Credit Supply Shocks and Their Moderating Effects on Employment and Wages in Brazil

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Abstract This working paper provides a firm-level analysis of the impact of credit supply shocks on employment and wages among Brazilian firms, paying particular attention to the moderating role of financial leverage. We estimate the propagation of credit shocks between 2013 and 2022, as well as the variation of their effects across different phases of the credit cycle. Our findings suggest that the impact of a credit shock on employment is significant only in macroeconomic contexts of financial stress, and is heavily dependent on the degree of leverage of the firms in question. By contrast, wage rigidity in normal conditions, and even during recessions, differ from the flexibility observed during the pandemic, when institutional changes and simultaneous shocks encouraged wage reductions.

Keywords: credit supply shocks, employment, wages, Brazilian firms.
JEL codes: G21, G32, J23, E32, J31.

1. Introduction

The availability of credit plays a central role in firms' real decisions, influencing both investment and daily operations. Access to external capital, particularly relevant for firms with limited internal resources, ensures liquidity for day-to-day functioning and supports the expansion of productive capacity. In this context, periods of credit tightening or expansion directly affect

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investments in physical capital and labor (Fazzari et al., 1988). The literature consistently documents a positive relationship between external financing and capital formation: credit constraints discourage investment, whereas greater credit availability fosters it (Modigliani and Miller, 1958; Stiglitz and Weiss, 1981; Gomes, 2001).

A similar dynamic can be observed in the labor market. External financing is essential to cover the costs of recruiting, training, and hiring workers, as well as to ensure sufficient cash flow to pay wages before revenue is realized (Greenwald and Stiglitz, 1986; Oi, 1962). During periods of financial tightening, disruptions in credit supply can impose severe liquidity constraints, forcing firms to make rapid and sometimes drastic adjustments to their cost structures, including workforce reductions and wage cuts (Ofek, 1993; Asquith et al., 1994; Carlstrom and Fuerst, 1997). In contrast, credit expansions can stimulate growth and job creation, although their benefits are not distributed uniformly (Pagano and Pica, 2014). The heterogeneity of financial structures, particularly in terms of leverage and available liquidity, conditions firms' capacity to absorb or amplify such shocks.

As highlighted by Bernanke and Gertler (1989) in their seminal work on the balance sheet channel, the balance sheet positions of firms play a moderating role in the transmission of financial shocks. Credit contractions affect liquidity and investment capacity by reducing the value of liquid assets, thereby weakening the balance sheet. Consequently, firms that are more dependent on external financing tend to exhibit more leveraged structures and, therefore, experience more severe impacts under credit restrictions.

In this context, this paper aims to investigate how exogenous shocks to credit supply affect firms' employment and wage dynamics and whether these effects depend on firms' capital structure. More specifically, it seeks to understand whether more leveraged firms tend to respond differently to changes in credit availability, given their greater dependence on external financing and their lower capacity to absorb credit tightening shocks.

In other words, leverage acts as an amplifier of financial shocks. Given the relationship between external funding and employment, its effects directly impact the workforce. In contractionary contexts, highly leveraged firms implement deeper and less selective layoffs because they have a lower capacity to absorb temporary shocks (Bernanke and Gertler, 1995; Benmelech et al., 2021). Conversely, during expansionary periods, less leveraged firms can increase investment and hiring more rapidly, whereas highly leveraged firms often prioritize deleveraging, limiting the expansion of their activities (Kiyotaki and Moore, 1997; Almeida et al., 2004; Hanka, 1998).

These effects, however, are not limited to workforce composition. Although theoretical models support the hypothesis of wage rigidity, financial shocks can alter this dynamic. The threat of bankruptcy leads workers to accept lower wages and more flexible contracts, acknowledging that the firm's survival is at risk. Thus, credit crises not only reduce employment levels but also weaken workers' bargaining power, with direct repercussions on wage structures (Benmelech et al., 2012; Bentolila et al., 2018; Franklin et al., 2020; Popov and Rocholl, 2018).

Empirical evidence corroborates these theoretical predictions. In terms of employment, Hotchkiss (1995) and Graham et al. (2023) show that U.S. firms undergoing Chapter 11 bankruptcy tend to significantly reduce employment, largely due to greater difficulties in accessing financing. Moreover, the 2008 Great Recession, which negatively affected the global supply of credit, also had adverse impacts on employment in firms in the U.S. (Chodorow-Reich, 2014; Greenstone et al., 2020), Spain (Bentolila et al., 2018), and Germany (Popov and Rocholl, 2018). Positive shocks resulting from improvements in credit conditions have also been documented: in Italy, Berton et al. (2018) find favorable employment effects, while in Brazil, Fonseca and Van Doornik (2022) report similar results.

Regarding wages, empirical evidence indicates that periods of financial tightening tend to result in wage reductions. For example, Benmelech et al. (2012) show that financially distressed U.S. airlines were able to impose wage cuts. Similarly, Bentolila et al. (2018) document that Spanish firms reduced wages during the 2008 Great Recession. Comparable results were found by Franklin et al. (2020) for the U.K. during the same crisis.

As is evident, since the 2008 crisis, an expanding body of literature has explored the relationship between financial frictions and labor market outcomes. While many studies have shown that credit contractions reduce employment and that credit expansions can stimulate hiring, the underlying mechanisms remain only partially understood. In particular, few studies systematically examine how firm-specific financial constraints condition the magnitude and direction of labor adjustments.

This gap is especially relevant in emerging economies such as Brazil, where persistent credit frictions, a dual financial system combining directed and free credit markets, and structural labor market rigidities amplify the transmission of financial shocks. Brazil provides an ideal empirical setting to analyze these mechanisms: it features high banking concentration, heterogeneous access to credit across firms and sectors, and frequent policy-driven reallocations of credit between public and private banks. Together, these characteristics make

Brazil a compelling case for investigating how financial shocks propagate through employment and wages.

To address this gap, this paper combines three large administrative datasets from Brazil. I use matched employer–employee data from RAIS, detailed firm–bank credit information from the Central Bank of Brazil's Credit Information System (SCR), and firm-level financial data from the Alexandria database. Integrating these three sources allows the construction of a dataset linking credit supply shocks to firms' employment and wage dynamics, while accounting for the moderating role of their capital structures, over the period from 2013 to 2022.

The period from 2013 to 2022 is particularly relevant and thought-provoking. During this interval, Brazil experienced three distinct macroeconomic contexts that directly affected the supply of credit. The first, between 2013 and 2016, was marked by a severe economic recession that led to a sharp contraction in credit to firms, especially among public banks. Subsequently, the period from 2017 to 2019 was characterized by a gradual economic recovery, accompanied by a reduction in benchmark interest rates and a rebound in credit supply driven primarily by private banks. Finally, the Covid-19 pandemic triggered another recession, during which expansionary monetary policies and countercyclical measures sought to sustain financial system liquidity and mitigate the effects of the crisis.

This paper contributes to the ongoing debate by providing a firm-level analysis of the effects of credit supply shocks on employment and wages, with particular emphasis on the moderating role of financial leverage. Combining matched employer–employee data, credit registry information, and firm-level accounting records for Brazilian companies, we estimate how credit shocks propagated between 2013 and 2022 and how their effects varied across different phases of the credit cycle. The identification strategy builds on recent advances in the literature that allow for the estimation of exogenous credit shocks using panel data with high-dimensional fixed effects, capturing variation in credit supply across banks, sectors, and firms.

The core contribution of this paper is twofold. First, we test whether highly leveraged firms experience larger employment losses during periods of credit tightening and smaller gains during expansionary phases, given that their adjustment capacity is constrained by financial fragility. Second, we examine whether credit shocks shape firms' wage-setting behavior and whether this effect is amplified by the strategic use of leverage as a bargaining instrument.

In doing so, we advance the understanding of how financial shocks propagate through the labor market, identifying both the direct effects of changes

in credit supply and the channels through which capital structure moderates these effects. The Brazilian context offers a particularly rich environment for this analysis, given the coexistence of pronounced financial asymmetries, segmented labor markets, and limited institutional safeguards for workers.

Empirically, the findings of this paper reinforce and extend the existing literature by showing that the impact of credit shocks on employment is relevant only in macroeconomic contexts of financial stress and depends heavily on firms' degree of leverage. In the full panel (2013–2022), the aggregate credit shock exhibits coefficients close to zero and statistically insignificant, suggesting the absence of a uniform average effect on employment, consistent with studies indicating that credit becomes pivotal primarily during episodes of financial tightening (Bentolila et al., 2018; Berton et al., 2018; Benmelech et al., 2019). However, during the recession and fiscal consolidation period of 2013–2016, the interaction between credit shocks and leverage becomes positive and statistically significant (0.2606), indicating that more leveraged firms experienced substantially larger employment declines when facing more adverse credit shocks. This result aligns with the balance-sheet channel discussed in Bernanke and Gertler (1989), according to which financial constraints amplify firms' employment response to adverse credit conditions. In contrast, during the economic recovery (2017–2019) and throughout the pandemic (2020–2021), employment sensitivity to credit shocks ceases to manifest, with coefficients statistically indistinguishable from zero, suggesting that outside episodes of acute financial stress, the credit channel plays a limited role in shaping employment dynamics.

Regarding wages, the results reveal more moderate effects, strongly conditioned by the macroeconomic and institutional environment. Over the full sample horizon, isolated credit shocks display a negative coefficient of very small magnitude and only marginal statistical significance, suggesting that credit contractions exert only mild downward pressure on wage growth. This sensitivity remains statistically indistinguishable from zero both during the recession (2013–2016) and the recovery period (2017–2019), in line with evidence showing that in episodes of credit contraction, adjustments fall primarily on employment levels due to wage rigidity (Berton et al., 2018). In contrast, during the pandemic (2020–2021), the coefficient becomes significantly negative (–0.0139), indicating a slowdown in wage growth in response to stronger credit shocks—a dynamic enabled institutionally by Provisional Measure 936/2020, which allowed temporary reductions in working hours and compensation. The interaction with leverage is negative across all specifications, suggesting that more indebted firms adjust wages more aggressively when facing credit shocks, although the coefficients do not reach statistical

significance. In sum, the findings indicate that credit shocks affect wages in a heterogeneous manner: weak and fragile effects in conventional economic contexts, but economically meaningful wage adjustments in exceptional episodes of financial tightening, particularly when the institutional framework allows for wage reductions.

The remainder of the paper is organized as follows. Section 2 provides an overview of corporate credit market dynamics in Brazil between 2013 and 2022. Section **??** presents the theoretical framework underpinning the analysis, while Section **??** outlines the hypotheses tested in this paper. Section **??** describes the datasets used and the construction of the variables. Section **??** details the empirical strategy, including the estimation of credit shocks and the econometric specifications. Section **??** presents the empirical findings, and Section **??** concludes.

2. Corporate Credit Dynamics in Brazil (2013–2022)

Brazil represents a particularly compelling setting for analyzing the effects of credit shocks, whether procyclical, countercyclical, or externally driven, especially during the 2013–2022 period, which was marked by significant institutional and macroeconomic transformations.

Figure 1 provides an initial overview of these dynamics, illustrating the evolution of corporate credit as a share of GDP and its decomposition into earmarked and non-earmarked modalities, using data from the Central Bank of Brazil. The former comprises loans funded by public or targeted resources, predominantly extended by public banks such as the Brazilian Development Bank (BNDES), Banco do Brasil (BB), and Caixa Econômica Federal (CEF). The latter consists primarily of market-rate lending provided by private commercial banks. Complementarily, Figure 2 depicts the nominal balances (in millions of reais) of these two types of corporate credit—also based on Central Bank of Brazil data—offering a view of their absolute trajectories over time.

The period between 2013 and 2016 was marked by a sharp slowdown in Brazilian economic activity, accompanied by fiscal deterioration and a collapse in investment. During this interval, GDP experienced consecutive contractions, driven by a combination of domestic shocks—such as political turmoil and fiscal adjustment—and external shocks related to declining commodity prices and tightening global financial conditions.[1]

[1] For a detailed analysis of the domestic and external factors underlying Brazil's economic slowdown between 2013 and 2016, including fiscal deterioration, investment contraction, and the effects of declining commodity prices, see OECD Economic Surveys: Brazil 2018 OECD (2018) and Brazil: Selected Issues (IMF Staff Country Report No. 17/216) International Monetary Fund (2017).

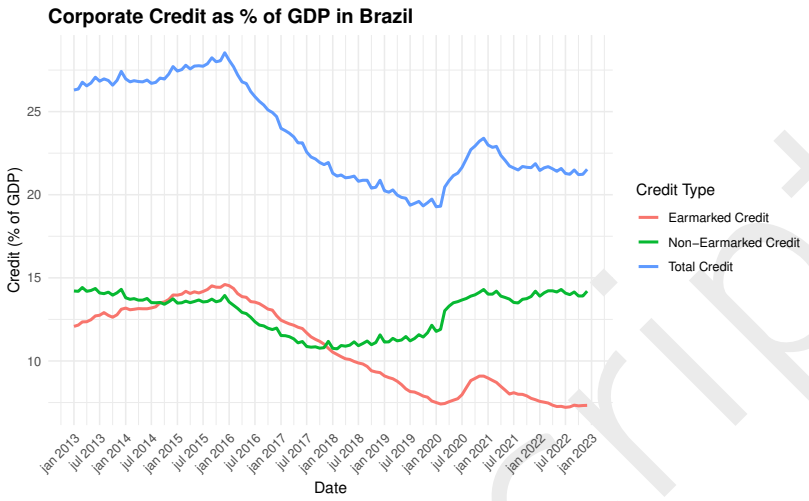

Figure 1
Evolution of corporate credit as a share of GDP, showing the total corporate credit series and its decomposition into earmarked and non-earmarked components. Earmarked credit comprises loans supported by public or targeted funds, while non-earmarked credit reflects market-rate lending by private commercial banks. Data from the Central Bank of Brazil (2025).

Despite the recession, corporate credit remained relatively high as a share of GDP, fluctuating between 26% and 28%. Earmarked credit rose from BRL 745 billion in 2014 to BRL 842 billion in 2015, reflecting the countercyclical role of BNDES and BB, but declined to BRL 834 billion in 2016 as economic activity weakened and fiscal constraints intensified. Non-earmarked credit followed a similar pattern—expanding until 2015 and contracting thereafter in response to rising corporate risk and tighter market credit conditions.

Between 2017 and 2019, the Brazilian economy entered a period of modest and gradual recovery following the deep 2014–2016 recession. GDP returned to growth, albeit slowly, while the policy rate fell to historically low levels, reflecting subdued inflation and a more accommodative monetary stance. Although the recovery remained fragile, business confidence improved gradually amid fiscal consolidation and the implementation of structural reforms aimed

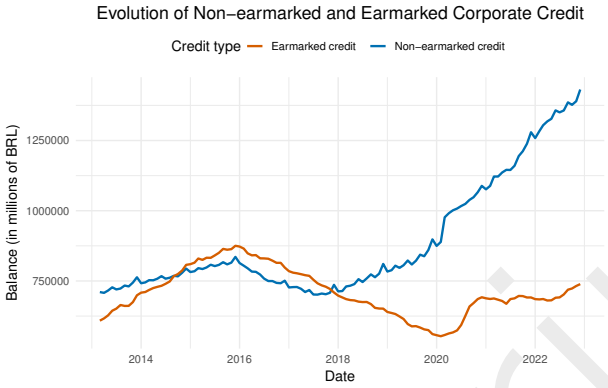

Figure 2

Nominal balances (in millions of reais) of corporate credit, showing the total credit extended to firms and its decomposition into earmarked and non-earmarked components. Earmarked credit comprises policy-based or targeted lending—primarily from public banks—while non-earmarked credit reflects market-based lending by private institutions. Data from the Central Bank of Brazil (2025).

at strengthening macroeconomic stability.[2]

In this environment, the ratio of total credit to GDP declined from 22.8% to 19.8%, reflecting both the normalization of public credit policies and ongoing fiscal adjustment. In nominal terms, earmarked credit contracted sharply—from BRL 754 billion in 2017 to BRL 601 billion in 2019—while non-earmarked credit exhibited a gradual recovery, increasing from BRL 716 billion to BRL 823 billion. This suggests a reconfiguration of the financial system, with private banks becoming increasingly central to credit provision amid lower interest rates and improving economic sentiment.

During the Covid-19 pandemic (2020–2021),[3] total credit rose again, reaching 22% of GDP in 2021. Non-earmarked credit was the main driver of this expansion, increasing from BRL 823 billion in 2019 to BRL 1.16 trillion in 2021, supported by expansionary monetary policy, emergency credit programs,

[2] For a comprehensive discussion of Brazil's economic recovery between 2017 and 2019—including GDP dynamics, historically low interest rates, and gradual fiscal and structural reforms—see Brazil: 2019 Article IV Consultation – Staff Report International Monetary Fund (2019), Staff Concluding Statement of the 2020 Article IV Mission International Monetary Fund (2020), and OECD Economic Surveys: Brazil 2020 OECD (2020).

[3] For an in-depth assessment of Brazil's macroeconomic conditions during and after the pandemic—including developments in growth, inflation, monetary policy, credit, public debt, and structural reforms—see OECD Economic Surveys: Brazil 2023 OECD (2023).

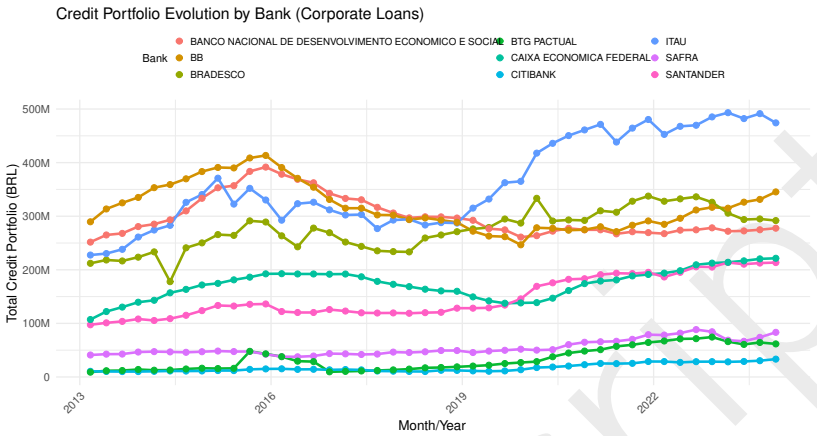

Figure 3

Evolution of corporate loan portfolios across major public and private banks, highlighting heterogeneous patterns of credit expansion and contraction over time. Data from the Central Bank of Brazil.

and strong participation from private banks. Earmarked credit remained stable at around 8% of GDP but posted a slight nominal increase, reaching BRL 687 billion.

In 2022, the withdrawal of stimulus measures and the tightening of monetary policy slowed the pace of credit expansion. Non-earmarked credit reached BRL 1.35 trillion (14% of GDP), while earmarked credit stabilized at BRL 701 billion (7% of GDP). These developments highlight the hybrid nature of the Brazilian financial system, in which public credit tends to operate countercyclically during downturns, while market-based credit responds more strongly during periods of recovery and expansion.

Taken together, these patterns illustrate how the Brazilian financial system alternates the leading role between public and private credit depending on the phase of the business cycle. Earmarked credit displays a clearer countercyclical profile during recessions, whereas non-earmarked credit reacts more intensively during recovery and expansion phases, shaping the transmission of financial shocks to the real economy.

The transformations observed during this period were also reflected in the structure of the Brazilian credit market, which is characterized by high concentration and the strong presence of large financial conglomerates. Approximately 70% of corporate credit is held by only six institutions: three public—Banco do Brasil (BB), Caixa Econômica Federal (CEF), and the

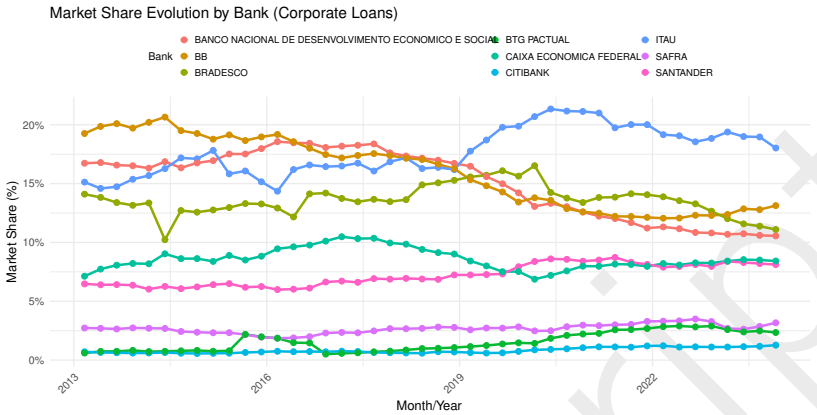

Figure 4

Market shares of public and private banks in the corporate credit market, illustrating the high degree of concentration in the Brazilian banking system and the distinct trajectories of these institutions. Data from the Central Bank of Brazil (2025).

Brazilian Development Bank (BNDES)—and three private—Itaú Unibanco, Bradesco, and Santander. This configuration underscores the central role these institutions play in financial intermediation and in the transmission of credit shocks to the real economy.

Figures 3 and 4 illustrate the evolution of these institutions' loan portfolios and market shares in the corporate segment, drawing on data from the Central Bank of Brazil. The evidence points not only to the high degree of concentration in the banking system but also to the heterogeneous trajectories of credit expansion and contraction across public and private banks in different economic cycles, reflecting their distinct institutional roles and strategic orientations.

During the economic slowdown and recession from 2013 to 2016, the corporate loan portfolios of Banco do Brasil and Caixa Econômica Federal continued to expand until mid-2015—reaching approximately BRL 400 billion and BRL 190 billion, respectively. This pattern reflects the countercyclical behavior of public banks, which expanded lending amid declining private credit supply and weakening economic activity. BNDES also maintained significant participation in corporate lending, with a portfolio of around BRL 380 billion at its peak, playing a central role in long-term financing and supporting productive investment in the early years of the crisis.

From 2015 onward, however, a widespread slowdown in credit growth

emerged—including among public banks—due to the deepening recession, falling credit demand, and the onset of fiscal adjustment policies that constrained the expansion of directed credit. In contrast, Itaú and Bradesco had already been adopting a more selective and moderate lending strategy—maintaining portfolios between BRL 330 and 370 billion—reflecting greater caution amid rising defaults and growing macroeconomic uncertainty.

In terms of market share, Banco do Brasil remained the leader until 2015 with roughly 20% of corporate credit, followed by BNDES and Itaú, both holding shares of around 17–18%. From 2015 onward, however, BNDES began to lose ground, consistent with the reduction in subsidized credit lines and the reorientation of public credit policy. By 2016, public banks experienced a modest decline in market share, partly offset by relative gains among private banks—particularly Itaú and Caixa—which increased their participation slightly.

Between 2017 and 2019, a significant shift occurred in Brazil's corporate lending landscape. Following the contractionary cycle that began in 2015, the loan portfolios of Banco do Brasil, Caixa Econômica Federal, and BNDES entered a downward trajectory, reflecting the rollback of stimulus measures and the retrenchment of directed credit programs. Banco do Brasil's portfolio fell from roughly BRL 330 billion to under BRL 280 billion, while Caixa's declined from around BRL 190 billion to just above BRL 150 billion. BNDES also experienced a pronounced contraction, consistent with the discontinuation of Treasury-funded subsidies for earmarked credit.[4]

In contrast, Itaú resumed robust growth, expanding its corporate portfolio from roughly BRL 300 billion in 2017 to more than BRL 350 billion in 2019, consolidating its position as the largest private bank in corporate lending. Bradesco and Santander also expanded gradually, reflecting the recovery of private credit amid moderate economic improvement and declining policy rates (Selic).[5]

In terms of market share, private banks consistently increased their presence—led by Itaú, whose share rose from roughly 17% to 20% of total corporate credit between 2017 and 2019. Public banks, by contrast, lost ground:

[4]The contraction in BNDES's loan portfolio after 2015 is closely associated with the phasing out of Treasury transfers (*repasses do Tesouro Nacional*) that financed subsidized credit programs during the previous decade. Beginning in 2016, these transfers were gradually discontinued as part of the fiscal consolidation agenda and the reform of Brazil's directed credit framework. See BNDES (2019) and Tesouro Nacional (2019).

[5]The decline in the Selic rate—from 14.25% in 2016 to 6.50% in 2018—was a key contributor to the recovery in private lending, as lower interest rates reduced borrowing costs and encouraged credit expansion among private banks. See Banco Central do Brasil (2019).

Banco do Brasil's share declined from about 18% to 16%, and Caixa's from 11% to around 7%. BNDES also experienced a notable reduction in relative participation, consistent with its strategic shift away from large-scale directed lending.

Between 2020 and 2021, years marked by the economic effects of the Covid-19 pandemic and the implementation of emergency monetary and credit policies, corporate loan portfolios expanded across major banks, though with varying intensities. Itaú remained the institution with the largest volume of corporate loans, increasing its portfolio from roughly BRL 420 billion to nearly BRL 480 billion, reflecting heightened firm demand for liquidity in a low-interest-rate environment.

Banco do Brasil also recorded meaningful growth, expanding its portfolio from approximately BRL 330 billion to over BRL 340 billion, while Caixa continued its upward trajectory—from around BRL 140 billion to nearly BRL 160 billion by the end of 2021. These developments underscore the countercyclical role of public banks in sustaining credit supply during the acute phase of the health crisis.

Among private banks, portfolio expansion was more moderate. Bradesco grew from roughly BRL 290 billion to BRL 340 billion, while Santander expanded from around BRL 170 billion to about BRL 190 billion. Banks focused on specialized market segments, such as BTG Pactual, also gained ground, expanding their portfolios from about BRL 40 billion to more than BRL 60 billion and strengthening their position in medium- and large-corporate lending.

From a market-share perspective, the period reveals gradual reallocation. Itaú maintained a dominant share, between 20% and 21%, while Banco do Brasil stabilized between 13% and 14%. Caixa registered modest gains (approaching 8%), aligned with its expanding portfolio. Bradesco and Santander experienced slight declines, reflecting stronger growth by selected competitors—both public and private. BTG Pactual, in particular, continued to expand, rising from roughly 2% to nearly 3%, and consolidated its relevance in the corporate credit segment.

3. Theoretical Framework

Credit exerts a central influence on the corporate landscape, directly impacting investment decisions, the scale of production, and labor management. As the predominant source of liquidity, credit facilitates the financing of ongoing operations, including wage payments, before the realization of revenues. However, when credit becomes constrained, this mechanism deteriorates, re-

sulting in intense financial pressure on firms. This, in turn, impedes their ability to retain employees and meet wage obligations. The result of these actions is frequently layoffs, renegotiation of employment contracts, and organizational restructuring. Conversely, positive credit shocks have been shown to enhance firms' capacity to hire and invest. However, the impact of these factors on employment is not uniform; it varies according to the financial health of firms, the capital structure, and strategic orientation.[6]

Despite the advancements in theoretical and empirical research on the labor market effects of credit shocks, there is a paucity of studies that offer a comprehensive analysis of their simultaneous impact on wages, bargaining power, and the asymmetries between periods of credit expansion and contraction. A significant portion of the extant literature focuses on large corporations in developed economies, thereby overlooking transmission mechanisms in contexts characterized by persistent credit frictions and rigid labor markets, such as Brazil.

In such contexts, understanding how fluctuations in credit availability influence not only employment levels but also wage structures and bargaining processes between labor and capital remains a critical and underexplored question, especially in emerging economies.[7]

This theoretical framework aims to synthesize the existing literature, both theoretical and empirical, on the effects of credit shocks, whether contractionary or expansionary, on employment and wages. The focal point of this inquiry lies in the examination of the adjustment mechanisms employed by firms to respond to financial shocks, with the objective of identifying the persistent gaps in the academic discourse.

3.1 Credit Shocks and Employment

Access to credit is fundamental to firms' operational continuity, directly influencing their investment, production, and employment allocation decisions. By enabling firms to fund expenditures before generating revenue, credit maintains liquidity and facilitates labor retention during normal business cycles (Greenwald and Stiglitz, 1986).

Credit shocks are exogenous changes in a firm's ability to secure external financing. They are typically driven by shifts in financial market conditions, contractionary monetary policy, or systemic banking crises. In economies with

[6] See Bernanke and Gertler (1989) and Holmstrom and Tirole (1997) for foundational discussions on how financial constraints influence corporate behavior and employment dynamics.

[7] See Banerjee and Duflo (2005) for discussions of credit frictions in developing countries and Pagano and Pica (2014) for evidence on the procyclical effects of finance on employment.

financial frictions and labor market imperfections, these shocks impact firms' ability to maintain employment levels, retain skilled labor, and honor existing wage contracts. Consequently, the labor adjustment process becomes more abrupt and uneven, especially for firms that are highly leveraged or dependent on credit.[8]

The primary way in which credit restrictions affect firms is by creating liquidity constraints. When credit availability suddenly decreases, companies must rebalance their budgets by prioritizing non-deferrable expenditures, such as debt servicing and essential operating expenses. In this context, employment — a substantial and recurring cost — often becomes the first area of adjustment. Firms respond by freezing new hires, renegotiating contracts, or laying off higher-cost workers. Furthermore, the interdependence between capital and labor implies that reduced investment, which is usually dependent on external financing, also depresses labor demand (Cobb and Douglas, 1928; Solow, 1956; Arrow et al., 1961). Firms facing credit constraints tend to postpone capital expenditures and shift to less capital-intensive production processes, modifying the composition of their workforce accordingly.[9]

During credit crunches, companies under financial pressure often implement cost-cutting strategies, and layoffs are usually one of the most common results. The specific approach to these adjustments—whether through layoffs, hiring freezes, or workforce restructuring—depends on the firm's financial structure, the level of leverage, and the broader institutional environment. Firms with high levels of debt are particularly vulnerable to tightening credit conditions. The urgency of refinancing their debt often leads these firms to reduce their workforce to manage liquidity risks (Bernanke and Gertler, 1995; Chava and Jarrow, 2004). Theoretical models such as those of Shumway (2001), Chava and Jarrow (2004), and Campbell et al. (2008) demonstrate that the probability of bankruptcy of a firm increases proportionally with its leverage over time.[10]

The literature identifies three main mechanisms by which credit shocks affect firms' financing and labor decisions.

First, firms rely on external financing to cover payroll since wages must be

[8] On the transmission of credit shocks through firm-level financial constraints, see Carlstrom and Fuerst (1997) and Gilchrist and Zakrajšek (2007). For labor market frictions in this context, Wasmer et al. (2002) offers a unified framework.

[9] This substitution effect is particularly relevant in developing economies, where informal or less capital-intensive labor may buffer firms during financial stress. See Loayza (2018) for a discussion on informality as an adjustment margin.

[10] For a broader overview of financial fragility and employment under stress, see Gertler and Gilchrist (1993) and Bernanke and Gertler (1989).

paid before revenue is generated (Greenwald and Stiglitz, 1986). When access to credit tightens, a firm's ability to sustain employment is immediately at risk.

Second, the fixed or quasi-fixed nature of labor costs constrains employment adjustments. Hiring, training, and integrating new employees requires significant upfront expenditures, which makes rapid changes to the workforce costly and inefficient. Consequently, companies typically adjust their workforce slowly over time, balancing the trade-off between short-term financial relief and long-term productive capacity (Oi, 1962). The view of labor as a quasi-fixed input is supported by the empirical findings of Hamermesh (1988), Farmer (1985), and Hamermesh and Pfann (1996), who demonstrate how firms manage labor strategically under financial pressure.

Third, the interdependence between labor and capital means that investment constraints also shape employment trajectories (Cobb and Douglas, 1928; Solow, 1956; Arrow et al., 1961). When firms delay or cancel capital projects due to restricted credit, they simultaneously reduce the demand for complementary labor, especially for skilled or capital-intensive occupations. Thus, credit shocks influence the scale and composition of employment, potentially affecting productivity and organizational structure in the long term.

In contrast to contractionary credit shocks, periods of credit expansion generate favorable conditions for higher labor demand, as firms scale up operations and invest in productive capacity. The development of the financial sector is closely associated with employment growth, particularly in emerging economies where access to external financing has historically been constrained (Pagano and Pica, 2014). Pagano and Pica (2014) show that credit expansion significantly contributes to job creation, especially in industries highly reliant on external funding. Empirical evidence from Fonseca and Van Doornik (2022) corroborates this view, highlighting that increased credit availability stimulates hiring, particularly in fast-growing sectors.[11]

Importantly, the effects of credit shocks are not uniform across firms or sectors. Bernanke and Gertler (1989) identify firms' balance sheets as a critical transmission channel for restrictive monetary policy, producing real effects on output and employment. Firms with higher leverage, greater reliance on external financing, and fewer assets to pledge as collateral are more vulnerable to financial tightening (Bernanke and Gertler, 1995; Holmstrom and Tirole, 1997).

As a result, firms often respond to financial stress by reducing investment and production, which has a negative impact on employment. This behavior

[11] For related evidence on the procyclical impact of finance on employment in developing economies, see Rajan and Zingales (1998) and Beck et al. (2004).

aligns with the previously discussed mechanisms. Pagano and Pica (2014) argue that industries that rely heavily on credit for their operations and expansion are especially sensitive to credit cycles. These industries experience more pronounced employment fluctuations during economic booms and recessions. During banking crises, firms that depend on external financing tend to experience significant job losses as they struggle to maintain operations. These companies often respond by cutting capital expenditures and restructuring their workforce, affecting not only the number of employees, but also the wage structure (Ofek, 1993; Asquith et al., 1994; Carlstrom and Fuerst, 1997).

The empirical literature supports these theoretical predictions, consistently documenting a negative relationship between financial fragility and employment outcomes. For instance, Hotchkiss (1995) demonstrates that U.S. firms undergoing Chapter 11 bankruptcy face persistent operational challenges, including substantial job losses both prior to and following the bankruptcy process. Similarly, Graham et al. (2023) reports that approximately 76% of employee departures—including resignations and voluntary separations—occur in firms undergoing judicial restructuring, underscoring the prolonged impact of financial fragility on firm-level employment. Moreover, Agrawal and Matsa (2013) shows that financial crises triggered by corporate defaults lead to sustained declines in employment, highlighting the lasting effects of financial fragility on labor market dynamics.

There is also robust evidence that credit shocks directly induce reductions in firm employment. Using Spanish data during the Great Recession, Bentolila et al. (2018) finds that companies linked to banks weakened by the crisis experienced job losses of approximately 2.8 percentage points. Similarly, Greenstone et al. (2020) estimates that the contraction in credit supply following the 2008 U.S. financial crisis led to a significant 0.6 percentage point decline in the employment growth rate of small- and medium-sized enterprises. In a German context, Popov and Rocholl (2018) examine exogenous financing shocks suffered by German public banks exposed to the U.S. subprime market and their effects on over 30,000 firms, finding that affected firms reduced employment by up to 2.5%.

On the other hand, while credit expansions generally enhance firms' financial flexibility, enabling them to sustain hiring and investment, the effects are heterogeneous. The model developed by Holmstrom and Tirole (1997) illustrates that firms' responses to increased credit availability critically depend on their financial health. Firms with strong balance sheets and higher net worth encounter fewer constraints in accessing external financing and are thus better positioned to capitalize on positive credit shocks. In contrast, financially fragile

firms continue to face binding constraints even in environments characterized by abundant liquidity.

In such cases, highly leveraged firms often prioritize deleveraging —reducing debt —over immediate workforce expansion. The framework proposed by Kiyotaki and Moore (1997) reinforces this view, showing that financial frictions, such as collateral constraints, can inhibit efficient allocation of resources, even during periods of abundance of credit. Consequently, vulnerable firms can allocate additional liquidity toward balance sheet repair instead of hiring or productive investment.

Consequently, vulnerable firms can allocate extra liquidity to repair their balance sheets rather than hiring or making productive investments. [12]

Complementing this perspective, Almeida et al. (2004) theoretically argue that financially constrained firms adopt precautionary strategies when exposed to positive liquidity shocks, allocating resources to build cash reserves. This behavior aims to preserve flexibility for future periods of credit scarcity; however, in the short term, it reduces both investment and hiring. Moreover, Hanka (1998) demonstrate that high leverage limits firms' operational choices, constraining their ability to expand employment even under favorable financial conditions.[13]

Therefore, pre-existing financial obligations constrain firms' capacity to expand their payroll or hire additional workers. Consequently, highly indebted firms often prioritize the reallocation of resources toward balance sheet consolidation. This behavior tends to persist even under favorable macroeconomic conditions, reflecting a cautious preference for reducing financial exposure before resuming growth and expansion strategies.

In summary, the positive effects of credit shocks on employment are contingent upon a firm's financial health. Firms with robust capital structures are more likely to increase hiring and investment when credit conditions improve. In contrast, those with higher leverage tend to use this financial reprieve to restore solvency and mitigate risk exposure. This pattern is particularly evident in the post-crisis periods, which are characterized by elevated uncertainty and decreased confidence.[14]

A mounting body of empirical research highlights the substantial real effects of positive credit shocks on labor market dynamics. Chodorow-Reich

[12] This behavior also reflects a form of endogenous risk management in financially constrained firms, as discussed in Gamba et al. (2008).

[13] See also Myers (2003) for a discussion on how capital structure rigidity can hinder firms' responsiveness to external shocks.

[14] On post-crisis deleveraging and its real effects, see Borio et al. (2020) and Kalemli-Özcan et al. (2019).

(2014) show that, during the 2008–2009 financial crisis, firms more exposed to financially healthier banks experienced employment declines approximately 4 to 5 percentage points smaller than those linked to weaker banks. These findings underscore the central role of credit access in sustaining and expanding employment, particularly among small and medium-sized enterprises (SMEs), which are often more dependent on external financing.

Consistent with this evidence, Berton et al. (2018), using data on Italian firms, document that positive credit supply shocks translate into higher employment growth within firms, reinforcing the view that relaxing credit constraints not only preserves existing jobs but also fosters net job creation. In the Brazilian context, Fonseca and Van Doornik (2022) report a notable increase in labor demand—especially in high-growth sectors—associated with improved credit conditions.

At the same time, other studies emphasize that firms frequently channel financial relief toward strengthening their balance sheets rather than accelerating hiring or investment. Demirgüç-Kunt et al. (2020) show that, in the post-crisis period, the main corporate priority was deleveraging, particularly among SMEs and unlisted firms, often at the expense of expansion. Similarly, Almeida et al. (2004), analyzing U.S. firms between 1971 and 2000, find that financially constrained firms tend to accumulate liquidity as a precaution against future financing frictions when exposed to positive cash flow shocks. This conservative behavior reinforces patterns of balance sheet adjustment, even in periods of abundant liquidity.

Smets and Villa (2016) further emphasize that the sluggish pace of economic recovery since the mid-1980s is partly attributable to firms' tendency to prioritize savings and liability reduction, rather than exploiting available credit to expand operations. This shift in corporate responses to monetary stimulus is also evident in China. As shown by Liu (2021), despite aggressive credit expansion policies, many companies opted for debt-for-equity swaps to repair their balance sheets rather than increase investment or hiring.

These findings suggest that improved financial conditions do not automatically translate into greater economic activity. Instead, the effects of credit expansions depend critically on firms' preexisting financial positions and their tolerance for risk.[15]

Despite significant advances, the existing literature on credit shocks and employment still lacks a comprehensive account of the heterogeneity in firms'

[15]This conditionality reflects a broader trend in the post-crisis era, in which corporate behavior has become increasingly shaped by concerns over long-term solvency and macrofinancial uncertainty. See also Borio (2014).

responses to financial contractions and expansions. While many studies confirm that credit constraints reduce aggregate employment and that credit easing can stimulate job creation, most analyzes overlook the role of firm-specific financial conditions, particularly leverage, in mediating these effects. Employment dynamics are often treated as direct outcomes of macrofinancial shocks, rather than as strategic decisions shaped by firms' capital structure and liquidity constraints. This omission hampers efforts to distinguish how highly indebted firms adjust compared to financially healthier counterparts across different credit environments.

These gaps underscore the need for a more refined understanding of the mechanisms linking credit conditions to employment outcomes. In particular, the literature has yet to systematically test whether highly leveraged firms disproportionately bear the effects of contractionary shocks. It also remains unclear whether these firms are forced to reduce labor costs more aggressively to meet financial obligations, or whether they are less able to benefit from expansionary periods due to a preference for deleveraging. Addressing these questions is crucial for identifying the causal channels through which credit shocks propagate within firms and for understanding the structural asymmetries that shape employment adjustments across financial cycles.

The following section develops the theoretical framework by focusing on the wage effects of credit shocks at the firm level. Specifically, it examines how financial frictions influence wage-setting behavior, with particular attention to the extent to which leverage and liquidity constraints shape compensation strategies in periods of both tight and abundant credit.

3.2 Credit Shocks and Wages

The literature shows that credit shocks can also influence wage determination and wage dynamics at the firm level, depending on the firm's capital structure and on workers' aversion to the perceived risk of job loss. This interaction lies at the core of several theoretical models, including Baldwin (1983), Dasgupta and Sengupta (1993), and Perotti and Spier (1993), and is synthesized particularly clearly by Pagano (2020).

Models that investigate the relationship between financial risk and wages assume that workers are averse to the risk of dismissal, given that losing one's job involves high costs. These costs include, for example, the time required for reemployment (Katz and Meyer, 1990), as well as financial impacts resulting from income loss, which often translate into reductions in consumption (Hsu et al., 2018; Gruber, 1994). In addition, unemployment imposes relevant psychological costs, such as increased stress, a higher incidence of anxiety,

and deterioration of well-being (Burgard et al., 2007).

In periods of greater uncertainty, these perceived risks intensify, leading workers to demand higher wages as a form of compensation. This uncertainty becomes particularly pronounced when workers are employed in firms with high levels of indebtedness because, as argued in Section 3.1, leverage increases the probability of bankruptcy and, consequently, the risk of dismissal. Thus, the interaction between financial risk and capital structure becomes central to understanding wage differentials.

Rosen (1986) provides a synthesis of the theoretical literature that formalizes this trade-off between risk and wages, and several empirical studies confirm its practical relevance. For example, Abowd and Ashenfelter (1981) show that wage differentials compensating for unemployment risk vary significantly across sectors, representing up to 14% of total compensation in high-risk contexts. Similarly, Li (1986) and Hamermesh and Wolfe (1990) estimate that between 14% and 41% of wage differences across industries can be attributed to differences in unemployment risk.[16]

The findings of Berk et al. (2010) reinforce this logic, showing that workers respond to a firm's financial fragility by demanding higher ex-ante wages, especially in firms with high leverage. These results demonstrate that capital structure influences not only investment and employment, but also wage-setting decisions.

Additional evidence is presented by Graham et al. (2023), who used matched worker–firm data in the United States to show that workers systematically demand wage premiums as compensation for the income-loss risk associated with possible employer insolvency. This ex-ante premium, interpreted as a compensating differential, rises as the firm's credit quality deteriorates, reaching up to 3% of firm value in companies rated BBB. These results provide strong empirical support for the theoretical predictions proposed by Titman (1984) and Berk et al. (2010).

In this context, workers' bargaining power is a key factor in wage negotiations. Theoretical models propose that workers weigh expected gains in favorable states against potential losses in adverse states. The higher the expected net gain—i.e., when wage increases in good states outweigh the risk of cuts or dismissals in bad states—the greater the likelihood that they adopt more assertive bargaining strategies (Baldwin, 1983; Dasgupta and Sengupta, 1993).

[16]These wage differentials are also shaped by institutional factors, such as the existence of severance protections or unemployment insurance systems, which can attenuate workers' sensitivity to firm-level financial risk. (Benmelech et al., 2012; Simintzi et al., 2015).

It is important to note, however, that the literature also emphasizes that the existence of social protection mechanisms, such as unemployment insurance or severance guarantees, tends to reduce the expected cost of job loss and, therefore, strengthen workers' bargaining power. These institutional arrangements function as safety nets, expanding the room for higher wage demands (Baldwin, 1983; Simintzi et al., 2015; Laeven et al., 2023; Karpuz et al., 2023).[17]

Within this institutional and financial environment, workers may adopt two strategic stances. A moderate strategy seeks to secure sustainable wage agreements even under adverse scenarios, reducing the risk of insolvency and mass layoffs. In contrast, an aggressive strategy seeks to maximize wages by taking advantage of favorable economic conditions, assuming that the firm will remain solvent despite higher labor costs (Pagano, 2020).

The choice between these strategies depends on the perceived trade-off between expected benefits and potential risks associated with dismissal. Workers tend to adopt more assertive positions when the anticipated benefits of pushing for higher wages outweigh the risks of triggering layoffs or restructuring. Otherwise, they may moderate their stance to preserve employment and firm viability (Pagano, 2020).

Although the literature on compensating differentials suggests that higher risk induces workers to demand higher wages, this mechanism changes substantially when the increase in risk stems from a credit shock that compromises the firm's financial health. In such situations, the deterioration of financing conditions reduces the firm's capacity to pay wage premia while increasing the risk of dismissal. This misalignment—workers' perceived risk rising while the firm's capacity to pay falls—shifts bargaining power toward the firm, favoring wage stabilization or even wage reductions. This type of mechanism follows from the interaction between risk, leverage, and financial fragility discussed by Pagano (2020) and by bargaining-under-financial-constraint models such as Perotti and Spier (1993) and Baldwin (1983).

The theoretical literature reinforces this point by modeling firms as agents who are typically risk-neutral. They seek to maximize expected profits without assigning differential weights to adverse states (Baily, 1974; Azariadis, 1975). This behavioral asymmetry—workers being risk-averse versus firms being risk-neutral—supports the strategic use of financial leverage as a disciplining instrument in wage negotiations. By increasing leverage, the firm raises the

[17] This asymmetry is especially pronounced in segmented labor markets, where informal workers face higher income volatility and weaker institutional protection, widening disparities in wage-bargaining outcomes (Ulyssea, 2018).

perceived risk of insolvency and transfers part of that risk to workers while retaining shareholders' gains in favorable states (Dasgupta and Sengupta, 1993).

In contexts of collective bargaining, especially with unionized workers, firms with sufficient financial capacity can deliberately raise leverage to weaken workers' negotiating power (Ellul and Pagano, 2019). To contain more assertive union behavior, firms strategically increase indebtedness to alter the risk–return calculation at the bargaining table. The higher probability of bankruptcy discourages aggressive wage demands, as it increases the potential losses workers could face in the event of layoffs or firm collapse. This mechanism constitutes a deliberate redistribution of financial risk: while shareholders retain returns in prosperous states, workers absorb part of the costs of insolvency in adverse states (Pagano, 2020; Bronars and Deere, 1991).

This dynamic creates an implicit risk-sharing arrangement between capital and labor. By increasing leverage, firms raise the likelihood that part of the adjustment burden will fall on the workforce during downturns—through layoffs, wage cuts, or delayed payments. This transfer occurs because, unlike debt contracts, labor contracts lack priority in bankruptcy proceedings. In practice, workers become residual claimants, absorbing losses that shareholders would have borne in an unlevered scenario.[18]

Empirical evidence from a growing body of research consistently shows that firms employ financial leverage strategically to restrain workers' bargaining power. Bronars and Deere (1991) and Hirsch (1991) provide early evidence suggesting that firms with greater union presence tend to have higher debt levels, implying that leverage may be used deliberately in response to union pressures.

As Hanka (1998) show, increases in corporate indebtedness are associated with lower wages, reduced employee benefits, and greater reliance on flexible labor arrangements. These findings suggest a broader mechanism through which firms redistribute financial risk and reduce labor costs. Similarly, Matsa (2010) provide causal evidence indicating that firms facing stronger union power respond by increasing leverage to limit workers' capture of quasi-rents.

However, this dynamic works only when the firm has sufficient financial flexibility to manipulate its leverage. As Ellul and Pagano (2019) demonstrate, the strategic use of debt as a bargaining instrument is effective only when the firm operates below its optimal leverage level, which gives it room to increase indebtedness without jeopardizing solvency—an essential condition for the

[18]This asymmetry is especially relevant in legal environments where labor claims lack protection or priority in insolvency regimes, which is common in emerging economies. See (Pagano, 2020).

implicit threat of bankruptcy to remain credible in negotiations. From the same logic, Simintzi et al. (2015) show that in institutional environments characterized by strong labor protections and high wage rigidity, firms' capacity to expand leverage is substantially constrained. In those settings, high fixed labor costs compress financial maneuvering space and increase the risks associated with issuing additional debt.[19]

During periods of financial stress and credit contraction, highly leveraged firms may find themselves in a stronger position during wage negotiations. As financial conditions deteriorate, the perceived risk of default rises, as do the expected costs of unemployment for workers. This scenario pressures unions to adopt a more cautious stance. In such moments, the threat of bankruptcy functions as a disciplining force, facilitating the renegotiation of contracts on terms more favorable to firms.

Additional empirical evidence reinforces the theoretical prediction that financial constraints weaken workers' bargaining power and depress wages. Benmelech et al. (2012), analyzing the U.S. airline industry, show that financially distressed firms managed to impose significant wage cuts and introduce greater contractual flexibility—even in sectors traditionally characterized by strong union presence. Similarly, Bentolila et al. (2018) document that during the Great Recession in Spain, firms more exposed to banks in distress experienced sharp falls in credit supply, accompanied by employment reductions—especially among temporary workers—and cuts in total payroll expenditures.

Franklin et al. (2020) find that a 10% contraction in credit supply led to an average wage reduction of between 7% and 9% among British firms during the 2008–2009 crisis. In a complementary study, Popov and Rocholl (2018) examine German firms affected by the subprime shock and show that credit contractions reduced average wages by up to 1.8%, with particularly strong effects among small and financially constrained firms. These results suggest that negative credit shocks compress employment levels and reconfigure wage structures by weakening workers' bargaining positions during times of financial stress.

Although the literature provides robust evidence that credit constraints compress wages by weakening workers' bargaining power (Franklin et al., 2020; Popov and Rocholl, 2018; Bentolila et al., 2018), important gaps remain in understanding the transmission mechanisms of these shocks at the firm level.

[19]This trade-off becomes even more relevant in countries with rigid labor regulations or generous severance mechanisms, where excessive leverage can significantly raise the probability of operational insolvency (Simintzi et al., 2015; Ellul et al., 2018).

In particular, little is known about how firms adjust wages immediately after episodes of credit scarcity.

Moreover, while studies such as Hanka (1998) and Matsa (2010) suggest that leveraged firms strategically use debt to curb wage growth, and evidence from Berk et al. (2010) and Graham et al. (2023) indicates that workers in indebted firms demand ex-ante wage premia, few works systematically examine how the degree of leverage amplifies or attenuates the impact of credit shocks on wages. This gap is especially relevant in heterogeneous institutional environments, where different levels of labor protection and contractual rigidity shape the extent to which financial constraints translate into wage adjustments (Simintzi et al., 2015; Ellul and Pagano, 2019).

4. Hypotheses

Credit shocks play a critical role in shaping firms' labor market decisions, particularly through their interaction with financial constraints such as leverage and limited access to external financing. Firms with elevated debt levels or reduced liquidity buffers tend to be more vulnerable to credit contractions and may exhibit distinct adjustment patterns in both employment and wage outcomes. While previous studies have documented some of these relationships, important gaps remain in understanding the firm-level mechanisms through which credit supply shocks propagate to labor outcomes.

Against this backdrop, the central research question guiding our study is: How do credit shocks affect firms' employment and wage decisions, and to what extent do financial constraints, especially leverage, amplify these effects?

To address this question, we formulate four hypotheses, organized into two analytical dimensions: the employment effects and the wage effects of credit shocks. These hypotheses are grounded in the theoretical framework and supported by the empirical literature reviewed in the previous sections. They aim to disentangle not only the direct effects of credit fluctuations on labor market outcomes, but also the mediating role of firm-specific financial structures.

4.1 Employment Effects

Hypothesis 1 (H1): Highly leveraged firms experience greater employment reductions during contractionary credit shocks, due to tighter financial constraints and limited internal liquidity.

The rationale is that when credit conditions deteriorate, financially fragile firms must reallocate scarce resources to service outstanding debt and ensure

operational continuity. In this context, employment—being a major, partially adjustable cost—becomes a key margin for adjustment.

Hypothesis 2 (H2): During expansionary credit periods, employment gains are more pronounced among low-leverage firms, as highly leveraged firms tend to prioritize deleveraging over workforce expansion.

Although improved credit conditions may support job creation, financially exposed firms often remain focused on balance sheet repair—especially in the aftermath of economic downturns—limiting their willingness or ability to expand hiring.

4.2 Wage Effects

Hypothesis 3 (H3): Contractionary credit shocks lead to downward adjustments in wages paid by firms.

Credit shortages constrain firms' liquidity and increase financial stress, limiting their capacity to maintain pre-shock wage levels. These pressures become particularly acute during periods of systemic financial instability, when insolvency risk is heightened and cost-cutting becomes essential.

Hypothesis 4 (H4): The wage-reducing effect of credit shocks is more severe among highly leveraged firms.

Firms with higher leverage face greater pressure to reduce payroll expenses due to their heightened insolvency risk. In addition, leverage may be strategically used to weaken workers' bargaining position—particularly in unionized settings—by raising the perceived costs of job loss in the event of firm failure.

5. Data and Variables

We draw on three main data sources for this analysis: (i) the Credit Information System (SCR), maintained by the Central Bank of Brazil; (ii) the longitudinal employer–employee records from the Annual Report on Social Information (RAIS), produced by the Brazilian Ministry of Labor and Employment; and (iii) the financial statements and other corporate information from the *Alexandria* (Docha and Rodrigues, 2023) database, also administered by the Central Bank of Brazil.

The SCR is available at a quarterly frequency since 2003 and contains stable identifiers for each credit operation, firm, and financial institution, as well as the location of the lender's headquarters. The dataset records all corporate credit operations above BRL 5,000 provided by any financial institution operating in the country. Because the information is reported directly to the Central Bank and must be consistent with banks' quarterly balance sheets, the

system exhibits a high degree of accuracy and reliability.

Given the characteristics of the Brazilian credit market, discussed in Section 2, which is marked by a high degree of banking concentration, and in order to obtain robust estimates of credit-supply shocks, we restrict the analysis to banks whose market share in the corporate credit segment exceeds 1%. This selection improves the precision with which credit-supply shocks are identified, as it excludes institutions with portfolios that are too small or volatile. Applying this criterion yields a sample of nine banks, which together account for approximately 82% of total corporate credit in the country.[20] The sample includes six private banks (Itaú, Bradesco, Santander, Citibank, Safra, and BTG Pactual) and three public banks (Banco do Brasil, Caixa Econômica Federal, and BNDES).

The second data source is RAIS, an annual census mandatory for all firms registered in Brazil's tax system. Due to the legal penalties for noncompliance, the database offers near-universal coverage of formal employment relationships. RAIS provides persistent firm and worker identifiers, enabling the construction of a longitudinal panel of employment relationships. The dataset includes variables such as monthly gross wages, contracted hours, education, occupation, race, age, gender, and other sociodemographic and occupational characteristics.

The third source is the Alexandria database, developed by researchers at the Central Bank of Brazil. It is a comprehensive dataset that integrates accounting and non-accounting information for more than 42,000 Brazilian entities, of which approximately 31,000 are non-financial firms, mostly medium-sized and often with foreign ownership. The database covers both listed and unlisted firms, offering substantially broader coverage than other firm-level datasets available in the country, especially among privately held companies. In addition to standardized financial statements (assets, liabilities, profits, and indebtedness), Alexandria includes institutional and operational information—such as ownership structure, labor-force links, banking relationships, and external debt. Data are available annually for the 2013–2023 period. Firms are classified by sector (CNAE/ISIC) and by listing status.[21]

Integrating RAIS and SCR allows us to build a firm–bank–quarter panel for the period 2013–2022, from which we obtain the credit shocks later formalized in Equation 1. The dependent variable is defined as $\Delta L_{f,b,t}$, the quarterly change in the credit balance of firm f with bank b. Identification follows the

[20] According to the Central Bank of Brazil's 2023 Banking Report (Banco Central do Brasil, 2023), the four largest banks account for roughly 58% of the total stock of credit in the country, illustrating the high concentration of the Brazilian banking system.

[21] For more information on the Alexandria database, see Docha and Rodrigues (2023).

ILST structure of fixed effects, based on firm headquarters location (state), economic sector (CNAE), firm size (RAIS), and quarter, the full methodological treatment of which is presented in the subsequent section. Because the Alexandria accounting data are available only annually, we aggregate the quarterly bank-specific shocks by weighting them according to each bank's share in the firm's annual credit portfolio, after temporal centering; Section 6.1 details the complete procedure.

After estimating the firm-level credit shocks, we construct a firm–year panel by merging RAIS and Alexandria. To assess how these shocks affect employment and wages, we draw on the annual RAIS records of employment relationships and remuneration. Our main dependent variables are: (i) the annual change in the firm's employment level, measured using symmetric growth rates, whose formal definition is provided in Equation 5; and (ii) the annual change in the log of the firm's average monthly gross wage.

Control variables are obtained from Alexandria and capture structural characteristics of firms. The main controls, widely used in the literature, include: (i) firm size, measured as the logarithm of real assets; (ii) return on assets (ROA), defined as the ratio of operating income to total assets; and (iii) firm age.

In addition, we construct a measure of financial leverage by combining information from Alexandria with SCR data. Leverage is defined as the ratio of the firm's annual bank credit balance (SCR) to its total assets (Alexandria). To mitigate the influence of outliers, this variable is winsorized at the 99th percentile.

Finally, we center the leverage on the sample mean, which facilitates the economic interpretation of the coefficients, particularly in specifications including interaction terms, without altering the underlying identifying variation of the model.

All financial variables are deflated using the Broad Consumer Price Index (IPCA), calculated by the Brazilian Institute of Geography and Statistics (IBGE), to ensure comparability over time in real terms.

To ensure comparability across sectors and avoid biases associated with specific institutional environments, we exclude all observations referring to firms whose main activity falls within certain CNAE subclasses. The exclusions include, among others, petroleum refining, metallic mineral extraction, electricity and gas supply, rail and public transportation, port and airport operations, financial institutions and insurers, public administration, and religious, political, or associative organizations. The full list appears in Appendix A. These sectors are excluded because (i) they operate under strong regulation

Table 1
Summary of Bank and Firm-Level Variables

Variable	Measure	Source
Employment (ΔEmp_{ft})	Symmetric growth rate	RAIS
Wages ($\Delta \ln(\text{Wage}_{ft})$)	Difference of the log of the average annual wage	RAIS
Credit Growth (ΔL_{fbt})	Variation in firm-bank credit balance	SCR
Financial Leverage ($\text{Lev}_{f,t-1}$)	$\frac{\text{Credit Balance}}{\text{Total Assets}}$	SCR + Alexandria
Firm Size ($\ln(\text{Assets}_{f,t-1})$)	Log of real total assets	Alexandria
Return on Assets ($\text{ROA}_{f,t-1}$)	$\frac{\text{Operating Profit}}{\text{Total Assets}}$	Alexandria
Firm Age ($\text{Age}_{f,t-1}$)	Years since firm creation	Alexandria

or pursue objectives beyond profitability, and therefore exhibit financing and hiring patterns not comparable to typical private-sector firms; and (ii) financial institutions have fundamentally different balance-sheet structures and are subject to extensive prudential regulation.[22]

After applying these criteria, the final firm–year panel used in the employment and wage analysis contains 12,718 firms and 77,855 observations, covering the period 2013–2022. Descriptive statistics for all variables used in the estimations are reported in Table 2.

Table 2
Summary statistics

Variable	# Obs.	Mean	Median	Std. Dev.	Min – Max
Symmetric employment growth	77,855	0.03	0.02	0.29	-2.00 – 1.99
Average wage (BRL, log)	77,855	6.46	6.60	2.11	-0.76 – 14.87
Firm age (years)	77,855	25.09	21.00	16.32	1.00 – 131
Real total assets (log)	77,855	18.41	18.46	2.31	-4.14 – 27.95
Bank shock	77,855	0.312	0.275	0.508	-2.418 – 2.902
Leverage (centered)	77,855	0.03	-0.073	0.16	-0.096 – 0.91
Return on assets (ROA)	77,855	-103.174	0.019	29660.823	-8273964.6 – 133157.914

Note: This table summarizes the variables used in the empirical analysis. 'Symmetric

[22] The exclusion of regulated sectors, financial institutions, state-owned enterprises, and public activities follows common practice in empirical firm-level research, as these segments operate under substantially different incentive structures, regulatory regimes, and accounting practices. State-owned enterprises, for instance, face softer budget constraints and pursue multiple objectives beyond profitability, which affects their credit, investment, and employment policies (Megginson and Netter, 2001; Shleifer, 1998). Regulated sectors such as energy, public transport, and mining face specific government interventions that limit the comparability of their economic decisions with those of industrial or service firms (Bronars and Deere, 1991). Financial institutions, in turn, have fundamentally distinct balance-sheet structures and are subject to extensive prudential regulation, compromising their comparability in studies of credit and leverage (Degryse et al., 2019).

employment growth' is measured using the Davis-Haltiwanger-Schuh transformation. 'Average wage' is calculated as the natural logarithm of the average gross monthly wage of all employees in a firm-quarter. 'ROA' is the ratio of operating profits to total assets. 'Credit growth' is the quarterly change in total bank credit reported by the firm. 'Financial leverage' is calculated as the ratio of total credit (from SCR) to total assets (from Alexandria).

6. Methodology

6.1 Credit Shock Estimation

To assess the impact of credit shocks on firms' employment levels, as well as their varied effects and the efficiency of labor, it is essential to define a model that estimates the exogenous shocks to the supply of credit from banks.

The selected model is based on the proposal of Degryse et al. (2019). In this model, the authors suggest estimating credit shocks on supply financing using a panel with industry-location-size-time (ILST) fixed effects. The main advantage of estimating exogenous credit shocks, including the ILST fixed effects, according to the authors, is that it allows the identification of time-varying cross-sectional measures of bank credit using all firms, regardless of whether they are customers of one or more banks, without the need to depend on a specific exogenous event.

This innovation addresses a significant limitation in the tracing model introduced by Khwaja and Mian (2008), which estimates credit shocks by depending solely on firm-time fixed effects. This method restricts the analysis to firms with loans from multiple banks, thus leaving out a large portion of single-bank borrowers from the estimation sample. Although this approach is prevalent in the literature — even in research examining the impact of credit shocks on employment (Chodorow-Reich, 2014) — it imposes substantial constraints that the current model aims to resolve.

Another benefit of this estimation method is the ability to calculate the magnitude of credit shocks without the need to identify a specific event, such as the 2008 financial crisis. This contrasts with many studies in the literature focusing on the real effects of shocks on credit supply. The model proposed by the authors is presented in Equation 1:

$$\Delta L_{f,b,t} = \alpha_{ILS,t} + \beta_{b,t} + \varepsilon_{f,b,t} \tag{1}$$

In this specification, $\Delta L_{f,b,t} = \frac{L_{f,b,t} - L_{f,b,t-1}}{L_{f,b,t-1}}$ denotes the annual growth rate of credit from bank b to firm f at time t. To address the influence of extreme values, the credit growth rates were winsorized at the 99% level. The term $\alpha_{ILS,t}$ captures fixed effects at the industry, location, and size levels for each time period (ILST fixed effects), while $\beta_{b,t}$ is the parameter of interest, representing the bank fixed effect associated with the credit supply shock—commonly referred to as the bank credit channel.

A key identifying assumption is that credit demand is homogeneous across firms operating in the same industry, location, and size group within a given period.

Formally, this implies that $\alpha_{1,t} = \alpha_{2,t} = \cdots = \alpha_{F,t}$ for all firms $f \in ILS$.

To estimate Equation 1, we must address the issue of multicollinearity, particularly the dummy variable trap. Since the specification includes two full sets of fixed effects and excludes a constant term, identification requires omitting at least one category from either fixed effects group. To avoid the omitted fixed effect, the estimated fixed effects of the bank $\hat{\beta}_{b,t}$ are mean-centered by their time-specific averages[23]:

$$\tilde{\beta}_{b,t} = \hat{\beta}_{b,t} - \bar{\beta}_t$$

The estimated credit supply shock $\tilde{\beta}_{b,t}$ is then aggregated at the firm level by weighting each bank's shock by its share in firm f's loan portfolio at time t. The resulting firm-level credit shock is denoted by $\bar{\tilde{\beta}}_{f,t}$:

$$\bar{\tilde{\beta}}_{f,t} = \sum_b \omega_{f,b,t} \times \tilde{\beta}_{b,t} \tag{2}$$

Where $\omega_{f,b,t}$ corresponds to the relative share of bank b in the total loan portfolio of firm f in the same period, reflecting the firm's exposure to each bank. Thus, the aggregate shock $\bar{\tilde{\beta}}_{f,t}$ is calculated by the weighted sum of these individual shocks, allowing us to capture the heterogeneity in the financing structure of firms, which is consistent with the hypothesis of homogeneous demand within groups defined by industry, location, and size, as previously established.

6.2 Validation of Credit Shock Estimates

To verify that the estimated credit shocks ($\hat{\beta}_{bt}$) indeed reflect supply-side disturbances, we examine whether shifts in banks' funding conditions help explain the estimated coefficients. This validation strategy follows Degryse et al. (2019), who argue that genuine credit-supply shocks should correlate with exogenous movements in banks' balance-sheet liquidity and funding structures.

Using supervisory balance-sheet data from the Central Bank of Brazil, we focus on five primary sources of bank funding: demand deposits, time deposits, equity, interbank liabilities, and earmarked credit liabilities. For each bank–quarter observation, we compute the growth rate of these funding components and scale them by total assets in the same period, ensuring comparability across institutions of different sizes.

To assess whether the estimated shocks have a supply-side interpretation, we estimate fixed-effects regressions of $\hat{\beta}_{bt}$ on these funding indicators, including bank and time fixed effects and clustering standard errors at the bank level. This specification exploits

[23] Therefore, the calculated shocks are in relation to a (quarterly) standard, and should thus be understood only in the context of the same time frame. This concept can be applied in panel regressions by either incorporating time dummies or by estimating the model over different time segments — the latter approach is the one utilized in this paper.

within-bank variation while controlling for aggregate shocks common to all institutions.

Given the high concentration of the Brazilian banking system (see Section 2), we also estimate weighted regressions using total assets as analytical weights. This procedure increases the influence of larger banks, those responsible for most aggregate credit supply, while helping to verify that the results are not driven by small or idiosyncratic institutions. The estimating equation is given by:

$$\hat{\beta}_{b,t} = \mathbf{X}'_{b,t}\gamma + \alpha_b + \tau_t + \varepsilon_{bt} \tag{3}$$

where α_b and τ_t denote bank and time fixed effects, respectively, and $\mathbf{X}_{b,t}$ corresponds to the vector of funding-structure variables—namely, the growth rates of demand deposits, time deposits, equity, interbank liabilities, and earmarked credit liabilities.

Table 3
OLS Estimates of Credit Supply Drivers by Subperiods

Dependent Variable: Credit Supply Shocks				
	(1) 2013–2022	(2) 2013–2016	(3) 2017–2019	(4) 2020–2022
Demand Deposits Growth	0.0129*	-0.0019	0.0372	0.3982**
	(0.0056)	(0.0040)	(0.0805)	(0.1205)
Time Deposits Growth	0.0094	0.0430**	0.0312	-0.0465
	(0.0340)	(0.0178)	(0.0406)	(0.0526)
Interbank Liabilities Growth	0.0096	0.0559	0.1050	-0.3210
	(0.0627)	(0.0327)	(0.1240)	(0.3631)
Equity Growth	-0.1450	-0.0040	-0.0948	-0.0694
	(0.0850)	(0.0859)	(0.0697)	(0.0628)
Earmarked Credit Growth	3.7010***	1.3481	1.1250	-0.9496
	(1.0064)	(0.8713)	(1.8354)	(4.9442)
Observations	351	135	108	108
R^2	0.7598	0.8191	0.8314	0.7851
Within R^2	0.0317	0.0894	0.0399	0.1787
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Cov. Estimator	Clustered	Clustered	Clustered	Clustered
Weights	None	None	None	None

Notes: The dependent variable is the estimated bank–time credit supply shock $\hat{\beta}_{bt}$. All regressors are quarterly growth rates of balance-sheet funding items scaled by bank total assets. Each specification includes bank and time fixed effects, and standard errors are clustered at the bank level. Columns correspond to different sample windows: full period (2013–2022), recession (2013–2016), post-recession (2017–2019), and pandemic period (2020–2022). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Tables 3 and 4 report the estimates using unweighted and weighted regressions, respectively. The results are shown for the full sample period (2013–2022) and

separately for the recession years (2013–2016), the post-recession recovery (2017–2019), and the Covid-19 period (2020–2022).

The results indicate that movements in banks' funding structures help explain part of the variation in the estimated credit supply shocks, although the strength and significance of these relationships vary across subperiods. Growth in demand deposits consistently shows a positive association with $\hat{\beta}_{b,t}$, particularly during the post-recession years and the Covid-19 period, suggesting that increases in low-cost, liquid funding relax banks' supply constraints.

Time deposit growth also correlates positively with credit supply during the recession (2013–2016), but its effect weakens or turns negative in later years, possibly reflecting structural changes in deposit composition and remuneration. Interbank liabilities display limited statistical significance, indicating that interbank market conditions were not a systematic driver of credit supply across periods. Equity growth generally shows a negative association with the estimated shocks, consistent with the notion that increases in bank capitalization often follow adverse conditions rather than expand lending capacity contemporaneously. Finally, earmarked credit growth exhibits large positive coefficients in several specifications, particularly in the weighted regressions, although estimates are imprecise and vary substantially across subperiods, reflecting the institutional and policy-driven nature of this funding source.

Overall, the patterns support the interpretation that $\hat{\beta}_{b,t}$ captures meaningful supply-side variation linked to banks' balance-sheet conditions, in line with the identification strategy.

6.3 Effects on Employment

After estimating firm-level credit shocks, the next step is to empirically assess the hypotheses presented in Section 4.1. To this end, we estimate a panel data model with fixed effects, a method widely employed in the empirical literature. To test hypotheses **H1** and **H2**, we estimate the following specification:

$$\Delta \text{Emp}_{f,t} = \delta_1 \bar{\bar{\beta}}_{f,t} + \delta_2 \text{Lev}_{f,t-1} + \delta_3 \left(\bar{\bar{\beta}}_{f,t} \times \text{Lev}_{f,t-1} \right) + \mathbf{X}'_{f,t-1}\gamma + \theta_{i,t} + \lambda_f + \varepsilon_{f,t} \quad (4)$$

The variables in the model are defined as follows. $\Delta \text{Emp}_{f,t}$ denotes the percentage change in firm-level employment between periods $t-1$ and t, computed as:

$$\Delta \text{Emp}_{f,t} = \frac{\text{Emp}_{f,t} - \text{Emp}_{f,t-1}}{\frac{1}{2}(\text{Emp}_{f,t} + \text{Emp}_{f,t-1})} \quad (5)$$

This symmetric growth rate measure ranges between $(-2,2)$ and is centered around zero. It is widely used in the literature because it mitigates the influence of outliers and

Table 4
WLS Estimates of Credit Supply Drivers by Subperiods

Dependent Variable: Credit Supply Shocks				
	(1) 2013–2022	(2) 2013–2016	(3) 2017–2019	(4) 2020–2022
Demand Deposits Growth	0.0236**	0.0010	0.1654*	0.5636***
	(0.0097)	(0.0020)	(0.0749)	(0.1503)
Time Deposits Growth	-0.0022	0.0422**	0.0351	-0.1228**
	(0.0427)	(0.0150)	(0.0194)	(0.0505)
Interbank Liabilities Growth	0.0628	0.0713**	0.2218	-0.3058
	(0.0533)	(0.0252)	(0.3086)	(0.5000)
Equity Growth	-0.2144*	-0.0839*	-0.0371	-0.1040
	(0.1119)	(0.0416)	(0.0551)	(0.0947)
Earmarked Credit Growth	4.2094	1.7175**	3.6570	-7.1847
	(2.8776)	(0.7272)	(2.5454)	(4.9980)
Observations	351	135	108	108
R^2	0.7951	0.8918	0.8454	0.8385
Within R^2	0.0447	0.1634	0.0701	0.2380
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Cov. Estimator	Clustered	Clustered	Clustered	Clustered
Weights	Assets	Assets	Assets	Assets

Notes: This table reports weighted least squares (WLS) regressions, using bank total assets as analytical weights. The dependent variable is the estimated bank–time credit supply shock $\hat{\beta}_{bt}$. Funding variables are quarterly growth rates scaled by bank total assets. All models include bank and time fixed effects, with standard errors clustered at the bank level. Column windows follow the same sample periods as in Table 3. *, **, and *** denote significance at the 10%, 5%, and 1% levels.

allows for consistent comparisons across firms of different sizes.[24]

The variable $\tilde{\hat{\beta}}_{f,t}$ represents the estimated credit shock for firm f in period t, derived from the decomposition of bank–firm–time effects, as discussed in the previous section. $\text{Lev}_{f,t-1}$ denotes firm leverage in the previous period, typically measured as the ratio of total bank debt to total assets. The interaction term $\tilde{\hat{\beta}}_{f,t} \times \text{Lev}_{f,t-1}$ captures how the effect of credit shocks varies with the firm's financial leverage. The matrix $\mathbf{X}_{f,t-1}$ includes lagged firm-level control variables such as firm size, profitability, and age.

The model also incorporates two sets of fixed effects: $\theta_{i,t}$ corresponds to industry–time fixed effects, which control for sector-specific shocks, while λ_f captures firm-level time-invariant characteristics. Finally, $\varepsilon_{f,t}$ denotes the idiosyncratic error term.

Furthermore, to ensure the comparability and interpretability of the estimated

[24] For further details on this measure, see Davis et al. (1996). See also, for instance, Berton et al. (2018) and Fonseca and Van Doornik (2022) for applications of this metric in employment adjustment analyses.

coefficients across distinct macroeconomic regimes that characterized the Brazilian economy between 2013 and 2022 — as discussed in Section 2 — and to maintain consistency in the interpretation of period-normalized exogenous credit shocks, as detailed in Section 6.1, the model in Equation 4 was re-estimated for subsamples corresponding to three phases of the economic cycle. The first subsample (2013–2016) captures the period of economic slowdown and recession; the second (2017–2019) reflects the recovery phase; and the third (2020–2021) encompasses the shock associated with the Covid-19 pandemic.

6.4 Effects on Wages

To test the hypotheses presented in Section 4.2, we estimate the impact of credit shocks on firm-level wages. The empirical strategy mirrors the approach adopted in the employment regressions, focusing here on the average wage paid by each firm. The dependent variable is the natural logarithm of the firm's average wage, computed as the ratio between the firm's total wage bill and the number of employees.

The baseline specification for testing hypothesis **H3** evaluates the direct effect of credit shocks on wages, while controlling for firm-specific characteristics and unobserved heterogeneity through fixed effects:

$$\Delta \ln(\text{Wage}_{f,t}) = \delta_1 \bar{\bar{\beta}}_{f,t} + \mathbf{X}'_{f,t-1}\gamma + \theta_{i,t} + \lambda_f + \varepsilon_{f,t} \tag{6}$$

In this equation, the dependent variable $\Delta \ln(\text{Wage}_{f,t})$ represents the change in the natural logarithm of the firm's average wage between periods $t-1$ and t, that is, $\ln(\text{Wage}_{f,t}) - \ln(\text{Wage}_{f,t-1})$. This transformation linearizes percentage changes and helps mitigate the influence of extreme values in the wage distribution.

The estimation model incorporates several components to isolate the effect of credit shocks on wages. The coefficient δ_1 captures the semi-elasticity of firm-level wages with respect to credit shocks, indicating the average percentage change in wages associated with a unit variation in $\bar{\bar{\beta}}_{f,t}$. The vector $\mathbf{X}_{f,t-1}$ includes lagged firm-level controls – such as firm size, profitability, and age – to mitigate concerns about reverse causality and to account for relevant observable characteristics. Industry–time fixed effects ($\theta_{i,t}$) absorb sectoral and macroeconomic shocks varying over time, while firm fixed effects (λ_f) control for unobserved time-invariant heterogeneity at the firm level. The idiosyncratic term $\varepsilon_{f,t}$ captures all other unobserved factors affecting wages.

To examine whether the wage response to credit shocks depends on firms' financial structure, in line with hypothesis **H4**, we estimate an extended specification that introduces an interaction term between credit shocks and lagged leverage:

$$\Delta \ln(\text{Wage}_{f,t}) = \delta_1 \bar{\bar{\beta}}_{f,t} + \delta_2 \text{Lev}_{f,t-1} + \delta_3 \left(\bar{\bar{\beta}}_{f,t} \times \text{Lev}_{f,t-1} \right) + \mathbf{X}'_{f,t-1}\gamma + \theta_{i,t} + \lambda_f + \varepsilon_{f,t} \tag{7}$$

In this specification, the interaction coefficient δ_3 identifies whether more leveraged firms adjust their wages more sharply in response to credit shocks. As in the previous model, all control variables are lagged to mitigate reverse causality and simultaneity biases.

Finally, following the same procedure adopted for the employment regressions, we re-estimate the wage models for different macroeconomic regimes to ensure comparability and interpretability of the estimated effects across distinct phases of the business cycle. Specifically, the model is estimated separately for the three subperiods defined in the employment analysis: 2013–2016, corresponding to the economic slowdown and recession; 2017–2019, representing the recovery phase; and 2020–2021, capturing the effects of the Covid-19 pandemic.

7. Results

7.1 Main results

In this section, we commence by examining the employment outcomes to test hypotheses **H1** and **H2**. Table 5 displays the estimates derived from equation 4 (column 1) for the entire period spanning 2013 to 2022, alongside the re-estimations for various macroeconomic conditions, which are shown in columns 2 through 4.

The coefficient of interest is the interaction term between the aggregate credit shock ($Bank\ Shock_t$) and firms' lagged financial leverage ($Bank\ Shock_t \times Leverage_{t-1}$). All specifications include firm and time fixed effects, with standard errors clustered at the firm level.

In column (1), which presents the results for the full sample, the coefficient associated with the stand-alone bank shock ($Bank\ Shock_t$) is very close to zero and statistically insignificant, suggesting that, on average, credit shocks do not exert a direct and uniform effect on firm-level employment. However, once the credit shock is interacted with financial leverage ($Leverage_{t-1}$), the coefficient becomes negative (-0.0266), indicating that more leveraged firms tend to experience slightly larger reductions in employment growth when exposed to credit shocks. Nevertheless, the effect remains statistically insignificant, pointing to relevant heterogeneity but without robust evidence of an average aggregate impact.

These findings align with existing studies that highlight the critical role of macro-financial conditions in spreading credit shocks (e.g., Bentolila et al. (2018); Berton et al. (2018); Benmelech et al. (2019)). Typically, during stable macroeconomic periods, the credit channel is less active; however, in times of financial tightening, banking shocks are often intensified through companies that rely heavily on external financing.

The empirical research on shocks to bank credit supply has yet to reach a consensus on whether these shocks influence firm outcomes exclusively during recessions or also during periods of economic growth. Some recent studies report significant impacts even during expansion periods (e.g., Amiti and Weinstein (2018); Degryse et al.

(2019)), whereas others observe tangible effects only in times of crisis (e.g., Gilchrist et al. (2018); Greenstone et al. (2020); Alfaro et al. (2021)). This ambiguity is reflected in the non-significant coefficients observed across the entire sample, suggesting that the real effects of credit shocks on employment are heavily contingent on the current macroeconomic environment.

Against this backdrop, columns (2) to (4) re-estimate the same model for distinct subperiods: 2013–2016 (recession and fiscal adjustment), 2017–2019 (recovery), and 2020–2021 (pandemic). In the recession and fiscal adjustment period (column 2), the coefficient associated with the stand-alone shock remains statistically insignificant, although its magnitude is larger than that observed in the full sample. The interaction between the credit shock and financial leverage, however, becomes positive and statistically significant (0.2606), indicating that during the recession, a one–standard deviation more negative banking shock is associated with a reduction of approximately 0.26 p.p. in employment growth among more leveraged firms. This finding suggests that, in this period, the balance-sheet channel described by Bernanke and Gertler (1989) operates more strongly, amplifying the sensitivity of employment to credit shocks via financial constraints.

Moreover, this result is fully consistent with previous evidence such as Bentolila et al. (2018), Berton et al. (2018), Benmelech et al. (2019), and Greenstone et al. (2020), which document that negative credit shocks reduce firms' employment levels. The additional contribution of this study stems from the availability of detailed financial data, which makes it possible to show that more leveraged firms are precisely those experiencing the most pronounced employment declines. This highlights that capital structure plays a central role in the transmission of credit shocks to the labor market.

In the remaining periods, both the economic recovery phase (2017–2019) and the pandemic (2020–2021), the interaction coefficient is negative, though still statistically insignificant. This pattern suggests that, in contexts of greater liquidity, macroeconomic stabilization, or strong mitigating policy measures, the sensitivity of employment to credit shocks becomes substantially weaker. In other words, outside episodes of acute financial stress, credit-supply shocks appear to play a more limited role in employment dynamics, possibly due to greater availability of alternative financing sources, improved balance-sheet conditions, or a lower marginal dependence on bank credit to sustain employment.

In sum, Table 5 shows that the impact of credit shocks on employment is not homogeneous over time, but instead varies according to the macroeconomic regime and firms' degree of leverage. These results reinforce the view that credit policy — and, more broadly, macro-financial conditions — plays a central role in the transmission of financial shocks to the labor market.

We now turn to the analysis of the effects of credit shocks on wage growth, through which we evaluate hypotheses **H3** and **H4**. Table 6 presents both the specifications without interaction (Panel A) and the models including the interaction term between the banking shock and financial leverage (Panel B). All regressions include firm and sector–time fixed effects, and standard errors are clustered at the firm level.

Table 5
Effect of Credit Shocks on Employment Growth

Dependent Variable: Employment Growth				
	(1) 2013–2022	(2) 2013–2016	(3) 2017–2019	(4) 2020–2021
Bank Shock$_t$	-0.0020	0.0268	-0.0033	0.0015
	(0.0031)	(0.0226)	(0.0097)	(0.0070)
	(0.0031)	(0.0226)	(0.0097)	(0.0070)
Bank Shock$_t$ × Leverage$_{t-1}$	-0.0266	0.2606**	-0.0738	-0.0498
	(0.0201)	(0.1265)	(0.0658)	(0.0358)
Leverage$_{t-1}$	-0.1887***	-0.2833***	-0.1643***	-0.2334***
	(0.0167)	(0.0446)	(0.0487)	(0.0546)
Log Assets$_{t-1}$	-0.0502***	-0.0619***	-0.0723***	-0.1406***
	(0.0040)	(0.0126)	(0.0124)	(0.0183)
ROA$_{t-1}$	1.00e-07***	0.0069	1.42e-07***	0.0002***
	(8.0e-09)	(0.0165)	(2.23e-08)	(3.60e-05)
Firm Age$_{t-1}$	-0.0285***	-0.0457	-0.0485***	-0.0504**
	(0.0072)	(0.0337)	(0.0173)	(0.0202)
Observations	77,855	23,790	27,208	17,933
R^2	0.3243	0.5721	0.5502	0.6752
Adjusted R^2	0.1828	0.2777	0.2535	0.2761
Firm FE	Yes	Yes	Yes	Yes
Sector-Time FE	Yes	Yes	Yes	Yes
Cov. Estimator	Clustered	Clustered	Clustered	Clustered

Notes: Clustered standard errors (firm level) in parentheses. All specifications include firm and sector-time fixed effects. Dependent variable: change in firm employment (ΔEmployment).
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

In Panel A, the coefficient for the stand-alone banking shock (*Bank Shock$_t$*) for the full sample, reported in column 1, is negative and marginally significant (–0.0061, p<0.10), but very close to zero, suggesting that, in isolation, credit shocks do not exert a consistent effect on wages. Nevertheless, there is notable heterogeneity across different macroeconomic regimes.

During the period 2013–2016 (column 2), corresponding to a more gradual economic contraction, the coefficient turns positive, though statistically insignificant, indicating the absence of a robust pattern. This result aligns with Berton et al. (2018), who argue that, in periods of negative credit shocks during recessions, firms tend to adjust primarily through employment rather than wages, given the relative rigidity of wages. In other words, faced with financial constraints, firms encounter high costs to reduce wages — whether due to contracts, collective agreements, or reputational considerations — and are more likely to adjust the workforce through layoffs or reductions in hiring. This mechanism highlights the importance of the macroeconomic context and labor market institutions in transmitting credit shocks to wage-setting decisions.

In the economic recovery period, 2017–2019 (column 3), the coefficient is again

positive but statistically insignificant, reflecting a context of relative macroeconomic normalization. This pattern suggests that, in contexts of lower financial stress and more stable growth, credit shocks alone exert limited effects on wages, indicating that firms do not face significant pressure to adjust workers' compensation.

Finally, during the pandemic, the interaction coefficient becomes significantly negative (–0.0144), indicating that even in a context of expansionary credit policy, large-magnitude credit shocks (e.g., above one standard deviation) are associated with a slowdown in average wage growth among firms. This effect suggests that firms, when facing more severe financial constraints, implemented cost-containment measures that included actual wage reductions.

This behavior is institutionally supported by the exceptional circumstances at the time: MP 936/2020 (Emergency Program for the Maintenance of Employment and Income) legally authorized proportional reductions in working hours and wages (25%, 50%, or 70%) for up to 90 days, subject to individual or collective agreements, with partial government compensation via an emergency benefit (Presidência da República – Secretaria-Geral, 2020).

The adoption of this policy indicates that, during the pandemic, many firms preferred to adjust the payroll through wage cuts rather than immediate layoffs, largely because the reductions were regulated and partially compensated by the state, increasing their feasibility. In sum, the estimated effect of negative credit shocks on wage growth during the pandemic reflects a real adjustment mechanism in an extraordinarily atypical macro-financial and institutional context, characterized by simultaneous credit, demand, and liquidity shocks, in which wage reduction emerged as a central tool for preserving liquidity and mitigating risk.

In Panel B, we introduce the interaction term ($Bank\ Shock_t \times Leverage_{t-1}$) to test hypothesis **H4**, which predicts stronger effects of credit shocks on wages in more leveraged firms. For the full sample, the interaction coefficient is negative (–0.0359), consistent with the theoretical prediction of **H4**, but statistically insignificant. This pattern persists across subsamples corresponding to different macroeconomic regimes, indicating that, although there is suggestive heterogeneity, the amplification of shocks through financial leverage does not manifest in a statistically robust way on wages — contrasting with the results observed in the employment analysis.

Nevertheless, the direction of the coefficients provides suggestive evidence that highly leveraged firms tend to adjust worker compensation more sharply in response to credit shocks, partially corroborating the idea that financial fragility intensifies the need for labor cost containment and may reduce workers' bargaining power. In other words, leverage operates as a vulnerability channel that amplifies pressure for wage containment when firms face more severe liquidity constraints, even if average effects are not statistically significant.

This finding complements the interpretation of Panel A, where isolated credit shocks had limited impact on wages, reinforcing the notion that wage adjustments are less sensitive to credit supply than employment decisions, particularly under normal

macroeconomic conditions. The evidence from Panel B thus suggests that the interaction between financial fragility (leverage) and credit shocks may be relevant for understanding heterogeneity in wage responses, even if its magnitude is insufficient to generate statistically significant effects at the firm average.

In sum, the results from Panels A and B indicate that credit shocks have heterogeneous effects on wages. While their impact is limited or statistically insignificant under normal macroeconomic conditions, negative wage adjustments emerge significantly during the pandemic, reflecting simultaneous credit, demand, and liquidity shocks, mediated by institutional instruments such as MP 936/2020. The interaction with financial leverage further suggests that more indebted firms tend to reduce wages more sharply in the face of credit constraints, although these effects are not statistically robust.

7.2 Extensions

To deepen the analysis of the effects of positive and negative shocks across different credit environments, we transform the bank-shock variable into two dummy variables. In the most restrictive period, between 2013 and 2016, the dummy D_{shock} takes the value 1 when the credit shock is below the mean ($\tilde{\bar{\beta}}_{f,t} < 0$), capturing negative shocks in a context of economic contraction and financial tightening. For the periods of normality and expansion — 2017–2019 (economic recovery) and 2020–2021 (pandemic) — the dummy D_{shock} takes the value 1 when the credit shock is above the mean ($\tilde{\bar{\beta}}_{f,t} > 0$), identifying positive shocks. This distinction is essential for addressing the study's hypotheses, as it allows examination of how the effects of credit shocks on employment and wages vary according to the macroeconomic context and liquidity conditions, isolating firms' behavioral responses under more or less severe financial constraints.

Table 7 summarizes the results for employment. In the recessionary period of 2013–2016 (column 1), negative shocks have an amplified effect on more leveraged firms: the interaction coefficient is negative and significant at the 10% level (–0.1036). This pattern reinforces hypothesis **H1**, according to which highly indebted firms reduce employment more sharply when facing a credit contraction — consistent with the idea that such firms, operating under severe financial constraints, adjust their workforce quickly to preserve liquidity.

During the economic recovery of 2017–2019 (column 2), positive shocks exhibit a marginally positive average effect, but they cease to benefit more leveraged firms: the interaction coefficient becomes negative, although statistically insignificant. This suggests that even in environments of expanding credit supply, more indebted firms do not translate these shocks into job creation, possibly prioritizing deleveraging and balance-sheet rebuilding.

In the 2020–2021 period (column 3), marked by simultaneous demand shocks, heightened uncertainty, and strong credit easing, the average effect of positive shocks is close to zero. However, for more leveraged firms, the effect becomes clearly

Table 6
Effect of Credit Shocks on Log Wage Growth

Dependent Variable: Log Wage Growth				
	(1) 2013-2022	(2) 2013–2016	(3) 2017–2019	(4) 2020–2021
Panel A: Without interaction (Bank Shock$_t$)				
Bank Shock$_t$	-0.0061*	0.0345	0.0138	-0.0139**
	(0.0035)	(0.0249)	(0.0114)	(0.0067)
Leverage$_{t-1}$	-0.1106***	-0.1043**	-0.0190	-0.1910***
	(0.0168)	(0.0404)	(0.0518)	(0.0515)
Log Assets$_{t-1}$	-0.0621***	-0.0430**	-0.0764***	-0.1908***
	(0.0048)	(0.0153)	(0.0155)	(0.0182)
ROA$_{t-1}$	1.175e-07***	0.0053	1.431e-07***	0.0003***
	(1.01e-08)	(0.0152)	(2.77e-08)	(4.55e-05)
Firm Age$_{t-1}$	-0.0535***	-0.2018***	-0.1983***	-0.0810***
	(0.0091)	(0.0377)	(0.0278)	(0.0184)
Observations	77,855	23,790	27,208	17,933
R^2	0.4179	0.5738	0.6153	0.6860
Adj. R^2	0.2960	0.2807	0.3617	0.3002
Firm FE	Yes	Yes	Yes	Yes
Sector-Time FE	Yes	Yes	Yes	Yes
Covariance Estimator	Clustered	Clustered	Clustered	Clustered
Panel B: With interaction (Bank Shock$_t$ × Leverage$_{t-1}$)				
Bank Shock$_t$	-0.0061*	0.0337	0.0125	-0.0144**
	(0.0035)	(0.0247)	(0.0115)	(0.0067)
Bank Shock$_t$ × Leverage$_{t-1}$	-0.0359	0.0616	-0.1126	-0.0461
	(0.0212)	(0.1659)	(0.0828)	(0.0372)
Leverage$_{t-1}$	-0.0990***	-0.1149**	0.0156	-0.1667**
	(0.0183)	(0.0466)	(0.0591)	(0.0539)
Log Assets$_{t-1}$	-0.0623***	-0.0429**	-0.0766***	-0.1912***
	(0.0048)	(0.0153)	(0.0155)	(0.0181)
ROA$_{t-1}$	1.176e-07***	0.0052	1.42e-07***	0.0003***
	(1.011e-08)	(0.0152)	(2.76e-08)	(4.6e-05)
Firm Age$_{t-1}$	-0.0533***	-0.2017***	-0.1983***	-0.0812***
	(0.0092)	(0.0377)	(0.0278)	(0.0184)
Observations	77,855	23,790	27,208	17,933
R^2	0.4179	0.5738	0.6154	0.6861
Adj. R^2	0.2960	0.2806	0.3617	0.3003
Firm FE	Yes	Yes	Yes	Yes
Sector-Time FE	Yes	Yes	Yes	Yes
Covariance Estimator	Clustered	Clustered	Clustered	Clustered

Notes: Clustered standard errors (firm level) in parentheses. All specifications include firm and sector-time fixed effects. Dependent variable: change in log wages (Δlog Wage). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

negative and significant (–0.0845; p<0.05), corroborating hypothesis **H2**. This result suggests that even under exceptional conditions of abundant liquidity and strong credit stimulus, financially fragile firms continue to adjust employment in order to mitigate risks and restore financial capacity.

Taken together, the findings show that (i) negative shocks during tightening periods are far more destructive for highly leveraged firms (**H1**), and (ii) positive shocks during periods of normality and expansion primarily benefit firms with lower financial exposure, while highly leveraged firms remain constrained, which confirms **H2**.

Table 7
Effects of Negative and Positive Credit Shocks on Employment Growth

Dependent Variable: Employment Growth			
	Negative Shocks (Bank Shock$_t$ < 0)	**Positive Shocks** (Bank Shock$_t$ > 0)	
	(1) 2013–2016	(2) 2017–2019	(3) 2020–2021
D_{shock}	-0.0013	0.0011	-0.0005
	(0.0094)	(0.0091)	(0.0073)
$D_{\text{shock}} \times \text{Leverage}_{t-1}$	-0.1036*	-0.0656	-0.0845**
	(0.0555)	(0.0553)	(0.0429)
Leverage_{t-1}	-0.2270***	-0.1991***	-0.2784***
	(0.0399)	(0.0477)	(0.0535)
Log Assets_{t-1}	-0.0624***	-0.0721***	-0.1403***
	(0.0126)	(0.0124)	(0.0183)
ROA_{t-1}	0.0069	1.419e-07***	0.0002***
	(0.0165)	(2.23e-08)	(3.63e-05)
Firm Age_{t-1}	-0.0461	-0.0484***	-0.0503**
	(0.0338)	(0.0173)	(0.0201)
Observations	23,790	27,208	17,933
R^2	0.5720	0.5502	0.6753
Adjusted R^2	0.2775	0.2535	0.2762
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Cov. Estimator	Clustered	Clustered	Clustered

Notes: Clustered standard errors (firm level) in parentheses. All specifications include firm and time fixed effects. Dependent variable: change in firm employment (ΔEmployment). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 8 documents how negative and positive credit shocks affect firms' average wage growth across different macroeconomic contexts. Overall, the results are consistent with hypotheses **H3** and **H4**: shocks that deteriorate firms' financial conditions tend to compress wages, and this effect is more pronounced among highly leveraged firms.

However, the magnitude and significance of these effects vary substantially depending on the credit cycle and, especially, the institutional environment during the pandemic.

In the contractionary period of 2013–2016 (column 1), negative shocks do not have a statistically significant effect on wages, although the signs are consistent with **H3**. This pattern suggests that in recessionary phases without direct labor-market interventions, firms adjust costs primarily through employment — as shown in the previous estimates — rather than through wage reductions, which tend to be institutionally rigid in Brazil.

This dynamic changes in later periods. During the recovery phase of 2017–2019 (column 2), positive credit shocks also do not translate into robust wage increases. The absence of a significant effect reflects an environment of economic normalization in which credit ceases to be a central constraint for compensation policies, and wage gains become more strongly determined by structural factors such as productivity and labor-market conditions. The interaction coefficient with leverage remains insignificant, indicating that even when credit expands, more indebted firms do not convert this financial relief into wage adjustments, possibly prioritizing balance-sheet rebuilding.

The pandemic period (2020–2021), in turn, reveals a distinctly different and highly informative pattern. Positive credit shocks have a negative and statistically significant impact on average wage growth (–0.0168 in Panel A; –0.0180 in Panel B). This result aligns directly with hypothesis **H3** and reflects the exceptional nature of the period: despite strong monetary easing and expanded directed lending, firms faced acute uncertainty, abrupt revenue declines, and an urgent need to preserve cash. Moreover, public policies — particularly MP 936 — legalized and institutionalized temporary wage reductions, creating a direct channel for firms to adjust costs through wage compression instead of layoffs.

Among highly leveraged firms, although the interaction is not statistically significant, the negative sign and magnitude reinforce the logic underlying hypothesis **H4**: financial fragility amplifies the need for wage containment, especially when operational survival depends on maintaining liquidity and managing insolvency risk. Indeed, the stand-alone leverage coefficient is substantially negative during the period (–0.2088), indicating that vulnerable firms reduced wages regardless of the marginal variation in the credit shock.

In summary, the results point to a strong asymmetry: (i) in normal or recovery periods, credit shocks exert limited influence on wages; (ii) in periods of systemic crisis — especially when legal mechanisms allow for wage flexibility — credit shocks, even when positive, may coexist with wage reductions; (iii) leverage intensifies wage compression, particularly when macroeconomic conditions make cash preservation central to survival.

Taken together, this evidence confirms **H3** and provides qualitative and quantitative support for **H4**, showing that the effects of credit shocks on wages depend critically on the macroeconomic regime, the prevailing institutional framework, and firms' financial positions.

Table 8
Effects of Negative and Positive Credit Shocks on Log Wage Growth

Dependent Variable: Log Wage Growth			
	Negative Shocks (Bank Shock$_t < 0$)	**Positive Shocks** (Bank Shock$_t > 0$)	
	(1) 2013–2016	(2) 2017–2019	(3) 2020–2021
Panel A: Without interaction (D_{shock})			
D_{shock}	-0.0088	0.0044	-0.0168**
	(0.0114)	(0.0114)	(0.0071)
Leverage$_{t-1}$	-0.1050***	0.0191	-0.1930***
	(0.0404)	(0.0518)	(0.0514)
Log Assets$_{t-1}$	-0.0433***	-0.0767***	-0.1907***
	(0.0153)	(0.0155)	(0.0182)
ROA$_{t-1}$	0.0051	1.437e-07***	0.0003***
	(0.0152)	(2.77e-08)	(4.54e-05)
Firm Age$_{t-1}$	-0.2025***	-0.1984***	-0.0809***
	(0.0377)	(0.0278)	(0.0184)
Observations	23,790	27,208	17,933
R^2	0.5738	0.6153	0.6861
Adjusted R^2	0.2806	0.3616	0.3003
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Cov. Estimator	Clustered	Clustered	Clustered
Panel B: With interaction ($D_{shock} \times$ Leverage$_{t-1}$)			
D_{shock}	-0.0058	0.0053	-0.0180**
	(0.0111)	(0.0115)	(0.0075)
$D_{shock} \times Leverage_{t-1}$	-0.1172	-0.0346	-0.0709
	(0.0789)	(0.0697)	(0.0739)
Leverage$_{t-1}$	-0.0917**	0.0255	-0.2088***
	(0.0419)	(0.0531)	(0.0554)
Log Assets$_{t-1}$	-0.0430**	-0.0767***	-0.1910***
	(0.0153)	(0.0155)	(0.0182)
ROA$_{t-1}$	0.0052	1.434e-07***	0.0003***
	(0.0152)	(2.76e-08)	(4.52e-05)
Firm Age$_{t-1}$	-0.2018***	-0.1984***	-0.0810***
	(0.0377)	(0.0278)	(0.0184)
Observations	23,790	27,208	17,933
R^2	0.5739	0.6153	0.6862
Adjusted R^2	0.2807	0.3616	0.3005
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Cov. Estimator	Clustered	Clustered	Clustered

Notes: Clustered standard errors at the firm level in parentheses. All specifications include firm and time fixed effects. Dependent variable: change in log wages (Δlog Wage). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

8. Conclusions

In this paper, we looked at what influences credit supply shocks and their real effects on employment and wages among Brazilian firms, considering different macroeconomic situations. Our empirical approach first involved identifying credit supply shocks at the bank level. We then connected these measures with firms' financial leverage to capture how differently each firm responds to these shocks.

While the approach does not rely on the specific nature of the shocks faced by banks during our analysis period, the measure of credit supply shock derived from bank fixed effects shows a strong link with changes in banks' funding conditions. This connection strengthens the interpretation of the estimated coefficients and makes our conclusions regarding credit shocks and labor market outcomes more reliable.

We found significant economic effects on employment, especially during the recession period. Specifically, the results indicate that the impact of credit shocks on employment is not consistent over time. Instead, it heavily relies on the current macroeconomic conditions and firms' financial leverage. Throughout the entire sample from 2013 to 2022, credit shocks have small and statistically insignificant average effects. This suggests that, in stable macroeconomic situations or when financial conditions are more favorable, the credit channel has only a weak influence on employment levels.

When we break down the analysis by time periods, we see that the recession from 2013 to 2016 stands out as a time when credit shocks had a strong effect on labor markets. During this period, the interaction between credit shocks and firms' leverage was positive and statistically significant. This means that firms with high leverage faced much larger drops in employment growth when they experienced negative credit shocks. This pattern supports the idea that weakened financial conditions can amplify the real impact of banking shocks, particularly in economic downturns.

In contrast, during the recovery (2017–2019) and the pandemic years (2020–2021), the interaction between credit shocks and leverage turned negative but remained statistically insignificant. This suggests that during times of greater liquidity, macroeconomic stability, or strong public policies, the effect of credit shocks on employment weakened significantly. In these situations, other funding sources, balance sheet adjustments, and easier credit conditions seem to cushion the negative impacts of the banking system on hiring.

Overall, our results show that the effect of credit supply shocks on employment varies widely based on firms' financial structures and the macroeconomic context. In stress periods, firms with high leverage are more exposed and show sharper declines in employment. In more stable times, the credit channel loses its strength. This variation highlights the need to understand how macro-financial conditions and capital structure influence how banking shocks reach the labor market. This understanding has clear implications for designing policies to lessen the real effects of credit crises.

For wages, the results show a different pattern from employment changes, indicating that the ways firms respond to credit shocks vary dramatically based on the macroeconomic and institutional context. Overall, the effects of credit shocks on wage

growth are limited and, for most of the analyzed period, statistically weak. This is in contrast to the strong response in employment during financial stress, suggesting that wages generally adjust less to credit conditions, except during specific periods of acute crisis.

From 2013 to 2022, credit shocks have a small but slightly significant effect on wage growth. The lack of a strong effect indicates that under stable macroeconomic conditions, firms do not typically change worker compensation due to credit constraints. This pattern aligns with the literature on wage rigidity, which arises from contracts, collective bargaining, or concerns about reputation. These factors limit short-term wage flexibility.

When we look at wage responses to credit shocks by macroeconomic conditions, we see that they depend on the current economic and institutional landscape. During the recession from 2013 to 2016, while the coefficients became positive, they remained insignificant. This suggests that during economic downturns, firms chose to reduce their workforce—either by laying off employees or hiring less—rather than cutting wages. Therefore, our findings support the idea that in times of recession with no significant institutional changes, wages tend to be a relatively rigid factor, while employment absorbs most of the effects of credit shocks.

The recovery period from 2017 to 2019 follows this logic. Despite positive changes in the coefficients, there is no statistical evidence that credit constraints significantly affected wage trends. The stabilization of the macro economy and lower intensity of financial shocks seem to decrease firms' motivation to adjust wages, showing wage stability in times of greater liquidity.

In contrast, the COVID-19 pandemic brought a clear shift in this pattern. The results show that more severe credit shocks led to significant and statistically robust drops in wage growth. This aligns with the unique institutional circumstances of the pandemic, especially following the implementation of MP 936/2020, which allowed for proportional reductions in working hours and wages through individual or collective agreements, with partial government compensation. The combination of simultaneous shocks—credit, demand, and liquidity—along with a legal framework that enabled wage adjustments made it necessary and possible for firms to cut wages as a key measure for maintaining liquidity and reducing costs.

Further analysis using the relationship between credit shocks and financial leverage supports this interpretation. Although the coefficients are consistently negative over the entire period and across different macroeconomic conditions, their statistical insignificance shows that the impact of credit shocks through financial weakness does not usually result in strong wage effects. Still, the results imply that firms with more leverage tend to adjust wages more significantly when facing credit constraints. This suggests that financial vulnerability may be a channel of weakness for wage negotiations, even if this variation is not statistically significant.

In summary, our findings reveal that wages respond less strongly to credit shocks than employment, except during unique macroeconomic situations that significantly change

the means of adjustment available to firms. Wage rigidity during normal conditions and even in recessions contrasts with the flexibility seen during the pandemic when institutional changes and simultaneous shocks encouraged wage reductions. These findings indicate that how credit shocks affect wages depends significantly on the interplay between the macroeconomic environment, institutional structure, and firms' financial vulnerability. This highlights that while the credit channel is a key factor in employment decisions, its effect on wages is more conditional and less consistent over time.

Overall, this paper shows that the impact of credit shocks on the labor market heavily depends on the macroeconomic environment, the institutional framework, and firms' financial conditions. While employment reacts quickly and strongly during stress periods—especially in firms with high leverage—wages generally remain rigid, adjusting only under extraordinary conditions that change institutional and contractual options, as we saw during the COVID-19 pandemic. This difference in adjustment strategies demonstrates that the credit channel primarily influences the labor market through hiring and firing decisions, with wage changes being secondary unless significant shocks occur alongside legal pathways for wage cuts. Overall, the results suggest that policies designed to address credit crises must take into account not only the economic cycle and firms' financial differences but also the degree of rigidity in labor adjustment channels.

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Artificial Intelligence This research utilized AI tools to assist in data analysis, manuscript drafting, and figure generation. All AI-generated content was critically reviewed and validated by the authors to ensure accuracy and alignment with the scientific integrity of the study. The use of AI adhered to ethical guidelines, ensuring transparency and compliance with academic standards. Any biases or limitations inherent to the AI tools were carefully considered in the interpretation of results. The authors affirm that the AI tools did not compromise the originality or integrity of the work.

Data availability All data used in this study are available from the corresponding author upon reasonable request.

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A. Excluded CNAE Subclasses

This appendix presents the list of excluded CNAE subclasses. These economic activities were removed from the sample to ensure comparability across sectors and avoid distortions caused by regulation, public sector participation, or unique balance sheet characteristics.

Table A1
List of Excluded CNAE Subclasses

Section	CNAE Subclass (Description)
06	0600-4/01 – Extraction of petroleum and natural gas
06	0600-4/02 – Extraction of oil and gas support activities
07	0710-3/01 – Iron ore mining
07	0721-9/01 – Non-ferrous metal mining
07	0722-7/01 – Extraction of other metallic minerals
19	1921-7/00 – Manufacture of refined petroleum products
25	2531-0/00 – Manufacture of steam generators
35	3511-5/01 – Generation of electric power
35	3511-5/02 – Transmission of electric power
35	3511-5/03 – Distribution of electric power
49	4911-4/01 – Intercity rail transportation
49	4921-3/01 – Urban and suburban passenger transport
49	4930-2/01 – Metro and train operations
52	5211-7/01 – Warehousing and storage services
52	5221-0/00 – Port and terminal operations
52	5223-6/00 – Airport operation and support
64	6410-1/00 – Central banking
64	6422-1/00 – Commercial banking
64	6423-9/00 – Cooperative credit institutions
64	6431-0/00 – Pension funds
64	6432-8/00 – Insurance and reinsurance
64	6499-9/00 – Other financial service activities
84	8411-6/00 – Public administration
84	8421-1/00 – International and national defense
84	8423-7/00 – Public safety
94	9412-0/00 – Religious organizations
94	9491-0/00 – Political parties
94	9499-5/00 – Other associative activities