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Torsten Ehlers
Petr Jakubik
Carlos Madeira
Ilhyock Shim
Saida Teleu

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Financial Function Migration and Systemic Relevance: The Role of Non-Bank Financial Institutions in Brazil ¹

Torsten Ehlers

Bank for International
Settlements

Petr Jakubik

Cayman Islands
Monetary Authority

Carlos Madeira

Central Bank of
Chile

Ilhyock Shim

Bank for International
Settlements

Saida Teleu ²

Charles University

Resumen

Este artículo examina cómo se distribuyen entre los bancos y las instituciones financieras no bancarias (IFNB) tres funciones financieras fundamentales: la provisión de crédito, la movilización del ahorro y la capacidad de absorción de riesgos. A partir de datos de supervisión de Brasil correspondientes al período 2000–2023, analizamos cómo las restricciones de los balances del sector bancario, la dinámica del sector no bancario y las condiciones macrofinancieras determinan la migración de las funciones financieras entre sectores. Encontramos que las IFNB mantienen un papel importante y persistente en la movilización del ahorro, un papel creciente en la capacidad de absorción de riesgos y un papel más condicionado en la provisión de crédito. Al ajustar las participaciones funcionales según la relevancia sistémica de cada sector, la migración de la actividad financiera hacia las IFNB resulta más evidente en la provisión de crédito y está estrechamente asociada con la capitalización del sector bancario, la razón entre crédito y capital (intensidad crediticia) y la razón entre provisiones y crédito (intensidad de aprovisionamiento), especialmente en los regímenes de baja capitalización. Además, la evidencia complementaria a nivel bancario muestra que la relación entre capitalización e intensidad crediticia es no lineal y más marcada entre los bancos con capitalización relativamente baja. Un estudio de eventos en torno a la introducción de Basilea III aporta evidencia adicional compatible con la existencia de un canal de balance bancario. En cambio, la distribución entre instituciones de las funciones de movilización del ahorro y de absorción de riesgos es más persistente y responde menos a las condiciones de balance y macrofinancieras a corto plazo. En conjunto, los resultados muestran que el crecimiento de la actividad de las IFNB no se traduce mecánicamente en un aumento proporcional de su importancia sistémica, lo que respalda un enfoque funcional de la vigilancia macroprudencial.

Abstract

This paper examines how three core financial functions, that is, credit provision, savings mobilisation and risk-absorption capacity, are allocated across banks and non-bank financial institutions (NBFIs). Using supervisory data for Brazil spanning 2000 to 2023, we examine how banking-sector balance-sheet constraints, non-bank sector dynamics and macro-financial conditions shape the migration of financial function across sectors. We find that NBFIs play a persistently large role in savings mobilisation, an increasing role in risk-absorption capacity and a more conditional role in credit provision. Once functional shares are adjusted for sectors' systemic relevance, migration of financial activity toward NBFIs is most evident in credit provision and is strongly associated with banking-sector capitalisation, the credit-to-capital ratio (credit intensity), and the provisions-to-credit ratio (provisioning intensity), particularly in low-capital regimes. Complementary bank-level evidence further shows that the relationship between capitalisation and credit intensity is nonlinear and strongest among relatively weakly capitalised banks, while an event study around the introduction of Basel III provides additional evidence consistent with a bank balance-sheet channel. By contrast, the allocation of savings-mobilisation and risk-absorption-capacity functions across institutions is more persistent and less responsive to short-run balance-sheet and macro-financial conditions. Overall, the results show that growth in NBFI activity does not translate mechanically into a proportional increase in their systemic importance, which supports a function-based perspective on macroprudential surveillance.

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² Torsten Ehlers: Bank for International Settlements. Email: torsten.ehlers@bis.org.

Petr Jakubik, Cayman Islands Monetary Authority and Charles University. Email: petrjakubik@cima.ky; petr.jakubik@fsv.cuni.cz; petrjakubik@seznam.cz.

Carlos Madeira: Central Bank of Chile. Email: cmadeira@bcentral.cl.

Ilhyock Shim: Bank for International Settlements. Email: ilhyock.shim@bis.org.

Saida Teleu: Charles University. Email: saida.teleu@fsv.cuni.cz; teleusaida@gmail.com.

1. Introduction

Over the past two decades, financial intermediation has undergone a significant transformation. This shift is characterised by the growing systemic role of non-bank financial institutions (NBFIs), notably insurance companies and investment funds, in delivering core financial services traditionally dominated by banks, namely, credit provision, savings mobilisation and risk-absorption capacity. As global financial systems become more complex and market-based, the boundaries between the banking and non-banking sectors are increasingly blurred, prompting a re-evaluation of systemic risk channels and regulatory perimeters (Claessens & Kodres, 2014; Adrian & Ashcraft, 2012).

This paper builds on the theoretical foundations of functional finance (Merton, 1995) and intermediary substitution theory (Pozsar, 2014) to analyse the evolving distribution of financial functions across the financial system. By focusing on the economic roles performed, rather than merely the institutional form, we adopt a functional perspective that has become increasingly relevant in the context of financial disintermediation and regulatory arbitrage (Plantin, Sapra & Shin, 2008; Allen & Carletti, 2013). Functional migration, whereby financial roles migrate from banks to non-bank intermediaries subject to different regulatory frameworks, may reflect rational portfolio choices in response to regulatory, sectoral and macro-financial drivers, but also introduces new vulnerabilities through opacity, liquidity mismatches and interconnected exposures (FSB, 2022; Acharya et al., 2017).

The paper distinguishes between raw functional shares and systemic risk-adjusted functional shares. Raw shares capture how much of a given financial function is performed by each sector. The systemic-risk adjustment reweights these shares by each sector's contribution to system-wide tail risk, allowing us to distinguish shifts in the volume of intermediation from shifts in its systemic relevance. Importantly, an increase in a sector's functional share need not translate one-for-one into greater systemic relevance. Such a divergence can arise when an activity migrates toward NBFIs whose contribution to system-wide risk is lower than that of banks from which the activity shifts or when their systemic-risk contribution increases more slowly than their functional activity. Differences in leverage, interconnectedness, liquidity transformation, funding structure and the allocation of losses across intermediaries can therefore cause systemic relevance to increase less than proportionately with the underlying activity. Our systemic-risk adjustment is designed to capture precisely this distinction instead of assuming that a migration of activity necessarily implies an equivalent migration of systemic risk.

In particular, recent advances in network theory have underscored how systemic risk can propagate through increasingly dense interconnections between banks and NBFIs. Recent work shows that the structure and topology of financial networks, especially when involving opaque institutions subject to different regulations, can amplify shocks (Bochmann et al., 2025) and lead to nonlinear systemic responses (Jackson & Pernoud, 2021). Understanding how functional roles are distributed within such networks is thus crucial for anticipating contagion dynamics and calibrating macroprudential tools.

While several studies have examined the growth of shadow banking and the systemic importance of NBFIs in advanced economies (e.g., Cetorelli and Peristiani, 2012), evidence from emerging markets remains relatively scarce and

fragmented (Acharya et al., 2013; Ehlers et al., 2018; Zhou & Qwabe, 2025). To our knowledge, there is no paper offering a comprehensive and dynamic mapping of function migration across banks, insurance companies and investment funds in emerging markets while also reweighting those functions by systemic relevance using supervisory data. This paper focuses on Brazil, a large emerging market in Latin America in which banks, insurance companies and investment funds operate under distinct sectoral regulatory frameworks. Functional reallocation across these sectors may therefore not be fully captured by institution-specific monitoring, complicating the assessment of the distribution of systemically relevant activity across the financial system. This reinforces the case for a function-based supervisory approach that aligns systemic risk surveillance with the actual economic roles performed across these institutions.

We construct time-series indicators of functional participation — credit provision, savings mobilisation and risk-absorption capacity — for banks, insurance companies and investment funds using supervisory and market-level data. These indicators are then reweighted using Conditional Value-at-Risk (CoVaR) to reflect each sector's contribution to system-wide tail risk, allowing us to distinguish changes in the volume of financial activity from changes in its systemic importance (Adrian & Brunnermeier, 2016). For the savings function, the comparison should be understood as the allocation of household and institutional savings across intermediaries rather than as substitution between perfectly identical products. The framework also incorporates regulatory, sectoral and macro-financial drivers to explain the potentially nonlinear dynamics and persistence of functional migration across financial intermediaries. This dual-layered approach, combining functional and systemic dimensions, allows us to capture how financial functions migrate across intermediaries and how their systemic relevance changes over time, which may be overlooked in institution-based monitoring.

This paper makes three contributions. First, it provides a unified cross-sector mapping of credit provision, savings mobilisation and risk-absorption capacity across banks, insurance companies and investment funds in a large emerging-market financial system. Second, it distinguishes migration in the volume of financial activity from that in its systemic relevance by combining functional shares with sector-level systemic-risk weights. Third, it complements the sector-level evidence with bank-level fixed-effects analysis and an event study around the introduction of Basel III, providing additional evidence on the balance-sheet mechanism underlying credit migration. Together, these contributions provide a framework for assessing when changes in the institutional location of financial activity are relevant for financial stability.

The findings carry important implications for macroprudential supervision in Latin American financial systems, where monitoring institutional balance sheets alone may be insufficient to capture systemic vulnerabilities. A functional lens can reveal hidden channels of risk migration, inform perimeter adjustments in regulatory frameworks, and guide policy calibration to mitigate procyclicality and contagion across sectors. This perspective also complements the evolving international approach to systemic-risk surveillance. While systemic-importance frameworks continue to identify individual systemically important institutions, such as global systemically important banks, current international discussion on NBFIs increasingly combines entity- and activity-based approaches. For example, the Financial Stability Board (FSB) recommends that authorities consider both entity- and activity-based measures, as well as concentration-related measures, when

addressing financial stability risks from NBFIs leverage (FSB, 2025). Systemic-risk assessment in the insurance sector has shifted away from annual identification of individual global systemically important insurance companies toward the International Association of Insurance Supervisors Holistic Framework. Our results suggest that this evolution can be complemented by explicitly tracking core financial functions across institutional boundaries and assessing whether their systemic relevance migrates with the underlying activity.

The paper is organised as follows. Section 2 provides a literature review. Section 3 presents the analytical approach and hypotheses. Section 4 describes data and empirical specifications. Section 5 reports empirical results. Section 6 discusses policy implications of the results. Finally, Section 7 concludes.

2. Related Literature

This study contributes to the literature on financial intermediation, systemic relevance and macroprudential policy, with a focus on the evolving roles of NBFIs in emerging markets. Our analysis integrates theoretical and empirical findings to motivate a functional, risk-adjusted approach to measuring financial substitution and systemic vulnerability.

2.1 Functional Perspective on Financial Intermediation

The theoretical foundation of this paper is rooted in the functional view of finance proposed by Merton (1995), which emphasises that the economic functions of the financial system can migrate across different institutional forms. As competition, technology and regulation evolve, the locus of financial intermediation shifts in ways that are not always visible through traditional institutional lenses.

This perspective aligns with Boot & Thakor (2000), who show that institutional evolution often follows changes in the relative cost-efficiency of fulfilling financial functions. In the context of emerging markets, where regulatory frameworks are often incomplete or fragmented, such migration may be accelerated by structural constraints in the banking system. Our framework extends these insights by empirically tracing this migration and adjusting functional shares for systemic relevance.

We focus on three core economic functions of financial intermediaries that can be proxied by available financial data: *credit provision, savings mobilisation and risk-absorption capacity*.

2.2 NBFIs, Shadow Banking, and Regulatory Arbitrage

An expanding literature on shadow banking examines how NBFIs take on core credit provision functions when banks are constrained by regulation or balance sheet pressures (Pozsar, 2014; Gennaioli et al., 2013). Investment funds and insurance companies have become prominent credit providers and liquidity transformation vehicles, particularly in the wake of post-Global Financial Crisis bank capital reforms.

This process is often driven by regulatory arbitrage and misaligned risk-based incentives (Plantin et al., 2008). While shadow banking dynamics have been extensively analysed in advanced economies, evidence from emerging markets

remains relatively scarce. Our study helps fill this gap by offering a dynamic, cross-sectoral mapping of functional migration using supervisory data from a Latin American country – Brazil.

Recent work by Aramonte, Schrimpf & Shin (2021) reinforces these concerns by showing that liquidity mismatches, leverage cycles and margin spirals in NBFIs can amplify systemic stress, especially under a dash-for-cash scenario. Their findings underscore the critical role of leverage-based intermediation and procyclical liquidity dynamics in shaping non-bank systemic vulnerabilities.

An additional mechanism may operate through financial conglomerate structures. In Brazil, major banking groups may include affiliated investment-fund administrators and insurance companies, allowing financial functions to be reallocated within the same corporate group as relative regulatory costs and revenue opportunities change. Banks may therefore influence whether client savings remain in deposits or move toward affiliated fund or insurance products through product pricing, fees and distribution channels. Such within-group reallocation does not contradict functional migration; rather, it may reduce the frictions associated with shifting financial activity across institutional forms and thereby reinforce the migration mechanism.

2.3 Systemic Risk and Financial Network Topology

Understanding systemic risk requires attention not only to financial institutions' balance sheets but also to their interconnections and shock propagation channels. Adrian & Brunnermeier (2016) introduce CoVaR as a metric to capture marginal systemic contributions, which we adopt in our empirical adjustment. More broadly, Jackson & Pernoud (2021) and Glasserman & Young (2016) emphasise that network structure — particularly the presence of highly central, opaque institutions — can create nonlinear amplification of shocks, even in the absence of balance sheet linkages.

In line with these insights, Krenz & Verma (2023) show that macroprudential tightening in the banking sector can unintentionally raise systemic risk from the NBFIs sector due to cross-sectoral linkages and regulatory arbitrage. Their findings underscore the importance of monitoring cross-institution risk transmission and reinforce the case for function-based macroprudential tools that span the full financial system.

Our methodology incorporates these insights by weighing sectoral functional shares by systemic relevance, yielding a more policy-relevant picture of risk distribution.

2.4 Macroprudential Supervision and Policy Challenges in Emerging Markets

The macroprudential policy literature recognises the difficulty of regulating evolving financial systems. Claessens & Kodres (2014) and FSB (2022) point to the challenge of regulatory perimeter risk, wherein risk migrates to parts of the system not subject to the same supervisory scrutiny. In emerging markets, these dynamics are compounded by external vulnerabilities and underdeveloped financial markets.

These considerations underscore the need for forward-looking, function-based supervisory frameworks, particularly in jurisdictions where NBFIs are growing fast but are subject to heterogeneous regulatory frameworks. Our results suggest that structural constraints and macro-financial shocks accelerate this migration, potentially weakening the effectiveness of bank-based prudential tools. The IMF (2023) emphasises that such vulnerabilities are intensified by liquidity mismatches, leverage and opacity within NBFIs, particularly where supervisory oversight and data coverage remain incomplete.

Recent cross-country evidence supports this mechanism. Lekobane (2025) shows that macroprudential policy tightening, particularly when targeted at financial institutions or borrowers, leads to increased FinTech credit growth, as borrowers and investors shift toward non-bank credit platforms. This illustrates how traditional macroprudential measures can inadvertently stimulate risk migration outside of the regulated core, reinforcing the case for activity- and function-based oversight.

This concern is further supported by the ESRB (2024), which documents persistent systemic risk stemming from leverage, liquidity mismatches and valuation uncertainty in the European investment fund sector, highlighting the need for expanded risk monitoring frameworks even in advanced supervisory regimes. The ESRB (2024) Risk Monitor further reinforces these concerns by emphasising the growing interconnectedness between NBFIs and banks, the procyclicality of liquidity provision in open-ended funds, and emerging vulnerabilities from synthetic leverage and illiquid holdings. The report calls for a macroprudential approach that explicitly incorporates activity-based monitoring, cross-sectoral stress testing and enhanced data collection, priorities that are consistent with the function-based perspective used in this paper.

The FSB Global NBFI Monitoring Report reinforces that NBFIs continue to grow in systemic relevance, with liquidity mismatches, leverage and cross-border interconnectedness emerging as key channels of risk transmission, especially where regulatory fragmentation persists (FSB, 2023).

3. Analytical approach and hypotheses

The rising prominence of NBFIs globally has prompted interest in their evolving role within financial systems, particularly in emerging markets. While prior research has mostly focused on either insurance companies or investment funds in isolation, few studies have addressed the joint dynamics of functional migration from banks to both sectors simultaneously. This paper empirically studies the migration of key financial functions across banks, insurance companies and investment funds. In particular, it examines how NBFIs are increasingly performing core financial functions, namely credit provision, savings mobilisation and risk-absorption capacity, which have traditionally been dominated by banks.

The trend is particularly evident in Latin America, where the growing presence of insurance companies and investment funds mirrors global financial deepening but occurs within distinct institutional and regulatory environments. Functional migration in these settings is not merely a consequence of competitive repositioning. Instead, it reflects deeper structural drivers, including regulatory changes, return differentials, macro-financial stress episodes and investor preferences for liquidity, yield or capital protection. These transitions raise new

challenges for financial stability, particularly when risk migration occurs outside the traditional regulatory perimeter.

To address these dynamics, we adopt a functional finance perspective (Merton, 1995; Pozsar, 2014), focusing not on institutional labels, but on what financial functions are performed and by whom. This enables us to map how the functions of credit provision, savings mobilisation and risk-absorption capacity are distributed across banks, insurance companies and investment funds. Crucially, we also assess the systemic importance of each sector's contribution using CoVaR and beta decomposition measures—allowing us to move from volume-based functional analysis to one that incorporates financial stability relevance.

Our analytical framework proceeds in three steps:

- First, we construct sector-level indicators to map the distribution of financial functions across bank, insurance and investment fund sectors.
- Second, we adjust these indicators using systemic risk metrics to account for each sector's conditional contribution to system-wide tail risk.
- Third, we empirically test how a set of institutional drivers and macro-financial shocks explain the observed distribution of the functions.

Hypotheses

Based on this analytical framework and observed sectoral dynamics, we propose the following five testable hypotheses:

- **H1:** Tighter banking-sector capital constraints are associated with a higher share of credit provision by investment funds and other NBFIs.
→ *When bank balance-sheet constraints become more binding, banks reduce their relative role in credit provision, creating space for investment funds and other NBFIs to expand credit provision through market-based and structured credit channels.*
- **H2:** Periods in which bank deposits become relatively less attractive as saving instruments are associated with a shift in household savings toward insurance companies and investment funds, particularly toward products with comparable liquidity and perceived safety characteristics.
→ *When bank deposits become relatively less attractive because of lower real returns or less favourable return–liquidity trade-offs, households may reallocate part of their financial wealth toward insurance and fund products that offer more attractive combinations of return, liquidity, tax treatment and perceived safety. In practice, such substitution is likely to be strongest for products with characteristics closer to deposit-like saving instruments, rather than across all insurance and fund products uniformly.*
- **H3:** When banks' balance-sheet capacity to absorb adverse shocks weakens, a larger share of system-wide risk-absorption capacity is associated with insurance companies and investment funds.
→ *As banks face tighter provisioning pressure or weaker balance-sheet capacity, part of the financial system's ability to absorb adverse shocks may become relatively more concentrated in insurance companies and investment funds. This does not imply that buffers are directly comparable across sectors or that the same underlying risks are absorbed in the same*

way. Rather, the hypothesis is that risk-absorption capacity may shift across institutions through different sector-specific mechanisms: for banks, through capital and provisions against credit and related balance-sheet risks; for insurance companies, through technical provisions, solvency margins, and equity buffers; and for investment funds, through market-based investor loss-bearing capacity reflected in net asset value and related pricing dynamics.

- **H4:** Functional migration intensifies during adverse systemic episodes and periods of macro-financial stress.
→ *During systemic stress, the cost of holding credit, market or liquidity risk on bank balance sheets may rise, encouraging a relative expansion of non-bank financial intermediation in activities from which banks retrench.*
- **H5:** Functional migration exhibits persistence and regime-dependent effects, such that reallocation toward NBFIs may not fully reverse after the initial shock dissipates.
→ *Once financial activity shifts toward insurance companies or investment funds, adjustment may remain persistent because of institutional features, product design, investor behaviour and slow-moving balance-sheet reallocation, particularly after periods of macro-financial disruptions.*

These hypotheses are explored throughout the conceptual and empirical sections that follow. Each is operationalised using sector-specific indicators, macro-financial variables and systemic risk measures introduced in Sections 3.1–3.3, operationalised in Section 4 and tested empirically in Section 5.

3.1 Mapping Financial Functions Across Sectors

To capture the functional distribution in a measurable way, we construct sector-level functional indicators using supervisory and market-level data, reflecting both the quantity and intensity of financial activity (Table 1). Each function is mapped to sector-specific proxies that reflect not only the size of the activity but also its characteristic and policy relevance. We draw on a growing literature that measures the economic footprint of NBFIs (eg, Adrian & Ashcraft, 2012; Gennaioli et al., 2013; FSB, 2022), while adapting these tools to capture cross-sectoral substitution dynamics.

Table 1. Indicators Used to Capture Functional Roles Across Sectors

Function	Banks	Insurance companies	Investment Funds
Credit Provision	loans, securitised credit	fixed-income and securitised credit instruments, granted mortgages	corporate bond funds, fixed-income credit instruments, structured

Function	Banks	Insurance companies	Investment Funds
			credit funds, private credit, asset-backed securities
Savings Mobilisation	sight deposits, term deposits	premiums and technical provisions related to life insurance and other long-term saving products, including unit-linked policies where relevant	money market and fixed-income fund shares, investor subscriptions and net asset value used as aggregate indicators of fund-based savings mobilisation
Risk-Absorption Capacity	capital, book equity, and credit-loss provisions	net worth-to-total assets, capital to total assets, IBNR (Incurred But Not Reported) and IBNER (Incurred But Not Enough Reported) reserves, and solvency margins	changes in net asset value and share/unit pricing, which reflect market-based loss absorption by investors

3.1.1 Credit Provision

Credit provision refers to the process by which financial institutions transform savings into credit for firms and households. For banks, this function is direct and on balance sheet, measured by total loans, leasing volumes and credit cards, as well as through off-balance-sheet securitised credit exposures. Insurance companies may contribute to credit provision indirectly through holding credit-related and fixed-income assets matching their long-term liabilities. In some jurisdictions insurance companies directly engage in mortgage lending, policy loans and other loan exposures. Investment funds participate in credit provision through a broader range of bond and credit-related portfolio exposures, including corporate bond funds, fixed-income credit instruments, structured credit products, asset-backed securities, private credit vehicles and receivables-based instruments, where captured in the data. In this sense, investment funds can channel financing to the real economy outside the traditional banking system, even when intermediation occurs through securities holdings rather than direct loan origination. Recent US evidence confirms this functional shift in credit provision: nonbank financial institutions now originate over 60% of residential mortgages and nearly half of consumer credit, while banks remain the primary source of business loans (Federal Reserve Bank of New York, 2025). This bifurcation in lending roles highlights differences in funding models with banks relying on deposits and nonbanks depending on securitisation and capital markets, which can amplify procyclicality and systemic vulnerabilities. These trends illustrate the broader relevance of a function-based monitoring framework that can capture credit risk migration outside the traditional banking sector, although the scale and form of such migration vary across jurisdictions.

We consider the following indicators:

- Banks: outstanding credit (total loans and sectoral credit exposures), leasing volumes, credit card and overdraft exposures; securitised credit exposures originated off-balance sheet.

- Insurance companies: holdings of credit-related instruments, including corporate bonds, fixed-income and securitised credit instruments, as well as mortgages and other loans granted by insurance companies where available.
- Funds: assets allocated to bond and credit-related instruments, including corporate bonds, fixed-income credit instruments, private credit, structured credit vehicles, asset-backed securities, and credit receivables-based funds.

3.1.2 Savings Mobilisation

Savings mobilisation refers to the capacity of financial institutions to attract, pool, and allocate household and institutional savings. The relevant products are not fully homogeneous across sectors, as they differ in liquidity, duration, tax treatment and risk-return profile. Accordingly, the empirical measures should be interpreted as broad indicators of how savings are allocated across intermediaries rather than as one-to-one substitution between identical products. In practice, substitution is likely to be strongest among products with more comparable risk and liquidity characteristics, such as bank deposits and lower-risk fund or insurance saving products.

This function captures how financial intermediaries attract and retain household and institutional savings, which can then be held in different forms across banks, insurance companies and investment funds. Its evolution often reflects interest-rate conditions, investor preferences and the relative attractiveness of available products. Households may reallocate savings between deposits, insurance products, and investment funds depending on relative returns, liquidity, risk characteristics and tax treatment.

Drawing on frameworks from Allen & Gale (2000) and Gorton & Metrick (2012), we proxy this function using saving-related liabilities and investment claims that reflect how savings are pooled and allocated across sectors.

- Banks: deposit volumes (sight and term accounts).
- Insurance companies: premiums and technical provisions related to life insurance and other long-term saving products, including unit-linked policies where relevant.
- Funds: money market and fixed-income fund shares; investor subscriptions and net asset value, capturing the flow and stock dimensions of fund-based savings mobilisation.

These indicators capture the volume and structure of savings held across institutions and enable comparison of market shares in household asset allocation.

3.1.3 Risk-Absorption Capacity

Risk-absorption capacity refers to the capacity of financial institutions to buffer shocks using capital, reserves or other financial cushions. In a macroprudential context, the function is critical for assessing resilience, as it determines the sector's ability to withstand adverse shocks without amplifying systemic risk.

In the banking sector, this is traditionally captured by capital, provisioning levels, retained earnings and related measures. For insurance companies, risk-absorption capacity includes technical provisions (eg, incurred but not reported (IBNR) and

incurred but not enough reported (IBNER) reserves) and financial surplus. In the investment fund sector, shock absorption is more market-based, as losses are transmitted primarily through changes in net asset value and investor valuations rather than through provisioning or capital buffers comparable to those used by banks or insurance companies. In this sense, fund-side risk-absorption capacity reflects investors' loss-bearing capacity and liquidity management features, rather than a balance-sheet cushion directly comparable to bank capital or insurance reserves (Scotti & Vega, 2020).

We consider the following indicators:

- Banks: capital, net worth and credit-loss provisions, with ratio-based capitalisation measures used separately in the empirical regressions.
- Insurance companies: net worth-to-total assets, capital to total assets, IBNR and IBNER reserves, and solvency margins.
- Funds: changes in net asset value and share/unit pricing, reflecting market-based investor loss-bearing capacity.

By linking these metrics to risk transmission literature (Adrian & Brunnermeier, 2016; Glasserman & Young, 2016), we can evaluate not just which sector provides risk-absorption capacity but also how robust that function is under systemic stress.

3.2 Functional Mapping with Systemic Risk Adjustment

While mapping financial functions by institutional sector provides a valuable lens on the distribution of economic roles, such a perspective remains incomplete without considering the systemic importance of each sector's activities. Raw functional shares measure quantity, but they do not account for how a given sector contributes to systemic risk. Therefore, we integrate a systemic risk adjustment into our functional mapping to reflect both the scale and the potential impact of each sector's role on overall financial stability.

3.2.1 Systemic Risk as a Weighting Mechanism

We adopt the systemic risk framework developed by Adrian and Brunnermeier (2016), specifically the Conditional Value at Risk (CoVaR) methodology, to assess the marginal contribution of each financial sector to systemic distress. CoVaR captures the value-at-risk of the financial system conditional on a specific institution or sector being under distress, thereby providing a dynamic and forward-looking proxy for systemic relevance.

Let $\omega_{i,t}^f$ denote the share of financial function $f \in \{credit, savings, risk\ absorption\}$ performed by sector $i \in \{banks, insurers, funds\}$ at time t . We define the systemic-adjusted functional share as:

$$\widetilde{\omega}_{i,t}^f = \omega_{i,t}^f \times SR_{i,t} \quad (1)$$

where $SR_{i,t}$ is the normalised systemic risk measure for sector i at time t , derived from CoVaR or a beta decomposition approach. In addition to the CoVaR approach which we use for measuring systemic risk in our main specification, a beta decomposition approach is used as an alternative robustness exercise. This adjustment allows us to identify whether increasing participation by a given sector enhances or mitigates systemic vulnerabilities.

3.2.2 Implementation Strategy

We complement the main specification with a beta decomposition approach, following the methodology of Nijskens & Wagner (2011) and Jakubik & Teleu (2024). In this framework, each sector's beta with respect to the market return is decomposed into:

$$\beta_{i,t} = \rho_{i,t} \frac{\sigma_{i,t}}{\sigma_{m,t}} \quad (2)$$

where:

- $\rho_{i,t}$ is the time-varying correlation between sector i 's returns and the market index,
- $\sigma_{i,t}$ is the standard deviation (volatility) of sector i 's returns,
- $\sigma_{m,t}$ is the standard deviation of the market index.

This decomposition allows us to distinguish the contribution of sector-specific return volatility from that of co-movement with the market in shaping each sector's beta-based systemic relevance.

We compute time-varying systemic weights for each sector and normalise them such that $\sum_i SR_{i,t} = 1$. These weights are then used to scale each sector's functional indicators, enabling us to identify whether systemic risk is migrating along with the underlying financial functions.

3.2.3 Interpretation

This dual-layer mapping provides insights into whether functional reallocation is:

- Neutral (volume shifts without systemic impact),
- Benign (volume shifts to less systemically relevant sectors), or
- Destabilising (volume shifts to highly interconnected or volatile sectors).

From a macroprudential perspective, the destabilising case is often the most important to monitor, but the empirical framework is designed to distinguish across these possibilities rather than assuming the outcome in advance.

Importantly, this framework also allows us to assess whether macroprudential oversight is aligned with the evolving distribution of systemic risk, especially in systems where supervisory focus remains largely centred on banks.

3.3 Functional Migration Mechanisms and Empirical Drivers

To explain the dynamics of functional migration across financial sectors, we identify and incorporate a set of empirical drivers that influence the speed, direction and persistence of reallocation between banks, insurance companies and investment funds. These drivers reflect regulatory and balance-sheet constraints, relative product attractiveness, macro-financial shocks and persistence mechanisms that shape intermediation outcomes in practice.

Drawing on theoretical foundations (eg, Allen & Gale, 2000; Gennaioli et al., 2013; FSB, 2022) and subject to data availability, we construct empirical proxies for key mechanisms underlying cross-sectoral reallocation of financial activities. These

include balance-sheet constraints in the banking sector, differences in the relative attractiveness of savings instruments, sector-specific expansion in insurance companies and investment funds, macro-financial stress episodes and persistence in previously established intermediation patterns. By integrating these indicators into our empirical framework, we assess how functional shifts are associated with structural constraints, cyclical conditions and institutional adjustment dynamics.

These drivers are operationalised through observable variables, enabling hypothesis testing. We group them into the following six categories.

3.3.1 *Bank Capital Constraints*

- Mechanism: Banks face capital and provisioning constraints that may limit their ability to expand credit and retain risk on their balance sheets. As these constraints become more binding, NBFIs may assume a larger role in credit provision. At the same time, weaker bank balance-sheet capacity to absorb adverse shocks may be associated with a greater relative role for insurance companies and investment funds in system-wide risk-absorption capacity, although through institution-specific channels rather than directly comparable provisioning mechanisms.
- Proxies: the capital-to-assets ratio, the credit-to-capital ratio and the provisions-to-credit ratio.
- Linked Hypotheses:
 - H1: Tighter banking-sector capital constraints are associated with a higher share of credit provision by investment funds and other non-bank financial institutions.
 - H3: When banks' balance-sheet capacity to absorb adverse shocks weakens, a larger share of system-wide risk-absorption capacity is associated with insurance companies and investment funds.

3.3.2 *Return Differentials Across Savings Instruments*

- Mechanism: Households may shift savings away from bank deposits when alternative savings instruments offered by insurance companies and investment funds become relatively more attractive. This relative attractiveness may reflect not only expected returns, liquidity, perceived safety and tax treatment, but also pricing, fee structures and distribution incentives within financial groups. Where banks are affiliated with fund administrators or insurers, the same group may have incentives to retain savings on the bank balance sheet under some conditions and place greater emphasis on fee-generating off-balance-sheet products under others. Accordingly, substitution is likely to be strongest among products with more comparable risk and liquidity characteristics, rather than across all savings products uniformly.
- Proxies: In the absence of directly comparable product-level return measures across sectors, the empirical specifications assess shifts in savings allocation indirectly through insurance premium growth, the insurance company provisions-to-assets ratio, fund net asset value growth and macro-financial controls. H2 below should therefore be interpreted as

an indirect test of relative savings attractiveness rather than a direct estimate of substitution driven by deposit-rate differentials.

- Linked Hypothesis:
 - H2: Periods in which bank deposits become relatively less attractive as saving instruments are associated with a shift in household savings toward insurance companies and investment funds, particularly toward products with comparable liquidity and perceived safety characteristics.

3.3.3 *Insurance Sector Attractiveness*

- Mechanism: Insurance products, especially life insurance and other long-term saving instruments, may attract household savings when they offer contractual features, tax advantages or risk-return characteristics that differ from bank deposits. In addition, insurance companies may account for a larger share of system-wide risk-absorption capacity through technical provisions, solvency buffers and equity-based cushions when banks become more constrained.
- Proxies: Insurance premium growth and the provisions-to-assets ratio.
- Linked Hypotheses:
 - H2: Periods in which bank deposits become relatively less attractive as saving instruments are associated with a shift in household savings toward insurance companies and investment funds, particularly toward products with comparable liquidity and perceived safety characteristics.
 - H3: When banks' balance-sheet capacity to absorb adverse shocks weakens, a larger share of system-wide risk-absorption capacity is associated with insurance companies and investment funds.

3.3.4 *Investment Fund Attractiveness*

- Mechanism: Investment funds offer product flexibility, liquidity, and access to market-based returns, making them attractive alternatives to bank and insurance products under some conditions. Their role in credit provision may expand through corporate bond funds, private credit vehicles, structured credit products, and other credit-related exposures, particularly when banks face tighter balance-sheet constraints. In addition, when deposit rates become relatively less attractive, savers may shift toward fund products offering higher expected returns or broader portfolio exposure (Drechsler, Savov & Schnabl, 2017; Aramonte, Schrimpf & Shin, 2021). Where investment funds are affiliated with banking groups, existing distribution networks and client relationships may further reduce switching frictions between bank deposits and fund products, facilitating functional reallocation across institutional forms.
- Proxies: net asset value growth.
- Linked Hypotheses:

- H2: Periods in which bank deposits become relatively less attractive as saving instruments are associated with a shift in household savings toward insurance companies and investment funds, particularly toward products with comparable liquidity and perceived safety characteristics.
- H1: Tighter banking-sector capital constraints are associated with a higher share of credit provision by investment funds and other NBFIs.

3.3.5 Macro-Financial Stress Events

- Mechanism: Large-scale shocks (e.g., pandemics, recessions, structural reforms) may interact with existing vulnerabilities and accelerate functional reallocation across sectors. During such episodes, banks may retrench from some forms of intermediation, while non-bank sectors absorb part of the displaced activity.
- Proxies: COVID-19 dummy, used as an illustrative systemic-stress episode.
- Linked Hypothesis:
 - H4: Functional migration intensifies during systemic episodes and periods of macro-financial stress.

3.3.6 Path Dependence and Behavioural Persistence

- Mechanism: Functional reallocation may exhibit persistence. Once savers or borrowers shift toward NBFIs, institutional features, product design, investor behaviour and slow-moving balance-sheet adjustment may limit a full return to previous intermediation patterns, even after the original trigger weakens.
- Proxies: Lagged functional shares by sector (e.g., lag share of credit by funds, share of savings via insurance companies, funds' net asset value share)
- Linked Hypotheses:
 - H5: Functional migration exhibits persistence and regime-dependent effects, such that reallocation toward non-bank financial institutions may not fully reverse after the initial shock dissipates.

Together, these six empirical drivers form the analytical backbone of our empirical model. By operationalising each with observable variables and linking them to testable hypotheses, we build a framework that explains the reallocation of financial roles across sectors and assesses how these shifts relate to systemic risk.

4. Data and Empirical Strategy

Consistent with the analytical framework developed in Section 3, we test the hypotheses above using supervisory data for Brazil. This section first describes the data sources and coverage, the construction of functional intermediation measures, the implementation of systemic-risk adjustments, and then provides the empirical specifications used to estimate functional migration.

4.1 Mapping Financial Functions Across Sectors

The empirical analysis relies on a merged supervisory dataset covering the Brazilian financial system over the period from January 2000 to March 2023. The dataset integrates information on banks, insurance companies and investment funds, enabling a unified empirical implementation of the function-based framework described in the previous section.

Banking and insurance data are originally reported at a monthly frequency, while investment-fund data are reported quarterly. For the main cross-sector analysis, all variables are harmonised to a quarterly frequency prior to estimation, and the analysis is conducted at the sector-quarter level, with aggregation procedures applied consistently across sectors. The complementary bank-level analyses described in Sections 4.4.3 and 4.4.4 instead use the underlying monthly banking panel.

The banking component covers the universe of banks regulated by the Central Bank of Brazil, with nationwide coverage across 26 federal states and 3,860 municipalities. Underlying branch- and municipality-level observations are aggregated to the bank-quarter level. System-level balance-sheet variables that are repeated across geographic records are retained once per reporting period prior to quarterly aggregation, avoiding duplication across municipality-level observations. For the bank-level analysis in Section 4.4.3, the underlying monthly observations are instead consolidated at the bank-month level before constructing the relevant balance-sheet ratios. The monthly banking panel also contains an equity measure, which is used to construct the predetermined pre-reform capitalisation exposure in the Basel III event-study analysis.

The insurance component draws on supervisory data for entities regulated by SUSEP (*Superintendência de Seguros Privados*, Brazil's insurance supervisory authority) and includes 277 insurance companies organised into 56 insurance groups, with an average of approximately 117 active entities per quarter. The data cover life and non-life insurance activities, as well as capitalisation and long-term saving products embedded within insurance company balance sheets. A complementary, geographically disaggregated panel captures geographic exposure across 39 geographic units, 188 insurance entities and 144 insurance lines. For ratio-based insurance variables, observations with non-positive total assets are treated as data anomalies and excluded from ratio construction, as such values do not provide an economically meaningful denominator for balance-sheet ratios.

The investment-fund component covers 2,214 regulated investment funds, grouped into six broad fund-type categories, observed quarterly from 2010Q2 to 2023Q1. On average, approximately 630 funds are active per quarter. Investment-fund data are not geographically disaggregated, consistent with their legal and operational structure.

Because investment-fund data are available only from 2010Q2, the common sample period used in the three-sector functional-share regressions covers the period of 2010Q2–2023Q1, yielding 52 quarterly periods. After excluding one observation within this period with a non-positive insurance total-assets value from specifications using the insurance provisions-to-assets ratio, the effective estimation sample contains 51 observations. The longer banking history is

additionally exploited in the complementary monthly bank-level analyses reported in Sections 5.4 and 5.5.

Closed pension funds (*Entidades Fechadas de Previdência Complementar*), which are regulated separately by PREVIC (*Superintendência Nacional de Previdência Complementar*), are not included as a separate institutional investor. However, long-term savings and pension-type products offered within insurance groups are captured to the extent that they are recorded within the insurance-sector data.

A complete list of variables used in the empirical analysis, organised by sector and economic function, is reported in Table 2. Table 3 summarises data coverage across sectors, while Table 4 reports sectoral activity measures. Detailed descriptive statistics for balance-sheet variables and ratios are reported in Tables A.1–A.4 in Appendix A.

Table 2. Variables Used in the Empirical Analysis, by Sector and Economic Function

Banking Sector	
Economic Function	Variable Description
Size and scale	Total assets
Size and scale	Total credit extended
Credit activity	Loans
Credit activity	Secured loans
Credit activity	Other credit exposures
Funding structure	Total deposits
Funding structure	Sight deposits
Funding structure	Time deposits
Capital and buffers	Capital
Capital and buffers	Net worth
Capital and buffers	Credit loss provisions
Capital and buffers	Equity
Liquidity management	Liquid assets
Portfolio allocation	Securities holdings
Portfolio allocation	Derivatives exposures
Institutional characteristics	State ownership indicator
Time structure	Monthly reporting date; aggregated to the quarterly frequency for the sector-level analysis and the monthly frequency retained for the bank-level analysis.
Insurance sector	
Economic Function	Variable Description
Balance-sheet size	Total assets
Liability structure	Technical provisions

Capital and solvency	Adjusted equity
Capital and solvency	Solvency margin
Capital and solvency	Capital requirement
Underwriting activity	Premiums written
Underwriting activity	Premiums earned
Underwriting activity	Claims retained
Operational intensity	Number of active insurance entities
Operational intensity	Number of active insurance lines
Geographic exposure	State-level premiums
Geographic exposure	State-level claims
Time structure	Quarterly reporting date (aggregated from monthly data)
Investment Funds	
Economic Function	Variable Description
Size and valuation	Assets under management
Size and valuation	Net asset value
Balance-sheet dynamics	Growth of assets under management
Market performance	Net asset value returns
Dynamic controls	Lagged assets under management
Dynamic controls	Lagged net asset value
Investor structure	Number of investors
Investor structure	Subscribed quotas
Fund classification	Fund type
Fund classification	Investor target
Fund classification	Legal class characteristics
Time structure	Quarterly reporting date (native frequency)
Macroeconomic variables	
Macroeconomic controls	Brazil real GDP growth
Macroeconomic controls	US long-term interest rate
Crisis conditions	COVID-19 dummy

Table 3. Data Coverage and Sample Structure by Sector

Sector	Start date	End date	Frequency	Observations	Entities	Groups / Types	Geographic coverage
Banks	2000-01	2023-03	Monthly (to quarterly)	2,767,670	214 banks	—	26 states, 3,860 municipalities
Insurance	2004-03	2023-03	Monthly (to quarterly)	40,299	277 entities	56 groups	39 geographic units
Investment funds	2010Q2	2023Q1	Quarterly	1,295,948	2,214 funds	6 fund types	No geographic breakdown

Note: Banking and insurance data are reported monthly and aggregated to quarterly frequency for the main sector-level analysis. The complementary bank-level analysis retains the banking data at monthly frequency. Investment fund data are natively quarterly.

Table 4. Sector Activity and Participation (Distribution Across Time)

Sector	Mean	25th percentile	75th percentile	Minimum	Maximum
Bank branches (monthly)	9,896	9,440	10,292	8,866	10,966
Active insurance entities	117	114	119	111	127
Active investment funds	633	325	869	1	1,422

Note: Activity measures reflect operational scale: branch networks for banks, active entities for insurance, and active funds per quarter.

4.2 Calculation of Functional Shares

To quantify the distribution of financial functions across sectors, we construct raw functional shares based on supervisory balance-sheet and activity data. For each financial function $f \in \{\text{credit, savings, risk-absorption capacity}\}$, the share of sector $s \in \{\text{banks, insurance companies, investment funds}\}$ at time t is defined as:

$$\text{Share}_{f,s,t} = \frac{X_{f,s,t}}{\sum_{k \in \{b,i,f\}} X_{f,k,t}}$$

where $X_{f,s,t}$ denotes the sector-specific proxy for function f performed by sector s at time t . In the denominator, k indexes the three institutional sectors, with b denoting banks, i insurance companies and f investment funds. The sector-specific proxies are constructed from supervisory reporting variables.

The empirical analysis follows a function-based aggregation approach, whereby economically comparable balance-sheet items are grouped across sectors to represent each financial function. This ensures consistency between the conceptual framework developed in Section 3 and the empirical measures used in the analysis.

Table 5 summarises the construction of the raw functional shares by mapping each financial function to its sector-specific numerator and the corresponding total-

system denominator. It also clarifies how economically comparable balance-sheet items are aggregated across banks, insurance companies, and investment funds to calculate their share in credit provision, savings mobilisation, and risk-absorption capacity in a consistent manner.

Table 5. Operational Construction of Raw Functional Shares

Financial Function	Banks: empirical numerator	Insurance companies: empirical numerator	Investment funds: empirical numerator	Total-system denominator	NBFI share used in estimation
Credit Provision	Loans, secured loans, other credit exposures, total credit extended	Fixed-income and securitised credit instruments; insurer credit exposures where available	Corporate bond funds, fixed-income credit instruments, private credit, structured credit, asset-backed exposures, and other credit receivables-based instruments	Sum of bank + insurance company + fund credit-function activity at time t	$(\text{Insurance companies}_t + \text{Funds}_t) / \text{System total}_t$
Savings Mobilisation	Total deposits (including sight and time deposits)	Technical provisions, life insurance liabilities, long-term saving products	Assets under management, net asset value, subscribed quotas	Sum of bank + insurer + fund savings-function activity at time t	$(\text{Insurance companies}_t + \text{Funds}_t) / \text{System total}_t$
Risk-absorption Capacity	Capital, net worth, credit-loss provisions	Adjusted equity, solvency margin, technical reserves	Changes in net asset value and share/unit pricing, reflecting market-based investor loss-bearing capacity ³	Sum of bank + insurer + fund risk-absorption proxies at time t	$(\text{Insurance companies}_t + \text{Funds}_t) / \text{System total}_t$

Note: Functional measures are constructed using supervisory data harmonised across sectors. Each function aggregates economically comparable balance-sheet items. The empirical analysis

³ For investment funds, the risk-absorption capacity function reflects market-based investor loss-bearing capacity rather than provisioning or capital buffers comparable to those of banks or insurance companies.

focuses on non-bank financial intermediation, defined as the combined share of insurance companies and investment funds relative to total system activity.

Because the empirical analysis focuses on non-bank financial intermediation, the estimated specifications are defined as the combined share of insurance companies and investment funds in total system activity. These measures capture the evolving allocation of financial intermediation across sectors, reflecting both structural shifts in the financial system and cyclical reallocation driven by balance-sheet constraints, regulatory requirements, and market dynamics. To explain their variation over time, the empirical analysis additionally incorporates a parsimonious set of sector-specific and macro-financial proxies constructed from supervisory data and standard macroeconomic indicators, respectively.

4.3 Implementation of Systemic-Risk Adjustment

As described in Section 3.2, raw functional shares are scaled using time-varying sector-level systemic-risk weights. In the baseline specification, systemic relevance is measured using tail risk-based indicators consistent with the CoVaR framework. $\omega_{s,t}$ denotes the normalised systemic-risk weight of sector s at time t . The systemic risk-adjusted share for financial function f is defined as

$$\text{SRShare}_{f,s,t} = \frac{\omega_{s,t} X_{f,s,t}}{\sum_{k \in \{b,i,f\}} \omega_{k,t} X_{f,k,t}}$$

where $X_{f,s,t}$ is the raw sector-level indicator introduced in Section 4.2. This transformation preserves the functional interpretation of the original indicators while weighting them according to each sector's contribution to system-wide risk.

To ensure comparability across sectors and over time, these weights are normalised before being applied to the raw functional measures. As in the raw-share case, the empirical analysis focuses on the combined contribution of insurance companies and investment funds relative to the total financial system.

To facilitate interpretation, Table 6 summarises the implementation of the systemic-risk adjustment, including the baseline weighting concept, the normalisation step, and the alternative weighting scheme used in robustness analysis. The resulting adjusted shares are used alongside the raw shares throughout the empirical analysis.

As a robustness exercise, we also construct alternative systemic-risk weights based on beta decomposition, as described in Section 3.2. This provides a covariance-based measure of systemic relevance that complements the baseline tail-risk approach. Using both weighting schemes allows us to verify that the main empirical patterns are not driven by a single definition of systemic importance.

Table 6: Implementation of the Systemic-Risk Adjustment

Component	Baseline Implementation	Empirical Role in the Paper
Underlying Quantity	Raw sectoral functional indicator $X_{f,s,t}$ for credit, savings, or risk-absorption capacity	Measures the sector's unadjusted participation in each financial function
Systemic-risk (SR) Weight	Time-varying sector-level weight $\omega_{s,t}$, based on CoVaR-consistent tail-risk indicators	Captures the relative systemic relevance of each sector
Normalisation	Weights are normalised across sectors and over time before being applied to raw indicators	Ensures comparability of adjusted shares across functions and dates
Adjusted Functional Measure	$\omega_{s,t} X_{f,s,t}$	Reweights functional participation f by systemic importance of sector s
Adjusted System Total	$\sum_k \omega_{k,t} X_{f,k,t}$	Defines the denominator for the SR-adjusted sector share
NBFI SR-adjusted Share	Adjusted contribution of insurance companies and investment funds relative to the adjusted system total	Main dependent variable in SR-adjusted regressions
Robustness Alternative	Beta-decomposition-based systemic-risk weights	Verifies that the results do not depend on tail-risk weights alone

Note: The baseline adjustment follows the Conditional Value-at-Risk introduced in Section 3.2, while the robustness check uses beta-based weights. Descriptive comparisons between raw and systemic-risk-adjusted measures are shown in Figure 1 and Figures A.1–A.3 in Appendix A, and their correlation structure is reported in Table A.6 in Appendix A.

4.4 Empirical Specification

This subsection examines how banking-sector balance-sheet conditions, the relative attractiveness of NBFI sectors, macro-financial conditions and persistence in NBFI activity relate to variation in the NBFI share of each financial function. The analysis is conducted separately for credit provision, savings mobilisation and risk-absorption capacity, using both raw and systemic-risk-adjusted NBFI shares as dependent variables. Table 7 summarises the empirical proxies used in the baseline and regime-interaction specifications.

Table 7: Empirical Proxies Used in the Functional-Share Regressions

Block	Proxy	Sector	Economic Interpretation	Used Primarily for
Bank Capital Constraints	Capital-to-assets ratio	Banks	Broad bank capitalisation measure	Credit, savings, risk-absorption capacity
Bank Credit Intensity	Credit-to-capital ratio	Banks	Intensity of credit provision relative to capital	Credit
Bank Provisioning Pressure	Provisions-to-credit ratio	Banks	Provisioning intensity associated with credit risk pressure	Credit, risk-absorption capacity
Insurance Expansion	Premium growth	Insurance	Broad growth in insurance-sector activity	Savings, credit
Insurance Buffer Pressure	Provisions-to-assets ratio	Insurance	Insurer provisioning intensity / reserve accumulation proxy	Savings, risk-absorption capacity
Fund Sector Expansion	Net asset value growth	Investment funds	Broad fund-sector balance-sheet growth, combining flow and valuation effects	Credit, savings, risk-absorption capacity
Crisis Conditions	COVID-19 dummy	System-wide	COVID-19 episode dummy capturing a discrete crisis-period shift	All
Domestic Macro Conditions	Real GDP growth	Macro	Broad domestic macroeconomic conditions	All
External Financial Conditions	U.S. long-term interest rate	Macro	Global financing conditions	All
Persistence	Lagged NBF functional share	Function-specific	Path dependence and adjustment persistence	Function-specific
Nonlinearity	Low-capital regime dummy and capital interaction	Banks / system	Regime-dependent substitution under capital stress	Regime-interaction regressions

4.4.1 Baseline Specification

For each financial function f , the baseline regression is specified as

$$\text{NBFIShare}_{f,t} = \alpha_f + \beta_f' B_t + \gamma_f' N_t + \delta_f' M_t + \rho_f \text{NBFIShare}_{f,t-1} + \varepsilon_{f,t},$$

where $\text{NBFIShare}_{f,t}$ denotes the NBF share of function f at time t , in either raw or systemic-risk-adjusted form. The vector B_t includes banking-sector variables capturing bank capitalisation, credit intensity (credit relative to bank capital) and provisioning intensity. In the baseline specification, bank capitalisation is proxied by the capital-to-assets ratio, which serves as a broad balance-sheet measure of capitalisation rather than a risk-weighted regulatory capital ratio. The vector N_t contains sector-specific NBF indicators, including insurance premium growth, the insurance company provisions-to-assets ratio, and fund net asset value growth, which should be interpreted as broad sector-level balance-sheet indicators that combine flow and valuation effects rather than as an exact product-level flow measure. The vector M_t includes macro-financial controls, notably Brazilian real GDP growth and the US long-term interest rate. A COVID-19 dummy is included in relevant specifications.

Lagged dependent variables are included selectively to account for persistence, depending on the institutional characteristics of each function. This is particularly important for savings mobilisation and risk-absorption capacity functions, where adjustment dynamics may be slower and more path-dependent than those in credit provision.

4.4.2 Low-Capital Regime Specification

To capture the regime-dependent mechanisms discussed in Section 3.3, we estimate specifications in which the marginal effect of bank capital varies between low- and higher-capital regimes. The low-capital regime is defined using the median capital-to-assets ratio over the longer available banking-sector history. This yields a cutoff of approximately 0.78% of total assets, which is subsequently applied to the 52-quarter common three-sector regression sample. The cutoff is therefore fixed prior to estimation of the common-sample regressions rather than estimated jointly with the regression coefficients. The specification is given by:

$$\begin{aligned} \text{NBFIShare}_{f,t} = & \alpha_f + \beta_{1f} \text{Capital}_t + \beta_{2f} D_t^L + \beta_{3f} (\text{Capital}_t \times D_t^L) + \theta_f' Z_t \\ & + \rho_f \text{NBFIShare}_{f,t-1} + \varepsilon_{f,t}, \end{aligned}$$

where D_t^L is a dummy variable equal to one when the banking-system capital-to-assets ratio falls below the median-based cutoff of approximately 0.78%, and Z_t includes the remaining banking, NBF and macro-financial controls. This specification allows the effect of bank capital on functional migration to differ between low- and higher-capital regimes without imposing a more restrictive nonlinear functional form.

4.4.3 Bank-Level Supporting Specification

To provide complementary micro-level evidence on the mechanism underlying the aggregate credit-migration results, we examine whether bank-level credit intermediation varies systematically with balance-sheet conditions. To avoid a mechanical relationship between the dependent variable and bank capital, bank credit intensity is measured as credit relative to total assets rather than credit relative to capital.

The bank-level specification relates credit intensity to lagged measures of bank capitalisation, provisioning intensity and liquidity conditions:

$$\begin{aligned} CreditIntensity_{i,t} = & \alpha_i + \gamma_t + \beta_1 CapitalRatio_{i,t-1} \\ & + \beta_2 ProvisionsToCredit_{i,t-1} + \beta_3 LiquidityRatio_{i,t-1} + \varepsilon_{i,t}, \end{aligned}$$

where $CreditIntensity_{i,t}$ denotes credit relative to total assets for bank i in month t , $CapitalRatio_{i,t-1}$ is the lagged capital-to-assets ratio, $ProvisionsToCredit_{i,t-1}$ is the lagged provisions-to-credit ratio and $LiquidityRatio_{i,t-1}$ is the lagged liquid assets-to-assets ratio. Bank fixed effects, α_i , absorb persistent differences across institutions, while month fixed effects, γ_t , control for common macro-financial shocks and other time-specific factors affecting all banks.

The explanatory variables enter with a one-month lag to reduce contemporaneous feedback from credit activity to balance-sheet conditions. Standard errors are clustered at the bank level. To limit the influence of extreme observations in the raw balance-sheet ratios, ratio variables are winsorised at the 1st and 99th percentiles.

To examine whether the relationship between capitalisation and credit intermediation varies across capitalisation states, we additionally estimate a regime-interaction specification that includes a low-capital indicator and its interaction with the capital-to-assets ratio. The low-capital regime is defined using the median bank-level capital-to-assets ratio in the estimation sample.

The bank-level specification is intended to provide complementary evidence on the balance-sheet mechanism underlying the aggregate migration results rather than causal identification of a direct transfer of credit activity from individual banks to NBFIs.

4.4.4 Basel III Event-Study Specification

To provide additional evidence on the balance-sheet mechanism underlying credit migration, we exploit cross-bank differences in capitalisation around the introduction of Basel III in Brazil. The Brazilian authorities published the main Basel III implementing regulations in March 2013, with the new framework entering into force on 1 October 2013 (BCBS, 2013). We therefore use March 2013 as the baseline event date, while treating October 2013 as an alternative implementation date.

Bank exposure is measured using the average equity-to-total assets ratio during 2012, prior to publication of the final regulations. The measure is standardised and reversed so that higher values indicate weaker pre-reform capitalisation. We estimate an event-study specification relating bank credit relative to total assets to interactions between this predetermined exposure measure and event time. The model includes bank and month fixed effects, with standard errors clustered at the bank level.

The baseline event window covers 24 months before and 36 months after March 2013. Event time is grouped into quarterly intervals for presentation. This specification allows us to examine both whether more and less exposed banks followed similar credit trends before the regulatory change and whether their credit intensity diverged subsequently. Because the exposure measure is based on accounting equity rather than banks' precise regulatory capital shortfalls under Basel III, the exercise is interpreted as supporting quasi-experimental evidence rather than as a causal estimate of the reform.

4.4.5 Estimation and Robustness

The main sector-level regressions are estimated using quarterly data with Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors, allowing for serial correlation of up to four quarters. The common three-sector sample period spans 52 quarters, while specifications containing the insurance company provisions-to-assets ratio use 51 observations after exclusion of one anomalous observation with non-positive insurance total assets. Given the resulting limited degrees of freedom, inference focuses primarily on coefficient signs, economic magnitudes, stability across specifications, and consistency between raw and systemic-risk-adjusted results. Robustness checks include alternative systemic-risk weights, exclusion of crisis periods, specifications without lagged dependent variables and alternative functional-share specifications. The estimation approach for the complementary monthly bank-level analysis, including fixed effects, lag structure, winsorisation and clustered standard errors, is described separately in Section 4.4.3. The Basel III event-study specification introduced in Section 4.4.4 is complemented by alternative event dates and exposure measures to assess the robustness of the estimated differential credit response.

5. Empirical Results

This section reports the empirical evidence on functional migration between banks and NBFIs in Brazil. The discussion proceeds in six steps. First, it documents stylised facts on the evolution of NBFI functional shares. Second, it examines the determinants of systemically relevant migration across credit provision, savings mobilisation and risk-absorption capacity functions. Third, it explores nonlinearities and regime dependence. Fourth, it provides complementary bank-level evidence on the balance-sheet mechanism underlying credit migration. Fifth, it examines differential bank credit responses around the introduction of Basel III as additional evidence on the balance-sheet channel. Sixth, it evaluates crisis effects and robustness to alternative specifications and measures of systemic risk.

5.1 Stylised Facts on NBFI Functional Intermediation

Brazil's financial system exhibits pronounced functional segmentation across institutional sectors. Table 8 reports unconditional means and standard deviations of NBFI shares in credit, savings, and risk-absorption capacity functions, computed both in raw form and after systemic-risk adjustment. Two patterns stand out. First, NBFIs account for a large share of savings mobilisation and a sizeable, though more volatile, share of system-wide risk-absorption capacity, while their average share of credit provision remains comparatively modest. This indicates that functional migration is concentrated in specific segments of the financial system. Second, the systemic-risk-adjusted shares are systematically lower on average than raw shares. Their volatility is also lower for credit provision and savings mobilisation, while remaining broadly similar for risk-absorption capacity. This suggests that balance-sheet expansion of NBFIs does not translate proportionally into systemic relevance, and that volume-based measures may overstate their contribution to systemic risk.

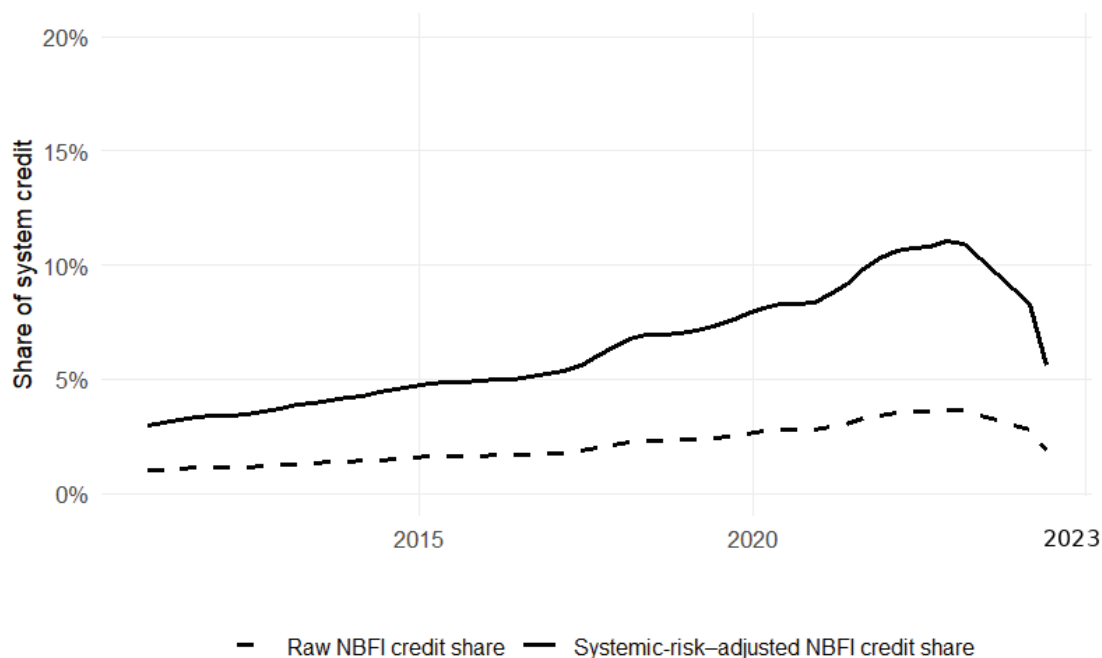
Table 8: Descriptive Evidence on the NBFI Share of Functional Intermediation

Function	Mean (Raw)	SD (Raw)	Mean (SR-Adj.)	SD (SR-Adj.)
Credit provision	0.152	0.326	0.124	0.309
Savings mobilisation	0.673	0.446	0.449	0.400
Risk-absorption Capacity	0.424	0.390	0.307	0.393

Notes: The raw functional shares represent the fraction of system-wide activity in each function performed by NBFIs. The systemic-risk-adjusted (SR-adjusted) shares apply time-varying sectoral systemic-risk weights to these raw values, yielding measures that reflect NBFIs' functional contribution after accounting for their relative systemic importance. Reported statistics summarise these measures over the sample period.

Figure 1 illustrates this divergence for credit provision. The raw NBFI credit share rose steadily from the early 2010s to 2022, while the systemic-risk-adjusted share increased more gradually and remained consistently below the raw share. This persistent divergence indicates that the expansion of NBFI credit activity was accompanied by a more moderate increase in systemic relevance. This interpretation is also consistent with the balance-sheet evidence in Figure B.2 in Appendix B, which documents a nonlinear relationship between bank liquidity buffers and credit intensity, providing complementary evidence on the role of bank balance-sheet composition in credit intermediation. Furthermore, Figure A.1 in Appendix A provides a higher-frequency view of the credit provision function and confirms the same qualitative pattern: short-run fluctuations in NBFI credit provision are more pronounced in raw terms than after systemic-risk adjustment.

Figure 1: Credit function, four-quarter moving average (raw vs systemic risk-adjusted share)



Notes: The figure plots the raw NBF credit share and the systemic-risk-adjusted credit share, each expressed as a four-quarter moving average. The divergence between the two series illustrates that increases in NBF credit activity do not translate proportionally into systemic relevance.

The remaining two functions display distinct trajectories. Savings mobilisation is characterised by a persistently high NBF share, with the systemic-risk-adjusted share remaining consistently below the raw measure. This indicates that the structural dominance of insurance company- and fund-based saving vehicles is not matched one-for-one by systemic relevance. By contrast, the NBFs' role in risk-absorption capacity increased more gradually from the mid-2010s onward, and the systemic-risk-adjusted series converged toward the raw measure over time, suggesting a closer alignment between functional participation and systemic importance (Figures A.2 and A.3 in Appendix A). Table A.6 in Appendix A further shows that raw and systemic-risk-adjusted measures are highly correlated within functions but only moderately correlated across functions, supporting a function-by-function empirical analysis.

5.2 Determinants of Systemically Relevant Functional Migration

We next examine the determinants of systemically relevant functional migration using the systemic risk (SR)-adjusted functional shares defined in Section 4. Table 9 reports the baseline regression results for credit provision, savings mobilisation, and risk-absorption capacity functions. The results reveal a sharp asymmetry across functions.

Table 9: Determinants of SR-adjusted Functional Shares (Credit Provision, Savings Mobilisation and Risk-Absorption Capacity)

Variable	Credit provision (SR-adj.)	Savings mobilisation (SR-adj.)	Risk-absorption Capacity (SR-adj.)
(Intercept)	-0.021* (0.011)	0.417 (0.298)	-0.084 (0.088)
Bank capital ratio	-1.261** (0.481)	-14.545 (18.010)	-1.298 (8.734)
Bank credit-to-capital ratio	2.685** (1.056)	-24.032 (28.222)	NA
Bank provisions-to-credit ratio	-0.083*** (0.012)	NA	-0.685*** (0.228)
Insurance premium growth	-6.55×10^{-6} ** (2.70×10^{-6})	2.89×10^{-4} *** (6.98×10^{-5})	NA
Insurance provisions-to-assets ratio	0.006 (0.005)	0.039 (0.216)	0.775 (0.597)
Fund NAV growth	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)
COVID dummy	0.006** (0.002)	0.039 (0.047)	-0.000 (0.047)
Relevant lagged share	-0.000 (0.002)	0.093 (0.058)	0.009 (0.035)
Brazil GDP growth (real)	0.000 (0.000)	0.004 (0.004)	0.005** (0.002)
US long-term rate	0.002 (0.001)	0.012 (0.034)	-0.015 (0.024)
N (observations)	51	51	51
R ²	0.905	0.293	0.483
Adjusted R ²	0.881	0.138	0.384

Note: Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with four quarterly lags are reported in parentheses. The insurance provisions-to-assets ratio excludes the observation with non-positive insurance total assets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

For credit provision, the systemic-risk-adjusted NBFI share is strongly associated with banking-sector balance-sheet constraints, consistent with the nonlinear relationship between bank capitalisation and credit intensity suggested by Figure B.1 in Appendix B and examined formally in Section 5.4. A higher bank credit-to-capital ratio is associated with a significantly larger NBFI credit share, while higher bank capital ratios and stronger loan-loss provisioning are associated with a significantly smaller NBFI share. This interpretation is further supported by Figure B.3 in Appendix B, which shows that interbank exposures are more strongly associated with credit intensity in private banks than in state-owned banks, pointing to meaningful heterogeneity in how funding structures relate to the scope for functional migration away from bank lending. Figure B.4 in Appendix B further shows that credit intensity declines steeply with bank size, especially among very large institutions, suggesting that functional migration may be particularly relevant when credit supply is concentrated in larger banks facing tighter balance-sheet constraints or more conservative portfolio allocation. The COVID-19 dummy

enters positively and significantly, indicating a level shift toward NBFIs during the pandemic. The lagged dependent variable is insignificant, suggesting that once systemic risk is accounted for, credit migration is largely state-contingent rather than trend-driven. The model explains a substantial fraction of the variation in the adjusted credit share.

In contrast, savings mobilisation displays little sensitivity to banking-sector constraints or macro-financial conditions. The lagged savings share remains positive, indicating persistence, although its statistical significance weakens once HAC standard errors are applied. Once systemic risk is taken into account, savings mobilisation appears largely insulated from short-run balance-sheet stress.

For the risk-absorption capacity function, migration toward NBFIs is limited and selective. Higher bank provisioning ratios are associated with a significantly lower adjusted NBFIs risk-absorption capacity share. The insurance company provisions-to-assets ratio enters positively but is not statistically significant once serial correlation and heteroskedasticity are taken into account. Real GDP growth is positively associated with the adjusted NBFIs risk-absorption capacity share. Overall, these results suggest that sector-specific balance-sheet conditions affect the allocation of loss-absorbing capacity, but the evidence for systematic migration of risk-absorption capacity toward NBFIs is considerably weaker than for credit provision. This interpretation is also consistent with Figure C.1 in Appendix C, which shows that return volatility varies systematically with investment-fund size, suggesting that the fund sector's capacity to absorb reallocated risk is heterogeneous and concentrated in specific segments rather than broadly distributed across all funds. It is further supported by Figure D.1 in Appendix D, which shows that lower insurer capital adequacy is associated with higher underwriting losses, consistent with the view that underwriting shocks compress insurance companies' balance-sheet capacity and thereby limit their role in system-wide risk-absorption capacity. Figure D.2 in Appendix D reinforces this mechanism by showing that systemic underwriting shocks are concentrated in a small number of economically important insurance lines, indicating that insurer balance-sheet constraints arise from concentrated sectoral stress rather than from broad-based cyclical weakness across the entire insurance sector.

Overall, the results indicate that systemically relevant migration toward NBFIs is concentrated in credit provision, while savings mobilisation and risk-absorption capacity remain more firmly anchored in their traditional institutional sectors. The corresponding baseline regressions using the raw functional shares reported in Table A.7 in Appendix A yield a similar qualitative pattern for credit provision, while the magnitude and persistence of the estimated relationships differ across the raw and systemic-risk-adjusted measures for savings mobilisation and risk-absorption capacity. Table A.10 in Appendix A presents the raw and systemic-risk-adjusted baseline models side by side and shows that the systemic-risk adjustment changes the relative magnitude and statistical strength of some function-specific relationships while leaving the central credit-migration result intact.

5.3 Nonlinearities and Capital Regimes in Credit Provision

To assess whether credit migration intensifies when banks operate in weaker capitalisation regimes, we estimate regime-interaction models that allow the marginal effect of bank capital to differ between low- and higher-capital regimes. The low-capital regime comprises 12 of the 51 observations used in the regime

regressions, while the remaining 39 observations fall in the higher-capital regime. The underlying common three-sector sample spans 52 quarters, with one observation excluded because of a non-positive insurance total-assets value. The capital cutoff used to define the low-capital regime is approximately 0.78% of total assets. The cutoff corresponds to the median capital-to-assets ratio in the longer available banking-sector sample and is not estimated from the 52-quarter regression sample. Table 10 reports the results for both the raw and systemic-risk-adjusted NBFIs credit shares.

Table 10: Credit regressions by capital regime (Raw and SR-adjusted)

Variable	Credit (raw)	Credit (SR-adj.)
Intercept	-0.087*** (0.032)	-0.029*** (0.010)
Bank capital ratio	-0.985 (1.377)	-0.327 (0.450)
Low-capital dummy	0.163*** (0.053)	0.054*** (0.017)
Capital × low-capital (interaction)	-21.443*** (7.248)	-7.130*** (2.363)
Bank credit-to-capital ratio	8.466*** (2.790)	2.822*** (0.920)
Bank provisions-to-credit ratio	-0.268*** (0.036)	-0.090*** (0.011)
Insurance premium growth	-0.000 (0.000)	-0.000 (0.000)
Insurance provisions-to-assets ratio	0.052*** (0.019)	0.017*** (0.006)
Fund NAV growth	0.000 (0.000)	0.000 (0.000)
COVID-19 dummy	0.005 (0.004)	0.002* (0.001)
Lagged NBFIs credit share	0.001 (0.006)	NA
N (obs)	51	51
R ²	0.919	0.918
Adj. R ²	0.898	0.901

Note: Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with four quarterly lags are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In both specifications, the low-capital regime dummy enters positively and significantly, indicating that NBFIs capture a larger share of credit when bank capitalisation is weak. Given that the low-capital regime contains 12 quarters, the nonlinear estimates should be interpreted as evidence of state dependence

concentrated in a relatively small subset of the sample. More importantly, the interaction between bank capital and the low-capital dummy is strongly negative, implying that marginal improvements in capitalisation are associated with disproportionately large changes in the NBF credit shares when banks operate in weaker capitalisation regimes. The coefficients on the credit-to-capital ratio and loan-loss provisions remain large and statistically significant, while overall explanatory power remains high. These findings provide evidence of nonlinear, regime-dependent migration in credit provision, and this pattern persists after adjusting the functional shares for systemic relevance.

By contrast, regime-interaction regressions for the savings mobilisation and risk-absorption capacity functions reported in Table A.8 in Appendix A show weaker and less stable effects. The savings mobilisation shares are driven primarily by persistence, with little evidence that capital regimes materially alter their dynamics, while the risk-absorption capacity shares display only selective sensitivity to low-capital states and capital-regime interactions. Nonlinearities therefore appear to be a distinctive feature of the credit provision function. Section 5.4 examines whether a corresponding state-dependent relationship between capitalisation and credit intermediation is also present at the individual-bank level.

5.4 Bank-Level Evidence on the Credit-Migration Mechanism

To complement the aggregate credit-migration results, Table 11 reports bank-level fixed-effects estimates based on the supervisory banking panel described in Section 4.4.3. The regressions are estimated on 30,391 bank-month observations covering 197 banks. Columns (1)–(3) build the baseline specification sequentially. Column (1) includes lagged bank capitalisation, column (2) adds lagged provisioning intensity, and column (3) further adds lagged liquidity conditions. Column (4) augments the full specification with the low-capital regime indicator and its interaction with bank capitalisation. The low-capital regime is defined by the median bank-level capital-to-assets ratio in the estimation sample, approximately 2.54%. This threshold is distinct from the 0.78% aggregate banking-system cutoff used in Section 5.3 because the two exercises operate at different levels of aggregation.

Table 11: Bank-Level Evidence on Balance-Sheet Constraints and Credit Intensity

Variable	(1)	(2)	(3)	(4)
Lagged capital/assets	-0.087*** (0.023)	-0.055** (0.026)	-0.055** (0.025)	-0.096*** (0.025)
Lagged provisions/credit		0.030*** (0.005)	0.030*** (0.005)	0.030*** (0.005)
Lagged liquid assets/assets			0.227 (0.288)	-0.007 (0.301)
Low-capital dummy				-0.056*** (0.009)
Capital × low-capital				2.038*** (0.375)
Bank FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Observations	30,391	30,391	30,391	30,391
Banks	197	197	197	197
Adjusted R ²	0.635	0.649	0.649	0.670

Note: The dependent variable is bank credit relative to total assets. Explanatory variables are lagged by one month. Ratio variables are winsorised at the 1st and 99th percentiles. All specifications include bank and month fixed effects. Standard errors clustered at the bank level are reported in parentheses. In column (4), the low-capital regime is defined using the median bank-level capital-to-assets ratio in the estimation sample, approximately 2.54%. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Across columns (1)–(3), the coefficient on bank capitalisation is negative and statistically significant, although its magnitude declines once provisioning intensity is included. The coefficient on the provisions-to-credit ratio is positive and statistically significant, while the liquidity ratio is not statistically significant. These results indicate that bank credit intensity is systematically associated with balance-sheet conditions even after controlling for persistent differences across institutions and common time effects.

Column (4) provides the closest micro-level counterpart to the aggregate regime evidence in Table 10. The interaction between bank capitalisation and the low-capital indicator is positive and highly statistically significant, indicating that the relationship between capitalisation and credit intermediation changes markedly when banks operate with relatively weak capital buffers. In the low-capital regime, improvements in capitalisation are associated with substantially higher credit intensity, whereas outside that regime the marginal relationship is negative. This pattern is consistent with the nonlinear relationship documented graphically in Figure B.1 in Appendix B and supports the interpretation that capital constraints are particularly relevant for credit intermediation when bank balance-sheet capacity is weak.

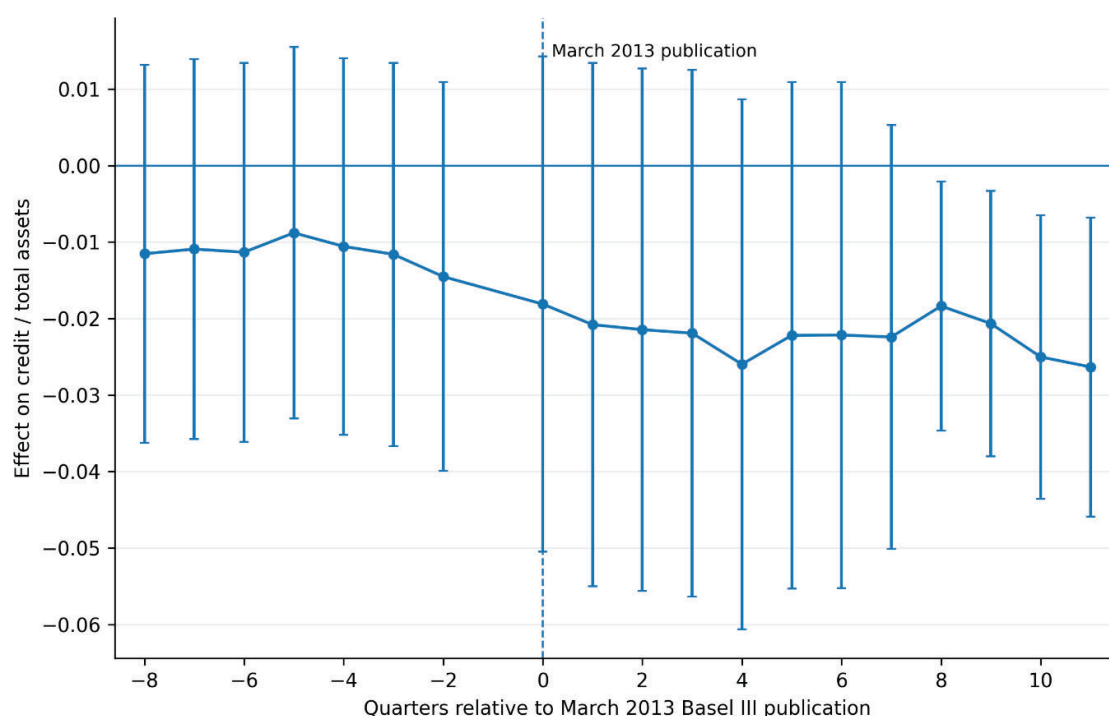
Taken together, the bank-level and sector-level evidence point to a consistent mechanism. Bank credit intermediation responds nonlinearly to balance-sheet conditions, with capitalisation playing a particularly important role among relatively weakly capitalised banks. At the aggregate level, periods of tighter banking-sector balance-sheet conditions are associated with a larger NBFIs share of credit provision. The bank-level estimates therefore provide complementary micro-level support for the mechanism underlying functional migration, while they should not be interpreted as causal evidence of a direct transfer of credit activity from individual banks to NBFIs. As a robustness check, we also apply the 0.78% capital-to-assets cutoff used in the aggregate regime analysis to the bank-level sample. The nonlinear result remains: the lagged capital coefficient is negative and statistically significant (-0.061 , $p = 0.012$), while the interaction between capitalisation and the low-capital regime remains positive and highly significant (5.220 , $p < 0.001$). Although only 17% of bank-month observations fall below this more restrictive threshold, the result confirms that the state-dependent relationship is not driven by the use of the bank-level median cutoff. The available data also do not allow us to distinguish whether such reallocation occurs between independent institutions or within financial conglomerates. In the latter case, common ownership, distribution networks and existing client relationships may facilitate rather than weaken the migration mechanism.

5.5 Regulatory Capital Tightening and the Credit-Migration Mechanism

To provide additional evidence on the credit-migration mechanism, we examine whether banks entering the Basel III reform with weaker capitalisation subsequently adjusted their credit intensity more strongly. Pre-reform exposure is measured by each bank's average equity-to-total-assets ratio in 2012, standardised and reversed so that higher values indicate weaker capitalisation.

Figure 2 reports the event-study estimates around the March 2013 publication of the Brazilian Basel III regulations. The specification contains 6,054 bank-month observations covering 112 banks. The pre-reform coefficients are jointly statistically insignificant ($p = 0.703$), providing no evidence of differential credit trends between more and less exposed banks before the regulatory change. Following the reform announcement, however, the coefficients become predominantly more negative and are jointly significant in the post-reform period ($p < 0.001$). In the later post-reform period, a one-standard-deviation increase in pre-reform exposure is associated with approximately a 1.8–2.6 percentage-point lower credit-to-assets ratio relative to the omitted pre-reform period.

Figure 2: Bank Credit Response to Basel III by Pre-Reform Capitalisation



Notes: The figure reports event-study coefficients for the interaction between event time and banks' pre-reform exposure. Exposure is measured as the negative of the standardised average equity-to-total-assets ratio in 2012, so that higher values indicate weaker pre-reform capitalisation. The dependent variable is credit relative to total assets. The specification includes bank and month fixed effects, and standard errors are clustered at the bank level. The omitted period is the period immediately preceding the March 2013 publication of the Basel III regulations.

A more parsimonious specification interacting exposure with a post-reform indicator yields an average differential of approximately -1.2 percentage points, although the estimate is statistically significant only at the 10% level ($p = 0.060$). Using October 2013, when the regulations formally entered into force, as the alternative event date produces a negative and statistically significant post-reform coefficient of approximately -0.95 percentage points ($p = 0.006$). The emergence of some adjustment before October is consistent with banks beginning to respond after the regulations were published in March, supporting the use of March 2013 as the baseline event date.

We also construct an alternative exposure measure based on the pre-reform share of lower-quality loans in credit categories D–H, where Brazilian regulatory credit grades range from AA (lowest risk) to H (highest risk). The corresponding event study shows no evidence of differential pre-trends, but the post-reform coefficients are not jointly statistically significant. Similar results are obtained using broader C–H and narrower E–H definitions. The differential credit response therefore appears more closely associated with banks' pre-reform capitalisation than with their initial credit-quality composition.

Taken together, the results are consistent with more weakly capitalised banks reducing credit intensity more strongly following the introduction of Basel III. This

provides additional support for a bank balance-sheet channel underlying the aggregate migration results: regulatory changes that make bank balance-sheet constraints more binding may reduce banks' relative capacity to provide credit, creating scope for credit provision to migrate toward NBFIs. Because the exposure measure is based on accounting equity rather than banks' precise Basel III regulatory capital shortfalls, these estimates should be interpreted as supporting quasi-experimental evidence rather than as a causal estimate of the regulatory reform. Additional results using the October 2013 implementation date and alternative credit-quality exposure measures are reported in Table A.11 in Appendix A.

5.6 Crisis Robustness

We next examine the role of the COVID-19 episode in functional migration. The COVID-19 indicator included in the baseline specifications provides an illustrative test of whether the pandemic was associated with a discrete shift in functional allocation across the three functions.

The COVID-19 dummy is positive and statistically significant in the credit provision equation, indicating a level shift toward NBFi credit during the pandemic. The associations with bank capitalisation and provisioning remain robust, while the credit-to-capital channel is more sensitive to excluding the pandemic period, as shown in Section 5.7. This suggests that the pandemic was associated with greater NBFi participation in credit provision without overturning the broader relationship between banking-sector balance-sheet constraints and functional migration.

For the savings mobilisation and risk-absorption capacity functions, crisis effects are economically smaller and statistically weaker. Their dynamics remain dominated by persistence and sector-specific balance-sheet features rather than by pandemic-related disruption. Savings mobilisation continues to reflect institutional and contractual structures, while risk-absorption capacity allocation remains linked to sector-specific provisioning and capital practices.

Taken together, these findings indicate that functional migration in Brazil is primarily driven by structural constraints and institutional features rather than crisis-specific dynamics. Periods of systemic stress can accelerate ongoing reallocation across sectors, but they do not fundamentally reshape the underlying transmission channels governing functional intermediation.

5.7 Robustness Checks

A key question in the empirical analysis is whether the baseline results for systemically relevant credit migration depend on particular modelling choices. To address this, we re-estimate the baseline credit specification using several alternative variants, including alternative systemic-risk weights, a specification without the lagged dependent variable and a pre-COVID subsample. Table 12 reports the corresponding robustness results for the systemic-risk-adjusted NBFi credit share. Additional alternative specifications are reported in Table A.9 in Appendix A.

Table 12: Determinants of NBF1 Functional Shares (Credit SR-adjusted Only, Robustness Variants)

Variable	Baseline	Alt. SR	No lag	Pre-COVID
Constant	−0.021* (0.011)	−0.021* (0.011)	−0.021* (0.011)	0.019** (0.008)
Bank capital ratio	−1.261** (0.481)	−1.261** (0.481)	−1.258** (0.480)	−1.919*** (0.405)
Bank credit-to-capital ratio	2.685** (1.056)	2.685** (1.056)	2.687** (1.051)	−0.655 (0.860)
Bank provisions-to-credit ratio	−0.083*** (0.012)	−0.083*** (0.012)	−0.082*** (0.011)	−0.060*** (0.010)
COVID-19 dummy	0.006** (0.002)	0.006** (0.002)	0.006** (0.002)	—
Lagged adjusted NBF1 credit share	−0.000 (0.002)	—	—	—
Observations	51	51	51	38
R ²	0.905	0.905	0.905	0.856
Adjusted R ²	0.881	0.881	0.884	0.816

Note: Newey–West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with four quarterly lags are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Across most specifications, the core credit results remain stable. Bank capitalisation and provisioning retain their expected signs and statistical significance, while the credit-to-capital effect remains strong in the baseline and alternative specifications but becomes weaker and statistically insignificant in the pre-COVID subsample. The magnitude and significance of these coefficients are broadly comparable to those obtained using tail risk-based weights, indicating that the identification of migration patterns is not sensitive to the choice of systemic risk metric. The results under alternative systemic-risk weights are nearly identical to the baseline specification, and excluding the lagged dependent variable leaves the principal coefficients essentially unchanged.

The pre-COVID subsample yields somewhat weaker results for the credit-to-capital ratio, but the effects of bank capital and provisioning remain statistically significant and retain their expected signs. This suggests that the pandemic amplified some migration channels without overturning the broader relationship between banking-sector constraints and NBF1 credit provision.

Taken together, these robustness exercises confirm that the main findings for credit provision are not an artefact of a particular weighting scheme, sample period or inclusion of the lagged dependent variable. This strengthens the interpretation of the results as evidence of function-specific migration dynamics.

5.8 Synthesis

Three main conclusions emerge from the empirical analysis. First, functional segmentation across sectors is pronounced. NBFIs play a structurally important role in savings mobilisation, are increasingly involved in risk-absorption capacity and become more relevant in credit provision under specific balance-sheet conditions. At the same time, systemic-risk-adjusted shares are lower on average than raw shares, indicating that volume-based measures overstate the systemic footprint of non-bank financial intermediation.

Second, systemically relevant migration is concentrated in credit provision. Banking-sector capitalisation, credit intensity relative to capital and provisioning intensity exert large and statistically significant effects on the NBFIs credit share. The effect of bank capitalisation becomes markedly stronger in low-capital regimes, while the credit-to-capital and provisioning effects remain large and statistically significant. Complementary bank-level estimates support this state-dependent mechanism, showing that the relationship between bank capitalisation and credit intensity changes markedly among relatively weakly capitalised banks. The Basel III event-study evidence reinforces this mechanism: banks entering the reform with weaker pre-reform capitalisation subsequently experienced a larger decline in credit intensity, while no corresponding differential trend is evident before the regulatory change. This indicates that migration is state-contingent and nonlinear, intensifying when banking-sector capital constraints become more binding.

Third, savings mobilisation and risk-absorption capacity functions are more structural in nature. Savings mobilisation displays substantial persistence, although the statistical significance of this persistence is sensitive to the treatment of serial correlation. Risk-absorption capacity shifts across sectors only selectively and remains associated primarily with bank provisioning and broader macroeconomic conditions, while the estimated insurance provisioning effect is not robust to HAC inference.

These findings support a function-based view of financial intermediation in which the migration of activity toward NBFIs is uneven across functions and most economically meaningful in credit markets.

6. Policy Implications

The empirical results have important implications for macroprudential policy. In particular, they show that function migration between banks and NBFIs is uneven across activities and becomes most economically relevant in credit provision. Migration is more pronounced when banking-sector constraints become more binding, indicating that institution-based monitoring alone is not sufficient to capture system-wide risk dynamics. The complementary bank-level evidence reinforces this finding by showing that the relationship between bank capitalisation and credit intensity is strongly state-dependent, with capital conditions becoming particularly relevant for relatively weakly capitalised banks.

The findings also highlight an important trade-off in the design of bank-focused macroprudential tools. The event-study evidence around Brazil's Basel III implementation is consistent with this channel, showing a stronger subsequent reduction in credit intensity among banks that entered the reform with weaker capitalisation. Stronger capital requirements and more stringent provisioning frameworks improve the resilience of banks, but when they make bank balance-sheet constraints more binding they can also be accompanied by a reallocation of credit provision toward NBFIs. While this migration does not necessarily increase systemic risk one-for-one, it changes the location and potentially the transmission channels of risk within the financial system. As a result, the calibration of bank-based measures should take into account the possibility of cross-sector spillovers rather than focusing exclusively on balance-sheet resilience within the banking sector. In financial systems where banks, investment funds and insurance companies operate within the same corporate groups, such reallocation may occur without a change in ultimate ownership, reinforcing the case for monitoring financial functions across institutional boundaries rather than relying only on legal-entity classifications.

From a supervisory perspective, the results suggest that monitoring efforts should place particular emphasis on non-bank credit provision, especially during periods of weak bank capitalisation or heightened stress. The evidence is consistent with NBFIs acting as contingent substitutes for banks in credit markets, expanding their relative role when traditional intermediaries are constrained. This reinforces the need for more comprehensive data collection and risk assessment frameworks that cover credit provision across sectors, rather than focusing only on bank lending.

More broadly, the results support the development of macroprudential surveillance frameworks that incorporate function-based indicators and explicitly account for nonlinearities. The state-dependent nature of migration, with stronger effects in low-capital regimes, implies that early warning systems should include measures of banking-sector constraints alongside indicators of NBFI activity. The bank-level results further suggest that aggregate measures of banking-sector conditions can usefully be complemented by information on the distribution of capitalisation across individual institutions. In addition, systemic-risk-adjusted metrics provide a more informative view of the financial system than volume-based measures alone, as they distinguish between expansion in intermediation and changes in systemic relevance.

Taken together, these findings suggest that effective macroprudential policy requires a system-wide perspective that integrates banks and NBFIs within a common analytical framework. Rather than focusing solely on the size of the non-bank sector, policymakers should monitor how core financial functions migrate across institutions and how this migration interacts with balance-sheet constraints and systemic relevance.

7. Conclusion

This paper studies how core financial functions such as credit provision, savings mobilisation and risk-absorption capacity are allocated across banks and NBFIs, and how this allocation changes once sectoral systemic relevance is taken into account. Using supervisory data for Brazil, we develop a function-based empirical framework that combines measures of sectoral activity with systemic-risk-adjusted indicators, allowing us to distinguish between shifts in the volume of intermediation and shifts in its contribution to financial stability. We complement the sector-level analysis with bank-level evidence on how individual-bank balance-sheet conditions are associated with credit intensity.

Three main findings emerge. First, functional segmentation across sectors is pronounced. NBFIs play a persistently large role in savings mobilisation and an increasing role in market-based risk-absorption capacity, while their participation in credit provision is more conditional. Second, systemically relevant migration is concentrated in credit provision and is closely linked to banking-sector balance-sheet conditions. In particular, migration is more pronounced when banking-sector capitalisation is weaker and balance-sheet constraints appear more binding. Complementary bank-level evidence supports this mechanism: the relationship between capitalisation and credit intensity is nonlinear and particularly pronounced among relatively weakly capitalised banks. This interpretation is further supported by an event-study around the introduction of Basel III in Brazil, in which more weakly capitalised banks exhibit a larger subsequent decline in credit intensity without evidence of differential pre-reform trends. Third, savings mobilisation and risk-absorption capacity functions appear more structural than credit provision, with weaker and less robust sensitivity to short-run balance-sheet and macro-financial conditions.

These results suggest that the expansion of non-bank financial intermediation does not translate mechanically into a proportional increase in systemic importance. A volume-based view of NBFI growth is therefore incomplete. What matters for financial stability is how core financial functions are reallocated across sectors and under what conditions this reallocation occurs.

The analysis also points to the value of a function-based perspective on financial intermediation. Monitoring financial systems that focus exclusively on institutional boundaries may miss important shifts in the distribution of economic activity, particularly when constraints in the banking sector induce migration toward NBFIs. This remains relevant where banks and NBFIs operate within the same financial group, as functional reallocation may occur across affiliated entities even when ultimate ownership is unchanged.

Several extensions remain for future research. While the main functional-migration analysis is conducted at the sector level, the complementary bank-level exercise provides initial institution-level evidence on the banking-side mechanism. Future work could extend the institution-level dimension to NBFIs, examine cross-country settings and incorporate richer measures of interconnectedness. Incorporating network-based approaches and exploring interactions with monetary and regulatory shocks are particularly promising directions.

Overall, the findings highlight that financial stability depends not only on the resilience of individual sectors, but also on how key financial functions are distributed across the system.

References

- Acharya, V. V., Pedersen, L. H., Philippon, T., & Richardson, M. (2017). Measuring systemic risk. *Review of Financial Studies*, 30(1), 2–47.
- Adrian, T., & Ashcraft, A. B. (2012). Shadow Banking: A Review of the Literature. *Federal Reserve Bank of New York Staff Report*, 580.
- Adrian, T., & Brunnermeier, M. K. (2016). CoVaR. *American Economic Review*, 106(7), 1705–1741.
- Allen, F., & Carletti, E. (2013). What is systemic risk? *Journal of Money, Credit and Banking*, 45(s1), 121–127.
- Allen, F., & Gale, D. (2000). *Comparing Financial Systems*. MIT Press.
- Acharya, V.V., Khandwala, H., & Öncü, T.S. (2013). The growth of a shadow banking system in emerging markets: Evidence from India. *Journal of International Money and Finance*, 39, pp.207-230.
- Aramonte, S., Schrimpf, A., & Shin, H. S. (2021). Non-bank financial intermediaries and financial stability. *BIS Working Papers* 972.
- Arora, R., Cetorelli, N., & Peristiani, S. (2019). Financial sector interconnectedness and the changing nature of systemic risk. *Economic Policy Review*, Federal Reserve Bank of New York, 25(1), 85–107.
- Basel Committee on Banking Supervision (BCBS) (2013). Regulatory Consistency Assessment Programme (RCAP): Assessment of Basel III Regulations in Brazil. Basel: Bank for International Settlements, December.
- Benigno, G., Chen, H., Otrok, C., Rebucci, A., & Young, E. R. (2016). Optimal capital controls and real exchange rate policies: A pecuniary externality perspective. *Journal of Monetary Economics*, 84, 147–165.
- Bochmann, P. , Dieckelmann, D., Grodzicki, M., Horan, A., Larkou, C. & Lenoci, F. (2025). Systemic risks in linkages between banks and the non-bank financial sector. *ECB Financial Stability Report*, November.
- Boot, A. W. A., & Thakor, A. V. (2000). Can relationship banking survive competition? *Journal of Finance*, 55(2), 679–713.
- Buch, C. M., & Prieto, E. (2014). Do better capitalized banks lend less? Long-run panel evidence from Germany. *International Finance*, 17(1), 1–23.
- Cetorelli, N., & Peristiani, S. (2012). The role of banks in asset securitisation. *Federal Reserve Bank of New York Economic Policy Review*, 18(2), 47–63.
- Carletti, E. (2022). Financial intermediation and regulation in the shadow of systemic risk. *Annual Review of Economics*, 14, 391–419.
- Claessens, S., & Kodres, L. (2014). The regulatory responses to the global financial crisis: Some uncomfortable questions. *IMF Working Paper* 14/46.

- Drechsler, I., Savov, A., & Schnabl, P. (2017). The deposits channel of monetary policy. *Quarterly Journal of Economics*, 132(4), 1819–1876.
- Ehlers, T., Kong, S., & Zhu, F. (2018). Mapping shadow banking in China: structure and dynamics. *BIS Working Papers* 701.
- European Systemic Risk Board (ESRB) (2024). *Non-Bank Financial Intermediation Risk Monitor 2024* (No. 9). Frankfurt: ESRB Secretariat, June.
- Financial Stability Board (FSB). (2022). Global Monitoring Report on Non-Bank Financial Intermediation 2022. Bank for International Settlements. December.
- Financial Stability Board (FSB). (2023). Global Monitoring Report on Non-Bank Financial Intermediation 2023. Basel: Bank for International Settlements. December.
- Financial Stability Board (FSB). (2025). Leverage in Nonbank Financial Intermediation: Final report. Basel: Financial Stability Board, 9 July.
- Gennaioli, N., Shleifer, A., & Vishny, R. (2013). A Model of Shadow Banking. *Journal of Finance*, 68(4), 1331–1363.
- Glasserman, P., & Young, H. P. (2016). Contagion in financial networks. *Journal of Economic Literature*, 54(3), 779–831.
- Gorton, G., & Metrick, A. (2012). Securitized banking and the run on repo. *Journal of Financial Economics*, 104(3), 425–451.
- International Monetary Fund (IMF) (2023). Chapter 2: Non-bank financial intermediaries and systemic vulnerabilities. In *Global Financial Stability Report* (pp. 55–90). Washington, DC: International Monetary Fund, April.
- Jackson, M. O. & Pernoud, A. (2021), Systemic Risk in Financial Networks: A Survey. *Annual Review of Economics*, 13, 171–202.
- Jakubik, P. & Teleu, S. (2024). Do insurance stress tests matter? Evidence from the EU-wide insurance stress tests. *Risk Management*, 26(16).
- Krenz, J., & Verma, A. K. (2023). A leaky pipeline: Macroprudential policy shocks, non-bank financial intermediation and systemic risk in Europe, WiSo-HH Working Paper Series 79, University of Hamburg, Faculty of Business, Economics and Social Sciences, WISO Research Laboratory.
- Lekobane, O. (2025). Do macroprudential policies influence FinTech credit growth? *Economic Modelling*, 132, 106602.
- Federal Reserve Bank of New York. (2025). Who lends to households and firms? *Liberty Street Economics*, 14 July.
- Nijskens, R., & Wagner, W. (2011). Credit risk transfer activities and systemic risk: How banks became less risky individually but posed greater risks to the financial system at the same time. *Journal of Banking & Finance*, 35(6), 1391–1398.
- Merton, R. C. (1995). A functional perspective of financial intermediation. *Financial Management*, 24(2), 23–41.

Plantin, G., Sapra, H., & Shin, H. S. (2008). Marking-to-market: Panacea or Pandora's box? *Journal of Accounting Research*, 46(2), 435–460.

Pozsar, Z. (2014) Shadow Banking: The Money View, *Office of Financial Research Working Paper* 14-04.

Rey, H. (2015). Dilemma not trilemma: The global financial cycle and monetary policy independence. *NBER Working Paper* 21162.

Scotti, C., & Vega, C. (2020). Measuring the liquidity profile of mutual funds. *International Journal of Central Banking*, 16(5), 143–178.

Zhou, S., & Qwabe, M. (2025). The Intersection Between Non-bank Financial Intermediation, Capital Market Development, and Bank Risk: The Case of Emerging Economies. In: *Zhou, S. (eds) Shadow Banking and Financial Risk in Emerging and Developing Markets*. Palgrave Macmillan Studies in Banking and Financial Institutions. https://doi.org/10.1007/978-3-031-86224-3_7.

Appendix A: Additional Tables and Figures

Table A.1: Banking System: Aggregate Balance Sheet Statistics

Variable	Mean	25th percentile	75th percentile
Total assets	4.93×10^{12}	2.60×10^{12}	7.02×10^{12}
Total credit	3.12×10^{11}	7.37×10^{10}	5.20×10^{11}
Total deposits	3.07×10^{11}	1.14×10^{11}	4.24×10^{11}

Note: Aggregate banking-system balance-sheet variables are reported at the system level and repeated across municipality-level observations in the source data. Descriptive statistics therefore use one system-level observation per reporting month to avoid duplication across geographic records.

Table A.2: Bank-Level Balance-Sheet Ratios: Estimation Sample

Variable	Mean	Standard deviation	25th percentile	75th percentile
Credit-to-assets ratio	0.0769	0.0697	0.0218	0.1151
Capital-to-assets ratio	0.0569	0.0935	0.0109	0.0551
Provisions-to-credit ratio	-0.1358	0.3522	-0.1020	-0.0206
Liquid-assets-to-assets ratio	0.00234	0.00573	0.00013	0.00197

Note: Descriptive statistics are reported for the bank-month estimation sample used in the bank-level analysis in Section 5.4. The sample contains 30,391 observations covering 197 banks. Credit intensity is measured as credit relative to total assets. The balance-sheet ratios are winsorised at the 1st and 99th percentiles, consistently with the bank-level regression specification. For comparability with the regressions, the reported capital-to-assets, provisions-to-credit and liquid-assets-to-assets ratios correspond to the one-month-lagged explanatory variables used in estimation.

Table A.3: Insurance Sector: Provisioning Ratio

Variable	Mean	Standard deviation	25th percentile	75th percentile
Provisions-to-assets ratio	0.0268	0.0354	0.0036	0.0473

Note: The provisions-to-assets ratio is calculated from quarterly insurance-sector supervisory data. Observations with non-positive total assets are excluded from ratio construction because they do not provide an economically meaningful denominator for balance-sheet ratios.

Table A.4: Investment Funds: Size, Growth and Investor Structure

Variable	Mean	Standard deviation	25th percentile	75th percentile
Log Assets Under Management (AUM)	18.0	2.47	16.9	19.5
AUM growth	0.012	0.85	-0.007	0.040
NAV return	-0.034	0.958	-0.007	0.005
Number of investors	9.46	—	1	5

Table A.5: Empirical Proxies Used in the Functional-Share Regressions

Driver / Control Block	Proxy used in Regressions	Sector	Economic Interpretation	Related Function(s)
Capital constraints	Capital-to-assets ratio	Banks	Broad bank capitalisation measure	Credit, savings, risk-absorption capacity
Credit leverage	Credit-to-capital ratio	Banks	Intensity of credit provision relative to capital	Credit
Credit risk pressure	Provisions-to-credit ratio	Banks	Provisioning intensity associated with credit risk pressure	Credit, risk-absorption capacity
Insurance-sector expansion	Premium growth	Insurance companies	Broad growth in insurance-sector activity	Credit, savings
Insurance solvency pressure	Provisions-to-assets ratio	Insurance companies	Insurer provisioning intensity / reserve accumulation proxy	Savings, risk-absorption capacity
Fund sector growth	Net asset value growth	Investment funds	Broad fund-sector balance-sheet growth, combining flow and valuation effects	Credit, savings, risk-absorption capacity
Crisis conditions	COVID dummy	System-wide	COVID-19 episode dummy capturing a discrete crisis-period shift	All
Domestic macro conditions	Real GDP growth (Brazil)	Macro	Broad domestic macroeconomic conditions	All
Global financial conditions	Long-term U.S. interest rate	Macro	External financing conditions	All
Persistence	Lagged functional share	Function-specific	Inertia and adjustment dynamics	Function-specific

Figure A.1: Credit function (raw vs systemic-risk-adjusted)

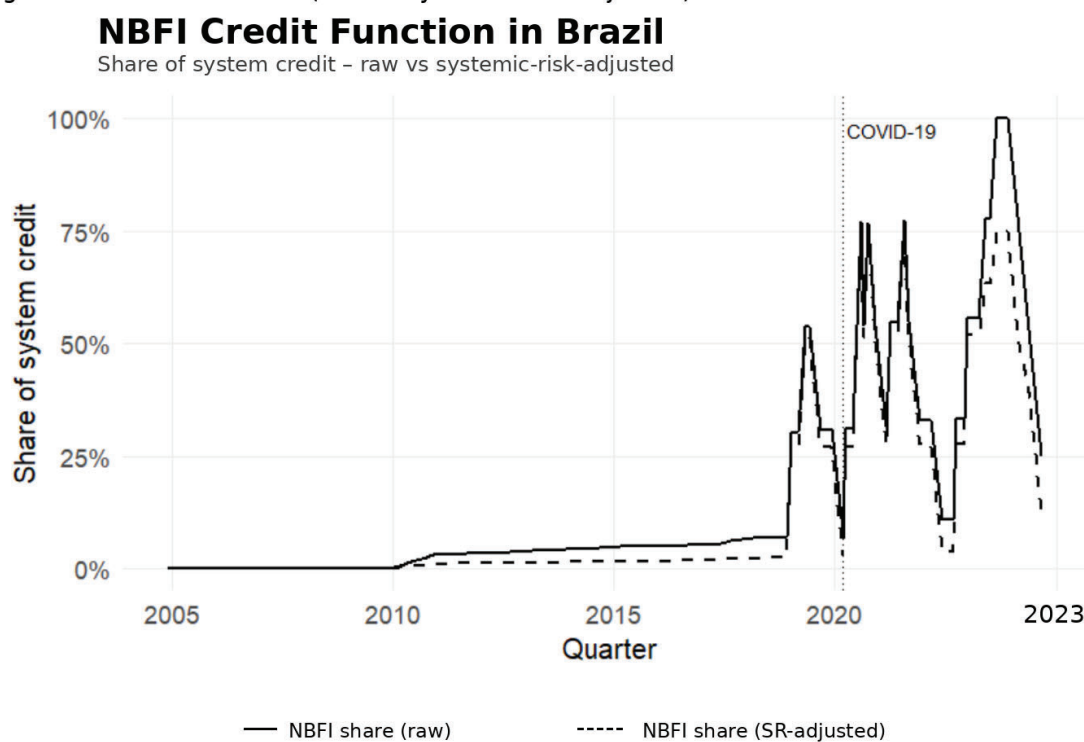


Figure A.2: Savings function (raw vs systemic-risk-adjusted)

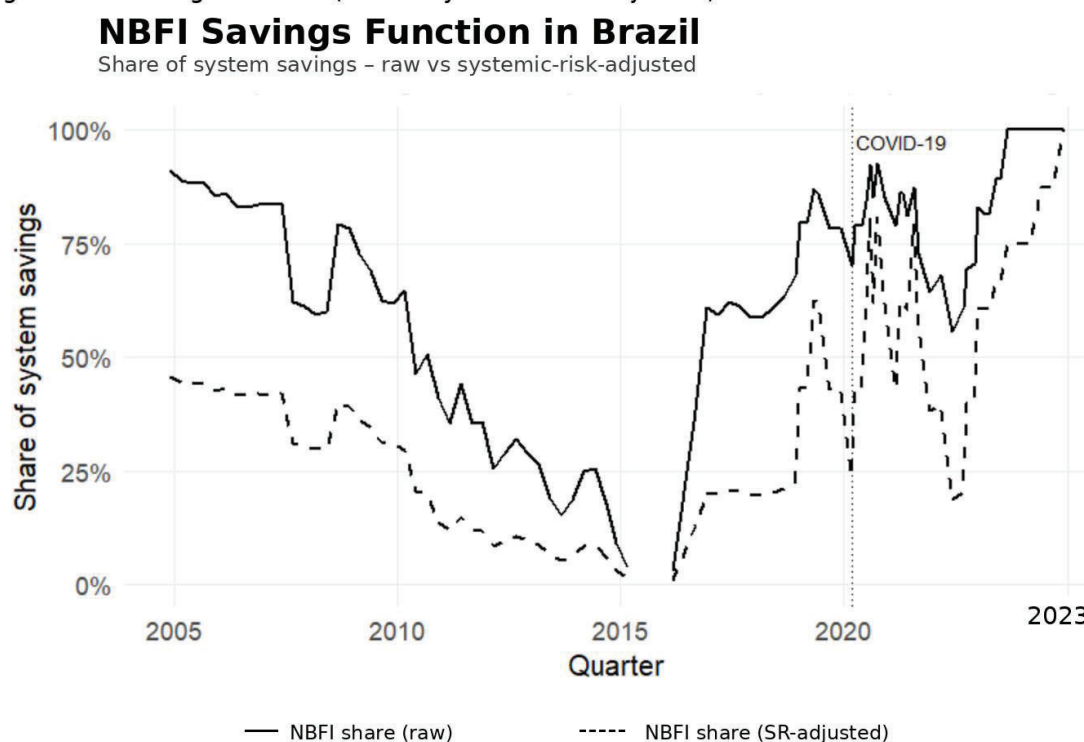


Figure A.3: Risk-absorption-capacity function (raw vs systemic-risk-adjusted)

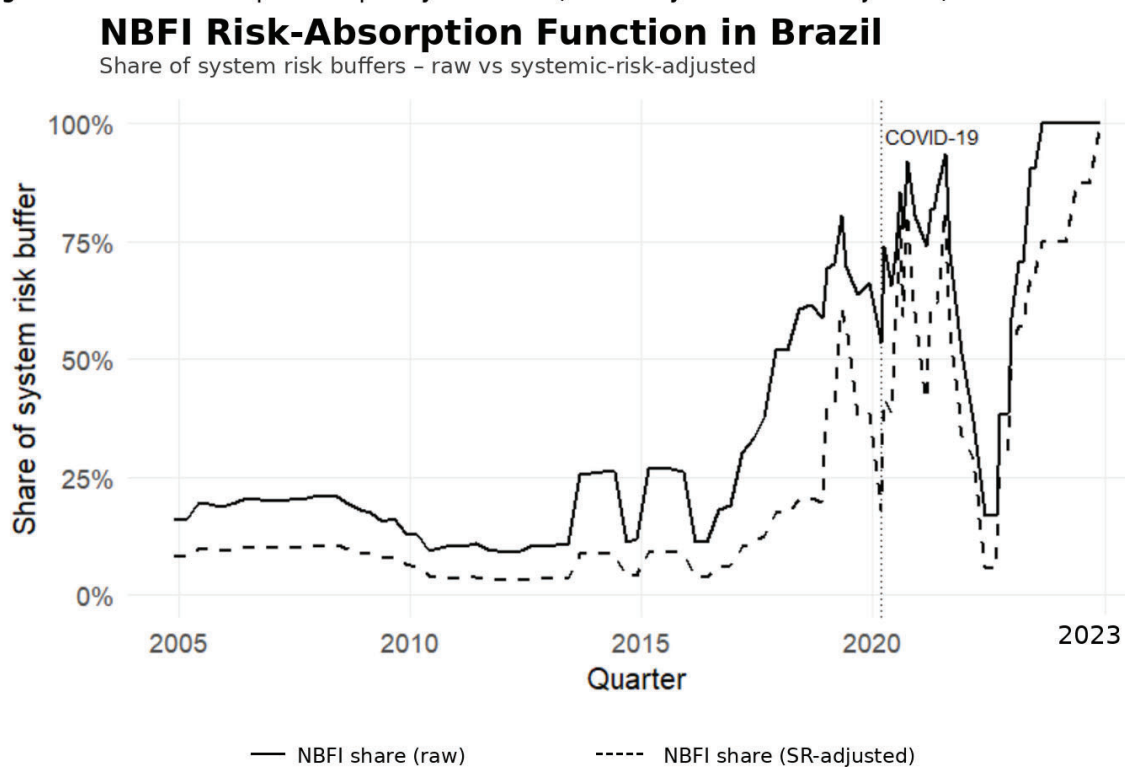


Table A.6: Correlation matrices of NBFI functional shares

Panel A: Correlations between Raw and Systemic-risk-adjusted NBFI Functional Shares (Credit, Savings, Risk-absorption Capacity)

Variable	Credit (raw)	Credit (SR-adj.)	Savings (raw)	Savings (SR-adj.)	Risk-absorption Capacity (raw)	Risk-absorption Capacity (SR-adj.)
Credit (raw)	1.000	0.973	0.258	0.400	0.565	0.566
Credit (SR-adj.)		1.000	0.266	0.455	0.552	0.605
Savings (raw)			1.000	0.829	0.418	0.440
Savings (SR-adj.)				1.000	0.600	0.742
Risk-absorption Capacity (raw)					1.000	0.923
Risk-absorption Capacity (SR-adj.)						1.000

Panel B. Correlation between NBFI functional shares and systemic risk weights

Variable	SR-Credit	SR-Savings	SR-risk-absorption Capacity
Credit (raw)	0.934	0.408	0.483
Credit (SR-adj.)	0.993	0.487	0.562
Savings (raw)	0.652	0.503	0.479
Savings (SR-adj.)	0.969	0.894	0.879
Risk-absorption Capacity (raw)	0.754	0.588	0.755
Risk-absorption capacity (SR-adj.)	0.976	0.792	0.937

Panel C. Correlation between NBFI functional shares and key banking and NBFI balance-sheet variables

Variable	Bank capital ratio	Credit-to-capital	Provisions-to-credit ratio	Insurance premium growth	Insurance provisions-to-assets ratio	Fund NAV growth
Credit (raw)	0.496	-0.567	-0.679	-0.031	-0.071	0.201
Credit (SR-adj.)	0.496	-0.567	-0.679	-0.026	-0.069	0.068
Savings (raw)	-0.226	0.187	-0.044	0.028	0.117	0.157
Savings (SR-adj.)	-0.333	0.316	0.101	0.001	0.247	0.050
Risk-absorption Capacity (raw)	0.111	-0.268	-0.393	-0.085	0.410	0.168
Risk-absorption Capacity (SR-adj.)	-0.020	-0.121	-0.277	-0.059	0.376	0.055

Note: Panel A reports pairwise correlations between raw and systemic-risk-adjusted NBFI functional shares for each function. Panel B reports correlations between NBFI functional shares and the corresponding systemic risk weights. Panel C reports correlations between NBFI functional shares and key banking and NBFI balance-sheet variables, including capital ratios, credit-to-capital ratios, provisioning ratios, and fund growth measures. All variables are defined in Appendix Table A.5. Correlations are computed using the full sample period.

Table A.7: Determinants of raw NBFIs functional shares

Variable	Credit (raw)	Savings (raw)	Risk-absorption Capacity (raw)
Intercept	−0.063* (0.034)	0.659 (0.707)	−0.232 (0.256)
Bank capital ratio	−3.773** (1.435)	−16.365 (47.834)	−0.787 (26.838)
Bank credit-to-capital ratio	8.061** (3.177)	−28.925 (61.939)	—
Bank provisions-to-credit ratio	−0.247*** (0.037)	—	−1.866*** (0.687)
Insurance premium growth	−0.000** (0.000)	0.001*** (0.000)	—
Insurance provisions-to-assets ratio	0.019 (0.016)	0.247 (0.558)	2.082 (1.752)
Fund NAV growth	−0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)
COVID-19 dummy	0.018** (0.007)	−0.010 (0.117)	−0.022 (0.141)
Relevant lagged share	−0.000 (0.007)	0.450*** (0.153)	0.108 (0.136)
Brazil GDP growth (real)	0.001 (0.000)	0.007 (0.010)	0.018*** (0.007)
US long-term interest rate	0.005 (0.004)	−0.025 (0.089)	−0.049 (0.069)
N (observations)	51	51	51
R ²	0.905	0.415	0.491
Adjusted R ²	0.881	0.287	0.394
Macro controls included	Yes (Brazil GDP, US LT rate)	Yes	Yes

Note: Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with four quarterly lags are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.8: Capital-regime regressions for savings and risk absorption

Variable	Savings (raw)	Risk-absorption Capacity (raw)
Intercept	0.437 (0.371)	0.677** (0.296)
Bank capital ratio	-23.995 (40.290)	-56.711* (28.463)
Low-capital dummy	0.054 (1.368)	-2.277** (1.000)
Insurance premium growth	0.001*** (0.000)	NA
Insurance provisions-to-assets ratio	0.212 (0.481)	1.264 (1.879)
Fund NAV growth	-0.000 (0.000)	-0.000 (0.000)
COVID-19 dummy	0.082 (0.095)	0.106 (0.097)
Relevant lagged share	0.455*** (0.163)	0.225* (0.112)
Capital × low-capital (interaction)	-23.310 (192.674)	301.174** (137.402)
N (obs)	51	51
R ²	0.417	0.391
Adj. R ²	0.306	0.292

Note: Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with four quarterly lags are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.9: Alternative Specifications of NBFI Functional Shares

Variable	Credit (Raw)	Credit (SR-adj.)	Savings (Raw)	Risk-absorption Capacity (Raw)
Constant	-0.079** (0.031)	-0.026** (0.010)	0.075 (0.376)	0.947*** (0.342)
Bank capital ratio	-2.284 (1.405)	-0.760 (0.472)	33.415 (29.573)	-36.507** (18.406)
Bank credit-to-capital ratio	9.294*** (2.722)	3.102*** (0.905)	-129.208*** (46.349)	-133.451*** (30.094)
Bank provisions-to-credit ratio	-0.259*** (0.038)	-0.087*** (0.013)	-3.904*** (0.819)	-2.489*** (0.573)
Insurance premium growth	-1.61×10^{-5} (9.91×10^{-6})	-5.41×10^{-6} (3.32×10^{-6})	4.88×10^{-4} *** (1.24×10^{-4})	-1.95×10^{-4} (2.00×10^{-4})
Insurance provisions-to-assets ratio	0.038* (0.022)	0.013* (0.007)	0.634 (0.441)	1.945 (1.431)
Fund NAV growth	-2.41×10^{-8} (2.96×10^{-8})	-6.83×10^{-9} (1.00×10^{-8})	2.65×10^{-7} (3.09×10^{-7})	-9.37×10^{-9} (7.98×10^{-7})
COVID dummy	0.011*** (0.004)	0.004*** (0.001)	0.159** (0.073)	0.106 (0.078)
Lagged dependent variable	0.000 (0.007)	-0.000 (0.002)	-0.085 (0.157)	-0.054 (0.138)
Observations	51	51	51	51
R ²	0.897	0.897	0.660	0.583
Adjusted R ²	0.878	0.878	0.595	0.503

Note: Newey-West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with four quarterly lags are reported in parentheses. The insurance provisions-to-assets ratio excludes the observation with non-positive insurance total assets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.10: Baseline Models for Raw and Systemic-Risk-Adjusted NBF1 Functional Shares

Variable	Credit (raw)	Credit (SR-adjusted)	Savings (raw)	Risk-absorption Capacity (raw)
Intercept	-0.063* (0.034)	-0.021* (0.011)	0.659 (0.707)	-0.232 (0.256)
Bank capital ratio	-3.773** (1.435)	-1.261** (0.481)	-16.365 (47.834)	-0.787 (26.838)
Bank credit-to-capital ratio	8.061** (3.177)	2.685** (1.056)	-28.925 (61.939)	—
Bank provisions-to-credit ratio	-0.247*** (0.037)	-0.083*** (0.012)	—	-1.866*** (0.687)
Insurance premium growth	-0.000** (0.000)	-6.55×10^{-6} ** (2.70×10^{-6})	0.001*** (0.000)	—
Insurance provisions-to-assets ratio	0.019 (0.016)	0.006 (0.005)	0.247 (0.558)	2.082 (1.752)
Fund NAV growth	-0.00000 (0.00000)	-0.00000 (0.00000)	0.00000 (0.00000)	-0.00000 (0.00000)
COVID-19 dummy	0.018** (0.007)	0.006** (0.002)	-0.010 (0.117)	-0.022 (0.141)
Lagged relevant share	-0.000 (0.007)	-0.000 (0.002)	0.450*** (0.153)	0.108 (0.136)
Brazil GDP growth	0.001 (0.000)	0.000 (0.000)	0.007 (0.010)	0.018*** (0.007)
U.S. long-term interest rate	0.005 (0.004)	0.002 (0.001)	-0.025 (0.089)	-0.049 (0.069)
Observations	51	51	51	51
R ²	0.905	0.905	0.415	0.491
Adjusted R ²	0.881	0.881	0.287	0.394

Note: Newey–West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with four quarterly lags are reported in parentheses. The insurance provisions-to-assets ratio excludes the observation with non-positive insurance total assets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.11: Basel III Event-Study Robustness

Specification	Exposure measure	Pre-trend test	Post-reform result	Observations	Banks
March 2013 baseline event study	2012 average equity/assets	$p = 0.703$	Joint post-event $p = 0.0006$	6,054	112
March 2013 post-reform interaction	2012 average equity/assets	—	-0.0122 $p = 0.060$	6,054	112
October 2013 implementation date	2012 average equity/assets	—	-0.0095 $p = 0.006$	5,980	110
March 2013 alternative exposure	Share of credit rated D–H	$p = 0.695$	Joint post-event $p = 0.401$	5,169	92

Notes: The dependent variable is bank credit relative to total assets. The baseline exposure measure is the negative of the standardised average equity-to-total-assets ratio in 2012, so that higher values indicate weaker pre-reform capitalisation. The March 2013 specification uses the publication of the Brazilian Basel III regulations as the baseline event date, while October 2013 corresponds to their formal entry into force. All specifications include bank and month fixed effects, with standard errors clustered at the bank level. The pre-trend tests assess the joint significance of the pre-reform event-time coefficients. The alternative exposure measure is the pre-reform share of credit in categories D–H. Under the Brazilian regulatory classification used in the data, credit grades range from AA (lowest risk) to H (highest risk). Broader C–H and narrower E–H definitions produce similarly insignificant post-reform differentials. Because the exposure measures do not capture banks' precise Basel III regulatory capital shortfalls, the results are interpreted as supporting quasi-experimental evidence rather than causal estimates of the reform.

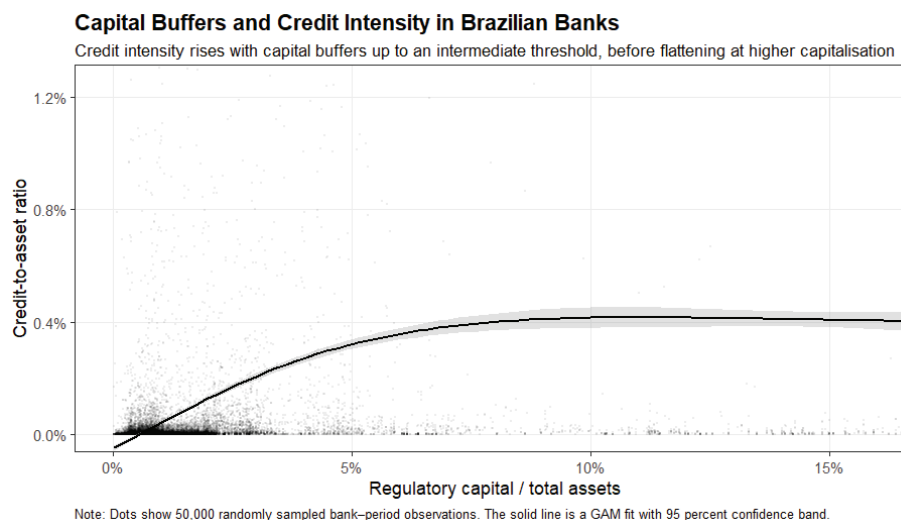
Table A.12: Bank-Level Robustness Using the Aggregate Low-Capital Cutoff

Variable	Credit / total assets
Lagged capital/assets	-0.061** (0.024)
Capital × low-capital	5.220*** (1.59)
Bank fixed effects	Yes
Month fixed effects	Yes
Low-capital cutoff	0.78%
Share of bank-month observations below cutoff	17%

Note: The dependent variable is bank credit relative to total assets. The specification applies the 0.78% capital-to-assets threshold used in the aggregate regime analysis to the bank-level sample. Explanatory variables follow the bank-level specification described in Section 4.4.3, with balance-sheet variables lagged by one month. Ratio variables are winsorised at the 1st and 99th percentiles. Bank and month fixed effects are included, and standard errors are clustered at the bank level. The table reports the coefficients central to the alternative-threshold robustness exercise. 17% of bank-month observations fall below the 0.78% cutoff. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

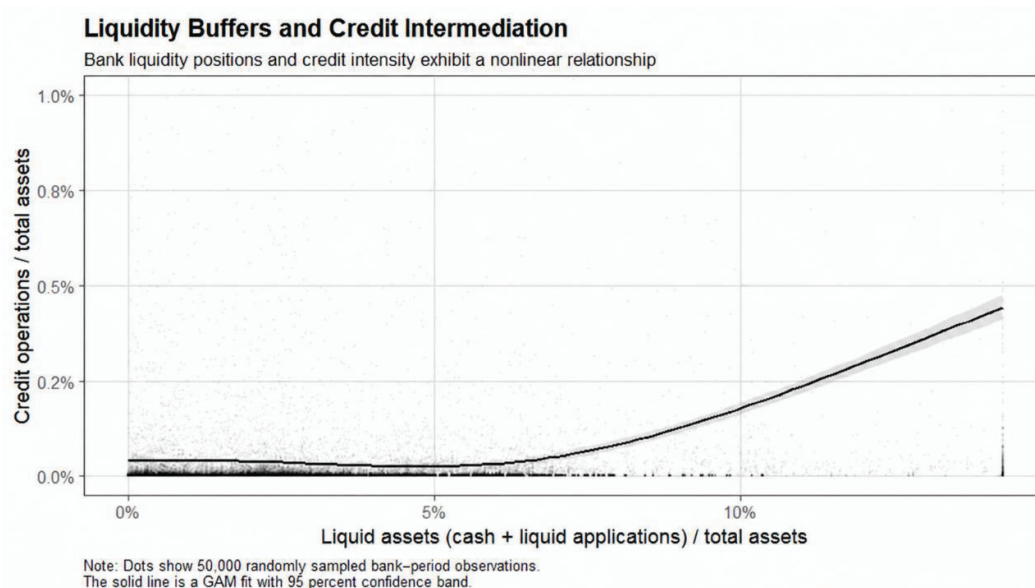
Appendix B: Banking-Sector Micro Foundations

Figure B.1: Capital buffers & credit intensity



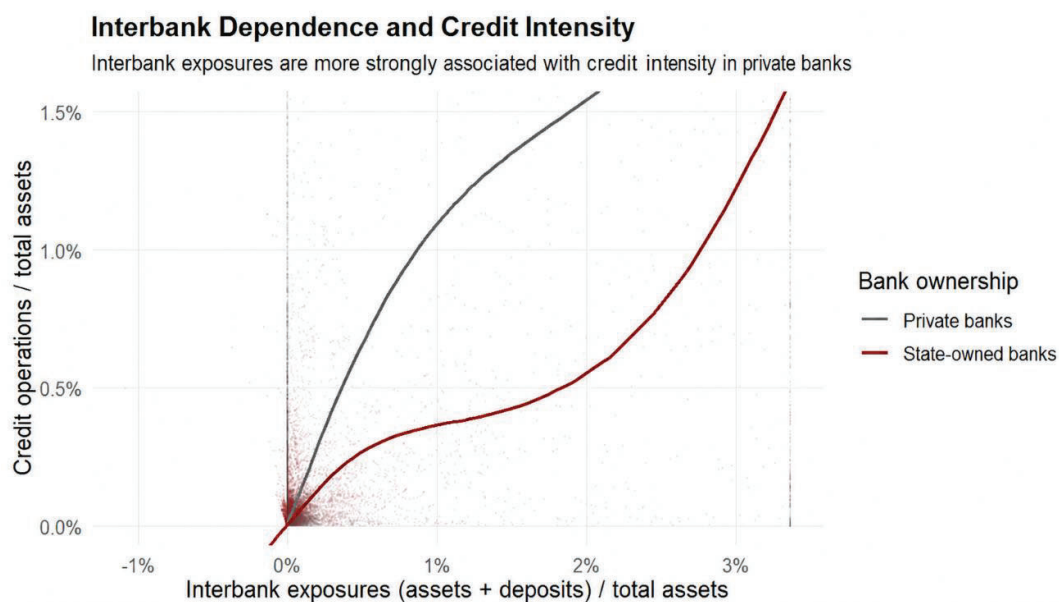
Note: This figure shows a hump-shaped relationship between bank capitalisation and credit intensity at the bank-month level. Credit intensity increases sharply with capitalisation up to an intermediate threshold, after which the relationship flattens. This nonlinearity is consistent with capital-constraint models of financial intermediation and provides descriptive motivation for the regime-dependent specifications examined in Sections 5.3 and 5.4.

Figure B.2: Liquidity Buffers & Credit Provision



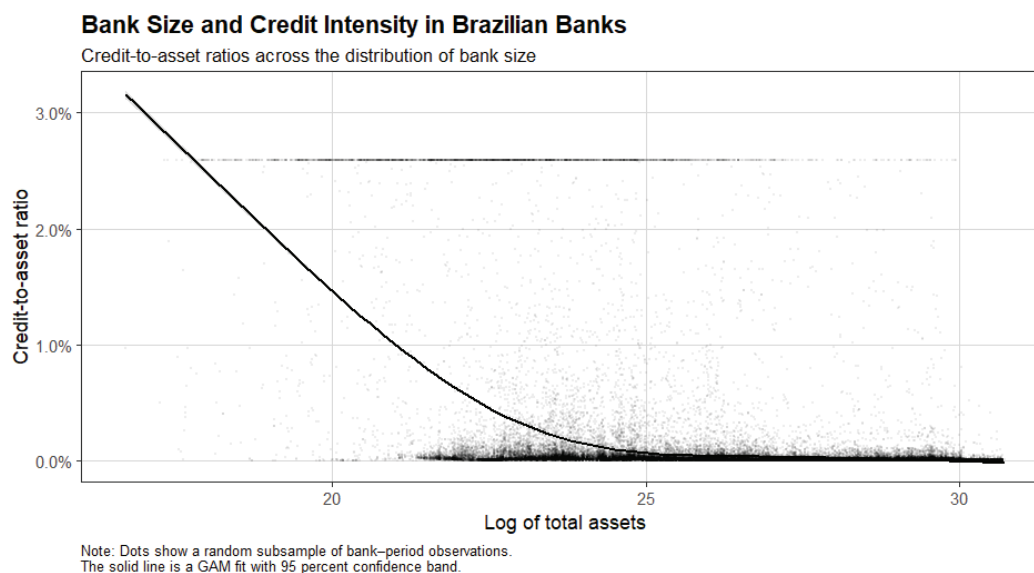
Note: The figure shows the relationship between bank liquidity positions and credit intensity at the bank-month level. The relationship is nonlinear, indicating that bank balance-sheet composition is systematically associated with the intensity of credit intermediation.

Figure B.3: Interbank Dependence (private/state)



Note: Interbank exposures are associated with credit intensity more strongly in private banks than in state-owned banks. This ownership-dependent pattern provides complementary evidence of heterogeneity in how funding structures relate to bank credit intermediation.

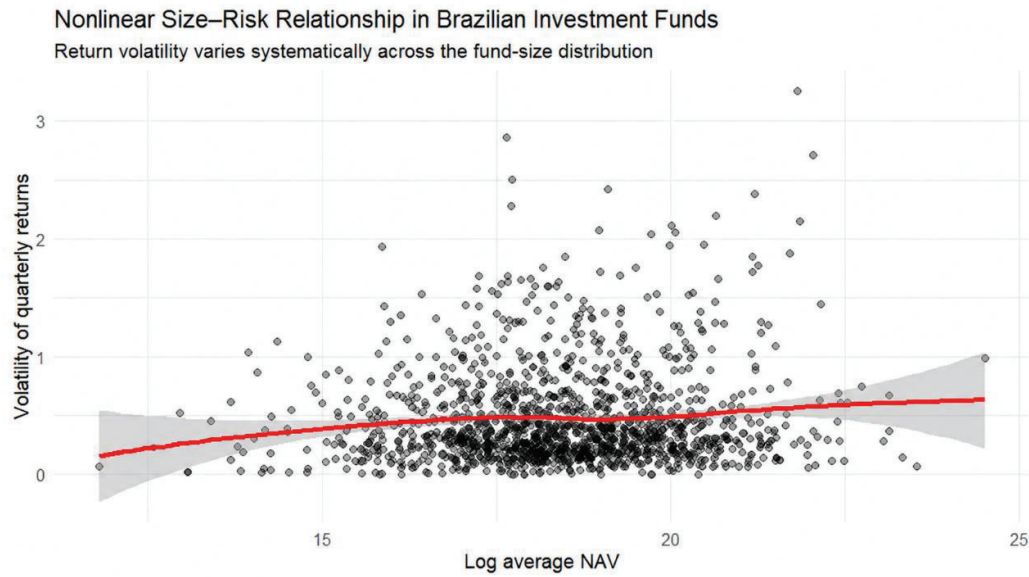
Figure B.4: Bank Size & Credit Intensity



Note: Credit intensity declines steeply with bank size, especially among very large institutions. This provides complementary evidence that the relationship between balance-sheet characteristics and credit intermediation differs across bank-size segments.

Appendix C. Investment Fund Size and Risk

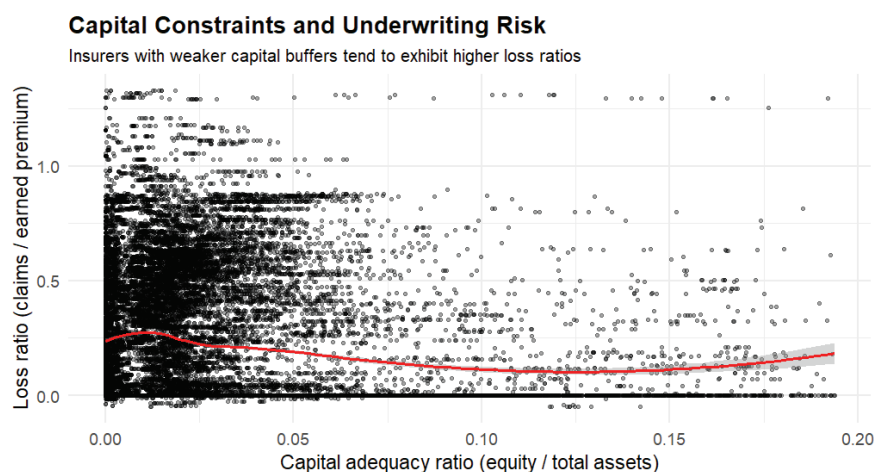
Figure C.1: Size–volatility Relationship



Note: Return volatility varies systematically with fund size, indicating meaningful heterogeneity in risk across investment-fund segments. This heterogeneity provides micro evidence for why the capacity of different fund segments to absorb reallocated credit or risk may vary during periods of bank stress.

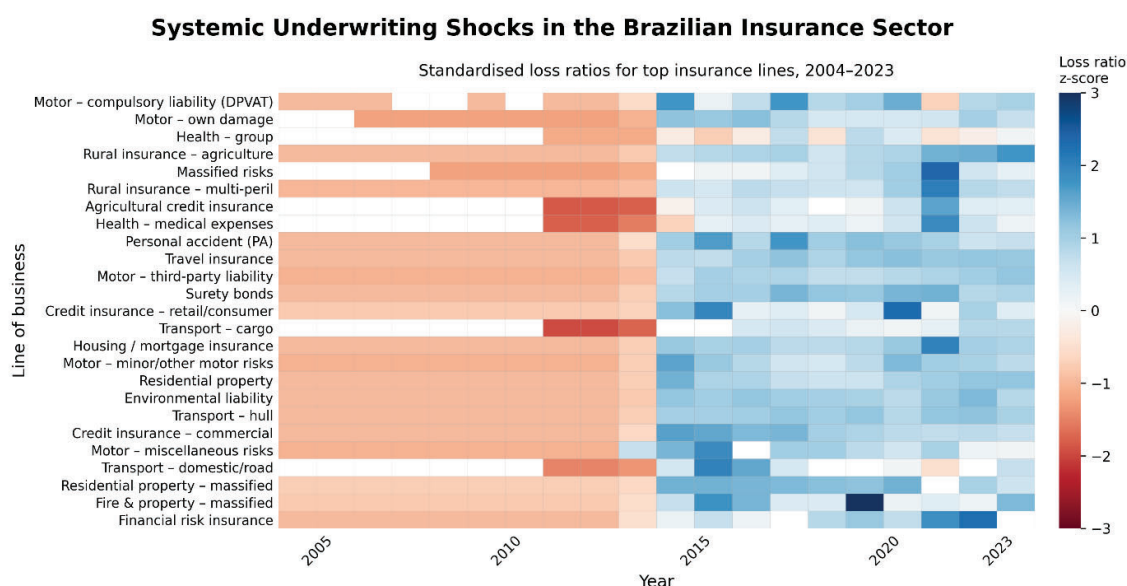
Appendix D. Insurance Sector Micro Foundations

Figure D.1: Capital constraints & underwriting losses



Note: Insurance companies with lower capital adequacy exhibit higher loss ratios, consistent with an association between underwriting shocks and tighter capital constraints. This capital-compression mechanism helps illustrate when insurance companies may have less capacity to perform risk-absorption functions.

Figure D.2: Heatmap of systemic underwriting shocks



Note: Underwriting shocks are concentrated in a small number of economically important lines (motor, health, rural, surety, credit), rather than occurring uniformly across the insurance sector. These concentrated shocks are consistent with episodes in which insurance-sector balance-sheet constraints may become more binding, potentially affecting the sector's capacity to absorb risk.

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