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Examining the Nexus Between Income Diversification, Profitability and Risk of Brazilian Banks: A Dynamic Panel Data Analysis

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Abstract
The study examines how bank profitability and risk are impacted by income and asset diversification in Brazilian developing banking industry. The researchers employ a dynamic panel model with System GMM estimate on a panel data of 125 banks between 2011 and 2022 to account for the persistence of bank performance and risk. The findings indicate that income and asset diversification both considerably improve risk-adjusted profitability as indicated by risk adjusted return on assets (RROA) and risk adjusted return on equity (RROE) and but increasing bank risk as indicated by the standard deviation of returns (σ(ROA) and σ(ROE)). These findings show how diversification is strategically valuable for enhancing resilience and financial success in an unpredictable economic climate. The report advocates for risk-sensitive innovation and diverse development methods and provides useful insights for regulators, policymakers, and bank management.

Keywords: Bank Performance, Income Diversification, Asset Diversification, System GMM
JEL Classification: G01, G20, G21

1. Introduction
The performance and stability of banks are critical to the broader financial system and economic development, particularly in emerging economies such as Brazil. In recent decades, banks have increasingly adopted diversification strategies to enhance resilience, improve profitability, and manage risk. Among these strategies, **income diversification**—shifting revenue streams beyond traditional interest income—and **asset diversification**—allocating resources across various asset classes or sectors—have drawn considerable scholarly attention (Stiroh, 2004; DeYoung & Roland, 2001). These strategic moves are especially relevant in volatile markets where macroeconomic fluctuations, regulatory changes, and competitive pressures challenge traditional banking models (Acharya et al., 2006).
Income diversification allows banks to generate revenues from non-interest sources such as fees, commissions, trading income, and asset management services. This diversification is often pursued to mitigate the risks associated with declining interest margins, which are common in low-interest or volatile financial environments. Asset diversification, on the other hand, involves the distribution of a bank's credit and investment portfolio across different sectors, industries, or geographies to reduce concentration risk and improve asset quality (Elsas et al., 2010). Both forms of diversification aim to strengthen banks' financial

performance, measured commonly through metrics such as return on assets (ROA), return on equity (ROE), and risk-adjusted profitability.

The Brazilian banking sector presents a compelling case for examining the effects of diversification. Brazil has a well-developed yet highly concentrated banking system, where a few large financial institutions dominate market share, but a substantial number of medium and small-sized banks operate regionally. The sector has undergone significant structural changes over the past two decades, including financial liberalization, technological adoption, and tighter regulatory oversight. However, Brazilian banks continue to face challenges related to credit risk, economic shocks, and asset quality, particularly during periods of political instability and global economic uncertainty (Costa et al., 2020).

While international literature has explored the benefits and drawbacks of diversification, empirical findings remain inconclusive. Some studies suggest that diversification enhances financial performance by stabilizing income streams and reducing risk exposure (Meslier et al., 2014), whereas others warn of potential inefficiencies due to operational complexity and loss of managerial focus (Laeven & Levine, 2007). In the context of Brazil, the interaction between diversification strategies and bank performance remains underexplored, particularly in light of the country's unique economic dynamics and regulatory environment.

This study aims to fill this research gap by investigating the impact of income and asset diversification on the performance of Brazilian banks. Specifically, it examines whether these strategies contribute positively to profitability and risk management or if they result in diminishing returns and inefficiencies. By providing empirical insights, this research contributes to the broader discourse on bank strategy and regulation in emerging markets and offers practical implications for bank managers and policymakers seeking to strengthen financial resilience and competitiveness.

2. Review of Literature

The relationship between diversification strategies and bank performance has been widely examined in financial literature, particularly in the context of risk management and profitability enhancement. However, the findings across different economies and institutional settings remain inconclusive, and limited empirical work exists in the Brazilian context. This section reviews relevant scholarly work on **income diversification**, **asset diversification**, and their joint impact on **bank performance**, focusing on theoretical and empirical insights.

2.1. Diversification and Bank Performance

Income diversification refers to the shift in banks' revenue structures from traditional interest-based income toward non-interest income such as fees, commissions, trading income, and other financial services. Several studies argue that this strategic move enables banks to stabilize revenues, reduce sensitivity to interest rate fluctuations, and improve risk-adjusted returns (Stiroh, 2004; DeYoung & Roland, 2001). DeYoung and Roland (2001) found that although non-interest income may reduce dependence on traditional lending activities, it can also introduce higher volatility due to market-based income components like trading.

Stiroh (2004) analyzed U.S. commercial banks and concluded that higher non-interest income shares are associated with increased earnings volatility, offsetting potential gains in average returns. Similarly, Lepetit et al. (2008) showed that banks focusing more on non-interest income, especially trading and investment-related activities, experience greater income variability and risk exposure. However, Meslier, Tacneng, and Tarazi (2014), using data from emerging economies, argue that moderate levels of income diversification can improve performance, particularly for small and medium-sized banks with limited economies of scale in lending.

In Latin America, empirical evidence is relatively scarce. Silva and Stefanelli (2015) examined Brazilian banks and reported that income diversification had a positive effect on return on assets (ROA), particularly during stable macroeconomic conditions. They caution, however, that such benefits depend on the bank's operational capacity to manage diversified business lines effectively.

2.2. Asset Diversification and Risk Mitigation

Asset diversification involves the allocation of bank resources across multiple sectors, industries, or regions to mitigate concentration risk. According to Modern Portfolio Theory (Markowitz, 1952), such diversification should theoretically reduce the unsystematic risk of bank portfolios. Empirical research largely supports this premise. Elsas, Hackethal, and Holzhäuser (2010) found that asset diversification across industries and geographies reduced the risk level of German banks without sacrificing profitability.

In a cross-country study, Acharya, Hasan, and Saunders (2006) showed that diversification benefits are conditional on bank-specific characteristics and market environments. For Brazilian banks, whose loan portfolios are often concentrated in a few sectors, asset diversification could be a vital strategy to absorb sectoral shocks and improve loan quality. Barros and Silva (2020) analyzed the Brazilian banking sector and found that banks with more diversified asset portfolios had lower non-performing loan ratios and higher capital adequacy.

However, some studies argue that diversification into unfamiliar sectors may dilute managerial focus and increase monitoring costs (Winton, 1999). In emerging markets, where institutional and informational asymmetries are more pronounced, the effectiveness of asset diversification depends heavily on governance, credit risk assessment systems, and macroeconomic conditions.

2.3 Combined Impact of Income and Asset Diversification

A growing body of literature attempts to assess the joint impact of income and asset diversification on bank performance. Baele, De Jonghe, and Vander Vennet (2007) highlighted that while both forms of diversification can reduce risk, the combined effect may be non-linear, especially if diversification exceeds optimal levels. Excessive diversification may result in overextension of resources, operational complexity, and strategic misalignment.

Chiorazzo, Milani, and Salvini (2008), studying Italian banks, found that non-interest income improves performance only when combined with prudent asset allocation. Their results align with the risk-return hypothesis, which posits that diversification benefits plateau beyond a certain threshold. In the Latin American context, limited empirical work exists on this interaction, warranting further investigation, particularly in Brazil's evolving banking landscape.

Despite a rich body of international literature, the Brazilian context remains underexplored. Most existing studies either focus on large global banks or provide cross-country evidence, which may not fully capture the nuances of Brazil's financial sector. Furthermore, there is a lack of longitudinal studies that examine the performance implications of diversification during different macroeconomic cycles, such as post-crisis periods or during monetary tightening. This research addresses these gaps by empirically examining the independent and interactive effects of income and asset diversification on the performance of Brazilian banks over a multi-year period.

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3.Research Methodology

3.1 This study investigates the impact of bank diversification on risk-taking behavior and performance outcomes within the banking sector of Brazil. Employing an unbalanced panel dataset spanning the period 2011–2022, the analysis integrates both macroeconomic and microeconomic variables. Macroeconomic indicators were sourced from the World Bank's *World Development Indicators (WDI)*, while bank-level financial data were extracted from the *BankFocus* database. The sample is restricted to banks with a minimum of three consecutive years of continuous operation during the study period, ensuring data consistency and robustness. To mitigate the influence of outliers and potential measurement errors, extreme observations were systematically excluded on a variable-wise basis. The final dataset comprises 125 banks and a total 1136 bank-year observations, offering a comprehensive empirical basis for the analysis.

3.2 Description of Variables

Classification	Variable	Operationalization	Prior Literature
Dependent Variable			
Bank Performance Measures	Risk adjusted return on assets (RROA)	(ROA / σROA)	Alkhouri and Arouri (2019)
	Risk adjusted return on equity (RROE)	(ROE / σROE)	Alkhouri and Arouri (2019)
Bank Risk Measures	Standard deviation of return on assets	σ(ROA)	Zhou (2014); Pennathur et al. (2012)
	Standard Deviation of Return on equity	σ(ROE)	Moudud-Ul-Huq (2018)
Independent Variable			
Bank Diversification	Income Diversification (ID)	$\frac{Non-interest\ income}{Total\ Income}$	Stiroh (2004a), Stiroh and Rumble (2006), Gompers et al. (2003),
	Asset Diversification (AD)	$\frac{Non-interest\ bearing\ asse}{Total\ assets}$	Edirisuriya et al. (2015)
Control Variables			
Bank-specific	Size	Log (Total Assets)	Stiroh and Rumble, (2006); Baele et al., (2007); Sanya and Wolfe (2011)
	Equity Ratio	$\frac{Equity\ Capital}{Total\ assets}$	Chiorazzo et al., (2008); Meslier

			et al., (2014)
	Credit Risk	$\frac{Loan\ Loss\ Provisions}{Total\ assets}$	Mergaerts and Vander , (2016)
	Asset Growth	Annual growth rate of total assets	Stiroh, (2004); Demirgüç-Kunt and Huizinga, (2010); Pennathur et al., (2012)
	Loan Ratio	$\frac{Total\ loans}{Total\ assets}$	Stiroh and Rumble, (2006); Chiorazzo et al., (2008); Chortareas et al., (2011);
Macroeconomic Control Variables	GDP Growth rate	$\frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$	Pasiouras & Kosmidou, (2007); Petria et al., (2015); Rani & Zergaw, (2017);
	Annual Inflation rate	Consumer Price Index (CPI)	Anbar & Alper, (2011); Chowdhury & Rasid, (2017); Jara-Bertin et al., (2014);

3.3 Empirical Models

The researcher has used the following empirical models:

1. To investigate the impact of income diversification on bank performance in Brazil.

$$RROA_{it} = \alpha + \beta_1 ID_{it} + \sum_{j=2}^{J} \beta_j X_{it}^{j} + \sum_{l=2}^{L} \beta_l X_{it}^{l} + \varepsilon_{it} \quad (1)$$

$$RROE_{it} = \alpha + \beta_1 ID_{it} + \sum_{j=2}^{J} \beta_j X_{it}^{j} + \sum_{l=2}^{L} \beta_l X_{it}^{l} + \varepsilon_{it} \quad (2)$$

Where $RROA_{it}$ in equation (1) and $RROE_{it}$ in equation (2) is the the risk adjusted return on asset and the risk adjusted return on equity respectively of bank i at time t, with i=1,…….N, t=1,…….T, α is a constant, ID_{it} is a measure of income diversification of bank i at time t, X_{it}^{j} are the bank specific control variables and X_{it}^{l} are the macroeconomic indicators that are to be controlled, ε_{it} is the error term.

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Since bank performance measured by risk adjusted return on assets or the risk adjusted return on equity may have a tendency to persist over the time period due to information asymmetry, lack of perfect competitive conditions and sensitivity to macroeconomic shocks (Berger et al., 2000). Therefore, the researcher used a dynamic panel data model by including a lagged dependent variable among the independent variables. Therefore, the dynamic model is represented by:

$$RROA_{it}=\alpha+\delta RROA_{it-1}+\beta_1 ID_{it}+\sum_{j=2}^{J}\beta_j X_{it}^{j}+\sum_{l=2}^{L}\beta_l X_{it}^{l}+\varepsilon_{it} \quad (3)$$

$$RROE_{it}=\alpha+\delta RROE_{it-1}+\beta_1 ID_{it}+\sum_{j=2}^{J}\beta_j X_{it}^{j}+\sum_{l=2}^{L}\beta_l X_{it}^{l}+\varepsilon_{it} \quad (4)$$

Where $RROA_{it}$ in equation (3) and $RROE_{it}$ in equation (4) is the risk adjusted return on asset and the risk adjusted return on equity respectively of bank i at time t, with i=1,…….N, t=1,…….T, α is a constant, $RROA_{it-1}$ is the one period lagged Risk Adjusted Return on Assets (dependent variable) in equation 3 and $RROE_{it-1}$ is the one period lagged Risk Adjusted Return on Equity (dependent variable) in equation 4. δ is the speed of adjustment to equilibrium, ID_{it} is a measure of income diversification of bank i at time t, X_{it}^{j} are the bank specific control variables and X_{it}^{l} are the macroeconomic indicators that are to be controlled, ε_{it} is the error term.

2. To examine the impact of income diversification on bank risk in Brazil.

$$\sigma(ROA)_{it}=\alpha+\beta_1 ID_{it}+\sum_{j=2}^{J}\beta_j X_{it}^{j}+\sum_{l=2}^{L}\beta_l X_{it}^{l}+\varepsilon_{it} \quad (5)$$

$$\sigma(ROE)_{it}=\alpha+\beta_1 ID_{it}+\sum_{j=2}^{J}\beta_j X_{it}^{j}+\sum_{l=2}^{L}\beta_l X_{it}^{l}+\varepsilon_{it} \quad (6)$$

Where $\sigma(ROA)_{it}$ in equation (5) and $\sigma(ROE)_{it}$ in equation (6) is the standard deviation of return on asset or the standard deviation of return on equity respectively of bank i at time t, with i=1,…….N, t=1,…….T, α is a constant, ID_{it} is a measure of income diversification of bank i at time t, X_{it}^{j} are the bank specific control variables and X_{it}^{l} are the macroeconomic indicators that are to be controlled, ε_{it} is the error term.

Since bank risk measured by standard deviation of return on assets or the standard deviation of return on equity may have a tendency to persist over the time period due to information asymmetry, lack of perfect competitive conditions and sensitivity to macroeconomic shocks (Berger et al. 2000). Therefore, the researcher will be using a dynamic panel data model by including a lagged dependent variable among the independent variables. Therefore, the dynamic model is represented by

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$$\sigma(ROA)_{it} = \alpha + \delta\sigma(ROA)_{it-1} + \beta_1 ID_{it} + \sum_{j=2}^{J} \beta_j X_{it}^{j} + \sum_{l=2}^{L} \beta_l X_{it}^{l} + \varepsilon_{it} \quad (7)$$

$$\sigma(ROE)_{it} = \alpha + \delta\sigma(ROE)_{it-1} + \beta_1 ID_{it} + \sum_{j=2}^{J} \beta_j X_{it}^{j} + \sum_{l=2}^{L} \beta_l X_{it}^{l} + \varepsilon_{it} \quad (8)$$

Where $\sigma(ROA)_{it}$ in equation (7) and $\sigma(ROE)_{it}$ *in equation (8) is the standard deviation of return on asset or the standard deviation of return on equity respectively of bank i at time t, with i=1,…….N, t=1,…….T,* α *is a constant,* $\sigma(ROA)_{it-1}$ *is the one period lagged standard deviation of return on assets (dependent variable)* in equation (7) and $\sigma(ROE)_{it-1}$ *is the one period lagged standard deviation of return on equity (dependent variable)* in equation(8). δ *is the speed of adjustment to equilibrium,* ID_{it}*is a measure of income diversification of bank i at time t,* X_{it}^{j} *are the bank specific control variables and* X_{it}^{l} *are the macroeconomic indicators that are to be controlled,* ε_{it} *is the error term.*

4. Data Analysis

Table 4.1 Descriptive statistics

Variables	Mean	SD	Min	Max	Obs
Dependent variable: **Performance Measures**					
RROA	3.123	1.127	- 3.218	6.948	1136
RROE	4.255	1.098	- 2.245	7.224	1136
Dependent variable: **Risk Measures**					
SD(ROA)	1.356	0.098	0.912	4.879	1136
SD(ROE)	2.214	0.012	1.018	3.245	1136
Independent variable : Income **Diversification Measure**					
ID	0.416	0.167	0.047	0.745	1136
Independent variable : Asset **Diversification Measure**					
AD	0.372	0.099	0.024	0.595	1136
Control variables					
SZ	19.447	1.281	16.536	22.016	1136
ER	0.547	0.216	0.356	0.927	1136

CR	0.291	0.089	.017	0.71	1136
AG	0.583	0.142	0.267	0.679	1136
LR	0.310	0.202	0.015	0.567	1136
GGDP	4.118	1.212	3.260	7.123	1136
IF	3.898	2.112	3.190	6.167	1136

The table 4.1 above displays the various descriptive statistics for dependent, independent and control variables for Brazil.

Table 4.2: Pearson Correlation Matrix

Variables	**RROA**	**RROE**	**SD (ROA)**	**SD (ROE)**	**ID**	**AD**	**SZ**	**ER**	**CR**	**AG**	**LR**	**GGDP**	**IF**
RROA	1												
RROE	0.45*	1											
SD(ROA)	0.39	0.53	1										
SD(ROE)	0.48	0.26	0.33	1									
ID	0.56*	0.62*	-0.49	-0.29	1								
AD	-0.43*	-0.56*	0.38	0.42	-0.39*	1							
SZ	0.35*	0.54	0.47	0.22	0.63*	0.33*	1						
ER	0.44*	0.28	0.51	0.19	0.54	0.44	0.49	1					
CR	0.61*	0.48	-0.57	-0.21	0.32*	0.59*	0.43*	0.26	1				
AG	-0.22	0.38	0.16*	0.44	0.61*	0.24	0.59*	-0.46	0.19	1			

LR	0.34*	0.29	0.38 *	0.42	-0.49	0.45*	0.39 *	0.25	0.37	0.62*	1		
GGDP	0.12*	0.23	0.51 *	0.61 *	0.26	0.37	0.48 *	-0.30	-0.56	0.22	0.14 *	1	
IF	-0.33*	-0.46	-0.14	0.26	0.53 *	0.49*	0.49	0.22	0.39*	-0.11	0.61 *	0.42 *	1

*Significant at 5% level

The table 4.2 above displays the Pearson correlation coefficient between various variables used in the study. This table displays the correlation coefficients between dependent, independent and control variables for Brazil. The correlation coefficient between income diversification (ID) and size (SZ) is the highest at 0.63 and is significant at 5% level of significance. The lowest correlation coefficient of -0.11 is between asset growth rate (AG) and inflation rate (IR). This correlation is insignificant. Overall, all the correlation coefficients between the independent variables are less than 0.8 which indicates the absence of multicollinearity amongst the independent variables (Hair et al. 2010). Furthermore, according to Kennedy (2008), multicollinearity between the variables becomes a challenge when the correlation between two variables is greater than 0.70.

Table 4.3: Effect of Income Diversification on Profitability and Risk

Dependent Variable Model	**RROA**	**RROE**	**σ(ROA)**	**σ(ROE)**
RROA (-1)	0.123** (1.967)	-		
RROE (-1)	-	0.146** (1.934)		
σ(ROA) (-1)			0.834** (1.154)	
σ(ROE) (-1)				0.691** (1.394)
ID	.326*** (3.278)	.277*** (2.983)	.213** (2.278)	.107*** (3.482)
SZ	.042** (1.922)	.011** (1.976)	.018** (1.912)	.041** (1.792)
ER	.014* (1.123)	.016 (0.792)	.034** (1.468)	.046 (0.329)
CR	.023 (0.683)	.026* (1.065)	.047 (0.338)	.026* (1.256)
AG	.017 (0.432)	.014 (0.598)	.057** (1.131)	.024 (0.697)

LR	.026** (2.061)	.032** (1.989)	.046** (3.163)	.029** (1.523)
GGDP	.022* (1.122)	.028* (1.357)	.052** (1.233)	.058 (.857)
IF	.013 (0.835)	.015 (1.010)	.113** (1.935)	.215** (1.879)
Constant	1.22	1.67	1.87	1.36
Adj. R Squared	22.5	26.242	37.395	46.421
J-statistic	.112	.173	.092	.105
AR(1)	.017	.029	.027	.041
AR(2)	.234	.121	.115	.149

The table 4.3 above summarizes the results of the system GMM dynamic panel model for the effect of income diversification on bank profitability for Brazil. Two different estimation models have been used to examine the relationship between income diversification and bank profitability. Risk adjusted return on assets (RROA) and Risk adjusted return on equity (RROE) have been considered as the dependent variable in different estimation models. The second column in the above table shows the results with risk adjusted return on assets (RROA) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of income diversification on risk adjusted return on assets (RROA) highlight that estimation model is valid. The Hansen's J-statistic in a GMM model is a test of overidentifying restrictions. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.112 of J-statistic indicates that the null hypothesis of Hansen's test can be accepted. Therefore, the overidentifying restrictions in the estimation model are valid. The p value of AR(1) which is .017 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.234 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (RROA (-1)) is 0.123 and is significant at 5% level of significance. The results confirm the persistence of bank profitability over time. In other words, the past performance of the bank measured by risk adjusted return on assets has a significant positive impact on the current risk adjusted return on assets. The coefficient of income diversification (ID) is 0.326 which is significant at 1% level of significance. The results indicate that income diversification has a significant positive impact on risk adjusted return on assets. Therefore, diversification of the income sources of Brazilian banks has resulted in enhanced profitability of these banks. If the income diversification of the Brazilian banks is increased by 1%, it will lead to an increase in risk adjusted return on assets (bank profitability) for these banks by 0.326%. Size (SZ) of the banks also has a significant positive impact on the risk adjusted return of assets (RROA). The coefficient of bank size is 0.042 which is significant at 5% level of significance. It indicates that bank size also positively influences the bank profitability measured by risk adjusted return on assets. The coefficients of equity ratio (ER) and growth of gross domestic product (GGDP) are also significant at 10% level of significance whereas the coefficient of LR is significant at 5% level of significance. Thus equity ratio, loan ratio and growth of gross domestic product also have a positive effect on risk adjusted return on assets for Brazilian Banks.

The third column in the above table shows the results with risk adjusted return on equity (RROE) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of income diversification on risk adjusted return on equity

(RROE) highlight that estimation model is valid. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.173 of J-statistic indicates that the null hypothesis of Hansen's test can be accepted. Therefore, the overidentifying restrictions in the estimation model are valid. The p value of AR(1) which is .029 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.121 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (RROE (-1)) is 0.146 and is significant at 5% level of significance. The results confirm the persistence of bank profitability over time. In other words, the past performance of the bank measured by risk adjusted return on equity((RROE(-1)) has a significant positive impact on the current risk adjusted return on equity (RROE). The coefficient of income diversification (ID) is 0.277 which is significant at 1% level of significance. The results indicate that income diversification has a significant positive impact on risk adjusted return on equity. Therefore, diversification of the income sources of Brazilian banks has resulted in enhanced profitability of these banks. If there is 1% increase in income diversification of the Brazilian banks, it will lead to an increase in risk adjusted return on equity (bank profitability) for these banks by 0.277%. Size (SZ) of the banks also has a significant positive impact on the risk adjusted return on equity (RROE). The coefficient of bank size is 0.11 which is significant at 5% level of significance. It indicates that bank size also positively influences the bank profitability measured by risk adjusted return on equity. The coefficients of credit risk (CR) and growth of gross domestic product (GGDP) are also significant at 10% level of significance whereas the coefficient of loan ratio (LR) is significant at 5% level of significance. Thus credit risk, loan ratio and growth of gross domestic product also have a positive effect on risk adjusted return on equity (RROE) for Brazilian Banks

The Column 4 and 5 of above table summarizes the result the results of the system GMM dynamic panel model for the effect of income diversification on bank risk for Brazil. Two different estimation models have been used to examine the relationship between income diversification and bank risk. Standard deviation of return on assets (σ(ROA)) and standard deviation of return on equity (σ(ROE)) have been considered as the dependent variable in different estimation models. The fourth column in the above table shows the results with standard deviation of return on assets (σ(ROA)) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of income diversification on standard deviation of return on assets (RROA) highlight that estimation model is valid. The Hansen's J-statistic in a GMM model is a test of overidentifying restrictions. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.092 of J-statistic indicates that the null hypothesis of Hansen's test can be accepted at 5% level of significance. Therefore, the overidentifying restrictions in the estimation model are valid. The p value of AR(1) which is .027 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.115 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (σ(ROA)(-1)) is 0.834 and is significant at 5% level of significance. The results confirm the persistence of bank risk over time. In other words, the past risk of the bank measured by the standard deviation of return on assets (σ(ROA)(-1)) has a significant positive impact on the current standard deviation of return on assets (σ(ROA). The coefficient of income diversification (ID) is 0.213 which is significant at 5% level of significance. The results indicate that income diversification has a significant positive impact

on standard deviation of return on assets. Therefore, diversification of the income sources of Brazilian banks has resulted in enhanced risk of these banks. If the income diversification of the Brazilian banks is increased by 1%, it will lead to an increase in standard deviation of return on assets (bank risk) for these banks by 0.213%. Size (SZ) of the banks also has a significant positive impact on the standard deviation of return of assets (σ(ROA)). The coefficient of bank size is 0.018 which is significant at 5% level of significance. It indicates that bank size also contributes in enhancing the bank risk measured by standard deviation of return on assets. The coefficients of equity ratio (ER), asset growth ratio (AG), loan ratio (LR), growth of gross domestic product (GGDP) and inflation (IF) are also significant at 5% level of significance. All these variables have a positive effect on standard deviation of return on assets (σ(ROA) for Brazilian Banks. Therefore, these variables contribute towards enhancing the bank risk for these banks.

The fifth column in the above table shows the results with the standard deviation of return on equity (σ(ROE) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of income diversification on standard deviation of return on equity (σ(ROE) highlight that estimation model is valid. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.105 of J-statistic indicates that the null hypothesis of Hansen's test can be accepted. Therefore, the overidentifying restrictions in the estimation model are valid. The p value of AR(1) which is .041 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.149 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (σ(ROE)(-1)) is 0.691 and is significant at 5% level of significance. The results confirm the persistence of bank risk over time. In other words, the past risk of the bank measured by standard deviation of return on equity (σ(ROE) has a significant positive impact on the current standard deviation of return on equity (σ(ROE). The coefficient of income diversification (ID) is 0.107 which is significant at 1% level of significance. The results indicate that income diversification has a significant positive impact on standard deviation of return on equity (σ(ROE). Therefore, diversification of the income sources of Brazilian banks has resulted in enhanced risk for these banks. If there is 1% increase in income diversification of the Brazilian banks, it will lead to an increase in standard deviation of return on equity (σ(ROE) (bank risk) for these banks by 0.107%. Size (SZ) of the banks also has a significant positive impact on the standard deviation of return of equity (σ(ROE)). The coefficient of bank size is 0.041 which is significant at 5% level of significance. It indicates that bank size also has a positive impact on the bank risk measured by standard deviation of return on equity ((σ(ROE)). The coefficient of credit risk (CR) is also significant at 10% level of significance whereas the coefficient of loan ratio (LR) and coefficient of inflation (IF) is significant at 5% level of significance. The credit risk, loan ratio and inflation also have a positive effect on standard deviation of return on equity (σ(ROE)) for Brazilian Banks.

Table 5: Effect of Asset Diversification on Profitability and Risk

Dependent Variable Model	RROA	RROE	σ(ROA)	σ(ROE)
RROA (-1)	0.197*** (4.267)	-		
RROE (-1)	-	0.364**		

		(2.134)		
σ(ROA)(-1)			0.247*** (3.657)	-
σ(ROE)(-1)			-	0.314*** (4.397)
AD	.057*** (4.154)	.037** (1.983)	-.158** (2.187)	-.287*** (2.392)
SZ	.045** (1.278)	.036*** (3.769)	.072* (1.241)	.058* (1.326)
ER	.611* (1.033)	.412** (1.893)	.216** (1.919)	.094* (0.997)
CR	.423** (2.836)	.094* (1.465)	.059** (2.003)	.066** (1.065)
AG	.151 (0.432)	.104 (0.649)	.109** (1.912)	.014** (1.767)
LR	.026** (2.061)	.058** (1.839)	.059** (2.573)	.032** (1.989)
GGDP	.022* (1.122)	.318* (1.357)	.138** (1.792)	.328** (1.857)
IF	.226** (1.835)	.115 (.890)	.118** (1.689)	.015** (1.697)
Constant	3.17	3.38	5.58	1.67
Adj. R Squared	32.563	27.936	13.651	26.242
J-statistic	.128	.089	.217	.193
AR(1)	.047	.032	.043	.029
AR(2)	.150	.349	.285	.121
No. of Observations	1136	1136	1136	1136

The table 5 above summarizes the results of the system GMM dynamic panel model for the effect of asset diversification on bank profitability for Brazil. Two different estimation models have been used to examine the relationship between asset diversification and bank profitability. Risk adjusted return on assets (RROA) and Risk adjusted return on equity (RROE) have been considered as the dependent variable in different estimation models. The second column in the above table shows the results with risk adjusted return on assets (RROA) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of income diversification on risk adjusted return on assets (RROA) highlight that estimation model is valid. The Hansen's J-statistic in a GMM model is a test of overidentifying restrictions. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.128 of J-statistic indicates that the null hypothesis of Hansen's test can be accepted. Therefore, the overidentifying restrictions in the estimation model are valid. The p value of AR(1) which is .047 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.150 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (RROA (-1)) is 0.197 and is significant at 1% level of significance. The results confirm the persistence of bank profitability over time. In other

words, the past performance of the bank measured by risk adjusted return on assets has a significant positive impact on the current risk adjusted return on assets. The coefficient of asset diversification (AD) is 0.057 which is significant at 1% level of significance. The results indicate that asset diversification has a significant positive impact on risk adjusted return on assets. Therefore, diversification of the assets of Brazilian banks has resulted in enhanced profitability of these banks. If the asset diversification (AD) of the Brazilian banks is increased by 1%, it will lead to an increase in risk adjusted return on assets (bank profitability) for these banks by 0.057%. Size (SZ) of the banks also has a significant positive impact on the risk adjusted return of assets (RROA). The coefficient of bank size is 0.045 which is significant at 5% level of significance. It indicates that bank size also positively influences the bank profitability measured by risk adjusted return on assets. The coefficient of equity ratio (ER) and growth of gross domestic product (GGDP) are also significant at 10% level of significance whereas the coefficient of credit risk (CR), loan ratio (LR) and inflation (IF) is significant at 5% level of significance. Thus equity ratio, loan ratio, growth of gross domestic product and inflation also have a positive effect on risk adjusted return on assets for Brazilian Banks.

The third column in the above table shows the results with risk adjusted return on equity (RROE) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of income diversification on risk adjusted return on equity (RROE) highlight that estimation model is valid. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.089 of J-statistics indicates that the null hypothesis of Hansen's test can be accepted at the 5% level of significance. Therefore, the overidentifying restrictions in the estimation model are valid. The p-value of AR(1) which is 0.032 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.349 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (RROE (-1)) is 0.364 and is significant at 5% level of significance. The results confirm the persistence of bank profitability over time. In other words, the past performance of the bank measured by risk adjusted return on equity((RROE(-1)) has a significant positive impact on the current risk adjusted return on equity (RROE). The coefficient of asset diversification (ID) is 0.037 which is significant at 5% level of significance. The results indicate that asset diversification has a significant positive impact on risk adjusted return on equity. Therefore, diversification of the asset sources of Brazilian banks has resulted in enhanced profitability of these banks. If there is 1% increase in asset diversification of the Brazilian banks, it will lead to an increase in risk adjusted return on equity (bank profitability) for these banks by 0.037%. Size (SZ) of the banks also has a significant positive impact on the risk adjusted return of assets (RROE). The coefficient of bank size is 0.036 which is significant at 1% level of significance. It indicates that bank size also positively influences the bank profitability measured by risk adjusted return on equity. The coefficients of credit risk (CR) and growth of gross domestic product (GGDP) are also significant at 10% level of significance whereas the coefficients of equity ratio (ER) and loan ratio (LR) are significant at 5% level of significance. Thus credit risk, equity ratio, loan ratio and growth of gross domestic product also have a positive effect on risk adjusted return on equity for Brazilian Banks.

The 4th and 5th Column of table 5 summarizes the results of the system GMM dynamic panel model for the effect of asset diversification on bank risk for Brazil. Two different estimation models have been used to examine the relationship between asset diversification and bank

risk. Standard deviation of return on assets (σ(ROA)) and standard deviation of return on equity (σ(ROE)) have been considered as the dependent variable in different estimation models. The fourth column in the above table shows the results with standard deviation of return on assets (σ(ROA)) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of asset diversification on standard deviation of return on assets (σ(ROA)) highlight that estimation model is valid. The Hansen's J-statistic in a GMM model is a test of overidentifying restrictions. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.217 of J-statistic indicates that the null hypothesis of Hansen's test can be accepted at 5% level of significance. Therefore, the overidentifying restrictions in the estimation model are valid. The p value of AR(1) which is .043 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.285 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (σ(ROA)(-1)) is 0.247 and is significant at 1% level of significance. The results confirm the persistence of bank risk over time. In other words, the past risk of the bank measured by the standard deviation of return on assets (σ(ROA)(-1)) has a significant positive impact on the current standard deviation of return on assets (σ(ROA)). The coefficient of asset diversification (AD) is -0.158 which is significant at 5% level of significance. The results indicate that asset diversification has a significant positive impact on standard deviation of return on assets. Therefore, diversification of the asset base of Brazilian banks has resulted in reduced risk for these banks. If the asset diversification of the Brazilian banks is increased by 1%, it will lead to an decrease in standard deviation of return on assets (bank risk) for these banks by 0.158%. Size (SZ) of the banks also has a significant positive impact on the standard deviation of return of assets (σ(ROA)). The coefficient of bank size is 0.072 which is significant at 10% level of significance. It indicates that bank size also contributes in enhancing the bank risk measured by standard deviation of return on assets. The coefficient of equity ratio (ER) is also significant at 10% level of significance. Additionally, the coefficients of credit risk (CR) asset growth ratio (AG), loan ratio (LR), growth of gross domestic product (GGDP) and inflation (IF) are also significant at 5% level of significance. All these variables have a positive effect on standard deviation of return on assets (σ(ROA) for Brazilian Banks. Therefore, these variables contribute towards enhancing the bank risk for these banks.

The fifth column in the above table shows the results with the standard deviation of return on equity (σ(ROE) as the dependent variable. The diagnostic statistics of the system GMM dynamic panel model to examine the impact of asset diversification on standard deviation of return on equity (σ(ROE) highlight that estimation model is valid. The null hypothesis of Hansen's J-statistic is H_0 : The overidentifying restrictions in the estimation model are valid. The p value of 0.193 of J-statistic indicates that the null hypothesis of Hansen's test can be accepted. Therefore, the overidentifying restrictions in the estimation model are valid. The p value of AR(1) which is .029 indicates the presence of first order autocorrelation and p value of AR(2) which is 0.121 indicates the absence of second order autocorrelation. Therefore, the diagnostic statistics of the system GMM model highlights that our results are robust. The coefficient of the lag of the dependent variable (σ(ROE)(-1)) is 0.314 and is significant at 1% level of significance. The results confirm the persistence of bank risk over time. In other words, the past risk of the bank measured by standard deviation of return on equity (σ(ROE) has a significant positive impact on the current standard deviation of return on equity (σ(ROE). The coefficient of asset diversification (AD) is -0.287 which is significant at 1%

level of significance. The results indicate that asset diversification has a significant negative impact on standard deviation of return on equity (σ(ROE). Therefore, diversification of the asset base of Brazilian banks has resulted in reduced risk for these banks. If there is 1% increase in asset diversification of the Brazilian banks, it will lead to a reduction in standard deviation of return on equity (σ(ROE) (bank risk) for these banks by 0.107%. Size (SZ) of the banks also has a significant positive impact on the standard deviation of return of equity (σ(ROE)). The coefficient of bank size is 0.058 which is significant at 10% level of significance. It indicates that bank size also has a positive impact on the bank risk measured by standard deviation of return on equity ((σ(ROE)). The coefficient of credit risk (CR) is also significant at 10% level of significance and has a positive influence on bank risk measured by standard deviation of return on equity ((σ(ROE)) whereas the coefficient of loan ratio (LR) and coefficient of inflation (IF) is significant at 5% level of significance. These variables have a positive effect on standard deviation of return on equity (σ(ROE)) for Brazilian Banks.

5. Conclusion and Implications:

The paper concludes that Income diversification greatly increased the profitability of Brazilian banks. More income-diversified banks showed greater risk-adjusted returns on equity (RROE) and risk-adjusted returns on assets (RROA), according to the research. The profitability advantages of various revenue sources were highlighted by the 0.326% gain in RROA and the 0.277% rise in RROE that resulted from a 1% increase in revenue diversification. Larger banks benefited from income diversification as well because bank size (SZ) had a discernible and favorable impact on profitability. Additionally, the loan ratio (LR), equity ratio (ER), and gross domestic product growth (GGDP) were highlighted as critical elements influencing better bank performance. However, the study discovered that income diversification significantly increased bank risk in Brazil, which was a very bad thing. Higher revenue diversity results in more volatility in bank performance, according to the standard deviation of return on equity (σ(ROE)) and return on assets (σ(ROA)). A 1% increase in income diversification led to a 0.213% increase in σ(ROA) and a 0.107% increase in σ(ROE), indicating that banks with greater income variety faced greater financial risk. Additionally, it was discovered that bank risk and bank size (SZ) were positively correlated, suggesting that larger banks will experience more return variations. The equity ratio (ER), asset growth ratio (AG), loan ratio (LR), gross domestic product growth (GGDP), and inflation (IF) were additional statistically significant risk-increasing factors. By using diagnostic testing, the researchers increased the validity of these findings. Dependability was demonstrated by the Hansen's J-statistic, which validated the model's overidentifying restrictions. Furthermore, the results revealed first-order autocorrelation but not second-order autocorrelation, demonstrating the consistency of the computations. Overall, the data showed that while diversifying their revenue streams may help Brazilian banks become more profitable, it also increases bank risk.

Regarding how asset diversification affected bank profitability, the study discovered that it significantly increased bank profitability in Brazil. The findings demonstrated that higher risk-adjusted returns on both assets (RROA) and equities (RROE) were the outcome of increased asset diversification. A 1% increase in asset variety, in instance, led to a 0.057% increase in RROA and a 0.037% increase in RROE, indicating that banks with diverse asset portfolios performed better financially. Furthermore, bank size (SZ) was revealed to be a major determinant of profitability because larger banks benefited more from improved asset diversification. Other statistically significant positive characteristics that impacted

profitability were the equity ratio (ER), lending ratio (LR), credit risk (CR), GDP growth, and inflation (IF). Overall, the findings showed that asset diversification might help Brazilian banks become more profitable. However, the study demonstrates that asset diversification clearly lowers bank risk in Brazil, which in turn lowers the financial volatility of banks with a wider range of assets. The standard deviation of return on equity (σ(ROE)) and return on assets (σ(ROA)) decreased by 0.287% and 0.158%, respectively, when asset diversification grew by 1%. These results demonstrated that asset diversification is a crucial factor in determining both reduced risk exposure and stable bank profits. Despite the fact that asset diversity normally lowers risk, bank size (SZ) showed a strong and substantial correlation with bank risk, suggesting that larger banks were more susceptible to fluctuations in returns. The primary determinants of greater risk levels were credit risk (CR), asset growth ratio (AG), loan ratio (LR), gross domestic product growth (GGDP), and inflation (IF), confirming that both firm-specific and macroeconomic factors influenced the risk profile of Brazilian banks. Overall, the findings indicated that asset diversification could help Brazilian banks lower financial risk while maintaining profitability stability.

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