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Bank Finance versus Bond Finance

We present a model with agency costs where heterogeneous firms raise finance through either bank loans or corporate bonds and where banks are more efficient than the market in resolving informational problems. We document some major long-run differences in corporate finance between the United States and the euro area, and show that our model can explain those differences based on information availability. The model fits the data best when the euro area is characterized by lower availability of public information about corporate credit risk relative to the United States, and when European firms value more than United States firms banks' flexibility and information acquisition role.

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Is there a special role of banks in lending? How do bank loans relate to nonintermediated corporate finance raised directly from the financial market? A strikingly robust message from contemporaneous theories of financial intermediation is that banks are more efficient than the market in resolving informational problems through screening and monitoring. Several reasons have been put forward: banks have scale economies and comparative advantages in the production of information and in debt-related monitoring (Diamond 1984); they have access to inside information, whereas debt holders in capital markets have to rely on publicly

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available information (Fama 1985), and banks have better incentives to invest in information acquisition because of their relatively large stake in the funding of the borrower (Boot and Thakor 2009). Empirical studies have confirmed the special role of banks in resolving informational asymmetries. They have also shown that this role has survived the steady reduction of banks' lending exposure to a single borrower over the recent decade, through the development of securitization and a secondary market for loans (Gande and Saunders 2010).

In this paper, we ask whether a theory that recognizes a special informational role for banks can account for the behavior of standard macroeconomic variables as well as the structure of corporate finance. In particular, we aim at replicating some differences between the United States and the euro area (EA) in key facts, such as the composition of debt finance, the debt to equity ratio, the cost of bank finance relative to the cost of bond finance, the corporate default rate, and the return to the accumulation of firm capital.

We cast the informational role of banks into a dynamic general equilibrium model, where firms can choose among different debt instruments. The model is characterized by three features. First, firms need to raise external finance in order to finance production but they have private information about a productivity factor (as in Carlstrom and Fuerst 1997, 1998, Bernanke, Gertler, and Gilchrist 1999, among others). Second, firms experience a sequence of three idiosyncratic productivity shocks, the first being realized before firms take financing decisions, and the third determining the default decision. Third, we introduce two types of financial intermediaries—commercial banks, offering bank financing, and capital mutual funds (CMFs), offering bond financing. We assume that banks are institutions that have close relationships with entrepreneurs, acquiring costly additional information about their second productivity shock and adapting the terms of the debt financing arrangements accordingly, while market bond financing relies on publicly available information about the first productivity shock only. Because banks spend resources to acquire information and arrange financing accordingly, the bond financing choice is less costly but also riskier for a firm than bank finance. Our distinction raises the rather fundamental and well-known question of where to draw the line between a firm and the market (see Williamson 2002), that is, what is the difference between transactions carried out on the market rather than inside a firm called a bank? We do not offer a fundamental resolution. Indeed, if a reader wishes to rather interpret our banks as rating agencies, to which entrepreneurs pay a fee for a public report before obtaining tailor-made market bond financing based on the reports of the agencies, she could. However, we interpret these institutions as banks, as the line between markets and banks has to be drawn somewhere, and as we find it reasonable to draw the line here.

We show that in our model, firms experiencing high risk of default choose to abstain from production, while firms with relatively low risk choose to raise external finance through bonds. Only firms with intermediate degrees of risk choose to sign a contract with banks, because they value the option of getting further information before deciding whether or not to produce. This equilibrium feature of our model is in line with theories of corporate finance arguing that, because bank loans are easier to renegotiate than corporate bonds, firms with relatively higher *ex ante* credit risk find the option offered by banks to renegotiate more valuable (Berlin and Mester 1992). It is also in line with existing empirical evidence showing that firms with relatively higher credit quality (as measured by higher ratio of fixed assets to total assets, credit rating, and profitability) choose to finance through public debt, while firms with lower credit quality choose to finance through bank loans (Denis and Mihov 2003).

Our modeling assumptions also find support in the existing literature. The distinction we introduce between banks and CMFs is consistent with recent theories of financial intermediation. Banks treat differently firms in situations of financial distress because they are long-term players in the debt market, while bondholders are not. By acquiring information about firms, banks minimize the probability of inefficient liquidation, build a reputation for financial flexibility and attract firms that are likely to face temporary situations of distress (Chemmanur and Fulghieri 1994). Our modeling of banks also reflects the idea that information acquisition during the relationship with a firm leads to greater contractual flexibility relative to the one offered by financial markets (Boot, Greenbaum, and Thakor 1993).

The contribution of our paper is twofold. First, we embed firms' heterogeneity in a dynamic general equilibrium model where financial contracts are optimal, without giving up analytical tractability. Firms' financing decisions are a function only of the distributional assumptions about the idiosyncratic shocks and of an aggregate markup variable, which acts as a summary statistic of the economy. Linearity in the firm's net worth allows to aggregate easily across firms, so the economy can be described by a system of aggregate conditions similar to those arising in models without heterogeneity.

Second, we calibrate the model to replicate some key facts about corporate finance in the United States and the EA. Some ingredients of our model, such as the degree of heterogeneity of firms in the risk of default or the uncertainty that banks are able to disclose about firms' productivity, cannot be confronted directly with the data because of limited empirical evidence. Our calibration procedure offers an indirect estimation of those unobserved characteristics. We can thus offer an explanation of the documented differences based on a structural model.

A broad literature claims that corporate finance differences are largely explained by legal systems and institutional settings (see, e.g., La Porta et al. 1997). It is argued that countries with more effective legal protection of shareholders and creditors (e.g., common law countries such as the United Kingdom and the United States) are those where entrepreneurs have higher valuation of securities and broader access to capital markets relative to countries with lower legal protection (e.g., civil law countries, such as France, Germany, and most countries whose legal system is based on Roman law). Thus, theories of legal determinants would predict—everything else equal—a larger role of market finance relative to intermediated finance, and easier access to equity finance, for firms in the United States than in the EA. These theories also predict that better legal protection enables financiers to offer entrepreneurs external finance at better terms in the United States rather than Europe.

The empirical evidence—such as the lower share of bank finance in total debt finance and debt to equity ratio in the United States relative to the EA—indeed provides support to the idea that legal and institutional factors are a major determinant of firms' financial structure. However, the data also show that the interest rate spreads on bank loans are higher in the United States than in the EA, while there is no significant differences in spreads on bond finance. This is at odds with the lower-cost implication of higher legal protection in the United States, but we show it to be consistent with our model, which emphasizes differences in fundamentals. Our model explains these differences as due to relatively lower availability of public information about firms' credit worthiness and higher need for the flexibility and information acquisition role offered by banks in the EA. We therefore view our model as providing an important complement and addition to an explanation that is based entirely on legal determinants. In this paper, we use the model to explain the entire US–EA differences for several key statistics. While the truth may lie in between, our exercise shows that a legal determinants theory is not needed to explain the differences, and therefore provides an alternative explanation.

The paper proceeds as follows. In Section 1, we describe the environment. In Section 2, we present the analysis. In Section 3, we illustrate the main qualitative properties of the model. In Section 4, we use the model to provide an explanation of corporate finance differences between the United States and the EA based on fundamentals. In Section 5, we conclude. Proofs of the main propositions, details of aggregation across heterogeneous firms, a characterization of the steady state, and a description of the data used for the numerical analysis can be found in an appendix not for publication, which is available from the authors upon request.[1]

1. THE MODEL

We cast the different role of corporate bonds and bank loans into a dynamic general equilibrium model with credit market frictions, where we maintain the assumption of one-period maturity of the debt.

The economy is inhabited by identical infinitely lived households, a continuum of heterogeneous firms owned by infinitely lived risk-neutral entrepreneurs, and two types of zero-profits financial intermediaries (FIs). Each firm, indexed by $i \in [0, 1]$, starts the period with some physical capital. It hires additional capital as well as labor, financed externally.

Two key ingredients allow to introduce a nontrivial choice of firms among alternative instruments of external finance. The first is the existence of two distinct types of FIs, where banks are willing to spend resources to acquire information about an unobserved productivity factor, while CMFs are not. The second key ingredient is a sequence of three idiosyncratic productivity shocks hitting each firm. The first shock, $\varepsilon_{1,it}$, is publicly observed and realizes before firms take financial and production decisions. The second shock, $\varepsilon_{2,it}$, is not observed by anyone. Information on the realization of this shock can be acquired by the bank at a cost, in exchange of an

1. The appendix can also be found in the working paper version of this article (De Fiore and Uhlig 2011).

up-front fee paid by the firm.[2] The third shock, $\varepsilon_{3,it}$, realizes after borrowing occurs and is observable to the entrepreneur only. It can be monitored at a cost by FIs at the end of the period. The first shock generates observable heterogeneity among firms in the risk of default. The second shock, in combination with the information acquisition role of banks, provides the rationale for choosing bank finance for firms facing high risk of default. The combination of these two shocks is crucial to generate cross-sectional variation in firms' financing choices. Finally, the third shock rationalizes the existence of risky debt as the optimal contract between lenders and borrowers.

1.1 Households

Households maximize the expected value of the discounted stream of future utilities,

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\ln c_t + \eta \left(1 - l_t\right)\right], \quad 0 < \beta < 1, \tag{1}$$

where β is the households' discount rate, c_t is consumption, l_t denotes working hours and η is a preference parameter. The households are also the owners of the FIs, to which they lend on a trade credit account to be settled at the end of each period. They face the budget constraints

$$c_t + k_{t+1} - (1 - \delta)k_t \leq w_t l_t + r_t k_t, \tag{2}$$

where w_t denotes the real wage and r_t the rental rate on capital.

1.2 Entrepreneurs

Each entrepreneur i enters the period holding capital z_{it}. The firm operates a constant return to scale technology

$$y_{it} = \varepsilon_{1,it}\varepsilon_{2,it}\varepsilon_{3,it} H_{it}^{\alpha} K_{it}^{1-\alpha}, \tag{3}$$

where K_{it} and H_{it} denote the firm-level capital and labor, respectively. The productivity shocks $\varepsilon_{1,it}$, $\varepsilon_{2,it}$, and $\varepsilon_{3,it}$ are random iid disturbances,[3] which occur at different times during the period. They have mean unity, are mutually independent, and have

2. An alternative interpretation is to view "banks" in this model as "consultants," examining the business plans of firms, or to view them as originators of asset-backed securities, by providing screening and monitoring of applicants. Indeed, the banking sector has moved toward that role in recent years: we view this as consistent with our model, if enlarged with a market for asset-backed securities.

3. Alternatively, one can allow for $\varepsilon_{1,it}$ to be persistent over time, $\varepsilon_{1,it} = \rho\varepsilon_{1,i,t-1}$ for some $|\rho| < 1$. This would affect the analysis via the intertemporal condition (25), since the expectation there would now be conditional on $\varepsilon_{1,it}$. One resolution to this issue is to posit an alternative model of the entrepreneur as dying and consuming his entire wealth with some constant probability each period, and otherwise saving everything.

aggregate distribution functions denoted by Φ_1, Φ_2, and Φ_3, respectively. Per independence assumption, these are also the marginal distributions. The entrepreneur faces the constraint that the available funds, x_{it}, need to equal the costs of renting the factors of production,

$$x_{it} = w_t H_{it} + r_t K_{it}. \tag{4}$$

Entrepreneurs are infinitely lived, risk-neutral, and more impatient than households. They discount the future at a rate $\beta\gamma$, where β is the discount factor of households and $0 < \gamma < 1$. Their problem is to maximize the expected value of the discounted stream of future utilities,

$$E_0 \sum_{t=0}^{\infty} (\beta\gamma)^t e_{it}, \quad 0 < \gamma < 1, \tag{5}$$

subject to the budget constraint

$$e_{it} + z_{it+1} = y_{it}^e, \tag{6}$$

where e_{it} denotes entrepreneurial consumption, z_{it+1} investment in physical capital to be used in period $t + 1$, and y_{it}^e entrepreneurs' profits in units of output. Because entrepreneurs are more impatient than households, they demand a higher internal rate of return to investment. This opens the room for trade between households and entrepreneurs despite the agency costs of external finance.

For the purpose of matching the model to data, we interpret the entrepreneurs as the firm owners or stock holders. What is crucial here is that entrepreneurs are more informed about all that is going on inside the firm than the financial intermediaries: an assumption that we do not find entirely unreasonable.

1.3 Agency Costs and Financial Intermediation

Entrepreneurs obtain labor and capital inputs from the households against the promise to deliver the factor payments at the end of the period. Because of default risk, this promise needs to be backed up by a contractual arrangement with an FI (a bank or a CMF). The competitive FIs are able to ensure repayment of the factors because they diversify the risk among the continuum of firms facing idiosyncratic risk. Since credit arrangements are settled at the end of the same period, the intermediaries break exactly even on average.

Let ω_{it} be the uncertain productivity factor at contracting time, when firms approach FIs,

$$\omega_{it} = \begin{cases} \varepsilon_{2,it}\varepsilon_{3,it} & \text{for CMF finance} \\ \varepsilon_{3,it} & \text{for bank finance.} \end{cases}$$

Firms that decide to raise finance from banks pay an up-front fee that covers the bank's cost of information acquisition about the signal $\varepsilon_{2,it}$. The fee is a fixed proportion

τ of the firm's value n_{it}. This cost is not faced by firms that sign a contract with CMFs, as these FIs do not acquire information about the unobserved shock. Hence, the disposable net worth of a firm at the time of the contract is given by $\tilde{n}_{it}$, where

$$\tilde{n}_{it} = \begin{cases} n_{it} & \text{for CMF finance} \\ (1-\tau)n_{it} & \text{for bank finance.} \end{cases}$$

Conditional on $\varepsilon_{1,it}$ and possibly $\varepsilon_{2,it}$, each entrepreneur chooses to invest an amount $0 \leq \widehat{n}_{it} \leq \tilde{n}_{it}$ of internal finance and $x_{it} - \widehat{n}_{it}$ of external finance, for total funds at hand of x_{it}.

Each FI finances a project whose size is a fixed proportion of the internal funds invested,

$$x_{it} = \xi \widehat{n}_{it}, \quad \xi \geq 1. \tag{7}$$

This assumption captures the idea that entrepreneurs differ in their ability: the maximal project size that an entrepreneur is capable of running is proportional to his net worth.

After the realization of the uncertain productivity factor, ω_{it}, the entrepreneur observes the actual production in units of goods, y_{it}, and announces to the FI repayment of the debt or default. The realization of ω_{it} is only known to the firm unless there is costly monitoring, which requires paying a fraction μ of the firm's output. After the announcement of the entrepreneur, the FI decides whether or not to monitor. The informational structure at contracting time corresponds to the costly state verification framework (see Townsend 1979). Restriction (7) is usually not imposed in the costly state verification literature. It is necessary in our model to ensure that all firms raise finite amounts of external finance despite the presence of *ex ante* heterogeneity; otherwise, only the top firms would receive financing, creating a homogenous pool of firms with a potentially high leverage ratio.[4]

1.4 The Timing of Events

Entrepreneurs and households enter the period holding respectively capital z_{it} and k_{ht}. Households plan, how much labor to supply, and how much consumption and investment goods to purchase. They also supply labor and rent out their capital stock. Entrepreneurs calculate the end-of-period value n_{it} of their capital holdings z_{it}, which is publicly observable. Financial decisions unfold over three stages.

In the first stage, the shock $\varepsilon_{1,it}$ is realized and publicly observed. Conditional on its realization, entrepreneurs decide whether to:

(i) Abstain from production. Entrepreneurs facing a low $\varepsilon_{1,it}$ decide not to borrow and not to produce; that is, they choose $\widehat{n}_{it} = 0$. They rent out capital on the market, thus retaining their initial net worth, n_{it}, until the end of the period.

4. This restriction is consistent with the observation of reasonably similar and modest leverage ratios among rather different firms (see Kurshev and Strebulaev 2006, table 1).

(ii) Possibly borrow from banks and produce. Entrepreneurs facing an intermediate realization of $\varepsilon_{1,it}$ decide to approach a bank and to postpone their production decision after the realization of $\varepsilon_{2,it}$.[5]

(iii) Borrow from CMFs and produce. Entrepreneurs facing a high realization of $\varepsilon_{1,it}$ raise external finance from CMFs and decide not to acquire information on $\varepsilon_{2,it}$.

In the second stage, the shock $\varepsilon_{2,it}$ is realized and not observed by anyone. Information on its realization is acquired by banks at a cost τn_{it} and communicated to entrepreneurs. Conditional on $\varepsilon_{2,it}$, entrepreneurs choose their investment level, that is, whether to:

(iv) Abstain from production, in which case $\widehat{n}_{it} = 0$. These entrepreneurs rent out capital, retaining their remaining net worth, $(1 - \tau)n_{it}$, until the end of the period.

(v) Borrow from banks and produce.

Entrepreneurs that have chosen to produce hire labor H_{it} and rent capital K_{it} from the households against the promise to deliver the factor payments at the end of the period. This promise is backed up by the value of their own capital holdings plus the value of the additional trade credit obtained from the FI (either a bank or a CMF).

In the third stage, the shock $\varepsilon_{3,it}$ is realized and observed by the entrepreneur only.The entrepreneurs produces y_{it}, keeps part of output, y^e_{it}, for own consumption and investment, and sells the rest to households to settle trade credit. Entrepreneurs announce the outcome of production and repay loans or default on loans, if they cannot repay the agreed-upon amount. Conditional on the announcement, the FI decides whether or not to monitor.

At the end of the period, entrepreneurs consume e_{it} and accumulate capital $z_{i,t+1}$. Households use the goods purchased for consumption c_t and investment in capital $k_{h,t+1}$.

2. ANALYSIS

2.1 Factor Prices and the Markup

Each entrepreneur's net worth is given by the market value of the accumulated capital stock,

$$n_{it} = (1 - \delta + r_t)\, z_{it}. \tag{8}$$

Firms that produce need to sign a contract with the FIs to raise external finance for total funds at hand x_{it}. Normalizing goods prices, the firm's demand for labor and capital is derived by maximizing expected profits subject to the financing constraint

5. At this point, we could introduce the possibilities for entrepeneurs to enter actuarily fair gambles or, equivalently, assume that banks are allowed to cross-subsidize projects. As common in the literature, we outlaw gambling and cross-subsidization. An assumption which can rule out the benefits of such gambles is sufficient risk aversion for the entrepreneurs. This, however, would substantially increase the complexity of the model.

(4). Denote with $\mathcal{E}[\cdot]$ the expectation taken with respect to the variables yet unknown at the time of the factor hiring decision. More precisely,

$$\mathcal{E}[\varepsilon_{1,it}\varepsilon_{2,it}\varepsilon_{3,it}] = \begin{cases} \varepsilon_{1,it} & \text{for CMF financed firms,} \\ \varepsilon_{1,it}\varepsilon_{2,it} & \text{for bank financed firms.} \end{cases}$$

Also, denote the Lagrange multiplier on (4) as $s_{it} - 1$. Optimality implies that

$$\begin{aligned} K_{it} &= (1-\alpha)\,\tfrac{x_{it}}{r_t}, \\ H_{it} &= \alpha\tfrac{x_{it}}{w_t}, \\ \mathcal{E}\left[y_{it}\right] &= s_{it}x_{it}, \end{aligned}$$

where

$$s_{it} = \begin{cases} \varepsilon_{1,it}q_t & \text{for CMF finance,} \\ \varepsilon_{1,it}\varepsilon_{2,it}q_t & \text{for bank finance,} \end{cases} \tag{9}$$

and $q_t = (\frac{\alpha}{w_t})^{\alpha}(\frac{1-\alpha}{r_t})^{1-\alpha}$. We can interpret q_t as an aggregate distortion in production arising from the presence of agency costs, and s_{it} as a firm-specific markup that firms need to charge in order to cover the costs of financial intermediation.[6]

2.2 Financial Structure

In our model, the financial contract is intraperiod but the game between firms and FIs unfolds over three stages, each one corresponding to one idiosyncratic productivity shock. We solve the model using backward induction. In the unpublished appendix, we provide proofs of the propositions stated in this section.

In stage III, firms and FIs stipulate a debt contract conditional on the available information. Let Φ_ω and φ_ω be respectively the distribution and density function of ω_{it} and define

$$f\left(\overline{\omega}^j\right) = \int_{\overline{\omega}^j}^{\infty}\left(\omega - \overline{\omega}^j\right)\Phi_\omega\left(d\omega\right), \tag{10}$$

$$g(\overline{\omega}^j) = \int_0^{\overline{\omega}^j}(1-\mu)\,\omega\Phi_\omega\left(d\omega\right) + \overline{\omega}^j\left[1 - \Phi_\omega\left(\overline{\omega}^j\right)\right], \tag{11}$$

as the expected shares of final output accruing respectively to an entrepreneur and to a lender, after stipulating a contract that sets the fixed repayment at $s_{it}\overline{\omega}^j_{it}x_{it}$ units of output, for $j = b, c$. The index j denotes the type of FI, where b indicates banks and c indicates CMFs. The optimal contract solves the following costly state verification

6. In Carlstrom and Fuerst (1998), as in most of the literature, nothing is known before firms produce, that is, $\mathcal{E}[\varepsilon_{1,it}\varepsilon_{2,it}\varepsilon_{3,it}] = 1$ and $s_{it} = q_t$.

problem:

$$\max \; s_{it} f(\overline{\omega}_{it}^{j}) x_{it} \tag{12}$$

subject to constraint (7) and

$$s_{it} g(\overline{\omega}_{it}^{j}) x_{it} \geq x_{it} - \widehat{n}_{it} \tag{13}$$

$$f\left(\overline{\omega}_{it}^{j}\right) + g\left(\overline{\omega}_{it}^{j}\right) \leq 1 - G_{\omega}\left(\overline{\omega}_{it}^{j}\right) \tag{14}$$

$$\widehat{n}_{it} \geq 0, \; s_{it} f(\overline{\omega}_{it}^{j}) x_{it} \geq \widehat{n}_{it}. \tag{15}$$

where $G_{\omega}\left(\overline{\omega}^{j}\right) = \mu \int_{0}^{\overline{\omega}^{j}} \omega^{j} \Phi_{\omega}(d\omega)$. Equation (7) restricts the project size,[7] (13) requires the FIs expected return to exceed the repayment to the household, (14) ensures feasibility, and (15) guarantees that the entrepreneur is willing to sign the contract. Since loans are intraperiod, the opportunity cost of lending for the intermediary is one.

Proposition 1. *Under the optimal contract, the entrepreneur either invests nothing, $\widehat{n}_{it} = 0$, or invest his entire net worth, $\widehat{n}_{it} = \tilde{n}_{it}$, requiring an amount $(\xi - 1)\,\tilde{n}_{it}$ of external finance. The optimal contract is characterized by a threshold $\overline{\omega}_{it}^{j}$, $j = b$, c, such that, if $\omega \geq \overline{\omega}^{j}$, no monitoring occurs. If $\omega < \overline{\omega}^{j}$, the FI monitors at a cost and completely seizes the resources in the hands of the entrepreneur. The threshold is given by the solution to*

$$s_{it} g(\overline{\omega}_{it}^{j}) = \frac{\xi - 1}{\xi}. \tag{16}$$

At the beginning of stage II, $\varepsilon_{2,it}$ is realized and not observed. Information on this shock is acquired by banks and communicated to the entrepreneur, who then chooses whether to abstain from production or to obtain trade credit and produce.

Proposition 2. *A threshold for $s_{it} = \varepsilon_{1,it}\varepsilon_{2,it}q_{t}$, below which the entrepreneur does not proceed with the bank loan, exists and is unique. It is given by a constant s_{d} that satisfies*

$$s_{d} f(\overline{\omega}^{b}(s_{d}))\xi = 1. \tag{17}$$

7. It is standard in this literature to have the project size (and leverage) optimally chosen by the contract. In our environment, instead, firm-level leverage is fixed by equation (7). The reason is that firms differ in terms of credit-worthiness. If the distribution of ε_{1t} is unbounded, the optimal project size for firms experiencing extremely large values of that shock is unbounded. If the distribution is bounded, one typically obtains a corner solution, with all financing going to the best firms.

Condition (17) also determines a threshold for the second firm-specific shock. The entrepreneur does not proceed with the bank loan if $\varepsilon_{2,it} < s_d/(q_t\varepsilon_{1,it})$.

In stage I, after $\varepsilon_{1,it}$ realizes, the entrepreneur chooses whether or not to produce and, if he does, how to finance production. For notational simplicity, we drop the subscripts. The expected profits of an entrepreneur, who proceeds with bank finance conditional on the realization of ε_1, is $F^b(s)n$, where $s = \varepsilon_1 q$ and

$$F^b(s) = (1-\tau)\left(\int_{\frac{s_d}{s}} s\varepsilon_2 f(\overline{\omega}^b(s\varepsilon_2))\xi\,\Phi_2(d\varepsilon_2) + \Phi_2\left(\frac{s_d}{s}\right)\right). \tag{18}$$

The expected profits of an entrepreneur, who proceeds with CMF finance conditional on the realization of ε_1, is $F^c(s)n$, where $s = \varepsilon_1 q$ and

$$F^c(s) = sf(\overline{\omega}^c(s))\xi. \tag{19}$$

Finally, the expected profits of an entrepreneur, who abstains from production, is simply n. Note that all payoff functions are linear in net worth n. Knowing its own markup $s = \varepsilon_1 q$, each entrepreneur chooses the best option, leading to the overall payoff $F(s)n$, where

$$F(s) = \max\{1; F^b(s); F^c(s)\}. \tag{20}$$

In the analysis below, we make the following assumptions: $(A1)$ $F^{b\prime}(s) \geq 0$; and $(A2)$ $F^{b\prime}(s) < F^{c\prime}(s)$, for all $s = \varepsilon_1 q$. These conditions impose mild restrictions on the parameters of the model and ensure uniqueness of the thresholds s_b and s_c.

Proposition 3. *Under (A1), a threshold for $s = \varepsilon_1 q$, below which the entrepreneur decides not to raise external finance, exists and is unique. It is given by a constant s_b that satisfies*

$$F^b(s_b) = 1. \tag{21}$$

Under (A1) and (A2), a threshold for $s = \varepsilon_1 q$ above which entrepreneurs sign a contract with the CMF, exists and is unique. It is given by a constant s_c that satisfies

$$F^b(s_c) = F^c(s_c). \tag{22}$$

Conditional on s_b, s_c and q_t, and depending on $\varepsilon_{1,it}$, entrepreneurs split into three sets: Ω_{at}, the set of entrepreneurs that abstain from raising external finance; Ω_{bt}, the set of entrepreneurs that sign a contract with banks, and Ω_{ct}, the set of CMF-financed entrepreneurs,

$$\begin{aligned}
\Omega_{at} &= \{\varepsilon_{1,it} \mid \varepsilon_{1,it} < s_b/q_t\}\\
\Omega_{bt} &= \{\varepsilon_{1,it} \mid s_b/q_t \leq \varepsilon_{1,it} \leq s_c/q_t\}\\
\Omega_{ct} &= \{\varepsilon_{1,it} \mid \varepsilon_{1,it} > s_c/q_t\}.
\end{aligned}$$

The firm's production decision can be characterized by the dummy variable D_{it}, where

$$D_{it} = \begin{cases} 1 \text{ if } \varepsilon_{1,it} > s_c/q_t \text{ or if } s_b/q_t \leq \varepsilon_{1,it} \leq s_c/q_t \text{ and } \varepsilon_{2,it} > s_d/\varepsilon_{1,it}q_t, \\ 0 \quad \text{else.} \end{cases}$$

2.3 *Consumption and Investment Decisions*

Households maximize (1) subject to (2). Optimality requires that

$$\eta c_t = w_t \tag{23}$$

$$\frac{1}{c_t} = \beta E_t \left\{ \frac{1}{c_{t+1}} (1 - \delta + r_{t+1}) \right\}. \tag{24}$$

Entrepreneurs maximize (5) subject to (6), where $y_{it}^e = \tilde{n}_{it}$ if firm i abstains, $y_{it}^e = s_{it} \left(\omega_{it} - \overline{\omega}_{it}^j \right) \xi \tilde{n}_{it}$ if firm i borrows and repays, and $y^e{}_{it} = 0$ if firm i borrows and default. Their optimality condition is given by

$$1 = \beta\gamma E_t \left\{ (1 - \delta + r_{t+1}) F(\varepsilon_{1,it+1} q_{t+1}) \right\}. \tag{25}$$

2.4 *Aggregation*

Aggregate variables can be computed by integrating across firms. Aggregate labor and capital are given by

$$w_t H_t = \alpha x_t, \tag{26}$$

$$r_t K_t = (1 - \alpha) x_t. \tag{27}$$

Aggregate demand for funds, x_t, output y_t, output lost to monitoring costs $y^m{}_t$, output lost to banks' information acquisition $y^\tau{}_t$, and agency costs can be computed as

$$x_t = \psi_x (q_t) \xi n_t \tag{28}$$

$$y_t = \psi_y (q_t) q_t \xi n_t \tag{29}$$

$$y_t^m = \psi_m (q_t) \mu q_t \xi n_t \tag{30}$$

$$y_t^\tau = \psi_\tau(q_t) n_t \tag{31}$$

$$y_t^a = y_t^m + y_t^\tau. \tag{32}$$

Aggregate entrepreneurial consumption and investment have to satisfy the constraint

$$e_t + z_{t+1} = \vartheta(q_t) n_t, \tag{33}$$

where $\vartheta(q_t)n_t$ denote aggregate profits of the entrepreneurial sector.

Notice that $\psi_x(\cdot)$, $\psi_y(\cdot)$, $\psi_m(\cdot)$, $\psi_\tau(\cdot)$, and $\vartheta(\cdot)$ are functions that aggregate across firms. For instance, $\psi_\tau(q)$ aggregates the costs of information acquisition per unit of net worth across all firms that sign a contract with a bank, implying that

$$\psi_\tau(q) \equiv \tau \int_{\frac{s_b}{q_t}}^{\frac{s_c}{q_t}} \Phi_1(d\varepsilon_1).$$

The other functions are defined in the unpublished appendix, where we also derive condition (32).

2.5 Market Clearing

Market clearing for capital, labor and output requires that

$$K_t = k_t + z_t, \tag{34}$$

$$H_t = l_t, \tag{35}$$

$$y_t = c_t + e_t + y_t^a + K_{t+1} - (1-\delta)K_t. \tag{36}$$

Market clearing for loans is ensured by condition (4).

3. EQUILIBRIUM PROPERTIES OF THE MODEL

We parameterize the model at the stochastic steady state.[8] To discuss equilibrium properties, we use the parameterization of the model calibrated on U.S. data reported in Section 5.2.

8. The stochastic steady state and the numerical procedure for computing it are described in the unpublished appendix.

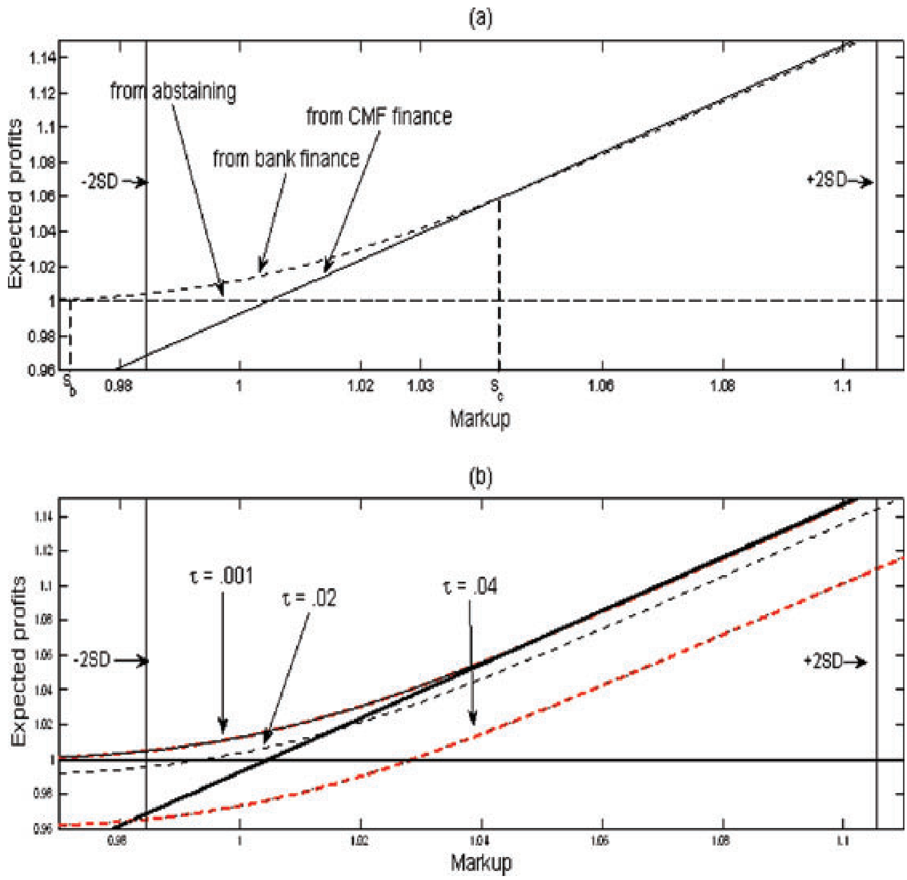

FIG. 1. Expected Profits and Financing Choices.

In Figure 1 , we show expected profits for entrepreneurs. Panel (a) plots expected profits from abstaining, from signing a contract with a bank and from signing a contract with a CMF, as a function of the firm's markup, s. The intersection points of the three curves provide the cutoff points, s_b and s_c. When $s < s_b$, the firm abstains because this provides highest expected profits. When $s_b < s < s_c$, the best option is offered by bank finance, while when $s > s_c$ the firm chooses CMF finance. The panel also shows the mean of the firm-specific markup s, plus/minus two standard deviations. After the realization of ε_1, 95% of the firms' markups lie within this region. Panel (b) shows how expected profits from bank finance move with the information acquisition fee τ. When $\tau = 0.001$, information acquisition is so cheap that expected profits from bank finance generally exceed those from abstaining or from CMF finance. The share of firms that raises external finance through banks approaches one. When τ is large (.04 in the figure), the option value of acquiring

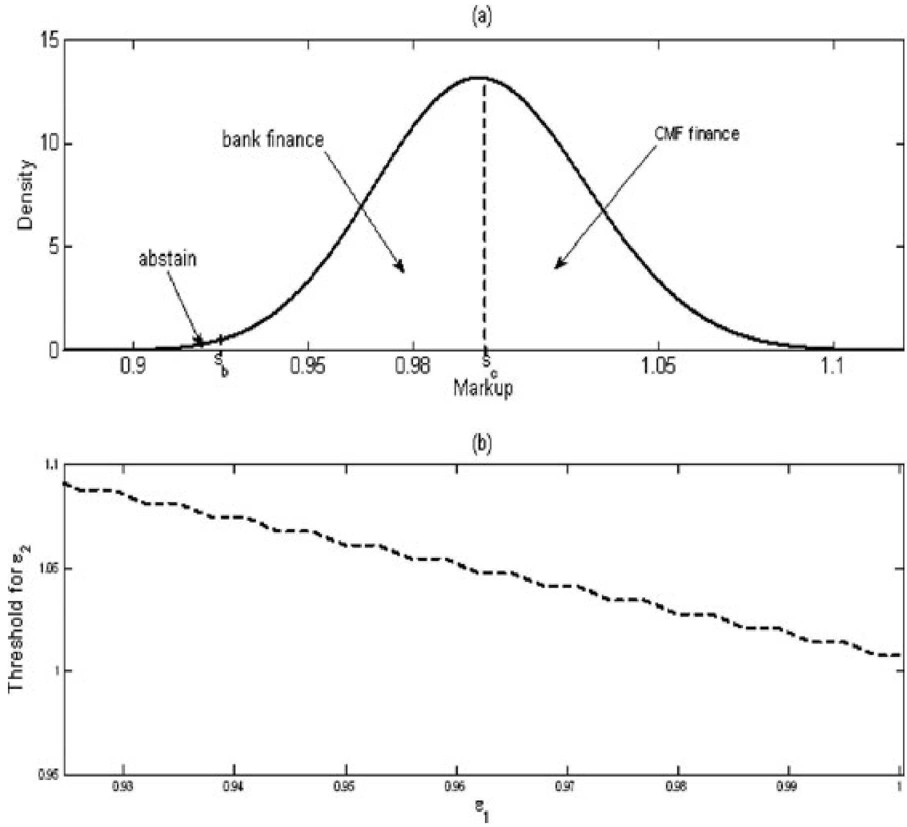

FIG. 2. Distribution of Financing Choices and Threshold for Continuing with Bank Financing.

more information is not large enough to offset the cost. All firms either abstain or use CMF finance. Only for intermediate values of τ (.02 in the figure),firms that decide to produce differentiate in terms of their financing choice depending on the realization of their markup.

Figure 2 , panel (a), illustrates how firms allocate among financial instruments. Firms experiencing a productivity shock $\varepsilon_1 \leq s_b/q$ decide to abstain from production. Firms with $s_b/q \leq \varepsilon_1 \leq s_c/q$ sign a contract with banks. Firms with $\varepsilon_1 \geq s_c/q$ sign a contract with CMFs. Among firms that sign a contract with banks, those experiencing a productivity shock below the threshold for ε_2, that is, $\varepsilon_2 \leq s_d/\varepsilon_1 q$, decide not to proceed to the production stage. Panel (b) plots the threshold $s_d/\varepsilon_1 q$, over the range of markups $(s_b/q, s_c/q)$, as a function of ε_1.

Figure 3 plots the steady state distribution of firms among production activities. Firms that do not produce are those that decide not to raise external finance because $\varepsilon_1 \leq s_b/q$, and those that sign a contract with the bank but, after the realization of ε_2, decide to drop out of production. For these firms, $s_b/q \leq \varepsilon_1 \leq s_c/q$ and $\varepsilon_2 \leq s_d/q\varepsilon_1$.

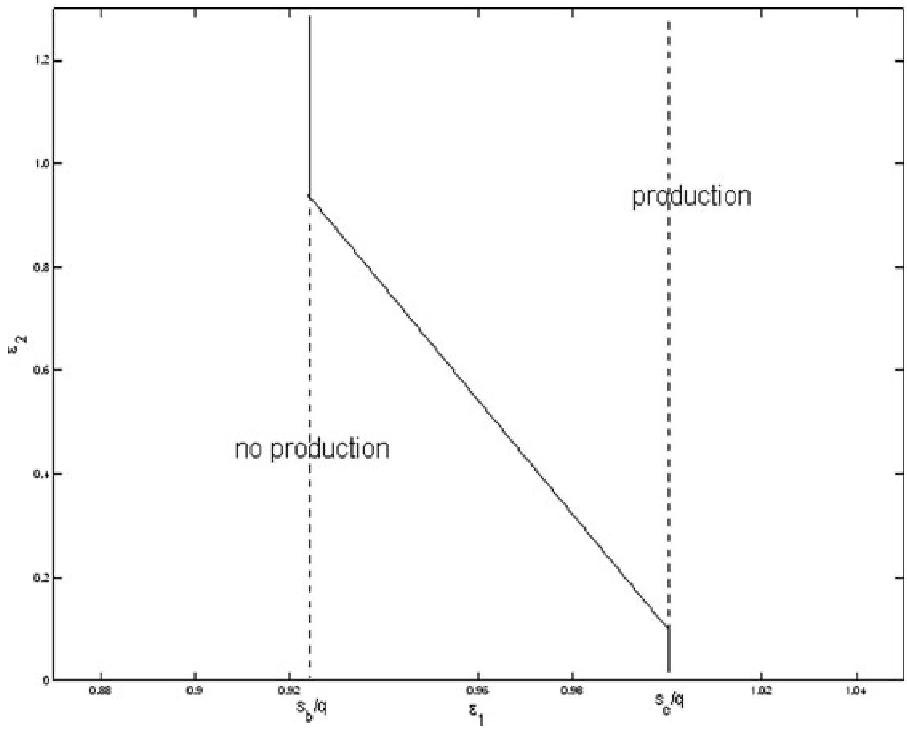

FIG. 3. Financing Choices as a Function of Observable Shocks (ε_1 and ε_2).

In our model, key parameters for the determination of the financial structure are the standard deviations of the different idiosyncratic productivity shocks, and banks' information acquisition costs. For instance, a higher σ_{ε_1} generates thicker tails in the distribution. Firms experience with lower probability intermediate realizations of the productivity shock ε_1 before taking their financing decisions. Therefore a lower share of firms raises bank finance. Similarly, a higher variance of the signal σ_{ε_2} implies that firms value more the possibility of acquiring additional information through banks. A larger share of firms raises bank finance. Notice that in our model, a reduction in τ acts as an increase in σ_{ε_2}. Both a reduction in the cost of information acquisition and an increase in the dispersion of the private information signal lead to a larger share of bank finance.

4. CORPORATE FINANCE IN THE UNITED STATES AND THE EA

4.1 Evidence on the Financial Structure

In our numerical analysis, we aim at replicating six stylized facts: (i) the ratio of bank loans to debt securities, as an indicator of the composition of firms' debt

TABLE 1

FINANCIAL FACTS

Variable	US Data	US Mod	EA Data	EA Mod
Bank to bond finance ratio	0.66	0.67	5.48	5.48
Debt to equity ratio	0.43	0.43	0.64	0.64
Risk premium on loans (bps)	170	169	119	119
Risk premium on bonds (bps)	143	143	143	147
Default rate on bonds (pp)	5.37	5.36	4.96	4.79
Return to entr capital (pp)	10.90	10.93	9.30	9.29

finance; (ii) the debt to equity ratio, as a proxy of the reliance on debt versus equity finance; (iii) the risk premium on loans and (iv) the risk premium on bonds, both reflecting the severity of the asymmetric information problem in financial markets; (v) the default rate on bonds, which determines the loss of resources due to bankruptcy for CMF financed firms; and (vi) the expected return on capital, which restricts in our model entrepreneurs' profits and their choice between consumption and capital accumulation.

In Table 1, columns 2 and 4 summarize the evidence on the financial structure of the EA and the United States, for the period 1999–2007.[9] The table shows several differences. First, bank loans account for a much larger fraction of debt finance in the EA than in the United States. The ratio of bank loans to debt securities is approximately eight times larger in the EA (5.48) than in the United States (0.66). Second, the debt to equity ratio is higher in the EA (0.64) than in the United States (0.43), reflecting a larger reliance of United States firms on financing through equity rather than debt. Third, corresponding measures of the risk premium on bank loans are higher for the United States (170 bps) than for the EA (119 bps). Fourth, no significant differences can be observed in the risk premium on bond finance (143 bps in both the United States and the EA). Finally, both the default rate on corporate bonds and the return to capital are higher for the United States (5.37% and 10.9%, respectively) than for the EA (4.96% and 9.30%, respectively).

The first two facts documented in Table 1 are consistent with theories that explain the composition of external finance with institutional and legal factors. For instance, La Porta et al. (1997) analyze the choice between debt and equity finance, and argue that countries with legal environments that offer more effective protection of shareholders and creditors are those where entrepreneurs have higher valuation of securities and broader access to capital markets, and where financiers offer entrepreneurs external finance (both through debt and equity) at better terms. They also show that common law countries (such as the United Kingdom and the United

9. In the unpublished appendix, we describe the data used to provide evidence on the financial structure of the corporate sector. We also provide analytical expressions for the financial variables used in the numerical application.

States) protect both shareholders and creditors more than civil law countries (such as France, Germany, and other European countries whose legal system is based on Roman law).

Thus, theories of legal determinants would predict a larger role of market finance in the United States than in the EA, in line with the reported evidence on the ratio of bank loans to debt securities. They would also predict easier access to equity finance for firms in common law countries than in civil law countries, in line with a lower debt to equity ratio in the United States relative to the EA. On the contrary, our findings on the cost of bank finance relative to bond finance in the two blocks pose a challenge to those theories. Indeed, the average risk premium on bank loans is higher in the United States than in the EA, and no significant differences arise in the average risk premium on bonds. These findings are in line with existing studies. On the one hand, Carey and Nini (2007) documents that interest rate spreads on syndicated loans to corporate borrowers are significantly smaller in Europe than in the United States (by about 30 bps), other things equal. Moreover, they argue that differences in borrower, loan, and lender characteristics do not appear to explain this phenomenon. On the other hand, Mahajan and Fraser (1986) and Carey and Nini (2007) provide evidence that no significant differences exist in yields between bonds issued by firms with similar characteristics in the United States and in Europe. We interpret this evidence as suggesting that theories of institutional and legal determinants are not sufficient to explain the composition of corporate debt finance.

In the rest of this section, we use our model to sheed light on whether differences in fundamentals can offer a complementary explanation.

4.2 *Numerical Analysis*

We search for a parameterization of the model that delivers the best fit with United States and EA data. The period is a year. The iid productivity shocks $v = \varepsilon_1, \varepsilon_2, \varepsilon_3$ are lognormally distributed, that is, $\log(v)$ is normally distributed with variance σ_v^2 and mean $-\sigma_v^2/2$. Both for the United States and the EA models, we fix some parameters to standard values. We set the depreciation rate at $\delta = 0.07$ and the discount factor at $\beta = 0.96$, implying a real interest rate of around 4%. We choose $\alpha = 0.64$ in the production function, and a coefficient in preferences η so that labor equal .3 in steady state. We also set monitoring costs at $\mu = 0.15$, a value in the middle of the range of the available estimates (see, e.g., Carlstrom and Fuerst 1998).

For the calibration exercise, it is convenient to specify one of the endogenous variables, q, as exogenous and to treat γ as unobservable. Thus, we choose six free parameters, $\xi, \tau, q, \sigma_{\varepsilon_1}, \sigma_{\varepsilon_2}$, and σ_{ε_3}, to minimize the squared log-deviation of the model-based predictions on the six financial facts documented in Table 1 from their empirical counterparts.[10] The parameter values selected from our

10. As a robustness check, we have also run our calibration exercise by using as a target the average default rate or the default rate on loans instead of the default rate on bonds. In both cases, the match of the

TABLE 2

PARAMETER VALUES

Parameters	Symbols	Model US	Model EA
Information acquisition	τ	0.001	0.028
Coeff. discount rate entr.	γ	0.939	0.953
Project size to net worth	ξ	1.551	2.102
Standard dev. ε_1	σ_{ε_1}	0.037	0.014
Standard dev. ε_2	σ_{ε_2}	0.024	0.069
Standard dev. ε_3	σ_{ε_3}	0.488	0.335
Overall variance unobserved shocks	$\sum^3{}_{j=2}\sigma^2{}_{\varepsilon_j}$	0.238	0.117
Precision avail info to precision private info	$\sigma^2_{\varepsilon_2} / \left(\sigma^2_{\varepsilon_1} + \sigma^2_{\varepsilon_2}\right)$	0.294	0.958
Precision total info to precision public info	$\sigma^2_{\varepsilon_1} / \sum_{j=1}^3 \sigma^2_{\varepsilon_j}$	0.006	0.002
Variance private info to info acquisition cost	$\sigma^2_{\varepsilon_2} / \tau$	0.590	0.168

benchmark calibration procedure are reported in Table 2, columns 3 and 4. The table also reports some focal statistics (shown in the last four rows), which we use below to interpret the different predictions generated by the United States and EA models. The implied model-based predictions are listed in Table 1, columns 3 and 5.

The focal statistics reported in Table 2 shed light on the differences in the financial structure, as interpreted by our model. The overall uncertainty about the *a priori* unobserved productivity shocks, $\sum_{j=2}^3\sigma^2{}_{\varepsilon_j}$, is higher in the United States (0.238) than in the EA (0.117).[11] The share of available information due to the additional information acquisition in a bank contract, $\sigma^2_{\varepsilon_2} / \left(\sigma^2_{\varepsilon_1} + \sigma^2_{\varepsilon_2}\right)$, is considerably higher in the EA (0.958) than in the United States (0.294), giving banks and their information acquisition a larger role in the EA. The demand of banking services in the EA is dampened, however, by a relatively low efficiency of European banks. Indeed, the overall measure of efficiency of banks in acquiring information about firms, $\sigma^2_{\varepsilon_2}/\tau$, is higher for the United States (0.590) than for the EA (0.168). Finally, the volatility of the public signal relative to the overall uncertainty, $\sigma^2_{\varepsilon_1} / \sum_{j=1}^3 \sigma^2_{\varepsilon_j}$, is lower in the EA (0.002) than in the United States (0.006).[12] The larger availability of public information in the United States allows firms to better assess their own default risk and to reduce the output loss induced by agency costs.

In Table 3, we compare some predictions of the model on variables that were not used as targets of our calibration procedure to their empirical counterparts. The

model with the data deteriorates but the results on model predictions and the interpretation of the corporate finance differences suggested by our statistics remain qualitatively unchanged.

11. Recent empirical evidence supports this finding. Using a large panel of firms over the period 1991–2006, Bartram et al. (2009) show that foreign firms face lower idiosyncratic risk than comparable U.S. firms, after controlling for industry, assets, age, and market-to-book ratio.

12. This finding is also in line with available empirical evidence. Indeed, market-based countries such as the United States have been shown to have higher standards than bank-based countries for information disclosure about firms, such as accounting information, income statements, balance sheets, funds flow statements, and stock data (see, e.g., Demirgüc-Kunt and Levine 2001).

TABLE 3

Additional Model Predictions and Data

Variable	US Data	US Mod	EA Data	EA Mod
Consumption to GDP ratio	0.85	0.78	0.77	0.76
Investment to GDP ratio	0.19	0.21	0.21	0.21
Average default rate	4.74	5.63	4.25	4.08
Def. rate loans to def. rate bonds ratio	0.80	1.12	0.73	0.82
Share abstain overall	n.a.	0.22	0.37	0.40
Entrepr. capital to aggr. capital ratio	0.46	0.25	n.a.	0.24

TABLE 4

Additional Model Predictions

Variable	Model US	Model EA
Share abstain	0.028	0.000
Share bank	0.503	0.910
Share CMF	0.469	0.090
Drop-out if banking	0.376	0.444
Aggr. markup	1.041	1.021
Agency costs to GDP ratio	0.004	0.024

model generates a reasonable ratio of aggregate consumption to GDP, $\frac{c+e}{y}$, and of investment to GDP, $\frac{I}{y}$. Both for the United States and the EA, the prediction on the average default rate is not far from the observed value. The model also predicts that default rates on loans are lower than default rates on bonds for the EA, in line with the empirical evidence.

The model has two main shortcomings. First, the predicted ratio of the default rate on loans to the default rate on bonds is higher than one for the United States, while it is lower than one in the data. Second, the model delivers a ratio of entrepreneurial wealth to total wealth, $\frac{z}{K}$, which is remarkably lower (0.25) than in U.S. data (0.46).

Predictions of the model on some unobservable characteristics are documented in Table 4. One distinguishing feature is that both in the United States and EA models, almost all firms approach a financial intermediary ("share abstain" is very low or zero), since the share of publicly available information $\sigma_{\varepsilon_1}^2 / \sum_{j=1}^{3} \sigma_{\varepsilon_j}^2$ is low, see Table 2. The share of firms that drop-out from production conditional on having approached a bank ("drop-out if banking") is larger for the EA than for the United States, reflecting a higher standard deviation of the relevant uncertain productivity factor (σ_{ε_2}) and therefore a higher occurrence of low realizations of ε_2. The value of the aggregate markup, q, is larger in the United States. This is needed to replicate the observed difference in the expected return to capital in the United States and in the EA. A higher financial markup increases the expected profits of entrepreneurs per unit of accumulated capital stock, because it increases the price charged by firms. Finally, agency costs as a share of GDP (y^a/y) are higher in the EA relative to the United States, due to the large use of bank finance and the consequent impact of information acquisition costs.

Table 2 shows that the model requires large differences in information acquisition costs, in order to replicate the data. One striking difference arises in the parameter τ, which is 0.001 for the United States and .028 for the EA. This should be understood as the difference between bank and bond financing costs: even the EA parameter is small, so that in absolute terms, the United States and EA are fairly similar. However, it is possible that such difference is needed for the model to capture the data, because monitoring costs are assumed to be identical despite differences in bankruptcy laws and procedures. To verify this conjecture, we checked the robustness of our results by restricting τ in the EA model to take progressively closer values to the one obtained for the United States, and instead endogenizing the monitoring costs μ. Indeed, the best fit is found for a lower level of monitoring costs in the EA, $\mu = 0.124$, and for an information acquisition cost parameter, $\tau = 0.005$, that is much closer to the one selected for the United States. While it is difficult to obtain evidence on monitoring costs in the EA, due to the high heterogeneity in legal systems and bankruptcy law across European countries, these results are consistent with the perception that bankruptcy procedures offer higher protection for business debtors in the United States (chapter 11 of the Bankruptcy Code) than in the EA, implying that U.S. banks overall recover a lower fraction of output. A more detailed discussion of the robustness analysis and of the results is available in the unpublished appendix. What matters here is that the model predictions and the focal statistics turn out to be qualitatively similar for a decently fitting alternative specification, and therefore our interpretation of the corporate finance differences remains unaffected.

5. CONCLUSIONS

This paper presents a model where firms are heterogeneous in the risk of default and banks have a special role in resolving informational problems. The model can be used to shed light on the determinants of key differences in corporate finance between the United States and the EA.

Some of the differences that we document are consistent with theories that point to legal and institutional factors as major determinant of firms' financing choices. Some others—such as a higher average risk premium on bank loans in the United States relative to the EA, and the absence of significant differences in the average risk premium on bonds—provide a challenge for these theories. Our model provides a complementary explanation that is based on fundamentals.

We argue that information availability might help to explain the composition of firms' debt. Our calibrated model suggests that differences in the financial structure of United States and EA firms can be explained by a relatively low level of disclosure of information about firms' credit risk in the EA relative to the United States, and by a higher need of European firms for the flexibility and information acquisition role provided by banks.

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