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Systemic Implications of Financial Inclusion

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Systemic Implications of Financial Inclusion
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ABSTRACT: This study contributes to the literature by analyzing the impact of financial inclusion (FI) on various bank risk dimensions, including systemic risk, which has been underexplored. We expand on recent research by examining not only the type of financial services, but also the source of FI, particularly the role of non-commercial banks (NCB). Our findings reveal that contrary to developed countries, credit expansions are linked to lower commercial banking risks, underscoring the benefits of loan diversification in developing and emerging economies,. However, while FI in deposits generally reduces individual banking risks, its effect on systemic risk is weaker in these countries, likely due to limited asset diversification. Moreover, NCBs tend to increase systemic and idiosyncratic risks for commercial banks through competitive pressures in the loan and deposit markets. Our results suggest that coordinating macroprudential policies with credit developments further reduces systemic risk by discouraging excessive risk-taking when banks' capital is more at stake. Banks with stronger Basel capital ratios show reduced idiosyncratic risks, yet there is evidence that banks may relax these ratios to accommodate lending demands. These insights underscore the necessity for regulators to synchronize macroprudential policies with FI developments and consider NCBs' role in financial stability.

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1. Introduction

The effect of financial inclusion (FI) on financial stability has gained substantial attention in recent years, underscoring its critical importance for effective policymaking. While policymakers aim to achieve FI and financial stability goals simultaneously, overlooking the potential trade-offs between them can expose economies to costly systemic crises or hinder the progress of FI (Čihák et al., 2016).

Only very recently has the literature begun to investigate the effect of FI on financial stability, particularly within the banking system, which is the main provider of formal finance (Feghali et al., 2021). So far, current research has mainly focused on assessing individual banking risk using indicators like Z-Scores, which may not fully capture the relationship between FI and financial stability (Čihák et al., 2021). While individual risks are significant, relying solely on the idiosyncratic risk dimension falls short in comprehensively addressing the potential broader repercussions of a bankruptcy on the entire economy, particularly in cases where the financial sector lacks sufficient capitalization. Our research fills this gap by examining *FI*'s effects across multiple risk dimensions, including systemic risk, which has received limited attention to date.

Furthermore, studies reveal diverse implications of FI on bank soundness, depending on the type of financial service considered. For instance, deposit inclusion can bolster banks' resilience by attracting more stable retail deposits (Ahamed & Mallick, 2019). On the other hand, credit inclusion, while promoting loan diversification (Morgan & Pontines, 2014), may elevate bank idiosyncratic risk in competitive banking systems, where relaxed lending standards prevail (Čihák et al., 2021; Feghali et al., 2021).

We align with recent literature that differentiates FI measures by the type of financial services and go a step further by distinguishing sources of FI, i.e. services provided by commercial and non-commercial banks. Notably, there is a gap in the literature regarding the impact of non-banking financial institutions on banking sector stability despite their significant role in advancing FI (Lopez & Winkler, 2018). The entry of non-commercial banks (NCB) exerts competitive pressures on commercial banks (CB). This competitive pressure can potentially lead to lower credit standards (Feghali et al., 2021), and higher funding rates (Craig & Dinger, 2013), undermining CB soundness.

Our paper acknowledges the delicate balance regulators must strike between promoting FI and enhancing systemic stability, with a focus on the collective risk-taking behavior of banks, as highlighted by Čihák et al. (2016). We aim to uncover the role of prudential regulation in moderating (enhancing) the impact of FI on banking stability. By drawing on insights from Anginer et al. (2014), Beck et al. (2013), and Sahay et al. (2015), our analysis encompasses macroprudential regulation at country-levels and adherence to Basel III guidelines at bank-levels. These policies enhance banking sector resilience by curbing individual banking risk-taking incentives, especially during periods of rapid FI expansion. However, they may also lead to regulatory arbitrage, fostering the entry of less regulated financial institutions (Claessens et al., 2021; Irani et al., 2021).

Financial exclusion is a significant issue in developing and emerging (Dev) countries due to the larger gap in the unbanked population (Demirgüç-Kunt et al., 2020). While most studies focus on either Dev countries, specific regions, or extensive panels of diverse economies, we aim to capture the specific impact of FI on banking risks in Dev economies, for which we start from a broad panel including both advanced (Ad) and Dev countries. By doing so, we recognize the rapid advancements in FI across income levels over the last decade and the specific challenges these economies face in efficiently allocating funds and diversifying assets (Čihák et al., 2021; Gennaioli et al., 2018).

Our findings reveal that in Dev economies, credit expansions are associated with lower banking risks, highlighting the significant role of loan diversification despite the relatively rapid pace of FI in credit. Additionally, while FI in deposits generally reduces individual banking risks, this effect on systemic risk is dampened in Dev countries, possibly due to their limited capacity for financial asset diversification. NCBs tend to increase systemic and idiosyncratic risks for CB through competitive pressure in the loan segment, although their involvement in deposit services enhances overall CB resilience. These insights underscore the importance of aligning FI efforts with macroprudential regulation to foster financial stability, supporting the need for NCB regulation to bolster both banking sector and financial system stability.

Consistent with the literature, we find that tighter macroprudential policies effectively reduce banking systemic risks (e.g., Altunbas et al., 2018). Additionally, our results suggest that aligning macroprudential policies with credit developments further mitigates systemic risk, likely because banks are less inclined to take excessive risks when a greater portion of their capital is at stake. We also observe that banks with stronger Basel capital ratios exhibit reduced idiosyncratic risks. However, there are indications that banks may relax these Basel ratios to meet lending demands, underscoring the need for regulators to synchronize macroprudential policies with credit developments.

The subsequent sections of this paper will review relevant literature (Section 2), outline the variables and methodology employed in this study (Section 3), present the empirical results (Section 4), and conclude by summarizing key findings and implications (Section 5).

Robustness checks and descriptive statistics are reported in the Appendix.

2. Literature Review

Research to date has focused on the effect of financial inclusion (FI) on the well-being of consumers and overall development and growth. However, there is much less international evidence on the effect of FI on financial stability, in particular the banking system, which is the main provider of formal finance (Feghali et al., 2021).

Within the literature devoted to study the effect of FI on the banking sector stability and resilience, the Z-Score emerges as a prevalent and extensively employed indicator, particularly in assessing the risk-taking choices of individual banks (Čihák et al., 2021). Its popularity stems from its effectiveness in capturing banks' risk-taking behaviour, often associated with increased competition to extend loans to individuals with lower creditworthiness who were previously subject to credit rationing (Beck et al., 2013; Feghali et al., 2021).

However, the Z-Score, while adept at assessing insolvency risks at the individual bank level, falls short in comprehensively addressing the potential broader repercussions of a bankruptcy on the entire economy, especially in cases where the financial sector lacks sufficient capitalization. Brownlees & Engle (2017) shed light on the vulnerability of the financial system, emphasizing that firms' risk-taking decisions often overlook the negative external costs generated during crises.

These limitations in using Z-Scores have led to calls for exploring alternative systemic metrics to better assess the impact of FI on the banking sector stability and resilience (Čihák et al., 2021). Such metrics, like the financial system's value at risk conditional on institutions being under distress (CoVaR; Tobias & Brunnermeier, 2016) or systemic expected shortfall measures (SES; Acharya et al., 2017), can provide a more comprehensive view of systemic vulnerabilities beyond individual banking risks.

Another avenue for assessing systemic risk is presented by Brownlees & Engle (2017), who introduce the SRISK - a measure that quantifies the capital shortfall of a financial entity in the event of a prolonged market downturn. SRISK, in contrast to other systemic risk metrics, merges market and balance sheet information, explicitly considering a financial firm's leverage. This measure has demonstrated greater predictive capability than its predecessors (SES; Acharya et al., 2017).

In terms of the effect of FI on banking systemic risk, this area remains largely unexplored. On one hand, following Beck & De Jonghe (2013), we can infer that when increasing lending results in higher concentration of loans, a higher tail dependency is expected, consequently elevating *SRISK*. On the other hand, recent research by Hua et al. (2023) finds an inverted U-shaped relationship between FI and *SRISK* at a country level. However, the authors assume that FI has the same effect on banking risks regardless of the type of financial service and provider.[1]

Contemporary research places a growing emphasis on the importance of differentiating between types of financial services when exploring the effect of FI on the banking sector stability (Feghali et al., 2021; Ghosh, 2022; Vo et al., 2021). This shift recognizes the diverse and sometimes conflicting findings in the literature. By considering different types of services, studies have found a wide range of outcomes, with some showing that

[1] To do so they construct a composite FI development index for 115 countries using principal component analysis (PCA). They combine indicators related to financial services provided by commercial banks, credit unions, and microfinance institutions without distinction.

FI enhances banking stability (e.g., Ahamed & Mallick, 2019; Danisman & Demirel, 2019; Ghosh, 2022; Neaime & Gaysset, 2018; Vo et al., 2021), while others indicate it may increase banking risks (e.g., Čihák et al., 2016; Feghali et al., 2021; Le et al., 2019).

These discrepancies often arise from the use of composite indicators involving different combinations of FI measures (Feghali et al., 2021)[2]. Therefore, recent studies have utilized single FI indicators for different financial services, such as deposits and loans (Feghali et al., 2021; Ghosh, 2022).

The differentiation between financial services acknowledges that each type may impact financial stability differently. In regards to deposit services, Han & Melecky (2017) argue that low-income savers behaviour typically does not change significantly through the business cycle. Thus, during periods of systemic distress, low-income clients continue to provide deposits to banks, even as other sources of credit become unavailable or difficult to roll over.

They posit, therefore, that small customers are a stable source of funding. Similarly, Ahamed & Mallick (2019) show that bank individual risk is reduced with broader FI in deposits. The researchers claim that, by reaching out to more customers, banks may collect cheap retail deposits and reduce their cost of funding, which in turn enhances their profitability and resilience.

In terms of loan inclusion, there are different perspectives on its impact on banking sector stability. On one side, loan inclusion may contribute to banking system soundness through the diversification of loan portfolios. Adasme et al. (2006) suggest that losses on small loans are associated with lower systemic risk than the large, infrequent, and less predictable losses associated with large loans. Furthermore, Morgan & Pontines (2014) find evidence that, small loans reduce the level of nonperforming loans and the probability of default of credit institutions via loan diversification. However, extending credit to individuals previously constrained and excluded by limited collateral or information incompleteness can increase banking risks (Čihák et al., 2021). Mehrotra & Yetman (2014) observe that fast credit growth might be accompanied by the reduction of lending standards to expand the pool of borrowers, increasing bank standalone risk, and potentially systemic risk through contagion. In this line, Feghali et al. (2021) prove that credit inclusion can lead to elevated idiosyncratic risk (measured with Z-Scores) in a competitive banking system, where banks might be competing to offer loans to less credit worthy individuals.

Recognizing that FI can potentially exert adverse effects on banking soundness through intensified competition among financial institutions to expand their provision of financial services, it becomes essential to examine the role of non-commercial banks (NCB). NCB play a significant role in advancing FI by targeting low-income communities and extending financial services to underserved regions (Lopez & Winkler, 2018). Should consumers increasingly rely on NCB for their financial service needs, commercial banks (CB) could witness a decline in their market share. This competitive pressure, as highlighted by Feghali et al. (2021), may prompt CB to relax credit standards, such as loan collateral requirements, potentially leading to riskier lending practices. Furthermore, Craig & Dinger (2013) argue that, competitive pressure increases the incentives to invest in risky projects by increasing the costs of bank funding.[3] In this context, to the best of our knowledge, there exists a

[2] The authors claim that despite various FI indicators being typically positively correlated, their impact on financial stability varies. Thus, they recommend exercising caution in the use of composite indicators.

[3] For further literature on financial sector competition see for example Schulte & Winkler (2019) and Cull et al. (2014) for micro-financial institutions, Ari et al. (2017), Górnicka (2016), Jiang (2023) and Luck & Schempp (2023) for shadow banking and Ferri et al. (2014) and McKillop et al. (2020) for credit cooperative institutions.

gap in the literature concerning the impact of NCB' contributions to FI on the traditional banking sector stability. While literature often overlooks the distinction in the source of FI, namely, the financial institutions providing the financial services, a few studies exclusively focus on services provided by CB to assess the associated banking risks (Feghali et al., 2021; Le et al., 2019; Marcelin et al., 2022). Financial exclusion is generally considered more of an issue in developing and emerging countries because of the significant gap in unbanked adults compared to advanced economies (Demirgüç-Kunt et al., 2020). However, existing research clearly shows that much remains to be done in advanced countries in terms of promoting FI (Deku et al., 2016; Danisman & Demirel, 2019). Most studies focus on developing countries (e.g., Wang & Luo, 2022), specific regions (e.g., Danisman & Demirel, 2019; Neaime & Gaysset, 2018), or utilize broad panel datasets spanning diverse countries (e.g., Čihák et al., 2016; Feghali et al., 2021; Marcelin et al., 2022; Vo et al., 2021), while we aim to capture the specific effect of broader FI in developing and emerging economies on banking risks. Similarly, Ahamed & Mallick (2019) suggest that FI might be more beneficial for developing countries, significantly enhancing their bank stability.[4] This specific outcome might be driven by the FI of low-income individuals in these economies over the last decade (Demirgüç-Kunt et al., 2020). Furthermore, when considering a sample of developing economies, Wang & Luo (2022) find that, with higher FI, banks' nonperforming loans significantly decrease, indicating that bank stability enhancement may be due to loan portfolio diversity. However, these economies tend to have a limited capacity to ensure efficient allocation of funding to creditworthy firms and individuals (Čihák et al., 2021) and scare opportunities to diversify assets, potentially affecting banking risks (Gennaioli et al., 2018).

Prudential regulations play a crucial role in mitigating the potential negative impact of FI on banking risks. Following Beck et al. (2013), certain type of regulation may limit the extent to which banks can or will engage in riskier activities in the context of expanded FI. Furthermore, Anginer et al. (2014) show that stringent capital requirements would help minimize contagion and may also incentivize bank investors to control systemic risk taking, particularly in the context of rapid extensions of financial services[5]. Consequently, Čihák et al. (2021) claims that regulators should aim to enhance systemic stability while promoting FI, since the correlation in the risk-taking behavior of banks (as a measure of systemic risk) is much more relevant than the absolute level of risk taking in any individual institution.

The list of studies that have examined the effect of FI on banking risks accounting for the role of financial regulation is concise. We encounter Sahay et al. (2015), who constructed Basel Core Principles (BCP) scores based on the level of compliance with the capital requirements guidance provided by the Basel Committee on Banking Supervision in 2012. The authors prove that bank individual risks raise with broader FI due to increasing nonperforming loans, especially in cases where loan losses are under-provisioned. However, when broader FI is accompanied by enhanced compliance to Basel regulation, i.e. *BCP* scores interacted with FI indicators, the negative impact of FI on standalone risks is mitigated[6]. Recently, Wang & Luo (2022) conducts

[4] The researchers employ a composite FI index which combines various metrics of access and use of financial services, such as loans and deposits. In their heterogeneous analysis for advanced and developing economies they find similar dynamics. However, they infer by the magnitude of the coefficients that inclusive finance might be more beneficial for developing countries, significantly enhancing bank soundness.

[5] It is essential to note the potential effects of tighter capital requirements on the goals of FI: by analyzing the effect of capital adequacy on FI indicators, Anarfo et al. (2020) finds that tightening this macroprudential tool could have a negative impact on the provision of financial services, conflicting with the FI objectives. They suggest that the capital adequacy requirement reduces banks' capacity to provide financial services, which could lead to credit rationing and, consequently, reduced FI.

[6] As noticed in Sahay et al. (2015), in the context of broader FI, it is important to acknowledge the challenges in developing efficient regulation. Rapid inclusion of individuals in the financial system can render regulatory policies less effective in mitigating

(continued…)

heterogeneous analysis to explore the effect of FI in bank individual risk in emerging countries. For this purpose, four indicators are incorporated from Barth et al. (2013), such as Activity, Capital, Supervisory power, and Market discipline, aiming to capture the stringency of banking system supervision. Stricter banking regulation is found to mitigate the elevated idiosyncratic risk stemming from FI.

The advancement of non-traditional banks in contributing to FI also has regulatory implications. As documented in Mehrotra & Yetman (2014), broader FI may increase financial risks if it results from the expansion of relatively unregulated parts of the financial system. The increased contribution of NCB to the advancement of FI amplifies competition among financial institutions, prompting banks to increase their risk appetite, such as by lowering lending standards. Accordingly, Darst et al. (2020) find that one way to mitigate the decrease in lending standards of CB caused by the entrance of non-traditional banks is to increase capital requirements, as banks are less tempted to engage in riskier loans if a larger portion of their own capital is at stake (see also Agénor & Bayraktar (2023)). However, other studies suggest that prudential regulation can have a leakage effect, leading to less regulated financial institutions increasing lending in response to tighter capital requirements imposed on the banking sector (Aiyar et al., 2014). For instance, when banks face tighter capital requirements, they may encounter limitations in extending credit. Consequently, NCB, which are often subject to fewer regulatory constraints, may step in to fulfill the increased demand for financial services.[7]

systemic risks due to increased implementation challenges. Supervising activities associated with FI poses significant difficulties, including assessing credit risk without collateral, overseeing numerous small loans and diverse lenders, collaborating with multiple regulatory bodies, and managing systemic risk tied to banks providing credit to microlenders.

[7] See also Irani et al. (2021). Analyzing data from the US corporate loan market, they demonstrate that stricter bank capital regulations prompt non-bank financial institutions to play a more prominent role. Furthermore, using data of 24 countries, Claessens et al. (2021) show how macroprudential policies applied to banks, particularly borrower-based measures increase non-bank financial intermediation activities.

3. Methodology and Data

3.1. Data and Variables

We employ an extensive unbalanced panel dataset covering the years 2009 to 2021, comprising 574 commercial banks (CB) from 31 countries, of which 12 are developing or emerging economies.[8,9]

We include only CB in our sample due to their distinct operational objectives compared to investment banks and their potentially different interaction with financial inclusion (FI), a decision in line with Wang & Luo (2022).[10] To simplify, we refer to banking risks as those related to CB, while any indicator related to non-commercial banks is generally specified with an NCB designation. Our bank-level dependent and control variables are sourced from Bloomberg and the SRISK database available on the V-Lab website.[11] It is important to note that banks lacking bank-level control variables are excluded to ensure data consistency and reliability. Additionally, we omit banks with less than four years of observations across all the selected dependent variables, and we exclude countries with less than four banks.

The selection of the sample period, commencing in 2009, is driven by two key considerations. Firstly, it aligns with the availability of FI data, as documented in López & Winkler (2019). Secondly, it allows us to capture the post-global financial crisis era, which holds particular significance given the substantial shift in the regulatory landscape of the banking sector, as elaborated by Danisman & Demirel (2019).

In the following subsections, we provide further description of the selected variables. For a comprehensive reference, Tables 4, 5, and 6 summarize variable notations, definitions, and data sources.

3.1.1. Banking Risks

The literature devoted to analyzing the interplay between FI and financial stability has predominantly focused on idiosyncratic banking risks. However, this narrow focus fails to capture the broader systemic risks that can threaten the stability of the entire financial system (Čihák et al., 2021). Systemic risk is commonly defined as widespread failures of financial institutions or freezing of capital markets that impair financial intermediation-payments system and lending to corporations or households.[12] The degree of contagion between financial institutions following the failure of a single entity, arises from various factors, including interconnectedness, shared risk exposure, and financial imbalances (Acharya et al., 2017).

[8] The examination of the financial inclusion-stability nexus using bank-level data is relatively recent. Notably, Ahamed & Mallick (2019) pioneered the utilization of granular data which allows to control for bank specific characteristics.

[9] Following IMF World Economic Outlook database, in our sample, developing and emerging (Dev) countries are: Brazil, Colombia, India, Indonesia, Malaysia, Mexico, Philippines, Saudi Arabia, South Africa, Thailand, United Arab Emirates, Vietnam, while advanced (Ad) economies are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Israel, Italy, Japan, Norway, Singapore, Spain, Sweden, Switzerland, United Kingdom and United States.

[10] To do so, we assign the category of CB to those that provide financial services to households, according to the description of their economic activities reported by Bloomberg.

[11] https://vlab.stern.nyu.edu/srisk.

[12] In the literature there is no universally agreed definition of systemic risk, even though it is often linked to externalities arising from bank distress. The above definition is introduced in Rochet & Tirole (1996).

While individual risks contribute to financial system vulnerabilities, monitoring solely idiosyncratic risk is sub-optimal because the collective risks borne by financial institutions do not fully reflect those faced by the entire financial system. Therefore, a comprehensive analysis of the implications of FI on financial stability should examine not only the risk of individual institution failure (idiosyncratic risk) but also the broader impact such failures can have on the ongoing viability of the overall financial system.

In examining systemic risks, we employ the SRISK measure introduced in Brownlees & Engle (2017) which is derived from the monthly data provided by V-Lab, and aggregated to obtain annual SRISK values in billion of U$S. *SRISK* is defined as the expected capital shortfall of a financial entity conditional on a prolonged market decline. *SRISK* is a function of the size of the firm, its degree of leverage, and its expected equity loss conditional on the market decline. Essentially, *SRISK*, measures the contribution of a single financial institution to the existing systemic risk, where firms with the highest *SRISK* are the largest contributors to the undercapitalization of the financial system in times of distress.

For a firm *i* in the period *t*, SRISK is computed as:

$$SRISK_{i,t} = kD_{i,t} - (1 - k)W_{i,t}(1 - LRMES_{i,t}), \quad (1)$$

where $D_{i,j}$ is the book value of debt, $W_{i,t}$ signifies the market value of equity, k is the prudential capital factor.[13] Finally, $LRMES_{i,t}$ stands for the Long Run Marginal Expected Loss and denotes the expectation of the firm equity return conditional on a market decline of over 40% in six months. Specifically, $LRMES_{i,t}$ is calculated as $1-\exp(\log(1 - d) * \beta_{i,t})$, where d is the six-month crisis threshold for the market index decline and its default value is 40%, and $\beta_{i,t}$ is the firm's beta coefficient with respect to the country's market return.

For assessing idiosyncratic risk, we employ Z-Scores, a measure commonly utilized in literature as a proxy for individual risk within the banking sector (Chiaramonte et al., 2015; Khan et al., 2017; Lepetit & Strobel, 2013). This indicator has been popularly used in prior studies aimed to analyse the effect of FI on financial stability (Ahamed & Mallick, 2019).

Our Z-Score for the bank *i* in year *t*, is expressed as:

$$Z_{i,t} = (-1) \times \left[ROA_{i,t} + \frac{EQA_{i,t}}{\sigma(ROA_{i,t})}\right] \quad (2)$$

where $\sigma(ROA_{i,t})$ is the standard deviation of returns on total assets (ROA) and $EQA_{i,t}$ is the equity to total assets, both retrieved from Bloomberg database. Following Beck et al. (2013), $\sigma(ROA_{i,t})$ is calculated using a three-year rolling time window. Note that, to ensure comparability with *SRISK*, we multiply the conventional Z-Scores by -1, thereby, higher levels of Z-Scores correspond to higher individual risk. Thus, Z-Score accounts for the number of standard deviations that the *ROA* can fall before depleting equity and force a failure.

Lastly, we propose another measure of idiosyncratic risk based on the Credit Default Swaps (CDS) spreads. According to Acharya et al. (2017), CDS spreads capture estimates of losses of the market value of a financial

[13] V-lab set *k* to be 8% for firms in Africa, Asia, and Americas and 5.5% for firms in Europe due to differences in accounting standards.

firm's assets, as opposed to just its equity. Moreover, Giglio (2016) demonstrates that CDS spreads can be decomposed into idiosyncratic and systemic risk components. The idiosyncratic component refers to the specific risk of default associated with individual firms, while the systemic component pertains to the broader probability of multiple banks defaulting.[14] Additionally, Bhansali et al. (2008) show that CDS spreads can further be decomposed among systemic risk, sectorial risk and idiosyncratic risk, where systemic risk is defined as the sensitivity of each firm to country and global risk factors.

To retrieve the individual risk component from CDS spreads, we adopt a principal component approach as suggested by Zhang et al. (2009). Specifically, we calculate the first principal component across the log transformation of CDS spreads of banks within a country and the corresponding country-level stock equity volatility.[15] On average, we find that the first principal component explains the 60.5% of the total variation.[16] The portion of risk unexplained by this common factor is assumed to account for the idiosyncratic risk. For brevity, hereafter, we refer to it simply as *CDS*, while the log-transformed CDS spreads, incorporating both common factors and individual risks, are denoted as *CDS.lt*.

Note that both the Z-Score and the idiosyncratic component of CDS spreads provide measures of idiosyncratic risk. However, while the Z-Score relies on balance sheet metrics to calculate insolvency risks, the idiosyncratic component of CDS spreads is derived from market prices of CDS contracts, reflecting market expectations and perceptions of the institution's credit risk. The description of the banking sector risks measures and data sources are reported in Table 6.

3.1.2. Financial Inclusion

FI is commonly defined as the access to and use of formal financial services (Čihák et al., 2016). Following Čihák et al. (2021), we focus on the market-clearing outcome of FI - that is, the use of financial services. The authors argue that broader access (supply-side) can coexist with voluntary financial exclusion (demand-side).[17]

We utilize the IMF Financial Access Survey database (FAS) which gauges several indicators covering the access and use dimension of FI. This database spans 189 economies from 2004 to 2021. The advantage of FAS over The World Bank's Global Findex (WBGF) database lies in its annual coverage from 2004 to the present, while the WBGF survey only publishes data for the years 2011, 2014, 2017, and 2021. Regarding the limitations, it is important to acknowledge that certain categories within the FAS database contain information primarily for more recent years, with some indicators having incomplete data for specific countries (López & Winkler, 2019).

[14] Since the bank that sells the CDS contract can default, the buyer of the CDS is exposed to counterpart risk. In particular, suppose that bank A sells a credit default swap against bank B. The CDS price then reflects the individual probability that B defaults as well as the joint probability that A and B default: the purchaser of the CDS may not receive the promised insurance payment from A, if when B defaults A defaults as well (Giglio, 2016).

[15] The stock price volatility (SV) is reported in the World Bank's Global Financial Development database. This measure is the average of the 360-day volatility of the national stock market index (see Table 4). The *SV* is standardized before computing the principal components.

[16] The proportion of variance explained by the first principal component ranges from 45% to 82% across countries, with an average of 60.5%. Similar results are found in Berndt & Obreja (2010) and Zhang et al. (2009).

[17] Under this perspective broader access to financial services does not guarantee active utilization of these services due to voluntary financial exclusion. Voluntary financial exclusion may stem from factors such as low financial literacy (Carpena et al., 2011) or the preference for informality in response to poor regulatory quality and general governance problems (Čihák et al., 2021). In the latter case, changing the incentives for FI requires broader reforms outside the purview of FI policy (Klapper & Singer, 2015).

For the use dimension, a common indicator employed by the literature is the outstanding loans and deposits to GDP (see Ahamed & Mallick, 2019; Danisman & Tarazi, 2020; Sarma & Pais, 2011; Wang & Luo, 2022). Moreover, Feghali et al. (2021) and Han & Melecky (2017) proxy the use dimension with the number of depositors and borrowers per 1000 adults, available in FAS database.[18]

We argue that the choice of these two metrics to account for the demand side of FI prevent overlook important dynamics. For instance, considering only the number of borrowers per 1000 adults may overstate inclusivity, as simply being a borrower does not ensure regular or significant borrowing. Conversely, using solely outstanding loans to GDP might may mask the concentration of loans among high-income clients, thus not adequately reflecting the potentially significant portion of the population excluded from borrowing activities.

Additionally, both measures might have different consequences for financial stability. Outstanding loans to GDP can be interpreted as a measure of financial deepening, which may not necessarily have the same implications for financial stability as broader inclusion of lowincome borrowers (Sahay et al., 2015). Barajas et al. (2007) observe that, while in some countries financial deepening has followed an even path, in others it has been a bumpy process with sharp accelerations in aggregate credit, or credit booms, sometimes followed by episodes of financial distress and banking crises. In this regard, including numerous, small and diverse lenders allows banks to mitigate the concentration of large loans, which are associated with larger and less predictable losses (Adasme et al., 2006; Morgan & Pontines, 2014). Furthermore, López & Winkler (2019) find evidence suggesting that higher level of FI, measured as borrowers per 1000 adults, contributes to a dampening of credit boom-bust cycles, as indicated by a substantial change in credit to GDP.[19]

The choice of single indicators is based on the diverse and sometimes conflicting findings in the literature when using different FI metrics, ranging from trade-offs to synergies with financial stability (Čihák et al., 2021).[20] We specifically concentrate on deposit and loan services. Unlike other available indicators, such as the number of CB branches, ATMs and mobile money transactions per adult, deposits and loans services have remained less susceptible to technological advancements over time.[21] Furthermore, we leverage the differentiation present in the FAS database between deposit and loan services provided by CB and NCB.[22]

The selected FI indicators are described in Table 5. Firstly, we choose the ratios of outstanding deposits with CB to GDP (Dep.CB), outstanding deposits with NCB to GDP (Dep.NCB), outstanding loans from CB to GDP

[18] Special surveys of the demand side of financial services are highly costly and often lack a time dimension (López & Winkler, 2019). With the advantage of being annual, the FAS surveys the supply side (regulators of formal financial institutions) on the number of accounts, number of customers, and so on. Some of these might be multiple accounts belonging to the same customer or inactive accounts. In contrast, the WBGF provides an estimate of the share of the adult population that has saved or borrowed in the past year, accounting more specifically for the use dimension of FI. However, Feghali et al. (2021) find similar results when using the number of borrowers (depositors) per 1000 adults from FAS and the share of the adult population that has borrowed (saved) in the last year from WBGF.

[19] Note the distinction between the use of financial services, measured as credit to GDP, and the financial cycle. The latter involves the extraction of long-run dynamics, or equilibrium credit, to account for rapid credit expansions and contractions (see for example Drehmann et al., 2012).

[20] Divergent results can be driven by the selection of different FI indicators to construct composite indicators, see for example Ahamed & Mallick (2019), Anarfo et al. (2020), and Wang & Luo (2022).

[21] CB branches and ATMs are susceptible to technological advancements, with the increasing digitization of banking services potentially diminishing their relevance. Moreover, the adoption of mobile accounts has been a relatively recent phenomenon.

[22] Following FAS database NCB are defined as: deposit-taking microfinance institutions, non-deposit taking microfinance institutions, credit unions and credit cooperatives, and other deposit takers. For the latter, the FAS methodology clarifies that, across different countries, these institutions may go by various names, including savings and loan associations, building societies, rural banks, agricultural banks, post office giro institutions, post office savings banks, savings banks, and money market funds.

(Loan.CB), and outstanding loans from NCB banks to GDP (Loan.NCB). Secondly, we select the percentage of adults with loan accounts (Adu.Loan) as in Han & Melecky (2017).[23] Note that for the latter, we do not distinguish between loan services provided by CB from those provided by NCB.

We consider the source of FI, namely, the financial institutions providing the financial services, to analyze the impact of FI on commercial banking risks. To do so, we explore the effect of larger penetration of NCB on CB risks. NCB promote FI by targeting low-income communities and extending financial services to customers that were previously rationed (Lopez & Winkler, 2018). However, if consumers increasingly rely on NCB for their financial services needs, CB could experience a loss in their market share. As noticed in Feghali et al. (2021), in response to this competitive pressure, CB may resort to relax credit standards, such as loan collateral, resulting in risky lending practices. Similarly, micro-financial institutions' penetration is associated with lower efficiency in the traditional banking sector, measured as the difference between lending and deposit interest rates (cull2014banks). Finally, Craig & Dinger (2013) show that deposit market competition is associated with higher banking risks, as banks tend to invest in risky project when the cost of funding increase.

To quantify the share of NCB in the provided financial services, we propose to divide the outstanding loans (deposits) provided by NCB by the total outstanding loans (deposits) provided by CB (see Table 5). This ratio will offer insights into the relative dominance of NCB and its potential implications for the stability and risk profile of traditional CB.

3.1.3. Control Variables

We control for bank-specific and country-specific factors in our analysis, building on the precedent literature (e.g. Ahamed & Mallick, 2019; Altunbas et al., 2018; Wang & Luo, 2022). While we utilize a prudent number of controls, we choose a parsimonious set of variables to prevent endogeneity issues, ensuring that the regressors exhibit no significant correlations.[24]

The bank-specific controls are retrieved from Bloomberg, while for the country-specific controls we rely on different data sources (see Tables 4, 5 and 6). As we detail in Section 3.2, these control variables are utilized in differences (not in levels), thereby influencing our interpretation.

We include the logarithm of total assets (Size) at bank-levels in our analysis, recognizing that size expansions can increase a banks' risk through two routes. First, they could stem from aggressive leverage strategies, elevating funding risks (Vazquez & Federico, 2015). Second, banks may direct their asset expansions towards certain asset categories, thereby increasing common exposures and consequently augmenting systemic risk (Acharya et al., 2017).

Additionally, we consider the return on total assets (ROA) at bank-levels. A decline in profitability could limit a bank's capacity to absorb future losses, increasing the likelihood of default. Consequently, investors may view the bank as riskier and seek higher returns to offset this heightened risk. This perception might be mirrored in fluctuations in the market betas (Xu et al., 2019).

[23] Due to the lack of observations across the selected countries, we do not include the percentage of adults with deposit accounts (see Table 3, column: obs (C&B)).

[24] We test for multicollinearity problems within the regressors. To do so, we compute the variance inflation factors (VIF), see Section 3.2.

We control for the stock price volatility (SV), retrieved from The World Bank's Global Financial Development database, to capture country-level market volatility. While the Chicago Board Options Exchange Market Volatility Index (VIX) is an alternative measure, *SV* offers a more precise reflection of market dynamics within a specific country. In addition, it is noted that LRMES is an increasing function of the equity market volatility (Brownlees & Engle, 2017).

We utilize GDP per capita (GDP) in our analysis, as prior literature indicates that, business cycle fluctuations are associated with higher credit risk (Albertazzi & Gambacorta, 2009).

We also account for the ratio of net portfolio equity inflows with respect to GDP, hereafter denoted as *CF*. While most of the studies include the Chinn and Ito Financial Openness Index (e.g., Čihák et al., 2021; Feghali et al., 2021; Ghosh, 2022 and López & Winkler, 2019), we opt for the relevance of capital flows concerning the economy (see Morgan & Pontines, 2014). Unlike the Chinn and Ito index, which primarily reflects changes in regulatory conditions affecting the degree of capital account openness, *CF* captures the dynamics of capital flows, reflecting changes in local regulatory environments, macroeconomic fundamentals, and global financial conditions. In this way, capital inflows enhance liquidity, provide a cushion against potential shocks, and potentially strengthen the overall financial stability. This increased availability of funds could contribute to a more stable banking environment, as financial institutions have better access to resources for their lending activities. Additionally, the influx of capital might boost investment opportunities and economic growth, which can further contribute to reducing the overall risk level within the banking sector.

We further include deposit interest rates as a proxy of monetary policy rate as in Ghosh (2022) and Wang & Luo (2022). The literature presents two differing views on the effect of interest rates on banking risks. As noted in Borio (2014), lower interest rates, for instance, boosts asset and collateral values as well as incomes and profits, which in turn can reduce probabilities of default. In contrast, Laeven et al. (2010), posit that low interest rates may increase incentives for asset managers to shift towards higher-yielding but also to riskier assets.

3.1.4. Bank Regulation

In our study, we examine how the relationship between FI and banking risks is shaped by regulatory responses and banking risk-taking behaviors. Our investigation spans macroprudential regulation, compliance to Basel III guidance at a bank-level and deposit insurance coverage combined with developments in regulatory quality.[25]

Macroprudential policies have a preventive role aimed at avoiding the excessive build-up of systemic risk over time, particularly intensifying in usage after the Global Financial Crisis. These tools are proven to increase the resilience of the banking sector by limiting the banks' individual risk-taking incentives (Galati & Moessner, 2018; Maddaloni & Peydró, 2013).

We argue that macroprudential regulators integrate both the financial cycle and the prevailing conditions within the banking sector into their decision-making framework (see Alam et al., 2019 and Altunbas et al., 2018). In alignment with Basel guidelines on countercyclical buffers, macroprudential authorities adjust banks' capital requirements during upswings in the financial cycle, often characterized by rapid credit expansions. These buffers serve to fortify banks against potential losses during subsequent downturns in the financial cycle. Additionally, policymakers closely monitor the banking sector performance. For instance, if banks are experiencing significant shortfalls, capital requirements may be relaxed in order to enable to better absorb

[25] For the latter, refer to the Appendix.

losses. Conversely, during periods of exceptional profitability for banks, authorities may opportunistically raise capital requirements, leveraging favorable market conditions when the cost of raising capital is low.

The integrated Macroprudential Policy (iMaPP) database provides monthly dummy-type indicators that capture the impact of various macroprudential policy instruments through tightening (+1) and loosening (-1) actions. These indicators are amalgamated to form a representation of regulatory endeavors aimed at taming the financial cycle and limiting bank's risk-taking incentives. Our approach involves aggregating the instruments related to bank capital requirements to gauge the overall intensity of macroprudential policy adjustments, whether they involve tightening or loosening, within a specific year. When a macroprudential policy tightening (loosening) is undertaken, regardless of the type of measure or its intensity, the level of the index will increase (decrease) by one unit. If two tightening measures are undertaken during the same period, and none in the direction of easing, the level of the index would increase by two units. Due to such a construction, the effects of policies should be interpreted as average responses to the various policy actions (see Kim & Mehrotra, 2018).

Limiting the analysis to instruments concerning bank capital requirements facilitates the capture of the impact of macroprudential policies specifically targeted to banks. Following the iMapp database listed instruments, we consider (i) countercyclical capital buffers, (ii) capital conservation buffers, (iii) other capital requirements, (iv) limits on leverage and (v) liquidity requirements, (see Table 4). Among these instruments, the database is filtered in order to eliminate specific regulation aimed at non- traditional banks like credit cooperatives, credit unions, among others. We refer to this index as *MPP*. This variable will be treated as endogenous, as macroprudential authorities react based on the observed risk in year *t* (see Section 3.2).

In order to capture the coordination of macroprudential authorities' reactions to credit developments, we introduce the index *MPP.cred*. This index integrates the cumulative change in outstanding loans from CB to GDP into the one year lagged cumulative sum of *MPP* index. As follows, *MPP.cred* represents the cumulative regulatory efforts to enhance the soundness of banks based on the credit developments.

Moving forward, our focus shifts to bank-level Basel III ratios. Utilizing data available in Bloomberg, we consider (i) the leverage ratio; (ii) the TIER1 capital ratio; (iii) the liquidity coverage ratio; and (iv) the net stable funding ratio. We evaluate each bank's ratio against the Basel III guidelines, calculating the deviation for each bank-year observation (refer to Table 6). Ratios exceeding 1 indicate that the bank surpasses the minimum regulatory threshold, signifying enhanced compliance with microprudential regulations. Subsequently, we compute the simple average of these four ratios, hereafter referred to as *Mic*.

Even though banks are required to operate above the minimum Basel III guidance, typically by the microprudential regulator, this metric serves as an indicator of banks' own risk-taking behavior. This behavior arises from various incentives, including a desire to enhance market confidence, meet investor expectations, and safeguard against potential adverse scenarios. By maintaining Basel III ratios above the minimum requirements, banks can demonstrate their financial strength and resilience, which can positively influence their access to funding and their cost of borrowing. Additionally, stronger Basel ratios may reduce microprudential regulatory scrutiny and potential penalties, further incentivizing banks to operate with buffers above the minimum requirements.

Analogously to the *MPP.cred*, we introduce an index aimed at capturing bank-level reactions to credit developments. Termed *Mic.cred*, this index integrates the cumulative change in Basel scores with the cumulative credit development. As banks observe a cumulative increase in credit, they can proactively respond by bolstering their Basel scores to demonstrate financial strength and resilience. Alternatively, they may opt to operate closer to the minimum requirements to extend more loans and expand their market share.

Finally, in the Appendix, we investigate how the relationship between banking risks and deposit inclusion may be influenced by a more secure regulatory environment. To do so, we construct an index that integrates deposit insurance coverage with cumulative changes in regulatory quality. This index (DIRQ) combines a static measure of deposit insurance coverage with adjustments reflecting improvement or deterioration of regulatory quality (see Table 4).

3.2. Estimation Model

We want to investigate how the advancement of FI in deposit and loan services affects systemic and idiosyncratic banking risks. For each of the distinct forms of FI under examination, along with the three risk indicators, we conduct separate regression analyses. The estimation model is described as follows:

$$y_{i,j,t} = \alpha y_{i,j,t-1} + \beta_1 FI_{j,t-1} + \beta_2 FI_{j,t-1} \times Dev_j + \gamma Bank_{i,j,t-1} + \rho Macro_{j,t-1} + \delta_1 Reg_{j,t} + \delta_2 Reg.Cred_{j,t-1} + fe_i + fe_t + \epsilon_{i,j,t}, \quad (3)$$

where $y_{i,j,t}$ denotes one of the three dependent variables described in Section 3.1.1, i.e. SRISK, Z-Scores, CDS, for the CB *i* in country *j* in year *t*. *FI* denotes a FI indicator (see Section 3.1.2). *Bank* and *Macro* represent respectively the bank-level and country-level controls reported in Section 3.1.3. *Reg* and *Reg.cred* stands either for *MPP* and *MPP.cred* or *Mic* and *Mic.cred* as reported in Section 3.1.4. The dummy variable Dev is introduced to capture the specific effect of *FI* in developing and emerging economies on banking risks. Finally, fe_i represents an unobserved bank-specific fixed effect, fe_t an unobserved time fixed effect, and $\epsilon_{i,j,t}$ the idiosyncratic error.

Given the persistence of banking risks, the current values of our dependent variables are likely to depend on their one-year lags. As follows, we include the lagging dependent variable as a covariate. We employ Arellano & Bond (1991) difference GMM approach, for what Equation 3 is first differentiated in order to eliminate the unobserved bank-specific fixed effects. Due to the presence of the lagged dependent variable and possible endogenous explanatory variables, we opt for the GMM estimation with linear moment conditions as proposed by Holtz-Eakin et al. (1988). Under this approach, the exogenous variables, transformed in first differences, are instrumented by themselves, while the endogenous regressors (also transformed in first differences) are instrumented by their lags in levels. The time dummies are included in the equation in first differences. In contrast to OLS, the use of this methodology is essential to reduce the endogeneity bias that may affect the estimation of the regression parameters. In addition, it also takes into account the heterogeneity of the data caused by unobserved factors affecting individual banks.[26]

[26] Note that, assuming that banks assignment to countries is fixed, the bank fixed effect also removes the constant cross-country variation, i.e. country fixed effect.

We choose the initial estimate of the weighting matrix as in Arellano & Bond (1991) in order to perform the two-step GMM estimation.[27] Finally, the standard errors are corrected as in Windmeijer (2005).

Following Altunbas et al. (2018), we treat *MPP* and *Mic* as endogenous variables to mitigate possible endogeneity biases.[28] As proposed in Section 3.1.4, the prudential regulators are assumed to base their decisions of tightening (loosening) the macroprudential instruments according to contemporaneous heightened (lower) banking risks. Analogously, banks Basel scores are affected by prevailing risk conditions, such as through the risk-weighted assets included in the denominator of the Basel ratios.

When estimating the model with *SRISK* as dependent variable, we designate *SV* as endogenous variable, while *Size* and *ROA* are first lagged to address endogeneity issues.[29] In the Z-Score estimation model, *Size* and *ROA* are selected as predetermined variables.[30] Lastly, for the *CDS* estimation, we select *ROA* as predetermined and we first lag *Size* to mitigate endogeneity bias. In addition, we remove *SV* as explanatory variable given that *CDS* accounts for the estimated idiosyncratic risk component obtained after deducting the common variation with *SV* , (see Section 3.1.1). Across the tables of results, the endogenous and predetermined variables are reported in contemporaneous terms and the exogenous variables are notate with a first lag.

The optimal number of lags from which instruments are derived, across the three dependent variables, is found to be three. For the endogenous and predetermined variables, we use two and three lags respectively.[31]

The J-test (Hansen, 1982) of overidentifying restrictions is conducted to test the validity of the instruments. A large value of the test statistic indicates that some of the moment conditions may be invalid, that some of the model assumptions may be incorrect, or both.[32] The test does not provide any indications that the validity of the instruments employed in any of the estimations may be in doubt.

We also test for multicollinearity problems within the regressors. To do so, we compute the variance inflation factors (VIF) among the set of control variables for each of our model estimates with Pearson's r-correlation indices.[33] The test indicates that multicollinearity is not a cause of concern for our results. In addition, from the Wald test we infer that the population parameters of the slopes, the time dummies, and collectively, are not equal to zero. Finally, the Arellano & Bond (1991) test suggests that no autocorrelation of order two (p2) or higher is present in the idiosyncratic errors in any of the estimated models.

[27] This weighted matrix accounts for the serial correlation in the idiosyncratic remainder components induced after taking the first difference of Equation 3 to eliminate the unobserved bank-specific fixed effects.

[28] The researchers estimate the effect of macroprudential policies on banking idiosyncratic and systemic risks using bank-level panel data. To do so, they employ a difference GMM approach with endogenous regressors instrumented like in Holtz-Eakin et al. (1988).

[29] Similarly, Altunbas et al. (2018) first lag the bank controls (treated as exogenous variables) in order to avoid endogeneity issues.

[30] Note that predetermined variables are assumed to be correlated with future errors, meaning in this case that current idiosyncratic risks influence future observations of Size and ROA. In contrast, endogenous variables are assumed to be correlated with current errors, implying contemporaneous feedback from the dependent variable to the endogenous variables.

[31] Optimal lags are determined based on the results of the J-test starting from the most parsimonious instruments.

[32] This test is analogous to the Sargan test, but it imposes finite moment assumptions instead of conditional homoscedasticity. Additionally, the number of observations is adjusted for missing values in the unbalanced panel.

[33] VIF is equal to $1/(1 - r2)$, where $r2$ is the Pearson's correlation coefficient from the regression of a variable on the rest of the controls. We select the maximum correlation threshold at 0.1, see Dormann et al. (2013).

4. Estimation Results

In Sections 4.1 and 4.2, we provide a comprehensive assessment of the impact of financial inclusion (FI) on commercial bank (CB) systemic and idiosyncratic risks respectively. To do so, we use two metrics of FI: (i) outstanding loans and deposits with CB as a percentage of GDP, and (ii) borrowers as a percentage of adults. While both are aimed at capturing the use dimension of FI, the first one encompasses the effective demand for financial services, whereas the second emphasizes broader inclusion among the population, reflecting the diversification of borrowing across income levels. Lastly, in Section 4.3, we analyze how the relative participation of NCB banks affects CB systemic and idiosyncratic risks. To simplify, we refer to banking risks as those related to CB, while any indicator related to NCB banks is generally specified with an NCB designation.

In general, we observe that the estimated coefficients associated to the control variables, when significant, maintain the same sign across the regressions. These signs are in line with the expected association between the control variables and banking risk outlined in Section 3.1.3. In addition, the coefficients related to the first lagged dependent variables are estimated to be significant and negative across all the regressions, addressing a mean-reverting behavior in the yearly changes of banking risks, where positive changes tend to be followed by decreases in the subsequent period. The tables of results report the number of panel observations and the corresponding p-values for the tests outlined in Section 3.2.

4.1. Systemic Risk

4.1.1. Loans and Deposits to GDP

In Table 1, we report the results of the estimation model assessing the impact of FI on banking systemic risks, focusing specifically on outstanding loans and deposits with CB to GDP. For instance, when the estimated coefficients are significant and positive, it indicates that FI increases our measure of bank systemic risk, *SRISK*. This means that the contribution of a single CB to the undercapitalization of the financial system in times of distress increases with the advancement of FI.

The expansion of credit provided by CB seems to elevate systemic risk, as indicated by the significant and positive coefficient associated to *Loan.CB*. Conversely, deposits held with CB.

(Dep.CB) appear to mitigate systemic risk. However, in developing and emerging economies (Dev), these effects seem to be partially diluted. To interpret these results, it is crucial to consider the positive relationship between debt and *SRISK*, as well as the amplifying effect of the market betas on *LRMES* (see Equation 1).

When banks seek to increase lending, while maintaining equity levels, they resort to financing methods that increase their debt, thereby elevating *SRISK*. In addition, as demonstrated in Beck & De Jonghe (2013), when increasing lending results in higher concentration of loans, a higher tail dependency is expected, consequently elevating *LRMES*. In this context, the significant and negative coefficient associated to Dev economies may indicate a decrease in *LRMES* due to loan diversification, as credit expansions involve the inclusion of numerous small borrowers.

As outstanding deposits with CB (Dep.CB) increase, banks diminish their reliance on more expensive sources of funding, consequently lowering their debt levels (Ahamed & Mallick, 2019[34]), and reducing *SRISK*[35]. Taking equity as given, in this context, an increase in *SRISK* is conditional to a higher *LRMES*, which is subject to the allocation of this additional funding. Accordingly, we find that broader FI in deposits is associated with higher *SRISK* in Dev countries. This can be explained by the fact that that banks in Dev countries, where lending opportunities are scarce, tend to concentrate their assets, specially in governmental bonds, as observed in Gennaioli et al. (2018). Moreover, these economies tend to have a limited capacity to ensure efficient allocation of funding to creditworthy firms and individuals, as argued in Čihák et al. (2021).

Moving forward, we observe that *MPP* help reduce the contemporaneous *SRISK*, possibly indicating that markets perceive banks as becoming sounder due to the implementation of additional capital requirements. Furthermore, *MPP.cred* appear to reduce *SRISK* further. As observed in Figure 12 and discussed in Section 6.1, tighter macroprudential policy actions are associated to credit expansions. This implies that, to meet the increased demand for credit, banks may need to allocate own funds in order to align with the tighter capital requirements. As follows, banks are less tempted to engage in risky activities if a larger portion of their own capital is at stake.[36]

Lastly, Basel scores above the minimum requirements (Mic) help reduce the contemporaneous *SRISK*. However, *Mic.cred* do not appear to have a significant effect on *SRISK*. As discussed in Section 6.1, the *Mic.Cred* index is predominantly negative throughout the sample period, indicating that as credit activity expands, banks tend to relax their Basel ratios to accommodate lending demands.

[34] The authors note that literature has demonstrated that retail deposits are sluggish, insensitive to risks and provide a stable cheaper source of long-term funding, compared to wholesale funding which is extremely volatile and often costly. For instance, wholesale financiers are prone to very mild negative information or rumours on the quality of bank projects, and hence reluctant to rollover short-term funding.

[35] In addition, from a macroeconomic perspective, Han & Melecky (2017) indicate that the enhanced proportion of stable funding originated from broader utilization of bank deposits, tends to reduce the volatility of total bank deposits during economic downturns, consequently mitigating the pro-cyclical effect of economic contractions on bank liquidity.

[36] These results are aligned with Altunbas et al. (2018), who prove that macroprudential policies are more effective in mitigating banking risks during the tightening cycle than during the easing phase.

Table 1: Systemic Risk: Loans and Deposits to GDP

	Loans		Deposits	
	MPP	MIC	MPP	MIC
$SRISK_{t-1}$	-0.1659***	-0.1967***	-0.1855***	-0.2776***
$Loan.CB_{t-1}$	0.1267***	0.2518***		
$Dev.Loan.CB_{t-1}$	-0.0606*	-0.1683***		
$Dep.CB_{t-1}$			-0.1183***	-0.1707***
$Dev.Dep.CB_{t-1}$			0.1268***	0.1718***
MPP	-0.6456***		-0.6204***	
$MPP.cred_{t-1}$	-0.0102***		-0.0154***	
Mic		-2.0341***		-6.4424***
$Mic.cred_{t-1}$		-0.0619		-0.0489
SV	0.1537***	0.3440***	0.1694***	0.2100***
GDP_{t-1}	-0.0242	-0.1738***	-0.0727	-0.2636***
CF_{t-1}	-0.0743***	-0.0229***	-0.0721***	-0.0192***
Int_{t-1}	0.5450+	1.2845***	0.7571+	1.1443***
$Size_{t-1}$	7.0673***	4.0952***	7.1279***	4.0504***
ROA_{t-1}	-0.0034	-0.0186***	-0.0126	-0.0287***
Obs	329359	329359	329359	329359
J-test	0.1787	0.1511	0.1355	0.1937
$Wald_{slope}$	***	***	***	***
$Wald_{time}$	***	***	***	***
$Wald_{all}$	***	***	***	***
$Arellano\text{-}Bond_{p2}$	0.7841	0.8085	0.8439	0.5431

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.1.2. Adults with Loan Accounts (%)

In the Appendix, Table 7 presents the estimated coefficients reflecting the impact of changes in the percentage of adults with loan accounts on systemic risks. We compare these results to the ones obtained in the previous section for the FI indicator of outstanding loans with CB to GDP (Section 4.1.1)[37]. While the signs of the estimated coefficients for control variables remain consistent across the regressions, we observe a discrepancy in the sign associated with the FI indicator. Specifically, FI in loans appears to decrease SRISK across the entire sample, and in particular in Dev economies, when considering the percentage of adults with loan accounts.

[37] The *Adu.Loan* indicator is available for 13 countries. For comparative purposes with the results presented in the first column of Table 1, the analysis is limited to these countries. It is important to note that while the estimated coefficients may vary slightly across regressions due to the reduced sample size (13 countries compared to 31), the signs of the coefficients remain consistent.

This suggests that while credit extensions may increase systemic risk, when loans are distributed among numerous small borrowers, the risk becomes more dispersed, reducing the concentration of the loan portfolio. As a result, the overall systemic risk in the financial system decreases.

4.2. Idiosyncratic Risk

4.2.1. Loans and Deposits to GDP

Concerning individual banking risk, the estimated coefficients, when statistically significant, consistently demonstrate the same direction of impact on both the Z-Score and the idiosyncratic component of the CDS spreads. Compared to those for SRISK, the findings are similar, with the exception that the expansion of deposits in Dev countries appears to attenuate idiosyncratic risk.

As in the case of SRISK, we find that credit inclusion increases individual banking risks, and this effect is moderated in Dev economies. These results are in line with precedent literature focused on standalone banking risk finding that rapid credit extensions seem to increase banking risks. For instance, Čihák et al. (2016) claim that, while FI might be beneficial for the stability of individual banks because of the diversification of loan portfolios, fast credit growth might be accompanied by the reduction of lending standards to expand the pool of borrowers, increasing bank standalone risk, and potentially systemic risk through contagion. Furthermore, Feghali et al. (2021) prove that FI in loan services is associated to higher idiosyncratic risks in the context where banks compete to offer loans to less creditworthy individuals who were previously rationed. However, when considering a sample of developing economies, Wang & Luo (2022) find that nonperforming loans significantly decrease with the advancement of FI, suggesting that the stabilizing effect of loan portfolio diversification prevails in these countries.

We find that broader deposit inclusion helps reduce idiosyncratic risk, and this is also the case for Dev economies. According to Ahamed & Mallick (2019), increased access to retail deposits can reduce funding costs and enhance bank profitability and resilience. The authors find similar effects, in both advanced and emerging economies, when employ a FI composite indicator. Similarly, Marcelin et al. (2022), spanning a wide sample of countries, show that outstanding deposits with CB to GDP reduces individual bank probability of insolvency, a metric captured by the Z-Score.

Lastly, in the case of idiosyncratic risk, the estimated coefficient associated to *Mic.cred* appear to be significant. Both *Mic* and *Mic.cred* seem to reduce idiosyncratic risks, indicating that banks can further mitigate individual risks if credit expansions are associated to the improvement of Basel ratios.

Table 2: Idiosyncratic Risk: Loans and Deposits to GDP

	Loans		Deposits	
	Z-Score	CDS	Z-Score	CDS
Z-Score$_{t-1}$	-0.0846***		-0.0645***	
CDS$_{t-1}$		-0.5162***		-0.5061***
Loan.CB$_{t-1}$	0.0200***	0.0165***		
Dev.Loan.CB$_{t-1}$	-0.1127***	-0.0010		
Dep.CB$_{t-1}$			-0.1039***	-0.0058**
Dev.Dep.CB$_{t-1}$			-0.0351***	-0.0118*
Mic	-4.2921***	-0.3068*	-0.1471	-0.7884***
Mic.cred$_{t-1}$	-0.1631***	-0.0170***	-0.0326***	-0.0252***
SV	0.0813***		0.0024	
GDP$_{t-1}$	-0.1796***	-0.0197***	-0.0978***	-0.0143*
CF$t-1$	-0.0039***	-0.0040***	-0.0176***	-0.0043**
Int$t-1$	0.8013***	0.3435***	0.5044***	0.2752***
Size$_t-1$		0.3201***		0.2491***
Size	3.4772***		1.1384***	
ROA	-0.5237***	-0.0062+	-0.6131***	-0.0033
Obs	329359	329360	329359	329360
J-test	0.2127	0.2445	0.1925	0.1742
Wald$_{slope}$	***	***	***	***
Wald$_{time}$	***	***	***	***
Wald$_{all}$	***	***	***	***
Arellano-Bond$_{p2}$	0.9895	0.4942	0.9954	0.7026

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2.2. Adults with Loan Accounts (%)

Turning our attention to banking individual risks, in Table 8 of the Appendix, we display the estimated coefficients related to the percentage of adults with loan accounts (Adu.Loan). These results are compared to those obtained in the previous section, focusing on the FI indicator for outstanding deposits with CB to GDP (Section 4.2.1). Similar to the earlier analysis, we limit our examination to 13 countries. We find that the signs of the significant estimated coefficients remain consistent across regressions.

Similar to our findings regarding systemic risk, we observe a discrepancy in the sign associated with the FI indicator. When considering the percentage of adults with loan accounts, FI in loans appears to decrease idiosyncratic risk, and this effect is enhanced in Dev economies. This reduction in risk is likely driven by the distribution of loans among numerous small borrowers, which help reduce portfolio concentration.

4.3. The Role of NCB

Turning our attention to the source of FI, namely, the financial institutions providing the financial services, we examine the relative share of NCB in the provision of financial services. Our findings highlight distinct impacts of loan and deposit services on banking risks. The estimated results are reported in the Appendix in Section 6.2.2.

We observe that a higher share of loan services provided by NCB is associated to higher levels of bank systemic and idiosyncratic risks (Table 9). As NCB expand financial services, if consumers increasingly turn to NCB for their financial needs, CB could lose market share. In response to this competitive pressure arising from the penetration of NCB, CB may resort to relaxed credit standards, such as loan collateral, resulting in risky lending practices.

In terms of deposits services, we find that, an increased share of NCB increases banking risks (Table 10). This suggests that increased deposit competition prompts higher deposit rates, thereby decreasing efficiency and increasing risk-taking in the traditional banking sector, as banks are more likely to engage in risky activities when funding costs are high.

In accordance with our previous findings, when broader credit extensions are accompanied.

by sound macroprudential policies and prudent bank risk-taking behavior, banking risks are mitigated. This is evidenced by the significant and negative coefficients for *MPP.cred* and *Mic.cred* across the regressions. While our study does not directly observe a leaking effect from macroprudential policies contributing to increased banking risks, as documented in Aiyar et al. (2014), we do find evidence that greater penetration of NCB in certain financial services, such as loans, can elevate banking risks. These findings underscore the crucial role of effective regulatory frameworks in harmonizing FI objectives with the preservation of banking stability.

5. Conclusion

Our research marks a significant contribution to the literature by being the first to analyze the impact of financial inclusion (FI) across various commercial banking risk dimensions, including systemic risk, which has not been explored extensively before. Building upon recent literature that demonstrates the diverse impacts of FI on individual banking risks depending on the financial service considered, our study expands this analysis to encompass the source of FI, particularly if non-commercial banks (NCB) gain traction in promoting FI.

With respect to financial services provided by commercial banks (CB), existing literature generally agrees that rapid credit expansions are associated with higher banking risks, while credit diversification among low-income borrowers helps mitigate these risks. In this line, in our sample, we observe that even though credit to GDP appears to increase faster in developing and emerging (Dev) economies, the gap in the unbanked population remains larger. As follows, our findings reveal that in these economies, the increase of banking risks steaming from broader loan inclusion is diluted. This suggests that in these countries, the role of loan diversification is particularly significant. Accordingly, we find that, overall, a higher proportion of adults with loan accounts reduces both systemic and idiosyncratic risk, and this effect is enhanced in Dev economies.

Regarding deposit services, the literature has generally found a favorable relationship between FI in deposits and individual banking risks, arising from the cheaper and more stable source of long-term funding. We observe this same dynamic in general, with the exception of systemic risks in Dev countries. In these countries, the reduction of systemic risk stemming from the expansion of deposits is dampened, while this is not the case for idiosyncratic risks. Further research is needed on this topic; however, we can infer that this may be due to a limited capacity to ensure efficient allocation of funding to creditworthy firms and individuals in these economies (Čihák et al., 2016), or the comparatively limited availability of financial assets for diversification (Gennaioli et al., 2018).

We observe that a higher share of loan services provided by NCB with respect to CB is associated with higher levels of systemic and idiosyncratic risks, possibly suggesting that traditional banks tend to relax credit standards when facing competition from NCB. Furthermore, in terms of deposit services, we find that, an increased share of NCB elevates CB risks. This suggests that increased deposit competition drives up funding costs in the traditional banking sector, reducing efficiency and encouraging riskier behavior by banks when faced with higher funding expenses.

Lastly, findings emphasize the need for coordinating efforts to promote FI with prudent regulatory measures to foster financial stability. We find evidence suggesting that when macroprudential regulation is aligned with credit developments, it has a more pronounced effect in mitigating banking risks. Similarly, aligning sounder bank-level Basel scores with credit development appears to reduce banks' risk exposure, although there is a prevalent trend towards reducing scores to facilitate greater credit extensions. In line with our findings related to the share of NCB in loan services, our study lend support to the recent call for the regulation of NCB, aimed at enhancing both banking and overall financial system stability.

6. Appendix

6.1. Descriptive Statistics

In this section, we provide an overview of the selected variables, starting with a descriptive analysis. This analysis is complemented by the following two subsections, where we report Tables and Figures, (6.1.2 and 6.1.3 respectively). In Table 3, we present descriptive statistics, while in Tables 4, 5, and 6, we provide descriptions of the variables and data sources. Finally, Figures 1 to 14 illustrate the time series of the main selected variables.

6.1.1 Descriptive Analysis

On average, outstanding loans from commercial banks (CB) account for 72.76% of GDP

(Loan.CB). Annually, *Loan.CB* increases by an average of 0.69 percentage points (pp). However, in developing and emerging economies (Dev), the proportion of GDP represented by *Loan.CB* is significantly lower, by approximately 15 pp. Despite this lower baseline, these economies exhibit a higher annual growth rate in *Loan.CB*, averaging an increase of

1.01 pp per year (Figure 1). Similarly, outstanding deposits with CB average 78.48% of GDP (Dep.CB). On an annual basis, *Dep.CB* increases by an average of 1.82 pp. In Dev economies, *Dep.CB* is approximately 16 pp lower than the panel average. Nonetheless, in these economies the average annual change is 1.12 pp, indicating that the gap in FI, in terms of deposits, is narrowing at a slightly slower pace than the panel average (Figure 2).

Borrowers represent, on average, the 44% of total adult population, while in Dev economies, they constitute the 35%. In these economies, the average annual change in this proportion is higher, i.e. 2 pp vs 1 pp for the overall sample (see also Figure 3). Analogously, depositors represent 98% of total adults, while in Dev economies, 80%. Similarly, these economies experienced a higher yearly increase, i.e. averaging 3 pp vs 2 pp for the total sample. As reported in Figures 3 and 4, *Ad* economies appear to increase the proportion of borrowers and depositors at a slower pace compared to Dev countries.

The outstanding loans from non-commercial banks (NCB) represent, on average, 19% of the outstanding loans from CB (SLoan.NCB). In Dev economies, this proportion is significantly lower (12%). Across the entire panel, *SLoan.NCB* shows a slight annual increase of 0.1 pp, indicating that NCB are gradually gaining a larger share of the loan market relatively to CB. However, as illustrated in Figure 5, this trend is primarily driven by the higher participation of NCB in *Ad* economies. The outstanding deposits with NCB represent on average 17% of the outstanding deposits with CB (SDep.NCB). Similarly to the loan services, in Dev economies, this proportion is significantly lower (9%), and slightly decreases annually by 0.2 pp. This indicates that CB are gaining a larger share in the provision of the deposit services in Dev countries (see Figure 6). Furthermore, we observe that in Dev economies, the evolution of the shares exhibits more fluctuations compared to *Ad* economies. For instance, *SLoan.NCB* experienced a significant decline during the COVID-19 crisis in Dev economies, while remaining relatively stable in *Ad* economies.[38]

[38] See Zheng & Zhang (2021) for further discussion on the impact of COVID-19 on microfinance institutions in developing countries.

Moving forward on banking risks, *SRISK* is on average 2.57 U$S bn, declining 0.19 U$S bn per year. In Figures 7 and 8, we illustrate the evolution of *SRISK* and the *MPP* index across Dev and *Ad* economies. Since the global financial crisis, macroprudential authorities have been progressively reinforcing capital buffers, coinciding with a gradual decrease in *SRISK* over time. However, during the COVID-19 crisis, *SRISK* increased, prompting macroprudential authorities to respond by loosening capital requirements on average to help banks absorb potential losses. In terms of idiosyncratic risks, in *Ad* economies, Z-Score and the CDS appear to decline as of 2012, with an increase in 2020. However, this dynamic is not observed in Dev economies, particularly as Z-Scores seem to gradually increase over time (Figures 9 and 10).

The *MPP* index has an average of 1.05, indicating that the countries' prudential regulators have tended to tighten capital requirements over our sample period (Figure 11). This, combined with the cumulative credit extensions, results in a positive *MPP.Cred* index (Figure 12). This positive relationship reflects the strategic decision of macroprudential policies to accumulate capital during credit expansions, aligning with Basel guidelines.

As presented in Table 3 for the *Mic* index, the six selected Basel scores are, on average, 2.21 times above the minimum requirements. Maintaining Basel scores above regulatory thresholds signifies banks' strategic decisions aimed at bolstering market confidence and mitigating regulatory scrutiny. However, the average yearly change is negative, suggesting a gradual relaxation of Basel scores by banks. Particularly in *Ad* economies, *Mic* increased until the conclusion of the global financial crisis, subsequently experiencing a gradual decline (Figure 13). A similar pattern is observed in Dev economies, albeit with a lag, where *Mic* peaked in 2014 before declining. As follows, our *Mic.cred* index is predominantly negative throughout the sample period, probably indicating that as credit activity expands, banks tend to relax their Basel ratios to accommodate lending demands (Figure 14). Further research on bank risk-taking behaviour associated to credit expansions could be conducted.

Table 3: Descriptive Statistics

	mean	sd	min	max	diff.mean	diff.sd	obs	obs (C&B)
Country-level variables								
MPP	1.05	2.36	-13	10	0.08	3.23	403	31
MPP.cred	41.01	85.85	-810	1,518	12.60	77.92	327	31
RQ	0.98	0.30	0	1.37	0.002	0.04	403	31
DII	1.39	2.16	-1.36	4.62	0	0	403	31
DIRQ	1.13	0.66	0	2.10	-0.0001	0.07	403	31
SV	19.47	7.45	7.72	51.08	-1.01	5.44	403	31
GDP	39.89	22.17	1.10	103.55	0.62	3.63	403	31
CF	4.57	13.40	-65.48	59.58	-0.35	16.78	370	29
Int	2.62	3.03	-0.42	13.99	-0.17	1.00	197	17
CPI	2.10	2.21	-2.09	18.68	0.05	1.61	403	31
Dev	0.39	0.49	0	1	0	0	403	31
Dep.CB	78.48	20.02	20	300	1.82	8.76	403	31
Dep.NCB	11.79	8.97	1	39	0.13	1.45	246	22
Loan.CB	72.76	29.51	16	247	0.69	7.52	403	31
Loan.NCB	16.79	19.66	1	85	0.30	1.83	312	25
Dev.Dep.CB	62.08	17.40	20	151	1.12	4.94	156	12
Dev.Dep.NCB	6.28	8.74	1	31	0.04	0.80	84	8
Dev.Loan.CB	57.70	28.82	16	136	1.01	4.61	156	12
Dev.Loan.NCB	6.28	8.74	1	31	0.04	0.80	84	8
Adu.Dep	0.98	0.23	0.12	2.41	0.02	0.05	100	10
Adu.Loan	0.44	0.12	0.14	1.17	0.01	0.04	131	13
Dev.Adu.Dep	0.80	0.28	0.1	1.83	0.03	0.05	100	7
Dev.Adu.Loan	0.35	0.14	0.13	0.75	0.02	0.04	131	7
SDep.NCB	0.17	0.08	0.01	0.60	-0.002	0.02	246	22
SLoan.NCB	0.19	0.11	0.01	0.75	0.001	0.02	312	25
Dev.SDep.NCB	0.09	0.09	0.01	0.28	-0.002	0.01	84	8
Dev.SLoan.NCB	0.12	0.10	0.01	0.36	-0.001	0.01	126	10
Dep.CB.DIRQ	78.19	52.46	0	420.24	1.97	11.91	403	31
Dev.Dep.CB.DIRQ	52.34	40.85	0.05	163.91	2.08	6.13	144	12
Bank-level variables								
SRISK	2.57	17.00	-56.09	206.06	-0.19	4.14	6,935	574
Z-Score	-2.32	4.74	-53.37	40.93	0.01	3.24	6,597	549
CDS.lt	4.55	0.79	0	7.90	-0.04	0.49	6,767	565
CDS	0.01	0.54	-2.39	2.47	-0.02	0.54	6,409	565
Mic	2.21	0.82	-5.27	15.64	-0.01	0.62	3,194	273
Mic.cred	-0.47	11.09	-308.23	135.21	-0.06	6.70	5,709	574
Size	10.26	2.03	-3.18	15.14	0.05	0.20	6,749	569
ROA	1.92	5.65	-135.31	67.94	-0.02	3.72	6,723	568
EQA	21.02	23.10	-409.05	100.00	-0.1	6	6,749	569

Notes: obs: refers to the number of panel observations; obs (C&B) refers to cross sectional number of observations, i.e. for country- and bank-level variables.

6.1.2. Tables

Table 4: Macro Variables Description

Variable	Description	Unit	Source
MPP	Sum of monthly dummy-type indicators of tightening and loosening actions of macroprudential policy instruments. Selected instruments: countercyclical capital buffers (CCB), capital conservation buffers (Conservation), other capital requirements (Capital), limits on leverage (LVR), liquidity requirements (Liquidity) and limits on foreign exchange exposures (LFX). Tightened (+1), loosened (-1), 0 otherwise.	categ	iMaPP
MPP.cred	Cumulative sum of MPP up to year *t* multiplied by the cumulative change of credit provided by commercial banks to GDP up to year *t*.	categ	iMaPP and FAS
RQ	Regulatory Quality Index captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from -2.5 to 2.5.	log*	WBGI
DII	Deposit Insurance Index: first principal component between Coverage limit to GDP per Capita and other dummy variables such as unlimited government guarantee, foreign currency deposits coverage, etc.	index	IMFDID
DIRQ	Deposit Insurance Index (DII) multiplied by the cumulative yearly percentage change of the log-transformed Regulatory Quality Index (RQ).	index	-
SV	Stock price volatility, i.e., the average of the 360-day volatility of the national stock market index.	%	WBGFD
GDP	GDP per thousand people.	USD	WB
CF	Portfolio equity, net inflows as a percentage of GDP (per thousand), Net inflows from current account balance, i.e. direct purchases of shares in local stock markets by foreign investors.	%	WB
Int	Deposit interest rate, i.e. rate paid by commercial or similar banks for demand, time, or savings deposits.	%	WB
CPI	Inflation, consumer prices.	%	WB
Dev	Dummy variable: 1) developing or emerging economy, 0) advanced economy.	dummy	IMFWEO

Notes: iMaPP: IMF, Integrated Macroprudential Policy Database by Alam et al., 2019; FAS: IMF, Financial Access Survey; WBGI: World Bank, Worldwide Governance Indicators; WBGFD: World Bank, Global Financial Development Database; WB: World Bank, DataBank; IMFDID: IMF, Deposit Insurance Database, Moral Hazard Index by Demirgüç Kunt et al. (2015); IMFWEO: IMF, World Economic Outlook Database; categ: categorical variable; log*: natural log transformation after scaling each observation to ensure positive values, i.e. by subtracting the minimum observed Value.

Table 5: Financial Inclusion Variables Description

Variable	Description	Unit	Source
Dep.CB	Outstanding deposits with commercial banks (% of GDP).	%	FAS
Dep.NCB	The sum of outstanding deposits with credit unions and credit cooperatives, all microfinance institutions and other deposit and non-deposit takers (excl. commercial banks).	%	FAS
Loan.CB	Outstanding loans from commercial banks (% of GDP).	%	FAS
Loan.NCB	The sum of outstanding loans (% of GDP) from credit unions and credit cooperatives, all microfinance institutions and other deposit takers (excl. commercial banks).	%	FAS
Adu.Dep	The sum of depositors with commercial banks, deposit-taking microfinance institutions and credit unions and credit cooperatives, divided by total adults.	%	FAS
Adu.Loan	The sum of borrowers from commercial banks, deposit-taking microfinance institutions, credit unions and credit cooperatives and non-deposit taking microfinance institutions, divided by total adults.	%	FAS
SDep.NCB	Share of NCB in deposits: The sum of outstanding deposits with deposit-taking microfinance institutions, credit unions and credit cooperatives and other deposit takers (excl.c commercial banks), divided by outstanding deposits with commercial banks.	%	FAS
SLoan.NCB	Share of NCB in loans: The sum of outstanding loans from credit unions and credit cooperatives, all microfinance institutions and other deposit and non-deposit takers (excl. commercial banks), divided by outstanding loans from commercial banks.	%	FAS
Dev(...)	The corresponding indicator (...) multiplied by the dummy variable Dev: 1) developing or emerging economy, 0) advanced economy.	%	FAS, IM-FWEO

Notes: FAS: IMF, Financial Access Survey, IMFWEO: IMF, World Economic Outlook Database.

Table 6: Bank Variables Description

Variable	Description	Unit	Source
SRISK	Amount of capital a bank would necessitate in the event of a market loss (Acharya et al., 2017).	US$bn	V-Lab
Z-Score	Inverted Z-Score: number of standard deviations that the ROA can fall before depleting equity.	%	Bloomberg: ROA and EQA
CDS.lt	Credit default swaps spreads.	bps, log	Bloomberg
CDS	Idiosyncratic component of CDS.lt, i.e., after extracting first principal component between within-country bank-level CDS.lt and country-level standardized stock price volatility (SV).	bps, log	Bloomberg
Mic	Simple average of four BASEL scores, deviated from regulatory guidance, i.e., leverage ratio (LR/3), TIER1 capital ratio (TIER1/6), liquidity coverage ratio (LCR/100) and net stable funding ratio (NSFR/100).	%	Bloomberg and BIS
Mic.cred	Cumulative change of Mic up to year *t* multiplied by the cumulative change of outstanding loans with commercial banks to GDP up to year *t*.	%	Bloomberg, BIS and FAS
Size	Total assets.	US$m, log	Bloomberg
ROA	Returns to total assets.	%	Bloomberg
EQA	Equity to total assets.	%	Bloomberg

Notes: BIS: Bank for International Settlements, Basel III: international regulatory framework for banks; bps:basis points; log: natural logarithm transformation.

6.1.3. Figures

Figure 1: Loans CB

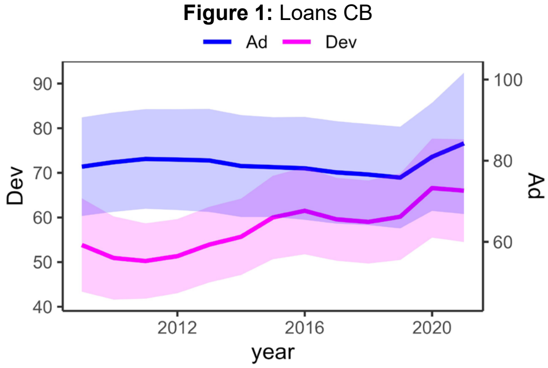
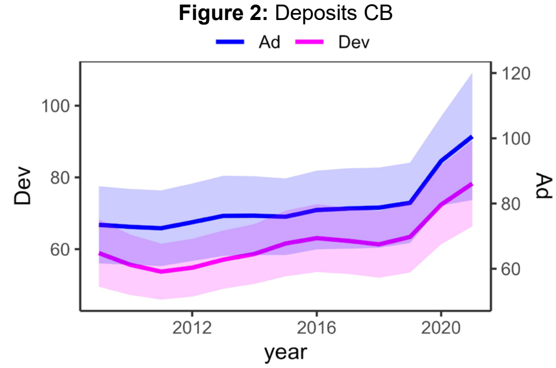


Figure 2: Deposits CB



Notes: Loan CB: cross-country average of outstanding loans from commercial banks (% of GDP); Deposits CB: cross-country average of outstanding deposits with commercial banks (% of GDP); Dev: developing or emerging economies; Ad: advanced economies; shaded areas: (+/-) cross-country standard deviations.

Figure 3: Borrowers (% adults)

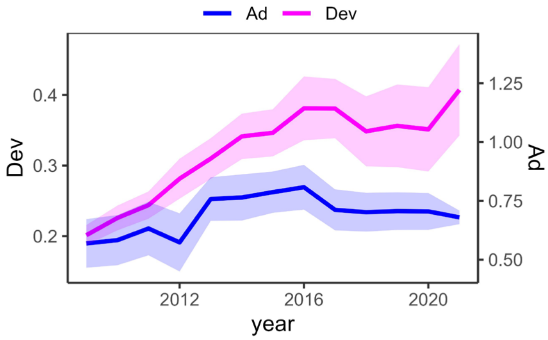
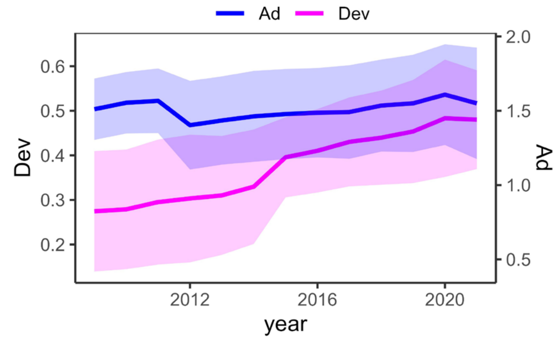


Figure 4: Depositors (% adults)



Notes: Borrowers (% adults): the sum of borrowers from commercial and non-commercial banks divided by total adults; Depositors (% adults): the sum of depositors with commercial and non-commercial banks divided by total adults; Dev: developing or emerging economies; Ad: advanced economies; shaded areas:

(+/-) cross-country standard deviations.

Figure 5: Share of NCB in loans

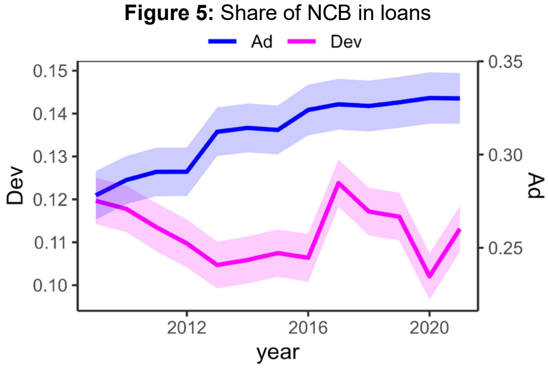
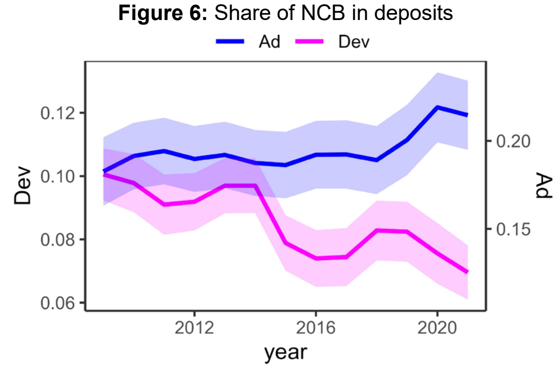


Figure 6: Share of NCB in deposits



Notes: Share of NCB in loans: cross-country average of outstanding loans from non-commercial banks divided by outstanding loans from commercial banks; Share of NCB in deposits: cross-country average of outstanding deposits with non-commercial banks divided by outstanding deposits with commercial banks; Dev: developing or emerging economies; Ad: advanced economies; shaded areas: (+/-) cross-country standard deviations.

Figure 7: Dev: SRISK and MPP

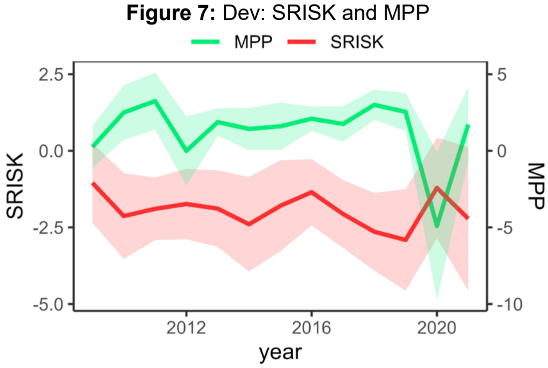
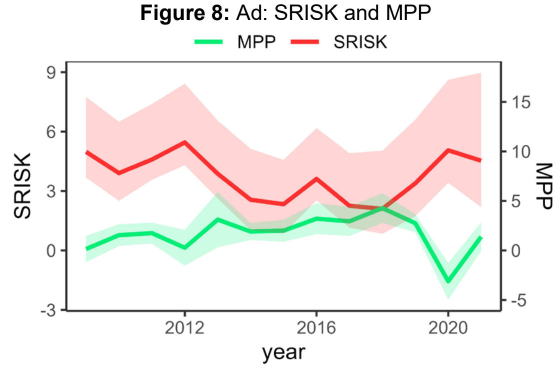


Figure 8: Ad: SRISK and MPP



Notes: SRISK: cross-country average of SRISK in US$bn, i.e. amount of capital a bank would necessitate in the event of prolonged market downturn; MPP: cross-country average of MPP, i.e. sum of six monthly dummy-type indicators of tightening and loosening of macroprudential policy instruments; Dev: developing or emerging economies; Ad: advanced economies; shaded areas: (+/-) cross-country standard deviations.

Figure 9: Dev: Z-Score and CDS

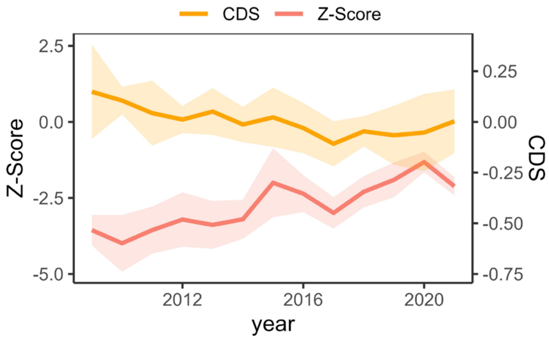
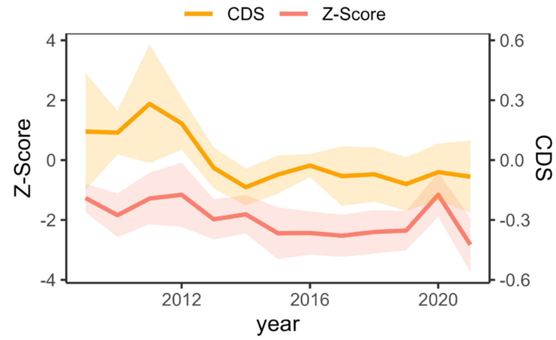


Figure 10: Ad: Z-Score and CDS



Notes: Z-Score: cross-country average of Z-Score, i.e. number of standard deviations that the ROA of a bank can fall before depleting its equity; CDS: cross-country average of idiosyncratic component of CDS spreads; Dev: developing or emerging economies; Ad: advanced economies; shaded areas: (+/-) cross-country standard deviations.

Figure 11: MPP

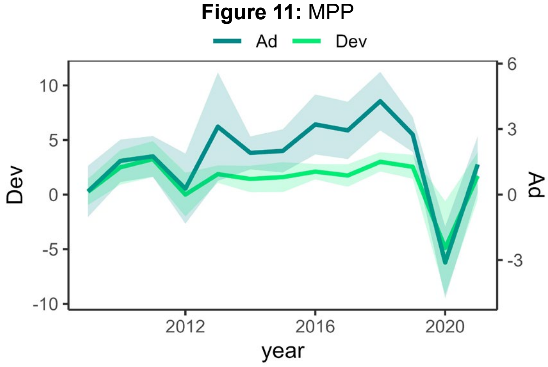
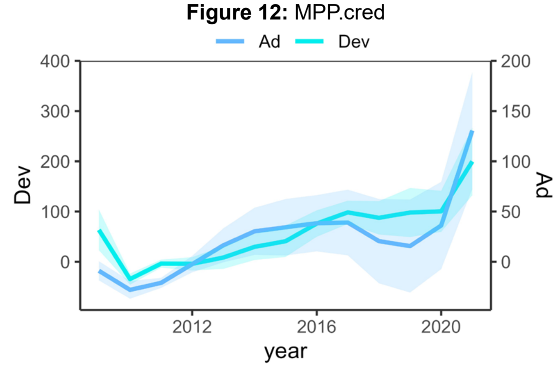


Figure 12: MPP.cred



Notes: MPP: cross-country average of MPP, i.e. sum of six monthly dummy-type indicators of tightening and loosening of macroprudential policy instruments; MPP.cred: cross-country average of MPP.cred, i.e., cumulative change of MPP up to year t multiplied by the cumulative change of outstanding loans from by commercial banks to GDP up to year t; Dev: developing or emerging economies; Ad: advanced economies; shaded areas: (+/-) cross-country standard deviations.

Figure 13: Mic

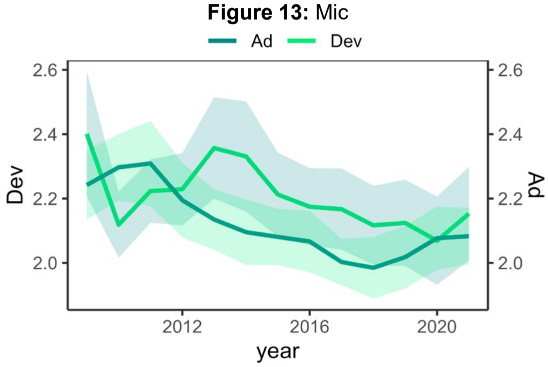
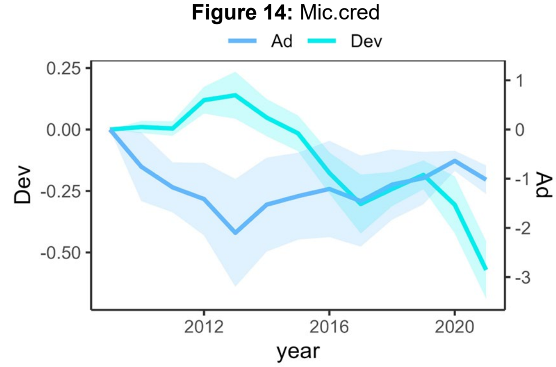


Figure 14: Mic.cred



Notes: Mic: cross-country average of Mic, i.e. average of four Basel scores deviation from regulatory guidance; Mic.cred: cross-country average of Mic.cred, i.e., cumulative change of Mic up to year t multiplied by the cumulative change of outstanding loans from by commercial banks to GDP up to year t; Dev: developing or emerging economies; Ad: advanced economies; shaded areas: (+/-) cross-country standard deviations.

6.2. Complementary Results and Robustness Checks

In this section, we present complementary tables of results and conduct robustness checks. Firstly, Tables 7 and 8 display the results discussed in the previous section regarding the impact of the percentage of adults with loan accounts on banking systemic and idiosyncratic risk respectively, see columns Adults (%). We compare these results with those obtained when using outstanding loans to GDP as a metric of FI. For the sake of comparability and robustness checks, we reduce the number of countries in our sample from 31 to 13. This reduction is necessary because the indicator for *Adu.Loan* is not available for all countries considered. We find that when the sample is reduced, estimated coefficients that remain significant also maintain the same sign with respect to our benchmark results reported in Tables 1 and 2 for loan services. This suggests that our benchmark results are robust. Secondly, in Tables 9 and 10 we present the results reported in Section 4.3.

In Section 6.2.3, we aim to verify whether the findings from our benchmark model with respect to deposit services, as reported in Section 4.1 can be attributed to differences in the regulatory environment, for what we account for regulatory quality and deposit insurance coverage measures. In addition, we investigate whether the impact of FI in loan services on banking risks is linked to lower credit standards, i.e. i) influenced by competition among banks as argued in Feghali et al. (2021), and ii) indicated by higher debt service to income ratios (see Section 6.2.4). Lastly, in Section 6.2.5, we explore the presence of a U-shaped relationship between FI and SRISK when utilizing bank-level data and individual FI indicators, contrasting the approach taken in Hua et al. (2023).

6.2.1. Adults with Loan Accounts (%)

Table 7: Systemic Risk: Adults with Loan Accounts (Percent)

	Adults (%)	Loans to GDP
$SRISK_{t-1}$	-0.0762***	-0.5115***
$Adu.Loan_{t-1}$	-0.5750***	
$Dev.Adu.Loan_{t-1}$	-0.8225***	
$Loan.CB_{t-1}$		0.4804**
$Dev.Loan.CB_{t-1}$		-0.5432**
MPP	-0.2617***	-0.0266
$MPP.cred_{t-1}$	-0.0095**	-0.0247+
SV	0.9631***	0.2815+
GDP_{t-1}	-0.2472***	-1.0983*
$CFt-1$	-0.1102***	-0.1283*
$Intt-1$	2.0566***	0.4548
$Size_{t}-1$	2.2527***	1.6345
ROA_{t-1}	-0.0785*	-0.6026
Obs	161385	161385
J-test	0.2150	0.2269
$Wald_{slope}$	***	***
$Wald_{time}$	***	***
$Wald_{all}$	***	***
$Arellano\text{-}Bond_{p2}$	0.6911	0.7857

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The *Adu.Loan* indicator is available for 13 countries. For comparative purposes with the results presented in the first column of Table 1, the analysis is limited to these countries. It is important to note that while the estimated coefficients may vary slightly across regressions due to the reduced sample size (13 countries compared to 31), the signs of the coefficients remain consistent.

Table 8: Idiosyncratic Risk: Adults with Loan Accounts (Percent)

	Adults (%)		Loans to GDP	
	Z-Score	CDS	Z-Score	CDS
Z-Score$_{t-1}$	-0.1489***		-0.1616***	
CDS$_{t-1}$		-0.0196***		-0.3752***
Adu.Loan$_{t-1}$	-0.4712***	-0.0241***		
Dev.Adu.Loan$_{t-1}$	-0.1967***	-0.0277		
Loan.CB$_{t-1}$			0.0129*	0.0007*
Dev.Loan.CB$_{t-1}$			-0.0291+	-0.0181*
Mic	-0.7867***	-0.5426*	-0.4229	-0.6722***
Mic.cred$_{t-1}$	-0.0467***	-0.0124***	-0.6045***	-0.0684***
SV	0.0756***		0.0495	
GDP$_{t-1}$	-0.0486***	-0.0084***	-0.0287***	-0.0042*
CF$t-1$	-0.0039***	-0.0038***	-0.0323***	-0.0001**
Int$t-1$	0.3941***	0.0509***	0.8379***	0.0075***
Size$_{t}$-1		0.0358*		0.4177***
Size	4.3052***		1.6355***	
ROA	-0.6901***	-0.0312***	-0.6999***	-0.0047
Obs	36747	36747	36747	36747
J-test	0.2867	0.2721	0.1656	0.1566
Wald$_{slope}$	***	***	***	***
Wald$_{time}$	***	***	***	***
Wald$_{all}$	***	***	***	***
Arellano-Bond$_{p2}$	0.9935	0.5542	0.8853	0.6021

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The *Adu.Loan* indicator is available for 13 countries. For comparative purposes with the results presented in the first two columns of Table 2, the analysis is limited to these countries. It is important to note that while the estimated coefficients may vary slightly across regressions due to the reduced sample size (13 countries compared to 31), the signs of the coefficients remain consistent.

6.2.2. Share of NCB

Table 9: Share of NCB in Loans

	SRISK	Z-Score	CDS
$SRISK_{t-1}$	-0.1940***		
$Z\text{-}Score_{t-1}$		-0.0804***	
CDS_{t-1}			-0.3600***
$SLoan.NCB_{t-1}$	0.1139**	0.1230***	7.2735***
$Dev.SLoan.NCB_{t-1}$	0.0364***	0.0021+	1.6514***
MPP	-0.6478***		
$MPP.cred_{t-1}$	-0.0144***		
Mic		-0.0291	-0.4609**
$Mic.cred_{t-1}$		-0.0219***	-0.0169***
SV	0.1985***	0.0214***	
GDP_{t-1}	-0.0727***	-0.1334***	-0.0242*
CF_{t-1}	-0.0708***	-0.0014***	-0.0006
Int_{t-1}	0.0031	0.5982***	0.2730***
$Size_{t-1}$	6.1490***		0.3110***
Size		2.4385***	
ROA_{t-1}	-0.0119		
ROA		-0.6374***	-0.0015
Obs	329359	329358	329359
J-test	0.1764	0.1897	0.1761
$Wald_{slope}$	***	***	***
$Wald_{time}$	***	***	***
$Wald_{all}$	***	***	***
$Arellano\text{-}Bond_{p2}$	0.7742	0.8177	0.7102

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Share of NCB in Deposits

	SRISK	Z-Score	CDS
$SRISK_{t-1}$	-0.1006***		
$Z\text{-}Score_{t-1}$		-0.0030	
CDS_{t-1}			-0.4173***
$SDep.NCB_{t-1}$	0.2460***	0.3048***	0.0180***
$Dev.SDep.NCB_{t-1}$	0.0048***	0.0211***	0.0118***
MPP	-0.3812***		
$MPP.cred_{t-1}$	-0.0248***		
Mic		-2.8421***	-0.2715***
$Mic.cred_{t-1}$		-0.1083***	-0.0069***
SV	0.2091***	0.0141***	
GDP_{t-1}	-0.1297***	-0.0136***	-0.0237***
CF_{t-1}	-0.0842***	-0.0044***	-0.0054***
Int_{t-1}	0.6240***	0.6954***	0.0531***
$Size_{t-1}$	1.9950***		0.0961***
Size		1.8928***	
ROA_{t-1}	-0.1834***		
ROA		-0.6612***	-0.0159***
Obs	329359	329358	329359
J-test	0.1670	0.1705	0.1940
$Wald_{slope}$	***	***	***
$Wald_{time}$	***	***	***
$Wald_{all}$	***	***	***
$Arellano\text{-}Bond_{p2}$	0.5308	0.8467	0.6812

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6.2.3. Regulatory Quality

Deposit insurance schemes play a crucial role in mitigating the adverse effects of rapid FI on depositors, addressing informational asymmetry between banks and depositors (Han & Melecky, 2013). Additionally, institutional quality has been identified as a significant factor influencing FI (Allen et al., 2014). Chen & Divanbeigi (2019) argue that enhancing regulatory standards and expanding deposit insurance schemes can further promote inclusion in depositservices.

Our analysis focuses on verifying whether the findings from our benchmark model, as reported in Section 4.1, concerning Dev countries, can be attributed to differences in the regulatory environment, potentially rendering depositors more susceptible to deposit withdrawals. To do so, we investigate the impact of changes in FI in deposits accompanied by more propitious regulatory environment, on banking systemic risk.

We construct an index that integrates deposit insurance coverage with cumulative changes in regulatory quality. This index (DIRQ) combines a static measure of deposit insurance coverage with adjustments reflecting improvement or deterioration of regulatory quality (see Table 4). By doing so, we capture the potential adverse effects of cumulative declining in institutional quality, which may discourage clients from maintaining their deposits even despite the ample insurance coverage. For the deposit insurance coverage measure, we rely on the moral hazard index presented in Demirgüç-Kunt et al. (2015). This index remains static over time, offering insights into the cross-country deposit insurance limits to GDP per capita among other categorical variables.[39] The regulatory quality index is retrieved from the World Bank's Worldwide Governance Indicators database, gauging the government's perceived capacity to formulate and implement policies facilitating private sector growth. It spans from -2.5 to 2.5 across countries and years. To ensure positive values, we log-transform the index after scaling each observation by subtracting the minimum observed value. Subsequently, we calculate the cumulative yearly change to capture the overall improvement or deterioration throughout our sample period.

We interact the FI indicator (*Dep.CB*) with the *DIRQ* index, i.e. *Dep.CB.DIRQ* and *Dev.Dep.CB.DIRQ* for the subset of Dev economies. We observe that deposit insurance coverage, coupled with improvements in regulatory quality (DIRQ), contributes to the mitigation of banking systemic risk, as evidenced by the negative and significant estimated coefficient associated with *DIRQ*. Consistent with the benchmark findings, the expansion of deposits in Dev countries is associated with increased systemic risk. Notably, even when accounting for changes in the regulatory environment that could potentially encourage depositors to entrust funds to banks, this effect persists. Thus, it appears that the limited relative capacity for asset diversification in Dev countries remains the predominant factor driving this outcome.

[39] More specifically, this index incorporates several dummy indicators and variables that encompass facets such as coverage limit to GDP per capita ratio, government guarantees, foreign currency deposit coverage, inter-bank deposit coverage, co-insurance absence, among others (see Demirgüç-Kunt & Detragiache, 2002).

Table 11: Deposit to GDP and Regulatory Quality (RQ)

	Deposit adjusted to RQ	Deposits to GDP (Benchmark)
$SRISK_{t-1}$	-0.0871***	-0.1855***
$Dep.CB.DIRQ_{t-1}$	-0.2879***	
$Dev.Dep.CB.DIRQ_{t-1}$	0.2627***	
$Dep.CB_{t-1}$		-0.1183***
$Dev.Dep.CB_{t-1}$		0.1268***
DIRQ	-1.8099+	
MPP		-0.6204***
$MPP.cred_{t-1}$		-0.0154***
SV	0.0693**	0.1694***
GDP_{t-1}	-0.0114	-0.0727
CF_{t-1}	-0.0397***	-0.0721***
Int_{t-1}	1.0450**	0.7571+
$Size_{t-1}$	6.8736***	7.1279***
ROA_{t-1}	-0.2164***	-0.0126
Obs	329360	329359
J-test	0.2371	0.2876
$Wald_{slope}$	***	***
$Wald_{time}$	***	***
$Wald_{all}$	***	***
$Arellano\text{-}Bond_{p2}$	0.7721	0.7417

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6.2.4. Credit Standards

In the benchmark results, we found that, in general, credit extensions increase banking systemic risk, however, this effect is mitigated in Dev countries. Now, we analyze whether this difference can be attributed to banks operating in environments that favor lending to less creditworthy individuals. On one hand, if the banking system is more competitive, banks may be incentivized to lower credit standards to extend more credit, as suggested by Feghali et al. (2021). They find that a more competitive structure intensifies the adverse impact of credit inclusion on bank stability, measured as Z-score, as banks extend loans to individuals with lower creditworthiness who were previously subject to credit rationing.[40] Similarly, we suggest that a higher debt service to income ratio (DTI) indicates that banks are providing more lenient terms to attract customers, potentially exacerbating banking risks.

[40] To arrive to these results, they interact the competition index with FI indicators. The authors employ the 3-bank asset concentration index to analyze how competition interacts with FI in taming (enhancing) individual banking risks. A more concentrated banking system is expected to be less competitive. Nonetheless, market contestability might not perfectly align with observed market concentration, so the authors also use other non-structural measures that are computed from prices and cost functions, such as the Lerner index.
See also López & Winkler (2019).

We find that the impact of FI in loans follows the same direction as in our benchmark results, as indicated by the significant terms associated with *Loan.CB* and *Dev.Loan.CB*. The sign of the estimated coefficients for the interaction terms suggests that higher systemic risks are expected in a competitive banking system. These results align with those obtained in Feghali et al. (2021) for idiosyncratic risks. However, when considering Dev economies, we find that increased competition also heightens banking systemic risks. This suggests that a significant part of the favorable impact of FI on banking risk, in these countries, is due to a less competitive banking system. In such a system, banks do not need to take aggressive measures to expand credit, as a large portion of the population remains unbanked.

Similarly, when considering DTI, the impact of FI in loans follows the same direction as in our benchmark results. In addition, higher systemic risk is associated with higher DTI, as shown by the significant coefficients of *Loan.CB.DTI* and *Dev.Loan.CB.DTI*. This suggests that the impact of FI on banking risks is influenced by the level of borrower indebtedness, indicating that higher DTI ratios exacerbate the risks associated with FI in loans.

Table 12: Credit Standards

	Competition	Debt Service to Income
$SRISK_{t-1}$	-0.1628***	-0.3492***
$Loan.CB_{t-1}$	0.1841***	0.1412
$Dev.Loan.CB_{t-1}$	-0.0828***	-0.2350*
$Loan.CB.Com_{t-1}$	0.0966***	
$Dev.Loan.CB.Com_{t-1}$	0.0747+	
$Loan.CB.DTI_{t-1}$		0.0323
$Dev.Loan.CB.DTI_{t-1}$		0.4461*
MPP	-0.4904***	-1.3335***
$MPP.cred_{t-1}$	-0.0105***	0.0021
SV	0.2255***	0.9035***
GDP_{t-1}	-0.0794*	-0.0403
CF_{t-1}	-0.0785***	-0.0258+
Int_{t-1}	0.3703*	1.2269***
$Size_{t-1}$	6.491***	4.0068
ROA_{t-1}	0.0161	-0.0674
Obs	329352	329350
J-test	0.4481	0.3220
$Wald_{slope}$	***	***
$Wald_{time}$	***	***
$Wald_{all}$	***	***
$Arellano\text{-}Bond_{p2}$	0.3801	0.9911

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: FI indicators are interacted with Competition and Credit Standards indicators. Competition (Com): is the 3-bank asset concentration index, retrieved from World Bank, Global Financial Development Database, multiplied by -1 (Feghali et al., 2021); Debt Service to Income (DTI): is the debt service to income ratio retrieved from OECD, i.e. household debt as a percentage of net household disposable income.

6.2.5. U-Shape

We include the squared terms of the FI indicators, following Hua et al. (2023)[41]. In line with the specification detailed in Section 4.1, we account for two different types of FI, i.e., deposit and loan services, along with their specific effects in Dev economies. We find that the associated estimated coefficients preserve the same sign as reported in our benchmark results, and the squared terms keep the same direction. Thus, we infer that the differing signs for the overall effect of FI on banking systemic risks and the specific effect on Dev economies are not due to the presence of an inverted U-shaped relationship between FI and SRISK.

[41] The authors find an inverted U-shaped relationship between FI and *SRISK* at a country level. To do so they construct a composite FI development index, combining different types of financial services and sources such as CB, credit unions, and microfinance institutions without distinction.

Table 13: U-Shape

	Loans to GDP	Deposits to GDP
$SRISK_{t-1}$	-0.0930***	-0.0174
$Loan.CB_{t-1}$	0.4582***	
$Dev.Loan.CB_{t-1}$	-0.0123	
$Dep.CB_{t-1}$		-0.8392***
$Dev.Dep.CB_{t-1}$		0.51923***
$Loan.CB.^2_{t-1}$	0.0025***	
$Dev.Loan.CB.Com_{t-1}$	-0.0007**	
$Dep.CB.^2_{t-1}$		-0.0049***
$Dev.Dep.CB.Com_{t-1}$		0.0041***
MPP	-0.6135***	-0.2099***
$MPP.cred_{t-1}$	-0.0105***	-0.0125***
SV	0.1322***	0.0838***
GDP_{t-1}	-0.0843**	-0.0968
CF_{t-1}	-0.0394***	0.0037
Int_{t-1}	1.055**	-0.9615***
$Size_{t-1}$	0.0952**	-0.0125
ROA_{t-1}	0.0163	-0.0224*
Obs	329348	329346
J-test	0.5510	0.3220
$Wald_{slope}$	***	***
$Wald_{time}$	***	***
$Wald_{all}$	***	***
$Arellano\text{-}Bond_{p2}$	0.6678	0.3440

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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