Bond Finance, Bank Credit, and Aggregate Fluctuations in an Open Economy*

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Abstract

Corporate sectors in emerging markets have noticeably increased their reliance on foreign financing, presumably reflecting low global interest rates. The evidence also shows a rebalancing from bank loans towards bonds. To study these developments, we develop a dynamic open economy model where these modes of finance are determined *endogenously*. The model replicates the stylized facts following a drop in world interest rates; in particular, rebalancing towards bonds occurs because bank credit becomes relatively more expensive, reflecting the scarcity of bank equity. More generally, the model is suitable for studying interactions between modes of finance and the macroeconomy.

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1 Introduction

Two related trends in emerging economies have recently attracted considerable attention: the foreign liabilities of those countries' firms have increased significantly; and the increase has been dominated by bond issuance, instead of the bank loans which dominated capital flows in the past.[1] Figure 1[2] documents these trends for Brazil, Chile, Colombia, Mexico, and Peru, as well as for their sum (LAC-5). The figure exhibits a clear acceleration in the amount of both bonds and loans owed by Latin American firms. It also shows that the relative importance of bonds has increased since the global financial crisis of 2007-08.[3]

[Locate Figure 1 about here.]

Since the period has been characterized by ample global savings and low world interest rates, as shown in Figure 2, one might conjecture that these developments are what would have been predicted by theories based on the canonical small open economy model, just reflecting that firms in emerging countries have been taking advantage of cheap credit terms by borrowing more from abroad. However, such an argument would fall short of explaining why bonds grew faster than bank loans. This points at a more general shortcoming of standard theories, namely, that they offer no account of the dynamic behavior of bonds and loans. This casts doubt on those theories, and on their usefulness to interpret and provide lessons for these stylized facts.

[Locate Figure 2 about here.]

[1] Note also that these developments have been dominated by corporate debt rather than sovereign debt, which was prevalent in earlier periods. As shown in Caballero et al. (2016a), corporate bond issuance has also increased domestically, but not as much as the one issued in international markets. Sovereigns, on the other hand, have displayed a tendency of substituting international bond issuance with domestic bond issuance.

[2] Figures and tables are gathered at the end of the paper.

[3] For the average country in the figure, the share of bonds in the stock of international corporate debt increased from 22 percent in 2000 to 43 percent in 2013. This process has taken place while, simultaneously, debt-to-output ratios have increased in emerging economies. In 2005 debt-to-quarterly GDP for LAC-5 was about 30 percent, while by the end of 2013 it had almost doubled, just below 60 percent. We measure debt on a residence basis. Stylized facts hold as well when debt is measured on a nationality basis. The Online Appendix reproduces Figure 1 by scaling the amount of debt by GDP.

Accordingly, the main objective of this paper is to develop a theoretical framework for a small open economy in which the quantities of direct versus intermediated finance are determined *endogenously*.[4] This is accomplished by embedding the static, partial equilibrium model of Holmström and Tirole (1997), henceforth HT, into an otherwise standard dynamic stochastic open economy setting. The resulting model is suitable for the study of the dynamic interaction between modes of finance and the macroeconomy, and suggests an intuitive explanation that rationalizes the aforementioned evidence.

The model is specified so that, within any given period, domestic investment is associated with a financing problem similar to that in HT. In each period, new capital goods are produced by a large number of agents that have varying amounts of internal funds or "equity".[5] However, capital production requires investing in projects the size of which is common to all agents (although time varying). Hence capital producers differ in their needs for outside funds.

Outside finance is available, in principle, from a large number of foreign lenders. However, because of a moral hazard problem, capital producers can obtain funds directly (via bond issuance) only if their equity is above a certain *endogenous* threshold value. Capital producers with equity below that threshold but above a second one (also endogenous) can still secure enough outside funds with the participation of monitors or "banks".[6] Banks provide monitoring services that reduce moral hazard; but monitoring is costly and also private information. This introduces a different incentive problem which implies that banks' expected repayment is strictly larger than their opportunity cost of monitoring. As in HT, banks compete for these rents by providing their own equity into investment projects. The

[4] Throughout this paper, we associate direct finance with corporate bonds and intermediated/indirect finance with bank loans.

[5] For concreteness and brevity, throughout the paper we use the term "equity" in a similar sense as "net worth" in, e.g., Bernanke et al. (1999).

[6] We abstract from equity issuance as a source of funding. In practice, however, this is not far from reality, particularly for emerging market economies. Gozzi et al. (2010) examine firm-level patterns in international financing decisions over the period 1991-2005 and find that debt issuance in public markets is much more important as a source of finance for firms than equity issuance, with debt accounting for 80 percent of the total funds raised through public markets.

rate of return on bank equity then adjusts to equate the demand for bank equity (associated with monitoring services) to its supply.

In each period, therefore, the amounts of bank loans and direct finance, and the returns to corporate and bank equity, are all endogenous and depend on variables such as the price of capital goods and the equity of capital-producing firms and banks. The latter are, in turn, determined in a dynamic general equilibrium, in contrast to HT.

As a main finding, the model suggests an intuitive explanation of the joint dynamics of bonds, bank loans, and interest rates summarized by Figures 1 and 2. In the model, an exogenous drop in world interest rates leads to an increase in the demand for capital goods and a corresponding increase in their relative price. The latter raises the profitability of capital goods production as well as pledgeable income and investment. As a result, both corporate bonds and bank loans increase. But, crucially, bank finance becomes relatively more expensive than bond finance because the return to the equity of the banking sector goes up, reflecting that such equity is scarce and slow to adjust. Accordingly, corporate bond issuance increases faster than bank loans. These implications are in line with the stylized facts and highlight the crucial roles of both corporate and bank equity in the adjustment process.

To make further progress, we calibrate the parameters of the model to match empirical macroeconomic and financial targets from emerging countries, and explore several implications. As in previous small open economy models in the literature, the calibrated model displays persistent increases in consumption, investment, and employment in response to a temporary shock to the world rate of interest. More novel, the increase in investment is financed with increases in both bonds issuance and bank loans, with the former responding more strongly than the latter. Hence the calibrated model is consistent with existing results on conventional aggregates, and confirms the intuition, given above, on the evolution of the modes of finance.

We then ask how far can the model go in accounting for the growth in foreign debt and the rebalancing towards bond financing in emerging economies if we take world interest rates as its prime and only driving force. For this purpose, we feed into the model a series of interest rate shocks recovered from the data and compare the resulting simulated outcomes against observed facts on the dynamics and composition of debt as well as macro aggregates. We find that the simulation captures well much of the dynamics of debt and its components observed empirically; in particular, it mimics the credit boom in the run-up to the global crisis, the post-Lehman reversal, as well as the recovery and rebalancing towards bonds until 2013. The simulation, however, generates a much larger contraction in debt around the spike in interest rates following the "taper tantrum" episode of 2013 and onwards, relative to that observed in the data. The simulated series for consumption and investment also exhibit fluctuations that, although somewhat wider, are roughly in agreement with the observed series. We argue that the model's empirical implications are not too much at odds with the data, although a full accounting of the period would require adding other realistic sources of fluctuations, such as shocks to commodity prices (see, e.g., Rodriguez et al., 2015).[7]

A related question concerns varying degrees of financial frictions in the long run and in the short run. Specifically, we investigate the implications of permanently higher monitoring costs for banks or smaller gains for capital producers from moral hazard behavior. Both variations favor direct finance over bank monitored finance and we find that, indeed, they both imply new steady states with increased bonds-to-loans ratios. However, higher monitoring costs imply less steady-state investment, capital, and output than under the benchmark calibration, while lower moral hazard gains imply the opposite. As for the short run, the calibrated model indicates that, in both cases, the two variations imply weaker responses of real quantities to world interest rate shocks than under the baseline calibration. This is of interest, in particular, because it has been conjectured that the observed increase in direct finance relative to indirect finance in emerging countries may reflect changes in the

[7]In Chang et al. (2016) we explore a variant of our model which confirms that, indeed, increases in commodity prices can also help rationalize the stylized facts regarding direct and intermediated finance.

underlying technology of finance which, at the same time, may have made those countries more sensitive to external shocks. Our model suggests that, in fact, the opposite may be true.[8] Also, to the extent that changes in the parameters of the financial technology may be due to policy reforms (a link that our model suggests, but we do not develop in this paper), the model indicates that such reforms affect not only the mode of finance in the long run but also the dynamic, short run responses of macroeconomic aggregates to shocks.

Last, we delve deeper into the implications of the model for macro dynamics by comparing the benchmark model against two counterfactual economies, one with only bonds and another with only bank loans. The counterfactuals are calibrated so that, in steady state, their outcomes for aggregate variables are the same as in the benchmark. We find that the mode of financing can alter significantly the economy's response to aggregate shocks. Specifically, the responses of macro aggregates to an interest rate shock in a banks-only economy are very similar to those of the benchmark economy (which, of course, features both direct and indirect finance) but considerably stronger than those of a bonds-only economy. This comes from the fact that banks can reduce moral hazard problems in the economy and therefore allow more agents to obtain external funding than otherwise. The mere fact that more agents are able to pursue investment projects and thereby react to aggregate shocks works as an amplifier of those shocks. Also, the existence of a meaningful financing choice creates an additional margin of adjustment for agents that can be taken advantage of, which implies a more elastic supply of capital than in a bonds-only economy. Hence our model's endogenous determination of finance mode may substantially affect the leverage-based financial accelerator put forward in the literature (Carlstrom and Fuerst, 1997; Bernanke et al., 1999; Kiyotaki and Moore, 1997).

Our work is related to several strands of literature. One is a set of empirical studies that have documented recent international trends in corporate debt issuance and analyzed the

[8] In contrast, Shin (2013) and others have argued that larger foreign liabilities are dangerous and place emerging economies in a precarious position. Shin (2013) has emphasized that the increase in commercial debt can be problematic because of the possibility of exacerbating currency mismatch problems, which we do not address in this paper.

determinants of corporate debt choice. Shin (2013) and Turner (2014) report the considerable increase in foreign currency borrowing in international bond markets by emerging market corporations.[9] Powell (2014) and Bastos et al. (2015) carefully document this phenomenon for Latin American economies while Caballero et al. (2016a) provide similar evidence for Asia and Eastern Europe.[10] Our model can be seen as a theoretical explanation of the above empirical evidence. In particular, it is consistent with the findings of Caballero et al. (2016a) that aggregate investment has responded to low credit spreads during the period of corporate debt expansion in emerging economies.[11]

In developing our model, we build upon HT and other basic contributions that have provided microfoundations for the choice between bank and market finance under moral hazard.[12] Our work is, to our knowledge, the first to extend this line of research by endogenizing the choice between bank finance and market finance embedding HT's dual moral hazard problem within a dynamic, stochastic general equilibrium context of a small open economy.

Our approach emphasizes the role of corporate equity and bank equity as determinants of the demand for credit, like HT. We go beyond HT, however, in exploring dynamics as

[9]Bruno and Shin (forthcoming) document the distribution of corporate bond issuance in emerging economies across sectors. The oil and gas sector accounts for over 23 percent of total issuance, while the telecoms and utilities sectors also represent a large portion of the issuance activity (24 percent). They argue that, to the extent that the cash flows of the latter sectors are mainly in domestic currency, the issuance of US dollar bonds entails some currency exposure for the issuing firms. Also, part of the borrowing has been done by firms' offshore affiliates and therefore does not show up in residence-based statistics.

[10]In terms of the maturity of the corporate bonds in emerging economies, Caballero et al. (2016a) document a median maturity at issuance of about 7 years between 2000 and 2014. Bruno and Shin (forthcoming), in turn, report an increase in the maturity for the bond issuance since 2001.

[11]On the other hand, using firm-level data, Bruno and Shin (forthcoming) find that emerging market corporates tend to borrow more in US dollars when they already hold large cash balances. This indicates that cash needs for investment may not be the only motivation for bond issuance; instead, Bruno and Shin suggest, firms have been engaging in carry trades. The question of whether corporates borrow for investment purposes or carry trades remains open. Using firm level data, Alfaro et al. (2016) find that the evidence is mixed: they document an increase in tangible fixed asset investment among firms in emerging markets that exceeds the average for the full emerging market sample in the pre-Asian crisis period; but they also uncover some cases of weaker liquidity, solvency, and corporate distress indications compared to the pre-Asian crisis average. See also Caballero et al. (2016b) who find that non-financial firms in emerging economies are more likely to act like financial intermediaries in countries with tighter capital controls.

[12]Repullo and Suarez (2000) also endogenize the choice between bank finance and market finance within an environment where firms are heterogeneous in the amount of available equity. See also Diamond (1991), Rajan (1992), Besanko and Kanatas (1993) and Bolton and Scharfstein (1996).

well as macroeconomic implications. Chen (2001), Aikman and Paustian (2006), Meh and Moran (2010), and Haavio et al. (2016) have also embedded HT into dynamic equilibrium settings. A crucial difference relative to our paper, however, is that none of these forerunners modeled the endogenous determination of direct finance versus intermediated finance, which is the central concern of our paper.

Perhaps the closest antecedents of our study are De Fiore and Uhlig (2011, 2015). The first paper introduces a model in which firms choose to finance productive projects either directly or with the help of financial intermediaries, but using a theoretical framework that is silent about the role of bank equity, and hence very different from ours. In that framework banks can draw a signal about the probability of project success, which helps avoiding bankruptcy. De Fiore and Uhlig (2015) embed this mechanism in a closed-economy setting and argue that it can account for a simultaneous fall in bank loans and an increase in bond issuance by US firms during the Great Recession. This is the case if firm-level uncertainty and intermediation costs of banks happen to increase at the same time.[13]

The plan of the paper is as follows. Section 2 presents the basic model, outlines its solution, and discusses its theoretical implications. Section 3 describes a baseline calibration. Section 4 examines dynamic implications of the calibrated model. Final remarks are given in section 5. An Online Appendix provides more details on the data and model calibration.

2 The Model

Our focus is on a small open economy. Time is discrete and indexed by $t = 0, 1, ...$ The economy is inhabited by households, final goods producers and holding companies which produce new capital goods. The rest of the world acts as a supplier for credit, both for holding companies as well as for households.

[13] See also Crouzet (2016), who develops a dynamic model where banks offer more flexibility than market lenders if a firm is in financial distress; banks lending is more restrictive than market lending otherwise. The role of bank equity, which is critical in our framework, is also absent in Crouzet's setup.

2.1 Households and Final Goods Production

Our specification of the household sector and of the production of final goods is standard, so it will be brief. This is because, for our purposes, the main aspect of this part of the model is to generate a dynamic demand for capital goods. Accordingly, we assume that producing final goods requires capital, which is owned by domestic households, and that the relative price of capital is time varying.

There is a freely traded final good that will serve as numeraire. Competitive domestic firms produce final goods with capital and labor via a Cobb-Douglas function $Y_t = ZK_t^{\alpha}H_t^{1-\alpha}$ with Y_t denoting output of final goods, K_t capital input, H_t labor input, Z total factor productivity (assumed to be constant) and $0 < \alpha < 1$. Competitive factor markets yield the usual marginal conditions $\alpha Y_t = r_t^K K_t$ and $(1-\alpha)Y_t = w_t H_t$, where r_t^K and w_t denote the rental rate of capital and the wage rate, respectively.

Households are the owners of productive factors, including capital. They can also borrow or lend in world markets at a gross interest rate $\Psi_{t+1}R_{t+1}^*$, where R_{t+1}^* is the safe world interest rate between periods and Ψ_{t+1} is a country specific spread.[14]

The household's budget constraint in period t is, then, $C_t + Q_t X_t + \Psi_t R_t^* D_t = w_t H_t + r_t^K K_t + D_{t+1} + \left(1-\phi^f\right)\Pi_t$, where C_t denotes consumption of the final good, X_t purchases of new capital, Q_t the price of new capital, and D_{t+1} the amount borrowed abroad. Finally, $\left(1-\phi^f\right)$ denotes the share of dividends Π_t from capital-producing firms which is transferred to the household, as described below.

The spread Ψ_t is exogenous to the household but, as discussed by Schmitt-Grohé and Uribe (2003), it depends on $\bar{D}_t$, the aggregate value of D_t: $\Psi_t = \bar{\Psi} + \tilde{\Psi}(e^{\bar{D}_t-\bar{D}} - 1)$. The representative household maximizes the expected present discounted utility of consumption and labor effort. We assume GHH preferences following Greenwood et al. (1988) so the

[14] We are thus assuming that international debts are denominated in tradables. This is a time-honored tradition and the natural one in a model without nominal rigidities. One can imagine other possibilities, for instance debts denominated in terms of some aggregate of tradables and domestic capital goods, which is not traded. This would presumably introduce non-trivial net worth effects which are outside the scope of this paper.

marginal utility of consumption is $\lambda_t^c = \left(C_t - \kappa \frac{H_t^\tau}{\tau}\right)^{-\sigma}$, where κ, τ and σ are parameters. Optimal labor supply is then given by $w_t = \kappa H_t^{\tau-1}$, and the optimal foreign borrowing-lending policy is given by $1 = \beta^h E_t \frac{\lambda_{t+1}^c}{\lambda_t^c} \Psi_{t+1} R_{t+1}^*$, where $\beta^h \in (0,1)$ is the household's discount factor and $E_t(.)$ is the conditional expectation operator.

Finally, capital accumulation is subject to adjustment costs $K_{t+1} = (1-\delta)K_t + X_t - \frac{\varphi}{2} K_t \left(\frac{K_{t+1}}{K_t} - 1\right)^2$, where $0 < \delta < 1$ is the depreciation rate and $\varphi > 0$ is a parameter giving the degree of adjustment costs. Then optimal investment is given by the dynamic equation:

$$
\begin{aligned}
& Q_t \left[1 + \varphi \left(\frac{K_{t+1}}{K_t} - 1\right)\right] \\
= \; & \beta^h E_t \frac{\lambda_{t+1}^c}{\lambda_t^c} \left[r_{t+1}^K + Q_{t+1}(1-\delta) + \varphi \left(\frac{K_{t+2}}{K_{t+1}} - 1\right) \frac{K_{t+2}}{K_{t+1}} - \frac{\varphi}{2} \left(\frac{K_{t+2}}{K_{t+1}} - 1\right)^2\right]
\end{aligned}
$$

For a given process for the price of capital Q_t, and given a process for Π_t, the equations derived thus far determine the demand for investment.

It is often assumed that domestic output can be split between consumption goods and new capital goods at no cost, so that $Q_t = 1$ always, and that capital production yields no profits (so that $\Pi_t = 0$). In that case, the equations in this subsection suffice to determine the rest of the variables so far.

2.2 Finance and Production of New Capital Goods

To depart from the usual approach, we assume that new capital goods X_t are produced via a process subject to financial frictions. In equilibrium Q_t will be variable and investment will reflect the dynamic supply of investment as well as demand. More importantly, those dynamic forces will interact with the behavior of alternative modes of corporate finance.

New capital goods are produced by "holdings", each of which manages a continuum of productive units ("branches" for short) indexed by $i \in [0,1]$. The representative holding arrives at period t with some amount of equity K_t^f , inherited from the previous period. At the beginning of the period, each branch i is charged with financing and executing a project of the same size, which takes I_t units of the final good as input, and returns a random amount of new capital goods at the end of the period, as we will describe below. The size of the project, I_t, is chosen by the manager of the holding to maximize end-of-period profits. At the end of the period, successful branches return all their profits back to the holding manager. Because holdings are ultimately owned by households, a fraction $1-\phi^f$ of these profits are paid out every period as dividends.

Also at the beginning of the period, the holding's equity is split evenly between its branches, so that each of them receives K_t^f (due to their unit mass). Every branch i then faces an idiosyncratic i.i.d. shock Ω_t^i to its equity which is a log-normally distributed random variable with mean one. This setting can be thought of as a situation in which there are nationwide corporations (holdings) that own units (branches) in different locations. The holding chooses a project design that has to be implemented by all branches. Each branch is given the same initial amount of equity money, but idiosyncratic, location-specific startup cost shocks imply that branches effectively start projects with equity $A_t^i = \Omega_t^i K_t^f$, distributed with the cumulative distribution function $G_t(\,.\,)$. Simple algebra shows that $G_t(A)$ can be re-expressed as $G_t(A) = \Phi(\log a_t)$, where a_t is the level A normalized by the holding equity K_t^f (i.e., "per-unit of holding equity" level of A) and $\Phi(\,.\,)$ is a time-independent cdf of $\log \Omega_t^i$.[15] This normalization will prove useful in the following discussion.[16]

2.2.1 Individual Projects

Consider the problem of a branch which starts period t with equity A_t^i. As mentioned, the branch manager takes the project size I_t as given. For most firms in the distribution (except for a small fraction very far in the right tail of the distribution, discussed below) it will be the case that $I_t > A_t^i$. These firms will seek external financing in order to implement the project. As we are interested in foreign borrowing by emerging markets' firms, we assume

[15] $G_t(A) = \Pr\left\{A_t^i \leq A\right\} = \Pr\left\{\log A_t^i \leq \log A\right\} = \Pr\{\log \Omega_t^i \leq \log A - \log K_t^f\} = \Pr\{\log \Omega_t^i \leq \log a_t\} = \Phi(\log a_t)$.

[16] The reason why the distribution of equity is not history dependent is entirely for tractability. Otherwise one would have to keep track of the entire distribution of equity in the economy.

that external financing in the model comes from abroad. As in HT, we allow for both direct and intermediated financing. Directly financed projects are not monitored and therefore can be associated with borrowing via bonds. Intermediated borrowing is subject to monitoring and can be associated with bank lending.

Specifically, projects are subject to moral hazard. If the branch manager has secured at least an amount I_t of funds at the beginning of the period, she can invest them into a "good" project that yields RI_t units of new capital with probability p_H and zero with probability $1 - p_H$. The manager can, alternatively, invest I_t in a "bad" project, which reduces the probability of the successful outcome to $p_L < p_H$ but gives the manager a private benefit of size BI_t. Here R, B, p_H and p_L are some given parameters.

Branches can seek funds from foreign outside investors. Because, for tractability, contracts are settled within a period, and the rest of the world is included in the set of outside investors, it is appropriate to assume that outside investors are risk neutral and have a zero opportunity cost for funds. However, assuming that the good project has positive expected value but the bad project does not, outside investors will agree to lend only under a contract that provides enough incentives to the branch manager not to undertake the bad project. Denoting by $R_t^{f,i}$ the payoff to branch manager i in case of project success, the necessary incentive compatibility constraint can be written as $p_H R_t^{f,i} \geq p_L R_t^{f,i} + BI_t$, or $R_t^{f,i} \geq \frac{BI_t}{\Delta}$, with $\Delta = p_H - p_L$.[17]

Also, for the branch to be able to finance the project by borrowing from outside lenders, the amount borrowed must be $I_t - A_t^i$. Then, the expected payoff to the lenders must be at least as large, that is, $p_H(Q_t RI_t - R_t^{f,i}) \geq I_t - A_t^i$. Combining the last two inequalities, it follows that the branch manager will be able to finance its project directly from outside lenders (i.e., via bonds issued abroad) only if it has enough equity: $A_t^i \geq \bar{A}_t$, where $\bar{A}_t =$

[17]Since the branch is not the ultimate owner of the equity it operates and has to return the net revenue back to the holding at the end of the period, it may be asked why would then the incentive constraint apply to the branch. We assume here that the remuneration of the branch is performance based and proportional to the expected branch revenue by factor x. The incentive constraint of a branch can then be written as $xp_H R^f > xp_L R^f + BI$, which makes the constraint equivalent to the one in the main text and x not separately identifiable from B.

$I_t\left[1-p_H(RQ_t-\frac{B}{\Delta})\right]$, or, normalizing by the aggregate level of holding equity K_t^f, $A_t^i/K_t^f \equiv a_t^i \geq \bar{a}_t = \bar{A}_t/K_t^f$, where

$$\bar{a}_t = i_t\left[1-p_H(RQ_t-\frac{B}{\Delta})\right] \tag{1}$$

and $i_t = \frac{I_t}{K_t^f}$. Given i_t, $\bar{a}_t$ depends naturally on parameters such as R, as in HT. In our setting, $\bar{a}_t$ also depends on the price of capital: it falls if Q_t increases. This will imply that more firms will be able to participate in bond financing, thus, in principle, increasing the supply of capital as Q increases.

Consider now a branch j for which $a_t^j < \bar{a}_t$. As in HT, we assume the existence of financial intermediaries or "banks". Banks start each period with some equity of their own that can be used for funding projects. More importantly, they also own a monitoring technology that allows them to reduce the branch manager's private benefit of the bad project from B to $b < B$. However, using the monitoring technology entails a private cost cI_t to a bank. This implies that, for a branch j to secure external funding with the participation of a bank, the bank's payoff if the project is successful, denoted by $R_t^{m,j}$, has to provide enough incentives for the bank to monitor: $p_H R_t^{m,j} - cI_t \geq p_L R_t^{m,j}$, or $R_t^{m,j} \geq \frac{cI_t}{\Delta} \equiv R_t^m$.

Also, for a branch j to convince a bank to participate in the project, it must offer the bank a return on its funds at least as large as what the banker would obtain elsewhere. Denoting the latter by β_t and the bank's contribution to the project by $I_t^{m,j}$, the condition is that $p_H R_t^{m,j} \geq \beta_t I_t^{m,j}$. Although the contract is within a period, β_t is greater than the market return (of one) to compensate the bank for the cost of monitoring but also, as we will see, because bank equity is scarce. This means that holding branches will never borrow more from bank's own equity than strictly necessary, so the condition must hold with equality, which combined with the previous relation gives $I_t^{m,j} \equiv \frac{p_H R_t^m}{\beta_t} = I_t^m$. In this case, the participation of outside investors implies the incentive compatibility constraint $p_H R_t^{f,j} \geq p_L R_t^{f,j} + bI_t$, that is, $R_t^{f,j} \geq \frac{bI_t}{\Delta}$, where $R_t^{f,j}$ denotes the payoff to the branch manager in case of project success.

For outside investors to recover the opportunity cost of their funds, their expected payoff must be at least as large as the amount they lend to the project. This can be written as

$p_H(Q_tRI_t - R_t^{f,j} - R_t^m) \geq I_t - I_t^m - A_t^j$. In equilibrium, this inequality will be binding.[18] As in the case of direct finance, one can show, by combining the previous three equations, that a branch j will be able to finance its project via monitored finance if it has enough equity: $A_t^j \geq \underline{A}_t$, or, normalizing again by K_t^f, $A_t^j/K_t^f = a_t^j \geq \underline{A}_t/K_t^f \equiv \underline{a}_t$, where

$$\underline{a}_t = i_t \left[1 - \frac{p_H c}{\beta_t \Delta} - p_H \left(RQ_t - \frac{b+c}{\Delta}\right)\right] \tag{2}$$

Finally, branches satisfying $A_t^j \leq \underline{A}_t$ have too little equity to overcome their moral hazard problem. Therefore they cannot borrow at all and are not able to pursue the project in period t. However, as mentioned previously, there exists also a small fraction of branches with equity $A_t^i \geq I_t$. These branches are fully self-financed and do not borrow at all. Instead, they invest their superfluous amount of equity $A_t^i - I_t$ at the riskless rate 1 (see Footnote 24).

The normalized version of the cutoffs are handy, because they allow to show that a given fraction of branches is solely a function of the normalized cutoff. Therefore $\Phi\left(\log \underline{a}_t\right)$ denotes the fraction of firms with no access to external finance in period t. We refer to this fraction of firms as "Category 1" firms. By analogy, the fraction of firms which borrow via banks ("Category 2") is given by $\Phi\left(\log \bar{a}_t\right) - \Phi\left(\log \underline{a}_t\right)$. Finally, the fraction of firms which finance themselves through corporate bonds (or are fully self-financed) is $1 - \Phi\left(\log \bar{a}_t\right)$ and labeled "Category 3".

For the purpose of later analysis let us add a comment on the determination of the rate of return to bank equity β_t. In this setting, as in HT, the return to a banker for participating in a project must be large enough to induce monitoring. This requires that the payoff to the banker, $R_t^m = cI_t/\Delta$, exceeds the opportunity cost of monitoring, which is just cI_t (since $\Delta < 1$ and the alternative rate of return is the intra-temporal return of zero). Therefore, bankers earn an excess return for participating in projects. The assumption in HT, which we adopt here, is that bankers compete for such excess returns by providing equity in the

[18]Note that, even in equilibrium, $R_t^{f,j}$ will not be constant across branches (i.e., we keep the j subscript) because branches have different levels of equity A_t^j.

amount I_t^m to the projects. The rate of return β_t then adjusts so as to equate the aggregate amount of bank equity thus offered to the available stock of bank equity at the beginning of the period, which will be denoted by K_t^m. In our formulation, K_t^m is predetermined, so the rate of return on equity β_t adjusts to reflect the scarcity of bank equity.

It may also be worth noting that the endogeneity of the return to bank equity β_t implies that the responses of $\bar{A}_t$ and $\underline{A}_t$ to exogenous shocks are qualitatively different. From (1) it is apparent that shocks affect $\bar{A}_t$ only through their impact on the price of new capital Q_t and project size I_t. In contrast, (2) tells that $\underline{A}_t$ responds to shocks not only through Q_t and I_t, but also through β_t. Thus the nature of financing has important consequences for how the economy responds to external shocks such as to world interest rates.[19]

2.2.2 The Choice of Project Size

The profits of a typical holding in period t can then be written as $\Pi_t^f = p_H Q_t R I_t \left[1 - G_t(\underline{A}_t)\right] + \int_0^{\underline{A}_t} A_t^i \mathrm{d}G_t\left(A_t^i\right) - \int_{\underline{A}_t}^{\infty} \left(I_t - A_t^i\right) \mathrm{d}G_t\left(A_t^i\right) - I_t^m \left[G_t(\bar{A}_t) - G_t(\underline{A}_t)\right](\beta_t - 1)$. The first two terms express the holding's end-of-period revenue, the sum of expected payoff from projects plus the (zero) return from funds from branches that will not be able to finance their projects. The third term summarizes the market cost of external finance paid to outside investors. The last term captures the remuneration for banks' equity and the excess return involved with it.

The holding chooses the project size I_t to maximize profits subject to (1) and (2), taking Q_t and β_t as given. After some manipulation, the first order optimality condition[20] can be

[19] To elaborate, suppose that β_t were (counterfactually) some exogenous parameter $\bar{\beta}$. Then (1) and (2) imply that $\underline{A}_t$ would be the same as $\bar{A}_t$, but with the term $b + c(1 - 1/\bar{\beta})$ in the former replacing the private benefit B in the latter. Then indeed the responses of $\bar{A}_t$ and $\underline{A}_t$ to a shock in R_t^* would be qualitatively the same. But this is not the case in our model, since β_t is an endogenous variable rather than an exogenous parameter and therefore it fluctuates over the business cycle.

[20] For our discussion, we assume here that the first order condition identifies a maximum. Later, in the calibrated version of our model, we checked that the second order conditions for maximization do hold at the non-stochastic steady state.

written as:

$$
\begin{aligned}
& (p_H R Q_t - 1)\left[1 - G_t\left(\underline{A}_t\right)\right] - \frac{p_H c}{\beta_t \Delta}(\beta_t - 1)\left[G_t\left(\bar{A}_t\right) - G_t\left(\underline{A}_t\right)\right] \\
= \; & \underline{A}_t g_t\left(\underline{A}_t\right)(p_H R Q_t - 1) + \left[\bar{A}_t g_t\left(\bar{A}_t\right) - \underline{A}_t g_t\left(\underline{A}_t\right)\right] \frac{p_H c}{\beta_t \Delta}(\beta_t - 1)
\end{aligned} \tag{3}
$$

where $g_t(A)$ is the density function associated with $G_t(\,.\,)$.

The preceding equation together with (1) and (2) now determine $I_t, \underline{A}_t$, and $\bar{A}_t$. The interpretation of this condition is illuminating. The LHS can be seen as the expected increase in the surplus to the holding from a marginal increase in project size I_t. Each additional unit of initial investment has expected return $p_H R Q_t - 1$, and is undertaken by $1 - G_t(\underline{A}_t)$ branches. Part of that gain, however, is appropriated by the banks because the return on bank equity exceeds the market return (that is, if $\beta_t > 1$). This is the second term in the LHS. The RHS collects terms associated with the impact of an increase in I_t on the distribution of branches. A larger I_t implies an increase in $\underline{A}_t$ and, hence, a reduction of approximately $\underline{A}_t g_t(\underline{A}_t)$ producing units, implying a corresponding reduction in the holding's revenue of $p_H R Q_t - 1$ per lost unit. Finally, $\bar{A}_t$ also increases, which means that approximately $\bar{A}_t g_t(\bar{A}_t)$ branches move from direct finance to bank finance. Since $\underline{A}_t g_t(\underline{A}_t)$ drop out from production, the number of branches resorting to bank finance increases by $\left[\bar{A}_t g_t(\bar{A}_t) - \underline{A}_t g_t(\underline{A}_t)\right]$, with each of them shifting profit towards banks by $(p_H c)/[\beta_t \Delta(\beta_t - 1)]$. In other words, the fact that the LHS equals the RHS in (3) means that the optimal decision of the holding equalizes the net marginal revenue of undertaking one more unit of investment with its marginal cost.

2.3 Market Clearing and Dynamic Equilibrium

As discussed before, the return on the banks' equity β_t adjusts so that the bankers' participation in projects $I_t^m\left[G_t(\bar{A}_t) - G_t(\underline{A}_t)\right]$ adds up to available bank equity, denoted by K_t^m. This requires:

$$K_t^m = I_t^m \left[G_t(\bar{A}_t) - G_t(\underline{A}_t)\right] = \frac{p_H c I_t}{\beta_t \Delta} \left[G_t(\bar{A}_t) - G_t(\underline{A}_t)\right] \tag{4}$$

In turn, the equilibrium price of new capital goods, Q_t, must adjust to equate the demand for new capital goods to their supply: $X_t = p_H R I_t \left[1 - G_t(\underline{A}_t)\right]$.[21]

To finish specifying dynamics, we need to describe the laws of motion of the equity variables K_t^m and K_t^f. As a first approximation, we simply assume here that banks and holding companies have fixed dividend rates $1-\phi^m$ and $1-\phi^f$ respectively: $K_{t+1}^m = \phi^m \beta_t K_t^m$ and $K_{t+1}^f = \phi^f \Pi_t^f$.[22] Now the system (1)-(3) plus the equations in this subsection give I_t, $\underline{A}_t$, $\bar{A}_t$, β_t, Q_t, μ_t and the motions of K_t^m and K_t^f. The specification of the model is completed with the equations in subsection 2.1 and an assumption about the stochastic process for the exogenous interest rate R_{t+1}^*.

2.4 The Choice Between Direct versus Indirect Finance

In spite of the complexity of the model, one can extract useful insight about the choice of direct versus indirect finance by studying the equilibrium conditions. Specifically, consider an unexpected increase of investment demand, which may be due to a favorable shock, specified in more detail later. Intuitively, in equilibrium, both the price and the quantity of investment must increase. Since the production of new capital goods requires external finance, and the equity of both holdings and banks is slow to adjust, the total amount of

[21] Here we follow other models of financial frictions in open economies in assuming that capital goods are not traded. To allow for trade in capital goods would presumably involve specifying the world demand for those goods, and perhaps other aspects of the model such as costs of moving capital between the domestic economy and the rest of the world. This can presumably be done but is outside the scope of our paper. For our purposes, such an extension is unlikely to change our basic analysis. In particular, a fall in world interest rates would presumably increase the foreign demand for home capital goods, raising its relative price. As we will see, this is what leads to the dynamic impact on direct versus indirect finance to be discussed in the text.

[22] These assumptions merit special comment. What is critical for our analysis, and indeed of the whole literature on financial frictions and net worth effects (see, e.g., Bernanke et al., 1999) is that equity accumulate sluggishly, so that neither corporate equity nor bank equity ever reach a point at which financial frictions cease to be binding. We anticipate that our analysis would essentially survive under alternative assumptions on the accumulation of equity, as long as they do not result in equity accumulating too fast in the sense just mentioned. This remains an open issue, however, and deserves further exploration, which lies outside the scope of this paper.

credit raised by the outside investors must increase, at least in the short run.

But we can say more than that. Increasing the production of new capital goods in this model requires a combination of a larger project size I_t and of adjustments in the numbers of branches resorting to either direct or indirect finance. The latter is determined by the thresholds $\bar{A}_t$ and $\underline{A}_t$, given by (1) and (2).

In this situation, for the model to generate an increase in both sources of finance and, simultaneously, a rebalancing towards more direct finance, as in the data, it must be the case that both thresholds fall in absolute terms and that $\bar{A}_t$ falls by relatively more than $\underline{A}_t$ (i.e., the ratio $\bar{A}_t/\underline{A}_t$ falls). This is, however, conditional on the shape of the assumed distribution of equity $G\,(\,.\,)$. We verify that this is indeed the case for the specific type of distribution that we use (see details below). But such a relative fall must reflect that bank finance has become relatively more expensive, as given by an increase in the return to bank equity β_t. More precisely, note that (1) and (2) imply that

$$\frac{\bar{A}_t}{\underline{A}_t} = \frac{1 - p_H(RQ_t - \frac{B}{\Delta})}{1 - \frac{p_H c}{\beta_t \Delta} - p_H\left(RQ_t - \frac{b+c}{\Delta}\right)}$$

An increase in the demand for new capital goods raises the price of new capital Q_t which, by itself, would raise the ratio.[23] Increased demand also raises the return on bank equity β_t and this must be the dominant force if the ratio is to fall.

The intuition is simple and illustrates the crucial roles of corporate equity and bank equity. As emphasized by HT, a branch will undertake a project of size I_t if and only if it has enough equity to cover the shortfall between the unit cost of the project, which is one, and the *pledgeable income* from the project, which is $p_H(RQ_t - \frac{B}{\Delta})$ per unit of investment. The cutoff $\bar{A}_t$ is the value of equity which is just enough to cover that difference: that is what (1) says. Branches with equity less than $\bar{A}_t$ resort to their next best option, which is monitored finance. This reduces those branches' moral hazard problem (reflected in the fall in the parameter from B to b) but entails two additional costs: monitoring costs reduce

[23]To see this, take logs and note that $\partial\left(\log \bar{A}_t/\underline{A}_t\right)/\partial Q_t = p_H R(1/\underline{A}_t - 1/\bar{A}_t) > 0$.

pledgeable income directly, as given by the term c/Δ, but also banks appropriate part of the surplus since $\beta_t > 1$, that is, since the rate of return on bank equity exceeds the (intra-temporal) market return (of one). Hence, when the price of capital increases, the fact that bank equity is scarce means that β_t must increase in equilibrium. This reduces pledgeable income for bank-monitored projects (but not for projects with access to direct finance).

In this way, our model provides an economic explanation of the absolute increase of bonds and bank loans, with a rebalancing towards the former, observed in emerging markets. Falling world interest rates led to increased demand for new capital, raising the profitability of projects. In response, producers of new capital goods increased project size and adjusted the number of active branches and borrowing. Total credit then increased, predominantly through direct finance, since bank finance became more expensive (higher β_t).

The above argument is somewhat loose in that it refers to the thresholds $\bar{A}_t$ and $\underline{A}_t$ only. Under our assumptions, however, the measure of branches resorting to either direct or indirect finance depends also on the shape of the distribution $G_t(A)$. Also, as we have seen, the thresholds depend on project size I_t. Therefore it will be useful to define measures of the total amounts borrowed via bonds or bank loans. For corporate bonds CB_t, a reasonable measure is $CB_t = \int_{\bar{A}_t}^{I_t} (I_t - A_t^i)\, \mathrm{d}G_t(A_t^i)$. CB_t is appropriate under the assumption that branches with access to direct finance put all their equity into their projects, and that branches with excess equity (those with $A_t^i > I_t$) do not issue bonds.[24]

The corresponding measure for bank loans BL_t is $BL_t = \int_{\underline{A}_t}^{\bar{A}_t} (I_t - I_t^m - A_t^i)\, \mathrm{d}G_t(A_t^i) + I_t^m \left[G_t(\bar{A}_t) - G_t(\underline{A}_t)\right]$, where the right-hand side indicates that bank loans are financed from a sum of deposits (first term) and banks' own equity (second term).[25] The expressions for CB_t and BL_t emphasize that the shape of $G_t\,(\,.\,)$ impacts both measures and their ratio. If

[24]These firms pursue the project and allocate excess equity on the market at the riskless intra-temporal interest rate (one). Notice that this allows the model to encompass the case of firms in emerging markets identified in some empirical studies that engage in carry trade activities (see Section 1).

[25]Here we are assuming that banks act as financial intermediaries. But, as HT note, an alternative interpretation might be that monitors provide certification services, which then allow branches in the indirect finance range to raise additional funds from outside investors. This would introduce some ambiguity in measuring bank loans. For concreteness, we stick to the financial intermediaries interpretation of the model.

$G_t\,(\,.\,)$ were a Uniform cdf, of course, it would follow directly from the reasoning given above that an increase in the demand for new capital would raise the bond measure relative to the loans measure. As argued below, it is more realistic to assume that $G_t\,(\,.\,)$ is not Uniform, however, and we will need to resort to numerical methods to examine the ratio. But the intuition given above remains valid.

3 A Calibration

To proceed further, it is necessary to work with a calibrated version of the model. As noted, our specification of households and production of final goods is fairly standard. Consequently, values for associated parameters are readily taken from the literature on small open economy models.

We calibrate the model at a quarterly frequency. Our choices for H, σ, τ and α, $\frac{C}{Y}$, R^*, $\tilde{\Psi}$, and φ are taken from Fernández and Gulan (2015). We normalize the steady state price of capital goods, Q, and the total factor productivity level Z to 1. We then choose β^h and δ to match the empirical ratios $\frac{X}{Y} = 0.2$ and $\frac{K}{Y} = 8$. The last value translates into capital stock being worth two years of output and is consistent with the data for Mexico collected by Kehoe and Meza (2011). We calibrate the R^* process to fit the data on ten year US bonds' interest rates deflated by the University of Michigan's survey-based inflation expectations (see Figure 2). All calibrated parameters, normalizations and matched ratios are summarized in Table 1.

[Locate Table 1 about here.]

The second step of the calibration is more novel and involved. It concerns the parameters of the capital goods supply side, that is, of the holding companies. Recall that $\Phi(\omega)$ denotes the cdf of $\omega_t^i = \log \Omega_t^i$. We assume that is Normal with standard deviation σ_G and mean $-\sigma_G^2/2$ (which is necessary to ensure that the expectation of Ω_t^i is one). This implies that the distribution of equity within the holding, $G_t\,(\,.\,)$ is log-normal, with mean K_t^f. Log-normality is often assumed in macroeconomics (see, e.g., Bernanke et al., 1999) and in line with the literature on the size of firms (see, e.g., Quandt, 1966).

We set the quarterly rate of return to bank equity $\beta = 1.0364$, based on the World Bank's Global Financial Development Database (GFDD) for the United States (see Čihák et al. (forthcoming).[26] This automatically gives the value of banks' dividend parameter $\phi^m = \frac{1}{\beta}$. We calibrate $p_H = 0.99$ following Meh and Moran (2010), which reflects a quarterly bankruptcy rate of 1 percent. We then manually set $p_L = 0.96$, the minimum value satisfying $\beta > \frac{p_H}{p_L}$.[27]

At this stage one is left with equation (3), describing the first-order condition of the holding. Normalizing all terms by K^f and simplifying, the equation reduces to an expression in only 6 unknowns: c, b, B, σ_G, $i = I/K^f$ and R. To pin down their values, we use five more independent restrictions.

The first target is the ratio of quarterly bank operating costs-to-bank assets, which we set to 0.78 percent guided by recent observations for the U.S. in the World Bank's GFDD. Because, empirically, monitoring costs constitute only a part of all banks' operating costs, this number constitutes in fact an upper bound for monitoring costs that one would like to target in the model.

Secondly, we try to match two leverage ratios. The first one is that of bank assets to bank equity (i.e., bank leverage) where we target the value 10.64, in line with the evidence reported in the World Bank's GFDD for U.S. commercial banks. The other is the representative holding's leverage: Fernández and Gulan (2015) report an average value of 1.71 for publicly-traded firms in EME-13.

Finally, we attempt to match two debt-related ratios akin to those presented in Figure 1. One is the median ratio of gross foreign bank loans stock to quarterly GDP, reported in the BIS for five selected Latin American countries (Brazil, Chile, Colombia, Mexico and Peru),

[26] Recall that banks are foreign based in the model because we attempt to explain the empirical dynamics of foreign bank loans.

[27] Keeping p_L low relative to p_H allows to widen the admissible parameter ranges for c, b, B and R in the calibration process and also implies a meaningful difference between the two probabilities.

approximately equal to 19.3 percent. The other, based on the same source of data, is the gross foreign corporate bond stock to quarterly GDP of 6.3 percent.

In addition to the six equations just listed, the unknowns c, b, B, σ_G, $i = I/K^f$ and R must satisfy several inequalities[28]. Hence we choose values for those unknowns to minimize an equally-weighted average of the differences between the model-generated and empirical ratios subject to the required inequalities. Details are given in the Online Appendix.

Table 2 presents the empirical targets of the ratios alongside those in the calibrated model. The overall match is satisfactory. We get very close to the chosen targets for bank leverage and corporate bonds-to-GDP ratio. We underestimate somewhat the volume of bank loans, but importantly, they are still over twice as large in the model than bonds, as it is the case in the data. While we underestimate the bank operating costs, as discussed previously, the empirical target should be only interpreted as an upper bound for bank monitoring costs because it reflects all banks' operating costs. The one dimension in which the match is not as close is the leverage of the holding: the target is 1.71 whereas the best we can generate with the model parameters is 4.76.

[Locate Table 2 about here.]

4 Further Analysis and Implications

This section expands on the analysis of the model by exploring its calibrated version. We start with the impulse responses to a transitory fall in world interest rates in order to confirm, in particular, that the model delivers implications in line with the stylized facts on bonds and loans. The second subsection explores a model simulation after feeding into it a series of interest rate shocks recovered from the data. This exercise is intended to give us a sense

[28] Specifically, it follows from HT that, for the model to be well behaved, the parameters c, b, B and R must satisfy: $0 < \underline{A} < \bar{A} < I - I^m < I$, $b + c > B > b$. Also, the Lagrange multipliers associated with (1) and (2) must be positive. Finally, there are natural restrictions; for example, monitoring costs cannot be negative and the rate of return R should be greater than 1. Finally, for the case of log-normal distribution, the second-order condition of the holding that delivers a profit maximum is $\frac{1}{2} - \frac{\log a}{\sigma_G^2} > 0$.

of the ability of the model, when buffeted with such shocks, to yield outcomes that resemble the observed behavior of international borrowing as well as of macro aggregates. The third subsection studies implications, both for the long run and the short run, of permanent changes in structural financial parameters of the model. Finally, a last subsection compares the quantitative implications of our benchmark model with alternatives in which there is only one mode of finance. The last two subsections are offered as an exploration of the interactions between financial development, modes of finance, and macroeconomic dynamics.

4.1 Implications of Lower Interest Rates

Figure 3 describes the calibrated model's responses to a one percentage point drop in the quarterly (non-annualized) world interest rate R_t^* (solid/black lines). Lower world interest rates raise the household's stochastic discount factor and the marginal utility of consumption. As a consequence, consumption, output, and hours increase for several periods (about 20 quarters in our calibration), reflecting the persistence of the R_t^* shock.[29] Also as a consequence, households increase their demand for capital goods. This is met, in equilibrium, with both an increase in the production of new capital goods X_t and the price of capital Q_t.

[Locate Figure 3 about here.]

The dynamic responses of projects and the mix of direct and indirect finance accord with the intuition presented earlier. Higher prices for new capital give holding companies an incentive to increase production. Accordingly, the size of the typical project relative to the holding's equity, $i_t = I_t/K_t^f$, increases for several quarters. Since K_t^f is predetermined, the project size I_t itself increases on impact; afterwards it is hump shaped.

To help understand the responses of the quantities of bonds and loans, the figure reports the responses of the normalized thresholds $\bar{a}_t = \frac{\bar{A}_t}{K_t^f}$ and $\underline{a}_t = \frac{\underline{A}_t}{K_t^f}$, denoted as "a upperbar" and "a lowerbar" in the figure, respectively. From (1) we know that the response of $\bar{a}_t$ is

[29] Output does not react on impact which reflects the key property of GHH preferences, namely the lack of income effect on the supply of labor.

ambiguous, since the increase in i_t raises it but the increase of Q_t lowers it. The latter dominates in our calibration: $\bar{a}_t$ falls on impact, implying that the fraction of branches resorting to direct finance (i.e., "Category 3") increases. In contrast, $\underline{a}_t$ increases. As discussed before, this is an implication not only of higher i_t and Q_t , but also of an increase in the relative cost of bank finance, as reflected in an upward jump of the return to bank equity β_t. The latter occurs, as discussed, because bank equity is predetermined.

Both corporate bonds (CB_t) and loans (BL_t) increase on impact, although bonds increase by more, so that the CB_t/BL_t ratio goes up. The ratio increases relative to its steady state level for about a year and a half, and then undershoots. The evolution of this ratio reflects the dynamics imparted by the accumulation of profits, which leads to increases in both the holding's equity K_t^f and bank equity K_t^m. Both increase for about two years, which in turn supports more capital production and, therefore, bond financing and loan financing.[30] As a consequence, Q_t drops relatively quickly.

Over time, β_t also falls sharply, reflecting both the fall in Q_t as well as the accumulation of bank equity. The fall in β_t means that bank finance becomes more attractive; this is reflected in the fact that BL_t has a hump shaped response, while CB_t is monotonic. This also explains why the CB_t/BL_t ratio appears to be less persistent than the projects. Over time, the impact of the shock wanes, and all variables return to their steady state values.

Overall, this experiment indicates that our model can replicate the recent observed increases in both direct and indirect finance, as the economy reacts to a fall in the world interest rate. In this sense, the model rationalizes the evidence presented in the introduction. The experiment also illustrates the key role of equity accumulation and returns to equity in the adjustment process.

[30]Part of this increase can be attributed to the fact that the number of branches with access to external finance, i.e the extensive margin, increases.

4.2 A Simulation

Next we examine the predictions of the model when hit by a sequence of shocks to real interest rates akin to those observed in the data. For brevity and concreteness, we focus on the implications of a single shock, and therefore the exercise is not intended to provide a full accounting of the observed dynamics of bonds, loans, and macro aggregates. But the exercise is useful to illustrate how well the model can approximate those dynamics, at least roughly, as responses to world interest rate shocks; it also indicates periods in which one might want to allow for alternative perspectives (e.g., other shocks, commodity prices being the leading suspect).

We compute fitted residuals from an AR(1) process estimated on the real *ex ante* 10 year US bond rate plotted in Figure 2. These residuals are then fed as R_t^* shocks into the model to simulate several series. The period of the simulation goes from 3Q 2004 until 4Q 2014.[31]

The left panel of Figure 4 plots the dynamic behavior of the total amount of corporate debt implied by the model (the sum of stocks of corporate bonds CB_t and bank loans BL_t) against its empirical counterpart based on data from Figure 1. For the latter, two series are displayed: the period-wise median across the five Latin American countries (median LAC-5) and the simple aggregate of the data for these countries (LAC-5).[32] For purposes of comparison, the vertical axis measures percentage deviations from an appropriate benchmark (steady state values for the simulated series, the 3Q 2004 observed level for the data series); the benchmark is normalized to one hundred.

[Locate Figure 4 about here.]

Qualitatively, the left panel of Figure 4 shows that the process of total debt simulated by the model ($CB_t + BL_t$) tracks reasonably well much of the dynamics observed empirically.

[31] We choose 3Q 2004 as the starting point because this was the quarter in which the real US interest rate was at its long-run average, or at the "steady state level". Following that quarter it continued the long-term downward trend. Therefore, this date can be loosely treated as the beginning of the era of low interest rates.

[32] We detrend the data to make it comparable to that coming from the simulation of model, which does not exhibit growth. Detrending is done simply by removing the long run average growth rates of each of the time series, which are taken over the entire available sample, i.e., from 1996 to 2014.

In particular, the simulation captures the external credit boom in the run-up to the crisis (2007-2008) observed in the data, and then the reversal during the global crisis of 2008-2009 as well as the vigorous recovery in the years 2010-2013. On the other hand, the simulation counterfactually predicts a rise in debt already in 2004-2006; also, it predicts a contraction in debt after 2013, whereas the data exhibits only a slowdown in its growth.

The right panel of Figure 4 plots the simulated paths of CB_t and BL_t separately in order to illustrate a noteworthy prediction of the calibrated model: bond finance is relatively more volatile than bank credit, in the sense that CB_t expands more in times of low interest rates and contracts more than BL_t when debt gets more expensive. This prediction is also borne out in the data: the median ratio of the standard deviation of corporate bonds to that of bank loans across the countries in the sample is 1.1. We obtain the same ratio with the simulated data.[33]

Figure 5 zooms separately into the dynamics of the simulated series for bonds and loans against their data counterparts. The left and right panels display series for bonds and loans, respectively. The simulation for bonds displays a fall during the Lehman crisis, as well as a strong recovery in the post-crisis period; both of these agree reasonably with the data. From the trough in 2009 to peak in early 2013, the simulation captures about half of the increase in bonds observed in the data; afterwards, it predicts a considerable fall of bond finance in the last part of the sample considered (until 4Q 2014). A fall is also observed in the median Latin American series (median LAC-5), although not in the average series (LAC-5).[34]

[Locate Figure 5 about here.]

The clear miss in the bonds panel occurs before the Lehman crisis: the model predicts an increase already in 2007, in response to low interest rates; this did not materialize and, instead, bond financing remained relatively stable during this period.

[33] The model, nonetheless, generates about half of the absolute volatility in each of the two sources of finance observed empirically.

[34] The latter is explained mainly by Mexico, where there the scale of bond issuance has been large relative to other countries and continued relentlessly until the end of our sample, unlike in the other countries.

The simulation does capture, however, the increase in the other mode of finance, i.e., bank loans, that occurred since 2006 until Lehman. As can be seen in Figure 1, it was this mode of financing that accounted for bulk of the growth in external corporate debt in Latin America over that period. The simulation also captures the continued growth in bank credit that took place in the post-Lehman period, although, as with the bonds, it overshoots the retrenchment in the two last of years of the sample.

Finally, Figure 6 displays simulated series and data series for consumption (left panel) and investment (right panel). The simulated series matches the observed boom in consumption prior to the crisis in 2008-2009 and, especially, that of the post-crisis recovery. A similar assessment can be made for investment although, in this case, the model generates a boom larger than the one observed empirically during the recovery. The two panels together suggest that the observed surge in debt issuance has been channeled to the real economy, through consumption and investment, along the lines of our model. This is also qualitatively consistent with the empirically observed growth in capital accumulation reported in Caballero et al. (2016a) and Alfaro et al. (2016).

[Locate Figure 6 about here.]

Overall, the simulation illustrates the model's view of how low interest rates may help explaining the outburst of corporate external debt in emerging markets over the past decade. By mimicking much of the empirically observed dynamics of bonds, loans, and real macroeconomic aggregates it also provides some external validation for the model driven by world interest rates, despite its parsimonious nature and simplicity.

The simulation also indicates that factors other than low interest rates may have also contributed to the considerable growth in debt in these economies, particularly before the Lehman crisis. An obvious suspect is commodity prices, whose evolution in the last decade has been quite favorable for several of the countries we are concerned with.

4.3 Varying Degrees of Financial Frictions

This subsection discusses implications of varying the deep parameters of the model, especially those related to financial frictions, both for the short run and the long run. We focus on monitoring costs and the private benefit from moral hazard. As we show, changes in these parameters can generate a rebalancing from bank loans to bonds in the steady state; at the same time, they have consequences not only for financial variables, but also for real ones, and for the way in which real shocks are propagated in the economy.

4.3.1 Monitoring Costs

Suppose that monitoring costs c are one third higher than in the benchmark calibration, while all other parameters of the model are kept at their benchmark values. The corresponding steady state is reported in the second column of Table 3.

[Locate Table 3 about here.]

Intuitively, a larger c, by making monitoring more costly, should result in smaller projects, so that aggregate investment in physical capital X should go down and the price of capital Q should go up. In turn, the steady state levels of capital, output, and consumption all should go down. The table shows that all of these implications are borne out, although the magnitudes are small.

More noticeably, bank loans BL fall in the steady state. This is not surprising, since a larger monitoring cost induces not only less total borrowing, but also a switch away from bank finance. To put it in terms of our previous discussion, a larger c is associated with a lower project size i and a higher price of capital Q. Looking at (1) and (2), both i and Q have the same effect on $\bar{a}$ and $\underline{a}$, given that they affect pledgeable income in the same way. However, the higher value of c has an additional, direct effect on $\underline{a}$, reflecting that larger monitoring costs reduce pledgeable income of monitored projects. So it must be the case that, for given i, the ratio $\bar{A}/\underline{A}$ must fall.

The switch away from bank finance explains why corporate bonds, CB, increase in the steady state. This reflects the fact that the effect of more branches moving into Category 3 (direct finance) dominates the fact that each branch borrows less (since project size i falls). In contrast, the fall in BL is explained by the fall in project size, since the measure of branches moving to Category 2 (bank finance) actually increases.

To see how the model's dynamics change when c is higher, compare the impulse responses for the benchmark case (solid/black) and the counterfactual case of higher c (dotted/red) in Figure 3. In the counterfactual case, the response of the macro aggregates (C, Y, X, Q) is noticeably dampened relative to the benchmark. The intuition is that increasing the cost of monitoring puts "sand in the wheels " of the mechanism by which financial shocks translate into movements in economic activity. This is most acutely seen in the responses of aggregate investment in physical capital X_t, which increases in the counterfactual by much less relative to the benchmark, thus making the price of new capital goods Q_t go upwards by more.

The explanation for the dampening can be traced back to the responses of the holding's debt, particularly that channeled through banks. When c is higher than in the benchmark, total loans are not only lower in the new steady state (as argued before), but also their response to a drop in interest rates is less vigorous. This comes intuitively from the fact that bank credit is more costly. In contrast, the response of bond finance is stronger relative to the benchmark, increasing the bonds-to-loans ratio.

Another direct consequence of higher monitoring costs and the associated reduction of the demand for bank loans is the reduction of banks' revenue. Consequently, bank equity accumulation is relatively more sluggish than in the benchmark, which inhibits banks lending later on. This has also negative implications for equity buildup of the holding companies which, likewise, experience a relatively slower pace of equity accumulation. As a further implication, the rate of return to bank equity, β_t, adjusts much more slowly than under the benchmark.

Lastly, household income is affected by the slower equity buildup of the holding insofar as the dividends are smaller than in the benchmark, reducing the extent to which consumption rises following the shock.

4.3.2 Private benefits

Suppose now that the private benefit B associated with moral hazard is ten percent smaller relative to the benchmark. As with a higher c, a lower B favors direct finance relative to monitored finance. But there is a key difference: a lower B should result in an increase in total investment and overall debt, while a higher c implies the opposite, as we have seen.

The impact on the steady state is given in the third column of Table 3. As expected, a lower B leads to more investment, capital, output, and consumption, as well as a lower price of new capital goods in the steady state, although the magnitudes are small. Also as expected, the amount of bonds CB increases, and so does the ratio of bonds to loans, CB/BL. In this case, bank loans BL fall.

To see the differences in terms of the dynamics, compare impulse responses for the benchmark (solid/black) and the counterfactual case (dashed/blue) of lower B in Figure 3. Perhaps the most remarkable feature of the counterfactual dynamics is reflected in the evolution of the holding's debt. The quantity of bonds increases by more relative to the benchmark while the opposite occurs with bank loans. Consequently, the bonds-to-loans ratio increases more on impact (in addition to the previously discussed increase in the steady state).

On the other hand, this change in the composition of debt does not translate into a stronger increase in the reaction of the real variables (output, aggregate investment, consumption) following an interest rate shock. The reactions of real variables are about the same in the benchmark case. The intuition is that a lower B induces substitution from indirect finance to direct finance, but it does not affect the overall supply of investment by that much. This is because, with a lower B, marginal projects still involve monitored finance; and since we have assumed that only B changes, the costs of monitored finance remain about the same. Put differently, we have assumed that B falls but b remains the same, so implicitly we have also assumed that monitoring is less effective, since it still involves a reduction from B (which is smaller) to b (which remains the same).

The analysis in this subsection sheds useful light on the implications of varying financial frictions for the short run and the long run. Both higher c and lower B imply that the bonds-to-loans ratio goes up in the long run. However, the total amount of investment and foreign debt falls in the former case but increases in the latter one. Also, a higher c implies smoother responses to interest rate shocks, while a lower B does not affect macroeconomic aggregates noticeably.

While we have taken c and B as exogenous parameters, it is plausible to conjecture that they may be related to institutions, regulations, and/or policies. For instance, they may be affected by transparency in the private sector, corruption, or the rule of law. Our analysis indicates that financial policies and institutional reforms may have (or not) significant and varying implications both for the short run and the long run, depending on what specific financial parameters they affect.

Also, the analysis here raises the interesting possibility that the observed increase in bond financing relative to bank financing may reflect changes in the financial technology, as given by an increase in c or a fall in B. Such changes, in turn, would not increase the economy's sensitivity to external shocks: here the responses of investment and aggregate demand to interest rate shocks are, if anything, smoother when c is higher or B lower. This should not be too surprising in the context of our model, because holdings do take advantage of an additional margin of adjustment when facing shocks. On the other hand, this perspective provides an interpretation of the data reviewed in the introduction that is more optimistic than that of Shin (2013) and others.[35]

[35] As mentioned in a previous footnote, the perspective of Shin (2013) is largely grounded on the possibility of currency mismatches. Our model does not feature mismatches, so it is not suitable to evaluate such perspective.

4.4 Comparison against economies with a single mode of finance

Given the discussion of the previous subsection, one might ask whether the existence of an endogenous financing choice, between bank loans and corporate bonds, has significant consequences for aggregate fluctuations, and what would one lose by ignoring this choice. A natural way to address this question is to construct counterfactual economies with the same real side but in which only one mode of finance is available (details are provided in the Online Appendix), and compare them to the benchmark case which features both modes . This is the objective of this subsection. Our main finding here is that the banks, by reducing the moral hazard problems, allow more firms to obtain financing, which makes the real quantities react more strongly to aggregate shocks. When only bonds are available, the opposite is the case. We conclude that the choice of financing mode does matter for macroeconomic fluctuations.

Consider an alternative economy without banks or monitoring: the only mode of finance to which branches have access are corporate bonds. Only one cutoff, $\bar{a}$, remains and splits holdings' branches into those that are able to pursue the project by issuing bonds (Category 3) and those that cannot invest at all (Category 1). To make the economy comparable with the benchmark we assume that all relevant parameters are as before. This applies both to the parameters describing the real sector as well as to the ones of financial nature. In particular, we assume that the degree of moral hazard B is the same and so is the return on projects R and the equity dispersion parameter σ_G.

The optimal investment size and other financial aggregates change in the steady state relative to the benchmark, which is summarized in the fifth column of Table 3. The former Category 2 (monitored branches) is split between the two remaining ones, which means that both Categories 1 and 3 are larger than before. Since the size of the real economy remains constant, the same amount of new capital goods X has to be delivered by a smaller fraction of firms (new Category 3) than before (Category 2 and 3 in the benchmark). This means that the per-branch project size I has to be larger. Nevertheless, it is optimal for the holding to choose a smaller project size per unit of available holding equity $i = I/K^f$. The intuition is straightforward. In the benchmark, it was profitable for the holding to choose i relatively high, because moral hazard problems could be mitigated by banks and branches in Category 2 could still obtain investment. Now monitoring is no longer available which excludes an overly large fraction of branches from financing. It makes it therefore optimal for the holding manager to reduce i so that the remaining threshold $\bar{a}$ drops (from 8.89 to 5.57) and Category 3 expands. Since at the same time the project size I has to be actually larger than in the benchmark, the only way to achieve it is by sustaining much more equity K^f than before. Clearly, a larger project size I combined with a larger fraction of firms issuing bonds means that the total outstanding stock of bonds CB is larger than in the benchmark.

To see the consequences for aggregate fluctuations, in Figure 7 we plot the impulse response of a negative shock to the world interest rate for the economy without banks (dotted/red) and compare it with the benchmark (solid/black). The picture is qualitatively similar to that of the previous subsection's case of higher c. Overall, real macroeconomic variables respond to the same shock by less than in the benchmark, whereas the response of the price of capital Q_t is more prolonged. In an economy without banks, the corporate sector is not able to expand its projects by the same magnitude because moral hazard problems cannot be mitigated. As a consequence, some projects that could be pursued with the assistance of monitoring can no longer be pursued and the real adjustment is now more sluggish. One interesting consequence of the sharper dynamics of Q_t is that now its growth more than offsets the effect of rising i_t on the cutoff $\bar{a}_t$ at all time. As a consequence, $\bar{a}_t$ drops and Category 3 expands already on impact, which was not the case in the benchmark.

[Locate Figure 7 about here.]

Next, consider another counterfactual economy which assumes that all branches in need for external finance have to go to banks and be monitored. This creates an additional inefficiency, because some branches satisfy the incentive compatibility constraint even in the presence of benefits B, but have to be monitored anyway.[36] The calibration approach is similar as in the bonds-only economy. The key difference relative to the bonds-only economy is that now moral hazard problems are alleviated by monitoring. Also, branches rich in equity (Category 3 in the benchmark) have to be monitored despite satisfying incentive compatibility without monitoring. As a result, the holding finds it optimal to choose a much larger project size relative to available equity, as reported in the last column of Table 3. Higher i mechanically raises the only existing cutoff $\underline{a}$. As a result, the fraction of branches with access to finance is smaller than in the benchmark (3.35 percent vs. 4.73 percent), but still slightly larger than in the bonds-only economy (2.92 percent).

The dynamics of the banks-only model (dashed/blue) are noticeably different than those of the bonds-only case (dotted/red). In particular, the fact that more branches can now pursue projects translates, in the banks-only economy, into a much stronger and upfront response of aggregate investment than in the bonds-only economy.[37] As a result, the price of capital Q_t drops faster.

On the other hand, the banks-only economy and the benchmark economy imply similar responses of X_t and Q_t, and indeed of the other real macroeconomic aggregates. There are some differences on the financial side. Most noticeably, the banks-only economy differs from the benchmark in the dynamics of equity. In the benchmark, branches could amass equity at a much faster pace because more of them were active and, importantly, because by getting partly bond-financed they did not have to rely so heavily on the more costly bank credit. In opposition to that, bank equity accumulates at a faster pace in the banks-only economy than in the benchmark, as banks can extract rents from a larger fraction of branches. But this also means that bank equity is less scarce and the bank premium β_t drops faster.

The two experiments can be summarized as follows. An economy which can rely only on

[36] This can be motivated on institutional or legal grounds which result in a lack of developed bond market. We also assume that branches with equity A_t^i higher than I_t are not monitored as they don't borrow at all, only invest risklessly the superfluous funds.

[37] The dynamics of investment in banks-only economy is somewhat similar to that in the benchmark because in the latter case Category 2 is almost twice as large as Category 3.

bond-financing is significantly less volatile than the benchmark or an economy with banks only. This is because the existence of banks, by alleviating moral hazard problems, allows to accommodate more investment projects than otherwise, which leads to amplification of aggregate shocks. On the other hand, in terms of real fluctuations, the difference between the benchmark and the banks-only economy is minor.[38]

It is also instructive to put these results in a broader context. In both of the counterfactual economies studied in this subsection, leverage effects play a meaningful role. These effects have been long known to work as a financial accelerator of macroeconomic shocks, as documented in the influential papers by Carlstrom and Fuerst (1997), Bernanke et al. (1999) and Kiyotaki and Moore (1997). But our analysis here suggests that these leverage effects are quite different in the banks-only economy vis-à-vis the bonds-only economy. A fortiori, when both modes of finance are possible, the financial accelerator changes over time in response to endogenous choice of bonds versus bank loans. In particular, a separate banking sector allows to accommodate more projects than otherwise and works as an amplifier of shocks of its own kind.

5 Final Remarks

Our model offers an intuitive economic explanation of the recent dynamics of bonds and bank loans in emerging markets' data: low world interest rates increase the demand for capital goods, raise their relative price and firms' profitability; for a given level of corporate equity, this raises pledgeable income and allows for growth in both corporate bonds and bank loans stocks; at the same time, however, the return to the equity of the banking sector goes up, reflecting its scarcity and slow pace of adjustment. Hence bank finance becomes relatively

[38] It may be noticed, however, that the difference between the benchmark and the banks-only economy is less clear-cut. The first reason is that the benchmark is one in which Category 2 is almost twice as large as Category 3, so elimination of the latter category does not make a lot of difference. Secondly, the banks-only economy is deprived of an additional margin of adjustment, which is the choice between bonds an bank loans, present only in the benchmark. This margin allows holdings to choose their investment paths more efficiently.

more costly than direct finance and, accordingly, the bonds-to-loans ratio goes up.

It is not hard to see that the logic remains essentially the same if the profitability of domestic investment increases in response to other exogenous foreign shocks. A case in point is given by commodity prices, many of which increased substantially during the period of analysis, resulting in sizable gains for exporting emerging countries. In Chang et al. (2016) we explore a variant of our model which confirms that, indeed, increases in commodity prices can also help rationalize the stylized facts regarding direct and indirect finance.

For tractability, we made some strong simplifying assumptions. In particular, we assumed that the distribution of equity across investing branches is given by exogenous idiosyncratic shocks. We did so to ensure that the distribution of equity changes over time only through its first moment K_t^f. Relaxing it would be computationally hard although would allow us to understand the intertemporal interaction between the distribution of firms and their borrowing needs. Last, but not least, our current framework does not allow for the possibility of currency mismatches in corporate debt. These assumptions ought to be relaxed in future work.

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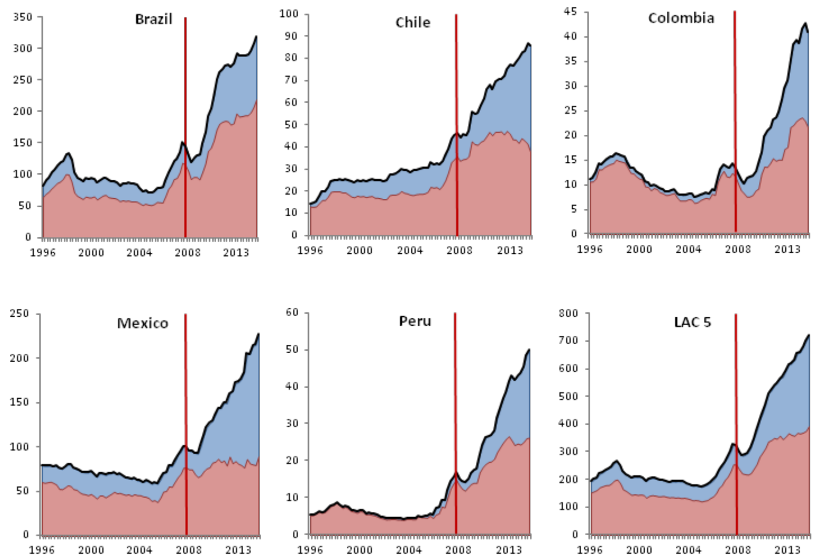
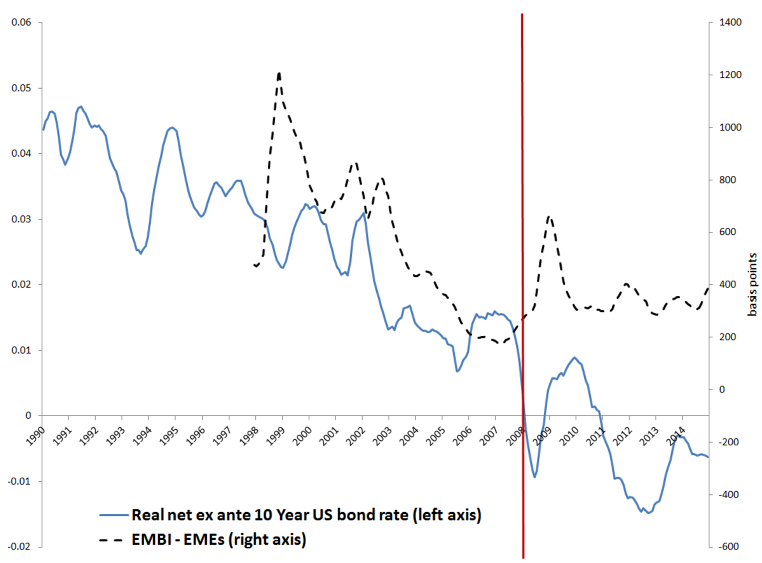
Figure 1: Stock of foreign corporate debt in Latin America.



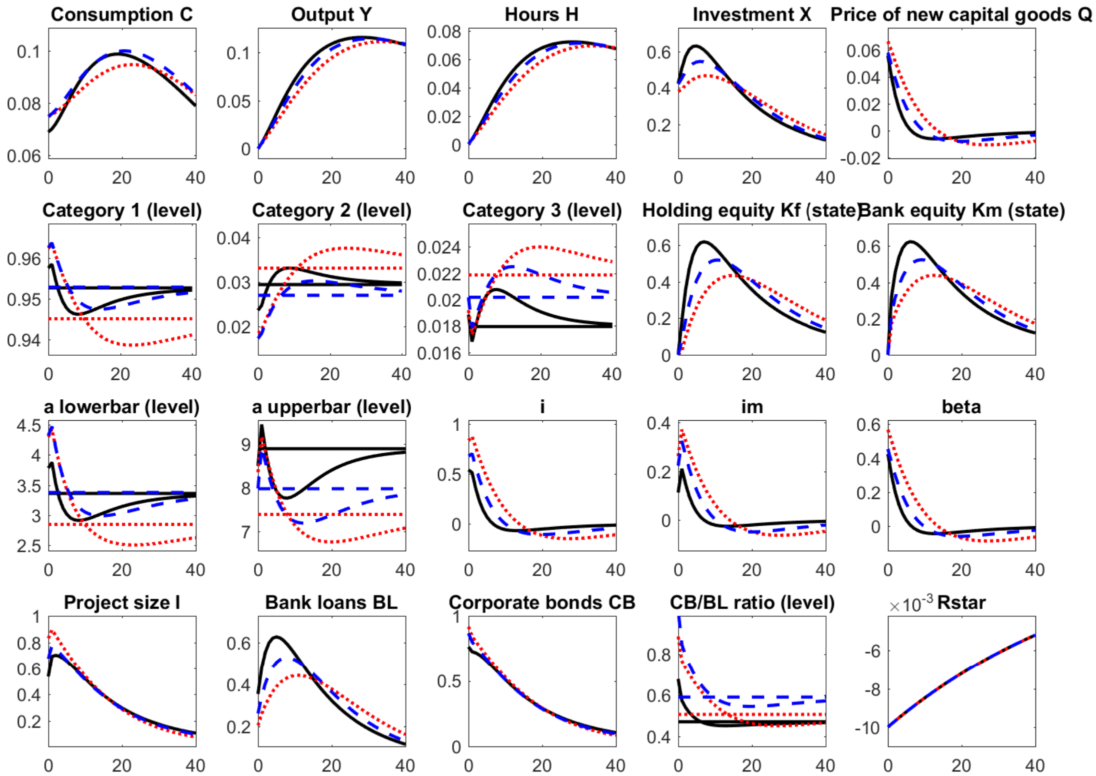
Notes: Units are billion USD. Bottom/red areas indicate the stock of outstanding bank loans and top/blue areas indicate outstanding corporate bonds, both measured on a residence basis. Vertical lines indicate the collapse of Lehman Brothers. *Sources:* Powell (2014) and BIS.

Figure 2: Global Interest rates and Risk Premia for Emerging Economies.



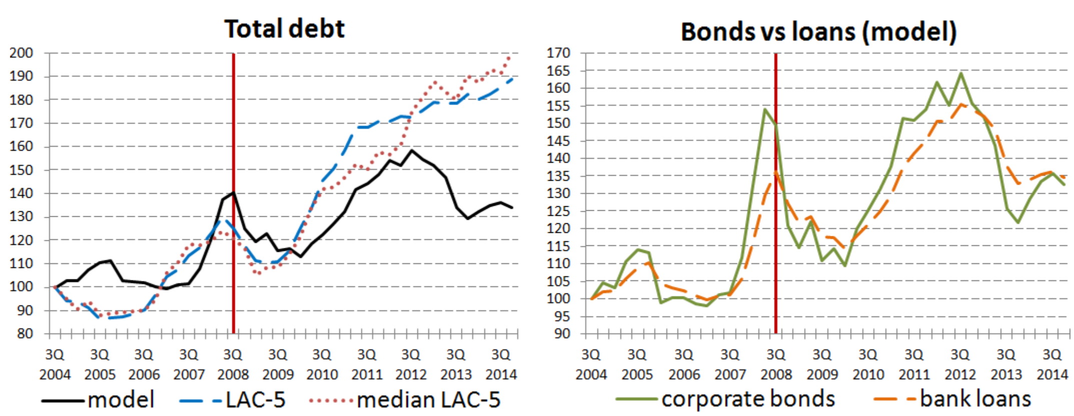
Notes: The 10 Year U.S. bond rate is deflated using the University of Michigan Consumer Survey Inflation Expectations. EMBI spread is the J.P. Morgan Emerging Markets Bond Index. Monthly series were smoothed using a 7-month moving average. Vertical line indicates the collapse of Lehman Brothers. *Sources*: Bloomberg and University of Michigan.

Figure 3: Impulse responses to one percentage point drop in quarterly R^*.



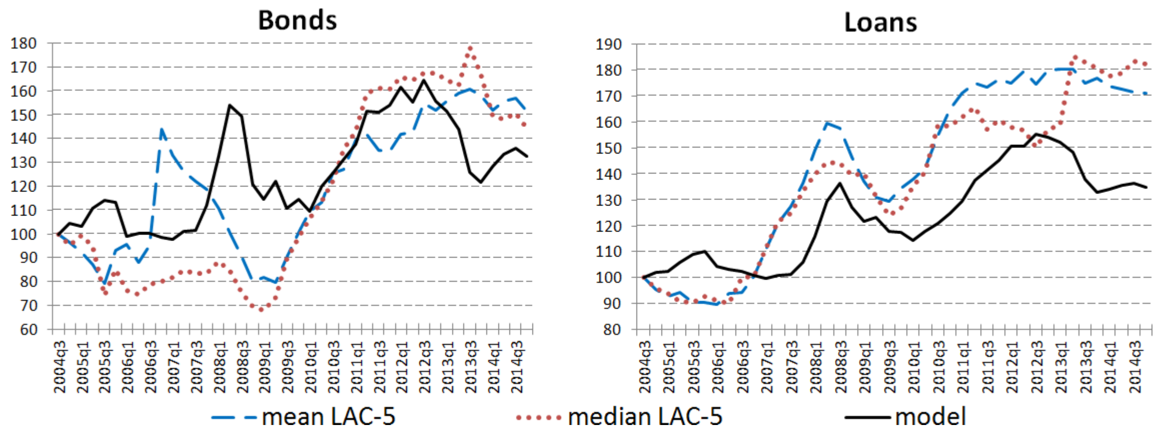
Notes: All variables plotted are percentage deviations from the non-stochastic steady state, unless indicated that they are in levels. Horizontal lines denote steady state values of the variables plotted in levels. Benchmark case is solid/black. Counterfactual with c higher by 1/3 relative to the benchmark is dotted/red. Counterfactual with B lower by 10 percent relative to the benchmark is dashed/blue.

Figure 4: Simulation of debt with R^* shocks, 3Q 2004 - 4Q 2014.



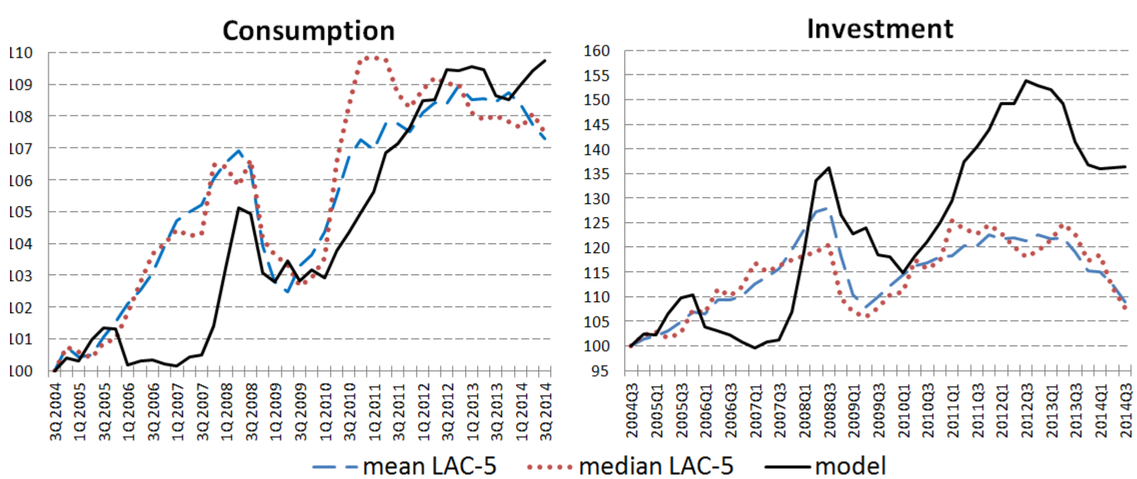
Notes: In the simulation the real interest rate shocks, proxied by fitted residuals from an AR(1) process on the real *ex ante* 10 year US bonds rate, are fed to the model. The left panel plots the total amount of corporate external debt implied by the model and compares it to the data for LAC-5 (Brazil, Chile, Colombia, Mexico and Peru). The right panel splits model-generated debt into stocks of bank loans BL_t and bonds CB_t. All series are in levels and normalized to 100 for the first period of the simulation. Vertical line indicates the collapse of Lehman Brothers. *Sources*: Powell (2014), BIS and authors' computations.

Figure 5: Simulation of bonds and loans with R^* shocks, 3Q 2004 - 4Q 2014.



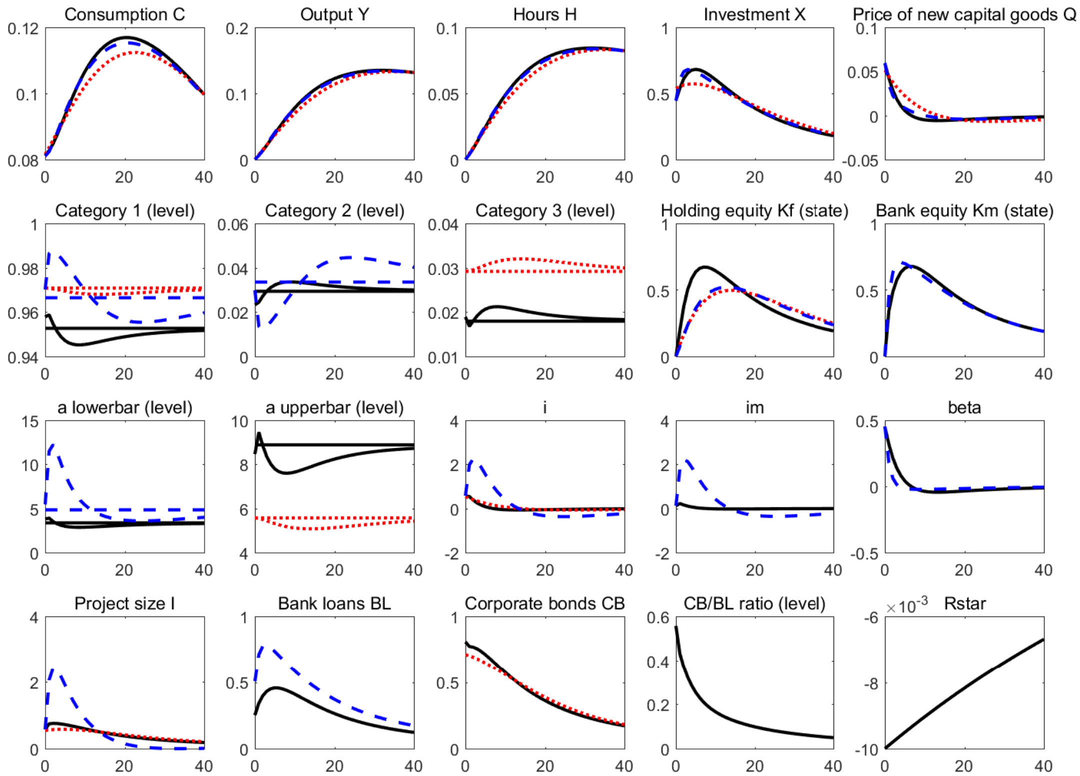
Notes: In the simulation the real interest rate shocks, proxied by fitted residuals from an AR(1) process on the real *ex ante* 10 year US bonds rate, are fed to the model. The left panel plots the total outstanding amount of corporate bonds CB_t implied by the model and compares it to the data for LAC-5 (Brazil, Chile, Colombia, Mexico and Peru). The right panel plots the corresponding series for bank loans BL_t. All series are in levels and normalized to 100 for the first period of the simulation. *Sources*: Powell (2014), BIS and authors' computations.

Figure 6: Simulation of consumption and investment with R^* shocks, 3Q 2004 - 4Q 2014.



Notes: In the simulation the real interest rate shocks, proxied by fitted residuals from an AR(1) process on the real *ex ante* 10 year US bonds rate, are fed to the model. The left panel plots the level of consumption C_t implied by the model and compares it to the data for LAC-5 (Brazil, Chile, Colombia, Mexico and Peru). The right panel plots the corresponding series for investment X_t. All series are in levels and normalized to 100 for the first period of the simulation. *Sources*: Authors' computations.

Figure 7: Impulse responses to one percentage point drop in R^* with single mode of financing.



Notes: All variables plotted are percentage deviations from the non-stochastic steady state, unless indicated that they are in levels. Horizontal lines denote the respective steady state values for the variables plotted in levels. Benchmark case is solid/black. The bonds-only economy is dotted/red. The banks-only economy is dashed/blue.

Table 1: Calibrated parameters and steady state values.

Parameter	Description	Value	Source
φ	cost of capital adjustment	4.602	Fernández and Gulan (2015)
$\tilde{\Psi}$	risk premium elasticity	0.001	Schmitt-Grohé and Uribe (2003)
β	rate of return to bank equity	1.0364	Čihák et al. (forthcoming)
ϕ^m	banks' retained earnings rate	0.9649	found endogenously
ϕ^f	holdings' retained earnings rate	0.9942	found endogenously
p_H	high probability of project success	0.99	Meh and Moran (2010)
p_L	low probability of project success	0.96	min. satisfying $\beta > \frac{p_H}{p_L}$
α	Cobb-Douglas capital share	0.32	Aguiar and Gopinath (2007)
K/Y	capital-to-quarterly output ratio	8	Kehoe and Meza (2011)
β^h	households' discount factor	0.9852	found endogenously
δ	depreciation rate	0.025	found endogenously
Z	TFP	1	normalization
H	labor time	0.33	Aguiar and Gopinath (2007)
Q	price of capital	1	normalization
X/Y	investment-to-output ratio	0.2	Data
C/Y	consumption-to-output ratio	0.746	Fernández and Gulan (2015)
R^*	foreign interest rate on HH debt	0.49%	Data (non-annualized)
τ	GHH labor parameter	1.6	Neumeyer and Perri (2005)
σ	relative risk aversion	2	Aguiar and Gopinath (2007)
ρ_{R^*}	AR(1) coeff. of R^* process	0.9837	Data (non-annualized)
σ_{R^*}	std dev. of R^* shock	0.001	Data (non-annualized)
c	monitoring cost	0.0030	found endogenously
b	small private benefit	0.0011	found endogenously
B	large private benefit	0.0031	found endogenously
σ_G	std dev. of branch equity	2.2789	found endogenously
$i = \frac{I}{K^f}$	normalized project size	92.3384	found endogenously
R	return on the project	1.0149	found endogenously

Table 2: Matched empirical financial ratios.

Condition	Model	Target	Target Source
Bank operating costs to bank assets	0.0032	0.0078	World Bank GFDD
Bank assets to bank equity	9.7639	10.6444	World Bank GFDD
Holding assets to holding equity	4.7582	1.7100	Fernández and Gulan (2015)
Gross foreign bank loans stock to GDP	11.64%	19.28%	BIS
Gross foreign corporate bond stock to GDP	5.48%	6.28%	BIS
FOC of the holding	0	0	equation (3)

Notes: For flow variables, quarterly (non-annualized) data is used. For the "FOC of the holding", 0 indicates that the equation is exactly satisfied (i.e., LHS − RHS = 0).

Table 3: Steady states of alternative model versions.

Variable	**High c**	**Low B**	**Benchmark**	**Bonds only**	**Banks only**
i	77.2777	92.3520	92.3384	57.8814	132.9360
I	3.1759	3.7098	3.6931	5.9909	5.2125
Q	1.0007	0.9998	1.0000	1.0000	1.0000
X	0.1753	0.1757	0.1756	0.1756	0.1756
K	7.0128	7.0266	7.0240	7.0240	7.0240
r^K	4.0028%	3.9994%	4.000%	4.000%	4.000%
Y	0.8772	0.8782	0.8780	0.8780	0.8780
C	0.6544	0.6645	0.6550	0.6550	0.6550
K^f	0.0411	0.0402	0.0400	0.1035	0.0392
K^m	0.0135	0.0097	0.0105	N/A	0.0166
$\bar{a}$	7.3821	7.9702	8.8869	5.5706	N/A
$\underline{a}$	2.8481	3.3763	3.3610	N/A	4.8386
Category 1	0.9450	0.9528	0.9527	0.9708	0.9665
Category 2	0.0331	0.0270	0.0294	N/A	0.0335
Category 3	0.0219	0.0202	0.0179	0.0292	N/A
CB	0.0501	0.0558	0.0481	0.2218	N/A
BL	0.0989	0.0945	0.1022	N/A	0.0995

Notes: In the "High c" case the monitoring cost parameter c is increased by 1/3 relative to the benchmark. In the "Low B" case the private benefit parameter B is reduced by 10% relative to the benchmark. Other than that, in all four alternative model versions the relevant parameters are kept unchanged relative to the benchmark and endogenous variables are allowed to adjust.