make payments and provide loan financing [29;30;31].

The following inputs were used for this study: lagged values of liquidity, operating expenses, personnel expenses, investments and proportion of productive assets. For the outputs we use the values of financial income, service income and loan portfolio to maturity for the same period. It is essential to note that lagged numbers are utilized as inputs since bank productivity cannot be accurately judged without taking the time context into account. Banks' previous activities, such as asset and liability management and investment decisions, have a direct impact on their current financial performance.

The following step is to compute the Malmquist index and its decomposition for each bank and time. This will allow us to determine how external variables, such as the international uncertainty index [32], or the Herfindall index, affect bank productivity. Additional macroeconomic factors, such as annual inflation and nominal GDP growth, are also controlled to capture the underlying economic backdrop and isolate the effects of relevant variables. To explore the dynamic link between productivity and its determinants, we will employ an Error Correction Model (ECM), which allows us to examine the long-run equilibrium of potentially cointegrated variables.

Formally, the ECM is specified as a reparameterization of an autoregressive process of distributed lags:

$$\Delta y_{it} = \phi_i\left(y_{i,t-1} - \theta_i' X_{it}\right) + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{i,t-j} + \sum_{j=1}^{q-1} \delta_{ij}'^{*} \Delta X_{i,t-j} + \mu_i + \epsilon_{it} \tag{4}$$

The dependent variable y_t is productivity growth, X_{it} is a $k \times 1$ vector of explanatory variables. The vector θ'_i contains the equilibrium relationships between the variables in the long run. While the vectors λ_{ii}^{*} and $\delta_{ii}'^{*}$ contains the short-run coefficients. On the other hand, the parameter ϕ_i represents the speed of adjustment to deviations from the long-run equilibrium, a significant negative value evidences the existence of such a stable relationship, however if it is equal to 0 there will be no evidence of a long-run relationship.

There are three techniques to estimate this dynamic. The first is dynamic fixed effects estimation (DFE), which assumes that the short- and long-run coefficients and error variances are equal across groups, capturing a homogeneous effect; however, if the effects of each group differ. The DFE method produces inconsistent and potentially misleading results. On the other hand, the Mean Group (MG) estimator suggested by [33] is the least restricted while also being less informative. This indicator considers heterogeneity in all parameters and assumes that short- and long-term coefficients differ between groups. Finally, reference [34] produced the Pooled Mean Group (PMG) estimator, which is less heterogeneous than the prior one. This approach captures varied short-term dynamics as well as shared long-term limitations among units, eliminating the potential biases of techniques that apply identical parameters across all eras and banks. However, its validity should be compared to the DFE and the MG using a Hausman test to decide which approach is most appropriate based on our data.

IV. Results and Discussions

This section examines the evolution of the productivity index in Ecuador's banking sector, as well as the findings of the estimations used to quantify the short- and long-term influence of the factors of interest. Figure 1 displays the evolution of the inputs and outputs used to calculate the productivity index, which measures the banking sector's quarterly median. It is possible to see unexpected behavior in the first quarter of 2016 in all the variables. In addition, in 2015, there was also a decrease in the credit portfolio, which comprised productive assets, this was linked to the economy's slower dynamism. This finding is related to the fact that during economic downturns, households and businesses tend to be more careful with their spending and investments. During the first phase of this contraction, economic agents harmed by the shock withdraw funds to pay future expenses or crises, reducing deposits. In the second phase, the process is reversed, and economic agents begin to prioritize saves, resulting in an increase in bank savings. When the banking system enters this phase, it sees increased liquidity, which leads to the reactivation of credit placement operations in subsequent periods.

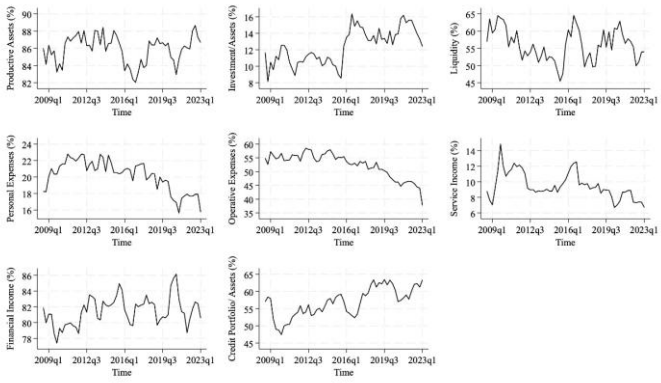

Fig. 1 Evolution of the inputs and outputs.

On the other hand, Fig. 2 depicts the average behavior of the dependent variables used; in 2009, there was a significant reduction in the first quarters following the international financial crisis in 2008, as well as a decrease in the PTFCH and TECH in the first quarter 2016. The crisis reduced global liquidity, limiting banks' access to financing. The credit constraint may have had a detrimental impact on the banking sector's TFP since less productive lending might lower operational efficiency and technical innovation in banking [35; 36].

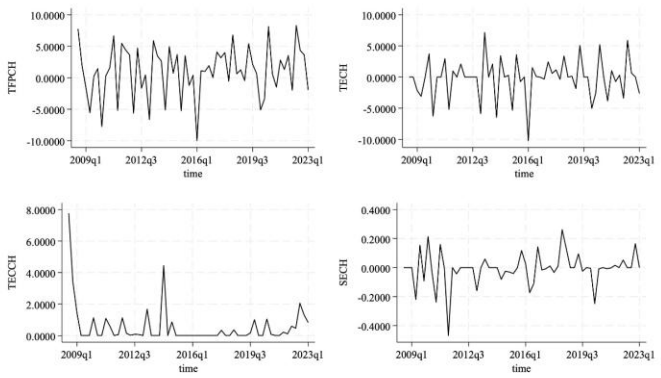

Fig. 2 Depends on variable average behavior in 2009

Nevertheless, Table II displays the examination of exogenous factors, which provide a global perspective on the economic and financial environment. The World Uncertainty Index shows a range of 11.99 to 49.821, indicating considerable oscillations in global uncertainty caused by international events and political changes. Reference [37] mentions that the banking industry is subject to spillers' uncertainty, countries with more limited financial systems see a higher drop in banking efficiency and economic production. In terms of the delinquency rate, the statistics show an average of 4.659 percent of nonperforming loans in the financial sector. Significant variances in loan portfolio quality are demonstrated by the wide variability and range of 0 to 87.043. These findings indicate that changes in credit criteria or the status of the economy are to blame for these outcomes. According to [38] smaller banks in Ecuador are especially vulnerable to delinquency-related risks, according to the report, due to financial limits and market obstacles that these institutions confront when compared to larger banks.

TABLE II
DESCRIPTIVE STATISTICS

Variables	Mean	Median	Std. Dev	Min	Max
World Uncertainty Index	23.844	22.052	7.609	11.99	49.821
Deliquency Rate	4.659	3.385	6.597	0	87.043
Financial Managment	0.102	0.128	0.303	-2.216	0.888
Herfindahl Index	1492.402	1495.541	62.811	1372.121	1654.26
Annual Inflation	2.553	2.85	2.369	-0.933	9.966
GDP Growth	3.554	3.491	5.44	-14.578	18.958

Similarly, the Herfindahl index, which measures market concentration, returned a mean of 1492.40. Values close to the mean with a moderate standard deviation imply a generally consistent concentration in the sector under examination and a competitive market. Reference [39] argue that large levels of concentration might have a negative influence on financial institutions' operational efficiency. The authors demonstrate that institutions in highly concentrated markets are less efficient, however the link varies by country and model. Furthermore, the annual inflation and GDP growth fluctuation may reflect distinct inflationary pressures and economic contractions across time, affecting both consumers and companies [40] emphasized that high inflation has been linked to lower banking efficiency, but GDP growth improves financial institution efficiency due to higher demand for banking services.

Table III displays the TFPCH calculations, which reveal that the coefficient of the speed of adjustment ($\hat{\Phi}$) is negative and statistically significant, indicating the existence of a long-term association. Ecuador's economy has encountered issues such as inflation, currency depreciation, and volatile interest rates. These variables can have a detrimental impact on the banking sector's performance and efficiency, limiting its potential to increase total productivity [41;42].

TABLE III
TOTAL FACTOR PRODUCTIVITY CHANGE ESTIMATION

TFPCH	(1)	(2)	(3)
$\hat{\phi}$	-1.2183***	-1.223***	-1.2418***
	(0.0412)	(0.0404)	(0.0382)
Long Run			
World Uncertainty Index	-0.0767**	-0.0721*	-0.0656
	(0.0388)	(0.0397)	(0.0428)
Deliquency Rate	-0.122**	-0.1096**	-0.107**
	(0.0518)	(0.0527)	(0.0525)
Financial Management	-0.7763	-0.4006	-0.4255
	(1.5436)	(1.586)	(1.5503)
Herfindahl Index	-0.0001	0.0006	0.0005
	(0.0044)	(0.0047)	(0.0048)
Annual Inflation		0.0694	0.0487
		(0.1256)	(0.136)
GDP Growth			0.0391
			(0.0631)
Short Run			
D1. World Uncertainty Index	0.0457	0.0388	0.0244
	(0.0615)	(0.061)	(0.0602)
D1. Deliquency Rate	-3.8653***	-3.9789***	-3.9877***
	(1.4536)	(1.5412)	(1.4709)
D1.Financial Management	8.0618	9.2401	8.2509
	(7.6158)	(7.7121)	(6.9825)
D1. Herfindal Index	0.0102	0.0099	0.0078
	(0.0292)	(0.0294)	(0.0296)
D1. Annual Inflation		0.4079	0.3724
		(0.3671)	(0.3705)
D1. GDP Growth			-0.0975
			(0.1721)
Constant	6.2038***	4.6799***	4.5732***
	(0.4649)	(0.4531)	(0.4449)

In the context of the Global Uncertainty Index, it is seen that not employing local macroeconomic indicators has a detrimental impact in the long term; however, when these variables are included, this impact disappears in both the short and long term. This lack of relevance could be due to the

Ecuadorian financial system's limited worldwide exposure. In contrast, bank productivity growth has a stronger relationship with the Delinquency Rate, both short and long term, with a negative correlation. In the short term, the Delinquency Rate has a more direct and obvious impact on technical or operational efficiency, with a rise in the Delinquency Rate resulting in an immediate decrease in the banks' ability to generate products and services using the available inputs.

Although the current research finds a strong negative relationship between delinquency and productivity due to decreased technical efficiency, reference [43] in his analysis in Latin America countries, suggests that the overall development level of financial institutions, particularly their capacity for credit access and risk mitigation, moderates this impact. Countries with more established financial markets are less sensitive to rising delinquencies in terms of TFP erosion, implying that Ecuador's system may still lack enough resilience mechanisms.

In comparation, Table IV demonstrates that the speed of adjustment ($\hat{\phi}$) is negative and statistically significant, indicating that the relationship remains persistent over time. Models (4) and (5) employ changes in technological efficiency (TECH) as their dependent variable. The findings indicate that in the long run, no macroeconomic component has a lasting effect. However, in the short run, the default rate has a negative and statistically significant influence on technical efficiency.

Furthermore, we demonstrate that inflation has a positive and statistically significant short-term effect on technical efficiency. This tendency arises from the fact that inflationary eras are characterized by greater interest margins and increased loan demand. These results confirm other studies, inflation might help banks optimize certain expenses by capitalizing on increased interest margins. This is because inflation frequently allows banks to absorb the additional expenses associated with inflation in the short term, which improves technical efficiency ratings in areas where inflationary conditions prevail [44;41]. However, in models (6) and (7), there were notable variations in the way inflation influences change over time with respect to the impact of technical change (TECCH). While inflation has a detrimental impact in the near term, which obscures its primary source of influence, it has a positive and statistically significant effect on technological advancement in the long term.

TABLE IV
DECOMPOSITION OF THE TFPCH

	TECH		TECCH		SECH	
	(4)	(5)	(6)	(7)	(8)	(9)
$\hat{\phi}$	-1.2541***	-1.2654***	-0.8782***	-0.9584***	-1.3856***	-1.3891***
	(0.034)	(0.0338)	(0.0441)	(0.037)	(0.0375)	(0.039)
Long Run						
World Uncertainty Index	-0.0349*	-0.0239	-0.0271**	-0.0163	-0.0013	-0.0008
	(0.0208)	(0.0235)	(0.0128)	(0.0132)	(0.0022)	(0.0024)
Deliquency rate	-0.1756	-0.154	-0.017	-0.011	0.0062	0.0112
	(0.1165)	(0.1258)	(0.0183)	(0.0174)	(0.0156)	(0.0169)
Financial management	-0.7047	0.1378	0.4255	0.0268	0.1051	0.1561
	(1.2158)	(1.2068)	(0.4456)	(0.3953)	(0.1251)	(0.124)
Herfindal index	-0.0034	-0.0008	0.0014	-0.0011	-0.0001	0.0001
	(0.0023)	(0.0026)	(0.0016)	(0.0016)	(0.0002)	(0.0003)
Annual Inflation		-0.0359		0.1689***		-0.0036
		(0.0744)		(0.0422)		(0.0075)
GDP Growth		0.0075		0.0154		0.0011
		(0.0367)		(0.0194)		(0.0036)
Short Run						
D1. World Uncertainty Index	-0.0368	-0.0589	-0.0109	-0.0112	0.1181**	0.1181**
	(0.0612)	(0.0599)	(0.0162)	(0.0168)	(0.0544)	(0.0557)
D1. Deliquency rate	-4.093***	-3.949***	0.4982	0.2924	-0.1012	-0.0628
	(1.342)	(1.4153)	(0.7418)	(0.6842)	(0.2385)	(0.2534)
D1.Financial management	2.532	2.7819	2.6128	3.5948	0.8517	0.6079
	(5.4153)	(5.6789)	(2.4125)	(2.2924)	(1.7725)	(1.9228)
D1. Herfindal index	-0.0336	-0.0336	0.0223***	0.0189**	0.0188	0.0188
	(0.0261)	(0.0261)	(0.0087)	(0.0078)	(0.0154)	(0.0147)
D1. Annual Inflation		1.0488**		-0.3654***		0.4297
		(0.4259)		(0.1105)		(0.2707)
D1. GDP Growth		0.0789		-0.1705***		0.1019
		(0.1453)		(0.0637)		(0.0793)
Constant	7.8799***	2.61***	0.2453***	2.9937***	0.1178	-0.2524***
	(0.3008)	(0.1939)	(0.157)	(0.1862)	(0.0913)	(0.0822)

Additionally, a positive and statistically significant short-term influence on the Herfindahl index is demonstrated by the results. One possible explanation for this tendency is that dominating enterprises can create bigger profit margins in more concentrated markets, giving them the financial means to invest in R&D. To keep their dominant position and create obstacles to entrance for new competitors, leading companies can be more inclined to innovate. Reference [45] utilize the HHI index to investigate how competition and market structure influence technical efficiency in Latin American banks. Their research confirms that higher values of the HHI, which indicate concentrated markets, might drive technical change by motivating banks to innovate and increase efficiency to preserve competitiveness. In the medium term, the results show that GDP growth has a statistically significant negative impact on technical change. This could be because companies may put immediate production expansion and market share acquisition ahead of technological innovation during times of high economic growth. Some studies support this finding [46]. GDP growth frequently results in a bigger supply of credit, which can reduce pressure on banks to innovate as they rely more on existing systems to fulfill rising

demand. This trend can stimulate technological advancements, resulting in a less efficient banking organization overall

Finally, we find that the Global Uncertainty Index has a short-term, positive, and statistically significant effect when scale efficiency (SECH) is considered. It is crucial to remember that this influence does not show up as immediate gains in banking operations or productivity. Rather, the impact seems to be more evident in the way businesses modify their management approaches in reaction to international unpredictability. The finding indicates that, in the face of greater uncertainty, businesses tend to re-evaluate and adapt their managerial and strategy methods rather than making immediate operational changes.

V. Conclusions

The main purpose of this study is to contribute to the current literature by conducting an examination of bank productivity. It also examines how bank TFP is influenced in the short and long run by factors internal and external to bank management. Understanding the dynamics of these factors is critical for implementing strategies and regulations that improve banking productivity in Ecuador. Among the study's main findings, it was discovered that, contrary to popular belief, global uncertainty has no direct impact on banking productivity, operational or technological factors in Ecuador. Its influence is most noticeable in the areas of strategic and managerial management. This finding is critical in understanding how responses to global uncertainty are channeled primarily through management decisions that adjust goals and policies in the short term, rather than immediately impacting technical output or bank operations. To boost Ecuador's banking sector in the context of global uncertainty, tax incentives and particular credits must be used to encourage technological innovation and increase cybersecurity in banks, thereby strengthening the sector's infrastructure.

Moreover, a clear and negative association was found between the delinquency rate and bank productivity, with the primary mechanism of influence being a drop in technical efficiency. This suggests that a degraded loan portfolio with a high risk of default is directly proportional to poorer bank profitability. The higher expenses involved with managing and recovering non-performing loans, as well as the urgent need to implement more conservative lending practices, severely limit financial institutions' productivity and operational efficiency. To mitigate this detrimental impact, it is critical to implement policies that promote stability and more conservative risk management. Policymakers should not only push greater credit scoring and due diligence but also promote the use of automated loan monitoring systems and predictive analytics to detect early warning signs. Regulatory reforms can help by requiring greater portfolio transparency and offering tax breaks for digital credit risk infrastructure. In addition, it is suggested that a more conservative credit culture be fostered by rules that improve risk assessment and scoring. Financial education for both lenders and borrowers could minimize the likelihood of default, while more cautious lending processes would assist eliminating high-risk loans.

Likewise, in terms of technical progress, more concentrated markets provide large short-term benefits to innovative investments due to increased profit margins. This positions top businesses by providing them with the resources they require to stimulate innovation and increase their competitive advantages. In terms of GDP growth, there was a detrimental influence on technical innovation, even in the short term. This could be because, during periods of rapid economic growth, businesses emphasize production expansion and market acquisition over technical development operations. Promoting public-private collaborations and improving legislative frameworks to facilitate technology transfer and financial access are critical strategies for mitigating this adverse effect.

In terms of macro-financial stability, the findings also show that productivity-boosting measures are unlikely to succeed unless bank balance-sheet resilience is improved. To lessen systemic risk, Ecuadorian policymakers should follow effective regional approaches, such as Colombia's early adoption of countercyclical capital buffers and Chile's robust regulatory environment for digital banking.

Finally, one of the limitations is that the sample only contains one nation; future study might include multiple countries, allowing for the analysis of new variables and the capture of variations between various types of financial markets. This would provide a more comprehensive understanding of how diverse economic and regulatory conditions influence banking productivity. Moreover, future research could operationalize productivity using parametric approaches, ensuring that the impacts discovered are reliable. Using these methodologies, researchers might confirm the validity of present findings and even identify new nuances in the links between productivity, risk management, and market dynamics.

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