

Income Diversification, Market Structure and Bank Stability: A Cross-country Analysis*

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Abstract

Using a macro-level dataset covering 173 countries from 2000 to 2020, this study is the first attempt to examine how income diversification and market concentration are related to bank stability. Firstly, we document that bank stability is positively related to revenue diversification, suggesting that banks are more stable when they are more engaged in non-traditional activities. Secondly, market concentration is positively associated with bank stability, in line with the concentration-stability hypothesis that banks in a highly concentrated banking system are more likely to be more stable. Thirdly, we show that market concentration modifies the link between revenue diversification and bank stability. Specifically, it is shown that diversified banks are more stable in a more concentrated environment compared to those on a less concentrated market. These results are robust to multiple regression specifications with different proxies for bank stability and income diversification.

Keywords: income diversification, bank stability, market concentration

JEL Codes: G21, G33, L22, L25

1. Introduction

Banks play an important role in a financial system, and a robust banking system is crucial to attaining sustainable economic growth (Kristani, 2019). As a result, risks in the banking system may have widespread impacts on various stakeholders, including governments, firms, households, creditors and lenders. Thus, a fuller understanding of factors that determine bank

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stability is essential for researchers and policymakers. What motivates us to conduct research into bank stability is the fact that during the last two decades, bank regulators have urged reforms that encouraged privatizations, mergers and acquisitions, as well as facilitating the process of deregulation and liberalization of the banking system, leading to certain changes in market structure, in an attempt to make it more resilient (Hamid, 2017; Munoz-Mendoza et al., 2020). Furthermore, the global integration of banking systems is becoming deeper and deeper, which is bound to introduce additional competition among banks.

Given the new context of stronger international and domestic competition, banks are inevitably faced with the strategic choice of diversification. In fact, bank diversification has been identified as one of the important determinants of bank stability. According to the modern portfolio theory, diversification can efficiently reduce banks' risk, while improving economies of scale of banks (Shim, 2019). In contrast to the aforementioned "diversification benefits", opposing views forewarn of the "diversification costs", which might hamper bank stability (Stiroh, 2004; Stiroh and Rumble, 2006; Shim, 2019). In light of the contrasting hypotheses, the net effect of diversification on banking stability requires further empirical investigation.

Additionally, the numbers of banks have decreased in most countries, leading to an increase in concentration ratios (Munoz-Mendoza et al., 2020). Our calculation using Global Financial Development Database data reveals that there is a marginal rise in the average concentration ratio from 2010 to 2020 all over the world. There are two contrasting hypotheses regarding the effect of market structure on bank stability: (i) the concentration-stability and (ii) the concentration-fragility views. The concentration-stability hypothesis opines that larger banks in a highly concentrated system are conducive to more stability (Allen and Gale, 2004). In contrast, the concentration-fragility hypothesis argues that larger banks on a concentrated market are associated with higher instability (Boyd and De Nicolo, 2005; Schaeck et al., 2009; Uhde and Heimeshoff, 2009). One reason is the moral hazard issue of "too big to fail", which can emerge when there is higher concentration and fewer banks on the market, resulting in more instability (Mirzei et al., 2013). Many studies have been conducted to investigate bank competition or its impact on various aspects of bank operations and stability (Agoraki et al., 2011; Beck et al., 2013; Danisman and Demirel, 2019; Mateev et al., 2022). Nonetheless, as Calice et al. (2021) pointed out, despite numerous studies on the relationship between competition and bank stability, the effect of concentration on stability has received far less attention.

In the current context, it is pressing to find answers to several issues. Firstly, should banks diversify activities to lower their risk and maintain stable cash flows? Secondly, bank reforms and policies naturally lead to different levels of bank concentration, thus different levels of competition. So, is market structure also related to bank stability? Thirdly, the effectiveness of banks' diversification strategy could be a function of bank concentration. For exam-

ple, according to the transaction cost theory, banks should reduce their diversification level when operating in a highly competitive environment, because it is more imperative to maintain competitiveness by reducing costs associated with managing a multi-business firm (Bergh and Lawless, 1998; Shim, 2019). According to Beck et al. (2006), more concentration causes banks to diversify activities. Banks may have additional incentives to participate in riskier activities as they grow larger and more diverse (Boyd and De Nicolo, 2005). Therefore, it is interesting to investigate the joint effect of bank concentration and income diversification to offer a better comprehension of the impact of these two factors on bank stability.

Our study extends the literature from several perspectives. Firstly, this research is an effort in response to Calice et al. (2021), who called for more research into the relationship between market concentration and bank stability. Secondly and more importantly, previous studies have only focused on individual impacts of bank diversification as well as market concentration on banks' financial stability. There is only one empirical study (Shim, 2019) that examines the impact of the interaction between loan diversification and market structure on bank stability. Investigating the joint effect would help identify channels through which bank stability might be affected by diversification, thus contributing to resolving the inconclusive findings so far. However, Shim (2019) only studied banks on the US market and focused on loan portfolio diversification, so the finding might not be representative for the other countries. We use the most recent and more representative aggregate dataset, which spans across 173 nations from 2002 to 2020, covering almost all territories in the world. We also focus more on the mainstream type, which is revenue diversification. The implications from the two types of diversification might not be the same, so our study should provide a more comprehensive understanding. Another issue with Shim (2019) is that the author used a rather unique proxy from the Core Based Statistical Area dataset, perhaps more related to the US market, which has not been testified to be a proper proxy for concentration. It is not a conventional measure either, thus not allowing proper comparison with other studies. We, instead, rely on more conventional measures, 3-bank and 5-bank concentration ratios, to allow proper comparisons with the studies in the field. Finally, we conduct several robustness checks to ensure that the findings are more relevant for the current context and more reliable.

The study proceeds as follows. Foundational theories, relevant empirical studies, and testable hypotheses are discussed in Section 2. Section 3 discusses research methodology, including estimation strategies, empirical models and variable description. Then, Section 4 discusses the findings together with robustness tests to ascertain the findings. Section 5 concludes the article and provides implications.

2. Literature Review and Hypotheses

2.1 Income diversification and bank stability

According to portfolio theory, diversification can reduce bank risk by adding assets that do not have high correlation with current assets (Chiorazzo et al., 2008). In addition, diversification may consolidate bank stability thanks to the joint production of numerous services and increased revenue from cross-selling fee-based products, referred to as economies of scope (Klein & Saldenberg, 2000).

Several works have confirmed that diversification strategy can lower risk (Gallo et al., 1996; Kwast, 1989), minimizing the impact of financial distress (Froot and Stein, 1998). These articles suggest that if non-traditional activities are limited, there is a negative link between diversification and bank risk. Income diversification is shown to benefit banks in developed countries (Chiorazzo et al., 2008; Köhler, 2015). Non-traditional activities also reduce bank risk in lower-income countries, but such gains vary according to bank type and country (Lee et al., 2014). Nguyen et al. (2012) demonstrated that diversified banks with market power appear to be more stable. Nguyen (2019) also documented a positive linkage between income diversification and bank risk in Vietnam from 2010–2018.

To sum up, our first testable hypothesis is as follows:

Hypothesis 1a: Income diversification is positively related to bank stability.

Nonetheless, diversification may increase the operational complexity as it increases the scale of banks' activities (Rajan et al., 2000). Because there appear to be few capital requirements for fee-based activities, more diversified banks may benefit from operating with greater leverage and making riskier investments. According to Stiroh (2004), increased fee-based income is associated with higher systemic risks and return uncertainty. The results are similar to those of Calmès and Liu (2009) for a sample of banks in Canada, who found that income diversification is linked with higher income volatility. Other studies, including Moudud-Ul-Huq et al. (2018) for ASEAN-5 countries, Meslier et al. (2014) for the Philippines, and Sanya and Wolfe (2011) for emerging economies, have documented similar results.

Banks more involved in fee-based activities face higher systemic risk due to higher asset correlations (Lee et al., 2020), heightened insolvency risk (Lepetit et al., 2008), or increased revenue volatility (Mercieca et al., 2007). Furthermore, using international data, Laeven and Levine (2007) highlighted a diversification discount as a result of agency problems.

Therefore, we formulate another hypothesis on the linkage between revenue diversification and stability as follows:

Hypothesis 1b: Income diversification is inversely related to bank stability.

2.2 Market structure and stability of banking systems

There are two contrasting views regarding the effect of market structure on bank stability: (i) the concentration-stability and (ii) the concentration-fragility views.

Following the “concentration-stability” view, market power reduces asymmetric information and enhances loan portfolio quality (Petersen and Rajan, 1995). Hellmann et al. (2000) proposed a theoretical model in which market power encourages banks to be more prudent and take less risk to guard their franchise value. Allen and Gale (2004) argued that the ability to enjoy healthier profit margins would discourage asset deterioration and renders banking systems more stable when markets are more concentrated. Studying a sample of 69 countries from 1980 to 1997, Beck et al. (2006) discovered that on a more concentrated market, crises occur less frequently. Schaeck et al. (2009) provided similar results using a sample of banks in 48 countries. Interestingly, in addition to a linear relationship, Munoz-Mendoza et al. (2020) suggested a nonlinear association between market concentration and bank risk for a sample of 206 countries between 1994 and 2015.

The above literature leads us to the following hypothesis:

Hypothesis 2a: Market concentration has a positive impact on bank stability.

On the other hand, supporters of “concentration-fragility” theory believe that greater concentration might result in heightened banking instability. Boyd and De Nicolo (2005) suggested that banks with strong power on the lending market are more likely to charge higher interest rates on customer loans. This might exacerbate the risk-taking incentives of the borrowers and increase their default risk. According to Mirzaei et al. (2013), greater concentration can worsen the moral hazard issue in the case of large banks, incentivizing them to demand high interest rates on loans, rendering borrowers susceptible to defaults. Nicolás et al. (2004) found that higher concentration is associated with banking fragility for a sample of banks in 90 countries. Uhde and Heimeshoff (2009), Fu et al. (2014) and Kasman and Kasman (2015) have recorded similar results for banks in Europe, Asia Pacific and Turkey, respectively. Recently, Kristani et al. (2019) highlighted that a more concentrated market leads to higher probability of financial distress among Indonesian banks.

Hypothesis 2b: Market concentration is negatively associated with bank stability.

2.3 Joint impact of income diversification and market structure on bank stability

Belkhaoui et al. (2014) supposed that diversification is a response so that firms can strategically adjust themselves to changes to market conditions. Increased competition (lower concentration) has a negative impact on firm's profitability. As a result, firms consider diversifying business to remain profitable and/or tackle growth constraints.

According to transaction cost theory, managers weigh up benefits and costs of diversification to select the optimal level of diversification (Jones and Hill, 1988). Larger firms are more able to realize economies of scope. On a concentrated market, banks tend to be larger; thus, the benefit of diversification should be higher with such a market structure. When a market is more competitive, more uncertainty and complexity in the market conditions are introduced, and banks might consider reducing the operational inefficiency caused by multi-business (Shim, 2019). Banks can achieve this by shifting resources to traditional/main activities, in other words, scaling down non-core business (Bowen and Wiersema, 2005). Therefore, it is expected that diversification should be more beneficial on a less competitive (highly concentrated) market.

In a concentrated environment, diversified banks have better return prospects possibly thanks to a better market power and more efficient economies of scope. In the case of high concentration, the costs of diversification are likely to be lower. Therefore, diversified banks in a more concentrated system are expected to be more stable as opposed to specialized banks. Based on the arguments above, we formulate the following hypothesis:

Hypothesis 3a: The impact of income diversification on bank stability is more positive as bank concentration is higher.

Nonetheless, a contrasting hypothesis might also be formulated. Hughes and Mester (1998) suggested that a well-diversified bank can enjoy decreased marginal costs of risk handling thanks to diversification, thus being willing to take more risk. Moreover, O'Hara and Shaw (1990) argued that large and diversified banks are prone to have a larger safety net from authorities due to concerns about potential financial instability caused by spillovers from the collapse of large banks. This may incentivize bank managers to take on extremely risky activities and increase financial instability.

Hypothesis 3b: The impact of income diversification on bank stability is more negative as bank concentration is higher.

3. Research Methodology

3.1 Data

The research uses a sample of 173 countries over the period 2000–2020. We retrieved the data at national levels from the Global Financial Development Database (for aggregate bank system indicators) and the World Development Indicators (for macroeconomic variables). We selected the countries and period based on data availability.

3.2 Methodology

Arellano and Bover's (1995) GMM estimator is used in this study as a result of the panel data structure. We use the GMM estimator to address two fundamental issues of unobserved heterogeneity and endogeneity; as a result, this estimator produces consistent parameter estimates. The system GMM estimator uses lagged values of the dependent variable and other explanatory variables that are likely to be endogenous. Furthermore, we conduct conventional tests of order two autocorrelation and the over-identifying conditions. If the null hypothesis of both tests cannot be rejected, the set of instruments used is valid and the moment conditions are satisfied. Our first empirical dynamic model is as follows:

$$Zscore_{i,t} = \alpha + \alpha_1 Zscore_{i,t-1} + \alpha_2 MS_{i,t} + \alpha_3 INDIV_{i,t} + \alpha_4 Control\ variables_{i,t} + \varepsilon_t \quad (1)$$

We include MS*INDIV to examine the effect of the interaction between market structure and income diversification on stability as follows:²

$$Zscore_{i,t} = \beta + \beta_1 Zscore_{i,t-1} + \beta_2 MS_{i,t} + \beta_3 MS_{i,t} \times INDIV_{i,t} + \beta_4 Control\ variables_{i,t} + \varepsilon_{it} \quad (2)$$

We employ Z-score as a proxy of bank stability (Lepetit et al., 2008; Stiroh and Rumble, 2006; Shim, 2019). Better Z-score values imply greater banking stability and lower overall bank risk. Z-score values are attained from the Global Financial Development Database.

Market structure (MS): Market share, CR3 and CR5, is used to estimate market structure in the banking industry. These are structural measures to gauge bank concentration (Berger et al., 2004; Mirzaei et al., 2013). CR3 (CR5) is computed as the ratio of the largest three (five) banks' assets to the total assets of all commercial banks in an economy (Čihák et al., 2012). Higher CR3 (CR5) indicates more concentration on the market.

2 Equation (2) does not include the income diversification variable as a result of the multicollinearity problem, which is clear from the VIF test (not tabulated here).

Income diversification (INDIV): In line with Le (2021), Stiroh and Rumble (2006), INDIV, the ratio of non-interest income to total net income, is used to consider the effect of revenue diversification. Ideally, non-interest income should be split into more detailed categories, but this is not feasible due to limitations of the Global Financial Development Database.

Control variables

We include the cost-to-income ratio as a measure for operating efficiency (EFFICIENCY), following Khediri and Ben-Khedhiri (2009) and Hamid (2017). We anticipate that a higher cost-to-income ratio is expected to link with lower stability. The net interest margin (NIM) of a commercial bank measures its profitability in lending and investing activities (Wang and Lin, 2021).

Liquidity is calculated as the proportion of bank liquid reserves to bank assets. Several financial institutions have collapsed in crises due to a lack of liquidity. Berger and Bouwman (2013) believe that having a large amount of cash on hand can reduce liquidity risk and insolvency. Cole and White (2012) and DeYoung and Torna (2013) suggest that more liquid banks are less susceptible to failure.

GDP growth rate is used to account for economic conditions that might affect bank investment opportunities and, as a result, bank risk-taking behaviour. According to Dietrich and Wanzenried (2014) and Athanasoglou et al. (2008), the relationship between GDP and Z-score is positive because economic growth increases desire for bank products and services, leading to higher profitability and bank stability. On the other hand, banks can also pursue mass lending during periods of economic growth, putting them at greater risk. Inflation rate (INF) is included, because higher inflation rates may trigger lower repayment capability by affecting borrowers' financial strength and liquidity (Pervan et al., 2015).

4. Results and Discussion

4.1 Descriptive statistics

Descriptive statistics of the variables are provided in Table 1. The mean of bank stability (Z-score) is 16.09. Furthermore, a high standard deviation of Z-score suggests considerable volatility throughout the research period. CR3 and CR5 have means of 71.36 and 81.19, respectively, indicating highly concentrated markets on average. INDIV has a mean value of 37.53.

Table 2 provides the pairwise correlation coefficients of the variables. In general, diversification is positively associated with bank stability, whereas market structure is negatively correlated with bank stability. As pairwise correlations do not control for the coexistence of the other regressors, they just provide some initial evidence of the relationship between factors.

Table 1: Descriptive statistics

Factor	Proxy	Obs.	Mean	Standard deviation	Min.	Max.
Z-score	Bank stability	3,077	16.099	8.969	1.694	44.989
INDIV	Income diversification	3,005	37.532	13.757	10.119	78.898
CR3	Market structure	3,110	71.362	20.019	23.452	100
CR5	Market structure	2,602	81.192	16.584	13.793	100
EFFICIENCY	Bank operating efficiency	3,000	56.522	14.245	18.468	96.622
NIM	Bank profitability	2,970	4.614	2.896	0.619	15.355
LIQUIDITY	Bank liquidity	1,106	0.127	0.075	0.004	0.336
GDP	Economic growth	3,591	17.305	10.183	0.360	34.780
INF	Inflation	3,591	14.645	97.148	0.360	31.790

Notes: Bank-related variables are winsorized at the 1% and 99% levels.

Source: authors' calculations.

Table 2: Correlation matrix

	Z-score	CR3	CR5	INDIV	EFFICIENCY	NIM	Liquidity	GDP	INF
Z-score	1								
CR3	0.027	1							
CR5	0.003	0.941	1						
INDIV	−0.151	0.024	0.017	1					
EFFICIENCY	−0.130	−0.063	−0.067	0.251	1				
NIM	−0.064	−0.099	−0.041	−0.110	0.147	1			
LIQUIDITY	−0.036	0.144	0.105	0.358	0.053	0.030	1		
GDP	−0.019	−0.104	−0.084	0.005	−0.054	0.210	−0.060	1	
INF	−0.037	−0.083	−0.066	−0.072	−0.029	0.262	−0.046	0.159	1

Source: authors' calculations.

4.2 Base models

As seen in Table 3, the coefficients of the lagged dependent variable are significant for all the models, suggesting that stability exhibits dynamism. Furthermore, there is evidence of over-identification and no autocorrelation of order 2 conditions due to insignificant p-values of the two tests.

The results in Table 3 indicate that commercial banks' revenue diversification (INDIV) has a significant positive effect on Z-score, or a higher level of diversification is associated with lower bank risk. This result is in line with our Hypothesis 1a and the portfolio theory by Markowitz (1968). Our results support the view that diversification may consolidate bank stability thanks to the joint production of numerous services and increased revenue from cross-selling fee-based products, referred to as economies of scope, in line with several studies (Chunhachinda and Li, 2014; Wang and Lin, 2021). This result defies those of Stiroh (2004), Calmès and Liu (2009), Laeven and Levine (2007), Lee et al. (2020), and Lepetit et al. (2008), among others.

The market concentration variables (CR3 and CR5) are positively related to Z-score. This suggests that higher concentration is associated with more stability, lending credence to the "concentration-stability" argument. This result agrees with our Hypothesis 2a and previous works (Maudos and De Guevara, 2004; Beck et al., 2006; Schaeck et al., 2009). However, this finding contradicts Nicoló et al. (2004), Mirzaei et al. (2013), Uhde and Heimeshoff (2009), Fu et al. (2014) and Kasman and Kasman (2015). Our results support the positive attributes of banking concentration for those countries: better monitoring and higher charter value that reduce the incentives to take unnecessary risks.

Importantly, the interaction terms are significantly positive in Models 2–4 of Table 3, suggesting that the influence of income diversification varies depending on the level of market concentration. Specifically, the positive coefficients of interaction terms imply that banks with diversified activities in more concentrated environments are likely to be sounder, compared to those in less concentrated environments. The result provides support for Hypothesis 3a, which emphasizes that diversification has more pro-stability impacts on markets that are less competitive. Our findings further support the hypothesis that, in a concentrated environment, diverse banks have higher return prospects due to greater market strength and more efficient economies of scope, and that the costs of diversification are likely to be lower.

Regarding the control variables, the results are consistent with expectations. The cost-to-income ratio is significantly negative, indicating that lower efficiency is associated with a less stable banking system. Liquidity is found to have a positive coefficient, implying that a higher

proportion of liquid assets improves a bank's financial conditions (Shim, 2019). The NIM is significantly positive, indicating that bank profitability improves bank stability (Wang and Lin, 2021). Besides, the significantly negative coefficient of INF on Z-score suggests that inflation lowers loan repayment capability (Pervan et al., 2015).

Table 3: Income diversification, market structure and bank stability

Z-score	Model 1	Model 2	Model 3	Model 4
Z-score_{t-1}	0.678*** (0.115)	0.655*** (0.019)	0.511*** (0.017)	0.468*** (0.031)
INDIV	0.147** (0.070)		0.085*** (0.006)	
CR3	0.068* (0.037)	0.015** (0.006)		
CR5			0.023** (0.011)	0.055*** (0.018)
CR3*INDIV		0.000*** (0.000)		
CR5* INDIV				0.001*** (0.000)
EFFICIENCY	-0.283* (0.161)	-0.014*** (0.005)	-0.083*** (0.009)	-0.056*** (0.011)
NIM	0.367 (0.302)	0.303*** (0.041)	0.827*** (0.058)	0.320*** (0.090)
LIQUIDITY	-0.103 (0.100)	0.016*** (0.003)	0.001 (0.005)	0.027*** (0.002)
GDP	-0.000 (0.000)	-0.000 (0.000)	0.000*** (0.000)	0.000*** (0.000)
INF	-0.000 (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Constant	13.635* (7.509)	3.927*** (0.627)	3.704*** (1.378)	1.558 (2.186)
No. of obs.	2678	2678	2368	2368
No. of groups	167	167	155	155
AR1 test (p-value)	0.000	0.000	0.000	0.000
AR2 test (p-value)	0.983	0.885	0.599	0.845
Hansen test (p-value)	0.565	0.231	0.113	0.151

Notes: Z-score, bank stability. The market structure, CR3 and CR5, the degree of bank concentration. INDIV, income diversification. Robust standard errors are numbers in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Source: authors' calculations.

4.3 Robustness test

4.3.1 Alternative proxy for bank stability

Following Kasman and Kasman (2015) and Mirzaei et al. (2013), we replace the Z-score with the ratio of non-performing loans to total loans (NPL). NPL gauges asset quality, and a higher NPL value is interpreted as higher bank risk.

Market concentration and income diversification are negatively related to bank risk (Table 4). The interaction terms between diversification and concentration are negative and significant (Models 6 and 8 of Table 4), implying that banks with diversified activities in more concentrated environments tend to be more financially viable as opposed to those in less concentrated environments. In summary, all of these findings support our hypothesis. Additionally, there are no significant changes to the main results for the control variables.

Table 4: Robustness check using non-performing loans (NPL) as dependent variable

NPL	Model 5	Model 6	Model 7	Model 8
NPLt-1	0.790*** (0.028)	0.343*** (0.024)	0.854*** (0.014)	0.569*** (0.040)
INDIV	-0.049** (0.024)		-0.026* (0.014)	
CR3	-0.022* (0.012)	-0.044** (0.017)		
CR5			-0.018* (0.010)	-0.050*** (0.018)
CR3*INDIV		-0.000** (0.000)		
CR5*INDIV				-0.001** (0.000)
EFFICIENCY	0.124 (0.147)	-0.000 (0.015)	-0.002 (0.014)	0.040 (0.028)
NIM	0.124 (0.147)	-0.188*** (0.067)	-0.274*** (0.077)	-0.100 (0.123)
LIQUIDITY	-0.019 (0.012)	-0.065*** (0.011)	-0.042*** (0.010)	-0.013 (0.016)
GDP	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
INF	-0.001*** (0.000)	-0.002*** (0.000)	-0.000*** (0.000)	-0.000 (0.000)
Constant	6.072*** (1.103)	15.751*** (1.838)	6.929*** (1.142)	7.485*** (2.119)
No. of obs.	1697	1697	1574	1574
No. of groups	126	126	117	117
AR1 test (p-value)	0.005	0.001	0.012	0.020
AR2 test (p-value)	0.161	0.100	0.162	0.152
Hansen test (p-value)	0.240	0.126	0.170	0.268

Notes: NPL, bank stability, non-performing loans ratio to total loans. CR3 & CR5, bank concentration. INDIV, income diversification. Robust standard errors are presented in parentheses. *, ** and *** denote significance at 10%, 5% and 1 %, respectively.

Source: authors' calculations.

4.3.2 Alternative proxy for income diversification

We use an alternative proxy for income diversification (HHI_{INDIV}) (Stiroh and Rumble, 2006; Chiorazzo et al., 2008) as follows:

$$HHI_{INDIV} = 1 - \left(\left(\frac{\text{interest income}}{\text{total income}} \right)^2 + \left(\frac{\text{non-interest income}}{\text{total income}} \right)^2 \right) \quad (3)$$

HHI_{INDIV} ranges from zero to one, and higher values indicate greater diversity.

The results are presented in Table 5. The variables CR3, CR5 and HHI_{INDIV} exert a positive impact on Z-score. Furthermore, the results of Models 10 and 12 of Table 4 indicate that the joint effect between income diversification and market concentration is positive and significant, confirming the findings of the sections above.

Table 5: Robustness check using alternative proxy for income diversification (HHI_{INDIV})

Z-SCORE	Model 9	Model 10	Model 11	Model 12
Z-SCORE t-1	0.739*** (0.070)	0.735*** (0.090)	0.779*** (0.073)	0.574*** (0.030)
HHI_{INDIV}	20.583*** (7.579)		32.872*** (10.281)	
CR3	0.070** (0.024)	-0.050 (0.052)		
CR5			0.077** (0.035)	0.011 (0.017)
CR3* HHI_{INDIV}		0.197* (0.108)		
CR5* HHI_{INDIV}				0.079*** (0.019)
EFFICIENCY	-0.189** (0.076)	-0.047 (0.031)	-0.201** (0.085)	-0.091*** (0.012)
NIM	0.363* (0.207)	0.321* (0.179)	0.354*** (0.133)	0.227*** (0.073)
LIQUIDITY	-0.019 (0.018)	-0.016 (0.022)	-0.012 (0.023)	0.015* (0.009)
GDP	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000*** (0.000)
INF	-0.000 (0.000)	-0.000 (0.000)	-0.000* (0.000)	-0.000*** (0.000)
Constant	0.832 (5.116)	4.004 (3.755)	-6.161 (6.284)	6.060*** (1.811)
No. of obs.	2678	2678	2368	2368
No. of groups	167	167	155	155
AR1 test (p-value)	0.000	0.000	0.000	0.000
AR2 test (p-value)	0.734	0.864	0.502	0.892
Hansen test (p-value)	0.842	0.289	0.179	0.209

Notes: Z-score, bank stability. The market structure, CR3 & CR5, bank concentration. HHI_{INDIV} , income diversification. EFFICIENCY, cost to income ratio (%). Robust standard errors are presented in parentheses. *, ** and *** denote significance at 10%, 5% and 1 % levels, respectively.

Source: authors' calculations.

5. Conclusion

Using aggregate data for 173 countries over the period 2000–2020, this study empirically investigated the linkage between income diversification, market concentration and bank stability. The current paper revealed significant findings. Firstly, the findings indicate that bank stability is positively related to income diversification, indicating that banks are more stable when they are more diversified. Secondly, we found that the level of market concentration is positively related to bank stability. The result confirms the concentration-stability view that banks in a highly concentrated banking system are more stable. Thirdly, we argue that market concentration may moderate the impact of income diversification on bank stability. Specifically, the results show that banks with diversified activities in more concentrated environments are likely to be more financially viable. These results are robust to multiple regression specifications with alternative proxies for bank stability and income diversification.

This study contributes to research by providing the first empirical evidence on the relationship between income diversification, market structure and bank stability. Shim (2019) is the closest study to ours, but the author investigated loan portfolio diversification, which is another aspect of diversification strategy, and the implications are also different between these two aspects. Furthermore, our study uses more conventional market structure proxies, i.e., CR3 and CR5, rather than the somehow unique proxy in the case of Shim (2019). This effort allows better comparison with the extant studies in the field. Furthermore, the author only focused on Z-score, while we strive to include another proxy, the NPL, to check the robustness of the effect on bank stability. Finally, Shim (2019) investigated the link in the USA, so the result might not be representative. Our study uses aggregate data for 173 countries over a long period to facilitate generalizability of the results.

From the findings, it is clear that income diversification is important in the context of increased concentration on banking markets. As market concentration is the trend, partly due to regulations on capital consolidation, income diversification could be used to improve bank stability. Therefore, banks should be allowed to expand their fields of operation, especially to take advantage of the rise of financial technology. To facilitate this, regulatory bodies need to dissect the implications of bank revenue diversification on many other aspects of the economy to have proper directions for policymaking.

One of our study's shortcomings is the absence of some variables due to the use of an aggregate level in our sample. Bank loan portfolios, for example, which could be used to analyse another aspect of bank diversification (loan portfolio diversification), could reveal some other important implications towards bank stability management. Furthermore, analysis of the “too-

big-to-fail” hypothesis in the nexus between market concentration, income diversification and bank stability could bring more useful insights for developing policies towards healthy bank systems. Future studies might take advantage of these directions to enrich our understanding of the nexus.

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