BANCO CENTRAL DE RESERVA DEL PERÚ

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DT. N°. 2019-013
Serie de Documentos de Trabajo
Working Paper series
Junio 2022

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Abstract

We augment a standard dynamic general equilibrium model with financial frictions, in order to quantify the macroeconomic effects of the credit deepening process observed in Latin America in the 2000s – most notably in Brazil. In the model, a stylized banking sector intermediates credit from patient households to impatient households and entrepreneurs. Motivated by the Brazilian experience, we allow the credit constraint faced by households to depend on labor income. Our model is designed to isolate the effects of credit deepening through demand-side channels, and abstracts from potential effects of credit supply on total factor productivity. In the calibrated model, credit deepening generates only modest above-trend growth in consumption, investment, and GDP. Since Brazil has experienced one of the most intense credit deepening processes in Latin America, we argue that the quantitative effects that hinge on the channels captured by the model are unlikely to be sizable elsewhere in Latin America.

JEL classification codes: E20; E44; E51.

Keywords: credit deepening; financial frictions; *consignado* credit; payroll lending.

*For comments and suggestions we thank Sergio Alves, Juliano Assunção, Tiago Berriel, Alan Finkelstein-Shapiro, Cezar Santos, two anonymous referees, and seminar participants at LACEA 2014, INSPER, PUC-Chile, SBE 2014, the "Macroeconomics in Emerging Economies" conference held at EESP-FGV, and the IDB Discussion Workshop. Authors gratefully acknowledge funding from the IDB under the project "Macroeconomic and Financial Challenges Facing Latin America and the Caribbean after the Crisis". We also thank Cauê Dobbin and Felipe Leal for superb research assistance. All errors are ours. The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Central Reserve Bank of Peru. Emails: cvianac@econ.puc-rio.br, nilda.cabrera@bcrp.gob.pe, laurac.souza@gmail.com, zilberman@econ.puc-rio.br

1 Introduction

In the first decade of the century, many countries in Latin America (LA) experienced a process often referred to as "credit deepening," during which measures of credit usage in the economy increase markedly. By credit deepening processes, we mean credit expansions fueled by institutional changes that tend to generate permanent increases in the level of credit in the economy. Below we argue that this happened in at least one of the leading cases in LA – that of Brazil. Figure 1 plots the ratio of domestic credit to GDP for Brazil, Colombia, Ecuador, Mexico, Paraguay and Peru. It shows that these Latin American countries experienced large expansions of domestic credit – most notably, Brazil.

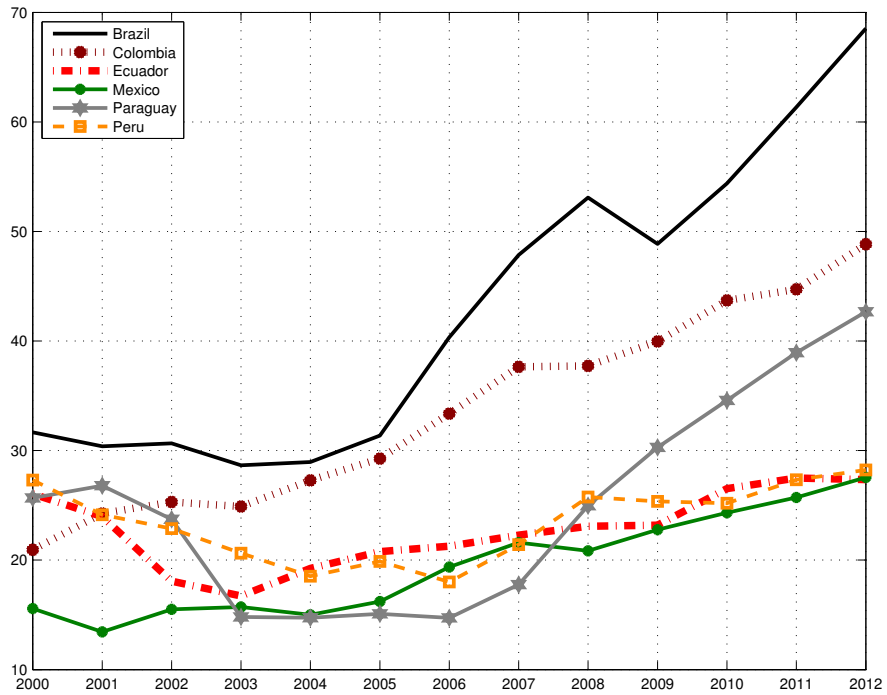

Figure 1: Domestic credit to private sector over GDP. Source: World Bank.

While credit deepening is often cited as a factor that contributed to above-trend growth in LA during that period and to the resilience of its economies in the aftermath of the global financial crisis, we are not aware of any attempt to quantify the macroeconomic effects of that process. The common view in the region is that the credit deepening process fostered growth because it generated a boom in consumption and investment. Put differently, a view that credit deepening stimulated demand, and fostered above-trend growth.[1]

In this paper, we use a relatively standard new Keynesian medium-scale dynamic general equilibrium model, augmented with financial frictions, to study the relevance of this "demand" channel.

[1]This view is reflected in articles in the main newspapers, magazines and web portals during the period of analysis. We list a few examples in Appendix E (all appendices are available online as Supplementary Material).

More specifically, our goal is to study the role of credit deepening processes as a source of short-to-medium-run ("above-trend") growth.[2] By abstracting from the effects of credit deepening on total factor productivity through resource allocation, our analysis aims to isolate this demand channel. Our findings do not corroborate the view that credit deepening has been an important source of above-trend growth in Brazil – at least not through this channel.

In the model, a stylized banking sector intermediates credit from patient to impatient households. While we borrow from several contributions available in the literature, our paper departs from these contributions in one specific way. We model the credit constraint faced by (impatient) households as a function of current and/or future labor income.[3] We do so motivated by the Brazilian experience, which featured a sizable increase in household credit that was *not* associated with purchases of real estate or other collateralizable physical assets (e.g., durable goods). In Brazil, an important factor behind the credit expansion was the emergence of the so-called *consignado* credit ("payroll lending"), whereby creditors are paid straight out of debtors' paychecks. Such lending is thus not collateralized by a physical asset, but by some valuation of the borrower's stream of labor income. Although our modeling of *consignado* credit is very stylized, we believe this is an important feature of the Brazilian credit deepening process that we should try to capture in our analysis, for two reasons. First, Brazil is the largest economy in LA, and the one that arguably featured one of the most intense credit deepening processes in the region (see Figure 1). Second, we believe our modeling of *consignado* credit might be a useful reduced-form way to account for credit frictions in other economies in which "non-collateralized" credit was an important part of the credit expansion process.[4]

Besides household credit, lending to firms in Brazil also increased meaningfully during the period of analysis (Figure 2 – top plot).[5] Hence, in our model, impatient entrepreneurs (firms) also borrow from patient households to consume and invest. This is another key feature that distinguishes our model from similar ones in the literature.[6] As we show below, the presence of *consignado* credit and credit-constrained entrepreneurs amplifies the responses of labor and investment, respectively, to a credit deepening process.

[2]Hence, our analysis does not speak to the relationship between the functioning of credit markets and long-run growth. For a review of that literature, see Levine (2005).

[3]Mendoza (2002) develops a model in which a fraction of consumption has to be financed with current income. This assumption leads to a debt limit that depends on current labor income. In contrast, creditors in our model are repaid out of debtors' paychecks. The papers that come closest to ours in terms of motivation for the credit limit based on future labor income are Carvalho et al. (2014) and Arruda et al. (2018). Both papers develop a DSGE model for Brazil with financial frictions. The former is interested in the role of macroprudential policies, whereas the latter focuses on the effects of monetary policy.

[4]Payroll lending has also been growing rapidly in other countries. Arruda el al. (2018), for instance, document that payroll lending in Mexico and Colombia represents 25 and 37 percent, respectively, of consumer credit.

[5]As the data in Figure 2 include only nonearmarked credit, the ratio of total credit to GDP differs from Figure 1. Appendix E provides details on the data used in this paper.

[6]To our knowledge, only Gerali et al. (2010) feature these three representative agents. Other related papers abstract either from the impatient household (e.g., Iacoviello, 2005; Liu et al., 2013) or from the impatient entrepreneur (e.g., Campbell and Hercowitz, 2009; Iacoviello and Neri, 2010; Justiniano el al., 2015).

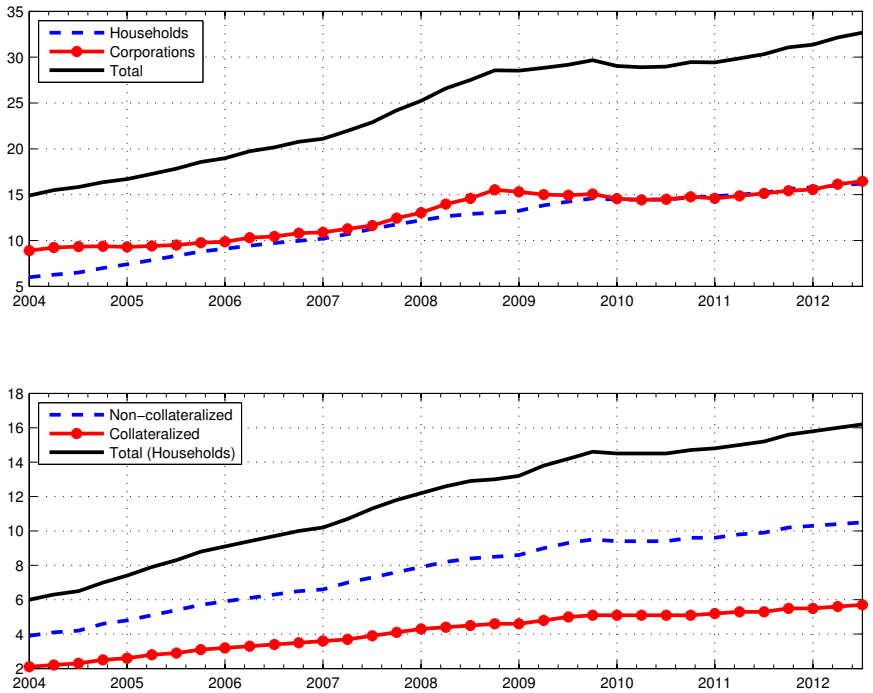

Figure 2: Ratio of nonearmarked credit to GDP in Brazil. See Appendix E on how these credit data are constructed. Source: Central Bank of Brazil.

We calibrate the model to replicate the credit deepening process witnessed in Brazil in the decade starting in 2004. In particular, by emulating a transition from a low-credit to a high-credit steady state, we require our model to match the credit expansion for both firms and households – including both non-collateralized and collateralized credit in the latter case (Figure 2 – bottom plot).[7] We match the path of the various credit measures over GDP by calibrating three time-varying parameters that dictate the tightness of the credit constraints in the model. This is consistent with the idea that a large fraction of the credit expansion was due to reforms and "innovations" (such as the spreading of *consignado* credit) that fueled the credit deepening process.[8]

[7]Throughout the paper, the term "collateralized" refers to loans backed by physical assets, whereas "non-collateralized" refers to every other type of credit, including loans backed by non-physical assets, such as *consignado*. Importantly for the purpose of this paper, *consignado* credit accounts for roughly 60 percent of the increase in non-collateralized credit during our sample period.

[8]At the micro level, Coelho et al. (2012) show that *consignado* credit increased the volume of personal credit and reduced interest rates in Brazil. Other two important institutional changes spurred the credit deepening process in Brazil. First, a change in lending practices backed by a new law allowed autos to be kept as property of creditors until the associated loans had been repaid in full. Before this law, a car could be used as collateral for the loan obtained to finance its purchase, but upon default judges often ruled against creditors seizing the collateral. As a result, that market was relatively underdeveloped, and credit was expensive. Second, a bankruptcy reform increased creditors' protection. This reform not only facilitated the sale of insolvent firms by making the new buyer not liable for previous tax and labor obligations, but also gave higher priority to creditors' claims (at the expense of workers and the tax authority) in case of liquidation. See Assunção et al. (2014) and Ponticelli and Alencar (2016) for micro evidence on the impacts of these reforms. Of course, other developments – some of which might be induced by policies – may interact with credit deepening. Due to the arguably exogenous nature of the credit innovations that we emphasize, however, our approach seems to be a natural starting point. Investigating possible interactions of these drivers with other developments is an interesting question for future research.

According to our calibrated model, the aggregate effects of the credit deepening process witnessed in Brazil were quite small in absolute terms. Credit deepening increased GDP by only 0.42 percent between 2004 and 2012 (that is, an annual increase of 0.05 percent). Still according to the model, during the same period consumption and investment increased by 0.26 and 0.25 percent, respectively. In our extensive sensitivity analysis, we experiment with many features of the model. Only very extreme parameterizations lead credit deepening to generate sizable aggregate effects. Importantly, were *consignado* or firm credit absent from the model, these figures would be much smaller. Without credit-constrained entrepreneurs in the model, the credit deepening process even generates a tiny short-to-medium-run recession. Given that Brazil has experienced one of the most intense credit deepening processes in LA, we argue that reasonable parameterizations of the model for other countries in the region are unlikely to produce sizable macroeconomic effects.

Because our model does not feature trend growth, in order to assess the contribution of credit deepening for above-trend growth in Brazil during the period of our analysis, we need to compare the results generated by the model with measures of above-trend growth during that period. If one assumes a trend growth of 2.5 percent per year, the effects of credit deepening quantified by the model account for 3.3, 1.4, and 0.5 percent of above-trend growth in GDP, consumption, and investment, respectively. If one is willing to assume an optimistic trend growth of 3.5 percent, the model is able to account for 13.2 percent of above-trend growth in GDP. We conclude that, unless trend growth was quite high during the sample period, the credit deepening process did not play an important role in terms of short-to-medium-term growth.

We assume that Brazil is a closed economy. As Justiniano et al. (2015) argue, however, results could be amplified in small open economies. In that case the demand for credit of one agent does not need to be compensated by higher savings (less consumption) by other agents. Although the assumption that Brazil is relatively closed to trade is realistic, some measures indicate Brazil is not closed to financial flows.[9] Hence, we address this concern by considering a small open economy version of the model. The macroeconomic effects stemming from the credit deepening process are not amplified. In particular, the effects on GDP are similar, although the dynamics of consumption and investment change somewhat. As most countries represented in Figure 1 are considered small open economies, these results reinforce our conclusion that the credit deepening processes experienced in LA are unlikely to generate sizable aggregate effects through the demand channels that we highlight.

This paper is organized as follows. Section 2 presents a brief review of the literature. Section 3 outlines the theoretical framework. Section 4 describes the quantitative analysis, encompassing the calibration procedure, results, sensitivity analysis and discussion. Section 5 considers the small open economy version. Section 6 concludes.[10]

[9] See, for instance, the financial openness indices reported by Quinn et al. (2011).

[10] In Appendix D we use a stochastic version of our calibrated model to study whether credit deepening changes the way in which monetary policy and technology shocks affect the economy. We find that the impulse response functions to both technology and monetary policy shocks are almost identical in economies with low and high levels of credit relative to GDP. That is, the financial frictions in our calibrated model do not change the propagation mechanisms of these key shocks in any meaningful way.

2 Brief review of the literature

There is a large empirical literature that studies the connections between finance and growth (for a survey, see Levine 2005). This literature suggests that financial development is positively correlated with economic growth. However, purely empirical research may leave some questions unanswered, as the underlying mechanisms that cause growth are hard to identify. Moreover, as Townsend and Ueda (2006) emphasize, standard assumptions in regression analysis, such as stationarity and linearity, are often inconsistent with transitional growth paths in theoretical models. Hence, this literature should benefit from insights generated by quantitative analysis, in general equilibrium settings.

Our paper fits a fast growing literature that integrates financial frictions into the new Keynesian workhorse model. Bernake and Gertler (1989) and Bernanke et al. (1999) are the leading early references in that literature. See Gertler and Kiyotaki (2010) for a recent survey.

We consider three types of financial frictions. First, we follow Kiyotaki and Moore (1997), who tied the amount an agent can borrow to the value of some collateral in a general equilibrium model, and Iacoviello (2005), who introduces this financial friction in a new Keynesian framework. We also follow these authors by introducing entrepreneurs who can use capital as collateral in order to borrow. By relaxing this financial friction over time, we can emulate the credit expansion we observe for firms.

Second, as in Iacoviello and Neri (2010) and Gerali et al. (2010), we also distinguish patient from impatient households. We tie the capacity to borrow of an impatient household to some collateral as well. This financial friction allows us emulate the consumer credit expansion we observe in practice. However, instead of using only durable goods (such as housing) as collateral, we also allow some valuation of the borrower's stream of labor income to serve as collateral. This is arguably in line with the Brazilian experience, where housing-related credit is still a relatively small fraction of household credit and *consignado* credit plays a prominent role.

Financial intermediaries in our model are in line with Curdia and Woodford (2010). In particular, we assume that there is a cost to some intermediation activities, which generates an endogenous spread between borrowing and lending rates. This friction is added for the sake of realism.

We study the credit deepening process in Brazil by changing the ability of firms and households to borrow along the transition from a low-credit to a high-credit steady sate. In that sense, our work is similar in spirit to Campbell and Hercowitz (2009), who use a general equilibrium model to study the welfare effects of the increase in household collateralized debt in the US since the early 1980s. The authors interpret this increase as a direct consequence of the deregulation of the mortgage market triggered by financial innovations. These innovations are modeled as unexpected changes in two key parameters of their model. Our exercise is similar in spirit, as we interpret the credit deepening process in Brazil since 2004 as a direct consequence of the aforementioned innovations in credit markets. In focusing on positive – as opposed to normative – effects of changes in the tightness of borrowing constraints, our paper is also related to Justiniano et al. (2015), who study the macroeconomic effects of household leveraging and deleveraging in the United States. Similarly,

Ferrero (2015) studies its implications for current account deficits and interest rates in a two-country framework. Finally, Justiniano et al. (forthcoming) show that a progressive relaxation of lending – rather than borrowing constraints in the US mortgage market – explains some empirical features of the housing boom between 2000 and 2006, before the Great Recession.[11] None of these papers consider jointly the expansion of both household and firm debt.

Recent papers use new Keynesian DSGE models with financial frictions to address questions that matter for the Brazilian economy – e.g., De Castro et al. (2011), Da Silva et al. (2012), Kanczuk (2013), Carvalho et al. (2014) and Arruda et al. (2018). However, we are not aware of other studies of the credit deepening process in Brazil or other Latin American countries using such a model.

Finally, many papers rely on other frameworks with financial frictions to study somewhat related, but different, questions (see the references cited in Dabla-Norris et al., 2015). In a context of heterogeneous agents and/or firms, for instance, credit deepening might interact with occupational choice and/or firm entry. Models with financial frictions and heterogeneous firms can generate misallocation of resources, which has been documented to decrease total factor productivity (Hsieh and Klenow 2009, and subsequent literature).[12] In addition, financial frictions may be a barrier to entry of talented, but credit constrained entrepreneurs. Since credit deepening tends to mitigate these financial frictions, one might expect a boost in total factor productivity during the process. Buera et al. (2011), Buera and Shin (2013) and Dabla-Norris et al. (2015) combine heterogeneous agents (with respect to wealth and entrepreneurial ability) and occupational choice. They find sizable macroeconomic effects stemming from financial frictions. As we emphasize the role of credit deepening in stimulating demand within a model with representative agents, these channels are shut down.[13]

3 The analytical framework

Time is discrete. We consider a closed economy populated by three types of infinitely-lived agents: entrepreneurs (e), patient households (p) and impatient households (i).[14] Each group consists of

[11] See also Eggertsson and Krugman (2012), Guerrieri and Lorenzoni (2017) and Jones et al. (2018), who study related issues in the context of heterogeneous-agent models in which a liquidity trap may arise.

[12] Recently, Midrigan and Xu (2014) argue that misallocation generates fairly small losses in a model disciplined by establishment-level data.

[13] If these channels were relevant in Brazil during the credit deepening process, one might expect the share of entrepreneurs in the labor force to have increased from 2004 to 2012. This can be checked in the data. By using microdata from a Brazilian household survey – *Pesquisa Nacional por Amostra de Domicílios* (PNAD) – we calculate the shares of self-employed and employers (who earn more than the minimum wage) in the labor force from 2004 to 2012. These series remained roughly constant around 10-12 percent and 3-4 percent, respectively, during the sample period. This evidence suggests that the credit deepening process in Brazil may not have had much of an effect on total factor productivity through the extensive margin. Although suggestive, this evidence is not conclusive, since the composition of the pool of entrepreneurs may have changed during the process, or other developments may have induced the exit of entrepreneurs.

[14] Although many Latin American countries are considered small open economies, we focus on Brazil, which is relatively closed to trade. As one may argue that Brazil is not closed to financial flows, we consider below a small open economy version of the model.

a measure one of agents.[15] The economic relevance of each group is captured by its income share, which is constant due to our assumptions below on production technology. Both entrepreneurs and impatient households have lower discount factors than patient households (i.e., $\max\{\beta^i, \beta^e\} < \beta^p$). Consequently, in equilibrium, both entrepreneurs and impatient households have incentives to borrow from patient households. We assume that agents face credit constraints that tie borrowing to some collateral. The tightness of these borrowing constraints governs the amount of credit in the economy.

In order to study the interactions between credit and monetary policy, which follows a simple Taylor-rule, we assume price stickiness in retailers that operate under monopolistic competition, as well as costly financial intermediation. Finally, to focus on the effects of a credit deepening process during the transition to a high-credit economy, we abstract from aggregate uncertainty (and thus omit expectations operators to lighten notation). In Appendix D we turn to a stochastic version of the model to study the way in which the level of credit in the economy might affect the amplification and propagation of monetary and productivity shocks.

3.1 Households

Representative patient and impatient households derive utility from leisure, a nondurable consumption good C_t^j, and a durable consumption good S_t^j, where $j \in \{i, p\}$ indexes the type of the household. We assume preferences for each household are given by:

$$\sum_{t=0}^{\infty} (\beta^j)^t \left\{ \log\left(\left[\xi (C_t^j)^\sigma + (1-\xi)(S_t^j)^\sigma \right]^{\frac{1}{\sigma}} \right) - \frac{(L_t^j)^{1+\varphi}}{1+\varphi} \right\}, \text{ with } \beta^j \in (0,1) \text{ and } \varphi > 0, \tag{1}$$

where L_t^j, $j \in \{i, p\}$ denotes labor supply. Nondurable and durable consumption are combined in a CES aggregator with elasticity $\frac{1}{1-\sigma}$.

3.1.1 Patient households

Given that $\beta^p > \max\{\beta^i, \beta^e\}$, patient households are more prone to save. We focus on transitions between a low-credit and a high-credit steady state along which patient households are always lenders. Thus, we do not need to explicitly account for a borrowing constraint in their problems. In particular, given the real wage rate (W_t^p), the relative price of the durable good in terms of the final good (q_t^S), and the interest rate accrued on deposits (r_t^d), they choose a stream of nondurable consumption (C_t^p), durable consumption (S_t^p), labor services (L_t^p), and bank deposits (D_t^p) in order to maximize (1) subject to the budget constraint

$$C_t^p + q_t^S S_t^p + D_t^p \leq W_t^p L_t^p + q_t^S (1-\delta_S) S_{t-1}^p + \frac{(1+r_{t-1}^d)}{\pi_t} D_{t-1}^p + T_t,$$

[15] This assumption follows other quantitative papers in the literature (e.g., Iacoviello and Neri, 2010; and Gerali et al., 2010). Quantitative analyses indicate that different configurations of group measures are immaterial for aggregate outcomes, although they affect per capita quantities. Campbell and Hercowitz (2009) prove this result analytically within the context of their model.

where $\pi_t = P_t/P_{t-1}$ is the gross inflation rate, and δ_S is the rate of depreciation of the durable good. We assume that patient agents own banks and firms in the economy and, thus, receive their profits, which are aggregated in T_t.

3.1.2 Impatient households

In contrast with patient households, the impatient ones are inclined to borrow, but face borrowing constraints. Let the nominal interest rate faced by borrowers be denoted by r_t^b. We explain below how the credit spread, $\omega_t = (1 + r_t^b)/(1 + r_t^d) - 1$, is determined endogenously. Given W_t^i, q_t^S and r_t^b, they choose a stream of nondurable consumption C_t^i, durable consumption S_t^i, labor services L_t^i, and debt B_t^i in order to maximize (1) subject to the budget constraint

$$C_t^i + q_t^S S_t^i + \frac{1 + r_{t-1}^b}{\pi_t} B_{t-1}^i \leq W_t^i L_t^i + q_t^S (1 - \delta_S) S_{t-1}^i + B_t^i,$$

and the following borrowing constraint

$$B_t^i \leq \tau_t^{WL} \tilde{b}_t + \tau_t^S \frac{q_{t+1}^S \pi_{t+1} (1 - \delta_S) S_t^i}{1 + r_t^b},$$

where

$$\tilde{b}_t = \lambda b_t^{fut} + (1 - \lambda) W_t L_t, \quad \text{and} \quad b_t^{fut} = \chi \frac{\pi_{t+1} b_{t+1}^{fut}}{1 + r_t^b} + (1 - \chi) \frac{\pi_{t+1} W_{t+1} L_{t+1}}{1 + r_t^b}.$$

The borrowing constraint above can accommodate several possibilities. If $\lambda = 1$ and $\chi = 0$, as we assume in the benchmark calibration, these equations collapse to

$$(1 + r_t^b) B_t^i \leq \tau_t^{WL} \pi_{t+1} W_{t+1}^i L_{t+1}^i + \tau_t^S q_{t+1}^S \pi_{t+1} (1 - \delta_S) S_t^i.$$

This borrowing constraint states that impatient households can borrow in proportion (governed by τ_t^{WL}) to the value of next period's labor income plus an amount in proportion (governed by τ_t^S) to the value of next period's stock of durable goods.

Similar constraints, which tie debt to the value of some collateral, have been adopted in the literature (e.g. Kiyotaki and Moore, 1997; Iacoviello, 2005; Gerali et al., 2010). Relative to these papers, we also allow the credit constraint to depend on the borrower's stream of labor income. However, in principle, it is not clear how borrowing might depend on income. As a robustness check for our quantitative results, one can set the parameters λ and χ to accommodate different hypothesis. If $\lambda = 0$, for example, current rather than future income enters the borrowing constraint. In contrast, if $\lambda = 1$ and $\chi \to 1$, the present value of the entire flow of future incomes is used as collateral. Of course, any convex combination of current and the entire flow of discounted future income is possible.[16]

[16] We thank an anonymous referee for suggesting such a recursive structure, nesting different assumptions for how labor income enters the borrowing constraint.

Finally, by calibrating τ_t^{WL} to replicate the expansion of non-collateralized credit (which includes *consignado* in the data),[17] we can study the macroeconomic effects of such expansion. Similarly, we calibrate τ_t^S to study the expansion of collateralized credit to households.

3.2 Entrepreneurs

Entrepreneurs have preferences given by

$$\sum_{t=0}^{\infty} (\beta^e)^t \log(C_t^e), \quad \text{with } \beta^e \in (0,1), \tag{2}$$

where, again, $\beta^e < \beta^p$. Moreover, they have access to a production technology that combines labor (L_t^p, L_t^i) and capital K_t to produce a wholesale good Y_t^e. After factoring in market clearing conditions for capital and labor, the production function reads:

$$Y_t^e = A_t K_{t-1}^{\alpha} \left[(L_t^p)^{\theta} \left(L_t^i \right)^{1-\theta} \right]^{1-\alpha}, \tag{3}$$

where A_t is the level of technology,[18] common to all entrepreneurs, and $\alpha \in (0,1)$ is the capital share. We also assume complementarity across labor types, which is governed by the parameter $\theta \in (0,1)$.[19] Note that the parameters α and θ, by determining the share of output that goes to each type of agents, govern its economic relevance.

In the economies that we analyze, entrepreneurs act as borrowers. Hence, we need to account for a borrowing constraint in their problems. Unlike households, entrepreneurs use capital as collateral. Given prices, they choose a stream of nondurable consumption C_t^e, capital K_t, debt B_t^e, and labor inputs (L_t^p, L_t^i) to maximize (2) subject to (3), the budget contraint

$$C_t^e + W_t^p L_t^p + W_t^i L_t^i + \frac{(1+r_{t-1}^b) B_{t-1}^e}{\pi_t} + q_t^K K_t \leq q_t^W Y_t^e + B_t^e + q_t^K (1-\delta_K) K_{t-1},$$

and the borrowing constraint

$$(1+r_t^b) B_t^e \leq \tau_t^K q_{t+1}^K \pi_{t+1} (1-\delta_K) K_t,$$

where δ_K is the depreciation rate of capital, q_t^K is the price of capital in terms of the final good, and $q_t^W \equiv P_t^W / P_t$ is the relative price of the wholesale good Y_t^e.

[17] Recall that non-collateralized credit consists of all loans to households that are not backed by physical assets. Moreover, *consignado* credit accounts for roughly 60 percent of its increase during the period of analysis.

[18] In our analysis of the transition effects of credit deepening we abstract from technology shocks. In Appendix D we use a stochastic version of the model to analyze their aggregate effects around low-and high-credit steady states.

[19] To our knowledge, the assumption that both types of labor enter the production function in a Cobb-Douglas fashion was pioneered by Iacoviello and Neri (2010), and followed by Gerali et al. (2010), Justiniano et al. (2015), among others. This is a purely technical assumption. In particular, the share of labor income that goes to patient households is constant and equal to θ, which facilitates the computation of the model. Otherwise, the labor supply decision of one type of household, by affecting the labor income share of the other type, would alter the budget (and borrowing) constraints of the latter. In addition, this complex interaction between labor supply decisions and constraints between types may hinder interpretability of results.

The nominal interest rate faced by entrepreneurs, r_t^b, and thus, the spread, $\omega_t = (1 + r_t^b)/(1 + r_t^d) - 1$, are the same as those faced by impatient households. We motivate this assumption by the empirical observation that average interest rate faced by firms is similar to those on *consignado* credit and vehicles financing.[20] Finally, by imposing an exogenous path for τ_t^K that replicates the expansion of firm credit in Brazil, we can study the macroeconomic effects of such expansion.

3.3 Firms

There are four types of firms: competitive capital producers, competitive producers of durable goods, retailers who operate in a monopolistic competitive market, and competitive final goods producers. All firms are owned by patient households.

3.3.1 Capital producers

At the beginning of each period, capital producers buy an amount of the final good I_t^K from final goods firms and the stock of undepreciated capital $(1-\delta_K)K_{t-1}$ at price q_t^K from entrepreneurs. The stock of undepreciated capital is transformed one-to-one into new capital, while the transformation of final goods into new capital is subject to quadratic adjustment costs. The new capital K_t is sold to entrepreneurs at relative price q_t^K, to be used in production in the subsequent period.

Hence, new capital is chosen to maximize

$$\sum_{t=0}^{\infty} \Delta_t [q_t^K (K_t - (1-\delta_K)K_{t-1}) - I_t^K],$$

subject to the law of motion

$$K_t = (1-\delta_K)K_{t-1} + \left[1 - \frac{\kappa_K}{2}\left(\frac{I_t^K}{I_{t-1}^K} - 1\right)^2\right] I_t^K,$$

where the parameter κ_K determines adjustment costs, and Δ_t is the stochastic discount factor of patient households. Any profits originated in this sector are transferred to patient households.[21]

3.3.2 Producers of durable goods

At the beginning of each period, producers of durable goods buy an amount of the final good I_t^S from final goods firms and the stock of undepreciated durable goods at relative price q_t^S from both patient and impatient households. The stock of undepreciated durable goods $(1-\delta_S)(S_{t-1}^p + S_{t-1}^i)$

[20] Between March 2011 (when these series became available) and December 2014, the average interest rate on loans to firms is 22.9 percent, whereas those rates on *consignado* credit and vehicle financing are 26.2 and 23.1 percent, respectively. In addition, the correlations among them are 0.86 and 0.95, respectively. These data are available at the Central Bank of Brazil webpage.

[21] Although capital producers behave competitively, profits can be different from zero (and the price of capital different from one) outside the steady state due to adjustment costs. A similar point applies to the production of durable goods, described in the next subsection.

is transformed one-to-one into new durable goods, while the transformation of final goods into new durable goods is subject to quadratic adjustment costs. New durable goods S_t are sold at relative price q_t^S to both patient and impatient households.

Hence, producers of durable goods choose the level of production to maximize

$$\sum_{t=0}^{\infty} \Delta_t [q_t^S (S_t - (1-\delta_S) S_{t-1}) - I_t^S],$$

subject to the law of motion

$$S_t = (1-\delta_S) S_{t-1} + \left[1 - \frac{\kappa_S}{2} \left(\frac{I_t^S}{I_{t-1}^S} - 1 \right)^2 \right] I_t^S,$$

where the parameter κ_S determines how costly it is to adjust durable goods, and $S_t = S_t^p + S_t^i$. Any profits originated in this sector are transferred to patient households.

3.3.3 Retail firms and final goods producers

In order to introduce price rigidities, we assume monopolistic competition among retail firms. Each retail firm m buys the wholesale good Y_t^e from entrepreneurs at the price P_t^W and differentiates it at no cost. They set prices $P_t(m)$ in order to maximize profits subject to the demand originating from final goods producers, and also subject to quadratic price adjustment costs that arise whenever a firm changes its price by more than a weighted average of past and steady-state inflation, with relative weights equal to ι and $1-\iota$, respectively.

Let $Y_t(m)$ denote production of variety m. We assume that final goods producers are competitive, and they simply aggregate the continuum of differentiated varieties produced by retailers in a CES composite. In particular,

$$Y_t = \left[\int_0^1 Y_t(m)^{\frac{\varepsilon-1}{\varepsilon}} dm \right]^{\frac{\varepsilon}{\varepsilon-1}},$$

where ε is the elasticity of substitution between varieties. This final good is purchased by patient households, impatient households and entrepreneurs for consumption, and by capital and durable goods producers for production.

Finally, it remains to formalize the retail firm m's problem. Let P_t be the associated Dixit-Stiglitz price index. $P_t(m)$ is chosen to maximize

$$\sum_{t=0}^{\infty} \frac{P_0}{P_t} \Delta_t \left[P_t(m) Y_t(m) - P_t^W Y_t(m) - \frac{\kappa_P}{2} \left(\frac{P_t(m)}{P_{t-1}(m)} - \pi_{t-1}^{\iota} \bar{\pi}^{1-\iota} \right)^2 P_t Y_t \right],$$

subject to the following demand schedule obtained from the cost-minimization problem of final goods producers:

$$Y_t(m) = \left(\frac{P_t(m)}{P_t} \right)^{-\varepsilon} Y_t.$$

The parameter κ_P controls the price adjustment cost and dictates the degree of price stickiness in the economy, and $\bar{\pi}$ denotes steady-state inflation. Any profits originated in this sector are transferred to patient households.

3.4 Banks

For simplicity, we model a representative bank that takes both r_t^d and r_t^b as given. Recall that r_t^d is the interest rate that accrues to savings of patient households, whereas r_t^b is the rate on debt of both impatient households and entrepreneurs.[22] At the beginning of each period, the bank collects deposits from patient households D_t, which are lent to both impatient households and entrepreneurs. Originating these loans entails an extra cost which is borne out in terms of the final good. As in Curdia and Woodford (2010), we assume such cost depends on aggregate debt, $B_t = B_t^i + B_t^e$, and is given by ηB_t^γ, with $\eta \geq 0$ and $\gamma > 1$. This is a shortcut to capture both agency and operational costs that are not modeled explicitly.

The excess funds of the bank are given by

$$D_t - B_t - \eta B_t^\gamma, \tag{4}$$

which are transferred to patient households. Let the credit spread ω_t be defined implicitly by $(1 + r_t^b) = (1 + \omega_t)(1 + r_t^d)$. Given that assets must equal liabilities at the end of the period, the following equation must hold

$$D_t = (1 + \omega_t)B_t. \tag{5}$$

By plugging (5) into (4), we obtain the following expression for excess funds:

$$\omega_t(B_t) - \eta B_t^\gamma,$$

which is maximized at $B_t = (\omega_t/\eta\gamma)^{1/(\gamma-1)}$. Since $\gamma > 1$, the model induces a positive correlation between the credit spread ω_t and the aggregate amount borrowed B_t.

3.5 Monetary policy

Monetary policy is conducted through a Taylor-rule with interest rate smoothing. In particular,

$$(1 + r_t^h) = (1 + \bar{r})^{1-\rho}(1 + r_{t-1}^h)^\rho \left(\frac{\pi_t}{\bar{\pi}}\right)^{\phi_\pi(1-\rho)} \left(\frac{y_t}{y_{t-1}}\right)^{\phi_y(1-\rho)} e^{u_t^r},$$

where ϕ_π and ϕ_y determine the responses of interest rates to inflation and output stabilization, respectively, $\bar{\pi}$ and $\bar{r}$ are the steady-state levels of inflation and the policy rate, respectively, and u_t^r is a monetary policy shock.[23]

[22] Recall that this assumption is motivated by the empirical observation that average interest rate on firm credit is similar to those on *consignado* credit and vehicles financing.

[23] In our analysis of the transition effects of credit deepening we abstract from monetary policy shocks. In Appendix D we analyze their aggregate effects around low- and high-credit steady states.

3.6 Market clearing and aggregation

The definition of the equilibrium is standard. We assume that capital, wholesale good, durable good, and both types of labor markets are competitive. In particular, notice that the market clearing condition for the wholesale good reads:

$$\int_0^1 Y_t(m)dm = Y_t^e.$$

In contrast, we assume monopolistic competition at the retail level, where the nondurable good is composed. Given that $C_t = C_t^p + C_t^i + C_t^e$, the market clearing condition in the final goods market is

$$Y_t = C_t + I_t^S + I_t^K + \eta B_t^\gamma + \text{ price adjustment costs.}$$

Finally, notice that transfers to impatient households are given by

$$T_t = \text{sum of profits of all firms, except entrepreneurs, and bank.}$$

4 Quantitative analysis

After calibrating the model outlined above, we use it to perform the following exercise. In order to assess the macroeconomic effects of the credit expansion observed in Brazil, we solve for the time-varying paths of τ_t^{WL}, τ_t^S, and τ_t^K that generate paths for non-collateralized credit, collateralized credit to households, and credit to non-financial corporations that resemble their counterparts in the data (see Figure 2).[24] In particular, we emulate a transition from a low-credit to a high-credit steady state. Notice that, by modeling the evolution of τ_t^{WL}, τ_t^S, and τ_t^K, this quantitative exercise is consistent with the idea that a large fraction of the credit expansion was due to institutional changes that fueled the credit deepening process.

4.1 Calibration

We consider several sources of information to calibrate the parameters of the model, in which the time period is set to one quarter. Whenever we set a parameter to match a given statistic for the Brazilian economy, we consider its average between 2004 and 2012. Details on the data used in the calibration can be found in Appendix E.

Steady state inflation is set to 5.37 percent per year. We set $\beta^p = 0.9834$ to generate a nominal interest rate that accrues on savings deposit of 12.21 percent per year, in steady state. This value is in line with the sample average of the SELIC interest rate, which is the short rate targeted by the Central Bank of Brazil.

Regarding the discount factors for borrowers, we set $\beta^i = \beta^e = 0.96$, which is associated with an annual "subjective time-discount rate" of 18 percent. We pick this arguably extreme value for

[24] Recall that the non-collateralized, rather than the collateralized, credit series includes *consignado* and other types of credit that do not use physical assets as collateral.

two reasons. First, as we show below, lower values for β^i and β^e enhance the ability of the model to produce meaningful aggregate effects in response to credit deepening. Second, with higher values for β^i and β^e, the borrowing constraints for impatient households and entrepreneurs do not bind at times during the transition.[25] In particular, we set $\beta^i = \beta^e$ at the maximum level that guarantees that credit constraints always bind along the transition.

The Frisch elasticity $1/\varphi$ is set to one, which is within the range commonly used in the literature. We follow Fernandez-Villaverde and Krueger (2004) to calibrate the parameters associated with preferences for durable and nondurable goods. In the absence of definitive estimates for σ, we set it to zero, so that the consumption composite becomes a Cobb-Douglas aggregate, $(C_t^j)^{\xi}(S_t^j)^{1-\xi}$, $j = i, p$, with ξ set to 0.8.

The depreciation rate of capital δ_K is set to 0.025, so that the investment to GDP ratio is approximately 18 percent. The adjustment cost parameter κ_K is 2.53, which is in line with the value estimated in De Castro et al. (2011). In the absence of similar information regarding the production of durable goods, we set $\delta_S = \delta_K$ and $\kappa_S = \kappa_K$.

Regarding the Cobb-Douglas technology used by entrepreneurs, since information on borrowers and lenders labor income shares in Brazil is not available, we set $\theta = 0.708$ to generate a ratio of average household debt to annual income of 22.4 percent. The capital share α is set to 0.44, in line with the evidence for Brazil reported in Paes and Bugarin (2006).

In line with previous literature, the elasticity of substitution ε between goods is set to 6, which corresponds to a markup of 20 percent. The parameter κ_P, which measures the degree of price stickiness in the retail sector, is calibrated to 50. As usual, this parameter can be mapped into a degree of price stickiness of 0.75 in the Calvo (1983) model, once the quadratic adjustment cost model and the Calvo model are cast as log-linear approximations around a zero inflation steady state. Finally, ι, which governs indexation, is set to 0.158, as in Gerali et al. (2010).

We follow De Castro et al. (2011) to calibrate the parameters associated with the Taylor-rule. In particular, $\phi_y = 0.16$, $\phi_\pi = 2.43$ and $\rho = 0.79$.

Regarding the banking sector, we fix $\gamma = 2$ and set $\eta = 0.00633$ to generate a spread of 4.1 percent per year – the average difference between the Brazilian prime rate, which reflects interest rates on loans made to preferential borrowers, and the average rate on overnight deposits during the sample. As these loans embed a lower risk of default, the targeted value of 4.1 percent per year underestimates the average spread in the Brazilian economy. One may argue that, in fact, the model should be calibrated to match a low spread, as it abstracts from many sources of default risk, such as aggregate fluctuations and unemployment.[26] We check robustness by varying η, the parameter associated with the level of spread. As we show below, lower spreads help the model produce more meaningful aggregate effects in response to the credit deepening process. Table 1 summarizes the calibration procedure.

[25] For a recent article that deals with credit constraints that bind occasionally, see Guerrieri and Iacoviello (2017).

[26] In addition, other series on interest rates accruing on different types of loans only became available in 2011, so they cannot be used to discipline the parametrization of the banking sector during the period of analysis (from 2004 to 2012).

Parameter	Description	Value
β^p	Discount Factor – Patient HH	0.9834
β^i, β^e	Discount Factor – Impatient HH and Entrepreneurs	0.96
φ	Inverse of the Frisch Elasticity	1
$\frac{1}{1-\sigma}$	Elasticity Between Nondurable and Durable Goods	1
ξ	Weight of the Nondurable Good in the Utility Function	0.8
δ_K, δ_S	Depreciation – Capital and Durable Goods	0.025
κ_K, κ_S	Adjustment Cost – Capital and Durable Goods	2.53
α	Capital Share in the Production Function	0.44
θ	Share of Patient HH in the Production Function	0.708
κ_P	Price Adjustment Cost – Final Good	50
ι	Steady-State Inflation Weight – Indexation	0.158
ε	Elasticity of Substitution – Final Good	6
ρ	Interest Rate Smoothing Parameter	0.79
ϕ_y	Response to Output in Taylor Rule	0.16
ϕ_π	Response to inflation in Taylor Rule	2.43
η	Scale of Intermediation Cost Function	0.00633
γ	Convexity of Intermediation Cost Function	2

Table 1: Calibration. See Section 4.1 for details.

Finally, recall that we set $\lambda = 1$ and $\chi = 0$ such that the borrowing constraint of the impatient household depends on next period's labor income. We postpone the discussion of how we calibrate the sequence $\{\tau_t^{WL}, \tau_t^S, \tau_t^K\}$ to the next section.

4.2 Macroeconomic effects of credit deepening

In order to assess the macroeconomic effects of the credit expansion we observe in Brazil, we solve for the time-varying paths of τ_t^{WL}, τ_t^S, and τ_t^K that generate paths for non-collateralized credit, collateralized credit to households, and credit to firms that resemble their counterparts in the data. We smooth the trajectories for the credit variables using a third degree polynomial. As in Justiniano et al. (2015), we assume that the evolution of τ_t^{WL}, τ_t^S,and τ_t^K is perfectly foreseen after the initial unforeseen shock in 2004, when the credit deepening process arguably started. We keep τ_t^{WL}, τ_t^S, and τ_t^K constant after 2012. Notice that this economy starts from a low-credit steady state and converges to a new high-credit steady state.[27] We focus the analysis on the first eight years (short-to-medium-term) of the transition. In Appendix A we report the calibrated paths for τ_t^{WL}, τ_t^S, and τ_t^K.

[27] To implement this exercise, we apply the shooting algorithm in Dynare to solve the system of equations given by the first-order conditions of the agents' optimization problems and the market clearing conditions. These equations are described in a separate appendix, available upon request.

Figure 3 compares the credit deepening experiment in the model with the data.[28] Notice that the model is able to replicate the evolution of the credit series fairly well, except for the last years of the data on credit to non-financial corporations ("entrepreneurs").[29]

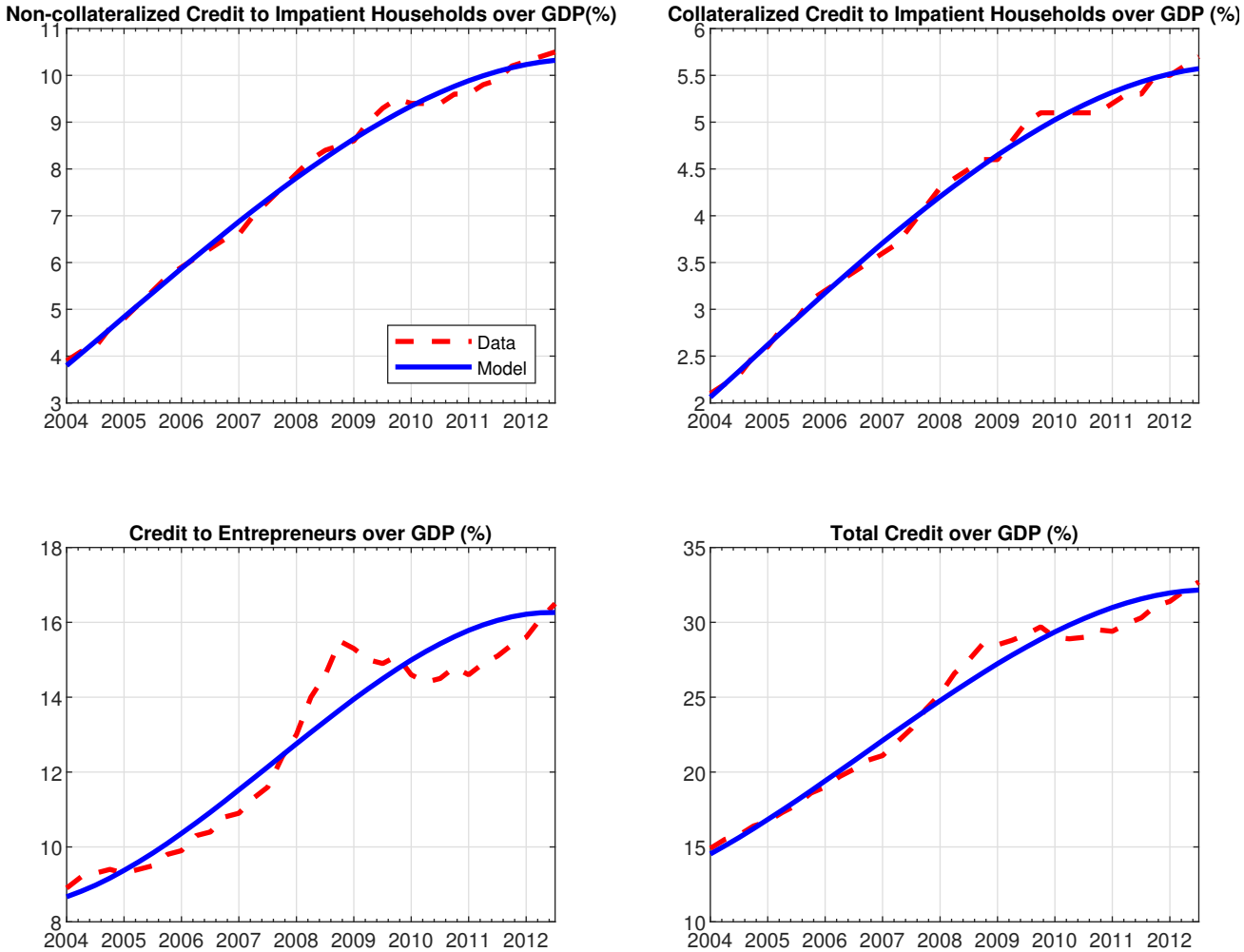

Figure 3: Credit deepening experiment: credit variables (model and data). See Appendix E on how these credit variables are constructed. Source: Central Bank of Brazil.

Figure 4 reports the trajectories of GDP (Y_t), consumption (C_t), investment ($I_t^S + I_t^K$), and aggregate labor services ($L_t^p + L_t^i$) in the model economy.[30] The macroeconomic effects of credit deepening are small in absolute terms. GDP increases by 0.42 percent, consumption by 0.06 percent, investment by 0.95 percent, and labor services by 0.34 percent, after a peak of cumulative growth

[28] Because we use a model with "representative agents" for each type of agent in the economy, the resulting paths for τ_t^{WL}, τ_t^S, and τ_t^K should be interpreted as encompassing both the intensive and extensive ("adoption") margins underlying the credit deepening process.

[29] To be precise, in that case the fitted third degree polynomial would decrease towards the end of the sample period, so we restricted it to be monotonic. In the next section, as a robustness check, we report results for paths of τ_t^{WL}, τ_t^S, and τ_t^K chosen to fit the trajectories of the credit variables point-by-point.

[30] Although labor services of patient and impatient households enter the production function in a Cobb-Douglas fashion, we opt to report aggregate labor, $L_t^p + L_t^i$, rather than the composite, $(L_t^p)^\theta (L_t^i)^{1-\theta}$, to make results comparable to the data.

of 0.50, 0.13, 1.21 and 0.41 percent, respectively.

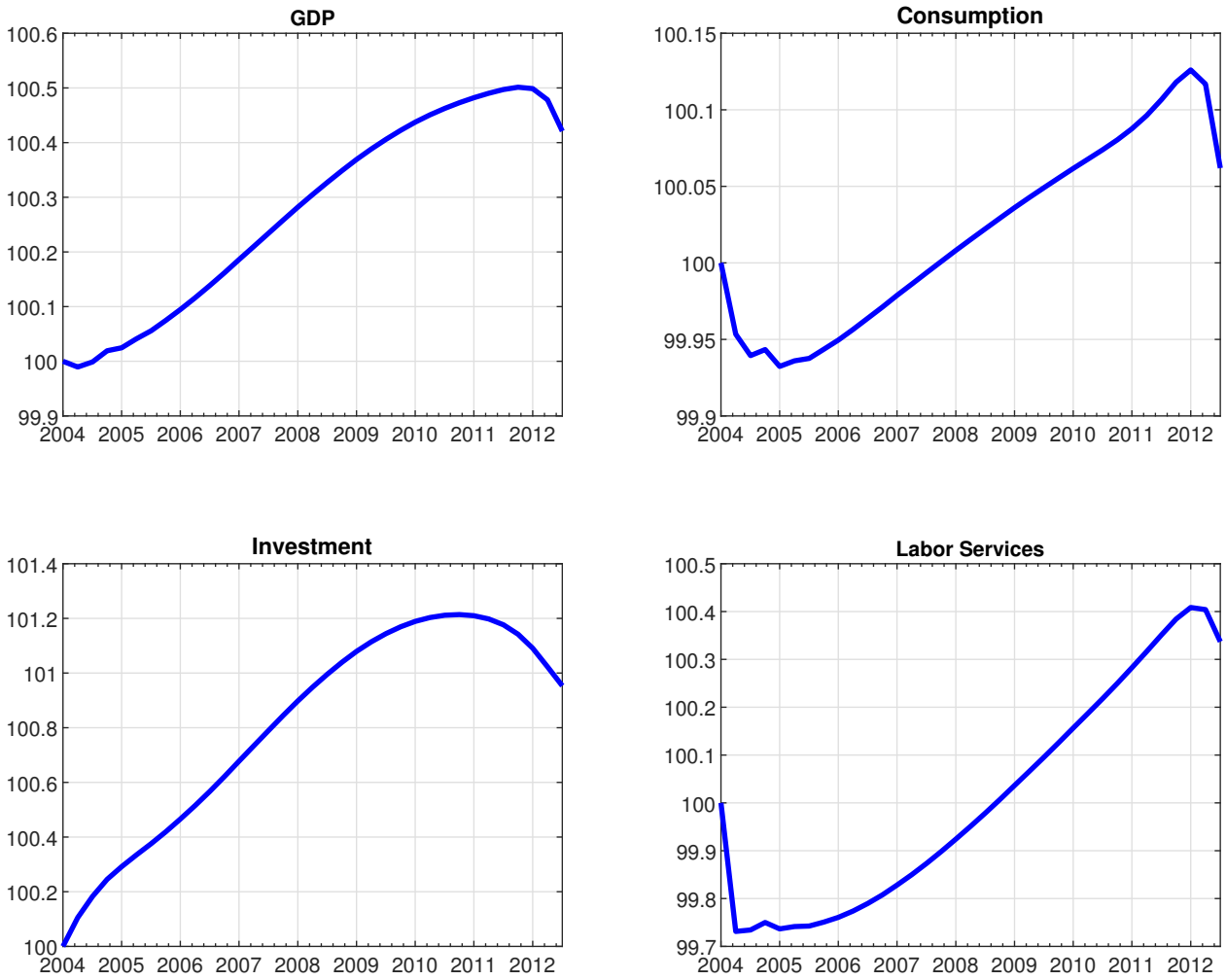

Figure 4: Credit deepening experiment: macro variables (model).

Consumption in the model aggregates nondurable consumption across types of agents, whereas investment aggregates investment in both durable goods by households and capital by entrepreneurs. Figure 5 reports the evolution of these variables, as well as the evolution of the stock of durable goods and capital by type of agents.

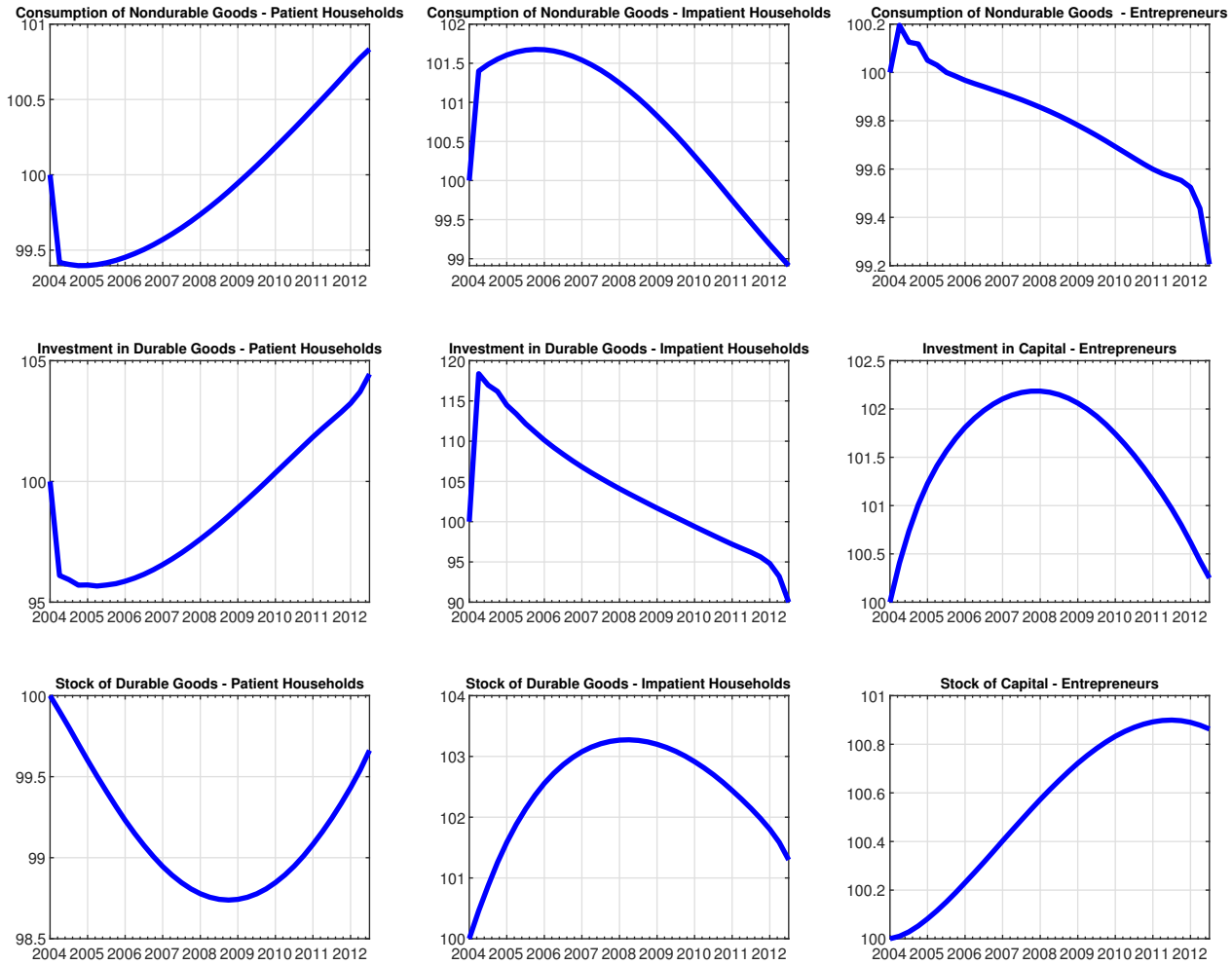

Figure 5: Credit deepening experiment: macro variables (model), by type of agents.

Once the credit deepening process starts, credit constraints faced by both impatient households and entrepreneurs ease, leading them to consume and invest more. In order to clear markets, the price of the nondurable good must increase and, thus, patient households reduce their consumption of nondurable goods and investment in durable goods.

As the credit deepening process evolves, consumption and investment of patient households increase, whereas the stock of durable goods follows a U-shaped pattern. In the first years of the process, market clearing prices imply that patient households exchange durable for nondurable goods. As patient households, by lending to other agents, accumulate more wealth during the transition, they can eventually sustain a higher level of consumption of both durables and non-durables.

After an initial spike, investment of impatient households declines, whereas, after reaching its peak in a few quarters, consumption starts to decline. Notice also that the impatient households' stock of durable goods follows an inverse U-shaped pattern. At the beginning of the credit deepening process, credit-constrained households can expand consumption of both durables and non-durables. As patient households get wealthier and, thus, increase the demand for these goods, market clearing

prices lead the impatient ones to reduce their purchases.

Although the credit deepening process relaxes the credit constraints faced by impatient households, wealth dynamics imply that the patient ones eventually end up consuming and investing more. In terms of magnitude, the strongest effects of credit deepening are on investment in durable goods by patient households, which increases by 4.44 percent from 2004 to 2012. In contrast, investment in durable goods by impatient households falls by 10.00 percent. In Appendix A we report and discuss results pertaining to labor market outcomes. As in Justiniano et al. (2015), during the credit deepening process, consumption, investment and labor of patient and impatient households move in opposite ways, muting its aggregate impact. In particular, labor of impatient (patient) households decreases (increases) in the first quarters and, then, gradually increases (decreases).

Along the transition, investment in capital follows an inverse U-shaped path, leading to an increase in the stock of capital by 0.86 percent. Notice also that entrepreneurs' consumption of nondurable goods falls by 0.79 percent, whereas investment increases by 0.25 percent (after reaching a peak of 2.19 percent). In Appendix A we report and discuss results regarding financial market outcomes. The interest rate on deposits also follows and inverse U-shaped path. It gradually increases to accommodate the extra demand for credit, reaching a peak of 0.43 percentage point higher than its steady-state value. After that, it gradually goes back to its steady-state value, consistent with the discount factor of the patient households.

Figure 6 shows that the model can replicate reasonably well the trends of both the spread and the average household debt to annual income observed in the data. While our calibration targets their average levels, it is not disciplined by their time paths. Hence, as these variables directly relate to credit market conditions, the model seems to be capturing at least some important aspects of the credit deepening process witnessed in Brazil.

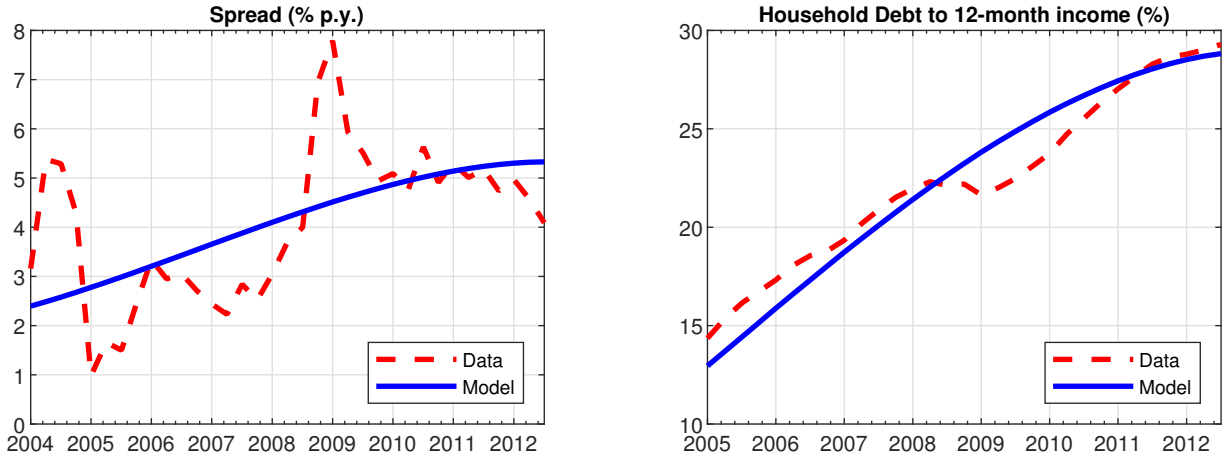

Figure 6: Credit deepening experiment (model and data): spread and ratio of household debt to annual income. See Appendix E on how these variables are constructed. Source: Central Bank of Brazil.

In absolute terms, the effects of the credit deepening process are small. However, the model lacks trend growth. Hence, depending on the actual level of trend growth in Brazil, the effects

of credit deepening as quantified by our model might nevertheless explain a more sizable share of above-trend growth in actual GDP, consumption and investment during the 2004-2012 period.

Brazil's short macroeconomic time series, along with the several macroeconomic shocks that hit its economy during the 1990s and 2000s, make estimates of trend growth very unstable across methods, variables and subsamples. If we fit, for instance, a linear trend to log quarterly data from 1996 to 2003, we obtain a trend growth of 2.0, 1.2 and -0.4 percent for GDP, consumption and investment, respectively.[31] Note that we consider a subsample prior to the credit deepening process, so to avoid that part of its short-to-medium-term effects be artificially incorporated into the trend. If we extend the sample to 2014, for example, we obtain a trend growth of nearly 3.5 percent per year for both GDP and consumption, but 4.0 percent for investment. Alternatively, we allow some non-linearity by applying the Hodrick-Prescott filter to the whole sample,[32] and get larger average trend growth before the credit deepening process: 2.5, 1.7 and 0.2 percent for GDP, consumption and investment, respectively. If we consider the whole sample, instead, these figures increase to 3.2, 3.5 and 3.7 percent, respectively. Given these unstable estimates, as a compromise, we start discussing the ability of the model to explain above-trend growth under the assumption of a common trend growth of 2.5 percent. Then, we argue that the key massage of this paper does not change under more extreme assumptions for trend growth.

From 2004 to 2012, GDP, consumption and investment grew 40.7, 48.4 and 82.6 percent, respectively, in the data. These figures correspond to cumulative above-trend growth of 12.7, 18.8 and 46.2 percent.[33] In contrast, our quantitative model produces cumulative growth rates for GDP, consumption (plus investment in durables) and investment in capital of only 0.42, 0.26 and 0.25 percent, respectively.[34] By dividing the cumulative growth of each variable in the model by its cumulative above-trend growth in the data, we obtain the share of above-trend growth that can be attributed to the credit deepening process, according to the calibrated model. The credit deepening process accounts for only 3.33, 1.36, and 0.54 percent of above-trend growth in GDP, consumption, and investment, respectively. Under a more optimistic (pessimistic) assumption on trend growth, say 3.5 (1.5) percent, the model accounts for 13.16 (1.82), 2.87 (0.86) and 0.73 (0.42) percent of the gap for GDP, consumption and investment, respectively.

Altogether, these results highlight that, unless trend growth was very high during this period, the credit deepening process did not play an important role in Brazil in terms of generating short-to-medium-term growth – at least not through the lens of this model. Given that Brazil has experienced one of the most intense credit deepening processes in LA, we conclude that analogous

[31] Data on GDP, consumption and investment are obtained from National Accounts, available at www.ipeadata.gov.br.

[32] We set the smooth parameter to 1600.

[33] The cumulative trend growth during the period is $(1 + 0.025)^9 - 1 = 24.9$ percent. Hence, the cumulative above-trend growth for GDP is $(1 + 0.407)/(1 + 0.249) - 1 = 12.7$ percent.

[34] In the National Accounts, investment corresponds to investment in capital. Hence, its counterpart in the model is the amount invested solely by entrepreneurs, i.e. I_t^K. Similarly, consumption in the data also includes the service flow of some durable goods, such as housing. Hence, we assume that the counterpart of consumption in the model also includes investment in durable goods by households, i.e. $C_t + I_t^S$. If anything, given that the model produces a growth rate of 0.06, rather than 0.26, percent, for non-durable consumption, i.e. C_t, effects would be even weaker if we assume that C_t is the proper counterpart of consumption data.

parameterizations of the model for other countries in the region are unlikely to generate sizable short-to-medium-term growth. Indeed, next section on sensitivity analysis reinforces this conclusion by showing that aggregate effects remain small within a wide range of possible parameterizations and modifications of the model.

With respect to labor services, total hours worked grew 18.8 percent according to an annual Brazilian household survey. Given that we abstract from demographics, the counterpart of labor services in the data is hours worked per working-age population. The latter grew 15.3 percent during the period of analysis. Hence, labor services increased 3.04 percent in the data, but only 0.34 percent in the calibrated model, accounting for 11.2 percent of labor services evolution.

Finally, although the focus of the paper is on the macroeconomic effects of credit deepening, which connects it better with the debate in LA, one may conjecture that this process could generate higher intertemporal welfare gains due to trade that do not necessarily translate into sizable effects on above-trend growth. In terms of consumption equivalent, patient and impatient households gain 0.57 and 0.45 percent, respectively, whereas entrepreneurs lose 0.30 percent.[35] The gain of patient households is one order of magnitude smaller than in Campbell and Hercowitz (2009). They studied the transition from low to high collateralized household debt that started in the early 1980s in the US economy, and found that patient households gained 10.8 percent, whereas impatient ones lost 1.3 percent. Note that, as in their exercise, without a compensation scheme, the credit deepening process is no Pareto improvement. Despite the potential intertemporal gains from trade, we attribute entrepreneurs' losses to the increase in the spread, as well as to general equilibrium effects that increase the interest rate during the transition (see Appendix A.3). This hinders the process of capital accumulation, forcing entrepreneurs to eventually consume less.

4.3 Sensitivity analysis

The ingredients associated with the new Keynesian and the bank sector modeling, in principle, allow richer dynamics for both interest rates, which are key determinants of lending and borrowing decisions. In addition, by entering the borrowing constraints, interest rates affect directly their degree of tightness. Nonetheless, it turns out that these ingredients play a minor quantitative role in the analysis. Price stickiness is not the driving force behind our results, and higher spreads are associated with even smaller macroeconomic effects. These findings motivate us to focus on a simpler version of the model without sticky prices ($\kappa_p = 0$) and costly financial intermediation ($\eta = 0$).

Within this simpler version, we show that even "extreme" calibrations of time-discount rate parameters, chosen to enhance the ability of the model to produce above-trend growth in response to credit deepening process, fail to generate sizable macroeconomic effects. Moreover, our conclusions are robust to variations in the labor income share of patient households and the Frisch elasticity. We also show that the magnitude of the macroeconomic effects does not change much with alter-

[35] Following Campbell and Hercowitz (2009), these figures represent the amount that both nondurable and durable consumption must increase in the initial steady state, so to make agents indifferent between experiencing the credit deepening process (including the transition) or not.

native collateral requirements. Furthermore, we show that our conclusions do not change when we consider a transition that matches the paths of credit variables pointwise. Finally, we show that the macroeconomic effects are even smaller if we drop the assumption that the credit deepening process is perfectly foreseen. Importantly, in all cases we recalibrate the path of τ_t^{WL}, τ_t^S, and τ_t^K to generate paths for the credit measures that are similar to their counterparts in the data.

We summarize our findings below, and present the associated figures in Appendix B, for brevity. In addition, next section shows that the macroeconomic effects are not amplified in a small open economy version of the model.

Flexible prices One may wonder about the relevance of price stickiness for our results. To analyze this issue, we set the parameter that determines the degree of price stickiness, κ_P, equal to zero – thus eliminating price rigidities from the model. Except for tiny differences in the first and last few periods, the trajectories of output, investment, consumption, and labor services overlap almost perfectly with those produced by the baseline calibration. The paths of interest rates on deposits are basically the same, suggesting that monetary policy barely interacts with the credit deepening process. After experimenting with several parameterizations of the model, we learned that the new Keynesian ingredients play minor qualitative and quantitative roles for the analysis of credit deepening processes (more on that below). Hence, from now on, we present results considering the version with flexible prices.

Spread As we argue above, a spread of 4.1 percent per year might be arguably too low for a calibration that targets the Brazilian economy. To assess the sensitivity of our results to the level of spread, we vary the parameter η, associated with the financial intermediation technology, so to produce different levels of spread. Higher – and perhaps more realistic – levels of spread are associated with smaller macroeconomic effects of the credit deepening process.[36] Noteworthy, for extreme levels of spread, consumption of non-durables decreases along the process. Lower levels of spread amplify the macroeconomic effects of credit deepening, but they are still small. Intuitively, spreads not only hinder the gains from intertemporal trade, but are also positively associated with intermediation costs, which drain resources from the economy. Since costlier financial intermediation reduces the macroeconomic effects, throughout the rest of this section, we set $\eta = 0$, which yields a spread equal to zero. The aim is to explore the most favorable calibration toward producing large effects. With $\eta = 0$, GDP, consumption (including investment in durables) and investment in capital increase, respectively, by 0.67, 0.56, and 1.34 percent between 2004 and 2012. These figures are higher than their counterparts in the benchmark calibration, but still far from explaining above-trend growth in Brazil.[37] Aggregate labor services do not vary much with the spread.

[36] We present results for average levels of spread of zero, 4.1 and 7.0 percent. We also experiment with the other parameter associated with the bank sector, γ, and obtain similar results (available upon request).

[37] With $\eta = 0$, impatient households become the group that benefits the most from the credit deepening process. They gain 1.18 percent in terms of consumption equivalent, whereas patient households gain 0.48 percent and entrepreneurs lose 0.06 percent.

Borrower impatience We calibrate $\beta^e = \beta^i = 0.96$, which is the maximum level of $\beta^e = \beta^i$ that guarantees that borrowing constraints bind throughout the transition in the benchmark calibration. This value is associated with an annual "subjective time-discount rate" of 18 percent, which may already seem high. In this section, we further decrease $\beta^e = \beta^i$ to 0.93 and 0.91, corresponding to even higher annual "subjective time-discount rates" of 34 and 46 percent, respectively. Lower values of β^e and β^i are associated with tighter borrowing constraints and, thus, also with a higher impact of the credit deepening process on aggregate variables.

For $\beta^e = \beta^i = 0.93$ (0.91), GDP, consumption including investment in durables, investment in capital increase, respectively, by 1.32 (1.81), 1.10 (1.54), and 3.44 (5.07) percent between 2004 and 2012. These figures are higher than their counterparts in previous calibrations, but still small in absolute terms, given the marked increase in measures of credit over GDP. In relative terms, if trend growth is 2.5 percent, the credit deepening process accounts for 10.41 (14.23) percent of above-trend GDP growth.[38]

Frisch elasticity We set the Frisch elasticity, $1/\varphi$, equal to one. As a robustness check, we also consider Frisch elasticities of 0.5 and 4, which are at the higher ends of microeconometric estimates and macroeconomic calibration exercises, respectively. Although a higher Frisch elasticity can amplify the macroeconomic effects, they are still modest. This amplification can be partially attributed to the evolution of the labor services of impatient households, which grow faster for higher elasticities (after a larger initial drop) .

Labor income share of patient households Recall that both types of labor enter the production function in a Cobb-Douglas fashion. We calibrate the labor income share of patient households, $\theta = 0.708$, to generate the ratio of average household debt to annual income we observe in the data. Since this is an unusual parameter, harder to discipline quantitatively, we check robustness of our results by setting it equal to $\theta = 0.5$, as calibrated in Justiniano et al. (2015) to match the relative labor income of borrowers and savers, and $\theta = 0.8$, in line with the value estimated by Iacoviello and Neri (2010) using Bayesian methods. Both papers consider US data. Although the degree of household indebtedness varies substantially with θ, the macroeconomic impacts stemming from the credit deepening process barely change, except for labor services. In fact, higher values of θ amplify the response of aggregate labor, $L_t^p + L_t^i$, but not the composite term, $(L_t^p)^\theta (L_t^i)^{1-\theta}$, that enters the production function.

Alternative collateral requirements As we emphasize above, in our baseline specification we assume that impatient households' credit limit depends on next period's labor income and on the value of durable goods. In order to inspect the relevance of this assumption, we consider other parameterizations of the borrowing constraint. By imposing that the path of τ_t^{WL} is equal zero, and then calibrating the sequence of τ_t^S to match the trajectory of total (instead of only collat-

[38] With lower values of $\beta^i = \beta^e$, the credit deepening process is Pareto improving, with patient households, impatient households and entrepreneurs gaining 1.86 (2.08), 0.98 (1.34) and 0.11 (0.17) percent, respectively.

eralized) credit to households, we eliminate the direct dependence of borrowing on labor income. Alternatively, we also consider a case in which only future labor income matters. To do so, the path of τ_t^S is set equal to zero, whereas τ_t^{WL} is set to match the path of total credit to households. The effects on GDP barely change with these alternative borrowing constraints. However, consumption and investment move in opposite directions, reflecting the behavior of impatient households whose labor, consumption and investment decisions are affected by the type of collateral in their borrowing constraint. Nonetheless, overall aggregate effects are still modest. We conclude that whether collateral is future labor income or the value of durables does not affect our main findings.

Finally, we run a specification keeping durable goods as collateral, but setting $\lambda = 0$, so that current rather than future income enters the borrowing constraint. We also consider a parametrization that sets $\lambda = 1$ and $\xi = 0.95$, so that the entire flow of future labor incomes serves as collateral (see Section 3.1.2).[39] For each specification, we recalibrate the sequence of credit shocks to match the credit variables observed in the data. Results, including implications for labor services, are largely independent of the specification used.

In the next subsection, we further discuss the role of collaterals by contrasting our baseline specification with a version of the model in which agents can borrow without posting capital, durable goods or "labor income" as collateral.

Non-smooth transition We also consider a transition between steady states in which the perfectly foreseen paths of τ_t^{WL}, τ_t^S, and τ_t^K are chosen to fit the trajectories of the credit variables pointwise. In order to guarantee that borrowing constraints always bind during the transition, we decrease both β^e and β^i to 0.93. This non-smooth transition does not change our conclusion that, through the lens of the model, the macroeconomic effects of the credit deepening process observed in Brazil are small. In fact, the trajectories of the macroeconomic variables along the non-smooth transition oscillate closely around their smooth counterparts.

Unanticipated shocks The assumption that agents perfectly foresee the intensity of the credit deepening process over such a long horizon is arguably unrealistic. Hence, as a last robustness exercise, we solve the model under an assumption on the other extreme of the "foresight spectrum". Namely, we assume that the credit deepening process takes the form of a sequence of unanticipated shocks to the parameters that govern the credit constraints. Reality should arguably be somewhere in between these two extremes assumptions about agents' foresight. In each period, agents are surprised by the values of τ_t^{WL}, τ_t^S, and τ_t^K, but assume they will remain constant thereafter. Shocks are chosen to fit the observed trajectories of the credit variables. In order to guarantee that borrowing constraints always bind during the transition, we need to decrease the values of β^e and β^i to 0.91. Except for labor services, we find that the macroeconomics effects are even smaller than those generated under perfect foresight with $\beta^e = \beta^i = 0.91$. Intuitively, as agents do not anticipate the full extent of the credit deepening, their responses are more muted throughout the process.

[39] Recall that $\lambda = 1$ and $\xi \to 1$ imply that the present value of the entire flow of future incomes is used as collateral.

4.4 Discussion

Altogether, the results presented so far suggest that the credit deepening process witnessed in Brazil did not play a prominent macroeconomic role, at least not through the lens of our model. Due to our extensive robustness checks, one might wonder whether the model is hard wired to produce small aggregate effects. If so, our quantitative exercise would be more informative about the modeling devices we chose, and less about credit deepening processes witnessed in LA. In this section, we argue that this is not the case. We proceed by justifying our modeling choices, and then, presenting some extreme parameterizations that generate sizable macroeconomic effects. Again, we always recalibrate the path of τ_t^{WL}, τ_t^S, and τ_t^K to emulate the credit deepening process we observe in the data. Finally, we compare our exercise with other related contributions in the literature.

4.4.1 Modeling choices and the role of collaterals

Our modeling choices reflect our conjecture that macroeconomic effects stemming from credit deepening processes depend on how tight the borrowing constraints are. Hence, we consider ingredients that could potentially generate endogenous feedback from economic conditions to the degree of tightness of borrowing constraints, once the credit deepening process is triggered by some exogenous driver. The new Keynesian ingredients and the bank sector modeling, for instance, allow richer dynamics for interest rates, which might be important determinants of the degree of tightness of borrowing constraints.

Similarly, by distinguishing between non-durables and durables, we could incorporate "valuation" effects into the borrowing constraint of impatient households, which might be another feature that generates endogenous feedback. In addition, motivated by the Brazilian experience, we assume that the borrowing limit also depends on current and/or future labor income. Hence, by considering endogenous labor supply, we allow for another source of endogenous feedback as households must take into account the effect of labor decisions on their borrowing constraints. Altogether, these ingredients translate into a rich set of channels through which borrowing constraints can become tighter or slacker as the credit deepening process evolves. Of course, this does not mean that all these ingredients are relevant quantitatively once the model is disciplined with data.

In fact, after experimenting with several parameterizations of the model, we learned that the new Keynesian ingredients play a minor role in the quantitative analysis. We also use this framework to study whether the transmission of monetary policy is affected by the steady-state level of credit in the economy – a relevant policy question in many emerging economies. We find that the degree of credit-to-GDP does not change the effects of monetary policy (see Appendix D). Nonetheless, we believe these findings are informative of the ability of somewhat standard DSGE models augmented with financial frictions to generate non-trivial interactions between credit and monetary policy.[40]

In contrast, as a large literature initiated by Kyiotaki and Moore (1997) suggests, our modeling of borrowing constraints, by featuring endogenous feedback through valuation effects, could be an

[40] In a two-country framework with a similar modeling of borrowing constraints, Ferrero (2015) also finds that monetary policy plays a minor role in amplifying the effects of credit shocks on current account dynamics and house prices.

important feature to amplify the effects of the credit deepening. To show that this is the case, we run a specification in which debt limits are equal to time-varying exogenous parameters, τ_t^i and τ_t^e, which we calibrate to fit the trajectories of credit to households and firms, respectively. Algebraically, $B_t^j(1+r_t^b)/\pi_{t+1} \leq \tau_t^j$, for $j = i, e$. Then, we adjust these debt limits accordingly and consider the role of each collateral at a time. For example, when agents can post durable goods as collateral, we fit the paths of τ_t^S and τ_t^i to match the trajectories of collateralized and non-collateralized credit to households, respectively, whereas the path of τ_t^e is set to match the trajectory of credit to firms.[41] Figure 7 plots the results considering the version with flexible prices ($\kappa_p = 0$) and costless intermediation ($\eta = 0$).

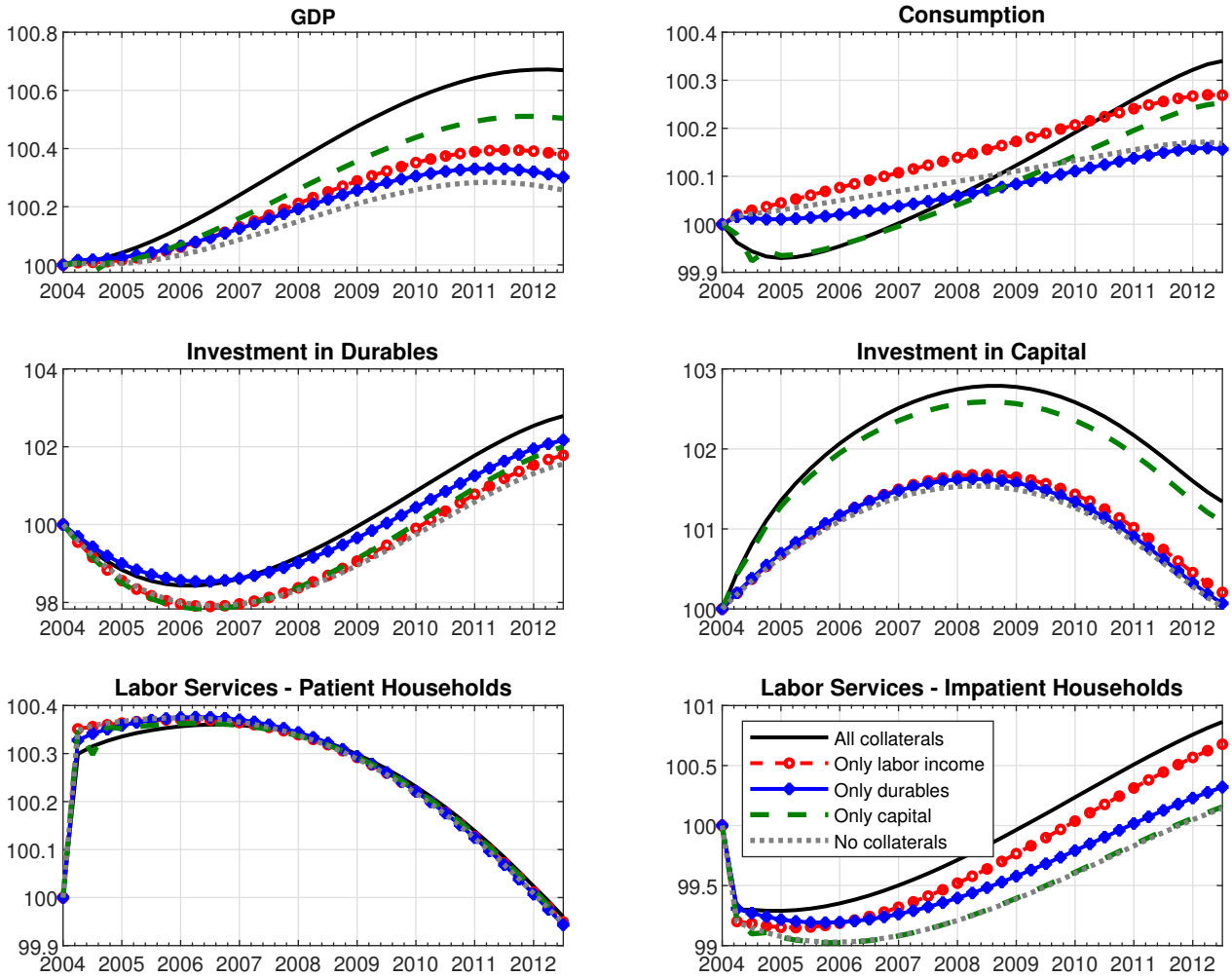

Figure 7: Credit deepening experiment: the role of collaterals.

Despite the small macroeconomic effects, these results underscore the importance of proper modeling borrowing constraints to study credit expansions. Indeed, the already small aggregate

[41] Analogously, when valuation effects rest only on future wages, we fit the paths of τ_t^{WL} and τ_t^i to match the trajectories of non-collateralized and collateralized credit to households, respectively. Similar, we consider the role of capital as collateral by fitting the paths of τ_t^K and τ_t^i to match the trajectories of total credit to firms and households, respectively.

impact stemming from the credit deepening process would fall by more than a half were all these "valuation effects" shut down. By enhancing the response of investment, the endogenous feedback of capital as collateral turned out to be the most important. The modeling of *consignado* credit also plays a role by enhancing the response of nondurable consumption and labor services to a credit deepening process. Intuitively, the possibility to post wages as collateral during the credit deepening process generates an extra incentive for impatient households to supply labor. Finally, the least important form of collateral is durable goods, which is associated with paths for GDP, consumption and investment in capital close to their counterparts in the version without any sort of collateral.

4.4.2 Extreme parameterizations that generate sizable effects

In what follows, within the version without sticky prices ($\kappa_p = 0$), we present results considering two extreme parameterizations that generate more sizable macroeconomic effects. In the first exercise, we set $\eta = 0$, $\beta^i = \beta^e = 0.91$ and $1/\varphi = 4$, which are extreme values already considered separately in the previous section. In the second, we consider an even more extreme calibration, by pushing the discount factors and the Frisch elasticity even further. In particular, we set $\beta^i = \beta^e = 0.85$ and $1/\varphi = 10$. Figure 8 presents the results.

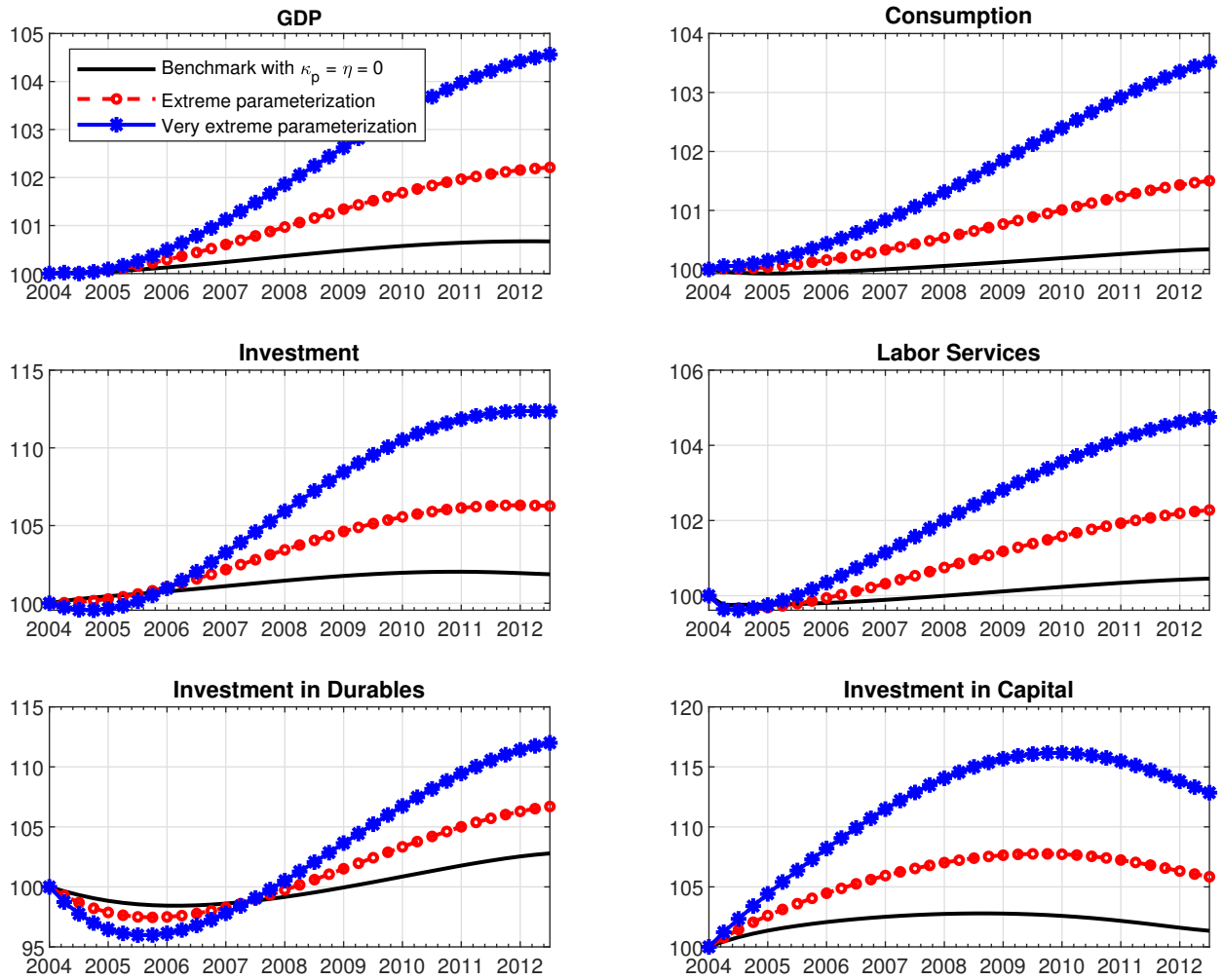

Figure 8: Credit deepening experiment (extreme parameterizations): macro variables.

For the extreme (very extreme) parameterization, GDP, consumption (including investment in durables) and investment in capital increase, respectively, by 2.21 (4.56), 1.91 (4.15), and 5.84 (12.85) percent between 2004 and 2012. These figures are higher than their counterparts in previous calibrations. In relative terms, if trend growth is 2.5 percent, the credit deepening process accounts for a meaningful share of above-trend growth. In particular, the extreme (very extreme) parameterization accounts for 17.41 (35.93), 10.18 (22.08) and 12.70 (27.93) percent of above-trend GDP, consumption and investment growth, respectively.[42] We would get even higher effects if discount factors were further reduced or labor elasticity increased even more. Altogether, these results suggest that credit deepening processes tend to generate sizable effects whenever the marginal borrower has an extreme "subjective time-discount rate" and labor supply is highly elastic.[43]

In Appendix B we reproduce the results in Figure 7 regarding the role of collaterals using

[42] Welfare effects are also higher. In terms of consumption equivalent, the extreme (very extreme) parameterization generates gains for patient households, impatient households and entrepreneurs of 1.61 (3.19), 2.09 (2.26) and 0.23 (0.29) percent, respectively.

[43] In a related experiment, in which borrowing constraints are gradually relaxed (and then tightened), Ferrero (2015) also needs an extreme value of 0.78 for the discount factor to replicate the evolution of house prices in the US.

these extreme parameterizations. In these cases, collaterals are crucial to generate more sizable effects. Without any sort of collateral, none of the macro variables of interest – GDP, consumption (including investment in durables) and investment in capital – increase more than 0.3 percent. It is worth noting that the role of *consignado* credit is even more prominent in these parameterizations, but capital is still the most relevant form of collateral in amplifying aggregate effects.

4.4.3 Comparison to other papers and the role of entrepreneurs

Finally, we briefly discuss two related papers in the literature: Campbell and Hercowitz (2009) and Justiniano et al. (2015). Both papers study transitions from a low- to high-debt steady state by relaxing collateral requirements in a perfect foresight framework that features representative patient and impatient households, but without a representative entrepreneur.[44] The former studies the deregulation of the mortgage markets in the early 1980s in the US, whereas the latter studies household leveraging between 2000 and 2007 (and the subsequent deleveraging) in the US. Although their objects of interest are different from ours,[45] they both present results concerning the evolution of some variables of interest. Importantly, as in our case, their experiments represent a substantial increase in debt-to-GDP ratio from the low- to the high-debt steady state.

Both papers find sizable effects on the stock of durables (or housing stock) and the consumption of non-durables by each type of household – see Figure 1 in Campbell and Hercowitz (2009) and Figure 4.5 in Justiniano et al. (2015). The latter also finds large effects on labor services by each type.[46] Importantly, these effects by types usually go in opposite directions, offsetting each other such that aggregate effects are fairly muted. Similarly, in an estimated DSGE model designed to study housing market spillovers, Iacoviello and Neri (2010) show that "credit shocks" that relax collateral requirements have little impact on aggregate prices and quantities, although it reallocates housing stocks from patient to impatient households (see Figure D.12 in their Supplementary Material Appendix D). This pattern is also present in our model, and in some of the several specifications we run, we also get larger effects at the household level.[47]

Given the different research questions, credit expansion experiments and institutional contexts that imply different modeling choices with regard to borrowing constraints, types of collateral, adjustment costs, and so on, our models are not easily nested. Besides *consignado* credit, another key ingredient that distinguishes our model from Campbell and Hercowitz (2009) and Justiniano et al. (2015) is the presence of a credit-constrained representative entrepreneur, who consumes and accumulates capital. The reason we include this third representative agent is to fully emulate the credit deepening process and, thus, account not only for the evolution of credit to households

[44] To be precise, Justiniano et al. (2015) emulate a subsequent unexpected tightening of borrowing constraints during the transition. But since this shock is unexpected, agents behave as if the relaxation of borrowing constraints is permanent.

[45] Campbell and Hercowitz (2009) focus on the welfare effects, whereas Justiniano et al. (2015) focus on the implications of leveraging to debt and house prices.

[46] In Campbell and Hercowitz (2009), the effects on labor services are nil, as they assume that impatient households supply labor inelastically, and that patient ones do not work.

[47] See, for instance, the path of investment in durable goods by type in Figure 5, or the short-run response of non-durable consumption of the impatient household in Figure B6, in Appendix B.

but also to firms. In order to assess its role, we follow the aforementioned papers, and run a specification without a representative entrepreneur, in which the patient household accumulates capital and supplies it to a representative firm. In this case, we only emulate the paths of credit to households. For completeness, we also consider an alternative specification with a representative credit-constrained entrepreneur, in which τ_t^K is kept fixed at its initial steady-state value. Figure 9 presents the results in the version of the model with flexible prices and costless intermediation.

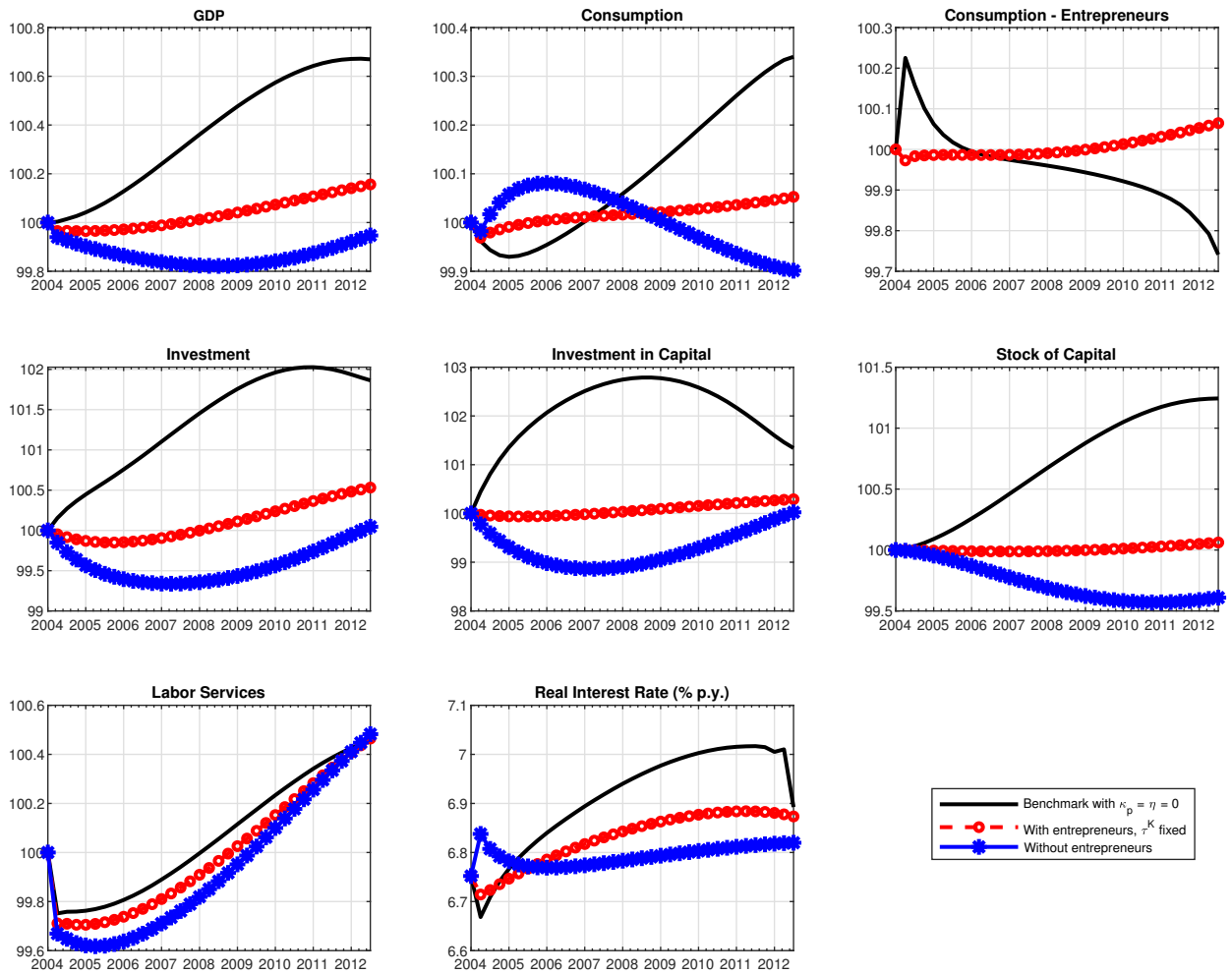

Figure 9: Credit deepening experiment: the role of entrepreneurs.

Interestingly, in the absence of entrepreneurs, the credit deepening process generates a tiny short-to-medium-term recession. In a closed economy without credit-constrained entrepreneurs, a higher demand for credit by impatient households for consumption purposes pushes the interest rate up, and decreases investment in capital by patient ones. Hence, both the stock of capital and GDP decline. Once credit-constrained entrepreneurs are introduced, a higher demand for credit by impatient households need not divert resources from capital accumulation. Importantly, without accounting for the credit expansion to firms, except for labor services, the macroeconomic effects would be even smaller – nearly one-third of the benchmark effects. Intuitively, once the credit

deepening process starts, entrepreneurs would like not only to consume more, but also to smooth consumption due to the concavity of their utility function. Hence, they invest for intertemporal smoothing motives and, thus, accumulate more capital.

Overall, these results highlight the importance of properly taking into account the expansion of credit to entrepreneurs, as investment in capital seems to be a key channel through which a credit deepening process can generate somewhat larger aggregate effects. This conclusion is reminiscent of Liu et al. (2013). They show that credit-constrained entrepreneurs, who post land as collateral, are crucial to capture the positive co-movements between land prices and business investment in a estimated DSGE model.

Finally, other papers in the literature, such as Buera et al. (2011), Buera and Shin (2013) and Greenwood et al. (2013), find sizable macroeconomic effects stemming from financial frictions in other frameworks. The key distinctive feature of these papers from ours is the heterogeneity of firms/entrepreneurs, which allows the credit deepening process to affect total factor productivity. As we emphasize the role of credit deepening in stimulating demand within a model with representative agents, this supply-side channel is shut down.

5 Small open economy version

Our benchmark specification assumes that Brazil is a closed economy. However, one may conjecture that the macroeconomic effects stemming from a credit expansion may be amplified in a small open economy (SOE). In this case, the demand for credit by entrepreneurs and impatient households does not need to be compensated by higher savings and, thus, less consumption by patient households.

Although the assumption that Brazil is relatively closed to trade is realistic, the financial indices reported by Quinn et al. (2011) as well as the Chinn-Ito index[48] suggest that Brazil is not closed to financial flows. In addition, most countries in LA are considered SOEs. Hence, in this section we study a SOE version of the model in which the interest rate is assumed to be constant, so that capital flows equalize demand and supply in this market, but the wage rate still adjusts to clear the labor market domestically. In particular, we fix the interest rate at its steady-state value obtained in the benchmark economy calibrated to Brazil.

In order to scrutinize the aforementioned conjecture, we assume an economy with only impatient households and entrepreneurs that borrow resources from the rest of the world. Therefore, we consider an extreme case of no "crowding out effect" of domestic lenders consuming less. Now we assume that profits generated by all firms in the economy are transferred to entrepreneurs. For simplicity, we also assume price flexibility. The rest of the model as well as the quantitative strategy remain basically the same as in the benchmark exercise.[49] Except for a few parameters, the model is calibrated as reported in Table 1. These parameters are: θ, set to zero due to the absence of patient households; κ_P, also set to zero due to the price flexibility assumption; and η, adjusted to

[48] See Chinn and Ito (2006). The updated version of the index is available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm.

[49] The equations of the SOE version of the model are described in a separate appendix, available upon request.

generate an average spread of 4.1 percent per year. Again, we solve for the time-varying paths of τ_t^{WL}, τ_t^S, and τ_t^K that generate the smooth paths for non-collateralized credit, collateralized credit to households, and credit to non-financial corporations that resemble their counterparts in the data. These paths are shown in Appendix C.

Figure 10 compares the paths for GDP, consumption and investment in the benchmark model with price flexibility and in the SOE version of the model. It also plots the path for the trade deficit to GDP and the evolution of labor market outcomes in the SOE version. The paths for non-durable consumption and investment by type of agents, as well as that for stocks of capital and durable goods, are shown in Appendix C.

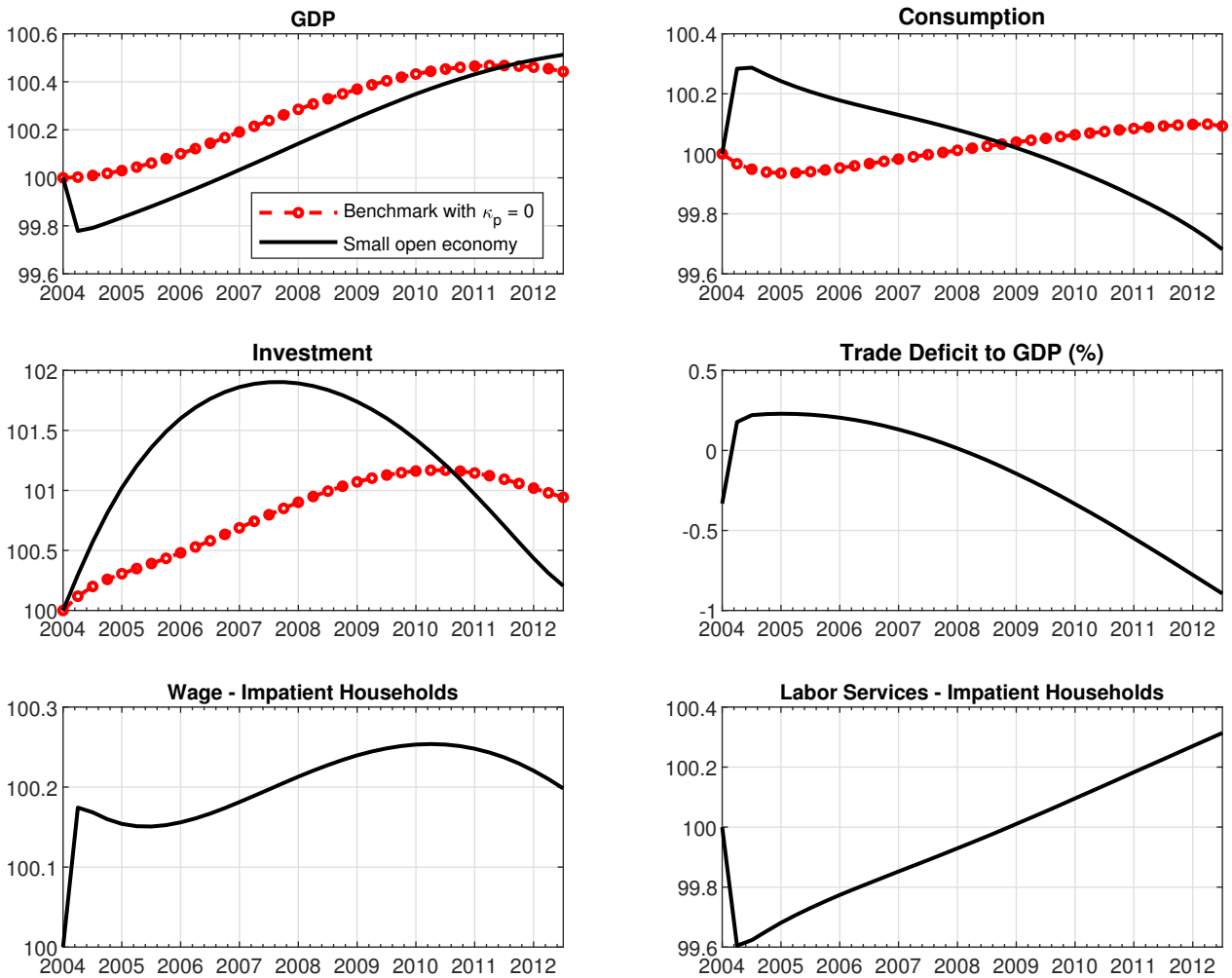

Figure 10: Credit deepening experiment (benchmark and SOE): macro variables.

Figure 10 shows that the macroeconomic effects of credit deepening are not amplified in the SOE version. In the first period, GDP falls and consumption rises. Intuitively, the credit deepening process generates an impulse akin to a wealth effect, so that households reduce their labor supply and, thus, the wage rate increases, GDP falls and consumption increases. Hence, the trade deficit must increase to balance the demand and supply of final goods. As the credit deepening process

evolves, GDP increases in the SOE and in the benchmark economy. The short-to-medium-run effect on GDP is roughly the same in both economies, 0.42 and 0.51 percent, respectively, between 2004 and 2012.

In contrast to the closed economy, after an increase of 0.29 percent in a few quarters, consumption starts to decline in the SOE. Intuitively, the flow of resources from abroad, due to the credit deepening process, leads households to shift consumption towards the present.[50] As this process evolves, the country accumulates foreign debt, and, eventually, net exports have to increase to cover interest payments. Hence, consumption converges to a level below its initial steady state. Ferrero (2015) argues that this intuition also applies to his two-country framework (without entrepreneurs).

Note that in an open economy, since agents can import consumption, they can also increase leisure in response to a credit deepening process, which may slow down its effects on GDP. Hence, the Frisch elasticity is likely to be a key parameter in this exercise.[51] In Appendix C, we report results by considering Frisch elasticities of 0.5 and 4, which are at the higher ends of microeconometric estimates and macroeconomic calibration exercises, respectively. Interestingly, although macroeconomic effects are still small, a higher Frisch elasticity amplifies the short-to-medium term cycle. Indeed, a higher elasticity is not only associated with a deeper initial decline of both GDP and labor supply, but also with a stronger recovery as the credit deepening process evolves.

Importantly, the overall macroeconomic effects stemming from the credit deepening process remain small in the SOE version of the model. As most countries represented in Figure 1 are considered small open economies, this result reinforces our conclusion that analogous exercises for other countries in LA, where the credit deepening processes were less intense, are unlikely to generate sizable short-to-medium-term growth.

Finally, the welfare gains from intertemporal trade due to the credit deepening process are again unequally splitted between impatient households and entrepreneurs. In terms of consumption equivalent, impatient households gain 0.24 percent, whereas entrepreneurs lose 0.32 percent due to the increase in the spread along the transition. If costly intermediation is shut down ($\eta = 0$), without general equilibrium effects through interest rates, then both types of agents benefit from the credit expansion. In particular, impatient households gain 0.48 percent, whereas entrepreneurs gain a tiny amount of 0.01 percent.

6 Conclusion

In this paper, we calibrate a relatively standard new Keneysian dynamic general equilibrium model, augmented with financial frictions, to study the macroeconomic effects of the credit deepening process witnessed recently in Brazil. With the exception of extreme calibrations, we find small aggregate effects from credit deepening. Moreover, were *consignado* or firm credit absent from the model, effects would be even smaller. Without credit-constrained entrepreneurs in the model, the credit

[50] In a related model, Justiniano et al. (2014) argue that an increase in the willingness of the "rest of the world" to hold US assets generates a flow of resources, so that consumption in the US is shifted towards the present.

[51] We thank one anonymous referee for making this point.

deepening process even generates a small short-to-medium-run recession. As Figure 1 illustrates, Brazil has experienced one of the most intense credit deepening processes among countries in LA. Given that effects remain small after an extensive sensitivity analysis, we conclude that, through the lens of a model analogously parameterized for another country in LA, the macroeconomic effects of the credit deepening process experienced by this country are unlikely to be sizable.

As Justiniano et al. (2015) argue, results may change in the context of a small open economy, in which the supply of credit is perfectly elastic at a given interest rate. In this case, the macroeconomic effects of credit deepening may be amplified, as the expansion of the demand for credit by impatient households and entrepreneurs does not need to be compensated by higher savings on the part of patient households. We show that such amplification does not occur in a small open economy version of the model. In particular, the effects on GDP are similar, although the dynamics of consumption and investment change somewhat. As most countries represented in Figure 1 are considered small open economies, these results reinforce the aforementioned conclusion that the credit deepening processes witnessed in LA are unlikely to generate sizable macroeconomic effects.

Almost goes without saying that this conclusion is conditional on our model. For instance, models with heterogeneous agents and firms subject to credit frictions may produce different results. Some papers in this literature have found sizable macroeconomic effects stemming from financial frictions (e.g., Buera and Shin, 2013). These frictions may induce misallocation of production factors, and barriers to entry of productive but credit-constrained firms. Hence, as the credit deepening process mitigates financial frictions, a boost in total factor productivity may occur. Of course, these channels are shut down in models with representative agents, such as the one we use. Indeed, our medium-scale dynamic general equilibrium model is not readily manageable to incorporate a meaningful channel that links credit supply and total factor productivity, as in, for example, Buera and Shin (2013). In particular, it is geared towards analyzing the "demand story" of above-trend growth due to a credit-induced consumption boom, which fits common wisdom about what happened in Brazil and elsewhere in Latin America. This view, however, is not corroborated by our quantitative analysis.

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