Sudden Stops under the Microscope: Evidence from Uruguay*

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Abstract

This paper studies the micro-level dynamics of firms' borrowing during sudden stops. Using data on the universe of loans in the Uruguayan economy, we provide evidence on three channels of transmission driving these episodes: a lender channel, which links borrowing adjustments to the balance sheets of financial intermediaries; a collateral channel, which links these dynamics to changes in collateral values; and a risk channel, which connects them to changes in external risky borrowing costs. We show that the lender channel significantly strengthens during sudden stops, suggesting that the distinctiveness of these episodes, relative to regular business cycles, may lie in acceleration mechanisms tied to financial intermediaries' balance sheets. Finally, we document that the channels tend to be stronger for unsecured loans and risky firms, suggesting an important role of risk in driving the credit dynamics observed during sudden stops.

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1. Introduction

Emerging markets have long experienced recurrent episodes of abrupt reversals of capital flows, or "sudden stops." At the aggregate level, these episodes tend to be characterized by significant contractions in economic activity, consumption, aggregate investment, and currency depreciation (see, for example, Calvo *et al.*, 2006). Our goal in this paper is to study the micro-level patterns of adjustment during sudden stops and to inform theories explaining these episodes and their macroeconomic adjustments. We focus on the case of Uruguay, an emerging market economy that experienced two sudden stops in its recent history (in 2002 and 2009) and that has rich loan-level data that allow us to characterize the micro-level adjustment of firms during these episodes.

Using these data, our paper studies three questions. First, what are the channels of transmission of sudden stops? We provide evidence on three channels that have been studied at the macro level. First, a "lender channel," which links the dynamics of sudden stops to the balance sheet of financial intermediaries (see, for example, Morelli *et al.*, 2022). The central idea of these theories is that sudden stops are caused by negative shocks affecting intermediaries' net worth, which contract the supply of credit for domestic agents. Second, a "collateral channel," which links the dynamics of sudden stops to changes in collateral values (see, for example, Mendoza, 2010). The main idea of these theories is that negative shocks (e.g., to aggregate productivity) lead to contractions in collateral values, which induce firms and households to decrease their borrowing. Agents' deleveraging, in turn, induces further contractions in collateral values, leading to a downward spiral characterized by deleveraging and contraction in economic activity. Third, a "risk channel," which links the dynamics of sudden stops to changes in external risky borrowing costs (see, for example, Neumeyer and Perri, 2005; Hegarty *et al.*, 2024). The main idea of these theories is that increases in the global price of risk lead to an increase in borrowing costs for risky agents, leading to declines in their borrowing.

We address this question by building on empirical methodologies developed in the empirical finance literature that studies the determinants of firm borrowing. For each of these channels, we exploit within–firm variation in borrowing and estimate local projections (à la Jorda, 2005) in our panel dataset that covers the full universe of firm borrowing over 20 years. For the lender channel, we examine how a firm's borrowing from a particular bank is linked to the bank's returns on assets (exploiting firm–time fixed effects, as in Khwaja and Mian, 2008). For the collateral channel, we study how borrowing backed by a particular type of collateral is linked to changes in that collateral's value. For the risk channel, we study how borrowing using unsecured and secured debt is differentially affected by changes in the global price of risk. For all three channels, we find economically large and persistent effects, linking firms' borrowing to lenders' balance sheets, collateral values, and changes in the global price of risk.

The second question in our empirical analysis is whether sudden stops are different from regular business cycles, a topic long discussed in the literature based on the macro-level patterns of these episodes (e.g., Calvo and Mendoza, 1996). We address this question by analyzing whether the strength of the three studied channels varies during periods of sudden stops. We find that the effect of the lender channel more than doubles during episodes of sudden stops, suggesting that bank performance becomes particularly relevant for the dynamics of firm credit in crisis periods, when banks face greater constraints in their ability to obtain external finance. We do not find a strengthening of the collateral and risk channels during episodes of sudden stops, suggesting that the primary reason why sudden stops are different may lie in acceleration mechanisms linked to financial intermediaries' balance sheets (e.g., Caballero and Krishnamurthy, 2001; Gertler and Kiyotaki, 2010; He and Krishnamurthy, 2012; Brunnermeier and Sannikov, 2014).

Finally, our paper examines whether the sudden stop channels are heterogeneous across different firms and types of loans. Our results suggest an important role of risk in driving credit dynamics during these episodes. For the lender channel, we document larger credit contractions for unsecured loans and for high-default-risk firms; and for the collateral channel, larger credit contractions for firms with high default risk.

It is worth emphasizing that, given the high level of data granularity involved in the analysis, our focus is on Uruguay, and hence our findings are based on the two Uruguayan sudden stops. These two episodes display macroeconomic dynamics similar to those of the average sudden stop in emerging economies, suggesting that the lessons from our analysis can be informative about sudden stops more generally. However, expanding our methodology to other emerging economies is a research avenue worth exploring in the future.

Related literature. Our paper is related to the literature on sudden stops and provides micro evidence on three channels analyzed in this literature.[1] First, a set of papers has focused on financial intermediaries, analyzing their role in the transmission of global shocks (see, for example, Calvo, 2004; Morelli *et al.*, 2022) and their effects on domestic credit.[2] Second, another strand of the literature studies the feedback loop between collateral values and borrowing, which can lead to amplification of shocks (see, for recent surveys, Korinek and Mendoza, 2014; Bianchi and Mendoza, 2020). Third, other papers emphasize the role of fluctuations in borrowing costs (see, Neumeyer and Perri, 2005; Uribe and Yue, 2006; Garcia-Cicco *et al.*, 2010, among others), which can be traced to the effect of fluctuations in the global risk premium on firms facing default risk (Hegarty *et al.*, 2024).

Our paper is also related to the literature that studies the domestic transmission of the global financial cycle and imperfections in global capital markets (see, for example, Rey, 2015; Maggiori, 2021, and references therein). One strand of this literature studies how shocks in global capital markets affect the macroeconomy of open economies (see, for example, Di Giovanni *et al.*, 2022; Hassan *et al.*, 2021; Hegarty *et al.*, 2024). Among these, our work is closely related to Di Giovanni *et al.* (2022), who study the domestic transmission of capital inflows using granular loan-level data from Turkey; our paper shares their methodology and focuses on periods of sudden stops with financial crises. We contribute to this literature by documenting how international shocks that affect domestic financial intermediaries transmit to firms' credit during these periods.

[1] In addition to the channels we study, the literature has also identified that fluctuations in borrowing during sudden stops can be linked to permanent fluctuations in productivity (see, for example, Aguiar and Gopinath, 2007). Given the structure of our data, we do not study this channel and refer the interested reader to Guntin *et al.* (2023) for microlevel evidence supporting it.

[2] A related literature studies how increases in sovereign risk can affect domestic banks' balance sheets and lead to capital outflows and contractions in domestic credit (see, for example, Gennaioli *et al.*, 2014; Bocola, 2016; Arellano *et al.*, 2017; Sosa-Padilla, 2018; Perez and Varraso, 2025).

Finally, our paper is related to the extensive empirical finance literature that studies the impact of credit demand and supply shocks (see, Khwaja and Mian, 2008; Jiménez *et al.*, 2014; Chodorow-Reich, 2014; Paravisini *et al.*, 2015, 2023; Alfaro *et al.*, 2021; Villacorta *et al.*, 2023, among others). We build on the methodology developed in this literature to study the transmission of sudden stops.

2. The Macroeconomic Dynamics During Sudden Stops

We begin by summarizing the key macroeconomic patterns observed during the sudden stop episodes experienced in the Uruguayan economy over the last three decades, which serve as background for the empirical analysis.

To illustrate these episodes, Appendix Figure A.1 reports the current account as a share of GDP. Since 1990, the Uruguayan economy has experienced two sudden stop episodes, marked with shaded gray areas. The first episode occurred in 2002, in the context of the Argentine crisis, and featured a 5 p.p. current account adjustment. The second episode occurred in 2009, in the context of the global financial crisis, and was associated with a 4 p.p. current account adjustment. In what follows, we provide a summary of the macroeconomic dynamics observed in each of these episodes.

The 2002 episode. This episode occurred as part of one of the largest economic crises in Uruguay's recent macroeconomic history. Appendix Table A.1 provides a timeline of key events marking this episode (see Antía, 2003; De Brun and Licandro, 2006; Fernández *et al.*, 2003; Polgar, 2004; Vallcorba, 2003, for detailed descriptions). The origin of this episode can be traced to Russia's default in August 1998, which was followed by a widespread recession in Latin America. The economic contraction was particularly severe in Argentina, which had a currency peg against the U.S. dollar, a substantial amount of liabilities denominated in that currency, and increasing levels of sovereign risk, as illustrated in Panel (b) of Appendix Figure A.2 (for a detailed analysis of this episode, see Calvo *et al.*, 2003; Kehoe, 2007, and references therein). The nadir of this crisis occurred in December 2001 and January 2002, marked by a deposit freeze (the "corralito"), sovereign default, abandonment of the fixed exchange rate, economic collapse, and social and political unrest.

In the decade before the crisis, Uruguay had developed strong economic ties with Argentina, one of which was a large share of deposits from Argentine residents (during 2001, 41% of private deposits were from nonresidents, and 80% of those belonged to Argentinians). As illustrated in Appendix Figure A.3, these deposits collapsed in 2002, triggering a severe banking crisis involving the bankruptcy of five major banks and a major contraction in domestic deposits and credit. As illustrated in Appendix Figure A.4, the real side of the economy was characterized by a deep economic depression, involving significant contractions in economic activity, consumption, and investment, along with a large increase in unemployment. Appendix Figures A.2 and A.5 show that the government was not insulated from this contraction, experiencing an increase in sovereign spreads, a large contraction in spending and foreign reserves, and the abandonment of the crawling peg, which resulted in substantial nominal and real currency depreciation (see Panel (c) of Appendix Figure A.4).

The 2009 episode. This episode occurred in the context of the global financial crisis, triggered by the bankruptcy of Lehman Brothers in September 2008 (for a detailed description of this episode, see Chodorow-Reich, 2014; Gertler and Gilchrist, 2018, and references therein). As illustrated in Panel (a) of Appendix Figure A.2, this episode was marked by a substantial increase in the global price of risk, measured by the excess bond premium and the VIX.

As illustrated in Appendix Figures A.2–A.4, the economic effects of the global financial crisis were not particularly severe in Uruguay, at least compared with those of the 2002 episode. In particular, this episode was characterized only by a deceleration in economic activity, minor increases in unemployment, and no bank failures or distress in the public sector. Yet investment contracted by 15%, accounting for the bulk of the current account contraction.

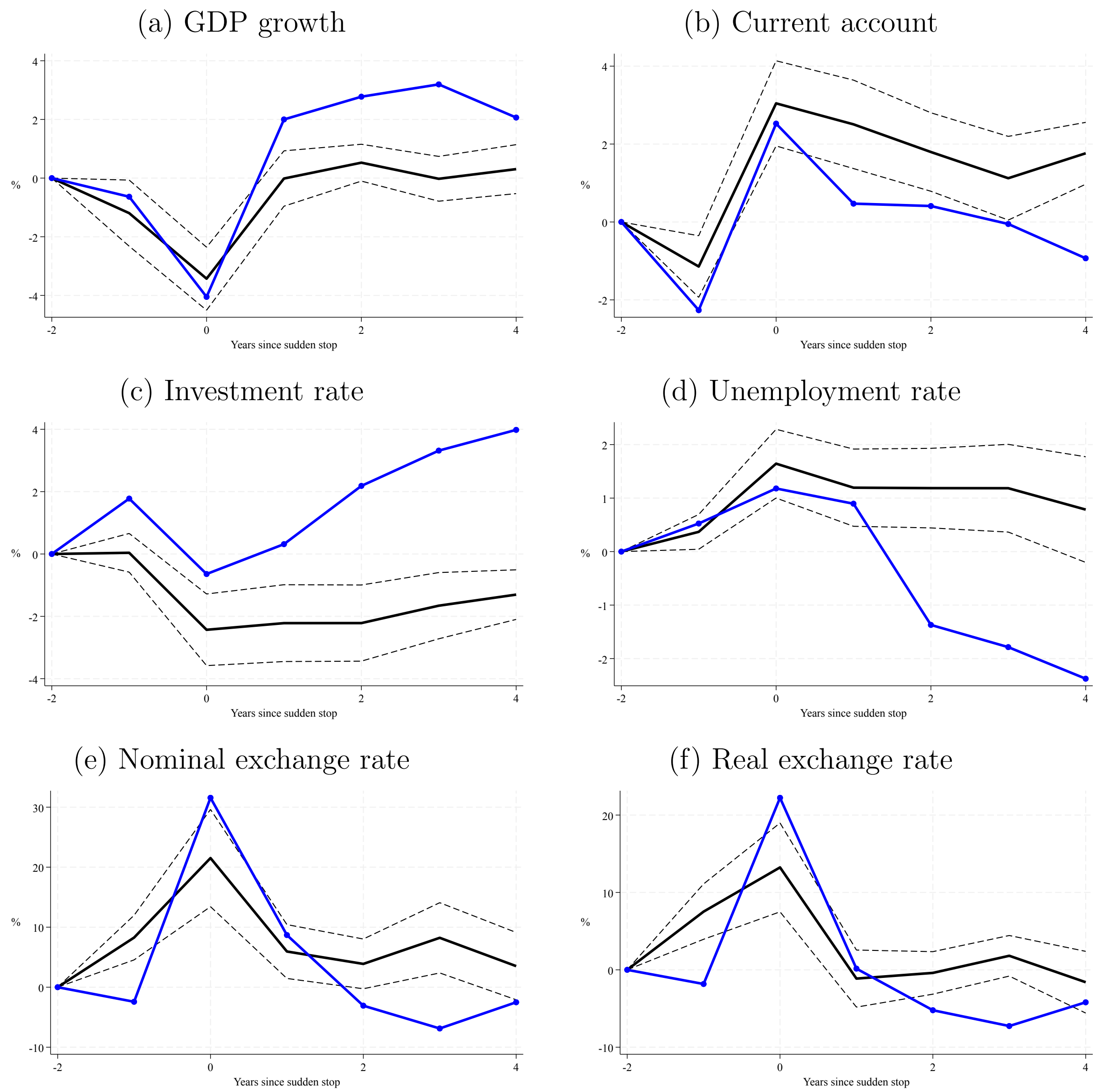
Uruguayan and emerging markets sudden stops. To analyze the external validity of our conclusions, we compare the average Uruguayan sudden stop with the average historical sudden stop episode identified in Bianchi and Mendoza (2020). Figure 1 shows that the magnitude and dynamics of the current account reversal and the contraction in economic activity in the average sudden stop in Uruguay are similar to those in the average sudden stop in emerging markets. We also observe similar patterns in the nominal and real exchange rates. As in the average emerging-market sudden stop, the nominal and real exchange rates reach a peak depreciation in the year of the sudden stop and are then followed by quick appreciations. We also find that unemployment increases in both the average Uruguayan and EM sudden stops, but their speeds of recovery differ. Finally, investment rates exhibit resilience in the Uruguayan sudden stops relative to the average sudden stop in emerging markets. Overall, this evidence suggests that the conclusions from our analysis can be informative about other emerging economies.

3. Microlevel Data and Descriptive Statistics

Data. Our empirical analysis uses two datasets managed by the Central Bank of Uruguay, containing monthly data from 1999 to 2019. The first dataset is the "Credit Registry" (*Central de Riesgos Crediticios*), which covers the universe of loans issued within the Uruguayan financial system. For each type of loan, it contains rich contractual information, such as the loan amount, currency, maturity, and collateral. Importantly for our identification, it also includes an identifier for the borrower and lender involved in the contract, as well as information about the borrower's country of residency, sector, and credit risk category assigned each month by its lender (according to Uruguayan regulation).[3] For part of our analysis, we also use a second dataset, which contains the balance sheet and income statement of

[3]The Uruguayan Credit Registry records information at the borrower–loan-type level rather than at the individual loan operation level. For instance, a borrower holding multiple loans of the same type, with the same institution, currency, and maturity will appear as a single entry in the database. Conversely, if one of these loans differs in currency, it will appear in a separate record. Hence, although we will refer to "loan-level" regressions for simplicity, each observation actually corresponds to a borrower–loan-type record as defined in the Credit Registry.

Figure 1: Macroeconomic Dynamics During Sudden Stops: Uruguay and Emerging Markets



Notes: This figure shows the dynamics of selected macroeconomic variables (real GDP growth, current account as a share of GDP, investment as a share of GDP, unemployment rate, nominal exchange rate depreciation relative to the U.S. dollar, and real exchange rate relative to the U.S. dollar) for the average of Uruguay's 2002 and 2009 sudden stops and for the average historical sudden stop episode identified in Bianchi and Mendoza (2020). The dynamics of historical episodes are computed using the estimated coefficients from the event-time study following the two-step procedure of Blanco *et al.* (2025). The average sudden stop corresponds to the solid black lines, with standard error bands in dotted lines, while the average values for Uruguay are shown with blue dashed lines. The horizontal axis represents years since the start of the sudden stop; $t = 0$ marks the beginning of the episode. In the case of Uruguay, $t = 0$ corresponds to 2002 for the 2002 episode and 2009 for the 2009 episode.

all financial institutions operating in Uruguay and is publicly available through the Central Bank of Uruguay.

Combining these data sources, we build a loan-level dataset containing information on both firms' borrowing and banks' balance sheets for the universe of loans in the banking system.[4] The dataset covers a total of 109,419 firms, 23 banks, and 170,924 different bank–firm pairs over the period considered.[5]

Descriptive statistics. Table 1 presents a set of descriptive statistics for key variables in our empirical analysis. We conduct this analysis at a quarterly frequency, pooling all periods and winsorizing the variables involved in the analysis at the top and bottom 1% of the distribution to mitigate the influence of outliers.

Table 1: Descriptive Statistics on Firms' Debt

	All firms	Firms w multiple banks		Firms w multiple collateral		Firms w multiple credit risk	
	$\Delta \log b_{jt}$	$\Delta \log b_{jt}$	# banks relationships	$\Delta \log b_{jt}$	# collateral types	$\Delta \log b_{jt}$	Unsecured loans (%)
Mean	-3.5	7.0	2.4	-3.6	2.0	-1.9	26.8
Median	-5.4	-1.7	2.0	-4.5	2.0	-3.6	1.6
SD	99.2	80.8	0.8	80.2	0.2	60.5	38.1
Bottom 5%	-152.9	-96.5	2.0	-124.8	2.0	-97.8	0.0
Top 95%	161.7	139.7	4.0	122.2	2.0	99.1	100.0
Number of units	109,409	2,123	2,123	7,765	7,765	24,144	24,144
Observations	1,919,998	345,327	345,327	51,474	51,474	345,327	345,327

Notes: This table reports summary statistics of firm-level variables, using quarterly data for the period 1999 to 2019. b_{jt} denotes the debt of firm j in period t. The variable $\Delta \log b_{jt}$ is expressed in percent.

The first column of Table 1 shows that the data exhibit considerable variation in the log change in debt, as measured by its standard deviation. The top panels of Appendix Figure B.2 indicate that firms in our sample experience a sharp contraction in borrowing following sudden stop episodes, with a lag relative to the changes in economic activity documented in the previous section. Appendix Figure B.3 shows that this adjustment is observed in both local- and foreign-currency debt and is not driven by debt revaluation.

[4] We exclude from the analysis non-banking institutions, as well as the state-owned bank whose unique line of business is mortgages (i.e., the *Banco Hipotecario*).

[5] Following the 2002 banking crisis, the Uruguayan banking system underwent a process of bank failures, mergers, and acquisitions, which reduced the number of banks from 23 in 1999 to 10 in 2019.

As further explained below, our empirical analysis exploits the fact that a subset of firms in our sample have multiple bank relationships, multiple loans that vary in the type of pledged collateral, and loans that differ in their credit risk. The second and third columns of Table 1 present descriptive statistics for the firms with loans from multiple banks. On average, these firms have 2.4 bank relationships, exhibit higher loan growth than the average set of firms, and a lower standard deviation. Despite these differences, Appendix Figure B.3 indicates that these firms experience similar average borrowing dynamics during sudden stops as the rest of the firms in the economy. In addition, the middle panels of Appendix Figure B.2 show a collapse in banks' return on assets during sudden stop episodes, which was particularly pronounced in the 2002 episode.

The fourth and fifth columns of Table 1 present descriptive statistics for firms with loans secured by different types of collateral. On average, these firms have two collateral types and exhibit descriptive statistics similar to those of all firms in the sample. In the dataset, firms pledge 13 different types of collateral (commonly used examples include real estate, machinery, vehicles, land, cattle, and government debt). Appendix B lists all collateral types. The aggregate value of collateral in our dataset contracts in the year following sudden stop episodes (see the bottom panels of Appendix Figure B.2 and Appendix Figures B.4 and B.5).

Finally, the last two columns of Table 1 focus on firms with loans of varying credit risk. We identify variation in credit risk across loans from the same borrowing firm based on whether or not the loans are collateralized. The rationale is that collateralized loans have greater recovery values and, therefore, lower credit risk. The average share of unsecured debt for firms with both types of loans is 27%, with significant variation in this share across firms.

4. The Micro Dynamics during Sudden Stops

In this section, we study the transmission of sudden stops through their microlevel patterns. Section 4.1 examines the economic relevance of three key channels of transmission studied in the sudden stop literature. Section 4.2 explores whether sudden stops differ from regular business cycle fluctuations across these three channels. Finally, Section 4.3 investigates whether different firms are heterogeneously exposed to these channels.

4.1. Channels of Transmission

We study three channels of transmission of sudden stops, as described in the introduction: the lender channel, the collateral channel, and the risk channel.

The lender channel. The lender channel, also referred to as the bank-lending channel, relates to theories that link variations in firms' borrowing to the balance sheets of financial intermediaries. To analyze this channel, we exploit within-firm borrowing from different banks and estimate the following local projections (à la Jorda, 2005):

$$\log b_{ijt+h} - \log b_{ijt-1} = \alpha_{ijh} + \alpha_{jth} + \beta_h Z^L_{it} + \mathbf{\Gamma}'_h \boldsymbol{X}^L_{ijt-1} + \varepsilon_{ijt+h}, \tag{1}$$

where b_{ijt} denotes the debt of firm j from bank i in period t; Z^L_{it} is the main covariate of interest for the lender channel (L), which in this case is the return on assets of bank i in period t (denoted R_{it}), i.e., $Z^L_{it} = R_{it}$; α_{ijh} and α_{jth} denote bank–firm and firm–time fixed effects; and $\boldsymbol{X}^L_{ijt-1}$ is a vector of controls constructed at the firm–bank level, including the non-performing loan ratio, the ratio of liquid collateral to debt, the share of short-term debt, the time length of the relationship observed in the credit registry, the firm's credit rating, Z^L_{it-1}, and $\Delta \log b_{ijt-1}$. Appendix B details the construction of each of these variables, as well as all other variables used in the following regression analyses. As emphasized by the literature on firms' borrowing, the firm–time fixed effect is aimed at absorbing firm-specific credit demand shocks (see, for example, Khwaja and Mian, 2008).[6] Our coefficients of interest are β_h, which measure the semi-elasticity of a firm's borrowing from a particular bank to that bank's return on assets at different horizons. Throughout, we estimate two-way clustered standard errors at the time and firm level.

Panel (a) of Figure 2 reports the results from estimating (1) for different horizons. The

[6] As pointed out by Villacorta *et al.* (2023), the validity of this approach relies on demand shocks not leading firms to adjust credit across banks in a way that is correlated with banks' returns on assets.

estimates for β_h are large and persistent. In particular, they indicate that a 1 p.p. contraction in a bank's return on assets is followed by a contraction of approximately 1 p.p. in firms' debt growth from that bank, which peaks three quarters after the shock and remains stable thereafter. This implies that a one–standard-deviation decline in a bank's return on assets is associated with up to a 4 p.p. decline in the credit growth of a firm borrowing from that bank. This pattern suggests that firms' borrowing from a given bank is tightly linked to changes in that bank's performance.

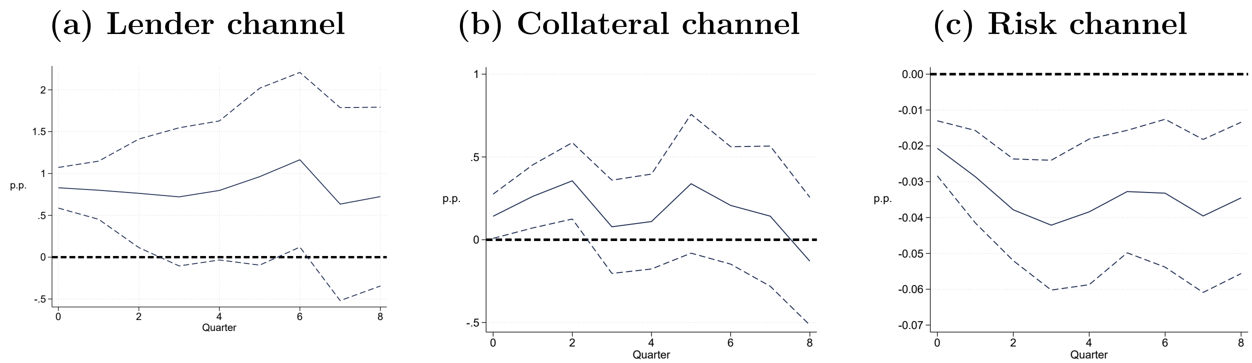
These results are robust to alternative specifications. Panel (a) of Appendix Table B.1 shows the robustness of the estimates to excluding the controls $\boldsymbol{X}_{ijt-1}$ and to replacing the firm–time fixed effects with separate time and firm fixed effects. Panel (a) of Appendix Figure B.8 shows the results when we replace the bank's return-on-assets variable with an indicator equal to one if a bank's return is above the quarter-mean return across banks and zero otherwise.

Overall, these results are consistent with the predictions of intermediary-based theories of sudden stops. In particular, in these theories, sudden stops are periods in which intermediaries face shocks that raise the marginal cost of external finance (see, for example, Morelli *et al.*, 2022). Therefore, if bank relationships are sticky (e.g., Chodorow-Reich, 2014), it can be costlier for firms that experience a contraction in the supply of credit from a bank to substitute that shock with credit from another bank.

We also estimate a similar regression to (1) but at the firm level (instead of exploiting within-firm loan-level variation). In this regression, the covariate of interest is the weighted average return on assets of the banks lending to the firm (see Appendix B for further details). In this case, we find that the estimates are positive but not statistically significant (see panel (a) of Appendix Figure B.1), suggesting that exploiting credit variation within a firm can be important for identifying the lender channel.

The collateral channel. Second, we study theories that link variation in firms' borrowing to changes in the value of their collateral. To analyze this channel, we exploit variation in loans with different pledged collateral within a given firm and estimate the following

Figure 2: Channels of Transmission for Firms' Borrowing



Notes: This figure reports the estimates linking firms' borrowing to the three channels studied. Panel (a) reports the estimates of β_h from the lender-channel regression in (1) over different horizons h; Panel (b) reports those from the collateral-channel regression in (2); and Panel (c) reports those from the risk-channel regression in (3). Confidence intervals are shown at the 90 percent level using two-way clustered standard errors at the firm and time levels. For further details, see Section 4 and Appendix B.

specification, in the subsample of firms' collateralized loans:

$$\log b_{kjt+h} - \log b_{kjt-1} = \alpha_{kjh} + \alpha_{jth} + \beta_h Z^C_{kt} + \mathbf{\Gamma}'_h \boldsymbol{X}^C_{kjt-1} + \varepsilon_{kjt+h}, \tag{2}$$

where b_{kjt} denotes the debt of firm j backed by collateral type k in period t; Z^C_{kt} is the main covariate of interest for the collateral channel (C), which in this case is the change in a measure of the log value of collateral type k (denoted q_{kt}), i.e., $Z^C_{kt} = \Delta \log q_{kt}$; α_{kjh} and α_{jth} denote collateral-type–firm and firm–time fixed effects; and $\boldsymbol{X}^C_{kjt-1}$ is a vector of controls constructed at the firm–collateral-type level, including the non-performing loan ratio, the ratio of liquid collateral to debt, the share of short-term debt, the time length of the relationship observed in the credit registry, the firm's credit rating, Z^C_{kt-1}, and $\Delta \log b_{kjt-1}$.

We measure q_{kt} by aggregating the value of individual collaterals of type k across all loans in a given period. Appendix Figures B.4 and B.5 show the time series for the measures of q_{kt} for all collateral types. It is worth noting that this measure potentially captures variation in both the value and the aggregate quantity of available collateral. To further validate that our measure captures price variation, Figure B.6 shows that it positively correlates with time series of collateral prices for those types where price data are available.

Panel (b) of Figure 2 reports the estimates of β_h for the collateral regressions at the firm level for different horizons. These estimates indicate that a decrease of 1 p.p. in the measured growth of a firm's collateral value is associated with a peak contraction in the firm's debt growth of 0.4 p.p. two quarters after the shock. This implies that a one–standard-deviation decline in the value of collateral is associated with up to a 5 p.p. decline in credit growth using that type of collateral. The estimated coefficient remains fairly persistent over the following two years, although it is statistically significant only in the first two quarters.

We next examine the robustness of these results to several alternative empirical specifications. Panel (b) of Appendix Table B.1 shows that the estimates are robust to excluding loan-level controls and to replacing the firm–time fixed effects with separate time and firm fixed effects. Panel (b) of Appendix Figure B.8 shows the results when we replace the change-in-collateral-value variable with an indicator equal to one if the change in collateral value is above the quarter-mean change across collateral types and zero otherwise. In addition, Panel (b) of Appendix Figure B.1 reports the estimates of the regression at the firm level, which have the same sign and display similar dynamics to the baseline estimates. On the whole, these results are consistent with theories that emphasize the role of collateral constraints and Fisherian debt-deflation dynamics during sudden stops (see, for example, Mendoza, 2002, 2010; Bianchi, 2011).

The risk channel. Finally, we investigate the relevance of theories that link economic contractions during sudden stops to spikes in the global price of risk (see, for example, Neumeyer and Perri, 2005; Hegarty *et al.*, 2024). Because this channel predicts larger contractions in firms' credit when loans are riskier, we analyze it by exploiting within-firm variation in loans with different risk. In particular, we estimate the following empirical model:

$$\log b_{ijt+h} - \log b_{ijt-1} = \alpha_{jlh} + \alpha_{jth} + \beta_h Z^R_{it} + \boldsymbol{\Gamma}'_h \boldsymbol{X}^R_{ijt-1} + \varepsilon_{ijt+h}, \tag{3}$$

where b_{ijt} denotes the debt of firm j with bank i at time t; α_{jlh} and α_{jth} denote firm–loan-type and firm–time fixed effects, respectively, where the subindex l distinguishes whether, in a given firm–bank pair at a particular point in time, the borrowing is characterized by collateralized or uncollateralized lending. The covariate of interest, Z^R_{it}, is the interaction between an aggregate measure of the market price of risk, ρ_t, and a measure of the risk of loans with bank i in the previous period, i.e., $Z^R_{it} = \rho_t \times (1 - \mathbb{I}\{\text{coll}_{ijt-1}\})$, where $\mathbb{I}\{\text{coll}_{ijt}\}$ is a dummy variable equal to one if firm j's borrowing from bank i in period t includes collateralized loans and zero otherwise. The motivation for this measure is that unsecured debt has lower expected recovery in a default event and, hence, entails more risk. In our baseline empirical model, we measure ρ_t using the emerging-market excess bond premium from Hegarty *et al.* (2024), which uses the methodology in Gilchrist and Zakrajšek (2012) to estimate an excess bond premium measure for emerging markets, and in robustness analysis we also consider the VIX. The vector of controls, $\boldsymbol{X}^R_{ijt-1}$, constructed at the firm–bank level, includes the non-performing loan ratio, the ratio of liquid collateral to debt, the share of short-term debt, the time length of the relationship observed in the credit registry, the firm's credit rating, $\mathbb{I}\{\text{coll}_{ijt-1}\}$, Z^R_{it-1}, and $\Delta \log b_{ijt-1}$.

Panel (c) of Figure 2 reports the estimates of β_h, indicating that following a one–standard-deviation increase in the excess bond premium, debt growth from banks not featuring collateralized lending contracts by about 4 p.p. more than debt growth from banks that do feature collateralized lending. This effect is statistically significant and persistent over the next two years after the shock and reaches its peak three quarters after the shock.

These results are robust to excluding loan-level controls and to replacing the firm–time fixed effects with separate time and firm fixed effects (see panel (c) of Appendix Table B.1). They are also robust to alternative measures of the market price of risk: Appendix Figure B.7 shows similar results when using the VIX instead of the excess bond premium. In addition, panel (c) of Appendix Figure B.1 reports the estimates of the regression at the firm level, which are also negative and persistent. Overall, these results suggest the presence of a risk channel through which riskier borrowing is more exposed to surges in the global price of risk.

Joint estimation of all channels. In this section, we simultaneously estimate all channels. To do so, we estimate the following regression:

$$\log b_{ijkt+h} - \log b_{ijkt-1} = \alpha_{ijkh} + \alpha_{jth} + \beta_{Lh} Z^{L}_{ijkt} + \beta_{Ch} Z^{C}_{ijkt} + \beta_{Rh} Z^{R}_{ijkt} + \boldsymbol{\Gamma}'_h \boldsymbol{X}_{ijkt-1} + \varepsilon_{ijkt+h}, \tag{4}$$

where b_{ijkt} denotes the outstanding borrowing in period t of firm j from bank i using collateral type k (with k including a category for loans without collateral). The variables Z^{x}_{ijkt} for $x \in \{L, C, R\}$ are the firm-bank-collateral-type-level counterparts of the covariates of interest considered in empirical models (1)–(3), i.e., $Z^{L}_{ijkt} = R_{it}$, $Z^{C}_{ijkt} = \Delta \log q_{kt} \times \mathbb{I}\{\text{coll}_{ijk}\}$, and $Z^{R}_{ijkt} = \rho_t \times (1 - \mathbb{I}\{\text{coll}_{ijk}\})$, where $\mathbb{I}\{\text{coll}_{ijk}\}$ is a dummy variable equal to one if the borrowing of firm j from bank i using collateral type k is collateralized and zero otherwise. The vector of controls, $\boldsymbol{X}_{ijkt-1}$, constructed at the firm-bank-collateral-type level, includes the non-performing loan ratio, the ratio of liquid collateral to debt, the share of short-term debt, the time length of the relationship observed in the credit registry, the firm's credit rating, Z^{L}_{ijkt-1}, Z^{C}_{ijkt-1}, Z^{R}_{ijkt-1}, and $\Delta \log b_{ijkt-1}$.

For comparability, the left column of Appendix Figure B.9 reports the results from estimating the three individual channels discussed in the previous section, but using firm–bank–collateral-type level variation as in (4).[7] These results lead to qualitatively similar conclusions to those obtained in the previous sections for each channel.

[7]For the lending channel, note that (1) is estimated at the firm–bank level, whereas (4) is estimated at the firm-bank-collateral-type level. Therefore, re-estimating the lender channel with $\log b_{ijkt+h} - \log b_{ijkt-1} = \alpha_{ijh} + \alpha_{jth} + \beta_{Lh} Z^{L}_{it} + \boldsymbol{\Gamma}'_h \boldsymbol{X}^{L}_{ijkt-1} + \varepsilon_{ijkt+h}$ makes these estimates more comparable to the joint regression.

Similarly, for the collateral channel, (2) is estimated at the firm–collateral-type level and only for the subset of collateralized loans. To make these estimates comparable with the joint regression, we re-estimate the collateral channel at the firm-bank-collateral-type level and for the full sample with $\log b_{ijkt+h} - \log b_{ijkt-1} = \alpha_{kjh} + \alpha_{jth} + \beta_{Ch} Z^{C}_{ijkt} + \boldsymbol{\Gamma}'_h \boldsymbol{X}^{C}_{ijkt-1} + \varepsilon_{ijkt+h}$. Because this specification uses all loans, the covariate of interest is constructed differently than in (2), as the interaction of the change in log collateral values with the dummy variable $\mathbb{I}\{\text{coll}_{ijk}\}$.

Finally, for the risk channel, (3) is estimated at the firm–bank level. For comparability with the joint regression, we re-estimate this channel at the firm-bank-collateral-type level with $\log b_{ijkt+h} - \log b_{ijkt-1} = \alpha_{jlh} + \alpha_{jth} + \beta_{Rh} Z^{R}_{ijkt} + \boldsymbol{\Gamma}'_h \boldsymbol{X}^{R}_{ijkt-1} + \varepsilon_{ijkt+h}$. In this case, note that the collateral indicator $\mathbb{I}\{\text{coll}_{ijk}\}$ is constructed at the firm-bank-collateral-type level, whereas the variable $\mathbb{I}\{\text{coll}_{ijt}\}$ used in (3) is constructed at the firm–bank level and varies across time.

For all three channels, the vectors $\boldsymbol{X}^{x}_{ijkt-1}$ for $x \in \{L, C, R\}$ are the firm-bank-collateral-type level equivalents of the control vectors defined in (1)–(3).

The right column of Appendix Figure B.9 shows that the joint estimation of the three channels leads to dynamic effects that are broadly similar to those obtained when estimating each channel separately, albeit with wider standard errors in some cases. This suggests that the three channels contribute independently to firms' borrowing dynamics.

4.2. Are sudden stops different?

In this section, we ask whether the strength of these channels varies during periods of sudden stops. To investigate this, we estimate the same regressions as in the previous sections, augmenting them with an additional independent variable given by the interaction of the covariate of interest with an indicator variable for sudden stop periods. Specifically, for the lender channel we estimate:

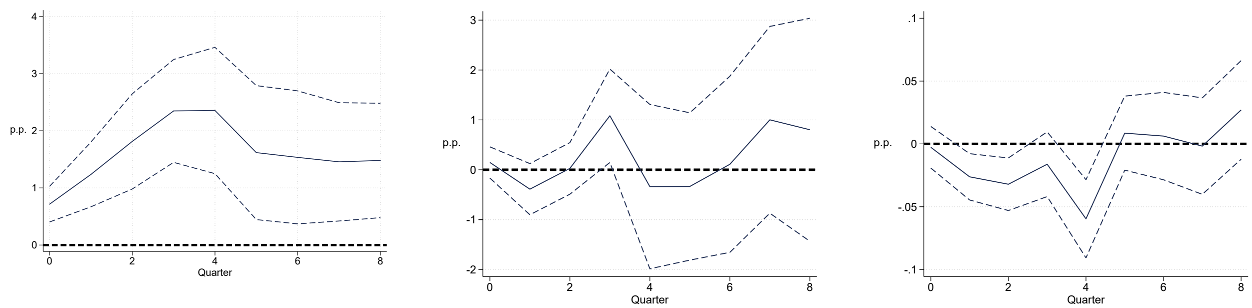
$$\log b_{ijt+h} - \log b_{ijt-1} = \alpha_{ijh} + \alpha_{jth} + \beta_h Z^L_{it} + \gamma_h Z^L_{it} S_t + \boldsymbol{\Gamma}'_h \boldsymbol{X}^L_{ijt-1} + \varepsilon_{ijt+h}, \tag{5}$$

where S_t is a dummy variable equal to one in the years 2002, 2003, 2009, and 2010, and zero otherwise. The coefficient of interest, γ_h, measures how the semi-elasticity of a firm's borrowing from a bank with respect to that bank's return on assets varies during periods of sudden stops. Similarly, for the collateral and risk channels, we estimate specifications analogous to (2) and (3), respectively, augmenting them with the interaction between the corresponding covariate of interest and the indicator variable for sudden stop periods.

Figure 3 reports the estimates of γ_h for the three channels. Panel (a) shows that, for the lender channel, the semi-elasticity of firm credit to bank returns on assets more than doubles during episodes of sudden stops, and these effects are persistent and statistically significant. This suggests that bank performance becomes particularly relevant for the dynamics of firm credit in crisis periods, when banks face greater constraints in their ability to obtain external finance. Panel (b) shows that the estimates for the collateral channel fluctuate around zero and are not statistically significant, suggesting that the collateral channel operates similarly during sudden stops and outside of these episodes. Finally, Panel (c) provides some indication of the risk channel strengthening during sudden stops, although these effects are statistically significant only at specific horizons. Overall, these results suggest that, across the three channels, the distinctiveness of sudden stops relative to regular business cycle fluctuations may lie in acceleration mechanisms tied to financial intermediaries' balance sheets.

Figure 3: Channels of Transmission for Firms' Borrowing: Differential Patterns During Sudden Stops

(a) Lender channel **(b) Collateral channel** **(c) Risk channel**



Notes: This figure reports the estimates linking firms' borrowing to the three channels studied during sudden stop periods. Panel (a) reports the estimates of γ_h from the lender-channel regression (5) over different horizons h; Panel (b) reports those from the analogous collateral-channel specification; and Panel (c) reports those from the analogous risk-channel specification. Confidence intervals are shown at the 90 percent level using two-way clustered standard errors at the firm and time levels. For further details, see Section 4 and Appendix B.

4.3. Heterogeneous effects

In this section, we study whether the channels of transmission of sudden stops vary across different firms, sectors, types of loans, and types of banks. To do so, we re-estimate the regressions of Section 4.1, interacting the main covariate of interest with indicator variables reflecting different characteristics at the firm, loan, and bank levels.

Table 2 reports the heterogeneous effects of the lender channel, showing the estimates of β_h when we interact banks' return on assets with firm- and bank-level characteristics based on the firm's risk and sector, the loan's type of collateral and currency of denomination, and the type of bank providing the loan. We estimate the lending channel to be most heterogeneous across loans with different types of collateral and firms with different risk. Specifically, uncollateralized loans experience an average contraction more than three times larger than that of collateralized loans following the same decrease in banks' returns on assets.

Table 2: The Lender Channel: Heterogeneous Effects

			Impact	Peak	Average	Obs
A	By type of collateral	Collateralized	.8	.11	.36	527,397
			(.213)	(.76)		
		Uncollateralized	.96	1.5	1.3	527,397
			(.254)	(.662)		
		Difference	-.16	-1.4	-.97	527,397
			(.276)	(.759)		
B	By firm's risk	High risk	1.5	1.5	1.2	527,397
			(.288)	(.288)		
		Low risk	.44	.44	.58	527,397
			(.23)	(.23)		
		Difference	1	1	.6	527,397
			(.34)	(.34)		
C	By firm's sector	Tradable	.79	2.1	1.5	527,397
			(.308)	(1.22)		
		Non-tradable	.85	.11	.57	527,397
			(.201)	(.972)		
		Difference	-.055	2	.95	527,397
			(.314)	(1.23)		
D	By currency denomination	Local currency	1.2	1.3	1.1	527,397
			(.251)	(.73)		
		Foreign currency	.48	.085	.47	527,397
			(.275)	(.714)		
		Difference	.74	1.2	.6	527,397
			(.356)	(.607)		
E	By type of bank	Foreign banks	.34	.34	.57	527,397
			(.303)	(.303)		
		Local banks	1	1	1	527,397
			(.189)	(.189)		
		Difference	-.66	-.66	-.44	527,397
			(.268)	(.268)		

Notes: This table reports the heterogeneous effects of the lender channel. It shows estimates of β_h at the impact ($h = 0$), peak (defined as the h with the largest difference between characteristics), and average effects for different firm and bank characteristics. For each characteristic, the table reports the estimated effect for each category and the difference. Two-way clustered standard errors at the time and firm levels are reported in parenthesis.

Consistent with this finding, firms with high risk exhibit a larger semi-elasticity of firm credit to banks' returns on assets. These findings are consistent with theories emphasizing the role of changes in intermediaries' risk-bearing capacity during crises (e.g., He and Krishnamurthy, 2013). We also find significant heterogeneity across different types of banks and currency-denomination of loans, with the semi-elasticity of firm credit to bank returns on assets being stronger for local banks and local-currency loans. Finally, we estimate fairly homogeneous effects for firms in different sectors.

Table 3 reports the heterogeneous effects of the collateral channel. We find that the effect of this channel varies most across firms with different default risks. In particular, the elasticity of firms' borrowing to collateral values is especially pronounced among high-risk firms. Heterogeneity across sectors, loan currencies, and types of banks appears more muted.

Finally, Table 4 reports the heterogeneous effects of the risk channel. In this case, we do not find salient heterogeneity across firms in different sectors, loans in different currencies, or different types of banks.

5. Conclusion

This paper provides evidence that key channels of transmission during sudden stops—financial intermediaries' balance sheets, collateral values, and external borrowing costs, traditionally studied at the macro level—are also present in micro-level data. Our findings highlight two central factors in these episodes: the role of intermediaries' balance sheets, which appears to be a distinguishing feature setting sudden stops apart from regular business cycles, and the risk associated with firms or types of loans, which amplifies these effects.

These results suggest that policies aimed at strengthening the stability of financial intermediaries, managing firms' indebtedness, and improving bankruptcy resolution frameworks can be central to mitigating the effects of sudden stops. Moreover, the empirical estimates provided in our framework can inform quantitative models of sudden stops when evaluating the effects of such policies. We leave this for future research.

Table 3: The Collateral Channel: Heterogeneous Effects

			Impact	Peak	Average	Obs
A	By firm's risk	High risk	.14	.66	.21	15,786
			(.139)	(.423)		
		Low risk	.14	-.3	.12	15,786
			(.114)	(.327)		
		Difference	-.0032	.97	.095	15,786
			(.142)	(.425)		
B	By firm's sector	Tradable	.19	.8101	.2	15,786
			(.199)	(.468)		
		Non-Tradable	.12	-.053	.15	15,786
			(.104)	(.264)		
		Difference	.064	.86	.041	15,786
			(.201)	(.471)		
C	By currency denomination	Local currency	.13	.49	1.9e-02	15,786
			(.149)	(.486)		
		Foreign currency	.14	-.0339	.22	15,786
			(.118)	(.225)		
		Difference	-.0054	.52	-.21	15,786
			(.164)	(.515)		
D	By type of bank	Foreign bank	.09	6.1e-02	.11	29,528
			(.098)	(.377)		
		Local bank	.04	-.21	2.8e-02	29,528
			(.111)	(.438)		
		Difference	.05	.27	.084	29,528
			(.112)	(.275)		

Notes: This table reports the heterogeneous effects of the collateral channel. It shows estimates of β_h at the impact ($h = 0$), peak (defined as the h with the largest difference between characteristics), and average effects for different firm and bank characteristics. For each characteristic, the table reports the estimated effect for each category and the difference. Two-way clustered standard errors at the time and firm levels are reported in parenthesis.

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Table 4: The Risk Channel: Heterogeneous Effects

			Impact	Peak	Average	Obs
A	By firm's sector	Tradable	-.0124	-.045	-.014	545,760
			(.007)	(.0241)		
		Non-tradable	-.0172	-.0236	-.0254	545,760
			(.0064)	(.0141)		
		Difference	.0048	-.0218	.0116	545,760
			(.0089)	(.0265)		
B	By currency denomination	Local currency	-.022	-.032	-.02	545,760
			(.0074)	(.016)		
		Foreign currency	-.00923	-.0173	-.0254	545,760
			(.0062)	(.0196)		
		Difference	-.0126	-.0143	.0052	545,760
			(.008)	(.0231)		
C	By type of bank	Local banks	-.017	-.017	-.04	545,760
			(.0107)	(.011)		
		Foreign banks	-.0153	-.0153	-.0173	545,760
			(.0053)	(.0053)		
		Difference	.0021	.0021	.0228	545,760
			(.0101)	(.0101)		

Notes: This table reports the heterogeneous effects of the risk channel. It shows estimates of β_h at the impact ($h = 0$), peak (defined as the h with the largest difference between characteristics), and average effects for different firm and bank characteristics. For each characteristic, the table reports the estimated effect for each category and the difference. Two-way clustered standard errors at the time and firm levels are reported in parenthesis.

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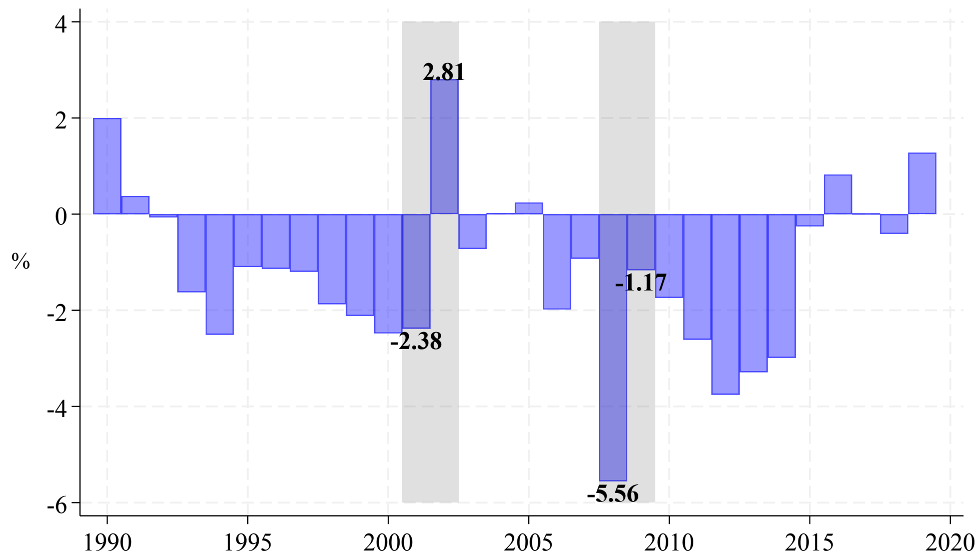
A. The Uruguayan Sudden Stops: Additional Tables and Figures

Figure A.1: Sudden Stop Episodes: Uruguayan Current Account Dynamics (% GDP)



Notes: This figure reports Uruguay's current account as a share of GDP. Data source: WDI. Shaded gray areas denote sudden stop episodes, with bold values indicating the current-account-to-GDP levels observed during these periods.

Table A.1: 2002 Sudden Stop Chronology

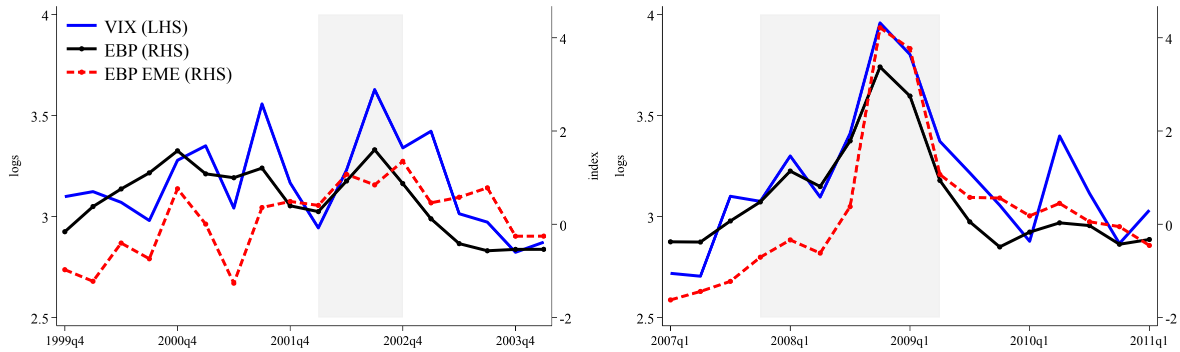
8/1998	Russia's devaluation
1/1999	Brazil's devaluation
6/2001	Uruguay extends crawling exchange rate band
12/2001	Argentina establishes the "Corralito"
	Argentinean president quits
	IMF suspends loan disbursements to Argentina
	Argentina defaults
1/2002	Argentina's devaluation
	Uruguay re-extends crawling exchange rate band
2/2002	Argentina establishes the "Corralón"
	BCU intervenes to re-capitalize Banco Comercial, the main private bank
	BCU suspends Banco Galicia Uruguay and bank run starts
	Uruguay loses investment grade status
	Uruguay's Congress approves fiscal adjustment package
3/2002	Agreement between IMF and Uruguay was achieved for $743 million
4/2002	Foot-and-mouth disease ("Aftosa") breaks in Uruguay
5/2002	Uruguay's Congress approves 2nd fiscal adjustment package
6/2002	BCU intervenes in Banco Montevideo and La Caja Obrera
	Uruguay abandons crawling peg exchange rate regime
7/2002	Uruguay's Minister of Economy quits followed by the president of the BCU
	Uruguay declares bank holiday
8/2002	Bank holiday lifted after $3 billion bailout package provided by the US and mulilaterals

Notes: BCU stands for Central Bank of Uruguay. During the "Corralito," the government of Argentina imposed capital controls and deposit freezes on Argentine nationals, while during the "Corralón," these deposit freezes were tightened. *Sources*: Díaz (2018), De la Plaza and Sirtaine (2005).

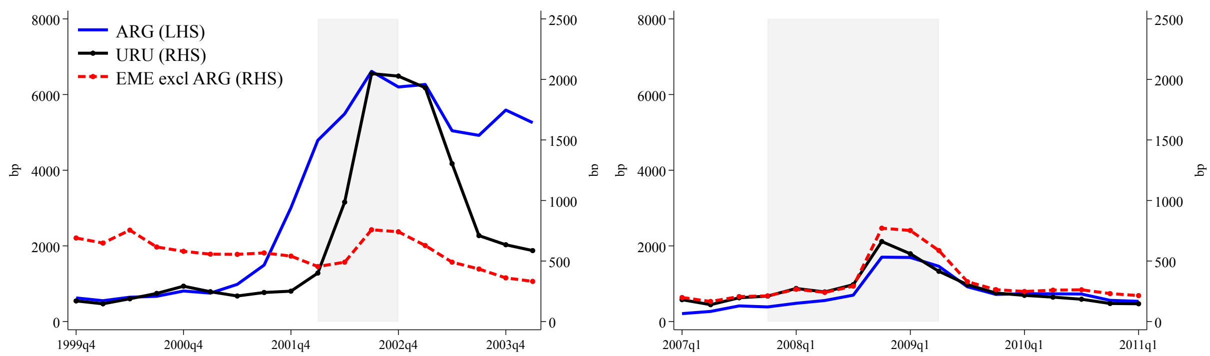
Figure A.2: Global and Regional Context during Sudden Stop Episodes

2002 episode | 2009 episode

a) VIX and EBP

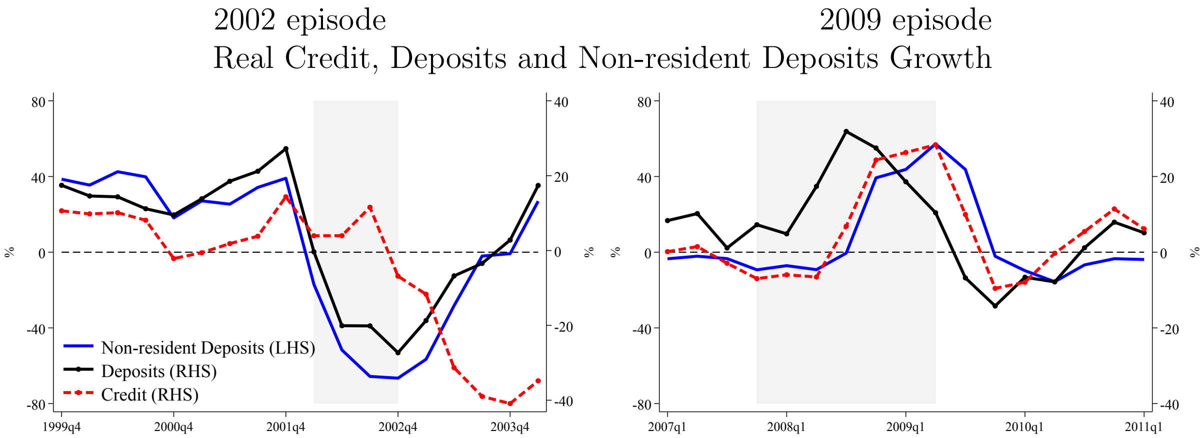


b) EMBI and Uruguay Bond Index (UBI) Spreads



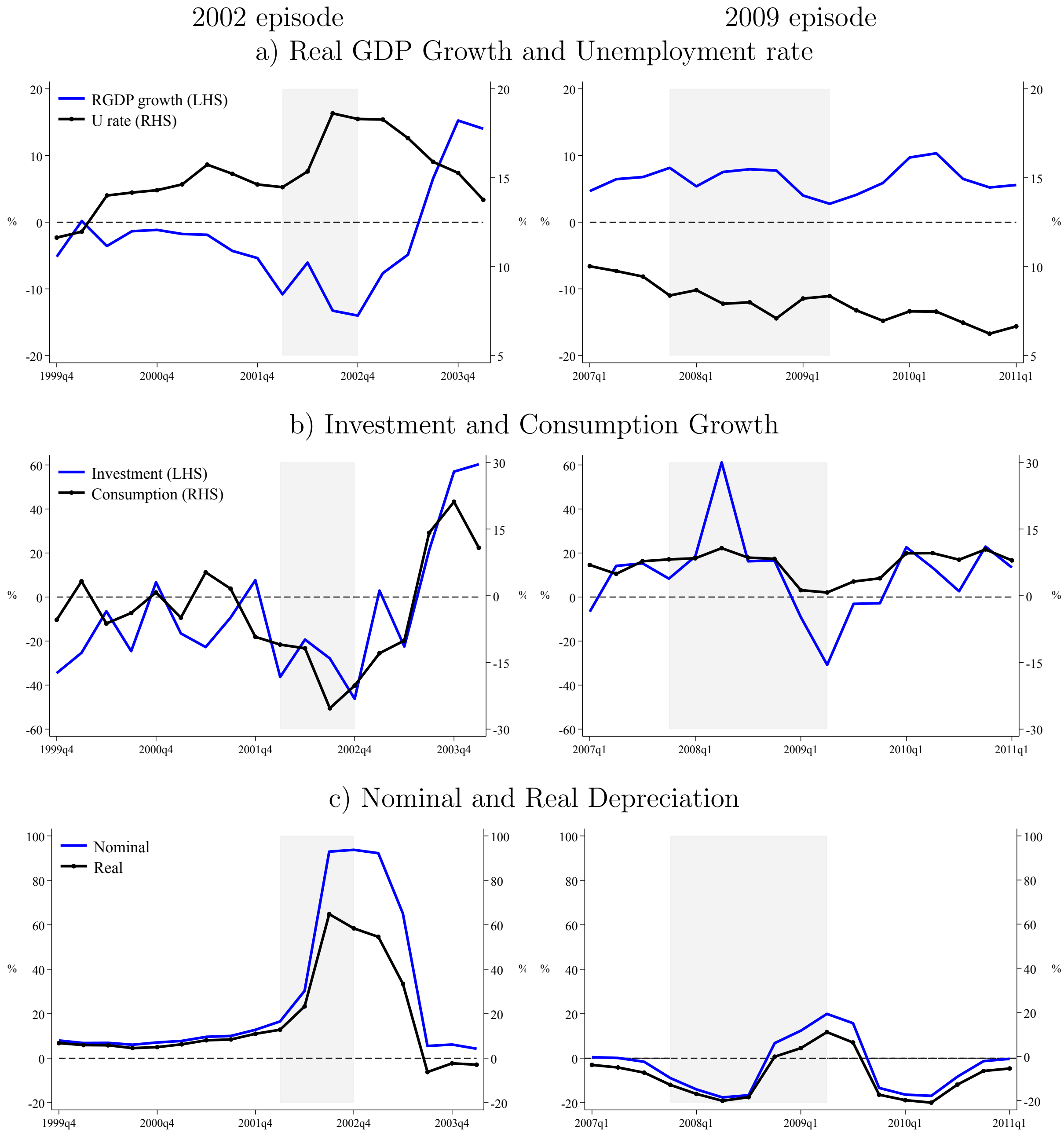
Notes: Panel (a) displays the VIX, the EBP from Gilchrist and Zakrajšek (2012), and the EME EBP from Hegarty *et al.* (2024). Panel (b) shows Uruguay's country risk index, the "Uruguay Bond Index" from República AFAP, which measures the average spreads of Uruguayan bonds over U.S. Treasury bill rates. Panel (b) also reports the EMBI spreads of Argentina and an EME average comprising the following countries: Brazil, Chile, Colombia, Ecuador, Korea, Malaysia, Mexico, Peru, the Philippines, South Africa, Thailand, Turkey, and Uruguay. Shaded gray areas denote periods of GDP growth decline associated with each sudden stop episode. *Sources*: Hegarty *et al.* (2024), FRED, Gilchrist and Zakrajšek (2012), World Bank, and República AFAP.

Figure A.3: Banking Sector Dynamics during Sudden Stop Episodes



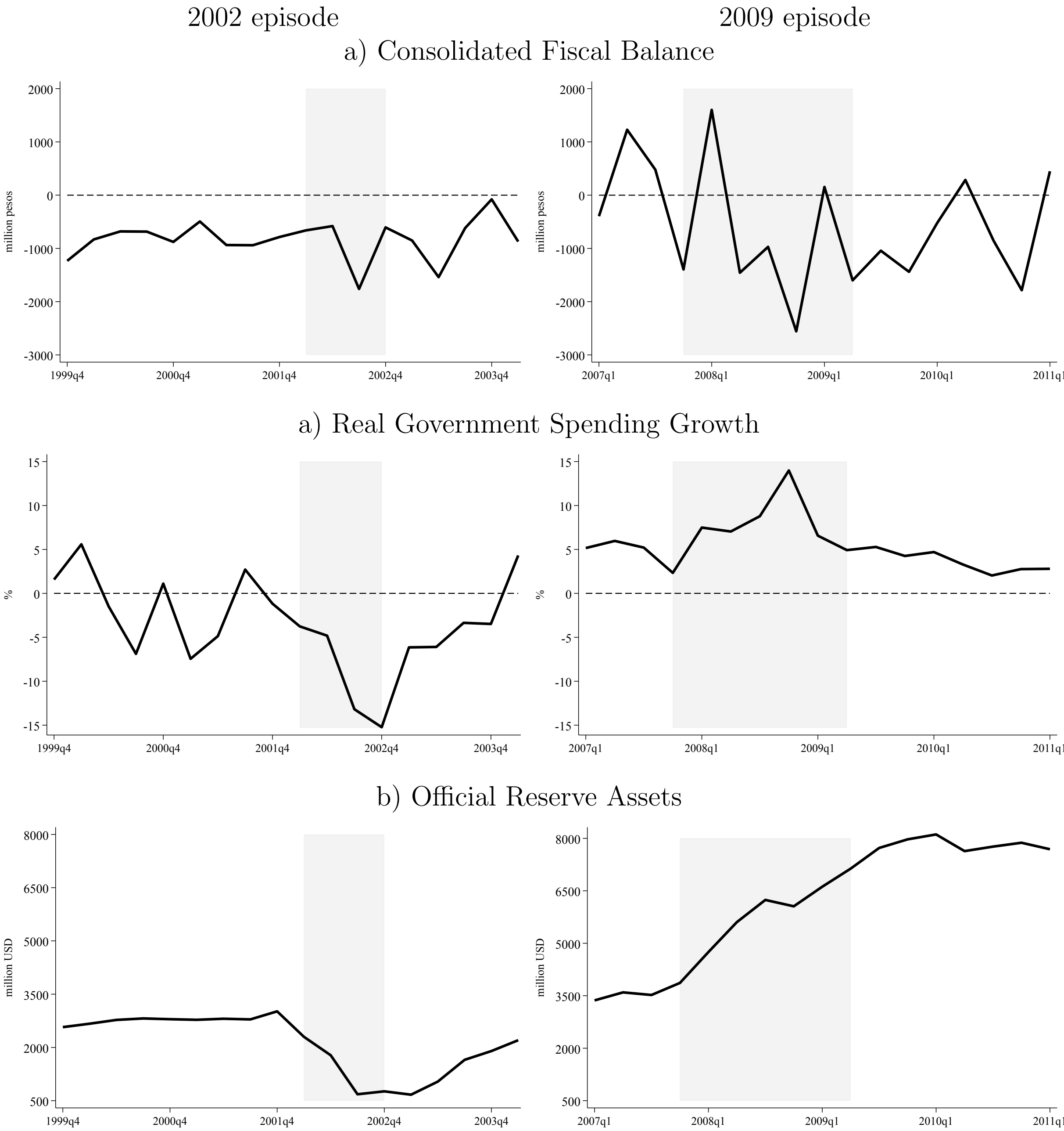
Notes: This figure reports the real growth rates of credit, deposits, and non-resident deposits within the financial system (including private banks, public banks, cooperatives, and non-bank financial institutions). All growth rates are year-over-year and expressed as percentages. Shaded gray areas denote periods of GDP growth decline associated with each sudden stop episode. *Source*: Central Bank of Uruguay.

Figure A.4: Economic Activity and the Exchange Rate during Sudden Stop Episodes



Notes: Panel (a) shows real GDP growth and the unemployment rate. Panel (b) displays real investment and consumption growth. All growth rates are year-over-year, expressed in percentages, and based on seasonally adjusted raw series. Panel (c) reports real and nominal depreciation rates relative to the US dollar. All series are in percent. Shaded gray areas denote periods of GDP growth decline associated with each sudden stop episode. *Sources*: Central Bank of Uruguay and IMF-IFS.

Figure A.5: Fiscal and Reserve Dynamics during Sudden Stop Episodes



Notes: Panel (a) reports the consolidated fiscal balance. Panel (b) shows the year-over-year growth of real government spending, expressed as a percentage. The raw series are seasonally adjusted. Panel (c) reports official reserve assets in millions of USD. Shaded gray areas denote periods of GDP growth decline associated with each sudden stop episode. *Sources*: Central Bank of Uruguay and IMF-IFS.

B. Data description and additional results

B.1. Data description

In this section, we provide additional details on the variable definitions used in the empirical analysis of Section 4.

- *Firms' debt*: The dependent variable in all empirical models is based on firms' outstanding bank debt, expressed in local currency at 2005 prices using CPI deflation. To study the different channels, this variable is aggregated at different levels depending on the specification. In regressions at the firm level (e.g., (B.1)), b_{jt} is constructed by aggregating all outstanding debt of firm j in period t. In regressions at the firm–bank level (e.g., (1), (3)), b_{ijt} is constructed by aggregating the outstanding debt of firm j with bank i in period t. In regressions at the firm–collateral-type level (e.g., (2)), b_{kjt} is constructed by aggregating the outstanding debt of firm j backed by collateral type k. In regressions at the firm–bank–collateral-type level (e.g., (4)), b_{ijkt} is constructed by aggregating, for each firm j, all outstanding debt with bank i associated with collateral type k in period t.

- *Banks' return on assets* (R_{it}): Defined as after-tax net income divided by average total assets, using balance sheet data from the Central Bank of Uruguay.

- *Collateral type*: Under Uruguayan banking regulations, institutions must report a detailed description of the assets pledged as collateral for loans.[8] We classify collateral assets into 13 categories: government debt instruments, corporate debt instruments, cash deposits, real estate, trust funds, public credit guarantees, vehicles, machinery, goods/merchandise, insurance, cattle, land, and third-party guarantees.

- *Non-performing loan ratio*: Defined as the ratio of past-due gross loans to total gross loans for a firm at the corresponding level of aggregation, namely with a given bank, for a given collateral type, or for a given bank-collateral-type combination.

- *Ratio of liquid collateral to debt*: Defined as the ratio of the value of liquid assets pledged by firms as collateral in their borrowing from a bank, collateral type, or bank–collateral type

[8] See: Accounting standards for financial statement preparation.

(government debt instruments, corporate debt instruments, cash deposits, and public credit guarantees) to their debt at the corresponding level.

- *Share of short-term debt*: Defined as the ratio of total debt with a maturity of less than one year to total debt for a firm at the corresponding level of aggregation, namely with a given bank, for a given collateral type, or for a given bank-collateral-type combination.

- *Firm's credit rating*: Under Uruguayan banking regulations, borrowers are classified using a rating scale that reflects their payment capacity. The rating scale is as follows:[9]

  - Rating 1A: Back-to-back loans; loans fully covered by very liquid collateral.
  - Rating 1C: Borrowers with strong payment capacity (i.e., less than 10 days past due).
  - Rating 2A: Borrowers with adequate payment capacity (i.e., less than 30 days past due).
  - Rating 2B: Borrowers with potential problems in their payment capacity (i.e., less than 60 days past due).
  - Rating 3: Borrowers with compromised payment capacity (i.e., less than 120 days past due).
  - Rating 4: Borrowers with highly compromised payment capacity (i.e., less than 180 days past due).
  - Rating 5: Unrecoverable borrowers (more than 180 days past due).

In addition, Figure B.6 uses the following data for collateral values:

- *Price of land:* The price per hectare of land, originally expressed in USD and converted to 2005 prices in local currency using the CPI and the monthly average exchange rate. The data are from the *Ministerio de Ganadería, Agricultura y Pesca* (Ministry of Livestock, Agriculture and Fisheries).

- *Price of real estate:* The price per square meter of transacted properties, originally expressed in USD and converted to constant 2005 prices in local currency using the CPI and the monthly average exchange rate. The data are from Ponce (2015).

[9]From 1998 to 2004, there were five categories. Subsequently, the first two categories were expanded. For more details, see: Comunicación $N°$ 2019/001, Superintendencia de Servicios Financieros, BCU.

- *Price of cattle:* The price per kilogram of live cattle, originally expressed in USD and converted to 2005 constant prices in local currency using the monthly average exchange rate and the CPI. The data are from the Instituto Nacional de Carnes (National Meat Institute).

B.2. Firm-level estimates

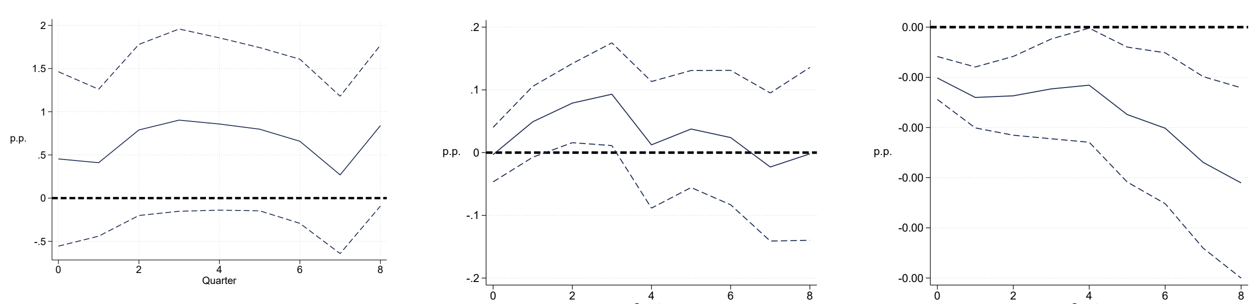
We analyze the lender channel at the firm level by estimating the following local projections:

$$\log b_{jt+h} - \log b_{jt-1} = \alpha_{jh} + \alpha_{th} + \beta_h Z_{jt} + \mathbf{\Gamma}'_h \boldsymbol{X}_{jt-1} + \varepsilon_{jt+h}, \tag{B.1}$$

where b_{jt} denotes the debt of firm j in period t. Z_{jt} measures the firm-level exposure to the lender channel and is defined as the average return on assets of the banks linked to firm j, i.e., $Z_{jt} \equiv \overline{R}_{jt} = \sum_i \omega_{ijt-1} R_{it}$, where R_{it} is the return on assets of bank i in period t and ω_{ijt-1} is the ratio of loans from bank i to firm j over total loans from all banks to firm j. The terms α_{jh} and α_{th} denote firm and time fixed effects. The control vector $\boldsymbol{X}_{jt-1}$ contains a similar set of variables to those in (1), but constructed at the firm level: the non-performing loan ratio, the ratio of liquid collateral to debt, the share of short-term debt, the time length since the first loan observed in the dataset (as a proxy for the firm's age), the firm's credit rating (measured by its riskiest loan), Z_{jt-1}, and $\log b_{jt-1}$. Panel (a) of Figure B.1 reports the estimates of β_h from (B.1) for different horizons, which are positive but not statistically significant.

Figure B.1: Channels of Transmission of Firms' Borrowing at the Firm-Level

(a) Lender channel **(b) Collateral channel** **(c) Risk channel**



Notes: This figure reports the estimates of β_h from three firm-level transmission channels (lender, collateral, risk). Confidence intervals at the 90% level use two-way clustered standard errors at the firm and time levels.

We also analyze the collateral channel at the firm level. For this, we estimate a version of (B.1) in which we define Z_{jt} as the average change in the value of collateral associated with all loans to firm j. Specifically, $Z_{jt} \equiv \overline{\Delta q}_{jt} = \sum_k \omega_{jkt-1} \Delta \log q_{kt}$, where q_{kt} is a measure of the value of collateral of type k in period t, and ω_{jkt-1} is the ratio of loans using collateral type k over total collateral from firm j. Panel (b) of Figure B.1 reports the estimates of β_h, which are positive and statistically significant at their peak effect in the second quarter, and not statistically significant thereafter.

Finally, we analyze the risk channel at the firm level. We do so by estimating a version of (B.1) in which we define Z_{jt} as the interaction between a measure of the risk of firm j and the emerging market excess bond premium (EBP). Specifically, $Z_{jt} = \text{Risk}_{jt-1}\,\text{EBP}_t$, where Risk_{jt} is the share of unsecured debt to total debt of firm j. Panel (c) of Figure B.1 reports the estimates of β_h for the risk regressions at the firm level for different horizons, which are negative and statistically significant for all periods.

B.3. Additional Figures and Tables

Figure B.2: Firms' Borrowing Dynamics during Sudden Stops

Notes: This figure reports, in the first row, the average change in firms' log debt, $\Delta \log b_{j,t}$, for the firms in our sample; in the second row, the average ROA, weighted by banks' total assets; and, in the third row, the average change in firms' log collateral values, $\Delta \log q_{j,t}$. The blue line denotes real GDP growth. All variables are expressed in percentage points. Shaded gray areas indicate periods of GDP growth decline associated with each sudden stop episode.

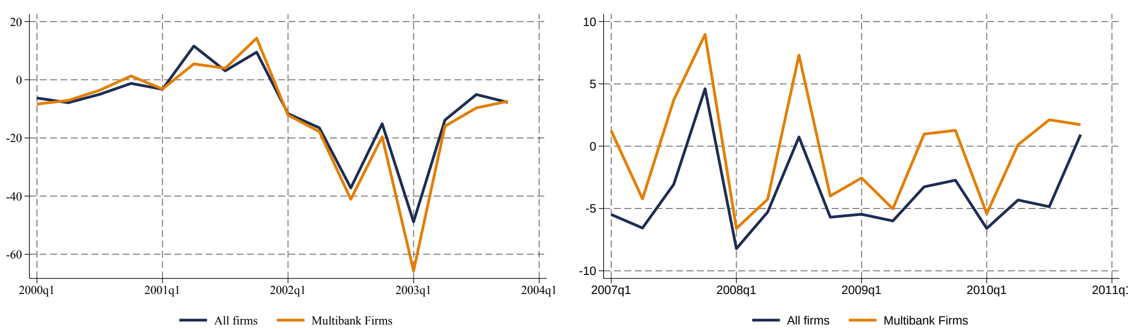
Figure B.3: Firms' Borrowing by Currency during Sudden Stops

2002 episode 2009 episode

(a) Firms' borrowing

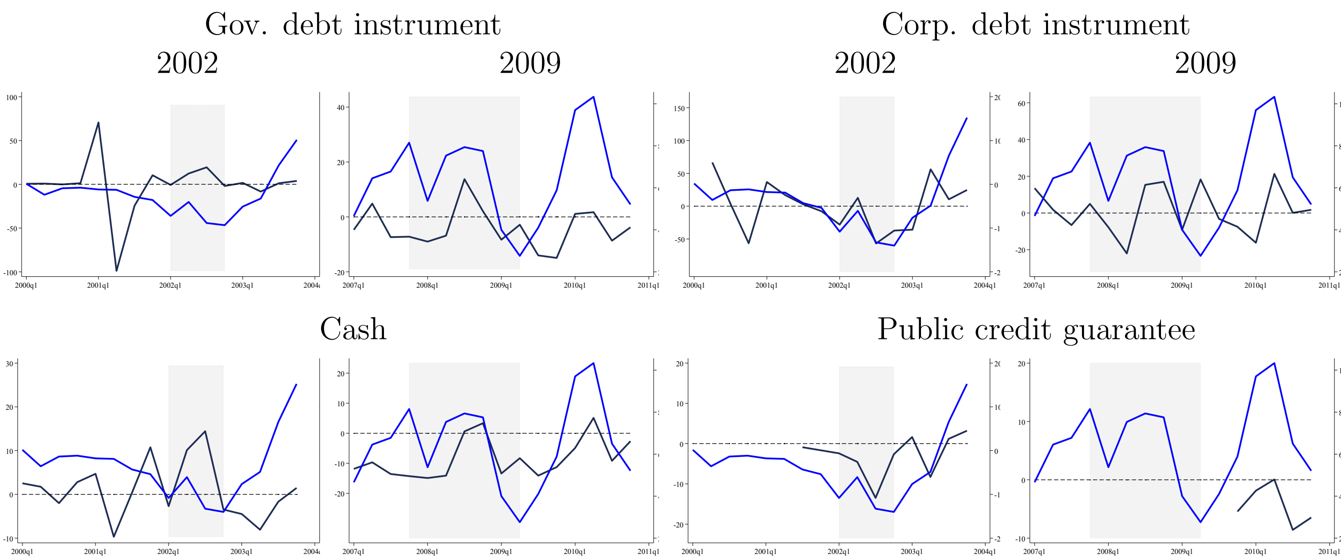
(b) Local currency debt

(c) Foreign currency debt



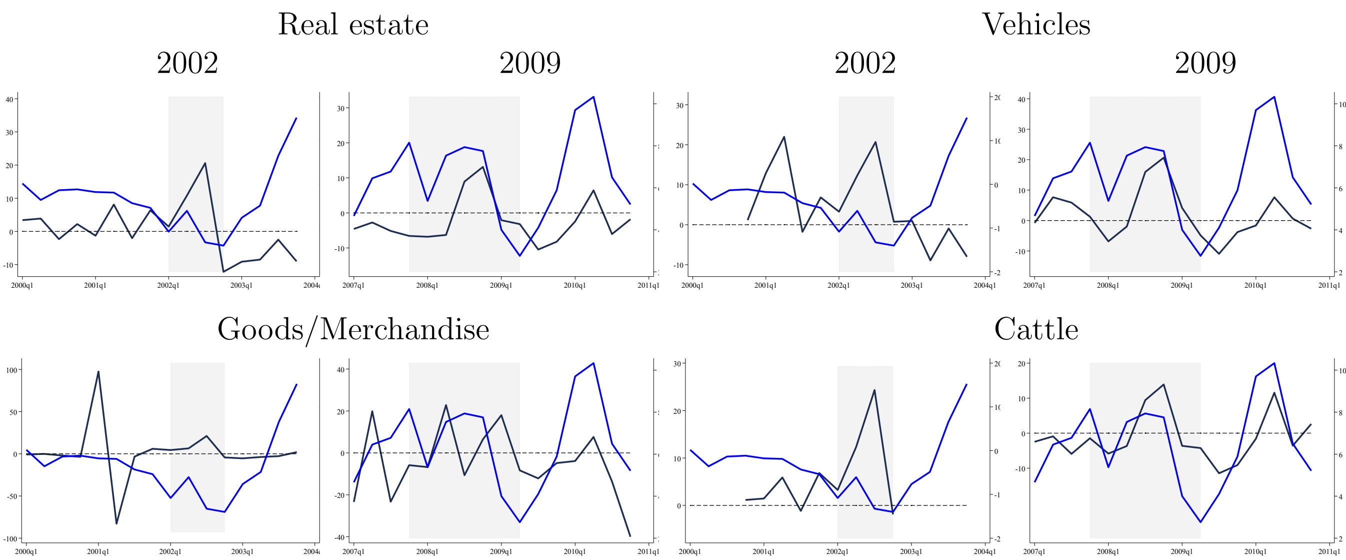
Notes: This figure reports the average $\Delta \log b_{jt}$ for firms in our sample during sudden stop episodes, expressed as a percentage, where b_{jt} denotes the debt of firm j in quarter t. "Multibank firms" refers to firms in our sample with two or more bank lending relationships within a quarter. Panel (a) shows total debt, Panel (b) shows debt denominated in local currency, and Panel (c) shows debt denominated in foreign currency. All variables are expressed in percentage points.

Figure B.4: Average dynamics of firms' collateral (liquid assets)



Notes: This figure reports the average change in collateral values for liquid types of collateral. The dark blue line denotes the growth rate of collateral values (left axis), while the blue line represents the growth rate of real GDP (right axis). For each series, we include only loans associated with a single type of collateral and then compute the total collateral value for each type at the firm level. All variables are expressed in percentage points. Shaded gray areas denote periods of GDP growth decline associated with each sudden stop episode.

Figure B.5: Average dynamics of firms' collateral (illiquid assets)

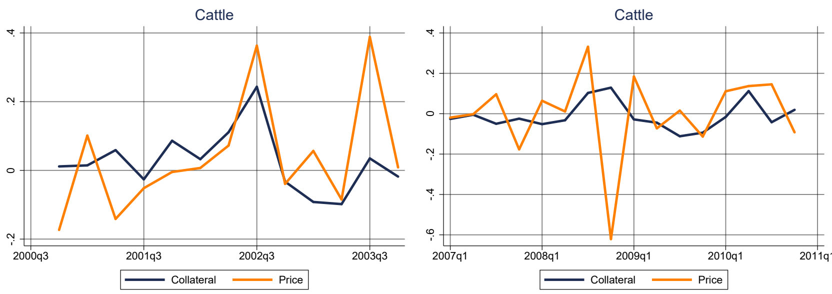


Notes: This figure reports the average change in collateral values for non-liquid types of collateral. The dark blue line denotes the growth rate of collateral values (left axis), while the blue line represents the growth rate of real GDP (right axis). For each series, we include only loans associated with a single type of collateral and then compute the total collateral value for each type at the firm level. All variables are expressed in percentage points. Shaded gray areas denote periods of GDP growth decline associated with each sudden stop episode.

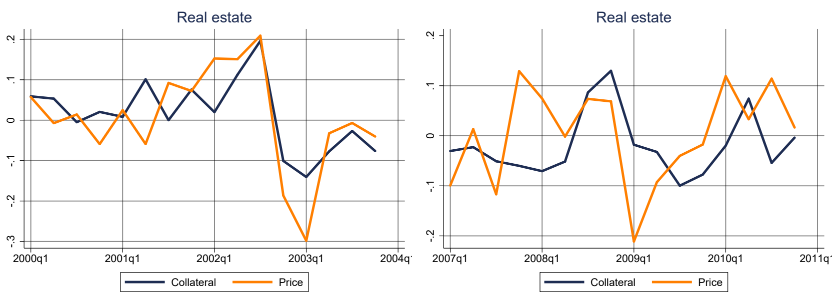
Figure B.6: Change in asset prices and change in collateral value

2002 episode 2009 episode

(a) Cattle



(b) Real Estate



(b) Land

Notes: This figure reports the average change in the log of the value of each type of collateral, along with the change in the corresponding asset price. Panel (a) shows the change in collateral value and price of cattle, Panel (b) shows the change in collateral value and price of real estate, and Panel (c) shows the change in collateral value and price of land.

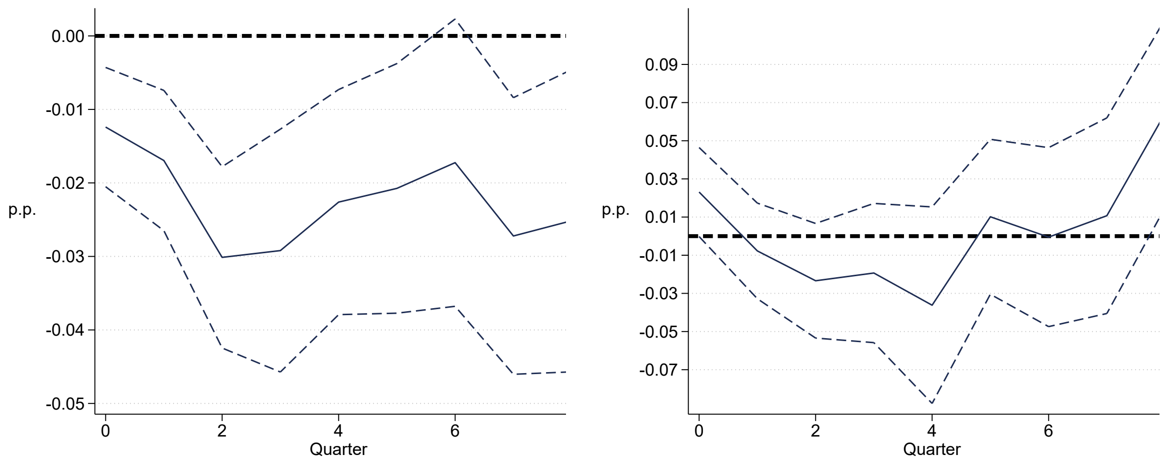
Table B.1: Channels of Transmission: Robustness Analysis

			Impact	Peak	Average	Obs
Panel A: Lender Channel						
A	Baseline		0.83	1.16	0.82	527,397
			(0.189)	(0.815)		
B	Robustness	No controls	0.85	1.15	0.80	527,397
			(0.189)	(0.819)		
		Separate firm and time FE	0.80	1.19	0.86	527,397
			(0.182)	(1.055)		
Panel B: Collateral Channel						
A	Baseline		0.09	0.37	0.17	15,786
			(0.088)	(0.277)		
B	Robustness	No controls	0.09	0.38	0.15	15,786
			(0.089)	(0.276)		
		Separate firm and time FE	0.09	0.27	0.07	15,786
			(0.069)	(0.194)		
Panel C: Risk Channel						
			Impact	Peak	Average	Obs
A	Baseline		-0.02	-0.04	-0.03	542,785
			(0.006)	(0.014)		
B	Robustness	No controls	-0.02	-0.04	-0.03	542,785
			(0.006)	(0.014)		
		Separate firm and time FE	-0.02	-0.04	-0.02	542,785
			(0.004)	(0.012)		

Notes: This table summarizes the estimates of β_h for different specifications. *Impact* corresponds to the estimated elasticity for $h = 0$. *Peak* refers to the largest estimated elasticity across all horizons within two years. *Average* reports the average elasticity across all horizons within two years. Double-clustered standard errors at the time and firm level are in parentheses.

Figure B.7: The Risk Channel of Firms' Borrowing During Sudden Stops: VIX (loan-level)

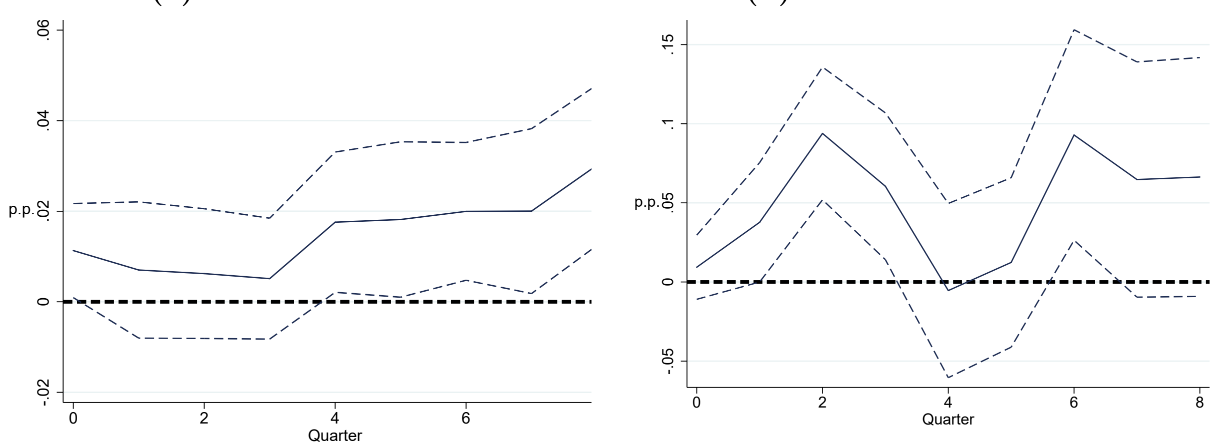
(a) Baseline **(b) Sudden-stops**



Notes: This figure estimates the risk channel using the VIX as a global risk premium measure. Panel (a) reports the estimates of β_h (see Section 4.1). Panel (b) reports the estimates of γ_h (see Section 4.2). Dashed lines indicate confidence intervals at the 90% level, using two-way clustered standard errors at the firm and time levels.

Figure B.8: The Lender and Collateral Channels: Alternative Specifications

(a) Lender channel **(b) Collateral channel**

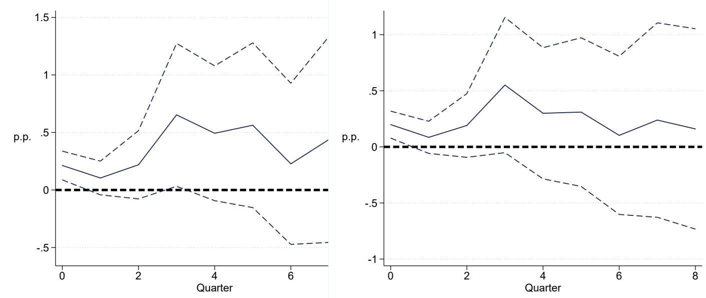


Notes: This figure reports the estimates of β_h from alternative empirical models at the loan level. The left panel shows results for the lender channel, and the right panel shows results for the collateral channel. For the lender channel, we replace the bank's returns on assets variable with a dummy indicating when bank returns are above the quarter mean. For the collateral channel, we replace the collateral value variable with a dummy indicating when the change in collateral value is above the quarter mean across collateral types. Confidence intervals at the 90% level use two-way clustered standard errors at the firm and time levels.

Figure B.9: Simultaneous Estimation of All Channels

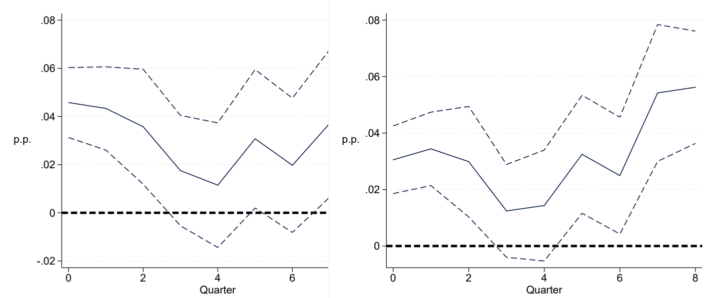
Lender channel

(a) Separate estimates (b) Joint estimates



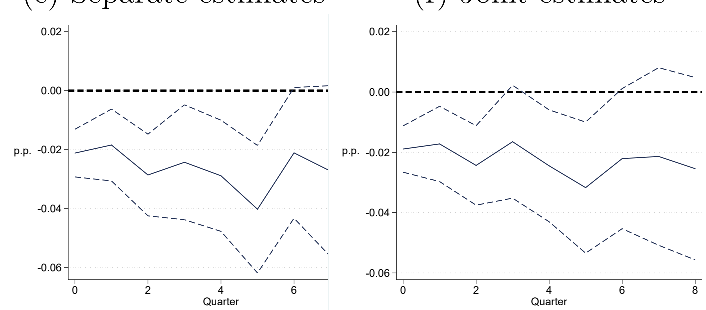
Collateral channel

(c) Separate estimates (d) Joint estimates



Risk channel

(e) Separate estimates (f) Joint estimates



Notes: This figure reports the estimates of β_h from the joint estimation of all channels. The left column shows the results of estimating each channel separately with data disaggregated at the firm-loan level. The right column shows the results of jointly estimating all channels. See Section 4.1 for further details on the regression specifications. Confidence intervals at the 90% confidence level are shown with dashed lines, using double-clustered standard errors at the time and firm level.