How to Respond to a Sudden Stop in Firm Financing— Government or Market? Lessons from the Pandemic-Era Policies[*]

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Abstract

Using administrative data of the universe of Chilean firms, we test the role of a new credit line from the Central Bank and of government-backed credit guarantees on firms' financing during the onset of COVID. Our identification rests on regression discontinuity design, where eligible firms increased their debt from domestic lenders relative to foreign lenders. By reducing the cost of local currency debt vis-a-vis the foreign currency debt, from domestic lenders, policies reduced the UIP premium of firms eligible for guarantees. An open economy model of heterogeneous firms with financial frictions accounts for these facts. An increase in the external debt default risk leads to a higher mass of firms demanding credit from domestic lenders, who are risk averse and lower their credit supply. The model shows how government policies complement each other to fully offset these demand and supply side costs. Government guarantees loosen firms' domestic collateral constraints and reduce banks' risk aversion, while the Central Bank credit facility increases the aggregate supply of credit in the economy.

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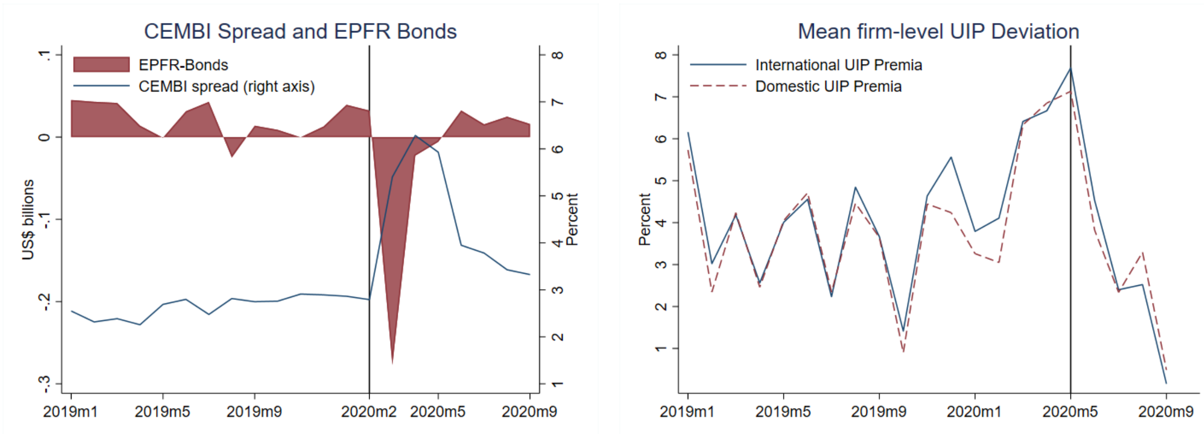
1 Introduction

Since the Global Financial Crisis of 2008, the use of unconventional policies has gained relevance among the stabilization tools available to policymakers when confronting large macroeconomic shocks. As the COVID-19 shock hit in 2020, their use took central stage in the policy packages deployed across countries, as capital flows retrenched, conventional monetary policies became constrained by the zero lower bound, and fiscal spaces shrank. Indeed, as the pandemic wreaked havoc on human lives and economies worldwide, governments, Central Banks, and regulators came up with a panoply of new and unconventional policies to counteract its economic impact. Our work studies the effectiveness of these policies. We do so through the analysis of a unique micro dataset of firms and unconventional policies deployed in Chile, as well as through a small open economy heterogeneous firms model that we build to account for our empirical findings.

We focus our analysis both on the choices between domestic and external debt, that is debt from domestic vs foreign lenders, and between local currency and foreign currency debt from domestic lenders. We consider both bond issuance and bank credit, as domestic firms face a sudden dry-out of available funds in international markets amid the onset of COVID. In particular, we study a credit support policy package aimed at helping both borrowers and lenders: a new Central Bank credit line facility for commercial banks, where access was granted conditional on the growth of credit issuance to firms below a certain size threshold; and the availability of sovereign guarantees on commercial banks' loans to firms, again for firms below a certain size threshold. The unique design of the policy lends itself to an RDD identification. Since only firms below an exogenous size cutoff were eligible, we can pin down the causal effects of these policies on the financing decisions of firms. As we also have access to firm-level interest rates, we can explicitly test the impact of policy on market rates, akin to transmission of monetary policy.

Figure 1 illustrates the magnitude of the shock and lays out several channels through

Figure 1: The COVID Shock in Chile: Capital Flows, Risk and UIP Premia



Notes. The left panel depicts the fund flows' EPFR measure and the CEMBI spread for Chile (right axis). The vertical line denotes February 2020, the month before the first COVID case in Chile in March 7, 2020. The data sources are, respectively, Informa PLC and Bloomberg. The right panel depicts our data's average International UIP Premia (solid blue line shows difference in firms borrowing rates on local and USD debt from foreign lenders after adjusting for exchange rate changes) and Domestic UIP Premia (dashed red line shows difference in firms borrowing rates on local and USD debt from domestic lenders, after adjusting for exchange rate changes). The vertical line denotes May 2020, the month when the sovereign guarantees policy was implemented. The source for the data in the right panel is explained in Section 3.

which the policies deployed might operate. The left panel documents how cross-border bond flows in dollars to Chile experienced a very sharp reversal of unprecedented size while the dollar default risk premia linked to corporate debt issuance in dollars abroad–captured with the CEMBI spread–more than doubled as the pandemic spread throughout Chile between March 2002 and June of that year.[1] The pattern described in the left panel is representative of emerging markets, a classic sudden stop with reduced access to international capital markets with capital flows exhibiting a sharp contraction and increased default risk premia, which stayed above pre-shock levels for at least the six months horizon depicted in the Figure.[2] The important thing to notice here is that while CEMBI captures only default risk, UIP, plotted on the right panel, captures both default and currency risk.

To make this point clearly, the right panel makes use of the firm level data that we

[1]The increase in the CEMBI spread and the fall in the EPFR bond flows was, respectively, about 5 and 4 standard deviations. For the UIP deviation it was about 4 standard deviations.

[2]The Appendix reproduces this figure for a panel of emerging markets and documents how the behaviour observed in the left panel is robust to looking at a larger sample of countries.

employ in our analysis by plotting the average uncovered interest parity (UIP) premia of firms' debt in foreign markets (blue, solid) and domestic markets (red, dashed) capturing the local currency risk premia that firms faced by borrowing in domestic currency from foreign lenders offshore and from domestic lenders onshore, respectively. Both measures of UIP premia more than doubled at the onset of the shock, from an average of about 3 percent in 2019 to 7 percent between March and May of 2020. This spike in UIP premia is reminiscent of earlier episodes of risk off and sudden stop in capital flows to emerging markets since these episodes are also associated with sharp currency depreciations vis-a-vis the dollar. In this particular episode, UIP premia came down fast to below pre-shock levels after May 2020. Interestingly, the decrease in the UIP premia coincides with the month when the credit support policy package was deployed (vertical line in the right panel), suggesting that their transmission channel operated through decreasing the UIP premia, something that we study in depth in our work.[3]

The administrative dataset that we analyze allows us to examine the finance mix for the universe of firms in Chile, in terms of their debt issuance—bonds and loans—in both domestic and international markets, and in both local and foreign currencies. Our empirical analysis yields two important findings. First, the RDD results show that eligibility for sovereign guarantees causes firms to increase their domestic debt. An eligible firm just to the left of the size cutoff has a domestic debt share 9.4 percentage points larger than an ineligible firm just to the right. This well-identified micro elasticities also impact the aggregate economy as eligible firms represent 18 percent of GDP in Chile. The increase in domestic credit by these firms at the beginning of the crisis reached about 1 percent of 2020's GDP. The RDD results are robust to a placebo period test, a manipulation test, as well as using alternative specifications of the polynomial regression in the RDD.

The second main finding from our empirical analysis is that the key underlying mech-

[3]See Basu and Gopinath (2024) for a model where the use of MCM/CFM measures during a risk-off shock that reduces the UIP wedge improves welfare.

anism behind the increase in domestic debt is the pricing of credit. Through loan-level regression analysis, we find that Chilean firms face a domestic UIP premium always that increased during the sudden stop. This result is in line with the well-established finding in the literature that a UIP premium exists, rendering dollar debt relatively less expensive than local currency debt in emerging markets (Kalemli-Ozcan and Varela, 2021). Indeed, between 2012 and 2019 we estimate a domestic UIP premium of around 4 percent, broadly in line with that found in other emerging markets like Turkey and Peru (di Giovanni et al. 2021; Gutierrez et al. 2023). Next, we zoom in on the onset of COVID in Chile, between March and July 2020, and find the crucial result that such premium disappears for firms that were eligible for the sovereign guarantees program. This is not the case for ineligible firms. This is a peculiar result in terms of sovereign back stopping currency risk. We document that the reduction in the UIP premium for eligible firms is mainly due to an average reduction in the domestic interest rate on local currency debtas opposed to an increase in the foreign interest rate and/or an appreciation of the dollar. We also show that the reduction of the UIP premium cannot be traced back liquidity or convenience yield of the dollar, that is an upward pressure over the interest rates of dollar-denominated loans due to banks having difficulty in obtaining dollar funding abroad, and thus a lower supply of dollar-denominated loans. These results are robust to including a rich battery of fixed-effects.

On the theoretical front, we build and analyze a two-period small open economy model with heterogeneous firms. The model complements our empirical analysis by matching our empirical results and also by allowing us to perform policy counterfactuals, where we study each policy separately, allowing us to study the independent impact of each pillar and, crucially, the extent to which the two complemented each other. The model features firms that can borrow domestically and abroad, and face different collateral constraints in each market à la Caballero and Krishnamurthy (2001). Crucially, different from them, we assume firms are heterogeneous in their international collateral. This limits how much they can borrow abroad and ensures that, consistent with the empirical evidence, firms also finance themselves in the domestic credit market. The supply of domestic credit comes from financial intermediaries who lend to firms what they obtain from households and the Central Bank. A critical element in the domestic supply of credit is financial intermediaries' risk aversion, which is assumed to increase amid shocks like COVID, and can be mitigated by the unconventional policies modeled.

The model displays three key properties. First, it delivers an endogenous firms' finance mix between domestic and foreign debt, allowing us to study how this mix responds to shocks and policies. Second, it features that larger firms are more leveraged and issue more debt abroad relative to smaller firms, in line with the Chilean microdata. Last, also as in the data, the model features an endogenous interest rate wedge between domestic and foreign currency debt that stems from the differential collateral constraints.

Despite being quite stylized, the model can reproduce the change in the firms' finance mix and the behavior of interest rates documented in our empirical analysis, shedding light on the mechanisms at play. The model points at the interplay of two forces. On one hand, an increase in the cost of borrowing abroad makes firms move away from foreign debt and towards domestic debt, increasing the domestic debt share. On the other hand, absent domestic credit support policies, the model predicts a counterfactual increase in domestic interest rates and UIP deviation where local currency debt is more expensive than foreign currency debt. When credit support policies are active, model can endogenously generate the declining UIP deviations as observed in the data. We also show that, via policy counterfactuals, the credit line facility alone cannot fully offset the domestic rate increase. A policy of sovereign guarantees also alone cannot fully offset the shock since this policy relaxes constrained firms' collateral constraints, boosting their credit demand and raising domestic rates. Thus, the credit volume is restored to its pre-shock level, but the domestic interest rate continues to be much higher. Only when both pillars are active that the model can account for the observed behavior of the domestic credit market, with volumes (rates) at higher (lower) levels than before the shock.

The findings from our empirical explorations together with the insights from the model, allow us to draw several lessons. The sudden stop in capital flows amid the onset of COVID brought about the exclusion from international markets of many firms in emerging markets. The Chilean firm-level microdata allow us to document how this was largely compensated by substituting foreign for domestic debt, and can be traced back to the credit support policies implemented. Indeed, the unconventional policy package deployed was effective in sustaining firms' financing and prevented a UIP spike observed in previous sudden stop episodes, thus tilting the debt composition towards domestic (peso) debt. The complementarity between a policy of sovereign guarantees on commercial bank loans to firms and a new Central Bank credit line to banks was crucial for the effectiveness of the policy.

Literature Review. Our work contributes to several strands of literature. A recent body of work focuses on how firms coped with the COVID shock and how the policies implemented helped these firms (see Gourinchas et al. 2020; Schivardi and Romano 2020; Gourinchas et al. 2021; Hassan et al. 2020; Albagli et al. 2021; Huneeus et al. 2022; among others). Another strand, focusing on emerging markets, has highlighted the difficulties for these countries in dealing with the shock, given their lack of fiscal space and reduced foreign financing, due to the turmoil in international markets (see Kalemli-Ozcan 2020; OECD 2020; BIS 2021; IMF 2021; among others). The intersection between these two strands, however, remains empty. Our work fills this gap by documenting how firms reacted to the sudden drying out of international financing through adjustment of their finance mix between international and domestic finance, and the extent to which this was related to credit support policies implemented by Central Banks.

By shedding light on the pricing of credit as the conduit for the debt substitution and the effectiveness of policies to compress the UIP premia, our work speaks also to a well established literature that has explored UIP premia and its determinants (e.g., Engel 2016;

Gopinath and Stein 2021; Gutierrez et al. 2023; Kalemli-Ozcan 2019; Kalemli-Ozcan and Varela 2021). Our work also expands the theoretical literature that models the access to international markets by emerging market firms in the presence of financial frictions (see Caballero and Krishnamurthy 2001; Lorenzoni 2008; and Rojas and Saffie 2022; Salomao and Varela 2022; among others), and the body of work that has studied the relationship between firm size and leverage (Rajan and Zingales 1995; Dinlersoz et al. 2019; and Gopinath et al. 2017). Lastly, our paper contributes to the recent strand of literature that rationalizes the use of unconventional policies to cope with external shocks by emerging markets characterized by various financial frictions (Basu et al. 2020; Adrian et al. 2021). In particular, our work provides evidence of–and a conceptual framework to rationalize–how government interventions can simultaneously address UIP premia linked to local currency debt markets and sudden stops that dry out dollar debt markets.

The rest of the paper is divided as follows. Section 2 describes in further detail the credit support policies implemented in Chile in the wake of COVID-19. Section 3 provides the empirical results of the paper and further robustness checks. Section 4 lays out the model and the various simulation exercises conducted. Concluding remarks are in Section 5.

2 Credit Support Policies Implemented

Like most countries, Chile experienced a sharp decrease in economic activity as the pandemic triggered by COVID-19 spread. In the second quarter of 2020, output and private consumption fell by 14.2% and 20.4%, respectively, relative to the same quarter of 2019. This was the trough of the crisis, with the largest drop in economic activity in recent history.[4]

The COVID crisis had a different nature than any other recent downturns, amplified through both supply and demand channels. Due to the sanitary restrictions and lockdowns

[4]During the global financial crisis, the trough of GDP growth in Chile was −3.32% during the first quarter of 2009. In 1999, during the crisis triggered in East Asia, the largest yearly fall in output was −3.43% during the first quarter of 1999.

enforced–well justified to minimize contagion and the loss of lives–, output fell initially because of a large drop in aggregate supply. With subsequent job losses and the fear of contagion, aggregate demand also fell. In this context, policy responses included new measures focused on minimizing potential scarring effects on firms and supporting household consumption.

As highlighted by Costa (2021) and the Central Bank of Chile's Monetary Policy Reports in 2020 and 2021, such policy responses were considerable in Chile. The Central Bank lowered the monetary policy rate (MPR) to its effective lower bound of 0.5% at the onset of the crisis in March 2020 and launched a series of special credit line facilities of more than 10% of GDP. Crucially, such credit programs were complemented by sovereign guarantees on commercial bank loans to firms that allowed to cover loans of up to 9% of GDP.[5]

We study the two main unconventional policies implemented at the onset of the COVID crisis to support credit to firms in Chile: 1) FCIC: a new credit line facility from the Central Bank to commercial banks conditional on the growth of credit issuance to small and medium firms;[6] and 2) FOGAPE-COVID: a program aimed at extending sovereign credit guarantees on commercial banks' loans to firms–below a chosen pre-determined size–for working-capital purposes.[7] We explain such policies in greater detail next.

2.1 Special Central Bank Credit Lines to Commercial Banks: FCIC

FCIC was a policy of unprecedented size and was implemented in various stages. It started in March 2020 as a credit line to commercial banks for four years at a fixed interest rate equal to the MPR. Most of these credits were given at the effective lower bound of the

[5]By the second half of 2020, the government also implemented policies aimed at supporting households via transfers, and Congress passed a law authorizing early withdrawals of pension savings, all of which are beyond of the scope of this paper. See Costa (2021) for a thorough explanation of the policies implemented during the COVID-19 crisis in Chile.

[6]There were other policies implemented by the Central Bank of Chile to ease financial conditions (e.g., bank bond purchases), but the size of FCIC was considerably larger than the rest.

[7]The Spanish acronym FCIC translates: Credit Facility Conditional on Lending, while FOGAPE translates as Guarantee Fund for Small Entrepreneurs

MPR (0.5%).

The first stage of FCIC was worth USD 24 billion, about 8.4% of Chile's 2019 GDP. Banks could access up to 15% of the loans in their balance sheets, out of which 3% had unconditional access to stimulate the demand for this credit line. To use the rest of the credit line, banks had to show an increase in their lending to either firms or households. There were additional incentives to credits given to small and medium firms. Access to FCIC required collateral. Part of it could be bank reserves held at the Central Bank; the rest required other assets. Access to this credit line was open for six months, after which 95% of it was used.

In June 2020, the Central Bank launched a second phase of FCIC with nearly USD 16 billion available and accessible for eight months. This second rollout of FCIC, FCIC-2, was conditional on the increase in either FOGAPE-COVID loans or loans to other non-banking credit institutions. The use of FCIC-2 was 30%. The other 70% was used in FCIC-3, triggered in March 2021, and tied to another FOGAPE program called "FOGAPE Reactiva" (aimed at stimulating firms' demand for investment).

2.2 Sovereign Credit Guarantees on Loans: FOGAPE-COVID

The FOGAPE program dates back to 1980 and makes government resources available for small and medium firms to use as collateral in bank loans, with the loan fraction accessible depending on firm size. Crucially, FOGAPE eligibility depends on yearly sales, defined in UF, an inflation-indexed unit of reference in Chile that varies daily.[8]

Resources used as guarantees come from a government fund with the sole purpose of acting as collateral for firm loans. The fund has been capitalized over the years. Before November 2019, firms with yearly sales below 25,000 UF were eligible to access FOGAPE loans. The program was expanded in October 2019 after the drop in economic activity due

[8] By January 31^{st}, 2019, $1UF = 34.5USD$.

to the episode of social unrest in Chile. By January 2020, it had been capitalized with USD 100 million, and the sales eligibility threshold increased to 350,000 UF.

On April 25, 2020, the government launched the FOGAPE-COVID program, which included a massive recapitalization of the fund by USD 3 billion, guaranteeing up to USD 24 billion in credits. It would only cover new and working-capital loans, providing guarantees between 60% and 85% of each credit depending on firm size.

Table 1 presents a summary of the main FOGAPE-COVID characteristics and compares them to the standard FOGAPE program that existed before the onset of the pandemic. Some institutional changes are worth highlighting. First, and critically for our empirical work, FOGAPE-COVID increased the cutoff required to access the typical FOGAPE credit from 350,000 UF to 1 million UF. Second, contrary to the previous version of the program, where the interest rate was the market rate, FOGAPE-COVID had an interest rate ceiling of the MPR plus 300 basis points. Finally, the fraction of the loan guaranteed and the maximum FOGAPE loan increased for all firm sizes.

Table 1: FOGAPE in April 2020 vs January 2020

	FOGAPE - Jan 2020	FOGAPE-COVID - April 2020
Fund capitalization (USD Millions)	100	3,000
Interest rate (CHP)	Market	MPR+3%
Max. annual sales eligibility threshold (UF)	350,000	1,000,000
	Fraction guaranteed/maximum loan value	
Sales range (UF)	Jan-20	May-20
0 - 25,000	80% - 5,000 UF	85% - 6,250 UF
25,000 - 100,000	50% - 15,000 UF	80% - 25,000 UF
100,000 - 350,000	30% - 50,000 UF	70% - 150,000 UF
350,000 - 600,000	Non elegible	70% - 150,000 UF
600,000 - 1,000,000	Non elegible	60% - 250,000 UF
$>$ 1,000,000	Non elegible	Non elegible

Notes: FOGAPE-COVID was triggered at the very end of April 2020. Sources: Chilean Financial Markets Commission and the Chilean Congress.

An important feature of FOGAPE-COVID, not included in Table 1, is that eligibility for the program was based on past sales from 2019.

The details of how FOGAPE-COVID was implemented provide an adequate setup to evaluate the effect of becoming eligible for these loans over a specific outcome variable. The fact that firms in the neighborhood of the cutoff were never treated with FOGAPE eligibility before and that such a cutoff is exogenous and based on a past outcome(sales of 2019) led us to use a Regression Discontinuity Design (RDD) for this purpose, as presented in the next Section.

3 Empirics

3.1 Data

The information used in this work comes from merging various administrative datasets owned by the State. The Central Bank of Chile created and maintains the repository with this data to support policy-making, statistics, and research.

For this project, we merged five administrative anonymized datasets from the universe of firms in Chile which allow us to document the entire spectrum of firms' finance mix: 1) Deudex: a foreign debt dataset, which contains all foreign debt loans (both stocks and flows) including a rich set of loan characteristics such as interest rates, maturity, currency, etc., between April 2012 and December 2020; 2) D32: a credit registry on firm-to-domestic bank new loans and their conditions, which we complement with that of firm-to-bank FOGAPE-COVID loans during 2020; 3) D10: consolidated debt stocks of firms with the domestic banking system; 4) Domestic Bond Issuance: records the value of each firm's bond issuance in the domestic bonds market; and 5) F29: firms' total monthly sales from value-added tax records.

The primary source for Deudex is the Central Bank of Chile; D32, D10, and the Domestic Bond Issuance are collected by the Chilean Financial Markets Commission, and F29 by the

Chilean IRS.[9] To our knowledge, we are the first to merge those datasets to study how credit support policies implemented during the COVID-19 crisis affect the firms' finance mix between domestic and foreign debt.[10]

The merged dataset has a monthly frequency between April 2012 and December 2020. For firms that borrow abroad directly, we keep only non-trade credit loans and bond issuance. We keep foreign credits in US Dollars, Euros, Japanese Yen, or Chilean Pesos, which represent more than 98% of total external borrowing. We also keep only credits with positive spreads to avoid distorting the data with credits that are not likely to represent a real need for credit.[11]

Table 2: Descriptive statistics - Merged Dataset

	Domestic loans	Foreign loans	Domestic interest rate (CHP -%)	Foreign interest rate (USD - %)	Foreign interest rate (CHP Ex-Post UIP - %)
Mean	150166 USD	39530000 USD	13.2	3.3	10.2
Standard Deviation	1164683 USD	184548000 USD	8.8	2.3	9.1
Total yearly loans (% of GDP)	34.59	32.13			
Number of loans	1972626	9872			
	Domestic loans only	Foreign loans only	Domestic and Foreign Debt	All firms	
Total yearly sales (% GDP)	122.2	2.8	32.7	157.7	
Total yearly sales (% F29 total sales)	56	1.3	14.9	72.3	
Number of firms	282922	465	703	284090	

Notes: The moments presented in both panels of the Table are from the merge of Deudex, D32, Foreign Debt, D10, and F29 datasets. The moments are averages for April 2012 to December 2020. Ratios to GDP are calculated on a yearly basis from 2013 to 2020 using Chile's nominal GDP, and then taking averages across years. The foreign interest rate measured in Chilean Pesos is calculated using ex-post UIP such that $i_t = i_t^\star + \frac{e_t}{e_{t-12}} - 1$, where t is the corresponding month.

Table 2 presents the most relevant descriptive statistics of our merged dataset. The top panel shows statistics regarding domestic and foreign credit conditions in our merged dataset. While the mean domestic peso loan has a size of about USD 150 thousand (using the spot exchange rate), the mean foreign loan is almost USD 40 million. This difference

[9] Disclaimer: Officials of the Central Bank of Chile processed the disaggregated data from the Chilean IRS and the Chilean Financial Markets Commission. The information contained in the databases of the Chilean IRS is of a tax nature originating in self-declarations of taxpayers presented to the Service; therefore, the data's veracity is not the Service's responsibility.

[10] Our work complements that of Albagli et al. (2021), which, unlike us, studies the real effects of credit support policies in Chile on firms' sales, employment, and investment. However, this work does not study firms' finance mix, which is our main focus. Huneeus et al. (2022) also studies access to credit support policies by firms in Chile during COVID and its impact on aggregate risk, but does not analyze changes in the finance mix.

[11] These are likely to be another type of transaction such as movement of resources between parent companies and their subsidiaries or temporary credits that work only for tax purposes, among others.

is natural since larger firms have access to foreign markets. The standard deviations show that domestic loans exhibit a higher dispersion in size than foreign loans.

The mean interest rate on a domestic loan in pesos is 13.2%, while for foreign loans in dollars it is 3.3%. Correcting the latter by (ex-post) UIP yields a mean of 10.2%. Hence, on average, it is cheaper to borrow abroad once you have access to external financial markets. Furthermore, fewer firms have access to foreign credit as the number of domestic loans is about 200 times larger than the number of foreign loans. The yearly debt stock-to-GDP ratio is 34.6% for domestic loans and 31.13% for foreign loans.

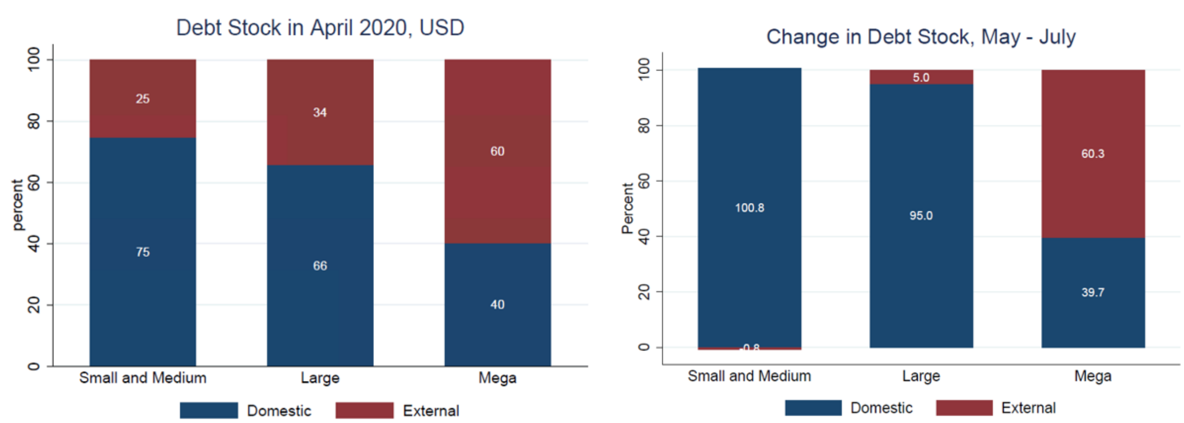
The last row of the bottom panel in Table 2 shows that, in our data, out of a total of 284,090 firms, 282,922 borrow only domestically, 465 only abroad, and 703 in both markets. The first two rows of the bottom panel compare sales among the firms studied as a share of GDP, confirming that large firms borrow abroad since their sales account for 15% of total sales despite being fewer ones than those that do not have access. As the last column shows, the mean yearly sales of all firms is 157.7% of GDP, and they represent on average 72.3% of total sales as recorded in the tax information before applying the filters.

3.2 Debt Composition and Interest Rate Behavior during COVID

We uncover two facts on the foreign-for-domestic debt substitution and the behavior of interest rates during COVID.

First, regarding firms' debt composition, the left panel in Figure 2 plots the domestic and external debt stock shares across firms' size in April 2020, right before implementing the FOGAPE-COVID policy. The finance mix of firms was such that the share of domestic debt in the total stock of debt was decreasing in size. Indeed, while the domestic debt share of small and medium firms was 75% and 66%, respectively, mega firms had a considerably smaller share of 40%. Yet, as the right panel in Figure 2 depicts, between April and July 2020, when credit support policies were deployed, firms tilted their new debt issuance much more towards domestic debt issuance.[12] Importantly, this relatively higher increased in the domestic debt share was entirely concentrated in small, medium, and large firms, which were the ones eligible for loans with the sovereign guarantees. Indeed, small-medium and large firms increase their share of domestic debt issuance to 99% and 95%, respectively. The share of domestic debt share for Mega firms–those that did not qualify for FOGAPE-COVID loans–remained virtually unchanged at 40%.[13] Furthermore, between April and July 2020, about 80% of credit flows are in pesos and 20% in dollars, showing that most of the substitution was from foreign dollar-denominated debt to domestic peso-denominated debt.

Figure 2: Stock and change in firms' finance mix - April to July 2020



Notes: The left panel depicts the domestic (blue) and external (red) debt share over total debt for three groups of firms in April 2020: 1) Small and medium (yearly sales of less than 100,000 UF). 2) Large (yearly sales greater than 100,000 UF and less than 1,000,000 UF). 3) Mega (yearly sales greater or equal to 1,000,000 UF). The right panel shows the change of each type of debt, domestic and foreign, as a share of the total change in the debt stock between May and July 2020. All calculations convert all debt to dollars using the spot exchange rate.

Second, regarding the behavior of interest rates, the first two rows of Table 3 document that the mean domestic interest rate considerably fell to 5% between March and May 2020,

[12] We take July 2020 as our last period because from August 2020 onward, the government implemented another set of policies (such as direct subsidies and approval for direct withdrawal from pension funds, among others) that could considerably distort our analysis.

[13] Figure 11 in the Appendix shows that this fact also holds when we consider the initial stock of debt in January 2020, right before the onset of the pandemic crisis, and when we measure the change in the stock of debt between February and July 2020.

from 15.9% in the same period of 2019. The mean foreign interest rate for newly issued debt in dollars also fell, but considerably less in relative terms, from 4.3% to 3.5%. Conversely, the third row of the table shows that when we measure the mean foreign interest rate in Chilean pesos (ex-post UIP corrected), it displays a sharp increase from 11.5% to 22.6%.

Notice from the last row of Table 3 that the mean 2019 sales of firms that borrowed abroad was higher in 2020 than in 2019. This means there is likely selection among the firms with access to foreign credits. This is, better-performing firms seem to have had access to foreign markets at relatively lower foreign interest rates in dollars. This fact, together with the increase in the ex-post UIP corrected foreign interest rate and the increase in the CEMBI spread from 2.5% to 5.1%, suggests that a larger risk faced by firms that had already issued bonds abroad–accompanied by a sharp currency depreciation during 2020–crowded out other firms from foreign markets.

The drivers behind the sharp fall in the average domestic interest rate are a very expansive monetary policy through the MPR and the implementation of FCIC and FOGAPE-COVID loans, which had a ceiling interest rate of 3.5% during that period. When we remove those loans from the sample, the average domestic interest rate is close to 9% instead of 5%, which still represents a significant drop in domestic interest rates. This documented fall in the relative domestic interest rate vis-à-vis the foreign one aligns with a fall in the average UIP deviation firms faced after the policies were implemented.

Lastly, as documented in the Introduction, the left panel of Figure 1 depicts two average UIP deviations across firms each month since January 2019: 1) between domestic debt in pesos and foreign debt in dollars; and 2) between domestic debt in pesos and domestic debt in dollars. The vertical line represents May 2020, when FOGAPE-COVID was in place. The figure shows how the UIP deviation between (domestic) debt in pesos and debt in dollars (be it domestic or foreign) increases at the onset of COVID in March 2020 and remains high until May when the credit support policies were implemented, dropping again to pre-COVID levels.[14]

Table 3: Interest rates 2019 vs 2020

	March - July 2019	March - July 2020
Mean i (CHP - %)	15.9	5
Mean $i^\star$ (USD - %)	4.3	3.5
Mean $i^\star$ (CHP Ex-Post UIP - %)	11.5	22.6
CEMBI (USD %)	2.5	5.1
Number of firms (i)	59479	174010
Number of firms (i*)	64	75
Mean 2019 sales UF (i)	16153	14587
Mean 2019 sales UF (i*)	864459	1360514

Notes: The table shows, using the merged dataset, the mean domestic and foreign interest rates for the March-July period in both 2019 and 2020. The foreign interest rate measured in Chilean Pesos is calculated using ex-post UIP such that $i_t = i_t^\star + \frac{e_t}{e_{t-12}} - 1$, where t is the corresponding month. The rest of the variables are from the merged dataset. The last two rows are the mean sales of 2019 for firms that borrowed in domestic and foreign markets, respectively.

We argue that the facts described by Figure 1, Figure 2, and Table 3 point out to an environment of higher risk in international markets, lower domestic interest rate triggered by credit support policies, and foreign-for-domestic debt substitution. We now turn to a more formal approach to establish causality from the policies implemented to the finance mix of firms.

3.3 Empirical Design

We use a regression discontinuity design (RDD) to estimate the causal effect of becoming eligible to receive a FOGAPE-COVID credit on firms' domestic debt share.[15] This approach is natural since we have exogenous changes in the sales thresholds required to be eligible for FOGAPE-COVID credits. Specifically, before May 2020, firms with annual sales between 350,000 UF and 1 million UF were not eligible for this type of credit. However, as described before, the threshold was increased to 1 million UF as part of the credit-supporting policies.

[14] Figure 10 in the appendix shows the right panel of Figure 1 extended to the whole period in our sample. The same pattern holds in both figures.

[15] Mullins and Toro (2018) applies a similar approach to study the effects of becoming eligible for FOGAPE credits in 2011 and 2012 over domestic debt growth and the number of new bank-firm relationships. They find positive and significant effects on both outcomes.

Since the annual sales to determine the cutoff are those of 2019, firms are quasi-randomly assigned around the new eligibility threshold in May 2020. In RDD terms, the assignment variable (2019 sales) is observable to the econometrician, and depends on a threshold due in the past, leaving small room for firms to conveniently sort themselves right below that threshold, an issue that we explore further below. Therefore, firms on the left-hand side of the cutoff (1 million UF in sales) that are eligible for the program are treated, and those on the right-hand side are controls. The causal effect of this policy over the domestic debt share is then estimated as the size of the discontinuity at the cutoff. In the absence of the cutoff, there would not be any type of discontinuity in the domestic debt share. Below we investigate this formally using alternative years as placebo tests, among other robustness tests.

We define the treatment as *being eligible to obtain FOGAPE-COVID loans*. This is, having sales in 2019 lower than 1 million UF. This implies that all firms to the left of this threshold that did not have access to FOGAPE credits before (i.e., firms with more than 350,000 UF) are treated, and those to the right are not. In this sense, we estimate a sharp RDD.[16] The specification is the following:

$$\frac{D_i^{domestic}}{D_i^{total}} = \beta_0 + \beta_1 Log(sales_i^{2019}) + \delta Eligible_i + \epsilon_i \tag{1}$$

The outcome variable in the left-hand side of Equation 1 is calculated by dividing the domestic debt over the total debt (i.e., domestic plus foreign debt) of firm i. For this, we transformed the foreign debt to dollars at the spot exchange rate and then calculated the share of domestic debt over the total.[17] Although domestic debt includes US dollar-

[16]One could think about a fuzzy RDD where the instrument is the probability of obtaining FOGAPE-COVID loans. However, we choose the sharp RDD for two reasons. The first one is grounded in economics: becoming eligible implies knowledge from the banks that firms could access the program either way. Thus, especially around this cutoff, which is the limit between large and mega firms, banks would simply charge lower interest rates to already eligible firms. The second is statistical: the number of firms that take FOGAPE-COVID loans around the cutoff is low, around 15, limiting the power of the fuzzy-RDD estimation.

[17]Evidently, our dependent variable will be affected by exchange rate movements such as the large Chilean

denominated loans issued in the domestic market, more than 80% of domestic debt is peso-denominated debt. Furthermore, FCIC, capitalized in pesos, was the largest source of funds for banks during April and July 2020, as the right-hand-side panel of Figure 5 shows. Thus, we often use domestic debt and peso-denominated domestic debt almost interchangeably.

The right-hand side in Equation 1 has the assignment variable, 2019 sales in logs, and the treatment, $Eligible_i$, which takes the value of 1 when firms have sales below the 1 million UF cutoff and 0 otherwise. The outcome variable is the firm-level average between May and July 2020. As mentioned before, we choose this period because the cutoff was increased in May and, starting in August 2020, other policies were launched which could distort our estimation.[18] Thus, the estimate of δ is the estimated causal effect of becoming eligible for a FOGAPE-COVID loan–the average effect of the treatment over firms close to the cutoff.

We estimate a local RDD with a triangular kernel. We do this for degrees zero (i.e., $\beta_1 = 0$) and 1 (i.e., $\beta_1 \neq 0$), and both Triangular and Epanechnikov kernel functions. As Cattaneo et al. (2021) recommends, we do not use controls other than log of sales, since we are not looking to define parameters of interest or to increase the efficiency of the estimation.

3.4 RDD Results

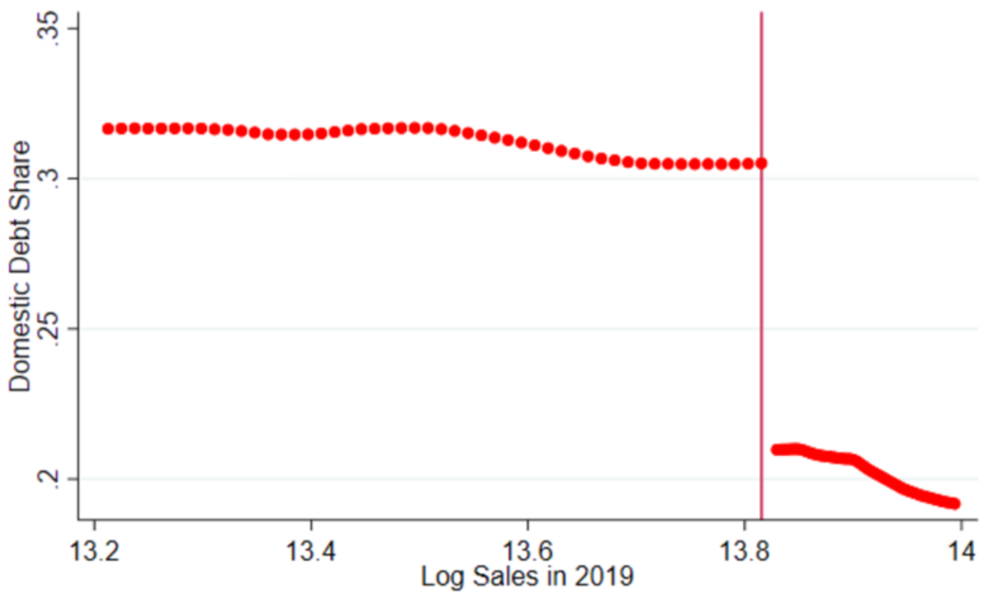
Table 4 presents the results of the RDD analysis described in Equation 1. There are 665 firms around the cutoff, with 442 to the left and 223 to the right. The first row reports the estimate of δ, and the other rows report the standard errors and the number of observations. The stars denote (robust) standard levels of significance. The first column corresponds to a baseline estimation, with a local regression of a degree-0 polynomial and triangular

peso depreciation observed during the period studied. However, if anything, this would bias results against the hypothesis tested, because a large depreciation implies a larger share of foreign debt over the total.

[18]Two prominent examples of these additional policies implemented in since August 2020 were a law that allowed workers to withdraw a fraction of their pension funds and direct cash transfers to households. Because these policies may evidently have brought about general equilibrium effects over domestic interest rates–among other variables–, we believe it is best to carry out our analysis for the period before these additional measures were implemented.

(tri) kernel. The second column is an estimate implementing a degree-1 polynomial and a Triangular Kernel. The third and fourth columns report the estimates with degree-0 and degree-1 polynomials using an Epanechnikov (epa) Kernel. Figure 3 shows a graphical representation of the local regression using the baseline specification. The vertical line depicts the cutoff of 1 million UF sales (in logs). At each side of the cutoff, the plot shows the estimated polynomial, where the gap at the discontinuity is the estimated effect of the treatment.

Figure 3: Domestic debt share vs Sales - Estimated polynomial May to July of 2020



Notes: The red dots depict local polynomial approximations around the cutoff (vertical line). The specification shown in the figure is a degree-0 polynomial with a Triangular Kernel.

All estimates are significant at the 10% level–with baseline and alternative 2 being significant at 5%. Considering the baseline specification, we interpret the result as follows: becoming eligible for FOGAPE-COVID credits has an average effect of increasing the domestic debt share by 9.4 percentage points for firms around the cutoff. We interpret this result as evidence of *debt substitution*: firms that became eligible to receive FOGAPE-COVID, altered their finance mix by taking on more domestic debt relative to foreign debt. That is, treated firms recomposed their liabilities towards less exposure to external foreign-currency

Table 4: Estimate - Regression Discontinuity Design

	Baseline (degree 0, tri)	Alternative 1 (degree 1, tri)	Alternative 2 (degree 0, epa)	Alternative 3 (degree 0, epa)
Treatment estimate	-0.09422**	-0.12271*	-0.09773**	-0.13589*
Standard Error	0.05115	0.06666	0.0505	0.06699
Number of Observations	665	665	665	665

Notes: The table shows the estimates of becoming eligible for FOGAPE-COVID loans, represented by δ in Equation 1 under different specifications. The domestic debt share is the firm-level average between May and July of 2020. *,**, *** are robustly significant coefficients at the three standard levels of significance. Each specification shows the degree of the polynomial and the type of kernel function used to estimate the local polynomial, where tri refers to Triangular Kernel and epa to Epanechnikov Kernel.

debt relative to domestic local-currency debt.[19]

The debt-substitution channel we are identifying is not only statistically significant, but it has also relevant macroeconomic implications. Indeed, the total sales of those firms that became eligible represent 18% of GDP and 8% of the total sales in the F29 database. Moreover, the increase in domestic credit by these firms at the beginning of the crisis reached about 1% of 2020's GDP.

3.5 Mechanism: The Role of Interest Rates

The estimates of the RDD described in the previous subsection provide evidence of a foreign-for-domestic debt substitution by firms in the wake of COVID, fostered by becoming eligible for FOGAPE-COVID loans. Because this result focuses on credit volumes, it is silent about prices. In this subsection, we study the role of interest rates in the mechanism that drove such debt substitution.

For this purpose, we rely on the well-established finding in the literature that a UIP premium exists for dollar loans in emerging markets (Kalemli-Ozcan and Varela, 2021). We follow this work and explore the following three things. First, we investigate if there is a

[19]It can still be argued that changes in the dependent variable in Equation 1 are driven by foreign debt falling. To address this, Figure 5 below shows the decomposition in the change of firms' debt, providing evidence that the change in the finance mix was due to a considerable increase in domestic liabilities with respect to the total.

UIP premium in the Chilean data pre-COVID. Second, we document the extent to which COVID-19 altered the UIP premium and, third, what role credit support played.

For the first two tests, we estimate the following specification:

$$i_{f,b,d,m} = \alpha_{f,b} + \lambda Trend_m + \delta FX_{f,b,d,m} + \Theta_1 X_{f,m} + \Theta_2 Z_{b,m} + \Theta_3 Macro_{m-1} + \epsilon_{f,b,d,m} \quad (2)$$

where $i_{f,b,d,m}$ is the nominal interest rate on a loan taken by firm f, lent by bank b, in currency denomination d, in month m; $\alpha_{f,b}$ are bank-by-firm fixed effects; $Trend_m$ is a monthly deterministic trend; $FX_{f,b,d,m}$ is a dummy that takes the value of 1 if the loan is in foreign currency and 0 otherwise. We restrict foreign currency loans to those in dollars, which represent more than 95% of domestic credits in foreign currency. We control for a vector of firm-level characteristics, $X_{f,m}$, a vector of bank-level characteristics, $Z_{b,m}$, and a vector of lagged macro controls, $Macro_{m-1}$. The variables in each of the first two vectors are value-added, market share (within the correspondent 2-digit economic sector), and leverage for both firms and banks. The macro controls are the price of copper (which is, by far, Chile's main export), the MPR, and a monthly indicator of economic activity in Chile. The last term of the equation is the mean-0 $i.i.d$ disturbance.

The specification in Equation 2 follows di Giovanni et al. (2021), who argue that the estimate of δ is the UIP premium. Thus, we run this estimation for domestic credits since we have information about each lender. The standard errors are clustered at the firm level.[20] In the next section, we show that our results hold both when we include foreign credits and alternative sets of fixed effects.

The first two columns of Table 5 show the results of estimating Equation 2 in two different periods. The first column reports results covering the beginning of our sample, April 2012, until September 2019, immediately before the October 2019 episode of social unrest. During

[20]Our results also hold clustering the standard errors at the firm-time level, and when we estimate the regression by OLS instead of WLS.

this period, we find a UIP premium of 3.95 p.p (relative to an average domestic rate in pesos of 13.2%), broadly in line with the literature. Indeed, di Giovanni et al. (2021) find a UIP premium of 6.9 p.p for Turkey, and Gutierrez et al. (2023) find a UIP premium of 2 p.p for Peru.

The second column of Table 5 covers the onset of COVID in Chile from March to July 2020. For this period, the coefficient on FX becomes statistically insignificant, suggesting that the UIP premium disappears and that, on average, during the beginning of the COVID-19 crisis, borrowing in dollars was not cheaper than borrowing in pesos.

To evaluate the role of policy, we run the following specification from March to July 2020:

$$i_{f,b,d,m} = \alpha_{f,b} + \lambda Trend_m + \delta FX_{f,b,d,m} + \psi E_{f,m} FX_{f,b,d,m} + \Theta_1 X_{f,m} + \Theta_2 Z_{b,m} + \Theta_3 Macro_{m-1} + \epsilon_{f,b,d,m}, \tag{3}$$

where $E_{f,m}$ is a dummy that takes the value of one if firm f in month m is eligible for a FOGAPE-COVID loan and zero otherwise. The remaining variables are the same as in Equation 2. Notice that $E_{f,m}$ is interacted with $FX_{f,b,d,m}$, meaning that if the coefficient of such interaction, ψ, is positive and significant, the reduction in the UIP premium is linked to this policy.[21]

The third column of Table 5 shows the results of estimating Equation 3. Two relevant results emerge here: first, for firms ineligible for FOGAPE-COVID, the UIP premium reappears, though it is one order of magnitude smaller than in the normal-times period; and second, such premium disappears for firms eligible for FOGAPE-COVID, as evidenced by the positive and significant estimate of ψ. In other words, the apparent disappearance of the UIP premium shown in the second column of Table 5 is driven by those firms affected by the FOGAPE-COVID policy.

[21] The eligibility dummy, $E_{f,m}$, is not included without the interaction because, given the subsamples studied, $E_{f,m}$ is time-invariant.

Table 5: Interest Rate Regression, UIP Premium, and policy effect

Variables	(1) April 2012 to Sept 2019	(2) March 2020 to July 2020	(3) March 2020 to July 2020
Fx	-0.0395***	0.00115	-0.00377*
	(0.00345)	(0.00131)	(0.00215)
Fx·elegible			0.0117***
			(0.00239)
Macro Controls	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes
Observations	5,929,453	348,550	348,550
R-squared	0.869	0.646	0.646

Notes: The first two columns of the table show the estimates the interest rate premium of USD-denominated domestic debt, represented by δ in Equation 2. Column 1 corresponds to the April 2012 - Sept 2019 period and column 2 to the March 2020 - July 2020 period. Column 3 adds the estimate of the effect that becoming eligible to FOGAPE-COVID loans has over the interest rate on USD-denominated domestic debt, represented by ψ in Equation 3, between March 2020 and July 2020. *,**, *** are significant coefficients at the three standard levels of significance. Standard errors are displayed in parenthesis and clustered at the firm level.

It is important to note that the reduction in the UIP premium for eligible firms is mainly due to an average reduction in the domestic interest rate, as opposed to an increase in the foreign interest rate. The first row of Table 3 shows how both the mean domestic interest rate in pesos and the foreign interest rate in dollars that firms faced fell between March-July 2019 and same period in 2020.[22]. Furthermore, Table 10 in the Appendix, documents that interest rates of domestic debt in pesos fell considerably more than those of foreign debt issued in pesos. Therefore, our main takeaway is that changes in domestic interest rates were crucial in the mechanism behind the observed debt substitution, for they dropped more than rates in dollars, considerably reducing the UIP premium in dollar loans. Specifically, this result can be traced back to the FOGAPE-COVID credits enacted during the crisis.

The next section performs robustness on these regression results, after discussing robustness for the RDD regression.

[22]Table 3 shows the interest rates aggregated at the firm level, calculating the weighted average by loan size. When taking the simple mean interest rate by loan, the domestic interest rate decreased from 8.7% to 5.9% between March-July 2019 and the same period in 2020, and the foreign interest rate dropped from 4.4% to 3% during the same period.

3.6 Robustness

3.6.1 RDD Robustness

The results presented in the RDD regression are evidence of a significant discontinuity at the sales cutoff set by the FOGAPE-COVID support program. An important requirement for the validity of a RDD like the one implemented in our work, is that firms do not self-select into the policy. Since the cutoff of 1 million UF was determined based on 2019 sales recorded by the Chilean IRS, while the policy was implemented in May 2020, it is unlikely that firms could manipulate their sales to sort into the treated group. However, the implementation challenges associated with a large-scale policy like this may still allow for some form of manipulation. We thus decided to formally test for this next.

To test for self-selection that leads to firms sorting themselves to the left of the cutoff, we implement the test developed by Cattaneo et al. (2020).[23] Figure 4 shows in the confidence bands, at the 95% level, the results of the test. Statistically, the mass of firms just to the left of the cutoff is similar to that just to its right. This is, we do not find evidence of manipulation.[24]

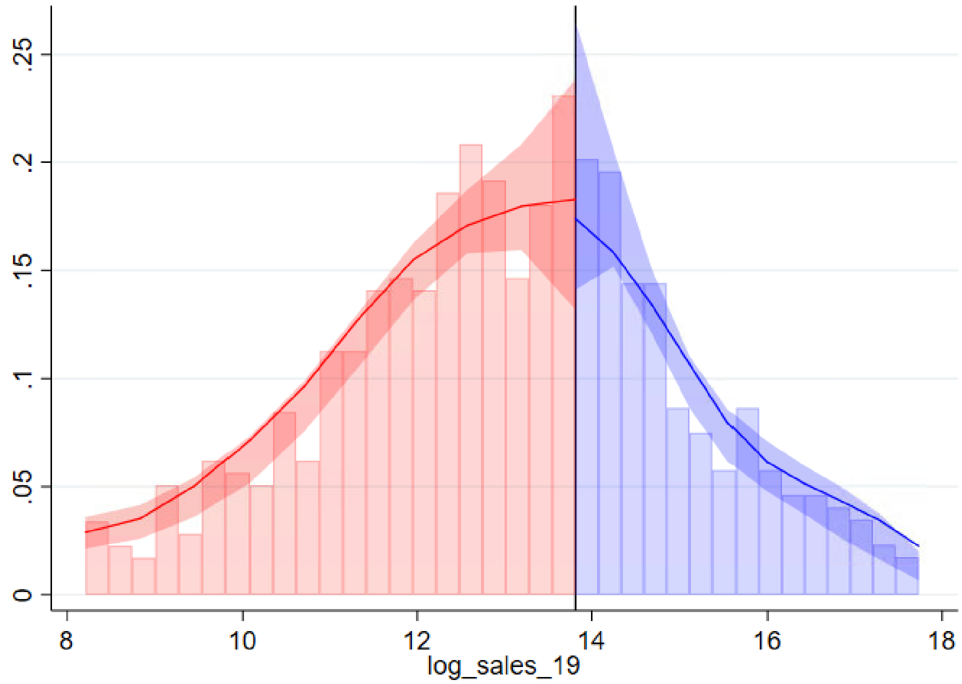
Another critical test on the RDD is to assess if, in absence of the treatment, there is evidence of discontinuity around the cutoff. For this purpose, we run a placebo test by re-estimating Equation 1 between May and July 2019. As in the baseline RDD, we take the firm-level average of the domestic debt share across those three months. Table 6 shows that the estimate of δ is not significant under the baseline specification or under any of the three alternative specifications. Therefore, we do not find evidence of lack of continuity in absence of the treatment.

In sum, our results of debt substitution towards the relatively cheaper domestic debt

[23] Cattaneo et al. (2020) develop a manipulation test that builds upon the seminal work of McCrary (2008). This new test is more flexible since it only requires the choice of one tuning parameter and allows for different local polynomial specifications.

[24] The results of the test at the 95% level of confidence lead a p-value of 0.68. This is, we reject the null hypothesis of manipulation in the running variable (log of sales).

Figure 4: Manipulation test around the cutoff



Notes: Cattaneo et al. (2020) manipulation test. The histogram (bars) is computed with default variables in Stata. The local polynomial and its robust confidence bands is estimated under the baseline specification at the 10% level of significance.

Table 6: Placebo test: Domestic debt share vs Sales - Estimated polynomial May to July of 2019

	Baseline (degree 0, tri)	Alternative 1 (degree 1, tri)	Alternative 2 (degree 0, epa)	Alternative 3 (degree 0, epa)
Treatment Estimate	-0.00131	0.00144	0.0003	-0.0023
Clustered Standard Error	0.05025	0.04697	0.0856	0.08585
Number of Observations	652	652	652	652

Notes: The table shows the estimates of a placebo test of becoming eligible for FOGAPE-COVID credits one year before the policy measure was implemented, represented by δ in Equation 1 under different specification. The domestic debt share is the firm-level average between May and July of 2019. *,**, *** are robustly significant coefficients at the three standard levels of significance. Each specification shows the degree of the polynomial and the type of kernel function used to estimate the local polynomial, where tri refers to Triangular Kernel and epa to Epanechnikov Kernel.

caused by credit support policies are robust to a placebo period, and to testing for manipulation. Also, as shown in Table 4, they are robust to different specifications of the polynomial regression.

3.6.2 Robustness of the Interest Rates Mechanisms

One potential caveat of the results obtained in Table 5–that show how the normal-times UIP premium disappears during the pandemic, and how this is driven by those firms eligible for FOGAPE-COVID loans–is that we estimate Equation 2 and Equation 3 with bank-by-firm fixed effects ($\alpha_{f,b}$). These fixed effects control for time-invariant unobserved heterogeneity at the firm-bank relationship level. However, although our rich dataset allows us to control for both firm-level and bank-level characteristics, there could be relevant unobserved time-variant heterogeneity.

To overcome this issue, we estimate Equation 2 and Equation 3 with different fixed-effects specifications. Aside from bank-by-firm fixed effects ($\alpha_{f,b}$), we also use the following: bank-by-firm and firm-by-month ($\alpha_{f,b} + \alpha_{f,m}$); firm-by-month ($\alpha_{f,m}$); bank-by-month ($\alpha_{b,m}$); firm-month-bank ($\alpha_{f,m,b}$); firm-by-month and bank-by-month ($\alpha_{f,m} + \alpha_{b,m}$). The top panel of Table 7 shows the results of these exercises. Each fixed effects specification listed above has two correspondent columns: one for the normal-times period, and another for the crisis period. The first specification in the table is our baseline, and the rest are displayed in the aforementioned order. Our main results here are twofold. First, there is always a UIP premium on foreign currency loans during the normal-times period, as shown by the first column of each estimation. Second, regardless of the type of fixed effects used, this premium considerably falls in the crisis period, which is explained by a positive effect of the FOGAPE-COVID eligibility as shown by the second column of this estimation.[25] Our results from Table 5 are thus robust to the fixed-effects specification considered, as shown by Table 7.

array

A second potential caveat to the interest rate mechanism behind the foreign-for-domestic

[25]Notice that whenever there are fixed effects at the firm-time level, the firm-level controls disappear since there is no variation anymore within the firm-time group. The same happens for bank controls, and for the macro controls.

Table 7: Interest Rate Regression Robustness: alternative fixed effects and inclussion of external debt

Fixed Effects	BankxFirm		BankxFirm & FirmxMonth		FirmxMonth		BankxMonth		FirmxMonthxBank		FirmxMonth & BankxMonth	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables	Until Sept 2019	March to July	Until Sept 2019	March to July	Until Sept 2019	March to July	Until Sept 2019	March to July	Until Sept 2019	March to July	Until Sept 2019	March to July
Panel A: Domestic Debt												
fx	-0.0395***	-0.00377*	-0.0425***	-0.00299	-0.0422***	-	-0.0652***	-0.0286***	-0.0465***	-0.00376	-0.0429***	-
						0.00637***						0.00703***
	(0.00345)	(0.00215)	(0.00650)	(0.00276)	(0.00636)	(0.00216)	(0.00168)	(0.00345)	(0.00833)	(0.00342)	(0.00581)	(0.00222)
fx_elegible		0.0117***		0.00694**		0.00712***		0.0199***		0.00750**		0.00760***
		(0.00239)		(0.00312)		(0.00245)		(0.00200)		(0.00376)		(0.00251)
Macro Controls	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Firm Controls	Yes	Yes	No	No	No	No	Yes	Yes	No	No	No	No
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Observations	5,929,453	348,550	5,140,684	312,865	5,166,051	329,039	6,087,838	457,751	4,981,579	307,515	5,166,004	329,039
R-squared	0.869	0.646	0.918	0.717	0.900	0.698	0.243	0.092	0.924	0.720	0.904	0.699
Panel B: Domestic and Foreign Debt												
fx	-0.0397***	-0.00361*	-0.0424***	-0.00303	-0.0432***	-	-0.0650***	-0.0286***	-0.0464***	-0.00377	-0.0435***	-
						0.00613***						0.00705***
	(0.00328)	(0.00215)	(0.00610)	(0.00275)	(0.00594)	(0.00211)	(0.00160)	(0.00351)	(0.00814)	(0.00342)	(0.00518)	(0.00222)
fx_elegible		0.0119***		0.00695**		0.00693***		0.0199***		0.00751**		0.00760***
		(0.00243)		(0.00312)		(0.00240)		(0.00202)		(0.00376)		(0.00250)
Macro Controls	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Firm Controls	Yes	Yes	No	No	No	No	Yes	Yes	No	No	No	No
Bank Controls	No	No	No	No	No	No	No	No	No	No	No	No
Observations	6,078,364	348,952	5,272,467	313,216	5,302,026	329,425	6,242,648	458,215	5,081,652	307,844	5,301,975	329,425
R-squared	0.870	0.646	0.919	0.717	0.899	0.698	0.248	0.092	0.925	0.720	0.904	0.699

Clustered standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Notes: The table estimates Equation 2 for the April 2019 - Sept 2019 period and Equation 3 for the March 2020 - July 2020 period under different fixed-effect specifications. Each type of fixed effect is displayed in each column of the first row, where the first one corresponds to the baseline case shown in Table 5. *,**, *** are significant coefficients at the three standard levels of significance. Standard errors are displayed in parenthesis and clustered at the firm level.

debt substitution in our baseline results is that it is pinned down using only domestic debt in both pesos and dollar loans. As explained above, the main reason for this is the lack of micro-level data on foreign lenders which prevents us from running the baseline specifications Equation 2 and Equation 3 using the foreign debt portion of our data. Even if the domestic supply of dollar loans comes directly from banks' access to dollars abroad, one could argue that the mechanism observed in the UIP reduction premium in the local credit market does not necessarily hold when we incorporate the foreign-credit market due, for example, to temporary frictions in the foreign exchange markets.

To tackle this issue, we re-estimate Equation 2 and Equation 3 by adding to the database foreign loans, assigning to foreign loans a unique lender identifier when controlling for bank fixed effects. The lower panel of Table 7 shows the results of this exercise with the same set of fixed-effects specifications explored before and shown in the upper panel of the table.[26] Once again, our baseline results are robust. There is always a UIP premium during normal times, and it considerably falls during the crisis due to eligibility of the FOGAPE-COVID loans.

A third concern regarding the interest rate mechanism behind our baseline results is that, alternatively, there may have been an external dollar credit dry-out for banks. This could have lowered the domestic supply of dollar-denominated loans, increasing their interest rate, lowering the UIP premium and leading firms to borrow more in domestic currency.[27]

The left panel of Figure 5 shows the net change in lending (in billion of USD) by banks in Chile, split between the type of liability between May and July of 2019 (first bar) and of 2020 (second bar). The main takeaway from this panel is that the net increase in foreign borrowing (i.e., bonds and loans) was similar in 2020 than in the same period of 2019, which

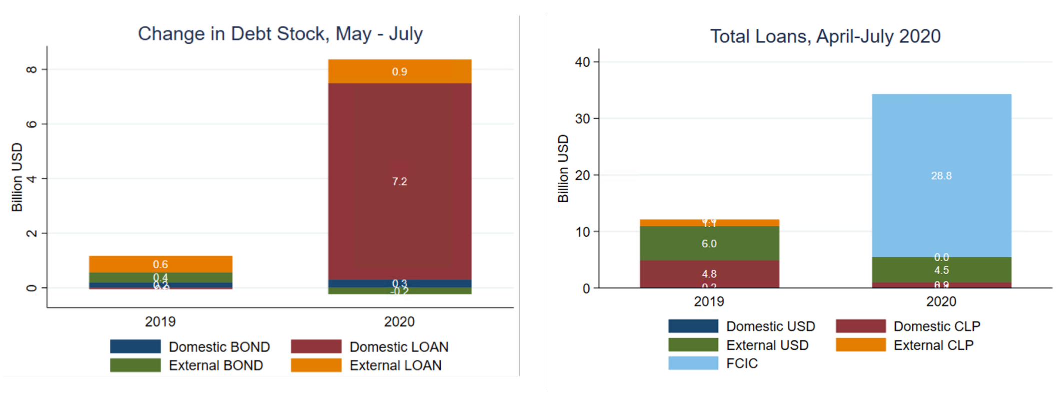
[26] In this case, we do not have bank-level controls in any specification because we do not have microeconomic information on foreign lenders.

[27] Notwithstanding this, less dollars in the system also generate an upward pressure over the UIP premium. First, less dollars in the credit market depreciate the dollar, which increase the expected appreciation. Second, lower total liquidity would increase the domestic interest rate via higher risk, specially for eligible firms which are smaller (hence riskier).

lends no support to the hypothesis that banks faced a credit dry out abroad. The right panel of Figure 5 shows the gross increase in domestic and foreign borrowing by currency, all expressed in billion of USD. On the one hand, it shows that new external borrowing in dollars was lower in 2020 than in 2019 (4.5 vs 6 billion USD), albeit still a significant amount. On the other hand, it shows how large the FCIC policy was in terms of new lending. Out of a total of USD 42.2 billion, FCIC represents more than two thirds of the new credit banks take. This suggests that, even though banks still had access to considerable foreign borrowing, they also substituted some for domestic loans, mainly due to FCIC. Indeed, that increase in FCIC explains the net increase in domestic loans for banks exhibited in the second bar of the left-hand side panel (red area).

Finally, if banks had faced a foreign credit dry-out, interest rates on the few credits taken should have increased. This was not the case: the average interest rate banks faced on foreign dollar-denominated debt was 2.8% between May and July 2019, and it fell to 1.3% in the same period of 2020.[28]

Figure 5: Total Loan and Change in Debt Stock by banks'



Notes: The left panel breaks down the change in banks' debt stock according to its origin (domestic or external) and type (bond or loan). The right panel breaks down the total bank loan amount according to its origin and currency (CLP or USD), including FCIC in 2020. All calculations are made by measuring the debt in dollars at the spot nominal exchange rate and comparing 2020 with 2019.

[28]This concern is akin to the possibility of mismatches in the local currency swap markets due to a lack of counterparties. If this were the case, due to regulation requiring zero balance sheet miss matches in swaps for banks, banks would have supplied fewer dollar-denominated loans, and their interest rate would have increased, which did not happen as evidenced in Table 10 in the Appendix.

Altogether, the evidence points to foreign-for-domestic debt substitution triggered by unconventional policies. On the one hand, since the spread between domestic and foreign interest rates falls, firms were likely less willing to take on the exchange rate risk derived from borrowing abroad. On the other hand, there might be a selection channel through which smaller firms did not tap international markets since the foreign borrowing costs were too high, making them switch to the local debt market. This selection channel leaves better firms borrowing abroad during the crisis than before. The last row of Table 3 shows some evidence of this channel, where the mean sales of firms that borrowed abroad during the crisis is higher than before the crisis. Notwithstanding this, Column 12 in Table 7 shows that when accounting for unobserved time variant heterogeneity (through firm-time and bank-time fixed effects), our results hold. This means that even within groups of the same unobserved characteristics, the UIP is deferentially lower for eligible firms and there is a UIP deviation for the rest, albeit lower than during normal times. This latter finding is also arguably driven by general equilibrium effects of the battery of other policies enacted simultaneously. These are, the large drop in the MPR and FCIC.

The model we develop in the following section rationalizes our empirical findings by focusing on the role that firm-level heterogeneity and financial frictions play in determining both the equilibrium foreign and domestic credit, as well as the endogenous UIP deviation in the economy.

4 Model

4.1 Overview

This section presents a stylized model of firms' debt financing to rationalize the mechanisms behind the documented debt-substitution effect, including the unconventional credit support policies implemented and their impact on the finance mix of firms as the COVID shock unfolded. Importantly, while the empirical analysis focuses on FOGAPE-COVID, the model allows us to study the effects of the COVID shock, FCIC only, and FCIC and FOGAPE jointly.

Our setup has three key elements. First, the model delivers an *endogenous firms' finance mix* between domestic and foreign debt issuance, with which we can study responses in this mix to shocks in international capital markets (e.g., COVID) and policies that affect domestic credit conditions akin to the aforementioned FCIC and FOGAPE-COVID programs. A second key ingredient of the model is to allow for *heterogeneity* in this finance mix across firms, with larger firms issuing relatively more debt abroad and smaller firms borrowing in domestic markets, akin to what we documented in the data. Lastly, as observed in the data, the model features an *endogenous interest rate wedge* between debt issued in domestic and global markets, generating incentives for firms to borrow abroad in equilibrium.

4.2 Setup and Equilibrium

Time, agents, and utility We consider a real two-period small open economy, with time indexed, $t = 1, 2$, a single good, and no aggregate uncertainty. The economy is populated by a unit mass of identical households and a unit mass of firms that differ in their endowment of international collateral. Abroad, foreign financiers have access to a savings technology that transfers goods one-to-one between periods, which pins down the gross foreign interest rate, $r^\star$, to one. The utility is linear in consumption and equals $U(c_1, c_2) = c_2$ for all agents, implying that all agents want to consume only in period 2.

Endowments and technology In period 1, foreign financiers have a large endowment, and domestic households get endowment $e_{1,H}$. Similarly to Caballero and Krishnamurthy (2001) (CK henceforth), in period 2, firm i gets international collateral, $\lambda^i_{f,2}$, which can be used to borrow in foreign capital markets in period 1, when types are revealed. Following CK, we take the extreme assumption that international lenders do not accept firms' output as collateral. Unlike CK, in this model, first, there is no aggregate uncertainty about international collateral, and second, international collateral, $\lambda^i_{2,f}$, is heterogenous across firms and drawn from a uniform distribution with bounds $\left[0, \bar{\lambda}\right]$, where $\bar{\lambda}$ is a parameter.

Firms produce by investing capital k^i_1 in a concave technology with productivity $A_2 > 1$, common to all firms:

$$A_2 (k^i_1)^\alpha \tag{4}$$

with $\alpha = 1/2$. We impose the following relationship between $\bar{\lambda}$, α, and A_2:

$$\bar{\lambda} < (A_2 \alpha)^{\frac{1}{1-\alpha}}, \tag{5}$$

which ensures that, as we will see below and consistent with the empirical evidence, all firms have some domestic debt.[29]

Borrowing and collateral constraints Because firms have no endowment in period 1, they need to borrow the capital stock used for production. Firm i borrows $d^i_{1,d}$ from the domestic market and $d^i_{1,f}$ from foreign financiers with interest rates R_2 and $R^\star$, respectively. The foreign interest rate firms face, $R^\star$, equals:

$$R^\star = r^\star + risk\ premium \tag{6}$$

where $r^\star = 1$ and it is pinned down by the savings technology. For simplicity, we assume that in normal times, the risk premium equals 0. Consistent with the empirical evidence in the first three rows of Table 3, the model's solution will feature a (positive) wedge between R_2 and $R^\star$, determined endogenously in equilibrium as described below.

[29] In our dataset, the number of firms with no domestic debt is very small. For example, for the largest firms (with more than 600,000 UF in sales), which tend to be those with less domestic debt, only 37 firms out of 1386 have no domestic debt.

Firm i's objective function equals:

$$\lambda^i_{2,f} + A_2(d^i_{1,d} + d^i_{1,f})^\alpha - R_2 d^i_{1,d} - R^\star d^i_{1,f} \tag{7}$$

Borrowing is subject to the following collateral constraints:

$$R^\star d^i_{1,f} \leq \lambda^i_{2,f} \tag{8}$$

$$R_2 d^i_{1,d} \leq \theta_d * A_2 * (d^i_{1,d} + d^i_{1,f})^\alpha + \lambda^i_{2,f} - R^\star d^i_{1,f} \tag{9}$$

which are similar to the ones in CK. Foreign borrowing must be backed up by international collateral. Only domestic lenders have access to a share $\theta_d < 1$ of firms' output as well as the international collateral not pledged to foreign financiers. The domestic collateral constraint resembles the one in Gennaioli et al. (2014). The foreign collateral constraint ensures that firms borrow both abroad and domestically, since if $R^\star < R_2$ and absent foreign collateral constraints, firms would finance themselves exclusively abroad, which is counterfactual. In other words, the foreign collateral constraint guarantees the existence of the domestic credit market.

First-best level of capital Firms wish to finance

$$(A_2\alpha)^{\frac{1}{1-\alpha}} \equiv k^\star \tag{10}$$

which can be found by maximizing Equation 4 minus the opportunity cost of capital, one.

Firms' decisions Solving the model for the case where $R_2 > R^\star$ implies that firms will always want to tap international debt markets before they go to the domestic debt market.[30]

Because $R^\star < R_2$ and Equation 5 holds, all firms borrow up to their foreign collateral

[30] The next section makes parametric assumptions for this to be the case.

constraint, Equation 8, implying that foreign debt for firm i equals:

$$d_{1,f}^{i} = \frac{\lambda_{2,f}^{i}}{R^{\star}} \tag{11}$$

which can be zero for firms with $\lambda_{2,f}^{i} = 0$. Using Equation 11, the domestic collateral constraint becomes:

$$R_2 d_{1,d}^{i} \leq \theta_d A_2 (d_{1,d}^{i} + \frac{\lambda_{2,f}^{i}}{R^{\star}})^{\alpha} \tag{12}$$

for firm i, which might bind or not, giving rise to two groups of firms, depending on whether they can finance the first-best level of capital, $k^{\star}$.

First, if the domestic collateral constraint is slack, firms finance the first-best level of capital, $k^{\star}$, and domestic borrowing equals:

$$d_{1,d}^{i} = k^{\star} - \frac{\lambda_{2,f}^{i}}{R^{\star}} \tag{13}$$

for firm i. Firms in this group are those with high enough international collateral,

$$\lambda_{2,f}^{i} > R^{\star} \left(k^{\star} - \frac{\theta_d A_2 (k^{\star})^{\alpha}}{R_2} \right) \equiv \hat{\lambda} \tag{14}$$

obtained operating on Equation 12, making $d_{1,d}^{i}$ equal to its expression in Equation 13, and making the constraint slack. International collateral also determines which firms are unconstrained domestically, because higher international collateral implies higher foreign borrowing, which is invested in the productive technology, implying higher output too. We call these firms domestically unconstrained or, simply, unconstrained. Note that, in equilibrium, firms that produce more also borrow more abroad, consistent with the Chilean evidence presented in the left-hand-side panel of Figure 2.

Second, if the domestic collateral constraint binds, firms cannot finance $k^{\star}$ and domestic borrowing for firm i is given by the solution to its domestic collateral constraint with equality:

$$d_{1,d}^{\star}(\lambda_{2,f}^{i}) = \frac{\theta_d A_2 \left(\theta_d A_2 + \sqrt{(\theta_d A_2)^2 + 4R_2^2 \frac{\lambda_{2,f}^{i}}{R^{\star}}}\right)}{2R_2^2}, \tag{15}$$

where we use the formula for the quadratic equation since the domestic collateral constraint with equality is a quadratic equation, and we focus on the positive solution. The Appendix shows the derivations and why Equation 15 is the only positive solution. We call these firms domestically constrained or, simply, constrained.

From Equation 12, it is clear that an increase in θ_d increases firms' access to domestic borrowing. Thus, we capture FOGAPE-COVID, which increased firms' access to domestic credit by providing sovereign debt guarantees, as an increase in θ_d.

In equilibrium, firms' total leverage –defined as domestic and international debt over output– is increasing in output. This is consistent with additional empirical evidence for Chile, as shown in Figure 12 in the Appendix, and for several other countries (Rajan and Zingales 1995; Dinlersoz et al. 2019; Gopinath et al. 2017, and Chatterjee and Eyigungor 2023). To see this, note that constrained firms' leverage equals:

$$\ell = \frac{\theta_d}{R_2} + \frac{\lambda_{2,f}^{i}/R^{\star}}{A_2(d_{1,d}^{\star}(\lambda_{2,f}^{i}) + \lambda_{2,f}^{i}/R^{\star})^{\alpha}} \tag{16}$$

where the first summand in the right-hand size of Equation 16 is the domestic leverage, pinned down by the domestic collateral constraint, and the second is the international leverage. Equation 16 is increasing in $\lambda_{2,f}^{i}$ because $\lambda_{2,f}^{i}$ enters linearly in the numerator but enters to a power smaller than one in the denominator, implying that the numerator increases faster than the denominator as $\lambda_{2,f}^{i}$ increases.[31] Because firms' output is increasing in $\lambda_{2,f}^{i}$, firms that produce more also have a higher leverage ratio.

[31]Indeed, $\lambda_{2,f}^{i}$ enters twice in the denominator: first in domestic debt, within the square root of Equation 15 and, second, in foreign debt as $\lambda_{2,f}^{i}/R^{\star}$. Both domestic and foreign debt appear within the square root in the denominator of Equation 16.

Our parametric assumptions later ensure this finding also holds between constrained and unconstrained firms.

Credit supply The total supply of credit in the domestic market, $e_{1,T}$, comes from households, who supply $e_{1,H}$, and from the Central Bank, which supplies $e_{1,CB}$. We pose the following expression for $e_{1,T}$:

$$e_{1,T} = e^{\phi}_{1,CB} + e_{1,H} \tag{17}$$

where $e_{1,CB} < 1$ and ϕ is a parameter that depends on the global shock and policies. In particular, we assume:

$$\phi = e^{R^{\star}-1} - \psi(\Delta\theta_d) \tag{18}$$

where Δ denotes change.

Equations 17 and 18 capture, albeit in reduced form, the behavior of financial intermediaries, which are left unmodeled in the main body of the paper, when a shock like COVID materializes (e.g., increases in $R^{\star}$ due to an increase in the risk premium) and, crucially, the extent to which policies can alter credit supply.

Financial intermediaries lend to firms what they obtain from households as deposits, $e_{1,H}$, and what they obtain from the Central Bank. In the baseline equilibrium without a risk-premium shock and no credit support policies, where $R^{\star} = 1$ and $\Delta\theta_d = 0$, $\phi = 1$, total credit supply, $e_{1,T} = e_{1,CB} + e_1$.

During periods of distress in world capital markets –akin to those observed at the onset of COVID via increases in risk premium–, financial intermediaries might contract their credit supply. In the model, an increase in $R^{\star}$ increases ϕ. Because $e_{1,CB} < 1$ an increase in ϕ decreases the Central Bank funds that get to firms, decreasing the total credit supply in the market.

Parameter ϕ can be interpreted as capturing financial intermediaries' risk aversion.

Around a global shock that increases ϕ, triggered by a rise in the risk premium, which increases $R^\star$, financial intermediaries lend out less of the Central Bank's funds to firms due to higher risk aversion.

In this set-up, a new Central Bank liquidity provision program like FCIC is akin to an increase in $e_{1,CB}$. However, depending on the size of the global shock, an increase in $e_{1,CB}$ might not translate into an increase in credit supply for firms, $e_{1,T}$. Crucially, a program of sovereign guarantees (e.g., FOGAPE-COVID) can complement and amplify the Central Bank's credit line facility by decreasing ϕ, that is, facilitating that Central Bank's funds be channeled to firms. In other words, both FOGAPE-type and FCIC-type policies increase credit supply.

It is important to highlight at this point that the main takeaway of this reduced-form extension of the credit supply in the model is robust to having a structural banking model. The Appendix provides a micro foundation for financial intermediaries à la Curdia and Woodford (2011), featuring loan origination costs decreasing in FOGAPE and FCIC, delivering that credit supply increases when the two policies are jointly implemented. The Appendix provides further details on the derivations.

Equilibrium The only equilibrium price in the model is R_2 and can be found equating firms' demand for domestic credit to the total credit supply, $e_{1,T}$.

$$\underbrace{\int_0^{\hat{\lambda}} d^\star_{1,d}(\lambda^i_{2,f}) d\lambda^i_{2,f}}_{\text{Demand from constrained firms}} + \underbrace{\int_{\hat{\lambda}}^{\bar{\lambda}} \left(k^\star - \frac{\lambda^i_{2,f}}{R^\star}\right) d\lambda^i_{2,f}}_{\text{Demand from unconstrained firms}} = e_{1,T} \tag{19}$$

where $\hat{\lambda}$ is the endogenous threshold that separates firms into constrained and unconstrained, given in Equation 14, $d^\star_{1,d}$ is given in Equation 15, and $e_{1,T}$ is governed by Equations 17 and 18. The Appendix solves the integrals in Equation 19.

4.3 Equilibrium: A Graphical Analysis

We now graphically characterize the equilibrium in the model by plotting the supply and demand curves in the domestic credit market. First, we depict how such equilibrium is affected by a COVID-type shock that increases the interest rate at which firms borrow abroad (R^*) due to an increase in the risk premium. Next, we study how such equilibrium is further altered by three types of policy experiments aimed at offsetting the impact on R^*: the deployment of a Central Bank´s credit line facility through an increase in $e_{1,CB}$ (akin to FCIC); the issuance of sovereign guarantees as an increase in θ_d (akin to FOGAPE); and the simultaneous deployment of both policies.

Figure 6 depicts the change in the equilibrium in the domestic credit market following an increase in R^*. Before such increase materializes, the equilibrium is characterized by point A, where the vertical supply curve intersects the negatively sloped demand curve. The latter negative relationship in the demand curve is easily verified from inspecting Equation 19, holding constant the supply of credit, $e_{1,T}$. In turn, the vertical shape of the supply curve derives from the fact that none of the two equations pinning it down (Equation 17, Equation 18) include the domestic interest rate.

The Figure highlights two separate effects that occur simultaneously, following the increase in R^*. First, the demand for domestic credit increases as the share of the unconstrained firms substitute foreign for domestic credit, shifting the demand curve upward, and pushing up the domestic interest rate from point A to B. This occurs with important redistributional consequences. As it is clear from Equation 13, unconstrained firms increase their demand for domestic debt because they can borrow less abroad. Indeed, they substitute foreign for domestic debt and still finance the first-best level of capital.[32] Instead, for constrained firms borrowing less abroad implies that their domestic collateral constraint tightens, negatively affecting their access to domestic credit. If θ_d is high enough, unconstrained firms' behavior

[32] Of course, the mass of unconstrained firms shrinks when $R^\star$ and R_2 increase (see Equation 14).

dominates, increasing the total credit demand as plotted in the Figure.

Second, the supply curve also retrieves amid the effect that a higher foreign interest rate faced by Chilean firms has on ϕ and subsequently in $e^{\phi}_{1,CB}$. The latter captures, albeit in reduced form, commercial banks' heightened aversion to lending in a riskier environment. The overall effect is captured in the new equilibrium point C, at a further higher domestic rate and a contraction in the volume of total domestic credit.

Figure 6: Equilibrium After an Increase in R^*

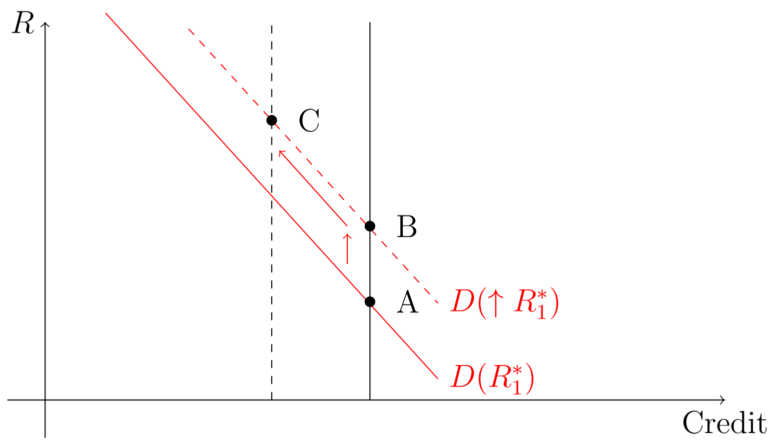


Figure 7 depicts the three policy experiments deployed to address the new COVID-induced equilibrium. The upper panel characterizes the use of a Central Bank credit line facility akin to FCIC, whereby the supply curve reverts to the right. This reduces the equilibrium domestic interest, though not all the way to its pre-COVID level, and raises domestic credit volumes to point D. It captures the Central Bank's inability to fully offset the negative effects on commercial banks willingness to lend under the same conditions as before the shock, by providing them with more credit. Banks will increase their lending, but in a riskier environment, this will only stimulate credit so much, possibly only to commercial banks' prime customers. As a result, credit volume is not at its pre-shock level, and domestic interest rates remain high. The policy of only deploying a Central Bank credit line without sovereign guarantees is not capable of fully offsetting the shock in terms of prices and quantities.

The middle panel characterizes the impact of implementing a policy of sovereign guarantees alone through an increase in θ_d, which relaxes constrained firms' collateral constraint, shifting the credit demand curve up. It boosts the demand for credit, further shifting upward the demand curve and raising domestic rates even higher. This is only partially offset by the effect that the policy of sovereign guarantees has in the supply of credit, captured in reduced form via the effect on ϕ by decreasing banks' risk-aversion, thereby unlocking the Central Bank's supply of funds.[33] This delivers a new equilibrium point D, where the credit volume is restored to its pre-shock level, but the domestic interest rate continues to be much higher. Thus, a policy of sovereign guarantees alone, without a Central Bank credit line, is also not capable of fully offsetting the shock in terms of prices and quantities.[34]

The lower panel depicts the case where both policies are deployed simultaneously. The key insight is that the complementarities between the two can restore domestic rates to levels equal to (or below) those prevailing before the risk-premium shock despite the large increase in demand for credit by firms. As a result, the volume of credit increases considerably to point D in the plot. This captures, albeit in a qualitative way, what was observed in Chile soon after deploying the policies, with credit growing considerably and domestic rates that were lower than those observed before the shock had materialized. The following subsection will explore these policies quantitatively.

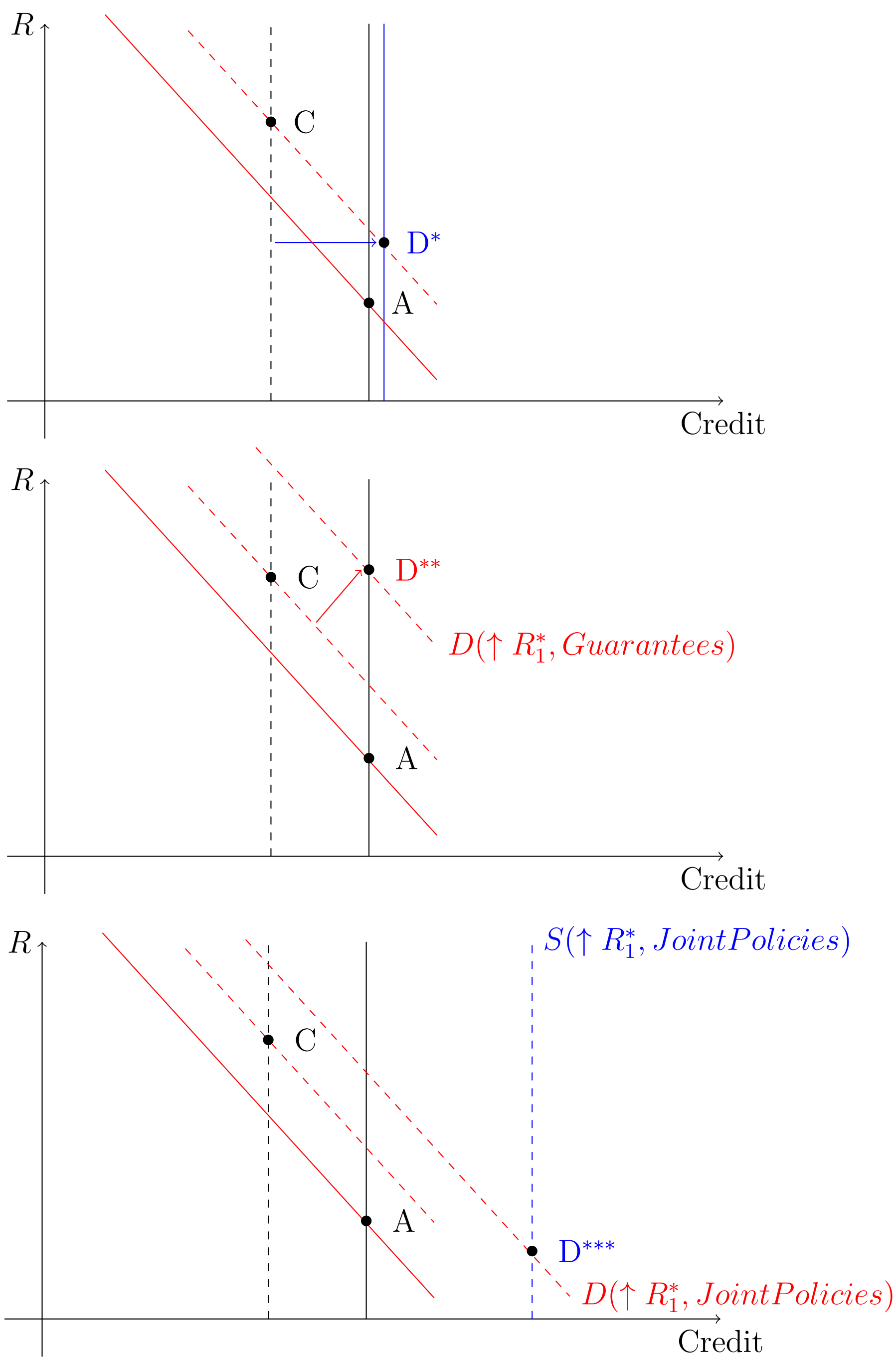
4.4 Quantitative Analysis

We turn now to the quantitative analysis of the model. Here, we assess the extent to which the model can deliver the patterns described in the previous subsection.

[33]Note that such a rightward shift also holds in the richer setup of financial intermediaries à la Curdia and Woodford (2011) who optimize over their credit supply decision, as shown in the Appendix.

[34]For ease of comparison, we have placed the new supply curve at the same location as the original one. Further quantitative exercises presented in the next section will precisely pin down the behavior of credit in this policy experiment.

Figure 7: Equilibrium After an Increase in R^*



Note: The panels present the equilibrium following three types of policy experiments aimed at offsetting the impact on R^*: the deployment of a Central Bank´s credit line facility through an increase in $e_{1,CB}$ akin to FCIC (upper panel); the issuance of sovereign guarantees as an increase in θ_d akin to FOGAPE (middle panel); and the simultaneous deployment of both policies (lower panel).

For this, we begin describing the model's parametrization given in Table 8. First, in the baseline equilibrium, the risk premium equals zero, and the foreign interest rate, $R^\star$, is pinned down by the savings technology and, hence, equal to one. Second, the upper bound on the international collateral, $\bar{\lambda}$, satisfies Equation 5. The exact difference between $k^\star$ and $\bar{\lambda}$, 0.2, is arbitrary. Third, the pledgeable share of output, θ_d, is small enough to ensure that the increasing leverage holds between constrained and unconstrained firms. Under the parametrization of Table 8, the total leverage ratios of unconstrained firms, which produce the first-best level of output, $y^\star = A_2(k^\star)^\alpha$, and the constrained firm $\lambda = 1.22$ right below the threshold firm, $\hat{\lambda} = 1.2273$, which produces less than $y^\star$, are given, respectively, by:

$$\begin{aligned}
\ell_U &= \frac{k^\star}{A_2(k^\star)^\alpha} = A_2^{-1}(k^\star)^{1-\alpha} = 0.5 \\
\ell_C(\lambda = 1.22) &= \underbrace{\frac{\theta_d}{R_2}}_{\text{Domestic leverage}} + \underbrace{\frac{1.22}{A_2\tilde{k}^\alpha}}_{\text{International leverage}} = 0.2273 + \frac{1.22}{(A_2)(2.24)} = 0.499
\end{aligned}$$

which satisfies $\ell_U > \ell_C$ and where $\tilde{k}$ is the level of capital for firm $\lambda = 1.22$ which is smaller than $k^\star$. In the model, all unconstrained firms, regardless of their international collateral, have the same leverage ratio because they all produce the same output level, $y^\star = A_2(k^\star)^\alpha$.

Table 8: Model Parametrization

Parameter description	Symbol	Value
Gross foreign interest rate	$R^\star$	1
Firms' productivity	A_2	3
Concavity of the technology	α	$\frac{1}{2}$
First-best capital	$k^\star$	2.25
Upper bound on international collateral	$\bar{\lambda}$	$k^\star - 0.2$
Pledgeable share of output	θ_d	0.25
Initial credit supply	$e_{1,T}$	1.4781
Central Bank supply of credit	$e_{1,CB}$	0.5
Responsiveness of financial intermediaries' risk-aversion to FOGAPE	ψ	24
FCIC size	$\Delta e_{1,CB}$	0.05
FOGAPE size	$\Delta\theta_d$	0.02

Notes: The table lists the parameter and policy values used in the analysis of the model's results. The values listed in the table generate the qualitative results of Figure 6, Figure 7, and the numerical results in Table 9.

Turning now to the credit supply and policy parameters in Table 8, the baseline total credit supply, $e_{1,T}$, is chosen so that the domestic interest rate is 10%, approximately the difference between the average domestic and foreign interest rates in the pre-COVID period (2019) in Table 3. The supply of credit coming from the Central Bank, $e_{1,CB}$, satisfies $e_{1,CB} < 1$. We pick a value of ψ equal to 24, an FCIC funding of 0.05, and an increase in θ_d (FOGAPE) of 0.02, from 0.25 to 0.27. We choose the last three parameters to qualitatively match the observed effect of both policies in the domestic credit market: a higher level of domestic credit and a lower interest rate. The following subsection performs sensitivity analyses with the size of the policies.

Figure 6 and Figure 7 present the qualitative behavior of credit demand and supply after a global shock (Figure 6) and after policies are implemented (Figure 7). Under the parametrization in Table 8, the model's numerical results are given in Table 9.

Table 9: Equilibrium Analysis: Numerical values

Variable	Pre-Shock	Post-Shock No policies	FCIC	FOGAPE	FCIC and FOGAPE
R^*	1.00	1.10	1.10	1.10	1.10
R_2	1.10	1.20	1.15	1.12	1.10
Credit	1.48	1.44	1.50	1.63	1.67
Policy Parameters					
θ_d	0.25	0.25	0.25	0.27	0.27
$e_{1,CB}$	0.50	0.50	0.55	0.50	0.55
Equilibrium	A - Fig. 6	C - Fig. 6	D* - Fig. 7.a	D** - Fig. 7.b	D*** - Fig. 7.c

Notes: This table gives the numerical values of the foreign interest rate, $R^\star$, the equilibrium domestic interest rate (R_2), the total credit in equilibrium, and the policy parameters considered in different scenarios (pre-global shock, post-global shock but pre-policies, FCIC, FOGAPE, and, finally, FCIC and FOGAPE jointly). The last row in this table makes the correspondence between the numerical values and the equilibria in Figure 6 and Figure 7.

As Table 9 shows, the domestic economy starts with an interest rate of 10% and an equilibrium level of credit equal to 1.48 (second column in the table). After the risk-premium shock (third column), the foreign interest rate increases to 10%, the domestic interest rate to 20%, and credit contracts to 1.44. We now turn to the policies.

FCIC only, in the fourth column, is able to decrease domestic rates to 15%, which is still above the pre-COVID crisis level of 10%. Total domestic credit after FCIC equals 1.5 and is only somewhat above the pre-global shock level. An FCIC of the magnitude considered here, a 10% increase in the Central Bank's credit supply, has limited power to expand credit and lower the interest rate.

FOGAPE only, in the fifth column, increases domestic credit to 1.63, substantially more than FCIC only, and lowers the interest rate to 12%, which remains above its pre-crisis level.

Lastly, the sixth column shows the equilibrium values of FCIC and FOGAPE jointly. This is the only case where the interest rate drops to its pre-COVID level of 1.1, making the UIP premium disappear, consistent with the empirical evidence from column (2) in Table 5. Equilibrium domestic credit expands the most, to 1.67.

4.5 Sensitivity Analysis

The qualitative analysis of the model's equilibria and its corresponding numerical analysis shown, respectively, in the previous two sections explain how the model is able to qualitatively rationalize the observed patterns of domestic credit and interest rates given the joint implementation of FOGAPE-COVID and FCIC. This is an equilibrium with higher domestic credit and a lower domestic interest rate–in its absolute level and relative to the foreign interest rate–than the initial equilibrium previous to the COVID-type global shock.

Nevertheless, as mentioned before, this result is conditional on the model's parametrization and on the chosen size of the policies ($\Delta e_{1,CB}$ and $\Delta \theta_d$). In this section, we explore how sensitive the results are to other values of changes in the policies for a plausible space of parameters of both FOGAPE, θ_d, and FCIC, $e_{1,CB}$.

For this purpose, we now define a parameter space for θ_d between 0.25, its initial value in the numerical analysis, and 0.29. For e_{1CB}, the parameter space is between 0 and 0.8. The upper limit of each parameter is defined as the maximum value for which any combination of the parameters θ_d and $e_{1,CB}$ yields an equilibrium defined in the space of real numbers, given the rest of the model's parametrization described in Table 8. Since the amount of domestic credit is increasing in both θ_d and $e_{1,CB}$, we focus our sensitivity analysis on the equilibrium domestic interest rate.

Figure 8 shows the equilibrium domestic interest rate, R_2 for each combination of θ_d and $e_{1,CB}$ in two cases, $R^\star = 1$ (before the risk-premium shock) and $R^\star = 1.1$ (after the shock). The bottom surface (in black) shows the former case, and the top surface shows the latter (in blue). The highlighted dots show the same equilibrium points depicted by Table 9 in the numerical analysis.

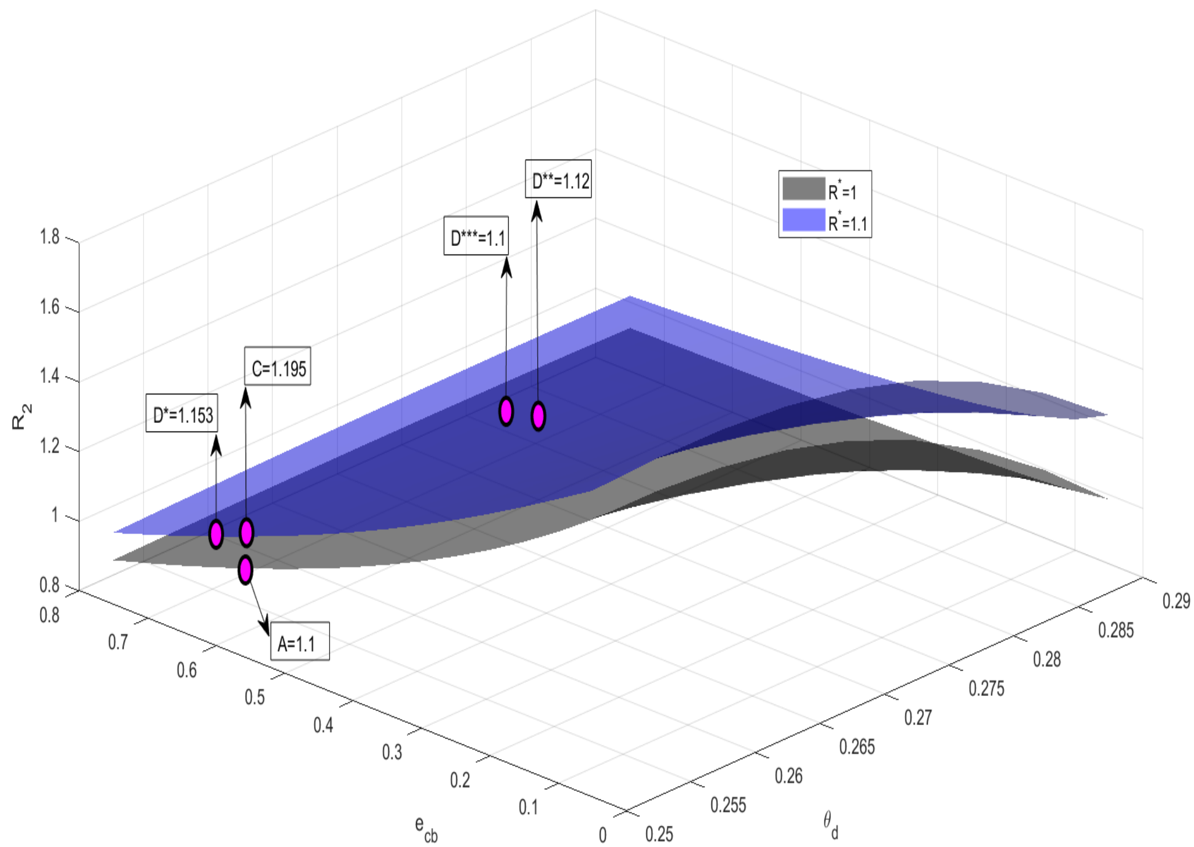
The first feature to notice in Figure 8 is that, regardless of the value of the policy parameters, the domestic interest rate is increasing in the foreign interest rate. In other words, a risk-premium shock mapped as an increase in $R^\star$ always yields an increase in the domestic interest rate, as explained in the previous two sections.[35]

A second feature is that, regardless of the value of R^*, there is a monotonic relationship between $e_{1,CB}$ and R_2. The higher the size of FCIC, the lower the domestic interest rate. This is a natural consequence of Equation 17 when $\phi > 0$. However, the rate at which a change in FCIC would lower the domestic interest rate is not linear and depends on the value of θ_d.

A third feature is that there is a non-monotonic relationship between θ_d and R_2. Notice from Figure 8 that, for very low values of $e_{1,CB}$, an increase in θ_d from 0.25 to higher values initially leads to an increase in the interest rate up to a certain point. This implies that the effect of FOGAPE-COVID on the demand for domestic credit is larger than its effect on supply. However, after a tipping point, the effect on the supply of credit dominates, and the interest rate decreases. The same happens for very high values of $e_{1,CB}$. Therefore, for extreme values of $e_{1,CB}$, given the same size of FCIC, we would require larger increases in θ_d to obtain a lower domestic equilibrium interest rate than the initial one (point A) after the

[35] An increase in $R^\star$ is isomorphic to a decrease in ψ, which has the net effect of increasing ϕ.

Figure 8: Sensitivity Analysis



Notes: The figure depicts a sensitivity analysis of the numerical results by varying $e_{1,CB}$ and θ_d. All reported values of these parameters are those for which a real solution is defined given the rest of the model's parametrization in Table 8.

shock. Conversely, the effect of FCIC is larger for very low initial values of e_{CB}, which could be thought of as an economy with very low participation from the Central Bank in lending to financial intermediaries.

However, for intermediate values of the policy parameters, between 0.1 and 0.65–which cover most of the parameter space–, an increase in θ_d always leads to a decrease in R_2. Yet, the rate of this decrease is non-linear with respect to $e_{1,CB}$. For example, as shown in Figure 8 and in the numerical analysis, an increase in θ_d from 0.25 to 0.27 leads to a fall in the R_2 from point C, 1.195. to point D*, 1.12.

Therefore, we can summarize our results from this exercise as follows: 1) For intermediate values of θ_d and $e_{1,CB}$, which cover most of the parameter space, the joint implementation of FOGAPE-COVID and FCIC generates a fall in the domestic interest rate, and the size of this fall depends on the initial state of the economy. 2) Given the risk-premium shock and the implausibility of having initial extreme values of $e_{1,CB}$ in the economy, the joint implementation of both policies is required to achieve an equilibrium with more domestic credit and a lower or equal domestic interest rate with respect to those before the shock. 3) There could be an initial state of the economy for which a sufficiently large increase in either θ_d or $e_{1,CB}$ is enough to obtain an equilibrium with lower domestic interest rates and higher credit than the initial ones. Yet, considering that such an outcome requires extremely high or extremely low liquidity provided by the Central Bank, this scenario of non-complementarity between both policies seems unlikely in light of the observed patterns of credit, interest rates, and the policies during the COVID-19 crisis.

5 Conclusion

This article examines a sudden stop episode and government policies implemented to counteract its effect on firms' financing in a emerging small open economy. We focus on Chile during the onset of COVID, for which we have a unique administrative dataset that allows us to see the full spectrum of firms' financing. We document that during early 2020, firms tilted their finance mix towards domestic debt and away from foreign debt. The firms that exhibited more pronounced changes in the composition of their borrowing were those eligible to access governmental credit support policies.

Our first contribution is to empirically identify the causal effect of government debt guarantees (namely, FOGAPE-COVID) using a RDD that exploits the program's exogenous eligibility thresholds. The estimation shows that becoming eligible for FOGAPE-COVID credits has an average effect of increasing the domestic debt share by 9.4 percentage points for firms around the eligibility cutoff.

Detailed loan-level regression analysis allows us to conclude that the well-known UIP premium in emerging economies, namely that borrowing in USD is cheaper than borrowing in local currency, holds in Chile during our pre-COVID sample. More importantly, we find that this UIP premium was reduced by an order of magnitude in Chile during the COVID-19 crisis and that this fall is driven by firms that were eligible for FOGAPE-COVID credits. Uncovering the interest rate mechanism that explains the observed debt substitution during COVID is the second contribution of our empirical analysis.

The third contribution of our work is to provide a model of heterogeneous firms with financial frictions in foreign and domestic financing. The theoretical framework sheds light on the mechanisms behind the observed changes in the financing mix and allows us to study another credit support policy implemented during COVID in Chile, namely, credit line facilities (FCIC) provided by the Central Bank to Commercial Banks. The model underscores the degree *complementarity* between sovereign guarantees and Central Bank credit line facilities. Under an empirically plausible space of the parameters that govern both policies, their joint implementation leads to an increase in the domestic debt share *and* lower domestic interest rates in the wake of a large global shock that pushes up the cost of foreign borrowing for EMEs, in line with what was observed during COVID.

Exploring the long-run real effects of the policies that result from changes in the firms' finance mix is a promising avenue for future research. For instance, whether this affects long term investment and labor choices, as well as the optimal allocation of resources, has considerable macroeconomic relevance. Also, understanding how these policies interact in the long run with fiscal policy is of interest. Since the likelihood of implementing a larger set of policy tools during a crisis depends on the fiscal space a country has during the shock, complementing our analysis with a normative framework of dynamic optimal taxation is a natural road to pursue in the future.

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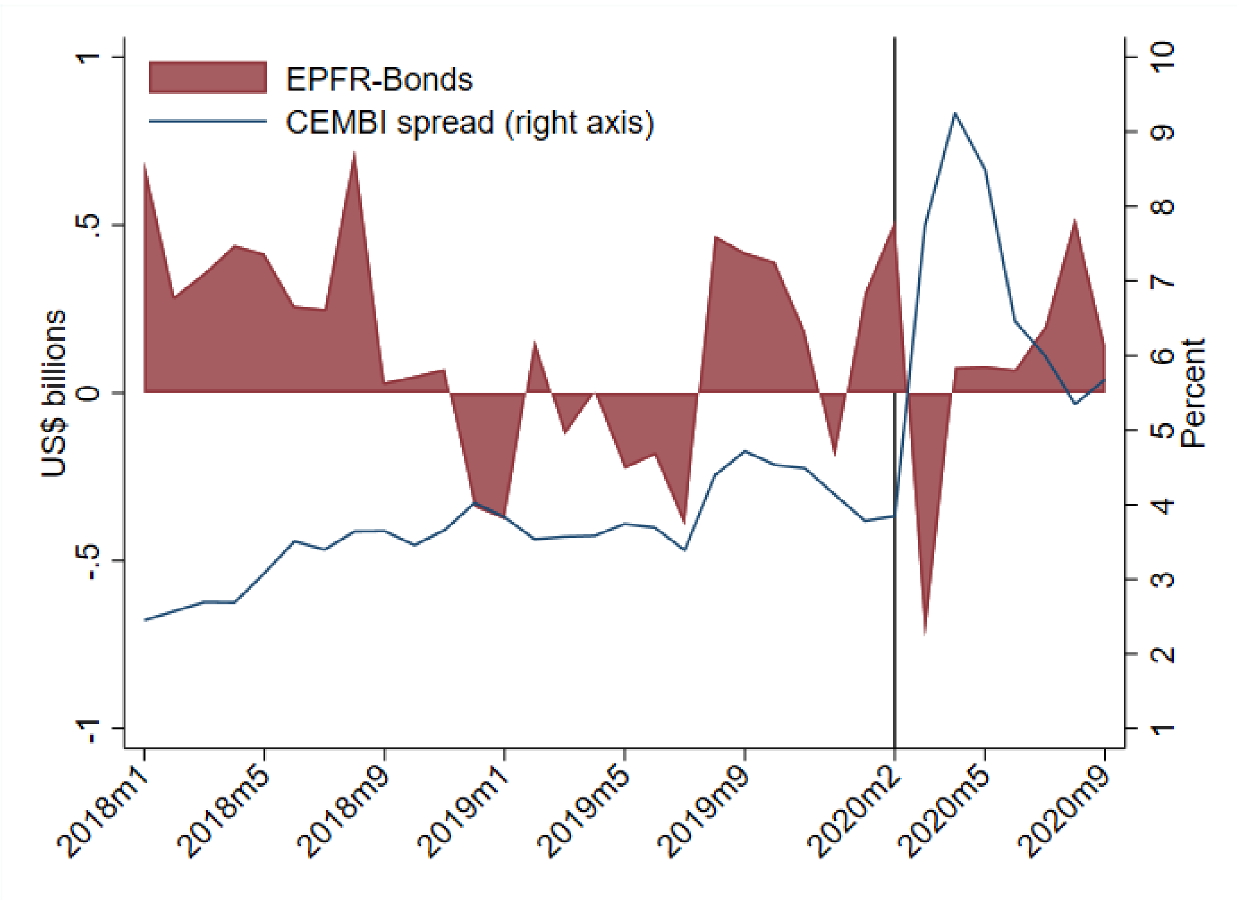
Appendix

A.1. Additional Tables and Figures

Figure 9 extends Figure 1 for a broader set of countries. It shows the cross-country means for EPFRs and CEMBI spreads of Argentina, Brazil, Colombia, Chile, Mexico, and Peru.

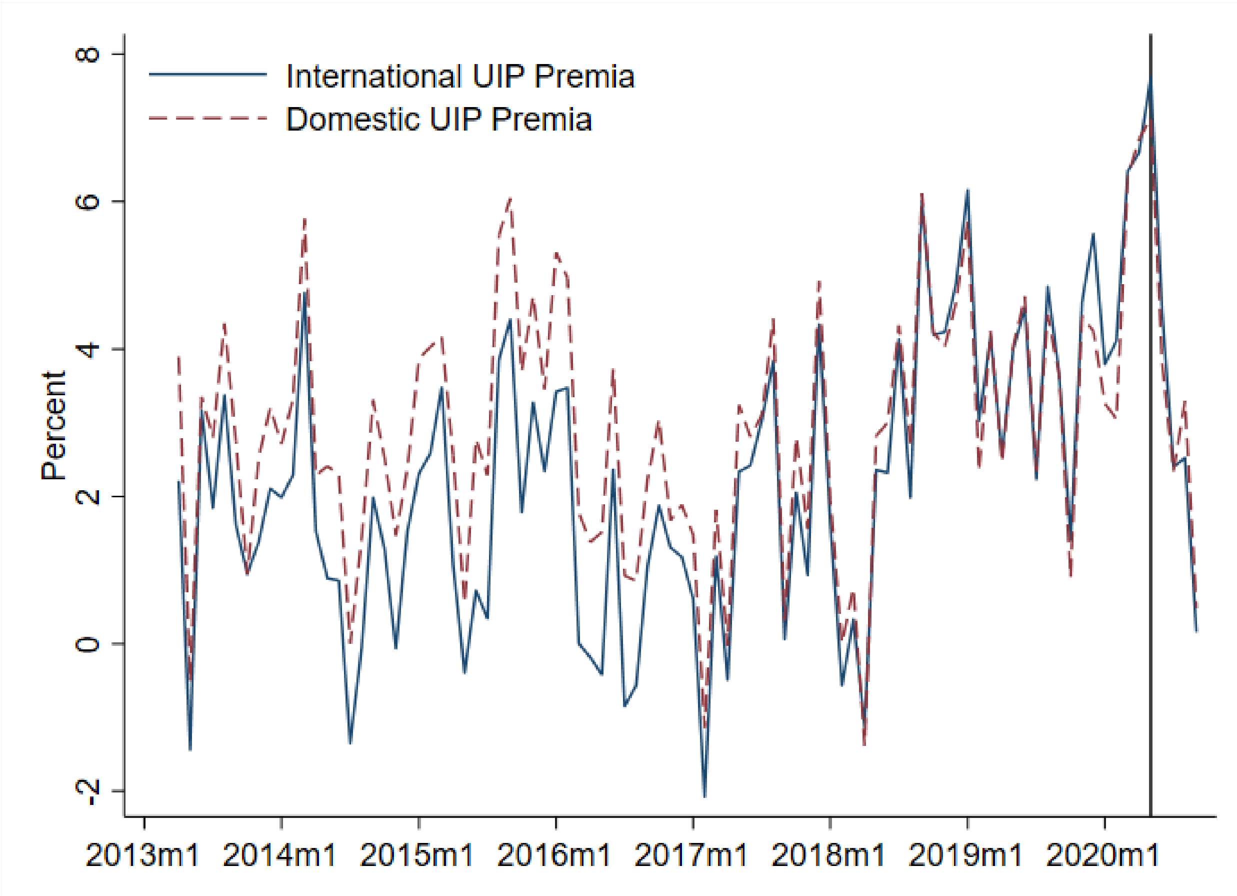
Figure 9: A picture of the pandemic: Capital flows and risk premium



Notes. The figure depicts the fund flows' mean EPFR measure and the mean CEMBI spread (right axis) for: Argentina, Brazil, Chile, Colombia, Mexico, and Peru. Vertical line denotes February/2020, the month prior to the first COVID case in Chile. The data sources are, respectively, Informa PLC and Bloomberg.

Figure 10 shows the behavior of the firm-level UIP deviation as the right-hand panel of Figure 1 for the whole period in our sample. The pattern holds, and the peak UIP deviation is right before the implementation of the FOGAPE-COVID credit.

Figure 10: Average UIP deviation of firms



Notes: The figure depicts the data's average International UIP Premia (solid blue line shows difference in firms borrowing rates on local and USD debt from foreign lenders after adjusting for exchange rate changes) and Domestic UIP Premia (dashed red line shows difference in firms borrowing rates on local and USD debt from domestic lenders, after adjusting for exchange rate changes). The vertical line denotes May 2020, the month when the sovereign guarantees policy was implemented.

Table 10 shows the comparisson between interest rates of debt issued either in Chilean pesos or follars, both domesticaly and abroad. It has the mean across firms for the whole sample, and the periods March-July 2019 and March-July 2020.

Figure 11 is akin to Figure 2, but considering the period between January and July 2020.

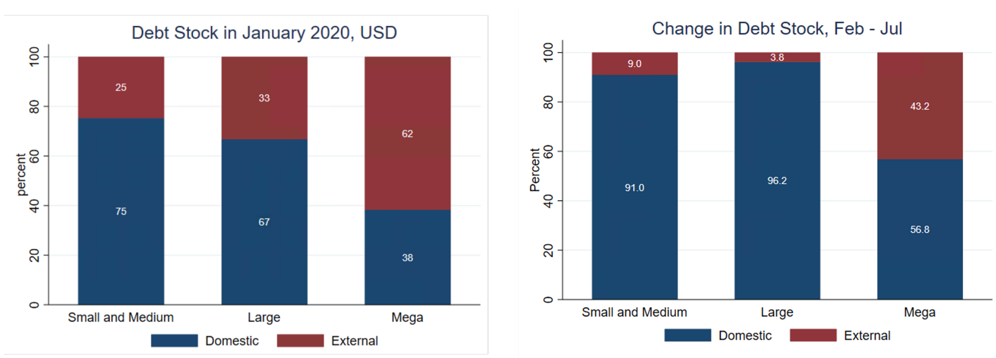
Figure 12 shows the average total leverage by firm size n 2019. The blue line depicts total leverage (i.e. foreign plus domestic debt over revenue), and the red line depicts domestic

Table 10: Interest rates of debt issued in CHP and USD

	Whole Sample	March - July 2019	March - July 2020
Mean i (CHP Domestic Debt - %)	13.2	15.9	5.0
Mean i (CHP Foreign Debt - %)	4.5	3.8	3.2
Mean i (USD Domestic Debt - %)	4.7	6.3	5.5
Mean i (USD Foreign Debt - %)	3.3	4.3	3.5

Notes: The first two rows are the mean interest rates of, respectively, domestic and foreign debt issued in Chilean pesos. The last two rows respectively correspond to the mean interest rates of domestic and foreign debt issued in dollars.

Figure 11: Stock and change in firms' finance mix



Notes: The left oanel depicts the domestic (blue) and external (red) debt share over total debt for three groups of firms: 1) Small and medium (yearly sales of less than 100,000 UF. 2) Large (yearly sales greater than 100,000UF and less than 1,000,000 UF.). 3) Mega (yearly sales greater or equal than 1,000,000 UF). The right panel shows the change of each type of debt, domestic and foreign, as a share of the total change. All calculations are made by measuring the debt in dollars at the spot nominal exchange rate.

leverage. The shaded areas are 95% level confidence intervals.

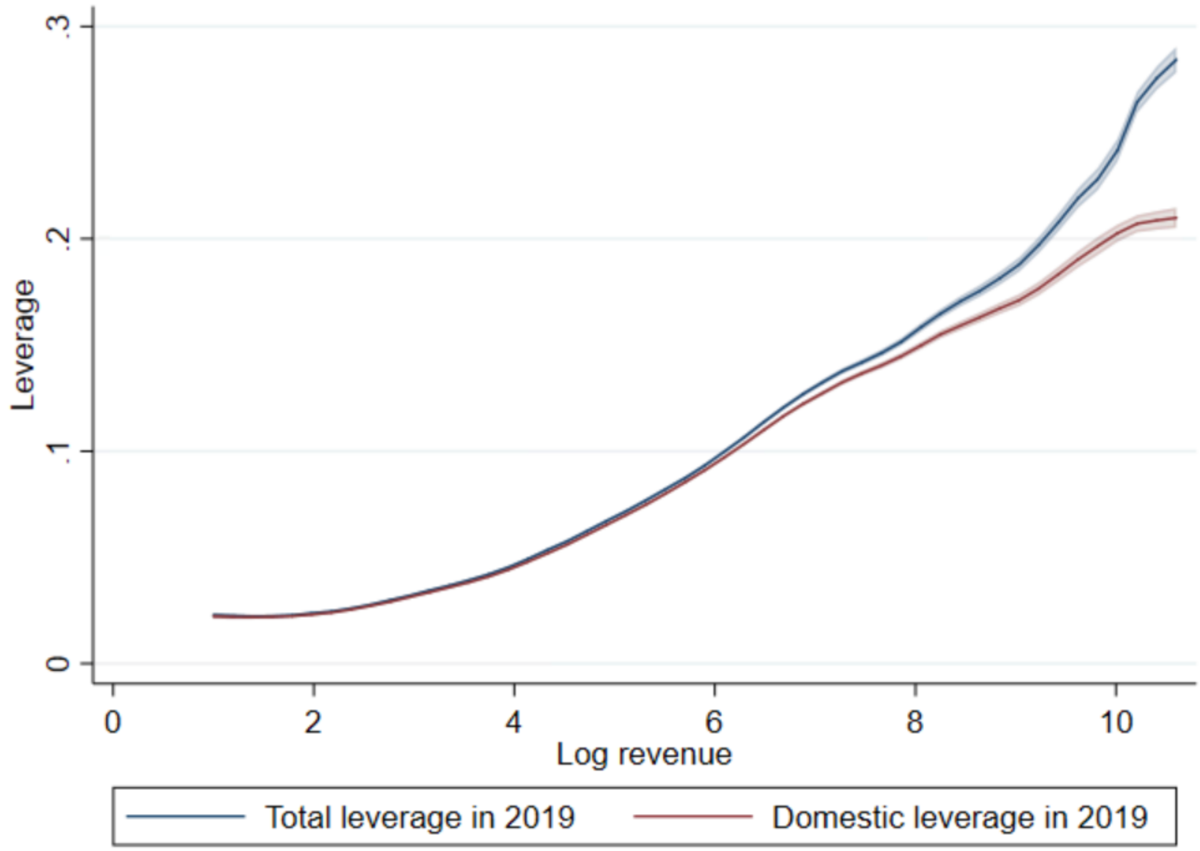
A.2. Model Derivations and Additional Results

Domestic debt derivation To find Equation 15, we operate on the domestic collateral constraint with equality as follows:

$$R_2 d_{1,d}^i = \theta_d A_2 \left(d_{1,d}^i + \frac{\lambda_{2,f}^i}{R^\star} \right)^{\frac{1}{2}}$$

$$R_2^2 (d_{1,d}^i)^2 - (\theta_d A_2)^2 d_{1,d}^i - (\theta_d A_2)^2 \frac{\lambda_{2,f}^i}{R^\star} = 0, \tag{20}$$

Figure 12: Mean leverage per firm size in 2019



Notes: The lines are constructed by taking average across different sales bins in 2019. Sales (revenue) are in UFs. The shades areas are 95% level confidence intervals.

where to get to the second equation we have squared both sides of the first equation and moved all terms to the left-hand side. Using the quadratic formula on Equation 20, we obtain:

$$d^i_{1,d} = \frac{(\theta_d A_2)^2 \pm \sqrt{(\theta_d A_2)^4 + 4R_2^2(\theta_d A_2)^2 \frac{\lambda^i_{2,f}}{R^\star}}}{2R_2^2} =$$

$$\frac{(\theta_d A_2)^2 \pm \theta_d A_2\sqrt{(\theta_d A_2)^2 + 4R_2^2 \frac{\lambda^i_{2,f}}{R^\star}}}{2R_2^2} = \frac{\theta_d A_2\left(\theta_d A_2 \pm \sqrt{(\theta_d A_2)^2 + 4R_2^2 \frac{\lambda^i_{2,f}}{R^\star}}\right)}{2R_2^2}$$

To see why we rule out the negative solution, note that for $\frac{\theta_d A_2\left(\theta_d A_2 - \sqrt{(\theta_d A_2)^2 + 4R_2^2 \frac{\lambda^i_{2,f}}{R^\star}}\right)}{2R_2^2}$ to be positive it must be that:

$$\begin{aligned} \theta_d A_2 - \sqrt{(\theta_d A_2)^2 + 4R_2^2 \frac{\lambda^i_{2,f}}{R^\star}} &> 0 \\ \implies 0 &> 4R_2^2 \frac{\lambda^i_{2,f}}{R^\star}, \end{aligned}$$

which is impossible because all the terms in the right-hand side of the last inequality are positive.

Credit market equilibrium Equation 19 can be solved using the power rule of integration, yielding:

$$\left[\frac{1}{2}\left(\frac{\theta_d A_2}{R_2}\right)^2 \lambda^i_{2,f}\right]_0^{\hat{\lambda}} + \left[\frac{\theta_d A_2 R^\star}{12 R_2^4}\left(\sqrt{(\theta_d A_2)^2 + \frac{4R_2^2}{R^\star}\lambda^i_{2,f}}\right)^3\right]_0^{\hat{\lambda}} + \left[k^\star \lambda^i_{2,f} - \frac{\left(\lambda^i_{2,f}\right)^2}{2R^\star}\right]_{\hat{\lambda}}^{\bar{\lambda}} = e_{1,T} \tag{21}$$

where the first two expressions in large brackets come from constrained firms, and the third expression in large brackets comes from unconstrained firms.

After evaluating the integrals at their respective upper and lower limits, Equation 21 becomes:

$$\frac{1}{2}\left(\frac{\theta_d A_2}{R_2}\right)^2 \hat{\lambda} + \frac{\theta_d A_2 R^\star}{12 R_2^4}\left(\sqrt{(\theta_d A_2)^2 + \frac{4R_2^2}{R^\star}\hat{\lambda}}\right)^3 - \frac{R^\star}{12}\left(\frac{\theta_d A_2}{R_2}\right)^4 + k^\star\left(\bar{\lambda} - \hat{\lambda}\right) - \frac{1}{2R^\star}\left(\bar{\lambda}^2 - \hat{\lambda}^2\right) = e_{1,T} \tag{22}$$

with $k^\star = (A_2\alpha)^{\frac{1}{1-\alpha}}$ and $\hat{\lambda} = R^\star\left(k^\star - \frac{\theta_d A_2 (k^\star)^\alpha}{R_2}\right)$.

TFP shock Figure 13 and 14 show the effect of a decrease in TFP (A_2) on the domestic interest rate, the threshold, and domestic debt share of a constrained firm, of an unconstrained firm, and total.

A negative TFP shock decreases the first-best level of capital that firms wish to finance, decreasing unconstrained firms' demand for domestic debt and, hence, also the interest rate. The share of constrained firms decreases slightly when TFP falls. A lower TFP has two effects on $\hat{\lambda}$. First, it tightens firms' domestic collateral constraints, increasing the share of constrained firms. Second, a lower domestic interest rate slackens domestic collateral constraints. The second effect dominates, decreasing the share of constrained firms and increasing the share of unconstrained firms. A lower domestic interest rate makes constrained firms increase their domestic debt. Because their foreign debt remains unchanged (i.e., $\lambda^i_{2,f}/R^\star$), the domestic debt share increases. Unconstrained firms behave very differently. They decrease their domestic debt because their desired level of capital (i.e., $k^\star$) is lower. On aggregate, the domestic debt share decreases when TFP falls. The domestic debt share is calculated dividing the market domestic debt over the sum of the domestic debt and foreign debt. Total foreign debt equals:

$$D_f = \int_0^{\bar{\lambda}} \frac{\lambda^i_{2,f}}{R^\star} d\lambda^i_{2,f} = \frac{1}{R^\star}\int_0^{\bar{\lambda}} \lambda^i_{2,f} d\lambda^i_{2,f} = \frac{1}{R^\star}\frac{(\lambda^i_{2,f})^2}{2}\Big|_0^{\bar{\lambda}} = \frac{(\bar{\lambda})^2}{2R^\star} \tag{23}$$

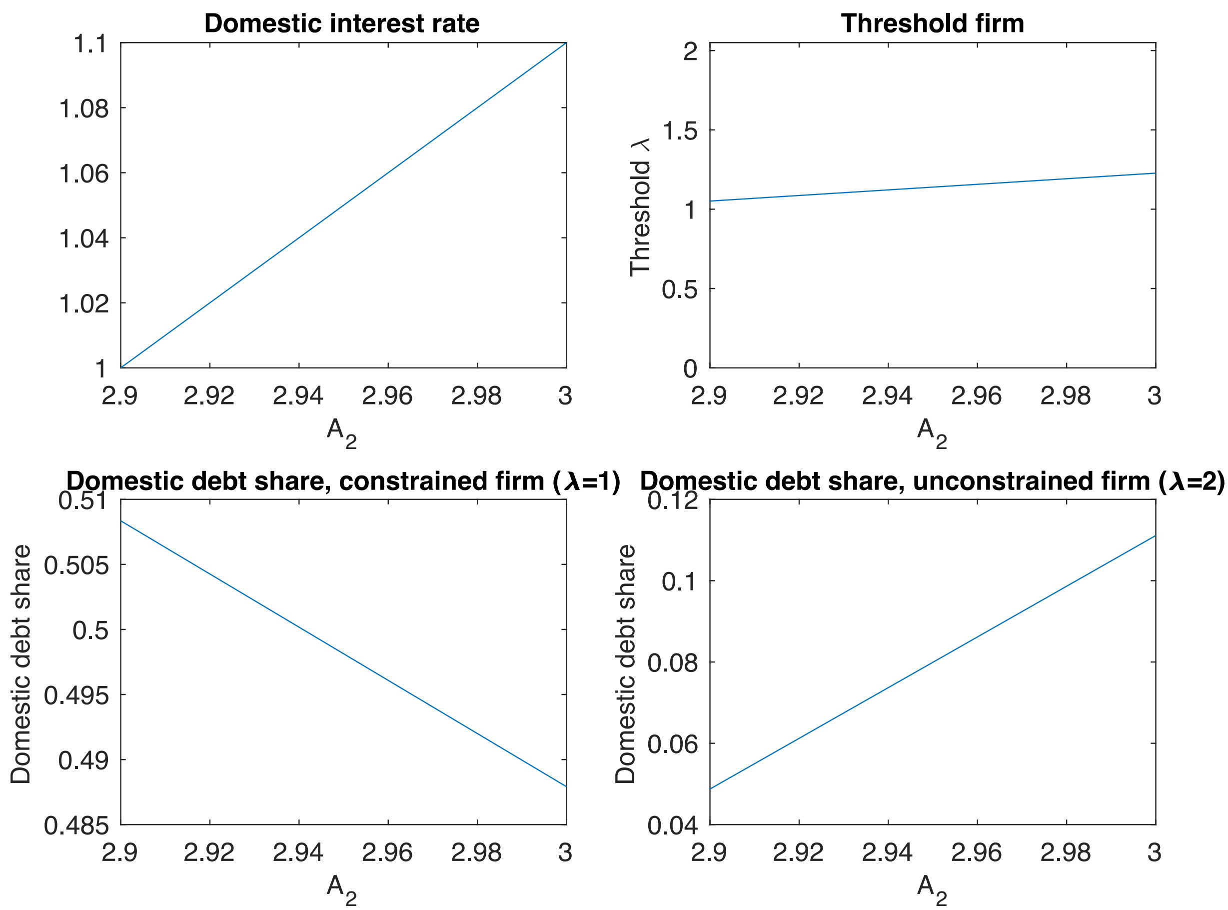
Credit supply microfoundation The microfoundation for the credit supply in the main body of the paper features financial intermediaries akin to the ones in Curdia and Woodford (2011), hereafter CW.

Financial intermediaries make loans L^i_1 to domestic firms i at rate R^b_2 and accept deposits s_1 from domestic households at a risk-less gross deposit return R^s_2 in period 2.

Similarly to CW, financial intermediaries also demand reserves m_1 and get paid an interest rate on reserves R^m_2. Differently from CW, they also demand FCIC, denoted as e^{CB}_1, and pay an interest rate R^{CB}_2 to access the public liquidity. Finally, some of the loans financial intermediaries issue have public sector guarantees backing them up (FOGAPE).

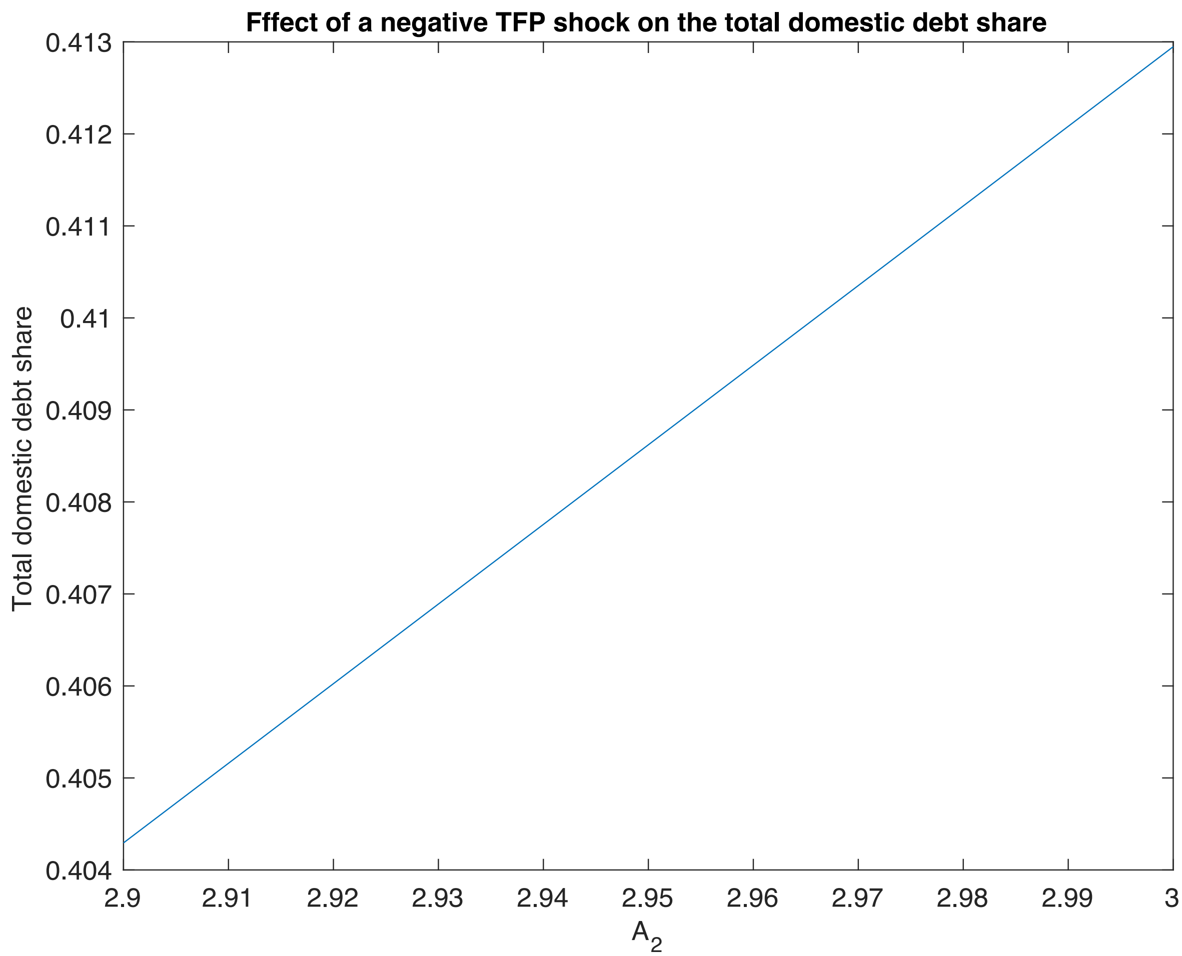
As in CW, financial intermediaries have loan origination costs. Namely, we assume the

Figure 13: Effect of a drop in A_2



Note: Effect of a decrease in A_2 on the domestic interest rate (R_2) (top left panel), the threshold firm ($\hat{\lambda}$) (top right panel), and the domestic debt shares for a constrained and an unconstrained firm (bottom left and right panels, respectively).

Figure 14: Effect of a drop in A_2 on the total domestic debt share



Note: Effect of a decrease in A_2 on the total domestic debt share following loan origination cost function:

$$\Xi(\int L_1^i di - e_1^{CB}, \theta_d, m_1) \tag{24}$$

which satisfies $\Xi_L(\int L_1^i di - e_1^{CB}, \theta_d, m_1) \geq 0$, $\Xi_{\theta_d}(\int L_1^i di - e_1^{CB}, \theta_d, m_1) \leq 0$, and $\Xi_m(\int L_1^i di - e_1^{CB}, \theta_d, m_1) \leq 0$. We also assume that financial intermediaries have a satiation point for reserves, $\Xi_m(\int L_1^i di - e_1^{CB}, \theta_d, m_1) = 0 \implies \bar{m_1}(\int L_1^i di - e_1^{CB}, \theta_d)$.

Equation 24 modifies CW's loan origination costs in two ways. First, loans with public sector guarantees (FOGAPE) decrease loan origination costs. Intuitively, public sector guarantees require less information acquisition about the quality of collateral. Second, only loans coming from private resources generate loan origination costs. In this way, we capture a benefit of the Central Bank's credit policy (FCIC). In CW, the credit policy given directly to domestic households also does not generate any loan origination costs for the Central Bank.

In this environment, financial intermediaries' problem is given by:

$$\begin{aligned} max_{L_1^i, s_1, m_1, e_1^{CB}} \quad & R_2^b \int L_1^i di + R_2^m m_1 - R_2^d s_1 - R_2^{CB} e_1^{CB} \\ & -\Xi(\int L_1^i di - e_1^{CB}, \theta_d, m_1) && (25) \\ s.t \quad & s_1 = m_1 + \int L_1^i di && (26) \end{aligned}$$

The constraint is financial intermediaries' balance sheet constraint.

Substituting Equation 26 into Equation 25 gives the following expression for financial intermediaries' objective function:

$$R_2^b \int L_1^i di + R_2^m m_1 - R_2^d(m_1 + \int L_1^i di) - R_2^{CB} e_1^{CB} - \Xi(\int L_1^i di - e_1^{CB}, \theta_d, m_1) \tag{27}$$

Taking FOC wrt L_1^i and m_1, we obtain:

$$\Xi_L(\int L_1^i di - e_1^{CB}, \theta_d, m_1) = R_2^b - R_2^d \equiv \omega_2 \tag{28}$$

$$-\Xi_m(\int L_1^i di - e_1^{CB}, \theta_d, m_1) = R_2^d - R_2^m \equiv \delta_2^m \implies m^d(L_1^i) \tag{29}$$

These are analogous to equations (15) and (16) in CW. Equation 28 determines the equilibrium credit spread, ω_2, that hinges upon the operating costs being increasing in loan volume. It also defines an implicit credit supply. Equation 29 states that the spread between interest rate paid on deposits and the interest rate paid on reserves are determined by those aggregate quantities. It also defines an implicit demand function for reserves.

The FOC for e_1^{CB} equals:

$$\Xi_L(\int L_1^i di - e_1^{CB}, \theta_d, m_1) = R_2^{CB} \tag{30}$$

which equates the private benefits of FCIC, that is, lowering loan origination costs, against its cost to financial intermediaries, that is, the interest rate they need to pay the Central Bank. R_2^{CB} is pinned down by the equilibrium credit spread, $R_2^b - R_2^d$ since the left-hand sides of Equation 28 and Equation 30 are identical.

Households and firms are identical to the model in the main body of the paper. Market clearing in Equation 19 changes because credit supply in the right-hand side is $\int L_1^i di$ in the model's extension instead of e_1.

From Equation 28, it is clear that credit supply is increasing in R_2^b, θ_d, and e_1^{CB}. Not surprisingly, in our baseline model, credit supply was not increasing in R_2^b because we did not have optimizing agents on the supply side. Crucially, in the current microfoundation, both FOGAPE and FCIC *complement* each other in increasing credit supply.