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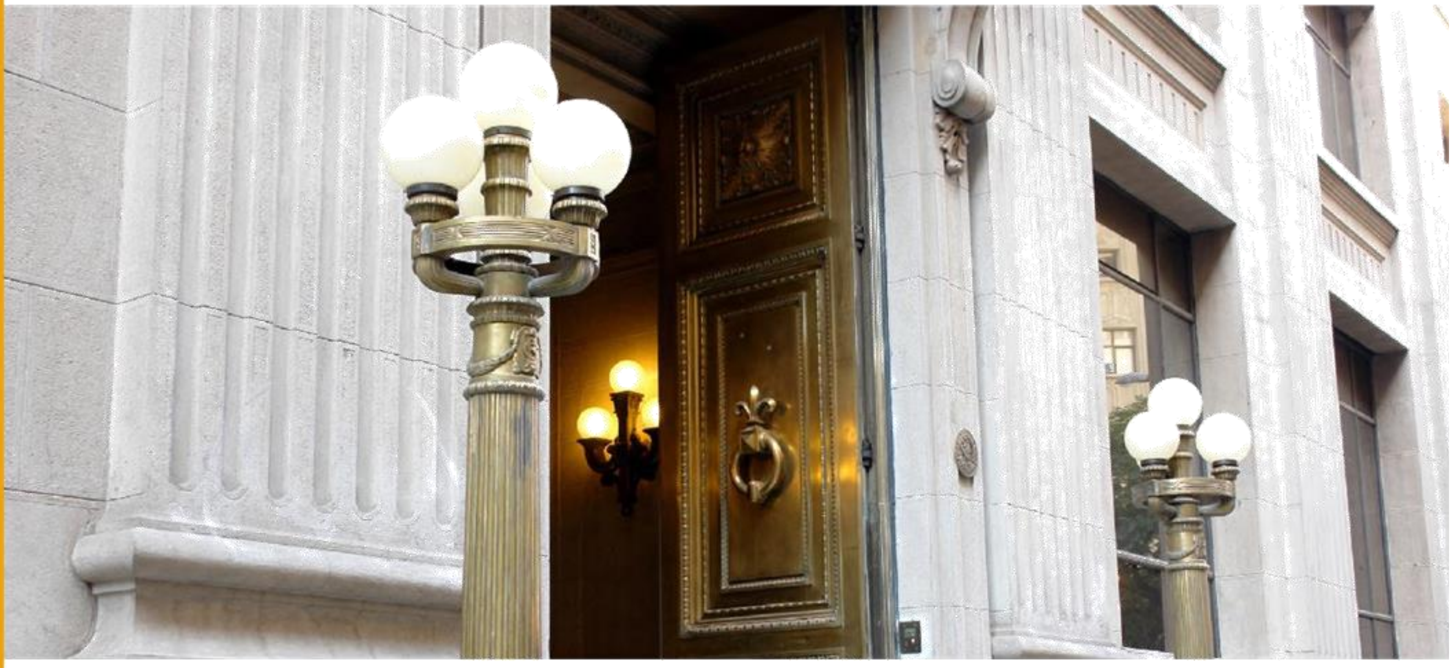

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Unconventional credit policies during crises: A structural analysis of the Chilean experience during the COVID-19 pandemic*

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Abstract

With the economy facing an unprecedented hit due to the COVID-19 pandemic, the Central Bank of Chile and the Chilean government jointly implemented several programs aimed at increasing liquidity and maintaining the flow of funds in the economy. In this paper, we extend the model described in Calani et al. (2022), a structural large-scale DSGE model with a financial system and financial frictions, to assess the impact of the different credit programs implemented during the COVID-19 crisis. We find that the policies' most significant impact was due to the FOGAPE program and from their joint ability to reduce credit risk. The quantitative analysis carried on in this paper shows that the contraction of GDP in 2020 was between 2.7 and 5.4 percentage points milder thanks to the implemented liquidity and credit policies.

Resumen

Con la economía enfrentada a un golpe sin precedentes debido a la pandemia del COVID-19, el Banco Central de Chile y el Gobierno de Chile implementaron en conjunto una serie de programas destinados a aumentar la liquidez y mantener el flujo de crédito en la economía. En este artículo extendemos el modelo DSGE macro-financiero descrito en Calani et al. (2022) con el objeto de evaluar el impacto de los diferentes programas de crédito implementados durante la crisis del COVID-19. Los resultados muestran que el impacto más significativo de las políticas se debió al programa FOGAPE y, principalmente, a la capacidad conjunta de las distintas políticas en reducir el riesgo crediticio. En particular, el análisis cuantitativo muestra que el PIB en 2020 se contrajo entre 2,7 y 5,4 puntos porcentuales menos gracias a los efectos de las políticas de liquidez y crédito implementadas.

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1 Introduction

To counteract the economic effects of the COVID-19 pandemic, the Central Bank of Chile (CBC) and the Chilean government implemented a series of credit and liquidity policies. These policies included a credit facility to private banks linked to the number of loans extended to firms, an increase in the number of assets eligible as collateral for CBC loans, allowing for direct purchases of private bank bonds in the secondary market by the CBC, and government guarantees for commercial loans extended to small and medium firms.

This paper quantifies the policies' effects on the Chilean economy. To do so, we model the implemented programs within the framework of the quantitative DSGE model described in Calani et al. (2022). It is a large-scale new-Keynesian small open-economy model with a focus on frictional financial intermediation.

This paper contributes to a series of newly released studies that analyze the impact of the COVID-19 pandemic on the Chilean economy. Among them, Fernandez et al. (2021), using micro-data from the Chilean corporate sector, build and show the evolution throughout the pandemic of an indicator of firms' liquidity, defined in terms of the number of months a firm can pay for their operational costs and short term financial obligations without depleting their cash reserves. In Huneeus et al. (2021), the authors analyze the effect of the large-scale program of credit guarantees FOGAPE and find that, although it increased lending towards riskier firms, the overall macroeconomic risk remained low. Finally, Madeira (2022) studies the economic impact of the 2019 Chilean social unrest and the COVID-19 pandemic. The paper documents that household debt risk decreased during the economic downturn thanks to the implemented policies.

The document's structure is as follows: Section 2 covers the details regarding the institutional framework of the CBC, as well as several policies, both conventional and unconventional, recently implemented. Section 3 reviews the relevant literature regarding the structural modeling of unconventional monetary policy in DSGEs. Section 4 outlines the base model. Section 5 describe the implementation of the policies within the model's framework and Sections 6 and 7 show the results, while section 8 concludes.

2 Liquidity and credit policies within the Chilean institutional framework

2.1 The CBC's institutional framework

The Central Bank of Chile is an autonomous institution of the Chilean Government with constitutional rank. Its independence is defined in its Organic Constitutional Law. Its objectives are to maintain the stability of the currency and the normal functioning of internal and external payments. The CBC has several tools to achieve its mandate of allowing for a smooth operation of the financial payments system. These tools include the exclusive ability to issue currency and to regulate and conduct monetary policy operations.

The CBC can also provide liquidity to banks, be the lender of last resort, guarantee the demand deposits, regulate the payment system, and activate a countercyclical capital buffer for commercial banks. Operationally, the CBC implements its monetary policy by defining a target interest rate for the interbank rate, the rate at which the banks lend to each other overnight. This operational instrument, the Monetary Policy Rate (MPR), is defined and announced eight times a year after monetary policy meetings. Until August 2020, the CBC could only provide financing to banks and financial firms. However, due to the COVID-19 pandemic, the Chilean congress amended the constitution to allow the CBC to, in limited circumstances, trade government debt in secondary markets.

2.2 Implemented policies during the COVID-19 pandemic

The CBC and the government put in motion several policies to attenuate the effects of the economic downturn. First, the CBC rapidly decreased the monetary policy rate, reaching it's effective lower bound of 0.5% in April 2020.

In addition, the CBC implemented several other unconventional policies. The policy objectives focused on reducing uncertainty, easing tensions in the financial markets – particularly a shortage of liquidity in both dollars and pesos – and, in general, cushioning the economic effects of the sanitary measures implemented to deal with the pandemic[1]. While some of the policies started being applied in November 2019, following the beginning of the Chilean social unrest crisis, the CBC implemented most of the measures after the coronavirus outbreak.

On November 13th, the CBC announced the REPO and FX Swap programs, which are, respectively, repurchase agreements of CBC bonds and purchase of foreign currency swaps. These policies provided liquidity in both dollars and Chilean pesos to the financial market and helped to decrease the excessive exchange rate volatility. It was followed, on November 28th, by a program that allowed for the sale of up to 20 billion USD in reserves. Then, on March 16th, when the coronavirus outbreak had worsened international financial conditions, the CBC extended the REPO and FX Swap programs to allow for new maturities in ongoing operations.

On March 23rd, the CBC put in place new supplementary measures to ease the tensions in the financial markets. The first of these measures was the implementation of the Credit Facility Conditional on the Increase of Loans, also known as FCIC[2]. The facility allowed for a special financial line for banking institutions, conditional on them continuing or increasing their lending to households and firms. The base credit line limit was set at 3 percent of the total loan base portfolio. Additional clauses allowed banks to increase their share of the total loan portfolio, up to 15%, depending on the annual growth of extended credit and the percentage of the FCIC resources destined for Small and Medium Enterprises (SMEs). After the first round of FCIC, two additional rounds were implemented, providing more than US$30 billions in total. The CBC activated an additional liquidity program to complement the FCIC program, the domestic currency Liquidity Credit Line (LCL) program. This line was limited to the institution's average amount of reserves in the central bank. Compared with the FCIC, it shared the same limit of 3% of the amount of extended loans, and was subject to similar conditions regarding the increase in the loan portfolio size. The two facilities were intended to increase the amount of credit provided by the banks. At first, they had a restricted set of eligible assets to be used as collateral, consisting, for the most part, of debt instruments issued by the Central Bank

[1] `https://www.bcentral.cl/web/banco-central/medidas-excepcionales`

[2] The acronym comes from the Spanish name of the program: *Facilidad de Crédito Condicional al Incremento de Colocaciones.*

or the Government. However, later on, as an additional measure, the CBC increased the number of eligible assets to include high-quality commercial loans and corporate bonds. The change in the asset eligibility conditions more than tripled the access to the facilities, providing further flexibility for banks to extend loans to households and firms.

The CBC also started a commercial banks bond purchasing program for an amount equivalent to 4 billion dollars[3]. The program's objective was to lower the financing cost for banks to ensure an efficient monetary policy transmission in a scenario where the monetary policy rate had already reached its effective lower bound. During this program, the central bank bought close US$ 3.8 billions.

Finally, the central government announced the extension of the FOGAPE program, where the government guaranteed commercial loans provided by banks. The program allowed the government to guarantee loans for up to US$24 billion. It aimed to provide working capital loans to SMEs, defined, for this purpose, as firms with annual sales less than US$34 millions[4], which comprise up to 99% of Chilean firms. The maximum nominal interest rate allowed for these guaranteed credits was the monetary policy rate + 3%. Since the beginning of the program, in May 2020, the peak of outstanding FOGAPE guaranteed loans was reached in July 2021, with 14,5 billion USD.

3 Unconventional monetary policy in structural DSGE models

In this section we briefly review some of the relevant literature, focusing on papers that, within a DSGE framework, explore similar programs to those implemented in Chile. In particular, Quantitative Easing (QE) programs as defined by Falagiarda (2013): "[. . .] *all policies carried out by central banks involving changes in the composition and/or size of their balance sheet aimed at, in a situation close to the ZLB, easing liquidity and credit conditions with the final goal of stimulating the economic system*". The policies implemented by the CBC and the Chilean government all fall under this category. Specifically, the FCIC corresponds to a type of Lending Operation (LO) similar to the Bank of England's Funding-for-Lending scheme or the European Central Bank's Long-Term Refinancing Operations (LTRO). The CBC's Bank Bond Purchase Program (BBPP for lack of an official acronym) corresponds to a type of Asset Purchase Program (APP) similar to the ECB's Covered Bond Purchase Programmes (see CGFS, 2019). Within that narrower scope, we focus on the academic literature incorporating these policies in a DSGE framework, as it is the goal of this project. We draw insights from Bhattarai and Neely (2016), who have already done an extensive job of covering the literature on unconventional monetary policy.

In standard New Keynesian DSGE models, such as Smets and Wouters (2007), QE can only be effective through the signaling channel, which works whenever any communication affects expectations of the future path of the monetary policy rate e.g. that it should stay at the ELB for an extended period. Therefore, DSGE models must be modified to include financial frictions to model other channels through which QE may influence macroeconomic outcomes. These frictions allow for real effects of QE through three other channels: liquidity, credit, and portfolio channels.

The liquidity channel emphasizes the need for liquidity in the interbank market, which is explicitly modeled, usually following a similar approach to Gertler and Kiyotaki (2010). In the event of a severe

[3]The program didn't allow for direct bond purchases, only allowing for transactions on secondary markets.
[4]The limit was set in terms of UFs, a real index that, at the exchange rate of the time, amounted to 34.25 dollars

absence of liquidity, and thus a disruption of normal financial intermediation, QE can be expansive by directly addressing the liquidity shortage and ameliorating the drop in credit supply to the non-financial sector. Other related papers include Dib (2010); Hilberg and Hollmayr (2013); Del Negro et al. (2017).

The credit channel addresses the Central Bank's role as a credit supplier. This channel is typically modeled through direct loans from the monetary authority to the private sector, which may boost activity in the presence of severe frictions in private financial intermediaries, despite some inefficiency in central bank credit allocation. Notable contributions to the literature include Curdia and Woodford (2010); Gertler and Kiyotaki (2010); Gertler and Karadi (2011). These papers tend to focus on either hypothetical central bank direct lending to the non-financial sector, or actual APP of private assets (e.g. commercial paper) done by central banks. We believe this channel might also be suitable to study LO programs such as the FCIC. However, the literature has scarcely followed this approach, with the exception of Cahn et al. (2017).

Finally, the portfolio channel's crucial friction consists of imperfect substitution between bonds of different maturities and currency denominations. In the presence of this friction, QE can have real effects through rebalancing investment portfolios, as prices and interest rates may be affected by changes in the relative supply of each asset. For example, Central Banks may purchase long-term bonds and reduce the supply available to the private sector, increasing their price and lowering their interest rate. Papers that include this channel in DSGE models include Harrison (2012, 2017); Falagiarda (2013); Ellison and Tischbirek (2014); Kabaca (2016); Hohberger et al. (2019); Chen et al. (2012). They tend to focus on large-scale APP, so approaches in this literature might be suitable to study the CBC's BBPP, in particular, because of the relatively long duration of the bonds purchased. We should also note that empirical results point out that most of the QE done by central banks has affected the term or risk premia, and therefore the effects are due to the portfolio channel (see Gagnon et al., 2011).

For the reasons exposed above, we will delve deeper into some papers addressing the portfolio channel, followed by a brief description of the literature regarding the credit channel. Lastly, we cover the literature on state-financed guarantee funds, as it relates to the implemented FOGAPE program of government guarantees on commercial loans.

3.1 Portfolio adjustment costs in household's budget constraints

The implications of imperfect substitution due to portfolio adjustment costs are analyzed in Falagiarda (2013). There are two zero-coupon bonds in their setup. They feature different maturities and are traded in a secondary market as in Ljungqvist and Sargent (2012). The portfolio adjustment costs are increasing in the ratio of long to short-term bonds. Their model features a joint restriction for the government and central bank, including rules for bond issuances from the former and purchases from the latter, allowing for QE shocks that affect the real economy. In Hohberger et al. (2019) the economy also features bonds with different maturities, in this case, denominated in both domestic and foreign currency, and with imperfect substitution between the long-term domestic and foreign bonds. Both households and the central bank demand bonds. The latter buy and sell long-term bonds as a type of QE policy, necessary at times as conventional monetary policy is restricted by an effective lower bound. They show that a (large) open economy setting creates an additional channel for QE:

the exchange rate channel. When the central bank buys long-term bonds, households seek alternative mechanisms to save through foreign bonds, depreciating the exchange rate, stimulating foreign demand for domestic goods, and affecting prices through an imported inflation channel. Kabaca (2016), on the other hand, deals with QE policies in the context of a small open economy, analyzing the importance of the substitutability between domestic and foreign bonds. They argue that if foreign bonds are excellent substitutes for domestic ones, QE has little real effect as foreign yields and the exchange rate don't react significantly, with only a portfolio rebalancing effect.

3.2 Central bank lending to financial intermediaries

Regarding the structural modeling of the central bank's ability to lend to financial intermediaries, our paper[5] relates to Dib (2010), who builds a DSGE model with a financial accelerator à la BGG and an interbank market for liquidity, and then studies quantitative easing by simulating a large injection of money into the banking system by the central bank, similar to an LO program except that money pays no interest. This results in cheap financing for banks, which translates to lower prime lending rate, produces an expansion of GDP and inflation. Cahn et al. (2017),, within the framework of a Gertler and Karadi (2011) type banking sector and an extended version of the discount window facilities described in Gertler and Kiyotaki (2010), study the impact of European LTROs and suggest that they boosted GDP by 2,5% in 2009. Their model demonstrates analytically that -under some assumptions- LTROs help relax the incentive constraint that bankers face, allowing banks to increase their leverage and extend more loans.

3.3 State-financed credit guarantees

To the best of our knowledge, the literature does not address the macroeconomic implications of credit guarantee programs through the use of DSGE models. These policies are usually addressed by studying the (mis)allocation of resources stemming from several financial market imperfections: moral hazard, asymmetric information, and others. The theory behind these imperfections and the appropriate policy responses are discussed in Anginer et al. (2014). Benavente et al. (2006) perform a similar analysis but targeted directly at studying FOGAPE, the Chilean program. This program is also directly addressed, within a purely empirical framework, by de la Torre et al. (2017).

4 The baseline model

To model the different credit policies, we extend the model described in Calani et al. (2022), a new Keynesian small open economy DSGE model with a financial sector, financial frictions, and the possibility for household, firms and banks to default on their financial obligations. The real sector of the model is based on the Central Bank of Chile's main DSGE model, described in Garcia et al. (2019). The model's framework for the financial sector is based mainly on Clerc et al. (2014).

[5] While a relevant part of the related literature discusses the effects of direct financing from the central bank to the non-financial sector, we abstain from discussing these topics as they relate to policies not allowed by the CBC's regulatory framework.

In this paper we will only briefly describe the structure of the model, focusing only in the sections that are relevant for the inclusion of the financial policies announced by the CBC and the Government.

The model's economy is populated by households, entrepreneurs, bankers, producers of capital, housing, and final goods, a central government, and a central bank. In this section, we describe the structure of the agents subject to financial frictions and directly affected by the credit policies: the households, the banks, and the entrepreneurs.

The model's financial frictions follow the structure first introduced by Bernanke et al. (1999), where they arise due to asymmetric information between lenders and borrowers, with lenders having to pay a verification cost to assess the borrower's actual realized return. In the setup, the agency problem creates a conflict of interest between borrowers and lenders, leading to the design of an optimal contract that promotes truth-telling and minimizes agency costs.

4.1 Households

There are two continuums of measure one, risk-averse and infinity lived households which differ in their discount factor: β_I for impatient households (I), and β_P for more patient households (P), where $\beta_P > \beta_I$. In equilibrium, the impatient households borrow and the patient household save in various financial assets. Households are ex-ante identical in asset endowments and preferences to others of their same patience. Their utility depends on the consumption of a final good C_t relative to external habits, their stock of housing H_t and labor supplied (hours worked) n_t in each period. Following Andres et al. (2004) and Chen et al. (2012), we allow for a distinction between two types of patient households: restricted (R) and unrestricted (U), depending on which assets they can access for saving purposes. While unrestricted households can buy both long and short-term assets with a transaction cost, restricted households can only buy long-term bonds, but do not face any transaction cost. Their combined measure is of size one. The long-term financial instruments that households can access: long-term government bonds, commercial bank bonds, and housing debt, are modeled as in Woodford (2001). In this framework, long-term instruments are structured as perpetuities paying a coupon of unitary value (in units of final goods) in the period after issuance and a geometrically declining series of coupons (with a decaying factor $\kappa < 1$) after that.

Households of type $i = \{U, R, I\}$ maximizes:

$$\max \ \mathbb{E}_0 \sum_{t=1}^{\infty} \beta_i^t \varrho_t \left[\xi_t^c \frac{\left(\hat{C}_t^i\right)^{1-\sigma}}{1-\sigma} - \Theta_t^i A_t^{1-\sigma} \xi_t^n \frac{\left(n_t^i\right)^{1+\varphi}}{1+\varphi} \right] \tag{1}$$

where $\beta_i \in (0,1)$ is the respective discount factor, ϱ_t is an exogenous shock to intertemporal preferences, ξ_t^c, and ξ_t^n are preference shocks that affect the (dis)utility from consumption, and labor, respectively, $\sigma > 0$ and $\varphi \geq 0$ denote the inverse of the intertemporal elasticity of substitution and the inverse elasticity of labour supply. Finally, following Galí et al. (2012) we introduce Θ_t^i as an endogenous preference shifter.

Unrestricted patient households face a borrowing constraint given by

$$
\begin{aligned}
BS_t^U + \left(1+\zeta_t^L\right) Q_t^{BL} BL_t^U + D_t^U + \left(1+\zeta_t^L\right) Q_t^{BB} BB_t^U + S_t B_t^{\star U} + P_t C_t^U + Q_t^H H_t^U = \\
R_{t-1} BS_{t-1}^U + Q_t^{BL} R_t^{BL} BL_{t-1}^U + \tilde{R}_t^D D_{t-1}^U + \tilde{R}_t^{BB} Q_t^{BB} BB_{t-1}^U + S_t B_{t-1}^{\star U} R_{t-1}^{\star} + W_t n_t^U \\
+ Q_t^H \left(1-\delta_H\right) H_{t-1}^U + \Psi_t
\end{aligned} \tag{2}
$$

where BS_t^U are short term government bonds held by the unrestricted households, Q_t^{BL} is the price of long term government bonds, BL_t^U are long term government bonds held by unrestricted households, Q_t^{BB} is the price of long term bank bonds, BB_t^U are long term bank bonds held by unrestricted households, S_t is the nominal exchange rate, $B_t^{\star U}$ denote short term bonds quoted in foreign currency and issued abroad held by unrestricted households. Furthermore, P_t denotes the price of the final goods, C_t^U denotes the amount of consumption incurred by unrestricted households, Q_t^H denotes the price of housing good, δ_H is the depreciation rate of housing, W_t denotes the nominal wage and, Ψ_t denotes lump-sum payments. Finally, R_t and $R_{t-1}^{\star}$ denote the interest rate on local government and foreign-denominated one period bonds, R_t^{BL} and R_t^{BB} are the gross yield to maturity for long-term government and bank-issued bonds at time t and R_t^D denotes the interest rate on bank deposits. The variable ζ_t^L denote a transaction cost that restricted households must incur to buy long-term bonds. The cost is introduced to capture the notion that buying long-term bonds is risky, as the return that the buyer will obtain if it is sold before maturity is unknown and thus entails a potential loss of liquidity. Therefore, investors must be compensated for that loss of liquidity. Chen et al. (2012) show that the discounted value of future transaction costs implies a term premium. We assume that the period transaction cost is a function of the ratio of the aggregate market value of long-term to short-term assets and an exogenous disturbance term. This ratio captures the idea that holding long-term debt implies a loss of liquidity that households hedge by increasing the amount of short-term debt. Specifically, the functional form for ζ_t^L is given by

$$
\zeta_t^L = \left(\frac{Q_t^{BL} \widetilde{BL}_t^U + Q_t^{BB} \widetilde{BB}_t^U}{\widetilde{BS}_t^U + S_t \widetilde{B}_t^{*U} + \widetilde{D}_t^U} \right)^{\eta_{\zeta_L}} \epsilon_t^{L,S}, \tag{3}
$$

where $\epsilon_t^{L,S}$ represents the exogenous shock to the term premium, and the hatted terms $\widetilde{X}_t$ denote aggregate holdings of the respective instruments, where in equilibrium $\widetilde{X}_t = X_t$. The functional form is set in terms of aggregate stocks to capture the assumption that households do not internalize the effect their choices have on ζ_t^L.

Restricted patient households differ from the unrestricted in that they can only save in long-term government bonds, and they do it without facing transaction costs. They are, then, subject to a simpler period-by-period budget constraint given by

$$
P_t C_t^R + Q_t^H H_t^R + Q_t^{BL} BL_t^R = W_t n_t^R + Q_t^H \left(1-\delta_H\right) H_{t-1}^R + Q_t^{BL} R_t^{BL} BL_{t-1}^R \tag{4}
$$

Finally, impatient households work, consume, and purchase housing goods. In addition, they take long-term loans in equilibrium from banks to finance their purchases of housing goods, which we model using the same structure presented in the previous section.

We follow the Clerc et al. (2014) by assuming that these mortgage loans are non-recourse and limited liability contracts, which enables the possibility of default for households. For the household, the only consequence of default is losing the housing good on which the mortgage is secured, therefore default is optimal when the value of the total outstanding debt is higher than the value of the assets, $R_t^I Q_t^L L_{t-1}^H > \omega_t^I Q_t^H (1-\delta_H) H_{t-1}^I$. Then the impatient household budget constraint is given by:

$$P_t C_t^I + Q_t^H H_t^I - Q_t^L L_t^H = W_t n_t^I + \int_0^\infty \max\left\{\omega_t^I Q_t^H (1-\delta_H) H_{t-1}^I - R_t^I Q_t^L L_{t-1}^H, 0\right\} dF_I(\omega_t^I) \tag{5}$$

Due to the limited liability on their debts, the loans taken by the household, and the interest rate paid by such loans, must also satisfy the banks' participation constraint given by

$$\mathbb{E}_t \left\{\left[1 - \Gamma^H\left(\bar{\omega}_{t+1}^H\right)\right]\left[\Gamma_I\left(\bar{\omega}_{t+1}^I\right) - \mu_I G_I\left(\bar{\omega}_{t+1}^I\right)\right] R_{t+1}^H Q_t^H H_t^I\right\} \geq \rho_{t+1}^H \phi_H Q_t^L L_t^H \tag{6}$$

Where $\Gamma_I(\bar{\omega}_t^I) - \mu_I G_I(\bar{\omega}_t^I)$ is the net share of the housing loan's return that goes to the bank, with $\Gamma_I(\bar{\omega}_t^I)$ denoting the share of the gross return that goes to banks, $G_I(\bar{\omega}_t^I)$ the part of those returns that comes from the defaulted loans, and $\mu_I G_I(\bar{\omega}_t^I)$ the share of the returns lost due to the verification costs μ_I. $\Gamma^H(\bar{\omega}_{t+1}^H)$ is the fraction of bank gross returns that is used to pay depositors or is lost due to bank defaults when their own idiosyncratic shock ω_{t+1}^H is too low. The rest of the left-hand side expression is the total amount of returns on the housing project that goes to the lender bank. The right-hand side indicates the opportunity cost, which is investing an amount of equity $\phi_H Q_t^L L_t^H$ at a market-determined rate of return of $\tilde{\rho}_{t+1}^H$, where ϕ_H is a regulatory capital constraint.

4.2 Entrepreneurs

Entrepreneurs are risk neutral agents that follow an overlapping generations structure, where each generation lives across two consecutive time periods. The entrepreneurs are the sole owners of productive capital. Part of the capital is received as a bequest from the previous generation of entrepreneurs, and the other part is bought from capital producers. Finally, they rent this capital to the firms that produce the home good.

In their second period, entrepreneurs born in period t draw utility in $t+1$ from transferring dividends C_{t+1}^e to households and leaving bequests N_{t+1}^e to the next generation of entrepreneurs in the form:

$$\max_{C_{t+1}^e, N_{t+1}^e} \left(C_{t+1}^e\right)^{\chi_e} \left(N_{t+1}^e\right)^{1-\chi_e} \text{ subject to}$$

$$C_{t+1}^e + N_{t+1}^e = \Psi_{t+1}^e.$$

In their first period, entrepreneurs will try to maximize expected second period wealth by borrowing from F banks an amount L_t^F at nominal rate R_t^l, and purchasing capital at nominal price Q_t^K, which will be productive (and rented) in the next period. Depreciated capital is sold in the next period to capital producers at Q_{t+1}^K. Then, in the first period entrepreneurs maximize their wealth by solving

$$\max_{K_t, L_t^F} \mathbb{E}_t\left(\Psi_{t+1}^e\right), \text{ subject to}$$

$$\Psi_{t+1}^e = \max\left[\omega_{t+1}^e \left(R_{t+1}^k + (1-\delta_K) Q_{t+1}^K\right) K_t - R_t^l L_t^F,\ 0\right] \tag{7}$$

$$Q_t^K K_t - L_t^F = N_t^e \tag{8}$$

$$\mathbb{E}_t \left\{\left[1 - \Gamma_F\left(\bar{\omega}_{t+1}^F\right)\right]\left[\Gamma_e\left(\bar{\omega}_{t+1}^e\right) - \mu_e G_e\left(\bar{\omega}_{t+1}^e\right)\right] R_{t+1}^e Q_t^K K_t\right\} \geq \rho_{t+1}^F \phi_F L_t^F, \tag{9}$$

Equation 7 shows the wealth of entrepreneurs as the difference between the income from owning capital and the repayment of their loans plus interests, where ω_t^e, with $\ln(\omega_t^e) \sim N(-0.5(\sigma_t^e)^2, (\sigma_t^e)^2)$, is an idiosyncratic shock to the entrepreneurs efficiency units of capital. Equation 8 defines their balance sheet, which states that their purchases of capital must be financed either by loans or equity. Finally, equation 9 is the participation constraint of the banks which states that banks will participate in the contract only if their net expected profits are at least equal to their alternative use of funds. The term $\Gamma_e\left(\bar{\omega}_{t+1}^e\right)$ denotes the share of gross returns of entrepreneurs that is paid to bank F, while $G_e\left(\bar{\omega}_{t+1}^e\right)$ denotes the share of entrepreneurs assets which belong to defaulting entrepreneurs, and thus $\mu_e G_e\left(\bar{\omega}_{t+1}^e\right)$ is the total cost of entrepreneurs default expressed as a fraction of total entrepreneurs assets.

4.3 Bankers and banks

4.3.1 Bankers

Bankers follow a similar structure to that of entrepreneurs: They belong to a sequence of overlapping generations of risk-neutral agents who live 2 periods and have exclusive access to the opportunity of investing their wealth as banks' inside equity capital. In the first period, the banker receives a bequest N_t^b from the previous generation of bankers and must distribute it across the two types of existing banks: banks specializing in commercial loans (F banks) and banks specializing in housing loans (H banks). That is, a banker who chooses to invest an amount E_t^F of inside equity in F banks will invest the rest of her bequest in H banks, $E_t^H = N_t^b - E_t^F$. Then, in the second period, bankers receive their returns from their investments in both types of banks and choose how to distribute their net worth Ψ_{t+1}^b between transferring dividends C_{t+1}^b to households and leaving bequests N_{t+1}^b to the next generation.

Given Ψ_{t+1}^b, the banker will distribute it by solving the following maximization problem:

$$\max_{C_{t+1}^b, N_{t+1}^b} \left(C_{t+1}^b\right)^{\xi_{t+1}^{\chi_b}\chi_b} \left(N_{t+1}^b\right)^{1-\xi_{t+1}^{\chi_b}\chi_b}, \text{ subject to}$$

$$C_{t+1}^b + N_{t+1}^b = \Psi_{t+1}^b$$

which determine dividends and bequests in $t+1$. Additionally, disturbances to the exogenous variable $\xi_{t+1}^{\chi_b}$ capture transitory fluctuations in the banker's dividend policy. Net worth in the second period is determined by the returns on bankers' investments:

$$\Psi_{t+1}^b = \tilde{\rho}_{t+1}^F E_t^F + \xi_{t+1}^{b,roe} \tilde{\rho}_{t+1}^H \left(N_t^b - E_t^F\right)$$

Where $\tilde{\rho}_{t+1}^j$, $j = \{F, H\}$ are the ex-post gross returns on inside equity. Thus, the portfolio problem of the banker in her first period can be written as:

$$\max_{E_t^F} \mathbb{E}_t \left\{ \Psi_{t+1}^b \right\} = \mathbb{E}_t \left\{ \tilde{\rho}_{t+1}^F E_t^F + \tilde{\rho}_{t+1}^H \left(N_t^b - E_t^F \right) \right\}$$

where $\tilde{\rho}_{t+1}^F$ and $\tilde{\rho}_{t+1}^H$ denotes the ex post gross returns at $t+1$ on the inside equity investment in banks F and H at t respectively.

4.3.2 Banks

Banks are institutions specialized in extending corporate and long-term housing loans. Those loans are financed with household deposits, the issuance of long-term bank bonds, and the equity brought by bankers. We assume a continuum of identical banking institutions of each class of banks $j = \{F, H\}$ that last for one period only: they are an investment project created at t and liquidated at $t+1$. The expected equity payoffs generated by banks of class j after their period of operation, considering they cannot be negative due to limited liability and the possibility of default, are given by:

$$\Pi_{t+1}^F = \max \left[\omega_{t+1}^F \tilde{R}_{t+1}^F L_t^F - R_t^D D_t^F, 0 \right], \quad \Pi_{t+1}^H = \max \left[\omega_{t+1}^H \tilde{R}_{t+1}^H Q_t^L L_t^H - R_{t+1}^{BB} Q_{t+1}^{BB} BB_t, 0 \right]$$

where D_t^F are the deposits taken at t by a bank of class F, BB_t is the period-t issues of bank-bonds by H-banks, ω_{t+1}^j is an idiosyncratic portfolio return shock, i.i.d across banks of class j. $\tilde{R}_{t+1}^j$ is the realized return on a well-diversified portfolio of loans to entrepreneurs or households, which depends on the default probability of the borrowers and is given by

$$\tilde{R}_{t+1}^F = \left(\Gamma_e \left(\bar{\omega}_{t+1}^e \right) - \mu_e G_e \left(\bar{\omega}_{t+1}^e \right) \right) \frac{R_{t+1}^e Q_t^K K_t}{L_t^F} \quad , \quad \tilde{R}_{t+1}^H = \left(\Gamma_I \left(\bar{\omega}_{t+1}^I \right) - \mu_I G_I \left(\bar{\omega}_{t+1}^I \right) \right) \frac{R_{t+1}^H Q_t^H H_t^I}{Q_t^L L_t^H}$$

Where $\Gamma_e(\bar{\omega}_t^e)$ and $\Gamma_I(\bar{\omega}_t^I)$ are the share of the gross return of the loans that goes to the banks, $G_e(\bar{\omega}_t^e)$ and $G_I(\bar{\omega}_t^I)$ are the part of those returns that come from the defaulted loans, and $\mu_I G_e(\bar{\omega}_t^e)$ and $\mu_I G_I(\bar{\omega}_t^I)$ the share of the returns lost due to the verification costs μ_e and μ_I.

The bank j balance is given by $L_t^j = E_t^j + D_t^j$. Banks face a regulatory capital constraint given by $E_t^j \geq \phi_j L_t^j$, where ϕ_j is the capital-to-asset ratio of banks of class j. It can be shown that this constraint is binding at all times in equilibrium so that the loans can be written as $L_t^j = E_t^j / \phi_j$ and the deposits as $D_t^j = (1-\phi_j/\phi_j) E_t^j$.

5 Modeling the implemented credit policies

To assess the impact that the implemented policies had on the Chilean economy, we use the following strategy: 1) include functional forms in the model associated with the implemented programs. 2) Feed the model with observed time series for the programs' total amounts. 3) Use the structural nature of the DSGE model to create counterfactuals in which the covid-19 pandemic was not accompanied by the set of policies the CBC and Chilean government did implement. And finally, 4) compare the actual and counterfactual time series to estimate the policies' effects.

In this section, we describe the modifications made to the baseline model that were necessary to simulate the economic impact of the policies. Then, in section 6, we analyze the implied economic consequences of the exogenous shocks associated with the different programs. Finally, in section 7, we measure the effects of the various programs on the Chilean economy during 2020 and the first half of 2021.

5.1 FCIC/LCL: CBC's credit facility

The FCIC and LCL programs[6] were intended to work through two main channels. First, they provided banks with an additional source of funding, useful due to the increased loan demand from firms. Additionally, it decreased the average cost of funding for banks. To capture the impact of the FCIC program, we introduce an exogenous variable, μ_{FCIC}, representing the percentage of commercial loans[7] financed with the program. The FCIC funding has a cost to the bank equal to the MPR rate. Then, the bank's funding cost becomes $R_t^D \left(D_t - \mu_t^{FCIC} L_t^F\right) + R_t \mu_t^{FCIC} L_t^F$, a weighted average between the cost of financing using deposits and the liquidity program from the central bank. The commercial bank's problem then becomes

$$\Pi_t^F = \max \left[\omega_t^F \tilde{R}_t^F L_{t-1}^F - R_{t-1}^D \left(D_{t-1} - \mu_t^{FCIC} L_{t-1}^F\right) - R_{t-1} \mu_t^{FCIC} L_{t-1}^F, 0\right]$$

This defines a new threshold for the idiosyncratic shock:

$$\bar{\omega}_t^F \equiv \frac{R_{t-1}^D D_{t-1} + \left(R_{t-1} - R_{t-1}^D\right) \mu_t^{FCIC} L_{t-1}^F}{\tilde{R}_t^F L_{t-1}^F} \tag{10}$$

Since $R_{t-1} < R_{t-1}^D$, a positive value of μ_t^{FCIC} decreases the financing cost of the bank its default threshold.

5.2 FOGAPE: Government guaranteed loans

In the FOGAPE program, the government acts as a guarantee to part of the loans provided by the banking system. In particular, we restrict the guarantees to loans extended to entrepreneurs.

Denote the share of the gross return that goes to the bank as $\Gamma_e\left(\bar{\omega}_t^e\right)$ where the share of gross return that goes to the impatient household is $\left(1 - \Gamma_e\left(\bar{\omega}_t^e\right)\right)$ where:

$$\Gamma_e\left(\bar{\omega}_t^e\right) = \int_0^{\bar{\omega}_t^e} \omega_t^e f_e\left(\omega_t^e\right) d\omega_t^e + \bar{\omega}_t^e \int_{\bar{\omega}_t^e}^{\infty} f_e\left(\omega_t^e\right) d\omega_t^e,$$

and let

$$G_e\left(\bar{\omega}_t^e\right) = \int_0^{\bar{\omega}_t^e} \omega_t^e f_e\left(\omega_t^e\right) d\omega_t^e$$

[6] Due to their similarity, for modeling purposes, we will group both policies under the FCIC moniker.

[7] While the actual policies (both the FCIC/LCL and the FOGAPE programs) focused on SMEs lending, in the modeling of the programs we left out the distinction, as the model lacks heterogeneity regarding the difference firm size has on labor, financing strategies or other dimensions. We do assume that the programs are contingent on commercial lending, leaving out housing loans.

denote the part of those returns that comes from the defaulted loans. Considering $\mu_e G_e\left(\bar{\omega}_t^e\right)$, the share of the return that is lost due to verification costs, the net share of the return that goes to the bank is

$$\Gamma_e\left(\bar{\omega}_t^e\right)-\mu_e G_e\left(\bar{\omega}_t^e\right)=\int_0^{\bar{\omega}_t^e} \omega_t^e f_e\left(\omega_t^e\right) d \omega_t^e+\bar{\omega}_t^e \int_{\bar{\omega}_t^e}^{\infty} f_e\left(\omega_t^e\right) d \omega_t^e-\mu \int_0^{\bar{\omega}_t^e} \omega_t^e f_e\left(\omega_t^e\right) d \omega_t^e .$$

Given that entrepreneurs make capital and borrowing decisions before knowing their idiosyncratic shock, the optimal contract will be characterized by a loan rate, R_{t+1}^L, and a threshold value of the idiosyncratic shock, $\bar{\omega}_{t+1}^e$. Above that threshold, the entrepreneur will be able, and willing, to fully pay for their financial obligations. In the baseline model, before the implementation of the FOGAPE program, this value is defined as $\bar{\omega}_{t+1}^e={R_t^L L_t^F}/{R_{t+1}^e Q_t^K K_t}$.

For credits under the FOGAPE program, the government guarantees the payments in case of default, so banks receive the full amount independent of the entrepreneur's idiosyncratic shock. Denote the share of the gross return that goes to the bank as $\Gamma_e^{FOGAPE}\left(\bar{\omega}_t^e\right)$ where:

$$\begin{aligned}
\Gamma_e^{FOGAPE}\left(\bar{\omega}_t^e\right) & =\int_0^{\bar{\omega}_t^e} \bar{\omega}_t^e f_e\left(\omega_t^e\right) d \omega_t^e+\int_{\bar{\omega}_t^e}^{\infty} \bar{\omega}_t^e f_e\left(\omega_t^e\right) d \omega_t^e . \\
\Gamma_e^{FOGAPE}\left(\bar{\omega}_t^e\right) & =\bar{\omega}_t^e \int_0^{\infty} f_e\left(\omega_t^e\right) d \omega_t^e \\
\Gamma_e^{FOGAPE}\left(\bar{\omega}_t^e\right) & =\bar{\omega}_t^e
\end{aligned}$$

Defining μ_t^w as the percentage of commercial loans provided under the FOGAPE program, the share of the entrepreneur's return that goes to the bank is then given by

$$\mu_t^w \Gamma_t^{e^{FOGAPE}}+\left(1-\mu_t^w\right)\left(\Gamma_t^e-\mu_e G_t^e\right) \tag{11}$$

With this new formulation, the entrepreneur's participation constraint becomes

$$\mathbb{E}_t\left\{\left[1-\Gamma_{t+1}^F\right]\left[\mu_t^w \Gamma_t^{e^{FOGAPE}}+\left(1-\mu_t^w\right)\left(\Gamma_t^e-\mu_e G_t^e\right)\right] R_{t+1}^e Q_t^K K_t\right\}=\rho_{t+1}^F \phi_F L_t^F, \tag{12}$$

with the entrepreneur's first order conditions defined by

$$\left(1-\Gamma_{t+1}^e\right) R_{t+1}^e=\lambda_t^e\left(\rho_{t+1}^F \phi_t^F-\left(1-\Gamma_{t+1}^F\right)\left[\mu_t^w \Gamma_t^{e^{FOGAPE}}+\left(1-\mu_t^w\right)\left(\Gamma_t^e-\mu_e G_t^e\right)\right] R_{t+1}^e\right) \tag{13}$$

$$\Gamma_{t+1}^{e'}=\lambda_t^e\left(1-\Gamma_{t+1}^F\right)\left[\mu_t^w \Gamma_{Fog,t+1}^{e'}+\left(1-\mu_t^w\right)\left(\Gamma_{t+1}^{e'}-\mu^e G_{t+1}^{e'}\right)\right]\left[\Gamma_{t+1}^{e'}-\mu^e G_{t+1}^{e'}\right] \tag{14}$$

The realized rate of return for the bank can then be written as

$$\tilde{R}_{t+1}^F=\left(\Gamma_{t+1}^e-\mu_e G_{t+1}^e+\mu_t^w\left(\Gamma_{t+1}^{e,FOGAPE}-\Gamma_{t+1}^e+\mu_e G_t^e\right)\right) \frac{R_{t+1}^e Q_t^K K_t}{L_t^F}$$

or, after rearranging, as

$$\tilde{R}_{t+1}^F=\left(\Gamma_{t+1}^e-\mu_e G_{t+1}^e\right) \frac{R_{t+1}^e Q_t^K K_t}{L_t^F}+\mu_t^w\left[\Gamma_{t+1}^{e,FOGAPE}-\Gamma_{t+1}^e+\mu_e G_t^e\right] \frac{R_{t+1}^e Q_t^K K_t}{L_t^F} \tag{15}$$

The first and second terms on the right side hand are, respectively, the original realized return of the commercial bank and the additional return to the bank given by the guarantees provided by the FOGAPE program.

In addition to acting as a guarantee to banks, loans given under this program also pay lower interest rates, linked to the MPR. We model this by defining the effective interest rate on loans payed by the entrepreneur, $R_t^{fin} \equiv R_t^L(1-\mu_t^w) + R_t\mu_t^w$, as a weighted average between the non guaranteed market rate, R_t^L, and the MPR, R_t. This new effective rate is used to determine $\bar{\omega}_{t+1}^e$, the threshold for the entrepreneur's default decision, now defined by

$$\bar{\omega}_{t+1}^e = \frac{R_t^{fin} L_t^F}{R_{t+1}^e Q_t^K K_t} \tag{16}$$

From this relationship, an increase in the amount of loans under FOGAPE lowers financing costs, decreasing the default threshold.

The program's cost to the government, as with the deposit insurance, is financed by lump-sum taxes to the patient households, T_t^w, in an amount given by

$$T_t^w = \mu_t^w \left[\Gamma_{t+1}^{e,FOGAPE} - \Gamma_{t+1}^e + \mu_e G_t^e\right] R_{t+1}^e Q_t^K K_t \tag{17}$$

5.3 Central bank bond purchases

To contain the effects of high volatility in the fixed income market, in march 2020, the CBC announced a program of commercial banks' bond purchases for up to US$ 4 billions. The program restricted the transactions to the secondary market. This policy implementation implies that, in terms of the modeling, rather than modifying the banks' balance sheet, the policy affects the bond's equilibrium market price as a shock to the CB holdings of bank bonds affects the available supply for private holdings. Then, as now both patient households and the CBC can hold commercial banks' bonds, the market closing condition changes with respect to the baseline model, becoming

$$BB_t = BB_t^{PH} + BB_t^{CB} \tag{18}$$

where BB_t stands for the total amount of bank bonds issued by the banks, BB_t^{PH} stands for the amount of bank bonds purchased by patient households, and BB_t^{CB} stands for the amount of bank bonds purchased by CBC.

5.4 Programs' fiscal impact

As the implementation of FCIC and FOGAPE programs involves government spending, the fiscal budget constraint needs to be adjusted accordingly. In the baseline model, the government consumes an exogenous stream of final goods G_t, pays for deposits defaulted by banks DIA_t levies lump-sum taxes on patient households T_t^P, and issues one-period bonds BS_t^G and long-term bonds BL_t^G.

Acknowledging the additional spending required by the programs, in the augmented model the government must also pay for the costs of the liquidity program FCIC, and for the loan guarantees program, FOGAPE, in amounts given by, respectively, $R_{t-1}\mu_t^{FCIC} L_{t-1}^F$ and T_t^w, with the last term defined in equation (17). Hence, the government must now satisfy a period-by-period budget constraint given by

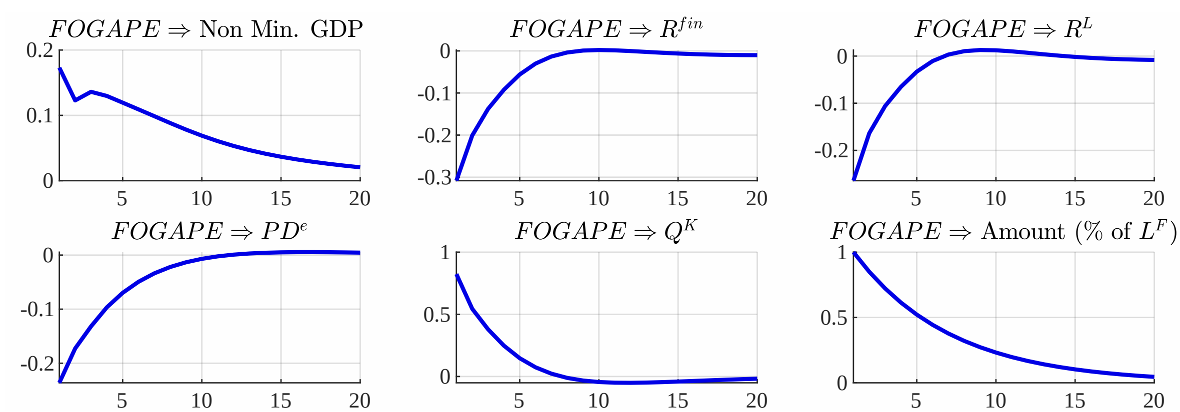
$$T_t - BS_t^G - Q_t^{BL} BL_t^G + \chi S_t P_t^{Co\star} Y_t^{Co} = P_t G_t - R_{t-1} BS_{t-1}^G - R_t^{BL} Q_t^{BL} BL_{t-1}^G + DIA_t + T_t^w + R_{t-1} \mu_t^{FCIC} L_{t-1}^F \tag{19}$$

6 Shocks to credit programs

This section describes the model implied economic effects of the shocks representing the different credit policies. In all cases, we model the dynamics of the shocks as AR1 processes. For all three shocks, the autoregressive coefficients are calibrated at 0.85, implying a four quarters half-life.

First, we study the effects of a one percent shock on the share of corporate loans guaranteed by the FOGAPE program. As shown in Figure 1, the policy reduces R_t^{fin}, the effective average interest rate that entrepreneurs have to pay for their loans. This reduction is not only due to FOGAPE loans being extended at a rate equal to the MPR. As the lower-left panel shows, the main driver of the decrease in R^{FIN} is a general equilibrium reduction of all loan rates, including R^L, the interest paid for non-FOGAPE loans. The drop of R^L arises due to the existence of a financial multiplier as in Bernanke et al. (1999). The initial improvement in credit standards leads to higher aggregate demand, raising the value of the entrepreneur's assets, Q^k, which, in turn, decreases their default probability, PD^e, allowing them to further improve their borrowing conditions, leading to a lower equilibrium R^L. Considering everything, the initial one percent increase in the percentage of loans guaranteed by the FOGAPE program leads to an increase of almost 20 basis points in non-mining GDP.

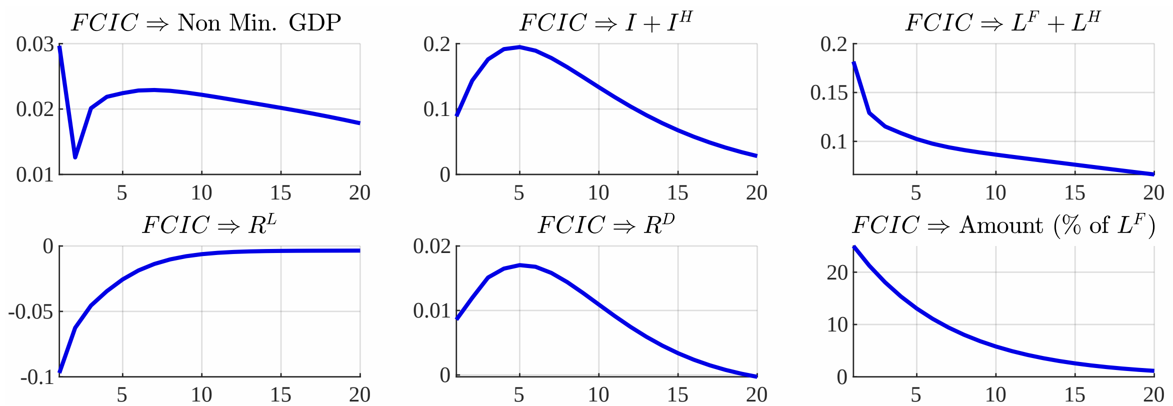
Figure 1: Response to a shock to the FOGAPE program



Notes.— The figure shows the effects of a shock to the FOGAPE program in an amount equivalent to 1% of the total commercial loans. The top panels show the impact on the level of non-mining GDP, the average loan interest rate, and the interest rate for non-FOGAPE loans. The lower panels show the effect on the entrepreneurs' default probability, the value of capital, and the program size in terms of a percentage of total commercial loans.

We next review the impact of the FCIC/LCL liquidity programs. These policies work mainly through two channels. First, a direct consequence of the programs is that they allow banks to raise funds at lower rates, lowering lending rates and increasing loans without pushing the demand for deposits, thus avoiding paying significantly higher interest rates for deposits. Figure 2 shows the impact of an FCIC line extended to the equivalent of 25% of the stock of commercial loans. Lending rates go down, and more loans are extended, allowing for more investment and higher GDP. All this with only a minor impact on the deposit rates. Even with a simulated shock of considerable size and the transmission mechanisms working as expected, the overall impact appears to be minimal. The reason is straightforward. As the equilibrium deposits rate is relatively low to begin with, bringing it closer to MPR levels only mildly reduces the banks' funding costs, attenuating any economic impact the policy might bring.

Figure 2: Response to a shock to the FCIC program

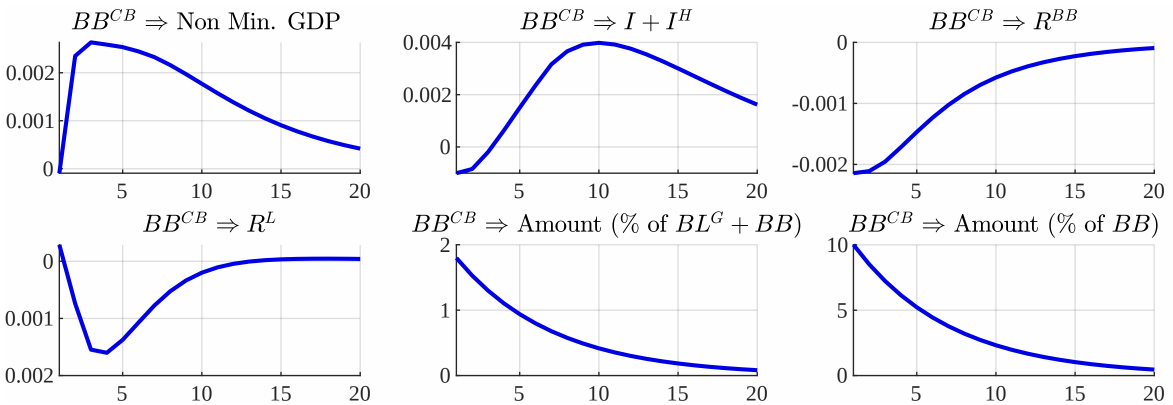


Notes.— The figure shows the effects of a shock to the FCIC program in an amount equivalent to 25% of the total commercial loans. The top panels show the impact on the level of non-mining GDP, total investment, and total loans. The lower panels show the effect on the interest rate on commercial loans and deposits, and the program size in terms of a percentage of total commercial loans.

However, an increase in the availability of the liquidity lines also has additional indirect effects due to its ability to reduce the risk of banks running out of funds, disrupting the whole financial system. Even if this risk is merely a possibility and in equilibrium never actually occurs, it may still cause higher interest rates, increasing in the level of risk prevailing in the economy. This risk reduction channel, as further discussed in section 7, appears to have had a material economic impact on the economy during the COVID-19 pandemic.

Finally, we analyze the impact of the commercial banks' bonds buying program. Due to the regulatory restrictions that only allowed the programs to work through secondary bond markets, the programs don't directly affect the banks' balance sheets. Instead, the program's transmission mechanism works by allowing the banks to raise funds at a lower cost by contracting the supply of long-term domestic currency bonds. Figure 3 shows minimal effects of buying 10% of the outstanding supply of commercial bank bonds. Why is that?. First, as banks and government long-maturity bonds are close substitutes, the bond-buying program will have a relevant effect only as long as it can successfully reduce the overall supply of long-maturity bonds. This condition is hard to meet, as commercial banks' bonds are only a small part of the economy's aggregate supply of long-term bonds. Additionally, as noted by Chen et al. (2012) while analyzing the quantitative effects of the Fed's LSAP II program under a similar setup, when allowing for an endogenous response of the MPR (the underlying assumption in the exercise conducted here), the economic effects of a reduction in the bond supply tend to be relatively small. However, the policy also had a different objective: to reduce the volatility in the fixed-income market at times when the economic uncertainty was exceptionally high.[8] As with the FCIC/LCL programs, this effect is better captured by a risk reduction channel that will be discussed in the next section.

Figure 3: Response to a shock to the bank bonds buying program



Notes.— The figure shows the effects of a shock to the bond-buying program in an amount equivalent to 10% of the total stock of commercial banks' long-term bonds. The top panels show the impact on the level of non-mining GDP, total investment, and the interest rate on banks' long-term debt. The lower panels show the effect on the interest rate on commercial loans and deposits, and the program size in terms of a percentage of long-term bonds, both total bonds (issued by both the government and the banks) and only considering bonds issued by commercial banks.

7 The impact of credit policies during the COVID-19 pandemic

In this section, we perform a set of experiments using the structural model described in sections 4 and 5 to understand and quantify the impact of the unconventional credit policies implemented during the COVID-19 pandemic in Chile. We analyze these policies using historical shock decompositions[9], finding suggestive evidence that the credit policies acted as a cushion against the adverse shocks faced by the economy during the pandemic.

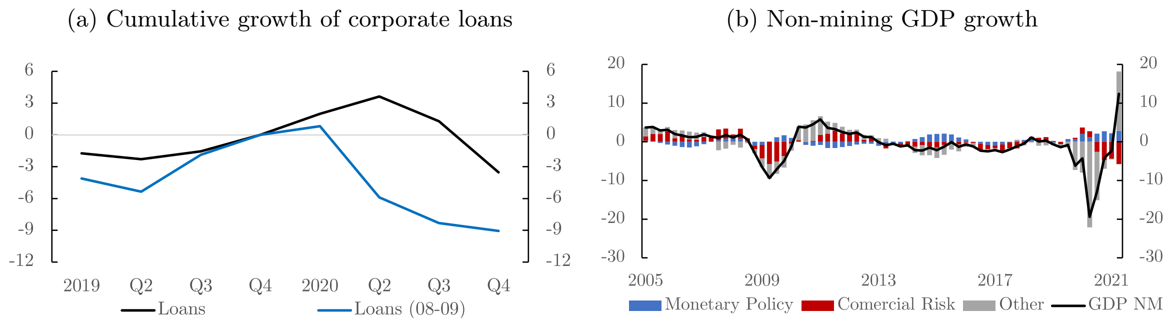
As highlighted by Garcia (2021), crises are typically associated with strong firm deleveraging that, from a policymaker's point of view, needs to be managed to avoid a spiraling effect that ends up further amplifying the downturn. However, the last COVID-19 induced crisis was different in that firms were able to get higher than usual credit access to deal with the consequences of the pandemic. Lending behavior during both the pandemic and the financial crisis is shown in the left panel of Figure 4. Corporate credit saw a sharp decline during the 2008-09 financial crisis. In contrast, in the first half of 2020 – at the height of the pandemic – credit appears to be increasing. Madeira (2022) makes

[8] Due to regulatory restrictions that, at the time, forbade the CBC from buying government debt, the purchase of commercial banks' long term bonds was chosen as the program's primary operational instrument.

[9] The shock identification is obtained by letting the model observe a broad set of time series from financial markets, real activity, and prices, both domestic and international. These include real consumption, government spending, housing and productive capital investment, mining and non-mining GDP, employment, wages, corporate, housing and total loans, inflation, housing prices, copper price, commercial partners' GDP and inflation, an imported price index, the real exchange rate, the monetary policy rate, banks ROE, interest rates for government long term bonds, deposits, corporate loans, housing loans and foreign bonds, the EMBIG index for Chilean risk premia, the trade balance as a percentage of GDP, and, finally, the size of the FOGAPE, the FCIC/LCL, and the CBC's bond-buying program

a similar observation. Using delinquency models calibrated with survey data, the author documents an increase in credit that can be attributed to the implemented public policies.

Figure 4: Credit and GDP during the financial crisis and the COVID-19 pandemic



Notes.— (a) In the left panel, the black line corresponds to the cumulative growth of corporate loans since 2019Q4, in deviation from the sample mean. The blue line show the cumulative loan growth from the great recession, where the first quarter of 2009 is aligned with the second quarter of 2020. (b) The right panel shows the historical decomposition for the observed time series of non-mining GDP growth, measured as the logarithmic change with respect to the previous year's same quarter in deviation from the sample mean. "Monetary policy shocks" refer to movements in the monetary policy rate that differ from what the systematic part of the Taylor rule would suggest. "Risk shocks" refers, as in Christiano et al. (2010), to surprises in the dispersion of returns on entrepreneurial projects. "Other shocks" refer to a group of traditional supply and demand shocks.

Analyzing the difference between the role of risk shocks in explaining the economic downturns of 2009 and 2020 allows us to gain further insight into the causes behind the dissimile credit behavior between those periods. The right panel of Figure 4 shows a striking difference between both crises' drivers. On the one hand, the model identifies a relevant role for risk shocks in explaining the economic downturn in the financial crisis. In contrast, in 2020, at the peak of the pandemic, risk shocks contributed positively to growth.[10]

To quantify and to better understand how the pandemic affected the economy and how the mitigating policies shaped those effects, we use our structural model to formulate a series of counterfactual scenarios that simulate an economy where the COVID-19 pandemic was not eased with either monetary or credit policies.

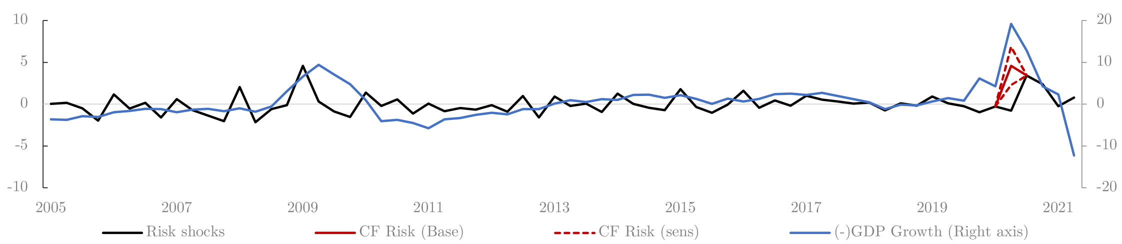
We build these counterfactual scenarios under two assumptions. First, we assume no direct effects from the credit policies by removing the economic dynamics that can be directly attributed to the FOGAPE, FCIC, and bond-buying programs. We implement this counterfactual by running a simulation where the inferred shocks related to credit policies are set to zero.

Our counterfactual scenarios additionally assume that credit policies had no role in reducing risk and uncertainty. We implement this by setting alternative risk shock dynamics to capture the indirect effects that the policies may have had on expected economic volatility, using the financial crisis of 2009 as a benchmark. As discussed before, credit dropped much faster and sharply in 2009 than in 2020, with risk shocks amplifying the 2009 downturn while cushioning the drop during the first half of 2020, when a set of credit policies focused on reducing risk and uncertainty were implemented.

[10] A positive contribution of risk shocks does not necessarily mean that the economy was less risky than normal times. Instead, it should be interpreted as that, through the lens of the model, the observed dynamics of the financial and real sides of the economy acted as if the risk was lower than what would be expected by its systematic behavior given the observed economic downturn.

We hypothesize, then, that if the economy had not had those mitigating policies, at the height of the pandemic, the second quarter of 2020, the economy would have faced similar risk disturbances to the ones inferred by the model for the first quarter of 2009. As additional sensitivities for this assumption, we simulate two extra counterfactuals where we included risk shocks half and one and a half times the magnitude of the one inferred for 2009. Figure 5 shows the three counterfactuals for the 2020's second quarter risk shocks and how they compare with the shock's dynamics during the financial crisis.

Figure 5: Risk shocks: baseline inference and counterfactuals



Notes.— The black line corresponds to the model inferred shock to the volatility of the idiosyncratic return of entrepreneurs, σ_t^e. The red solid line correspond to the baseline counterfactual for the shock trajectory. The dotted red lines show the sensibilities for the magnitude of the counterfactual shock. The blue line shows (the negative of) the non mining GDP growth in deviation from its sample mean.

Figure 6 shows, on its left panel, the direct effect of the FOGAPE, FCIC and bond purchases programs on fostering growth. Among them, FOGAPE appears, by far, as the most effective in helping stimulate the economy. In contrast, the direct effect of the other policies appears orders of magnitude smaller. This is not an unexpected outcome. The bond purchasing program was relatively small in magnitude, amounting to only a small fraction of the long-term domestic currency fixed-income market aggregate supply. The FCIC program, on the other hand, mainly focused on diminishing uncertainty and reassuring the financial markets that a liquidity crunch was unlikely to happen. Its effects, then, are more likely captured through an indirect risk channel.

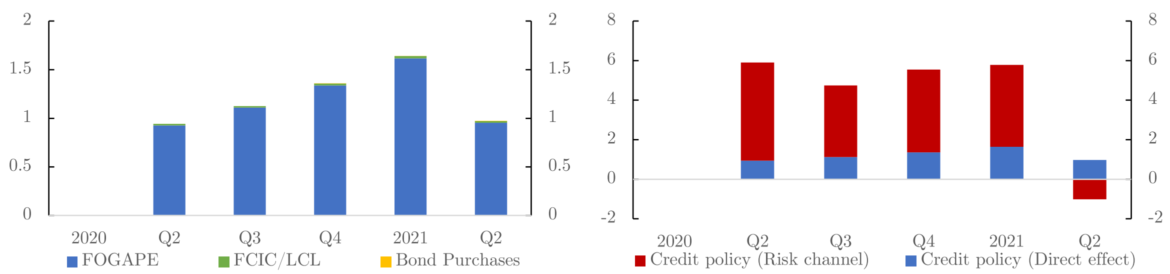
Under the assumptions from the baseline counterfactual, the right panel of the figure presents the relative importance, concerning their impact on GDP growth, between the direct and indirect channels of the credit policies. The risk channel of credit policies shows to be far more important than the direct channels, almost three times bigger during 2020. However, the impact of the risk channel appears to be more short-living, with its effect, in terms of year over year GDP growth, vanishing by the second quarter of 2021.

The aggregate impact that credit policies had on the economy is shown in Figure 7. The left panel shows that the counterfactual scenarios generate paths for corporate credit during the first year of the pandemic similar to those observed during the financial crisis. On the other hand, the right panel shows that if the central bank and the government hadn't implemented the credit policies, the GDP contraction would have been considerably more severe than we observed.

As summarized in Table 1, without the implementation of the credit programs, 2020's non-mining GDP growth would have been between 2.7 and 5.4 percentage points lower, with 1.8 to 4.6 percentage points of added growth attributable to the risk channel of the credit policies. For the first semester of

Figure 6: Role of policies explaining GDP Growth

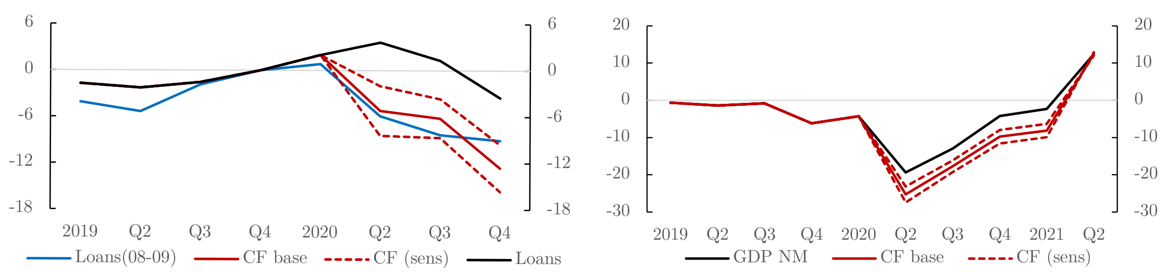
(a) Direct effects per policy (b) Aggregate direct and indirect effects



Notes.— The figures shows the inference on the effects that the different policies had on GDP growth under the assumptions of the baseline counterfactual.

Figure 7: Aggregate policy effect on credit and GDP

(a) Cumulative growth of corporate loans (b) Non-mining GDP growth



Notes.— (a) In the left panel, the black line corresponds to the cumulative growth of corporate loans since 2019Q4, in deviation from the sample mean. The red solid line correspond to the baseline counterfactual. The dotted red lines show sensibilities for the magnitude of the risk shock. The blue line show the cumulative loan growth from the great recession, where the first quarter of 2009 is aligned with the second quarter of 2020.
(b) In the right panel the black line corresponds to the actual non-mining GDP growth. The red solid line correspond to the baseline counterfactual. The dotted red lines show sensibilities for the magnitude of the risk shock.

2021, the programs contributed to an additional 2.2 to 3.5 percentage points of extra growth, of which 0.9 to 2.2 percentage points were due to the risk reduction channel.

Table 1: Impact of monetary and credit policies on non mining GDP growth

	Direct Effect			Risk channel			Total		
	low	base	high	low	base	high	low	base	high
2020	0.9	0.9	0.9	1.8	3.2	4.6	2.7	4.0	5.4
2021 S1	1.3	1.3	1.3	0.9	1.6	2.2	2.2	2.9	3.5

Notes.— The table reports the estimated direct and indirect(the risk channel) effects of credit policies under three different counterfactuals. The columns "low", "base", and "high" refer, respectively, to the counterfactuals that assume, for the second quarter of 2020, a risk shock of half, one, and one and a half times the magnitude of the one inferred for the 2009 financial crisis.

8 Conclusions

In this paper, we analyzed the impact that the credit policies implemented by the Central Bank of Chile and the Chilean government had on mitigating the effects of the COVID-19 pandemic on the Chilean economy through the lens of a large-scale DSGE model with financial frictions.

The policies were implemented to increase liquidity and maintain the flow of funds in the economy. The policies included a liquidity provision to banks (called the FCIC program), a bond-buying program, and an extension to the FOGAPE program in which the government guarantees credits provided to small and medium sized enterprises.

We find a relatively small direct effect of the FCIC and the bond-buying programs. The FOGAPE program did have a more substantial direct effect, increasing GDP growth by 0.9 percentage points in 2020. Nevertheless, the main impact of these policies came from their ability to reduce credit risk. The policies' reduction of economic risk and uncertainty added 1.8 to 4.6 percentage points to 2020's GDP growth. Overall, the implemented credit policies led to an additional 2.7 to 5.4 percentage points of growth in 2020 and 2.2 to 3.5 percentage points of extra growth in the first semester of 2021.

Our findings highlight the benefits of implementing policies aimed at preemptively diminishing the forced deleveraging frequently associated with downturns as a complement to policies that focus on dealing with the crises' economic consequences.

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