Corporate debt structure and the macroeconomy*

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Abstract

The composition of corporate borrowing between bank loans and market debt varies substantially, both across countries and over the business cycle. This paper develops a new model of firm dynamics, where firms choose both the scale and composition of their borrowing, in order to understand the aggregate implications of variation in debt structure. Banks are assumed to differ from markets in their ability to restructure debt payments when a firm is in financial distress; however, banks’ flexibility in distress comes at the expense of tougher lending standards. The steady-state of the model is consistent with key cross-sectional facts about debt composition: in particular, firms simultaneously use bank loans and market debt, and the share of bank loans in total debt is negatively related to its net worth. Over the business cycle, I show that asymmetric shocks to banks’ lending costs generate substitution from bank loans to market debt, as in the US during the 2007–2009 recession. Additionally, these shocks have magnified effects if the economy is initially more bank-reliant. For example, the recession they generate is 15–30% deeper in a version of the model calibrated to Europe than in one calibrated to the US. I then study the macroeconomic effects of corporate finance policies aimed at encouraging market debt financing by small and medium-sized firms. While these policies stimulate investment of small firms, they also induce mid-sized firms to adopt a debt structure that increases their vulnerability to financial distress.

Keywords: banks, bonds, financial structure, financial frictions, firm dynamics, output, investment, productivity risk.

JEL Classification Numbers: E22, E23, G21, G33.

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Introduction

How do financial frictions affect aggregate activity? Since the onset of the Great Recession, this question has attracted renewed attention among macroeconomists. A central hypothesis is that financial market imperfections limit firms’ ability to issue debt in order to finance investment. To formalize this mechanism, much of the macroeconomics literature on financial frictions has focused on total debt of firms, and narrowed down the analysis of financial frictions to a single borrowing constraint.

One important drawback of this approach is that it implicitly treats all debt contracts as homogeneous. Firms, however, use different types of debt to finance investment. In the US, for example, at the beginning of the Great Recession, bank loans only accounted for 27.5% of the stock of outstanding debt of non-financial corporations. Additionally, there is substantial firm-level evidence that firms’ ability to substitute between debt instruments affects their real decisions. Becker and Ivashina (forthcoming) find evidence of substitution between loans and bonds when lending standards are tight, and show that this substitution is a strong predictor of reductions in investment by small firms. Analogously, Adrian, Colla, and Shin (2012) study debt issued for investment purposes, and show that during the 2007-2009 recession, bank-dependent firms experienced a larger decline in debt issuance than firms that with access to markets. This evidence echoes previous empirical work, such as Kashyap, Lamont, and Stein (1994), who show that bank-dependent firms experience larger declines in inventory investment during recessions.

Motivated by this evidence, this paper studies the relationship between aggregate outcomes and debt heterogeneity, defined as the coexistence of different sources of funds for firms. At the aggregate level, the composition of debt varies substantially across countries – the US is the polar opposite of a country like Italy, where 65.7% of outstanding corporate debt consisted of bank loans before the Great Recession. The paper addresses three specific questions. First, what drives these differences in financial structure, and are they responsible for long-run differences in output and investment? Second, do differences in financial structure lead to different sensitivities to aggregate shocks? Third, can policy affect firms’ choices of debt structure, and if so, what are the effects on aggregate investment and output?

In order to answer these questions, I develop a macroeconomic model with heterogeneous firms in which both the scale and composition of borrowing are endogenous. Section 1 describes this model. It is the first model of firm dynamics with financial frictions to endogenize jointly the borrowing composition, investment choices, and firm growth. In this economy, firms have access to two types of debt: bank loans and market debt. Credit is constrained by the fact that firms have limited liability, and default entails deadweight losses.

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1 The remaining 72.5% are mostly accounted for by corporate bonds (63%). Data is from the Flow of Funds for 2007Q3; see online appendix for details.

2 Data for 2007Q3 from the Central Bank of Italy; see online appendix for details.
of output. The central assumption of the model is that banks and market lenders differ in their ability to deal with financial distress. Specifically, I assume that bank loans can be restructured when firms’ revenues are low, whereas market liabilities cannot be reorganized. In this sense, banks offer more flexibility than market lenders when the firm is in distress. On the other hand, outside of financial distress, bank lending is more restrictive than market lending. In the model, this difference is captured by assuming that banks have higher intermediation costs than markets. These additional costs are reflected in the equilibrium terms of lending contracts, which firms must honor outside of financial distress.

The assumption that banks are more flexible in distress than markets receives considerable support in the data. Gilson, Kose, and Lang (1990) show that, in a sample of 169 financially distressed firms, the single best predictor of restructuring success is the existence of bank loans in the firm’s debt structure. Denis and Mihov (2003), in a sample of 1560 new debt financings by 1480 public companies, show that bank debt issuances have more flexibility in the timing of borrowing and payment, and that firms with higher revenue volatility tend to issue more bank debt. Bolton and Scharfstein (1996) provide a theoretical rationale for bank flexibility, by noting that ownership of market debt tends to be more dispersed than ownership of bank debt. This creates a free-rider problem, as market creditors have little individual incentive to participate in debt renegotiations. Outside of distress, there is also substantial evidence that banks are more restrictive lenders. Rauh and Sufi (2010) document the fact that bank loans tend to be senior, secured, and associated with broader covenants that other types of debt. In the model, covenants are not explicitly introduced, but the existence of a wedge between bank and market lenders’ intermediation costs lead to more tougher terms for bank loans outside of bankruptcy.

Section 2 analyzes firms’ financial policies in the steady-state of the model. I show that the trade-off between flexibility in financial distress and costs outside of distress leads to cross-sectional predictions that are consistent with the data. Firms grow through the accumulation of retained earnings, and the model endogenously generates a distribution of firms across levels of net worth. Two main results characterize variation in the composition and scale of borrowing across this distribution. First, some firms choose to borrow simultaneously from bank and market lenders. This is a key empirical finding of Rauh and Sufi (2010), who nevertheless stress that few models of debt structure have this feature. Intuitively, simultaneous borrowing occurs in the model because issuing liabilities with market lenders may sometimes relax the bank borrowing constraint, by creating a hard claim that limits firms’ incentives to restructure bank debt too often. Second, the net worth of firms in the model is negatively related to their bank share, defined as the ratio of bank loans to total debt. I show that this is consistent with cross-sectional evidence from a number of advanced and developing countries. Because net worth in the model proxies for default probability, this result is also consistent the findings of Denis and Mihov (2003) and Rauh and Sufi (2010), who both show
that credit quality is negatively related to the bank share in their respective samples of firms. In the model, this arises because of the interaction between decreasing returns in production, and the degree of flexibility of each type of debt. Because of decreasing returns, firms have an ex-ante optimal investment scale. Firms with high net worth (or internal finance) will in general be less leveraged than firms with low net worth. High net worth firms will therefore be unlikely to face financial distress, and for them the flexibility gains associated with bank debt are of little value. In fact, the model indicates that sufficiently high net worth firms will only borrow from markets.

The remainder of the paper uses the model to study the aggregate implications of debt heterogeneity. Section 3 focuses on aggregate debt composition in the steady-state of the model. This composition only depends on structural parameters that affect the trade-off between flexibility in distress and costs outside of distress. In particular, a low lending wedge increases the aggregate bank share, by making bank borrowing relatively less constraining outside of bankruptcy. Likewise, higher idiosyncratic productivity risk increases the aggregate bank share, because it exposes firms to financial distress more frequently. By contrast, average productivity and average lending costs have no effect on aggregate debt composition. I calibrate the model using US and Italian data on idiosyncratic productivity risk and intermediation costs, and show that these two sources of exogenous variation alone can account for between one half and two thirds of the gap between the US bank share (25.5%) and the Italian bank share (65.7%). In this sense, the flexibility/cost trade-off gives a simple, yet powerful account of cross-country differences in aggregate debt structure. At the same time, the model suggests that these differences are manifestations of costly inefficiency in the intermediation of credit. For example, in the model, lowering Italian market lenders’ costs to a level comparable to the US would generate, ceteris paribus, increases in steady-state output and investment in the order of 5%.

Section 4 focuses on the response of the model to aggregate shocks. In order to understand whether differences in debt structure lead to different sensitivities to aggregate shocks, I compare the baseline US calibration of the model to a calibration which matches more closely the higher average bank share of European countries. In the US calibration, a shock that increases the cost of lending of banks relative to those of markets leads to a persistent fall in the aggregate bank share, as observed in the US since the onset of the Great Recession. This shock also generates a large and persistent fall in output, for two reasons. First, the shock increases financial costs for firms outside of distress, which results in lower borrowing and investment – a traditional intensive margin effect. Second, because the shock only affects the supply of credit and not firms’ riskiness, it induces medium-sized firms to switch to an entirely market-financed debt structure. This is optimal from the standpoint of profitability; however, these switching firms also renounce the flexibility associated with bank borrowing. The debt structure these firms adopt is effectively more fragile, as it exposes them more frequently to inefficient liquidation. As a result, market lenders charge them
high liquidation premia. This in turn has an impact on firms' investment choices. Most switching firms in fact choose to operate at a smaller scale than they did before the shock. This extensive margin effect of banking shocks on investment quantitatively accounts for roughly as much of the fall in total output than the intensive margin effect. Moreover, the same shock, in the European calibration the model, also generates a fall in output, but the fall is deeper, by 15-30%, than in the baseline US calibration. Extensive margin effects are particularly strong in the European calibration, because firms in that case have larger idiosyncratic volatility than in the baseline, so that they must drastically reduce their leverage when switching to the more fragile, market-only debt structures.

The long-run and business-cycle analysis of sections 3 and 4 point to complementary reasons for encouraging the development of alternatives to bank lending: long-run gains in aggregate investment and output, and a reduction of cyclical sensitivity to banking shocks. However, as suggested in the previous discussion, a shift toward disintermediation may have the adverse effect of pushing firms into choosing more fragile debt structures. In section 5, I use this insight to analyze the effects of two policies aimed at promoting disintermediation in Europe: German efforts to develop a bond market specifically targeted for small and medium-sized firms, and an Italian fiscal reform extending tax deductibility of interest payments to bond issues by private firms. In the model, these reforms have analogous effects: while they boost aggregate investment through their intensive margin effects on small and large firms, they also induce medium-sized firms that were previously partly bank-financed to switch entirely to market finance. As a result of their increased fragility, these firms borrow less, and their output and investment falls. The net effect of the policy on aggregate investment and output in steady-state is in general positive, but this comes at the expense of a precautionary reduction in leverage and activity of medium-sized firms.

Related literature This paper builds on the extensive literature on corporate debt structure, following the seminal contributions of Diamond (1991), Rajan (1992), Besanko and Kanatas (1993) and Bolton and Scharfstein (1996). While I do not model it explicitly, the assumption that bank and market lending differ essentially in their degree of flexibility in times of financial distress builds upon the insight of Bolton and Scharfstein (1996) that the dispersion of market creditors reduces individual incentives to renegotiate debt payments. The closest model to the one I develop in this paper is Hackbarth, Hennessy, and Leland (2007). This paper, along with most of theoretical literature on the topic, focuses on the structure of financing, given a fixed scale of investment; by contrast, in the model I propose, the scale of investment is also determined endogenously, which allows me to draw cross-sectional and aggregate implications of debt structure for output and investment.

This paper is also related to the literature on firm growth and financial frictions. My model's key
friction is limited liability, as in Cooley and Quadrini (2001), Clementi and Hopenhayn (2006) or Hennessy and Whited (2007). In particular, the connection between the firms’ optimal financial policies and their steady-state growth dynamics follows closely Cooley and Quadrini (2001). I contribute to this literature by introducing an endogenous debt structure choice, and illustrating its implications for firm growth and the distribution of firms size in steady-state.

The macroeconomic implications of debt heterogeneity have been addressed by relatively few papers. Bolton and Freixas (2006), in the context of a static model, show that, by affecting the spread of bank loans over corporate bonds, monetary policy can lower banks’ equity-capital base, in turn leading to a contraction in corporate credit. This channel is separate from the traditional “bank lending channel”, which operates through reductions in bank reserves. My model does not allow me to distinguish between causes of contractions bank lending; its focus is purely and squarely on their consequences for firm-level and aggregate investment. De Fiore and Uhlig (2011) study an asymmetric information model of bond and bank borrowing, and show that the model accounts well for long-run differences between the Euro Area and the US to the extent that information availability on corporate risk is lower in Europe. Their findings suggest a complementary channel through which productivity risk could affect the aggregate bank share, separate from that of bank flexibility which I study in this paper. My model additionally has richer cross-sectional predictions; in particular, it is consistent with the fact that firms use multiple types of debt instruments simultaneously, whereas, in their model, individual firms use a single type of liability.

Finally, this paper draws from the results of Crouzet (2013). In particular, the characterization of firms’ feasible set of debt structures, as a function of their net worth, is similar in the static setup of that paper, and the dynamic model considered here.

1 A model of debt composition

In this section, I describe a dynamic model in which heterogeneous firms interact with heterogeneous financial intermediaries. Firms have access to a decreasing returns to scale technology which takes capital as an input. Investment in capital is financed using three sources of funds: bank debt ($b_t$), market debt ($m_t$) and equity ($e_t$).\(^3\) Firms are infinitely-lived, but both bank and market debt take the form of one-period contracts.

In this economy, firm investment is constrained for two reasons. First, firms have limited liability. A firm can choose to default on its debt obligations, and this default may entail the liquidation of the firm and the transfer of its resources to its creditors. Liquidation is inefficient: it involves deadweight losses of

\(^3\)In this section, I describe a recursive competitive equilibrium of this economy in the absence of aggregate shocks; however, I use time subscripts for firm-level endogenous variables in order to emphasize the fact that firms solve a dynamic problem.
output. The second source of frictions in this economy is that firms cannot issue equity. Instead, I assume that equity is accumulated through retained earnings. Absent either friction, the firm would be able to finance investment to its optimal scale. With frictions to debt and equity issuance, the firm will, over time, accumulate equity out of retained earnings in order to fund investment through internal funds, and limit its dependence on external finance. In this sense, equity \( e_t \) also represents the net worth of the firm; I will use the two terms interchangeably.

### 1.1 Overview of firms’ problem

The productive sector is composed of a continuum of firms characterized by \( e_t \geq 0 \). All firms discount dividends using the same discount rate \( \beta \). At the beginning of period \( t \), the present discounted value of a firm with equity \( e_t \) is denoted by \( V(e_t) \). Total investment in capital is given by \( k_t = e_t + b_t + m_t \). Capital is the sole input in a decreasing returns to scale production function, and depreciates at rate \( \delta \), so that, given the firms’ current productivity \( \phi_t \), total resources after production are given by:

\[
\pi_t = \pi(\phi_t, k_t) = \phi_t k_t^\zeta + (1 - \delta)k_t,
\]

where \( 0 < \zeta < 1 \) denotes the degree of returns to scale. However, current productivity \( \phi_t \) is realized only after the firm has borrowed and invested in productive capital. I assume that \( \phi_t \) is drawn from a distribution \( F(.) \) with mean \( E(\phi) \) and standard deviation \( \sigma(\phi) \).

The terms of the borrowing contracts for \( b_t \) and \( m_t \) are given by \( R_{b,t} \) and \( R_{m,t} \). They represent the gross promised repayment from the firm to each type of entrepreneur, conditional on the firm not restructuring or being liquidated. These contract terms are agreed upon before the realization of \( \phi_t \), and cannot be indexed to \( \phi_t \). Financial intermediaries, however, observe the equity \( e_t \) of the firm as well as its borrowing from the other financial intermediary (\( m_t \) or \( b_t \)), so that lending terms will depend on \( (e_t, b_t, m_t) \). In order to alleviate notation, I omit this dependence in the exposition of the model. I come back to the assumptions governing financial intermediaries’ behavior after I discuss the firms’ problem.

Given the realization of current productivity \( \phi_t \), the firm can choose to either pay \( (R_{b,t}, R_{m,t}) \) to lenders, or try to restructure its debt; when the realization of \( \phi_t \) is sufficiently bad, it may also be liquidated. Each firm’s value, at this stage, is denoted by \( V^s(\pi_t; R_{b,t}, R_{m,t}) \).

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4The assumption that firms cannot issue equity at all is not crucial. It is sufficient to assume that equity issuance is costly for the main results of the paper to hold. This can be done by introducing a fixed marginal issuance cost of equity strictly larger than the marginal cost of lending of banks. However, the assumption of infinite equity issuance costs, effectively maintained here, allows the paper to focus on the relationship between debt composition and investment. Relative to debt and retained earnings, equity issuance accounts for a small fraction of funds used to finance investment of US firms.

5Productivity is i.i.d. across firms; in this section, it is also identically distributed over time. In section 3, I discuss the effects of time variation in \( E(\phi) \) and \( \sigma(\phi) \). Additionally, to ensure unicity of lending contracts, \( F(.) \) must have a strictly increasing hazard rate; see Crouzet (2013) for more details on this assumption.
After debt settlement, a firm with cash \( n_t \) can choose between issuing dividends and accumulating its cash as net worth for the following period. After this dividend issuance choice, only a fraction \( (1 - \eta) \) of firms survive; the rest are destroyed, and their net worth is lost.\(^6\) The value of the firm, at this stage, is denoted by \( V^c(n_t) \). The timing of firms’ problem is summarized in figure 1.

I next turn in more detail to the different stages of the firm’s problem. I discuss the model backward, starting from the determination of the dividend issuance policy of the firm.

### 1.2 Dividend issuance

Given the value of the firm in period \( t+1 \), the dividend issuance problem of a firm that was not liquidated at time \( t \) is given by:

\[
V^c(n_t) = \max_{\text{div}\tau, e_{t+1}} \text{div} + (1 - \eta)\beta V(e_{t+1}) \\
\text{s.t.} \quad \text{div} + e_{t+1} \leq n_t \\
\text{div} \geq 0
\]

(1)

Here, \( \text{div}\tau \) denotes dividends issued, \( n_t \) is the cash on hand of a continuing firm after the debt settlement stage, and \( \eta \) denotes the probability of exogenous exit.\(^7\) The dividend policy of the firm is given by the following lemma, which is analogous to results in Cooley and Quadrini (2001).

**Lemma 1 (Dividend policy)** If \( V \) is continuous on \( \mathbb{R}_+ \) and satisfies \( V(0) \geq 0 \), then \( V^c \) is continuous and strictly increasing on \( \mathbb{R}_+ \), and satisfies \( V^c(0) \geq 0 \). Moreover, if \( V \) is strictly increasing, \( V' \) is strictly decreasing except at a finite number of points, and if there exists a unique \( \bar{e} > 0 \) such that:

\[
(1 - \eta)\beta \frac{dV}{de}(\bar{e}) = 1,
\]

(2)

---

\(^6\)The assumption of exogenous exit is not necessary to guarantee the existence of a solution to each firm’s individual problem, but it guarantees the existence of a stationary distribution of firms across levels of \( e_t \). See the proof of proposition 3 for details.

\(^7\)Note that \( n_t \) depends on the realization of \( \phi_t \); I omit this to simplify notation.
then, the firm’s optimal dividend policy is given by:

\[
\hat{\text{div}}(n_t) = \begin{cases} 
0 & \text{if } 0 \leq n_t < \bar{e} \\
n_t - \bar{e} & \text{if } n_t \geq \bar{e}
\end{cases}
\]

Intuitively, if the continuation value function \( V(.) \) is concave, a firm with equity below \( \bar{e} \) will find that the marginal value of keeping its net worth in the form of retained earnings exceeds the marginal value of dividend issuance, which equals to 1.\(^8\) The firm will therefore choose the corner solution \( \text{div}_t = 0 \), and accumulate all its net worth as equity. On the other hand, a firm with net worth in excess of \( \bar{e} \) will be able to choose the interior solution \( e_{t+1} = \bar{e} \), and issue dividends. The relevant state-space of the firm’s problem is therefore \([0, \bar{e}]\).\(^9\)

1.3 Debt settlement

I now discuss the debt settlement stage. Given the realization of the firms’ productivity \( \phi_t \) and therefore its resources \( \pi_t \), the firm has three options: liquidation; debt restructuring; or full payments of its liabilities. Let \( V^L_t, V^R_t \) and \( V^P_t \) denote the respective values of liquidation, restructuring and payment to the firm, at the debt settlement stage. The firm faces the discrete choice problem:

\[
V^s(\pi_t, R_{b,t}, R_{m,t}) = \max_{L,R,P} (V^L_t, V^R_t, V^P_t).
\]

I next discuss the determination of the value of the firm under each of these three options.

Liquidation In liquidation, the firm is shut down and its resources \( \pi_t \) are seized by its creditors. I assume that the process of liquidating the firm involves a loss of resources.

Assumption 1 (Liquidation losses) The resources effectively available to be split among creditors are given by:

\[
\tilde{\pi}_t = \chi \pi_t , \quad 0 \leq \chi \leq 1.
\]

\(^8\)The properties of the value function discussed in this proposition will hold as a result of the existence of decreasing returns at the firm level. This will be formally established as part of the proof of proposition 3.

\(^9\)The key constraint in this problem is that firms are not allowed to issue equity: \( \text{div}_t \geq 0 \). This is a sufficient assumption to guarantee a non-degenerate solution to the problem. In general, following Cooley and Quadrini (2001), it is necessary that equity issuance be costly, that is, that the marginal cost of equity issuance be strictly larger than 1. Indeed, imagine that the firm were allowed to issue negative dividends at a marginal cost of 1. In that case, the firm can always achieve the interior optimum, by using the dividend policy \( \text{div}_t = n_t - \bar{e} \), even when \( \bar{e} > n_t \). All firms would then operate under identical debt structures and scales, and would only differ in the interim period, after idiosyncratic productivity has been realized.

\(^{10}\)\( V^L_t, V^R_t \) and \( V^P_t \) are functions of \( \pi_t, R_{b,t} \) and \( R_{m,t} \), but I omit this to simplify notation.
When there are strictly positive liquidation losses, $\chi < 1$, lenders charge the firm a liquidation risk premium. Absent these losses (when $\chi = 1$), if all participants are risk-neutral, lenders charge the risk-free rate, and firms can reach their ex-ante optimal size. This assumption embodies the notion that bankruptcy and liquidation may be costly processes, both in terms of time and resources devoted to bankruptcy proceedings, and in terms of changes in asset values after bankruptcies.\(^\text{11}\)

Given the resources available to creditors in the case of liquidation, I assume that the split follows a rule similar to the Absolute Priority Rule (APR) which governs chapter 7 corporate bankruptcies in the US. That is, a claim by a stakeholder to the liquidation resources $\tilde{\pi}_t$ can be activated only if all stakeholders placed higher in the priority structure have been made whole. In this model, there are three stakeholders: bank lenders; market lenders; and equityholders (the entrepreneur who owns the firm). Equityholders are residual claims, and will receive a share of the liquidation resources only if both bank lenders and market lenders have received full payment. I furthermore assume that bank lenders are senior to market lenders in the priority structure. Payoffs to stakeholders are given by:

$$
\tilde{R}_{b,t} = \min (R_{b,t}, \chi \pi_t) \quad \text{(bank lenders)}
$$

$$
\tilde{R}_{m,t} = \min (\max(0, \chi \pi_t - R_{b,t}), R_{m,t}) \quad \text{(market lenders)}
$$

$$
V_L^t = \max (0, \chi \pi_t - R_{b,t} - R_{m,t}) \quad \text{(equity holders)}
$$

In particular, note that the definition of $V_L^t$ implies that when a firm is liquidated, its entrepreneurs are left to consumer residual liquidation value, and cannot reinvest this liquidation value into future equity.

The assumption that bank lenders are senior is motivated by two considerations. First, empirically, bank loans tend to be either senior or secured by liens on firm assets, as documented by Rauh and Sufi (2010). Second, in this model, putting bank debt ahead in the priority structure improves the firm's ability to issue bank debt. Bank debt issuance is moreover efficient because it reduces liquidation losses.\(^\text{12}\)

**Restructuring** Restructuring debt is useful to both the firm and its creditors, because it offers a way to continue the project and avoid the losses that liquidation would involve. The model's key distinction between bank and market lenders relates to their ability to offer the benefits of this flexibility to the firm.

**Assumption 2 (Debt flexibility)** *Only bank debt can be restructured; market debt is not flexible.*

\(^\text{11}\)I discuss the empirical relevance of this assumption, as well as the case $\chi = 1$, in more detail in Crouzet (2013).

\(^\text{12}\)In Crouzet (2013), I show, in a static version of a similar model, that bank debt seniority is optimal, in the sense that it maximizes firm value, relative to other priority structures. This result is analogous to that obtained by Hackbarn, Hennessy, and Leland (2007). The optimality of bank seniority also obtains in other models of debt, in which banks' role is to provide ex-ante monitoring of projects, such as for example Besanko and Kanatas (1993), Park (2000) and Demarzo and Fishman (2007). The rationale for bank seniority, in these models, is that it raises banks' return on monitoring, by allowing them to seize more output in liquidation. This is distinct from the model I consider here, where seniority relaxes bank borrowing constraints.
Debt restructuring takes the form of an offer of a reduction of principal and interest payments made by the firm to the bank. Specifically, I model the restructuring process as a two-stage game between the firm and the bank. This game is summarized in figure 2. In this game, the firm moves first, and makes a repayment offer $l_t$ to the bank. The bank can choose to accept or reject the offer. In case the offer is rejected, liquidation ensues, and bank lenders and the firm receive the payoffs described above.

The optimal action of the bank is to accept the offer, if and only if it exceeds the banks’ reservation value, that is, if and only if $l_t \geq \min(R_{b,t}, \chi \pi_t)$. The value of an offer $l_t$ to the firm is therefore:

$$
\tilde{V}^R (l_t; \pi_t, R_{b,t}, R_{m,t}) = \begin{cases} 
V^c (\pi_t - l_t - R_{m,t}) & \text{if } l_t \geq \min(R_{b,t}, \chi \pi_t) \\
V^L_t & \text{if } l_t < \min(R_{b,t}, \chi \pi_t)
\end{cases}
$$

The firm chooses its restructuring offer, $l_t$, in order to maximize this value, subject to the constraint that its net resources, after the restructuring offer, must be positive:

$$
V^R_t = \max_{l_t} \tilde{V}^R (l_t; \pi_t, R_{b,t}, R_{m,t}) \quad \text{s.t. } \pi_t - l_t - R_{m,t} \geq 0 
$$

**Payment** Finally, the firm may choose to pay its creditors in full. I again impose the restriction that the firm’s outlays to creditors cannot exceed its current resources; otherwise, the firm is liquidated. The value of paying its creditors, for the firm, is therefore given by:

$$
V^P_t = \begin{cases} 
V^c (\pi_t - R_{m,t} - R_{b,t}) & \text{if } \pi_t \geq R_{b,t} + R_{m,t} \\
V^L_t & \text{if } \pi_t < R_{b,t} + R_{m,t}
\end{cases}
$$

**Debt settlement outcomes** Given values of $\pi_t$, $R_{m,t}$ and $R_{b,t}$, I refer to a solution to problem (3), subject to (4), (5) and (6) as a debt settlement outcome. The following proposition describes the optimal choices of the firm in the different types of debt settlement equilibria.

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13Formally, the solutions to problem (5) are the subgame perfect equilibria in pure strategies of the game of figure 2.
Proposition 1 (Debt settlement outcomes) Assume that $V^c(.)$ is increasing, and $V^c(0) \geq 0$. Then, there are two types of debt settlement outcomes:

- **When** $\frac{R_{b,t}}{\chi} \geq \frac{R_{m,t}}{1-\chi}$, the firm chooses to repay its creditors in full, if and only, $\pi_t \geq \frac{R_{b,t}}{\chi}$. It successfully restructures its debt, if and only if, $\frac{R_{m,t}}{1-\chi} \leq \pi_t < \frac{R_{b,t}}{\chi}$, and it is liquidated when $\pi_t < \frac{R_{m,t}}{1-\chi}$.

- **When** $\frac{R_{b,t}}{\chi} < \frac{R_{m,t}}{1-\chi}$, the firm repays its creditors in full if and only if $\pi_t \geq R_{b,t} + R_{m,t}$, and it is liquidated otherwise.

Moreover, in any successful restructuring offer, the bank obtains a payoff of $\chi \pi_t$, and in all debt settlement outcomes resulting in liquidations, $V^L_t = 0$.

**Figure 3** offers a graphical representation of the two situations. Two points worth noting. First, the firm does not necessarily exert its ability to restructure its debt. One may expect that given the ability to do so, the firm would always force a restructuring onto the bank. This is not the case, because the bank itself has bargaining power, as it can force liquidation. For restructuring to be worth the firm’s while, it must be the case that resources fall below the threshold $\frac{R_{b,t}}{\chi}$, so that the reservation value of the bank (that is, the liquidation value of the firm), $\chi \pi_t$, is sufficiently small.

Second, the option to restructure is not always sufficient to avoid liquidation. This is the case when $\frac{R_{b,t}}{\chi} < \frac{R_{m,t}}{1-\chi}$. In those cases, even if the option to restructure becomes profitable to the firm ($\pi_t < \frac{R_{b,t}}{\chi}$), the liabilities of the firm to market lenders are too large to avoid bankruptcy. This is not the case when $\frac{R_{b,t}}{\chi} \geq \frac{R_{m,t}}{1-\chi}$. In these cases, there is a region of realization of $\pi_t$ in which restructuring is preferable for the firm. Note that part of that region corresponds to ”opportunistic” restructurings, in which the firm, although it could pay in full both creditors, decides to exert its bargaining power and reduce its bank liabilities; this corresponds to cases when $R_{b,t} + R_{m,t} \leq \pi_t \leq \frac{R_{b,t}}{\chi}$.

11
Additionally, proposition 1 indicates that liquidation never involves a strictly positive payment to equityholders: at the optimal debt settlement choice, $V_L^t = 0$. This result is intuitive. Imagine indeed that $V_L^t > 0$. This is possible only if both bank and market lenders have been repayed, so that the firm’s resources must be such that $\chi \pi_t - R_{b,t} - R_{m,t} > 0$. But since $\chi \leq 1$, it is then also the case that $\pi_t - R_{b,t} - R_{m,t} \geq \chi \pi_t - R_{b,t} - R_{m,t} > 0$. The firm would therefore be better off by simply paying its creditors, instead of filing for liquidation.

Finally, note that the decision to liquidate, repay or restructure is independent of the value function of the firm. Intuitively, this is because the decision of whether to restructure or repay creditors depends on the value of each option in continuation, which is given by $V^c(.)$. Since, by lemma 1, this continuation value is increasing, the decision to restructure or repay takes the form of a simple threshold rule for $\pi_t$, or equivalently, for $\phi_t$. Analogously, because firms are liquidated whenever they have negative net worth after repayment or settlement, the liquidation decision also takes the form of a simple threshold rule. In what follows, I denote thes thresholds by $\bar{\phi}(e_t, b_t, m_t)$, for the restructuring threshold, and $\underline{\phi}(e_t, b_t, m_t)$, for the liquidation threshold.\(^{14}\)

### 1.4 Debt pricing and feasible debt structures

Given a capital structure and lending terms $R_{b,t}$ and $R_{m,t}$, the debt settlement equilibria described in proposition 1 determine gross lending return functions, conditional on the realization of the idiosyncratic productivity shocks $\phi_t$. I denote these functions by $\tilde{R}_b(\phi_t, k_t, R_{b,t}, R_{m,t})$ and $\tilde{R}_m(\phi_t, k_t, R_{b,t}, R_{m,t})$, respectively. For example, when $\frac{R_{m,t}}{\chi} \leq \frac{R_{b,t}}{1-\chi}$, the gross lending return function for market lenders is given by:

$$\tilde{R}_m(\phi_t, k_t, R_{b,t}, R_{m,t}) = \begin{cases} 
0 & \text{if } \pi_t(\phi_t, k_t) \leq \frac{R_{m,t}}{\chi} \\
R_{m,t} & \text{if } \pi_t(\phi_t, k_t) > \frac{R_{m,t}}{\chi} 
\end{cases}$$

The first case corresponds to realization of the productivity shock sufficiently low that the firm is forced into liquidation. The second case corresponds to realizations of the productivity shock such that the firm will either choose to pay its creditors in full, or will be able to successfully restructure debt payments with the bank.

Financial intermediaries are perfectly competitive, and have constant marginal lending costs $r_b$ (for banks) and $r_m$ (for markets). I come back below to the determination, in equilibrium, of these lending costs. Perfect competition implies that lenders will make zero expected profits, in equilibrium, on each loan.\(^{15}\) Therefore,

\(^{14}\)Note that these thresholds also depend on the lending terms $R_{b,t}$ and $R_{m,t}$, as indicated in proposition 1. I omit this depends because, in equilibrium, the lending terms will themselves depend only on $(e_t, b_t, m_t)$. A complete characterization of the restructuring and liquidation thresholds is given in the online appendix.

\(^{15}\)In particular, perfect competition precludes financial intermediaries from imposing tougher lending terms on certain firms
the equilibrium lending terms $R_{b,t}$ and $R_{m,t}$ must satisfy:

\[
\begin{align*}
\int_{\phi_t \geq 0} \tilde{R}_b(\phi_t, e_t + b_t + m_t, R_{b,t}, R_{m,t})dF(\phi_t) &= (1 + r_b)b_t \\
\int_{\phi_t \geq 0} \tilde{R}_m(\phi_t, e_t + b_t + m_t, R_{b,t}, R_{m,t})dF(\phi_t) &= (1 + r_m)m_t
\end{align*}
\]

(7)

I define the lending menu $S(e_t)$ as the set of all debt structures $(b_t, m_t) \in \mathbb{R}_+^2$ for which there exists a solution to (7); this is the set of feasible contracts, for a firm with equity $e_t$.\(^{16}\)

**Proposition 2** The lending menu $S(e_t)$ is non-empty and compact for all $e_t \geq 0$. Moreover, $S(e_t)$ can be partitioned into two non-empty, compact and convex subsets $S_K(e_t)$ and $S_R(e_t)$, such that:

- The lending terms $(R_{b,t}, R_{m,t})$ satisfy $\frac{R_{b,t}}{\chi} \geq \frac{R_{m,t}}{1-\chi}$, if and only if, $(b_t, m_t) \in S_R(e_t)$;
- The lending terms $(R_{b,t}, R_{m,t})$ satisfy $\frac{R_{b,t}}{\chi} < \frac{R_{m,t}}{1-\chi}$, if and only if, $(b_t, m_t) \in S_K(e_t)$.

The set $S(e_t)$ and its partition into the subsets $S_K(e_t)$ and $S_R(e_t)$ is depicted in figure 4. The first subset, $S_K(e_t)$ is made up of debt structures $(b_t, m_t)$ associated with lending terms $(R_{b,t}, R_{m,t})$ such that $\frac{R_{b,t}}{\chi} < \frac{R_{m,t}}{1-\chi}$. If a firm chooses these debt structures, following proposition 1, it will never restructure its bank liabilities once $\phi_t$ is realized. Visually, this corresponds to debt structures in the upper left part of figure 4, where borrowing from market lenders is larger than from bank lenders, and therefore restructuring in order to subsidize lending to others.

\(^{16}\)In Crouzet (2013), I show that there are at most two solutions to (7), and that one of the two solutions is strictly smaller, component-wise, than the other. Because of perfect competition in lending, in equilibrium the the contract with the tougher lending terms would not be offered to firms. This rules out multiplicity.
gains are less likely to allow the firm to avoid liquidation. As indicated in the graph, all the debt structures in that set have a ratio of bank to total liabilities of at least \( s_{K,\text{max}} \), where \( \frac{1 - s_{K,\text{max}}}{s_{K,\text{max}}} \) is the slope of the lower solid line in figure 4. On the other hand, if the firm chooses a debt structure in the second subset, \( S_R(e_t) \), it will sometimes use its restructuring option to reduce its bank liabilities and avoid liquidation. Likewise, debt structures in this subset have a ratio of bank to total liabilities of at least \( s_{R,\text{min}} \), where \( \frac{1 - s_{R,\text{min}}}{s_{R,\text{min}}} \) is the slope of the frontier of \( S_R(e_t) \) at \( b_t = 0, m_t = 0 \). The structure of the set of feasible contracts therefore reflects the intuition from proposition 1 that restructuring occurs, in equilibrium, only if bank liabilities are sufficiently large, relative to market liabilities.

Additionally, a key result of proposition 2 is that the lending menu does not depend on the value function of the firm. This follows from the results in proposition 1, which indicates that the thresholds for restructuring and liquidating are themselves independent of the value function of the firm.

### 1.5 The firm’s dynamic debt structure problem

The different elements of the firm’s problem can now be stringed together to obtain its recursive formulation:

\[
V(e_t) = \max_{(b_t, m_t) \in S(e_t)} \int_{\max(n_t^P, n_t^R) \geq 0} V^s(\pi(\phi_t, k_t), R_{b,t}, R_{m,t}) dF(\phi_t)
\]

\[
V^s(\pi(\phi_t, k_t), R_{b,t}, R_{m,t}) = V^c(\max(n_t^P, n_t^R))
\]

\[
V^c(n_t) = \max_{0 \leq e_{t+1} \leq n_t} n_t - e_{t+1} + (1 - \eta)\beta V(e_{t+1})
\]

\[
\begin{align*}
V^c(n_t) & \quad \text{(Debt settlement)} \\
V^R(n_t) & \quad \text{(Restructuring)} \\
V^P(n_t) & \quad \text{(Repayment)} \\
\end{align*}
\]

The formulation of problem (8) incorporates results from the different stages of the firm’s problem previously discussed. The debt structure chosen by the firm must be feasible \( ((b_t, m_t) \in S(e_t)) \). The expression for the value of the firm at the debt settlement stage, \( V^s(\pi(\phi_t, k_t), R_{m,t}, R_{b,t}) \), uses the results of proposition 1: between repayment and restructuring, the firm chooses the options which ensures it has the highest net worth. By restructuring, the firm can increase its net worth by \( R_{b,t} - \chi \pi(\phi_t, k_t) \), since restructuring offers always involve paying the bank its reservation value. The firm is liquidated if and only if its net worth under both restructuring and payment is strictly negative, and in this case, the payment to equityholders is zero.
\( V_t^L = 0 \), consistently with proposition 1. Finally, the continuation value of the firm is given by the current value of dividends issued plus the discounted value of future dividends, taking into account the possibility of exogenous exit after debt settlement.

### 1.6 Entry and exit

There are two sources of firm exit in this economy. The first is that some firms are endogenously liquidated at the debt settlement stage. Given that the realization of \( \phi_t \) is independent of \( e_t \), the fraction of existing firms with equity \( e_t \) that are liquidated is given by

\[
F\left( \phi\left( e_t, \hat{b}(e_t), \hat{m}(e_t) \right) \right),
\]

where \( \hat{b}(\cdot) \) and \( \hat{m}(\cdot) \) denote the policy functions associated to problem 8. On the other hand, a fraction \( \eta \) of all continuing firms exogenously exits after the debt issuance stage. Let \( \mu_t \) denote an initial arbitrary measure of firms on \([0, \bar{e}]\). The total mass of exiting firms after one period is given by:

\[
\delta^e(\mu_t) = \int_{e \in [0, \bar{e}]} d\mu_t(e_t) \left( F\left( \phi\left( e_t, \hat{b}(e_t), \hat{m}(e_t) \right) \right) + \left( 1 - F\left( \phi\left( e_t, \hat{b}(e_t), \hat{m}(e_t) \right) \right) \right) \right) \eta
\]

The fraction \( \delta^e(\mu_t) \) of exiting firms is replaced by an identical number of entering firms at the beginning of the following period. Entry involves two costs: the equity \( e^e_t \) at which entering firms start; and a fixed entry cost \( \kappa \). The surplus associated to entering at equity level \( e^e_t \) is given by \( \beta V(e^e_t) - (\kappa + e^e_t) \). There is free entry, so that the surplus associated with entering is 0 and \( e^e_t \) must solve:

\[
\beta V(e^e_t) = \kappa + e^e_t.
\] (9)

Given the entry scale, the mass of exiting firms, and the firm’s optimal policy functions along with their dividend issuance policies, the law of motion for the distribution of firm size can be expressed as:

\[
\mu_{t+1} = M(\mu_t)
\] (10)

where \( M : \mathcal{M}(\bar{e}) \to \mathcal{M}(\bar{e}) \) is a transition mapping over firm measures, and \( \mathcal{M}(\bar{e}) \) denotes the set of measures on \([0, \bar{e}]\) that are absolutely continuous with respect to the Lebesgue measure.
1.7 Financial intermediation

I conclude the exposition of the model by describing the determination of the lending costs $r_b$ and $r_m$ of financial intermediaries. Intermediaries raise funds to extend credit to firms. I assume that the opportunity cost of funds of intermediaries, $1 + r$, equals the inverse of the discount rate, $\frac{1}{\beta}$. This restriction can be thought of as a general equilibrium outcome. Indeed, it would hold in a model in which intermediaries raise deposits from a representative, risk-neutral household. In such a model, perfect competition in the market for deposits would impose that $\beta(1 + r) = 1$. Alternatively, the restriction $\beta(1 + r) = 1$ would hold if both financial intermediaries and firms had access to a risk-free technology offering a rate of a rate of return $r$.

In the model, I distinguish between this opportunity cost, which common to all lenders, and intermediation costs, which differ across lender types. I make the following assumption about intermediation costs.

**Assumption 3 (Financial intermediation costs)** Banks and market lenders face exogenous lending costs per unit of credit extended $\gamma_b$ and $\gamma_m$. The wedge between bank and market-specific intermediation costs is strictly positive: $\theta = \gamma_b - \gamma_m \geq 0$.

The fact that financial intermediation is costly is not controversial: Philippon (2012) provides recent and comprehensive that overall intermediation costs in the US financial sector have averaged approximately 2% between 1870 and 2012. The assumption specific to this model is that these intermediation costs are larger for banks than for markets. This cost spread, in the model, will be reflected in higher equilibrium lending terms of banks outside of distress, $R_{b,t}$. Thus, this assumption can be thought of as a reduced-form way of capturing the more stringent requirements imposed by banks on lenders outside of equilibrium, such as tighter loan covenants, as documented by Demiroglu and James (2010) and Rauh and Sufi (2010). The wedge in lending costs may also reflect differences in banks’ activities and regulatory environment that have an impact on their lending costs. One such difference is the fact that banks engage in costly screening and monitoring of borrowers, as documented in, for example, Berger and Udell (1995), Houston and James (1996) or Mester, Nakamura, and Renault (2007). Another difference is that banks face capital, reserve and liquidity requirements that other types of lenders do not.\(^{18}\)

Summarizing, in equilibrium, financial intermediaries’ costs are given by:

$$
r_m = r + \gamma_m, \quad r_b = r + \gamma_b, \quad r = \frac{1}{\beta} - 1.
$$

\(^{17}\)In the onlin appendix, I spell out in detail such a model. This model is notationally more burdensome, but leads to an exactly identical characterization of equilibrium.

\(^{18}\)See Santos (2001) for a review of the bank capital regulations.
1.8 Equilibrium

Definition 1 (Recursive competitive equilibrium) Given intermediation costs $\gamma_m$ and $\gamma_b$, a recursive competitive equilibrium of this economy are value functions $V$, $V^*$ and $V^c$, an upper bound on equity $\bar{e}$, policy functions $\hat{\text{div}}$, $\hat{b}$, $\hat{m}$, $\hat{\phi}$, equilibrium lending costs $r_b$ and $r_m$, and functions for equilibrium lending terms $R_b$ and $R_m$, an entry size $e^e$, a distribution of firm size $\mu$ and a transition mapping $M$ for the distribution of firm size such that:

- given $\bar{e}$, the value functions solve problem (8), and $\hat{\text{div}}$, $\hat{b}$, $\hat{m}$, $\hat{\phi}$ are the associated policies;
- given the value function $V$, the upper bound on equity $\bar{e}$ satisfies condition (2);
- equilibrium lending costs satisfy (11);
- functions for equilibrium lending terms satisfy the zero profit conditions of intermediaries (7);
- the entry scale $e^e$ satisfies the free-entry condition (9);
- the transition mapping $M$ is consistent with firms’ policies and with the entry scale of firms $e^e$;
- the distribution of firm size $\mu$ is a fixed point of $T$.

Proposition 3 (Existence of a recursive competitive equilibrium) There exists a recursive competitive equilibrium of this economy.

There are two key steps to proving proposition 3. First, one must show that problem (8) has a unique solution. In general, problem (8) is a triple fixed problem, where the value function $V(.)$, the maximum scale $\bar{e}$, and the correspondence $S(.) : [0, \bar{e}] \rightarrow [0, \bar{e}]$ must be simultaneously determined. However, an insight of the exposition of the model is that $S(.)$ can be characterized independently from $V(.)$ and $\bar{e}$, as implied by proposition 2. Thus, problem (8) can be reduced to a double fixed point problem in $\bar{e}$ and $V(.)$, analogously to Cooley and Quadrini (2001). However, unlike that paper, standard approaches do not directly apply, for two reasons. First, the fact that the problem features a discrete choice between liquidation, restructuring and repayment introduces non-convexities in the interim value function of the firm. Second, for each $e_t \in [0, \bar{e}]$, the set of feasible contracts $S(e_t)$ is not convex (a fact clearly visible in figure 4). Instead, the set of feasible contract is the union of two convex sets, $S_K(e_t)$ and $S_R(e_t)$, on which interim value functions of the firm are continuous. These difficulties can be overcome showing that problem (8) is equivalent to $V(e_t) = \max_{K,R} (V_K(e_t), V_R(e_t))$, where $V_K(e_t)$ denotes the continuation value of a firm with equity $e_t$ restricted to use debt structures that are in $S_R(e_t)$, and $V_K(e_t)$ is analogously defined. The existence of a fixed point can then be established by studying separately each of the two value functions $V_R$ and $V_K$, and the two associated constraints correspondences $e_t \rightarrow S_R(e_t)$ and $e_t \rightarrow S_K(e_t)$. Establishing

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19See the online appendix for the details of the proof.
20The characterization of the set of feasible contracts is studied in detail in Crouzet (2013); see propositions 2,4 and 10 in that paper.
monotonicity, differentiability (almost everywhere) and the existence of \( \varepsilon \) additionally requires exploiting the specific properties of these two value functions. The second step to prove proposition 3 is to use the policy functions implied by the firms’ problem, to derive the expression of the transition mapping \( M \), and show that it has a fixed point. This part of the proof also uses the insight that the firm’s problem needs to be decomposed into sub-problems with different feasible sets. This is because the probability that a firm with current equity \( e_t \) will find itself with an equity level \( e_{t+1} \) that is smaller than or equal to \( e' \) in the following period depends on the whether the current optimal debt structure of the firm is \( S_R(e_t) \) or \( S_K(e_t) \), since this determines, in particular, the likelihood with which it will be liquidated. However, given the expression for \( M \) provided in appendix, standard approaches, such as those described in Stokey, Lucas, and Prescott (1989), are sufficient to prove that \( M \) has a fixed point.\(^{21}\)

2 Financial policies in steady-state

I now turn to the cross-sectional properties of the stationary competitive equilibrium described in the previous section. The model has no closed form solution. Instead, the discussion of this section focuses on a baseline calibration of the model, summarized in table 1; however, the properties of the model discussed here hold for any calibration of the model in which the lending wedge \( \theta = \gamma_b - \gamma_m \) is strictly positive. The numerical solution procedure is standard and described in the online appendix.

2.1 A baseline calibration of the model

Wherever possible, I use existing empirical estimates of structural parameters of the model. I choose a degree of returns to scale of \( \zeta = 0.90 \). This is in line with the mean empirical estimates of Burnside (1996) for manufacturing industries.\(^{22}\) The frequency of the model is annual, and I assume that capital depreciates at a rate \( \delta = 0.10 \) per year. This value is in the range of the estimates of Epstein and Denny (1980).\(^{23}\) I set the discount rate to \( \beta = 1/1.04 \), so that the annual risk-free rate is \( r = 0.04 \), in line with the evidence in Gomme, Ravikumar, and Rupert (2011). I set the exogenous exit probability to \( \eta = 0.01 \).\(^{24}\) Finally, given

\(^{21}\)The issue of unicity never arises numerically, but I have not yet managed to establish that the sufficient conditions of monotonicity of the transition kernel developed by Stokey, Lucas, and Prescott (1989), or the weaker conditions of Hopenhayn and Prescott (1987) hold for every point in the state-space of the firm’s. They hold, however, within each of the two subsets of the state-space of the firm problem described in proposition 1.

\(^{22}\)Structural estimates of the degree of returns to scale, obtained using firm- or plant-level evidence, suggest lower values for the degree of returns to scale. For example, Cooper and Haltiwanger (2006) estimate that \( \zeta = 0.556 \), using plant-level data. A lower degree of returns to scale accentuates the concavity of the value function of entrepreneurs and tends to increase bank borrowing, but it does not alter the qualitative properties of the model.

\(^{23}\)This is somewhat higher than values obtained by matching steady-state ratios of investment to capital using aggregate data. In the context of the model, the rate of depreciation of capital governs the lower bound on firms’ output, which is equal to \( (1 - \delta)k \). A relatively high value of depreciation implies that firms’ lower bound on output is not too large, and that lending is risky for most small firms.

\(^{24}\)A necessary condition for the existence of a solution to the firm’s problem is that \( \beta(1 - \eta)(1 + r + \gamma_m) \leq 1 \). Large firms are risk-free borrowers and have a cost of debt of \( 1 + \gamma_m = 1 + r + \gamma_m \), so that the marginal value of an extra unit of equity
Parameter | Value | Parameter | Value
--- | --- | --- | ---
ζ | returns to scale | 0.900 | E(φ) | average productivity | 0.260
δ | depreciation rate | 0.100 | σ(log(φ)) | s.d. of productivity | 0.620
β | discount rate | 1/1.040 | χ | liquidation efficiency | 0.380
η | exogenous exit rate | 0.01 | γ_m | market intermediation costs | 0.010
κ | entry cost | 20.612 | γ_b | bank intermediation costs | 0.023

Table 1: Baseline calibration of the model.

all other parameters of the model, I choose the fixed entry cost κ so that the net worth of entering firms is one tenth of the average net worth of firms in the economy, as reported in Davis and Haltiwanger (1992).

I assume that idiosyncratic productivity shocks φ_t follow a Weibull distribution with location parameter λ and scale parameter ξ. I choose these parameters to match two targets. First, given values for δ, ζ and r, I choose λ and ξ so that E(φ) satisfies \( \bar{k} = \left( \frac{E(\phi) \zeta \delta + r}{\theta + r} \right)^{\frac{1}{\theta}} \). This normalization ensures that firms’ total size is smaller than or equal to \( \bar{k} \); I set \( \bar{k} = 100 \). Second, λ and ξ are also chosen to match estimates of the cross-sectional standard deviation of firm-level total factor productivity reported in the database on job flows and productivity constructed by Bartelsman, Haltiwanger, and Scarpetta (2009). These authors compute output-based measures of the dispersion of TFP across firms, for a sample of developed and developing countries. The model assumes a constant prices of goods, so that output-based measures of productivity dispersion are more directly relevant that revenue-based measures. The standard deviation for the US estimated by Bartelsman, Haltiwanger, and Scarpetta (2009), \( \text{sd}(\log(\phi)) = 0.620 \), is in line with other evidence for output-based productivity measures for the US, for example Hsieh and Klenow (2009).

The three remaining parameters are directly reflect financial intermediation costs: χ, γ_m and γ_b. Bris, Welch, and Zhu (2006) analyze a sample of 61 chapter 7 liquidations in Arizona and New York between 1995 and 2001. Their median estimate of the change in asset values pre- to post- chapter 7 liquidation is 38%. I therefore use χ = 0.38. As a proxy for market-specific lending costs γ_m, I use existing estimates of underwriting fees for corporate bond issuances. Fang (2005) studies a sample of bond issuances in the US, and finds an average underwriting fee of 0.85%, while Altinkilic and Hansen (2000), in a sample including lower-quality issuances, find an average underwriting fee of 0.85. Given this data, I set market-specific intermediation costs to γ_m = 0.0100. As discussed previously, differences between bank and market intermediation costs can arise because of several reasons: administrative costs, monitoring and screening costs, and bank-specific opportunity costs associated to capital and liquidity requirements. It is not straightforward

\[
\eta = \frac{\partial V}{\partial e} = (1 + r + \gamma_m). \]  

If \( \beta(1 - \eta)(1 + r + \gamma_m) > 1 \), these large firms will never find it optimal to issue dividends; that is, the condition of lemma 1 will never be met for any value of \( \epsilon \). When γ_m = 0, the condition \( \beta(1 - \eta)(1 + r_m) \leq 1 \) holds for any \( \eta \geq 0 \); when \( \gamma_m > 0 \), \( \eta \) must satisfy \( \eta \geq 1 - \frac{\gamma_m}{\beta(1 + r + \gamma_m)} = \frac{1}{1 + r + \gamma_m} \). The choice of \( \eta \) in the baseline calibration satisfies this condition.

25I use the Weibull distribution because it has an increasing hazard rate. This condition is sufficient to ensure unicity of lending terms. I discuss this in more details in Crouzet (2013).

26See their table III, p. 1265. This number adjusts for the value of collateralized assets that creditors may have seized outside of the formal bankruptcy proceedings.
to measure these costs from, for example, income statements of commercial banks, for two reasons. First, operating expenses of banks reflects expenses associated with a number of non-lending activities. Second, opportunity costs associated with capital or liquidity requirements are not directly incurred by the bank, and do not appear in income statements. Therefore, instead of trying to construct a direct measure of $\gamma_b$, I choose it to match the aggregate bank share of US nonfinancial corporations reported in the Flow of Funds in 2007Q3. Loans and advances from banks and bank-like institutions accounted for 27.5% of credit market liabilities of US non-financial corporations at that date. Given other parameters of the model, matching this aggregate share requires bank-specific intermediation costs of $\gamma_b = 0.0230$, or equivalently a lending wedge of $\theta = 0.0130$. Note that combining a risk-free rate of $r = 0.04$ with the values of intermediation costs $\gamma_m$ and $\gamma_b$, one arrives at a risk-free market lending rates of 5.0% and risk-free bank lending rates of 6.29%. After taking into account inflation, these align relatively well with the average Moody’s Seasoned AAA corporate bond yield between 1990 and 2007 (7.0%), and the average of the Bank Prime Loan Rate over the same period (7.29%).

2.2 Optimal debt structure

The key properties of the firm’s optimal debt structure are reported in figures 5 and 6, and summarized in the following result.

**Numerical Result 1 (The firm’s optimal debt structure)** Let $\hat{b}(e_t)$ and $\hat{m}(e_t)$ denote the policy functions associated to the solution to problem (8). There exists a unique value of equity $e^* \in [0, \bar{e}]$ such that:

- For $e_t \in [0, e^*]$, $\hat{b}(e_t) > 0$, $\hat{m}(e_t) \geq 0$, and $(\hat{b}(e_t), \hat{m}(e_t)) \in S_R(e_t)$;
- For $e_t \in [e^*, \bar{e}]$, $\hat{b}(e_t) = 0$, $\hat{m}(e_t) \geq 0$, and $(\hat{b}(e_t), \hat{m}(e_t)) \in S_K(e_t)$.

Moreover, the policy functions $\hat{b}(.)$ and $\hat{m}(.)$ are continuous on $[0, e^*]$ and $[e^*, \bar{e}]$, but piecewise continuous on $[0, \bar{e}]$.

This result first indicates that firms adopt two broad types of debt structure, as illustrated in figure 5. When a firm’s net worth is below $e^*$, it will choose a debt structure which involves both bank and market debt. On the other hand, large firms – those firms with equity levels strictly above $e^*$ – choose not to

---

27In the model, firms borrowing from banks are never entirely risk-free, so that these numbers cannot be used to directly match the lending wedge. Moreover, since lending terms are endogenous to the model and depend on firm characteristics and leverage, one cannot use observed differences in bank and market lending rates at the firm level to infer the lending wedge $\gamma_b - \gamma_m$ directly.

28The result indicates that $(\hat{b}(e_t), \hat{m}(e_t)) \in S_R(e_t)$, so the share of bank debt in that mix is bounded from below by $s_{R, \text{min}}$ (see figure 4). These firms therefore always borrow in strictly positive amounts from banks.
borrow at all from banks, but only from markets. As firms grow by accumulating equity through retained earnings, they will therefore switch from a mixed debt structure to a market-only debt structure.

The intuition for this is as follows. The trade-off between flexibility in distress and cost out of distress changes with the level of the firm’s internal resources $e_t$. Because of decreasing returns, firms with small $e_t$ tend to borrow more, relative to their internal resources, than firms with large $e_t$. But this also implies a higher probability of financial distress. Since, all other things equal, borrowing more from banks reduces the expected losses associated with financial distress, firms with small $e_t$, seeking high leverage, have a strong incentive to use bank debt. In general, one should therefore expect the composition of small firms’ debt to be more tilted towards bank debt.

This general intuition does not account for the fact that firms completely switch to market finance when $e_t \geq e^*$. To understand this, it is useful to think back to the results of proposition 1. This proposition indicates that, if a firm is sufficiently market financed, it never exerts its option to restructure bank debt when it faces financial distress. Intuitively, this occurs because even if the firm were to restructure its bank liabilities in those cases, it would not be able to extract sufficient surplus from the bank in order to honor its market liabilities. In that case, the flexibility associated with bank debt is irrelevant to the firm since, in equilibrium, the firm never uses that flexibility. But bank lending is still more restrictive outside of financial distress, since $\gamma > 0$. The net benefit of substituting a unit of bank debt for a unit of market debt, for these firms, is therefore always strictly positive. As a result, these firms choose the corner solution $\hat{b}(e_t) = 0$, $\hat{m}(e_t) > 0$. 

Figure 5: Optimal composition of debt.
Figure 6: Optimal level of bank and market debt, and total assets.

Apart from the declining bank share, the second key aspect of firms’ optimal debt choices is that they imply non-monotonicities in the investment policies of firms. This is illustrated in figure 6. In each of the two regions $e_t \leq e^*$ and $e_t > e^*$, the amounts borrowed from banks and markets are strictly increasing. However, when a firm crosses the threshold $e^*$, its total assets fall. Bank borrowing is not replaced one for one by market liabilities. This feature of the optimal debt structure is an example of the real implications of imperfect substitutability between types of debt. At the point $e_t = e^*$, the firm is exactly indifferent between a mixed debt structure, and a market-only debt structure. However, it would operate at a smaller scale (and therefore, produce on average less output) under the latter debt structure than under the former. This is because a similar level of leverage exposes the firm to a higher likelihood of liquidation if it is entirely financed through market debt, than if it is financed partially through bank borrowing. As a result, firms display a “precautionary” investment behavior, and reduce total borrowing when they switch to market lending.

The fact that firms “switch” to pure market finance when $e_t \geq e^*$ is a stark prediction of the model. One way to obtain a smoother transition of firms towards market finance would be to introduce a convex cost of market debt issuance for firms, that is sunk before productivity is realized. This cost would reduce firms’ surplus from using a purely market-financed debt structure, while not affecting the pricing of debt contracts. However, the underlying mechanisms just discussed would not disappear. In particular, sufficiently large firms would still choose a debt structure that does not allow them to successfully restructure their liabilities (formally, large enough firms choose $\left(\hat{b}(e_t), \hat{m}(e_t)\right) \in S_R(e_t)$). A threshold for switching to these debt structures would still exist, and as firms cross this threshold, firms would still reduce total borrowing, as a result of their increased fragility.

Finally, the dynamic nature of firms’ problem also has a strong influence on the choice of debt structure, as it accentuates the concavity of firms’ value functions. This concavity is particularly pronounced for small
firms. As a result, small firms borrow more from banks, and the switching threshold \( e^* \) is higher, in the dynamic version of the model than in a static version.\(^{29}\)

### 2.3 Debt structure in the cross-section

Are the model’s predictions about variation in debt structure consistent with the data? Figure 7 reports, on the left panel, the steady-state distribution of firms across levels of net worth in the model. The key property of this distribution is that it is strongly skewed to the left. This occurs both because the entry size of firms is relatively small, and because small firms are much more frequently liquidated than large firms. Because of this left-skewness, bank shares are high for most firms, and only decline for the largest firms in the economy. This is documented in the right panel of figure 7. Each point in this graph reports the median bank share of firms with a particular decile of the distribution of net worth. The bottom 70% of firms use both bank and market debt, while the top 20% use only market debt.

The cross-sectional predictions of the model receive strong support in the data. Figure 8 reports the same plot as the right panel of figure 7, for a set of publicly traded firms from different countries.\(^{30}\) Figure 7 distinguishes between OECD and non-OECD countries. In OECD countries, as in the model, the median bank share is high in the lower deciles of the net worth distribution, and rapidly declines for the top 3 deciles. The pattern for some non-OECD countries, such as Chile and Taiwan, is surprisingly close to that of OECD countries. The model thus accounts well for cross-sectional variation in debt structure in advanced economies, and certain developing economies in which market lending is well-established.

The model’s cross-sectional predictions differ from the data in two main ways. First, the overall level of

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\(^{29}\)In the online appendix, I report the composition of debt in a static version of the model with the same calibration.

\(^{30}\)The definition of net worth adopted in this graph follows closely that of the model; namely, it is measured as the difference between the book value of firms’ assets and liabilities. Details on the definition of variables are given in the online appendix.
Figure 8: Bank share and net worth in the cross-section. Each graph reports, for a particular country, the median ratio of bank loans to total firm liabilities, in each decile of the net worth distribution. For the US, data from Rauh and Sufi (2010); for other countries, data from Bureau Van Dijk. See online appendix for details on the definitions of variables.
the bank share is somewhat smaller in this calibration of the model than that in the data. Second, there seem to be too many market-financed firms, relative to the data. Both caveats can be partially addressed by allowing for firms to have persistently different average levels of productivities. Indeed, if the majority of firms in the economy have persistently lower productivity, but coexist with a minority of very productive firms, then the distribution of equity will be more skewed to the left (resulting in even fewer firms adopting a market-only debt policy), while the mix of credit to smaller firms will be more tilted toward bank debt (as a result of firms’ lower average productivities).

The model also predicts that a firm’s total assets and its bank share are negatively related, in the cross-section. In the online appendix, I report the distribution of firms across asset levels, and the associated cross-sectional link between bank share and total assets. The model predicts a downward sloping relationship between total assets and the location of the firm in the asset distribution. This relationship is also a prominent feature of the data; the appendix documents this for the same sample of firms used in the construction of figure 10.

The evidence reported in this section is consistent with previous empirical work on the cross-sectional variation of debt structure; in both the samples of Denis and Mihov (2003) and Rauh and Sufi (2010), for example, size (typically measured by total assets, rather than net worth) is negatively related to the bank share. These studies also document that credit quality negatively is the strongest empirical determinant of the choice and the composition of debt. This is consistent with the equilibrium choices of firms, in this model, in the sense that firms with smaller net worth have, ex-ante, the highest likelihood of restructuring or being liquidated. However, in the model, this link does not arise as a result of exogenous differences in risk, but rather, of endogenous choices of leverage of heterogeneous firms.

2.4 Other aspect of firms’ policies

The previous discussion indicates that the model has cross-sectional predictions on the composition of debt that align well with the data. Does this come at the expense other features of the model’s predictions for firm dynamics? Figure 9 reports other aspects of firms’ financial policies and dynamics. Besides the fact that total assets increases with internal resources (see figure 6), the model predict that (1) firms with small internal resources are generally more leveraged (top row, left panel) and (2) firms with small internal resources have a higher rate of profit, but distribute more dividends (top row, middle panel). These features of firms’ financial policies are broadly similar to the results found by Cooley and Quadrini (2001), and

31 In the online appendix, I report the liquidation probabilities implied by firms’ optimal debt policies. An interesting prediction of the model is that the very smallest firms in the steady-state distribution of firms will restructure bank debt with almost surely. For these firms, bank debt is a claim that is closely resembles equity, since it completely exposes bank lenders to small firms’ idiosyncratic productivity risk.
consistent with empirical facts on financial behavior of firms documented in, e.g., Fazzari, Hubbard, and Petersen (1988) and Gilchrist and Himmelberg (1998). On the other hand, the key aspects of firm dynamics can be summarized as follows: (1) small firms experience a higher rate of growth, either measured in terms of equity, output or total assets (top row, right graph; bottom row, left and middle graphs); (2) small firms have a higher volatility of growth (bottom row, right graph). These facts also align well with empirical evidence on the relationship between size and growth dynamics. Note that, as was the case for financial policies, the switch between financial regimes is associated with changes in the growth dynamics of firms. Namely, firms immediately to the left of the switching threshold experience negative expected growth rates, as they anticipate the fact that reaching the switching threshold will imply a reduction in the scale of their operations. The volatility of growth of firms that switch to market-only debt also increases, in line with the intuition that the debt structure adopted by these firms increases their exposure to liquidation risk.

Summarizing, in this section I showed that a baseline calibration of the model has cross-sectional predictions that are consistent with the data, both for the composition of debt, and for other aspects of firm’s

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32See for example Evans (1987), or more recently Davis, Haltiwanger, Jarmin, and Miranda (2006).
financial policies and firm growth. Additionally, I emphasized that firms in the model adopt two qualitatively different types of debt structures: when they are small, they combine bank and market lending; when they become large, they switch to market finance. Moreover, this change in debt structure has implications for firm-level investment. I now turn to the aggregate implications of the model.

3 Long-run differences in debt structure

Across countries, there is considerable variation in aggregate bank shares (defined as the fraction of the total stock of non-financial corporate debt that are bank loans). Figure 10 illustrates this for a sample of non-OECD and OECD countries, on average between 2000 and 2007.\footnote{See online appendix for details on the data used to construct this graph.} In this sample, output per capita and the aggregate bank share are negatively related; on average, the bank share is higher for non-OECD countries than for OECD countries. However, even within these two groups, there is considerable variation in the bank share. In fact, in some developing countries, such as Malaysia and Chile, banks seem to play, by this measure, a smaller role in credit intermediation than in certain developed countries.

Can the model shed light on the causes and implications of this variation? To answer this question, I start by establishing which structural parameters can account for variation in the aggregate bank share. I then ask to what extent evidence on cross-country variation in these parameters can account for observed
differences across countries, in the case of two specific countries, the US and Italy.

### 3.1 Comparative statics of the aggregate debt structure

The aggregate bank share, in the model, is given by:

$$BS = \frac{\int_{e_t \in [0, \bar{e}]} \hat{b}(e_t) d\mu(e_t)}{\int_{e_t \in [0, \bar{e}]} (\hat{b}(e_t) + \hat{m}(e_t)) d\mu(e_t)}.$$  

Variation in structural parameters of this economy always affect the composition of debt at the firm level, that is, the schedules $\hat{b}(e_t)$ and $\hat{m}(e_t)$. However, comparative statics of the model reveal that the aggregate bank share $BS$ only depends on a subset of structural parameters.

**What leaves the aggregate debt structure unchanged?** Figure 11 (1) looks at economies where mean productivity $E(\phi)$ is lower than in the baseline economy of table 1. Naturally, in these lower-productivity economies, total output is lower, as reported in the right panel of figure 11 (1).\(^{34}\) The aggregate debt structure, however, is identical to the baseline economy, as reported in the left panel. Firm-level borrowing policies, reported in figure 12 (1), help explain why this is the case. First, as the left panel of figure 12 (1) indicates, the switching threshold $e^*$ between mixed and market-only finance shifts to the left as a result of the fall in productivity. Given unchanged total borrowing, this shift should lead to a reduction in the share of bank finance; however, total borrowing by large firms also falls, as indicated in the right panel of 12 (2). In an analogous manner, economies in which the risk-free rate is lower $r$ (or equivalently, the discount factor $\beta$ is higher) have a lower total output, but an identical aggregate debt structure as the baseline economy. This is documented in figure 11 (2). At the firm-level, differences in the risk-free rate translate into qualitatively similar differences in firm-level borrowing as mean productivity, as documented in figure 12 (2). Thus, both mean productivity and the risk-free rate have scale effects on total borrowing and investment, but not composition effects on the aggregate debt structure.

**What affects the aggregate debt structure?** The left panel of figure 11 (3) plots the aggregate bank share in economies where productivity dispersion is larger than in the baseline calibration. Greater productivity dispersion is associated with a higher aggregate bank share. Economies with higher productivity differ from the baseline in two main ways. First, among firms that choose a mixed debt structure, the amount of bank borrowing is higher.\(^{35}\) This is higher productivity dispersion increases the likelihood of financial

\(^{34}\)Aggregate output, in the steady-state of the model, is defined as $Y = \int_{\phi \geq 0, e_t \in [0, \bar{e}]} \phi_t(e_t + \hat{b}(e_t) + \hat{m}(e_t)) \zeta d\mu(e_t) dF(\phi_t) = E(\phi) \int_{e_t \in [0, \bar{e}]} (e_t + \hat{b}(e_t) + \hat{m}(e_t)) \zeta d\mu(e_t)$.

\(^{35}\)The average bank share, among firms that use a mixed debt structure, is 45% in the baseline economy, and 49% in the high-dispersion economy depicted in figure 12 (3).
Figure 11: Comparative statics for aggregate bank share and aggregate output. The left column reports the ratio BS. The right column reports aggregate output $Y$ in different calibrations, expressed as a percentage of the baseline calibration reported in table 1. The grey point in each graph corresponds to that baseline calibration. Each line corresponds to a particular comparative static exercise; see text for details.
Figure 12: Differences in firm-level borrowing policies. The left column reports firms’ optimal composition of debt, and the right column reports firms’ optimal total borrowing. The grey lines correspond to the baseline calibration reported in table 1. The black lines correspond to alternative calibrations, among those reported in the comparative statics of figure 11.
distress, and makes bank borrowing a more attractive mode of financing for firms. The average liquidation probability in higher dispersion economies is indeed higher than in the baseline. Second, there are more firms using a mixed debt structure. This is because, as liquidation is more frequent, the steady-state distribution has of firm size has more mass to the left, and fewer firms reach the maximum size $\bar{e}$. Note that aggregate output is also lower in high-dispersion economies. Figure 12 (4) indicates that this reflects lower borrowing by small medium-sized firms, which display the highest degree of risk aversion. Borrowing policies of large firms, relative to the baseline, are almost unchanged.

Differences in the lending wedge $\theta = \gamma_b - \gamma_m$ also generate differences in BS. In figure 11 (4), I compare economies with identical bank intermediation costs $\gamma_b$ but higher market intermediation costs $\gamma_m$. This experiment can be thought of as reducing the efficiency of market lending, or tightening market lending requirements outside of financial distress. This increases the aggregate bank share. Interestingly, the resulting change in aggregate debt composition arises because more medium-sized firms choose to adopt a mixed debt structure, and not so much because existing firms borrow relatively more from markets, as the borrowing policies of figure 12 (4) indicate. Economies with high market intermediation costs $\gamma_m$ also have lower aggregate output. This occurs in large part because the scale of firms is smaller in such an economy, as indicated by figure 12 (4).

Finally, differences in liquidation efficiency $\chi$ also generates variation in BS, as reported in figure 11 (5). This effect is best understood by looking directly at differences in firm-level borrowing (figure 12 (5)). With a higher liquidation efficiency, more medium-sized firms choose to use market-only debt (the threshold for switching is smaller, as documented in the left panel). At the same time, firms using a mixed debt structure borrow more, and more of it comes from banks. This is because, with a higher liquidation efficiency, banks' restructuring payoff ($\chi\pi_t$) is larger, which relaxes bank lending terms outside of financial distress. Because the bulk of firms in the model are small, their increased borrowing and investment translates into higher output, as depicted in the right panel of figure 11 (5).

These aggregate comparative statics also suggest that, apart from their effects on BS, the two key financial frictions of the model – liquidation costs and the lending wedge – have large effects on aggregate output. A 10% increase in liquidation efficiency, for example, leads to an increase in aggregate output of 9.1%. Policies that alleviate these frictions can therefore lead to large output gains. I come back to this issue in section 5.

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36 Between the two economies represented in figure 12 (3), the fraction of firms using a mixed debt structure is 69% in the baseline economy, and 74% in the high-dispersion economy.
3.2 A quantitative example: the US and Italy

In the model, the aggregate bank share only with specific structural parameters, namely those that affect the trade-off between flexibility in distress and cost outside of distress: idiosyncratic productivity risk \( \sigma(\phi) \), the intermediation wedge \( \theta \) and liquidation efficiency \( \chi \). Can these parameters alone account well for observed differences in aggregate debt structures across countries? To answer this question, I study the case of two specific countries: Italy and the US. Italy is of particular interest because, among OECD economies, it is one of the most bank-oriented economies. In 2007Q3, bank loans accounted for 65.7% of financial liabilities of Italian non-financial corporations, a high number, even among European countries.\(^{37}\)

To evaluate the potential contribution of \( \sigma(\phi) \), \( \theta \) and \( \chi \) to the differences between Italy and the US, I compute the aggregate bank share, along with aggregate output and the aggregate debt/asset ratio, under alternative values of each of these three parameters. Results of these alternative calibrations, along with the corresponding moments in the data, and in the baseline calibration, are reported in table 2.

<table>
<thead>
<tr>
<th>Bank share</th>
<th>Debt/Assets</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data (US)</td>
<td>27.5%</td>
<td>71.9%</td>
</tr>
<tr>
<td>Data (Italy)</td>
<td>65.7%</td>
<td>56.3%</td>
</tr>
<tr>
<td>Baseline calibration (US)</td>
<td>27.5%</td>
<td>83.7%</td>
</tr>
<tr>
<td>Alternative calibrations (Italy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High market intermediation costs ( \gamma_{b,US} )</td>
<td>32.4%</td>
<td>83.1%</td>
</tr>
<tr>
<td>High productivity dispersion ( \sigma = 1.14\sigma_{US} )</td>
<td>32.8%</td>
<td>82.6%</td>
</tr>
<tr>
<td>High market intermediation costs ( \gamma_{b,US} )</td>
<td>36.8%</td>
<td>82.1%</td>
</tr>
<tr>
<td>High productivity dispersion ( \sigma = 1.30\sigma_{US} )</td>
<td>37.5%</td>
<td>80.7%</td>
</tr>
<tr>
<td>High liquidation efficiency ( \chi = 0.75 )</td>
<td>34.8%</td>
<td>86.2%</td>
</tr>
<tr>
<td>High productivity dispersion and high market costs ( \gamma_{b,US} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \gamma_{m,US} = 0.016, \sigma_{IT} = 1.14\sigma_{US} )</td>
<td>47.6%</td>
<td>78.3%</td>
</tr>
<tr>
<td>( \gamma_{m,US} = 0.016, \sigma_{IT} = 1.30\sigma_{US} )</td>
<td>52.1%</td>
<td>76.2%</td>
</tr>
</tbody>
</table>

Table 2: Sources of differences in debt structure between US and Italy. Output is expressed relative to US output; data is output-side real GDP at current PPPs for 2007, from World Penn Tables. Data for the ratio of debt to assets in the US are obtained from the Flow of Funds release Z.1, table L.102, and from Bank of Italy (2008) for Italy.

The bottom panel of table 2 focuses on alternative calibrations. The first lines of the panel focus on calibrations in which bank intermediation costs are identical to the US (\( \gamma_{b,US} \)), but market intermediation costs are higher than in the US. The lending wedge \( \theta_{IT} \) is therefore lower. This is motivated by the following evidence. First, OECD data on income statements of Italian and US banks indicates that, in 2007, the ratio of their total income to total expenses were close (12.3% for Italy and 13.8% for the

\(^{37}\)See Bank of Italy (2008).
US). This suggests that bank-specific intermediation costs in the two countries could be similar. For market lending costs, no direct evidence is available on Italian underwriting costs. However, Santos and Tsatsaronis (2003) estimate that the average difference in underwriting fees between the Euro-area and the US, between 1996 and 2001, stood at 56bps. This motivates choosing higher values for \( \gamma_{b,IT} \). I first set \( \gamma_{m,IT} = 0.006 + \gamma_{m,US} = 0.016 \), resulting in a lending wedge of \( \theta_{IT} = 0.010 \). In that alternative calibration, the bank share rises to 32.4%. I also consider the limit case in which market intermediation costs are as large as banks': \( \gamma_{m,IT} = \gamma_{b,IT} \). In that case, the bank share rises to 36.8%. In those calibrations, consistently with the data, both the Italian debt to assets ratio and output are smaller than in the baseline (US) calibration.

The following lines of table 2 looks at whether productivity dispersion can account for differences in the aggregate bank share between the US and Italy. The US calibration uses direct evidence on the dispersion of quantity-based total factor productivity to calibrate the standard deviation of log productivity, \( \sigma_{US} \). Direct measures of these quantities for Italy are not available. Michelacci and Schivardi (2013) estimate proxies for idiosyncratic business risk across a panel of countries, using data on firm-level stock price volatility; Italian idiosyncratic business risk is, according to this measure, 14% larger than the US’s. Accordingly, I first look at a calibration in which productivity dispersion in Italy is 14% larger than in the US; this increases the bank share to 32.0%. I also look at a more dramatic case, under which productivity dispersion in Italy is 30% higher, approximately corresponding to measured differences between China and the US in Hsieh and Klenow (2009). In that case, the bank share increases to 32.8%.

A higher liquidation efficiency in Italy could also account for the different aggregate bank shares. Accordingly, table 2 looks at a calibration with a liquidation efficiency of \( \chi = 0.75 \). This calibration leads to two counterfactual predictions: first, output increases relative to the baseline calibration; second, the ratio of debt to assets increase, as the main friction impeding borrowing increases. By contrast, Italy’s output per capita and aggregate debt to asset ratios are smaller than that of the US.

The last lines of table 2 looks at the combined effects of high productivity dispersion (\( \sigma_{IT} = 1.14\sigma_{US} \)) and high market lending costs (\( \gamma_{m,IT} = 0.016 \)). Together, these parameter values lead to an aggregate bank share of 47.6%. This calibration accounts for 20.1% out of the 38.0%, or roughly half, of the difference between the bank shares of the US and Italy. I also look at a calibration in \( \gamma_{m,IT} = 0.016 \) and \( \sigma_{IT} = 1.30\sigma_{US} \). This calibration can be viewed as an upper bound on the joint effects of productivity dispersion and the lending wedge on the aggregate bank share. This calibration leads to an aggregate bank share of 52.1%.

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38 As emphasized before, operating expenses do not only reflect monitoring and screening costs, as they include expenses associated with other, e.g. fee-based, activities of banks. However, for the underlying level of \( \gamma_b \) to be substantially different from the US’s, given similar operating expenses, the allocation of banks’ expenses would need to be substantially different.

39 See their table 3.

40 See table 2 of their online appendix.

41 Moreover, even the substantial difference in liquidation efficiency considered here only increases the bank share to 36.8%.
accounting for two thirds of the gap between the US and Italy. Both calibrations are also consistent with a lower debt to assets ratio and lower output per capita in Italy than in the US. Overall, these results indicate that productivity risk and lending wedge differentials, alone, can account for between one half and two thirds of the US-Italy difference in aggregate debt structure.

The results of this section suggest that long-run differences in countries’ debt structures are closely linked to cross-country variation in parameters associated with financial frictions (intermediation costs $\gamma_b$ and $\gamma_m$, liquidation losses $\chi$), or parameters that amplify their effects (productivity dispersion $\sigma (\log(\phi))$). Because of this, changes in debt structure can be associated with large gains in output: lowering market-specific intermediation costs, in Italy, to levels comparable to those of the US, would lead to long-run output gains of 4.7% ($= \frac{78.6}{78.1} - 1$). In this sense, the model indicates that cross-country differences in aggregate debt structure are manifestations of potential long-run inefficiencies in financial intermediation.

4 Aggregate shocks and the corporate debt structure

I now turn to the business-cycle implications of the cross-country differences in aggregate debt structure analyzed in the previous section. The central finding of this section is these differences also lead to different sensitivities to aggregate shocks. For most of the section, I center the discussion on shocks to the lending wedge $\theta$, which I argue offer the best account of observed changes in debt structure in the US since the onset of the Great Recession, from the standpoint of the model. I come back to other aggregate shocks at the end of the section.

4.1 A shock to the lending wedge

The US 2007-2009 recession was accompanied by large and persistent changes in debt structure, both at the aggregate and firm level. Figure 13 documents these changes. First, the aggregate US bank share fell substantially during the course of the crisis, from 27.5% in 2007Q3 to 19.5% in 2009Q2 (left panel). The pivotal moment is 2008Q3, indicated by a dotted line on the graph. Second, debt structure changes of small firms were different from those of large firms. The middle panel of figure 13 focuses on small firms. It shows the percentage change, from 2008Q3, in total bank and non-bank liabilities, for the subset of US firms with less than $1bn in assets, among the firms whose balance sheets are documented in the Quarterly Financial Report of manufacturing firms.\footnote{See online appendix for details on the QFR data.} Each series is scaled so their sum is equal to the change in total borrowing relative to 2008Q3. Both bank and non-bank borrowing by small firms in this sample fell through the crisis.
The right panel of figure 13 shows that this pattern did not hold for larger firms, those with more than $1bn in the sample. The reduction of these firms’ bank liabilities was accompanied by an increase in non-bank liabilities, so that their total borrowing did not change substantially.\(^{43}\)

In the model, these patterns emerge naturally in response to a shock to the lending wedge $\theta$.\(^{14}\) To illustrate this, I compute the perfect foresight response of the model to an exogenous increase in the lending wedge, driven by an increase in bank lending costs $\gamma_b$. The economy starts from the steady-state described in section 1. In the model, an increase in the lending wedge leads to a fall in the aggregate bank share; I choose the path of the lending wedge to match, quantitatively, the fall in the aggregate bank share documented in figure 13. The path of the aggregate bank share, and the implied path of the lending wedge, are reported on the left column of figure 14.\(^{45}\)

**The response of aggregate variables** The response of output and investment to the increase in the lending wedge are reported in the bottom row of figure 13. The shock generates a permanent fall in both output and investment. Aside from the permanent fall in the bank share, the permanent increase in $\theta$ cause output to fall by 3.9\% and investment to fall by 24.7\% in the first three years. This fall continues even after the lending wedge, $\theta$, has reached its new long-run value. Investment starts recovering at that point. However, both output and investment, in the long-run, are below their year 0 levels.\(^{46}\) The recession generated by this shock is thus large, and the responses of output and investment display endogenous persistence.

\(^{43}\)The patterns documented here echo other evidence on the 2007-2009 recession, most notably, Adrian, Colla, and Shin (2012). They are also consistent with evidence from other periods or other countries on the effects of shocks to the supply of bank credit on debt composition, such as Becker and Ivashina (2013) and Baumann, Hoggarth, and Pain (2003).

\(^{14}\)Below, I argue that from the standpoint of the model, recessions accompanied by the patterns documented in figure 13 are in fact characteristic of lending wedge shocks, in the sense that no other single aggregate shocks generates response consistent with these patterns.

\(^{45}\)Agents in the economy learn about the future path of the lending wedge at year 1; in year 0, the economy is at the steady-state. The computational details are reported in the online appendix.

\(^{46}\)In the new long-run steady-state, output is 10.1\%, and investment 11.3\%, below the year 0 steady-state.
The response of small and large firms

The increase in lending costs additionally has effects on firm-level debt structures that are in line with the patterns reported in figure 13. To maintain comparability with that figure, where “small” and “large” firms are defined, respectively, as those with less and more than $250m, I construct the “small” and “large” firms of the model as follows. I first determine a cutoff for equity, \( e_{S/L} \), such that, in year 0, firms with equity less than \( e_{S/L} \) account for 20% of total assets. At each period \( t \), I define borrowing by small and large firms, in bank and non-bank credit, as:

\[
BS_t = \int_{0 \leq e_t \leq e_{S/L}} \hat{b}_t(e_t)d\mu_t(e_t) \quad , \quad MS_t = \int_{0 \leq e_t \leq e_{S/L}} \hat{m}_t(e_t)d\mu_t(e_t) ;
\]

\[
BL_t = \int_{e_{S/L} \leq e_t \leq \bar{e}_t} \hat{b}_t(e_t)d\mu_t(e_t) \quad , \quad ML_t = \int_{e_{S/L} \leq e_t \leq \bar{e}_t} \hat{m}_t(e_t)d\mu_t(e_t) ;
\]

where, along the perfect foresight path, \( \hat{b}_t(.) \), \( \hat{m}_t(.) \) and \( \bar{e}_t \) characterize firms’ policies, and \( \mu_t \) is the distribution of firms across equity levels. This definition is analogous to that of the data because it uses fixed
cut-offs on successive cross-sections to characterize the small and large firm groups. The top row of reports the changes in $BS_t$, $MS_t$, $BL_t$ and $ML_t$. In the first 5 years, the response of these two groups of firms is qualitatively consistent with the data. Both market and bank debt falls for “small” firms; “large” firms, however, substitute market debt for bank debt. One potential issue with this interpretation of the impulse response of the model is that the firms that make up the small and large groups are not the same, over time, so that changes in the composition of debt may reflect shifting across size groups, and not only composition changes within groups. In appendix, I use policy functions along the initial path to generate a large panel of firms. I show that using initial size and debt structure to distinguish small and large groups, patterns of debt substitution are actually more persistent than those illustrated in figure 13.

**Decomposing the response of the economy to the increase in the lending wedge** In order to understand the effects of the increase in the lending wedge, it is useful to first think of the short-run response of the economy, because the distribution of firms across equity levels does not move much in the short run. Figure 15 illustrates the two key mechanisms through which the shock affects firms’ scale (and therefore output). The first mechanism is straightforward: the increase in the lending wedge tightens the term of bank lending contracts outside of financial distress, and thus makes bank lending less attractive for mixed-finance firms. This leads to a reduction in bank borrowing, which reduces firms’ scale, as illustrated on the left panel of figure 15. The model makes two more subtle predictions about this intensive margin effect. First, for mixed-debt firms, the increase in the lending wedge actually leads to a fall in market borrowing. The complementarity between bank and market debt, for mixed-debt firms, intuitively comes from the fact that issuing market liabilities, for the firm, is partly a way of relaxing its bank borrowing constraint. This is because issuing “hard” claims that cannot be restructured in distress acts somewhat like a commitment device, as it limits the incentives for the firm to enter restructuring too often. The fall in market debt is consistent with the data reported in figure 13 for small firms. The second additional prediction of the model about intensive margin effects is that, although firms with $e_t \geq e^*$ are not directly affected by the increase in the lending wedge (since, initially, these firms do not borrow from banks, and only the intermediation cost of bank $\gamma_b$ increases), they still somewhat reduce their borrowing from markets. Larger firms anticipate the fact that, given a sufficiently bad sequence of shocks $\phi_t$, they will have to revert to mixed debt structures and face the tighter lending terms of banks. They seek to avoid this by reducing their leverage and thus the volatility of their profits.

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47 Qualitative results on the borrowing of these aggregate “small” and “large” firms are similar if one uses a cutoff for assets, instead of equity. Because of the non-monotonicity of assets in equity, figures total borrowing $BS_t$, $MS_t$, $BL_t$ and $ML_t$ are however less precisely approximated.

48 These growth rates are weighted by their shares of total borrowing at year 0, so that they add up to the change in total borrowing, as in figure 13.
The second mechanism through which the increase in the lending wedge affects output and investment is that it affects the equity threshold $e^*$ at which firms switch to a purely market-financed debt structure. This is illustrated in the right panel of figure 15. This threshold shifts to the right, because the lending wedge directly affects the costs of using a mixed debt-structure relative to a pure market debt structure. Thus, all firms between the pre- and post-shock threshold switch to market finance. As discussed in section 2, this switch has real effects: it affects the scale at which these firms choose to operate. This occurs because these firms loose the flexibility associated with bank finance, and become more exposed to liquidation risk. Put differently, these firms would face excessively high liquidation premia, under a pure market debt structure, in order to continue operating at the same scale. This extensive margin effect is quantitatively large: it accounts for roughly half of the total response of output to the shock. It is this mechanism which is behind most of the increase in market lending of small firms documented in figure 12.

This helps understand the short-run response of the economy to the shock. In the long-run, the shock has protracted effects on firms’ net worth, both because lending terms of banks worsen, and because this induces firms to leverage less. As a result, the steady-state distribution of firm size shifts to the left: in the long run, the median size of firms in the economy falls. The slow adjustment of firms’ net worth in the new environment of tougher lending bank lending standards is what drive the long-run response of output and investment, since, after the lending wedge has stabilized to a new, higher level, the threshold $e^*$ does not change.
4.2 A counterfactual experiment

The recession triggered by an increase in the lending wedge is large, and deepens even after the lending wedge has stabilized to higher levels. A natural question is whether varying in the lending wedge has similar effects when the initial debt structure of the economy is different. That is, do differences in debt structure alter or amplify the response to shocks?

To answer this question, I compute the response of an initially more bank-dependent economy to the increase in the lending wedge depicted in figure 14. The initial calibration of the alternative economy differs from the US calibration of section 1 in two ways: intermediation costs of market lenders are larger ($\gamma_m' = 0.016$, instead of $\gamma_m = 0.010$), and firm-level dispersion of productivity is larger ($\sigma(\phi)' = 1.08\sigma(\phi)$). These two differences imply that the model, in steady-state, has an aggregate bank share of 40.3%, in line with the EU average in the sample of firms analyzed in sections 2 and 3. I refer to this as the European calibration of the model.

Figure 16 reports the response of the aggregate bank share and of output in this alternative economy. The increase in the lending wedge, in that economy, cause the aggregate bank share to fall, roughly by the same amount than in the baseline US calibration. However, the fall in output in the European calibration of the model is substantially larger than in the US calibration. Following the discussion of the effects of the shock in the US version of the model, the response of output can be understood as the combination of an intensive and an extensive margin effect. Both effects are larger in this counterfactual experiment. In this European calibration, the threshold $e^*$ at which firms switch to market finance is higher than in the baseline calibration. More firms therefore experience the intensive margin response, but at the firm level this response has quantitatively similar effects as in the baseline calibration. The extensive margin response, however, is magnified. The extensive margin effect in general arises because firms’ liquidation premia increase when they
switch to market finance. This effect is amplified in this calibration, firm-level productivity risk is higher. The combined effects of the intensive and extensive margin effects leads to a recession that is, at different horizons, between 15 and 30% deeper than in the baseline calibration.

4.3 Can other aggregate shocks account for the behavior of the bank share?

The previous discussion focuses on the effects of an increase in the lending wedge. The conclusion that responses to aggregate shocks differ with the economy’s aggregate debt structure holds across a variety of shocks. The specificity of shocks to the lending wedge, however, is that they are the only shocks which, in the model, can generate recessions accompanied by a fall in the aggregate bank share. I next look at the effects of an increase in productivity dispersion. Shocks to \( E(\phi) \), and shocks that increase \( \gamma_b \) and \( \gamma_m \) jointly (and thus do not affect the lending wedge), do generate large recessions, but have very limited effects on the composition of aggregate borrowing, and have no substantial substitution at the firm level. A recession driven by an increase in \( \sigma(\log(\phi)) \), on the other hand, is accompanied by a substantial increase in the aggregate bank share.\(^{49}\) This reflects the greater demand for debt flexibility when firm-level uncertainty is high. The response of small and large firms features debt substitution, but in the opposite direction, as medium and large firms substitute away from market debt and into bank debt. Thus, from the standpoint of this model, uncertainty shocks lead to responses in the corporate debt structure that are at odds with the patterns documented in figure 13.

Summarizing, this section has shown that lending wedge shocks can generate large recessions accompanied by substitution toward market borrowing, both at the firm and aggregate levels. The recession generated by such a shock is deeper in an initially more bank-dependent economy, thus suggesting that the differences in aggregate debt structure can amplify the effects of aggregate shocks.

5 Corporate finance policies and their real effects

The comparison between the US and Italy suggests that a more market-oriented intermediation sector can lead to higher long-run output and investment, independent of firms’ underlying productivity. Moreover, a more market-oriented intermediation sector is also associated with dampened responses to asymmetric financial shocks, such as shocks to the lending wedge. At first blush, these observations seem to suggest a rationale for policies that improve firms’ access to market-based intermediation. In Europe, some countries indeed seem to have embraced market-based intermediation as a potential remedy to the slowdown in bank

\(^{49}\)These impulse responses are reported in appendix.
lending that has taken place since 2008.\textsuperscript{50} This embrace has typically taken the form of corporate finance policies targeted at small and medium-sized firms. This section discusses the effects of two such policies: a German effort to lower barriers to entry into bond markets for SME’s, and an Italian tax reform introducing tax deductibility of interest payments on bonds issued by private firms. The environment analyzed in this paper incorporate the determination of firms’ size explicitly, so that it is particularly useful laboratory to study the effect of this type of size-dependent policy.

5.1 Reducing intermediation costs for SME’s

Similar to the trends described for the US, the slowdown in bank loan issuance in Germany since 2009 was partly offset by an increase in corporate bond issuance. The increase in corporate bond issuances mostly originated from large companies; the contribution of small and mid-sized firms was limited. In 2010, the Bondm exchange for small and mid-sized firms was launched by the Boerse Stuttgart. This exchange is restricted to issuances between €50m and €150m. It aims at making these issuances attractive to small and mid-sized firms by cutting down on intermediation costs. Bondm issuances do not need to be individually rated, and do not need to be underwritten by a bank. Underwriting requirements are particularly constraining for small and mid-sized firms, as few European investment banks specialize in underwriting small issuers. Instead, Bondm provides firms with a primary market for new issuances, and also operates a secondary markets in which private and retail investors trade existing issues.

A simple way to model the advantages offered by Bondm to small and mid-cap firms is to let market intermediation costs $\gamma_m$ vary with size, in the model:

$$
\gamma_m(e) = \begin{cases} 
\tilde{\gamma}_m & \text{if } e \leq e_{sm} \\
\gamma_m & \text{if } e > e_{sm}
\end{cases}, \quad \tilde{\gamma}_m < \gamma_m.
$$

The introduction of the Bondm exchange corresponds to an economy in which $e_{sm} > 0$, as opposed to the baseline case where $e_{sm} = 0$. Figure 17 compares the stochastic steady-state of two such economies. The baseline economy with $e_{sm} = 0$ is identical to the European calibration discussed in section 4. In the alternative economy, the threshold $e_{sm}$ is set to $e_{sm} = e^*$, where $e^*$ is the switching threshold in the baseline economy. The intermediation costs for SME’s is set to $\tilde{\gamma}_m = 0.010 < \gamma_m = 0.016$.\textsuperscript{51}

Overall, the effect of the policy $e_{sm} > 0$ on total output and investment is positive: they increase.

\textsuperscript{50}The Euro Area Bank Lending Survey indicates that between 2008 and 2009, half of Euro area banks tightened their margins on “normal” loans; two thirds tightened their margins on “risky” loans. An additional tightening of bank lending standards also took place in 2010, and coincided with a pick-up in the issuance of new corporate bonds.

\textsuperscript{51}The qualitative effects of the policy would be identical if $e_{sm} < e$, but this choice makes the graphical discussion that follows clearer.
Adverse effects of the policy may arise for medium-sized firms – those with equity levels \( \tilde{e}^* \leq e_t \leq \check{e} \). These firms are large enough that the policy will induce them to choose an entirely market-financed debt structure. As a result, following the intuition discussed before, their scale falls, relative to the economy with \( e_{sm} = 0 \). The switch fragilizes the debt structure of these firms, in the sense discussed previously, as they lose the ability to restructure debt in bad times. As a result, they deleverage. This affects significantly aggregate output, because the mass of firms that are in this region are large (see the left panel of figure 17). While the overall effects of the policy are positive, it therefore comes at the expense of a precautionary reduction in scale my medium-sized firms.

\[\text{Figure 17: The effect of lower intermediation costs on small and mid-sized firms’ choice of scale.}\]
5.2 Tax incentives

To the extent that they discriminate between bank and market liabilities, taxes are an alternative tool that can be used as an instrument to influence firms’ choice of debt structure. A recent (2012) Italian reform to open bond markets to private companies includes the tax treatment of interest payment to corporate bonds as a part of a larger array of policy tools.\footnote{The reform also relaxes the requirements to find a sponsor to guarantee the issuance of the bond, and eliminates existing limits on indebtedness as a fraction of net worth for private firms. See http://www.paulhastings.com/Resources/Upload/Publications/2351.pdf for more details on the contents of the reform.} Specifically, the reform allows private firms to deduct interest paid on bonds in the same way as interest paid on other debt, in line with the tax rules imposed on large firms. The model, as described in the paper, does not explicitly incorporate tax deductibility of debt. However, in appendix I show that a simple extension can accomodate this; namely, I let the net worth of the firm under repayment be given by:

\[
    n_t = (1 - \tau)\pi_t - (1 - \tau_b)R_{b,t} - (1 - \tau_m)R_{m,t},
\]

where \(\tau\) denotes the marginal corporate tax rate, and \(\tau_b \leq \tau\) and \(\tau_m \leq \tau\) reflect preferential tax treatments of different types of debt instruments. A simple way to capture the reform is to contrast the case in which \(\tau_b = \tau\) and \(\tau_m = 0\) (only bank debt is interest-deductible), to the case in which \(\tau_b = \tau_m = \tau\) (both types of debt are treated indentically for tax purposes). The model suggests that such reforms, if they target specifically SME’s, will have very similar effects to the german policies of lowering intermediation costs for market debt. Intuitively, the differential treatment of bank and market debt \((\tau_m < \tau_b)\) has analogous effects on firms’ debt structure choices as differences in intermediation costs, as they affect the relative cost of market and bank debt outside of liquidation. Shield interest payment on market debt from tax for SME’s will have qualitatively similar effects on their choice of investment scale as lowering market-specific intermediation costs. Namely, it will boost leverage for small firms, but reduce it for mid-sized firms that switch entirely to market finance, as a result of the lower effective costs of market debt outside of liquidation.

While there is a rationale for using corporate finance policies to encourage firms to rely more on markets as a source of funds, this section has shown that this these reforms may also have adverse effects on firm-level investment. The corporate finance policies may indeed create an incentive for firms to adopt more fragile debt structures. Crucially, the model indicates the real implications of this fragility: firms that these debt structures also reduce the scale at which they operate.
6 Conclusion

The composition of corporate borrowing between bank loans and market lending exhibits substantial variation, both across countries, across firms, and over time. In this paper, I started from the simple view that banks provide more flexibility to firms, while markets have lower marginal lending costs. I showed that embedding this trade-off between flexibility and cost into a simple model of firm dynamics leads to cross-sectional predictions that align well with cross-sectional data on the composition of firm debt. The model is additionally useful to parse some simple explanations of cross-country variation in debt structure; I argued that productivity dispersion and differences in marginal lending costs are the two only like drivers of this variation, with differences in marginal lending costs most likely accounting for the lion’s share. Over the business cycle, the model also indicates that the pattern of debt substitution between bank and market credit, a key feature of the recent US recession, is only consistent with aggregate shocks to relative lending costs, that is, banking shocks.

The findings of the model echo the early empirical literature on the bank lending channel, such as Kashyap, Stein, and Wilcox (1993) and Gertler and Gilchrist (1994), or, more recently, Chodorow-Reich (forthcoming). This literature has typically focused on a subset of firms of bank-dependent firms to assess the real effects of contractions in bank credit supply. By contrast, this model allows me to quantify to what extent, if any, the existence of other sources of funding for firms can offset the aggregate effects of these shocks on output and investment. The finding of this paper is that these offsetting effects can be large; absent the endogenous response of the corporate debt structure to bank supply shocks, the model suggests that the fall in output could have been 15-30% larger. In this sense, the findings of this paper coincide with those of the empirical literature on the bank lending channel, in that they suggest large real effects of banking shocks. They also suggest that the development of corporate bond markets can provide a tool for macroprudential policy. As discussed by Eichengreen and Luengnaruemitchai (2004), this is indeed the insight embraced by many Asian countries, whose active development of local currency corporate bond market came as a reaction to the large contraction in bank credit during the Asian crises of 1997-1998. As described in section 5, similar changes are taking place in Europe since 2010, in anticipation of the impact of the Solvency II and Basel III on bank financing to corporates. One potential drawback of this tool is that, to the extent that market debt is harder to restructure than bank loans, gains during banking crises may be offset by exacerbated volatility in response to other business-cycle shocks. I leave this topic to future research.
References


