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COURT EFFICIENCY AND AGGREGATE PRODUCTIVITY: THE CREDIT CHANNEL

by Guzmán González-Torres* and Giacomo Rodano*

Abstract

Credit contract enforcement influences financial market allocations and prices. Well-functioning credit markets enable firms to finance their operations. Can greater judicial efficiency therefore help to improve credit market allocations, by increasing firm dynamism and boosting aggregate productivity? We build a dynamic model of heterogeneous firms with short-term liquidity needs, in which two key features of enforcing credit contract proceedings, case resolution time and the expected recovery rate, directly affect credit supply. Once calibrated to replicate Italian firm dynamics, we use the model to analyze the extent to which court efficiency determines aggregate outcomes through the credit channel. In our economy, either increasing the average recovery rate on defaulted loans from 62 to 80 per cent, or reducing case resolution time from 9 to 5 years, raises average firm productivity by about 2 per cent. These gains are attained through a substantial improvement in the allocation of resources across firms.

JEL Classification: D25, E44, K12, K15, O47.
Keywords: financial markets, civil law, contracts, aggregate productivity, intertemporal firm choice.
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Contents

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1 Introduction[1]

Financial frictions can lead to the misallocation of talent across sectors (Midrigan and Xu, 2014; González-Torres, 2016) and resources across firms (Banerjee and Duflo, 2005; Gopinath et al., 2017), thereby contributing to the large cross-country differences in productivity we observe (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009). Inefficient access to credit partly results from limited debt contract enforcement (Djankov et al., 2008), as well as weak debtor and creditor protection by means of ineffective bankruptcy laws (La Porta et al., 1997). Improving court efficiency can increase firm dynamism (Ponticelli and Alencar, 2016; Giacomelli and Menon, 2017) and improve credit market allocations (Visaria, 2009; Bae and Goyal, 2009; Laeven and Majnoni, 2005; Fabbri, 2010; Chemin, 2010), having positive effects on input allocation, while simultaneously facilitating the survival of less productive firms. How the complex interactions between the civil court system, credit markets, and entrepreneurial choices shape aggregate productivity is an open question.

Our goal is to quantitatively trace the effects of increasing judicial efficiency on firm dynamism and aggregate productivity through changes in credit market outcomes. We explore a model in which heterogeneous firms finance their operating expenses by taking out short term loans. More efficient bankruptcy proceedings lower expected losses in case of default by increasing the recovery rate or shortening credit dispute proceedings. As banks become more willing to lend, they reduce the interest rate on loans, leading the aggregate amount of credit supplied to increase.[2] Using our benchmark model specification, we find that improving court efficiency can produce quantitatively relevant improvements of the aggregate economy. Increasing the expected recovery rate of defaulted loans from 62 to 80 per cent, increases aggregate productivity in our economy by 2.2 per cent. Similarly, a reduction in case resolution time from 9 to 5 years, improves aggregate productivity in our economy by 1.6 per cent.

The firm dynamics model we build is based on Hopenhayn (1992). We add two key ingredients. The first of these is a borrowing constraint on firms' static input choices: firms need to finance their operations at the beginning of each period. Additionally, they do so without knowing their productivity for that period. Both facts contribute to misallocation of productive resources across firms, as the ex-post most-productive firms' scales might result too low. They also introduce accidental default in the model, as firms with low productivity draws do not have sufficient resources to pay back their short term loans.[3] The second ingredient we add to the model is a banking sector that prices loans conditional on individual firm characteristics. We model banks' credit supply parsimoniously through an interest rate function incorporated in the recursive problem of the firm. We are thus able to contain the computational complexity of the economy within a flexible enough framework that permits a rich set of interactions in financial and final goods markets.

In an economy with a competitive banking sector, improving court efficiency leads banks to lower the interest rates on loans. Better credit conditions lower firms' production costs, thus improving their current and future profitability. On the one hand, this incentivizes low-productivity firms, which might have exited the market initially, to reconsider their choice, thus worsening selection at exit. On the other hand, it creates two countervailing effects on incumbents' hiring decisions. By expanding their current scale, they can reap higher profits in the present. However, given firms finance their operations ex-ante, expanding their production comes at the cost of a

[1]We thank Piergiorgio Alessandri, Marcello Bofondi, Luisa Carpinelli, Paolo Sestito and, in particular, Federico Cingano, Silvia Giacomelli, and Elisa Guglielminetti, for insightful comments and discussions. We also thank participants in various seminars and conferences, in particular at the Bank of Italy for the lively discussion and helpful comments, as well as two anonymous referees. Any remaining errors are attributable to the authors solely.

[2]Similar to Jappelli et al. (2005), the effects of improving default procedures on credit market outcomes depend on the degree of competition banks face. As banks internalize higher recovery values in case of bankruptcy, they may be willing to increase the probability of credit defaults by charging higher interest rates. The direction in which loan pricing is affected is thus unclear a priory. We assume bank profits are eroded by competition, the standard assumption in models with endogenous default (e.g. Chatterjee et al., 2007; Arellano, 2008). Additionally, empirical evidence on the Italian banking sector shows it is relatively competitive by international standards (see Section 2.2). When banks are able to exert market power instead, they choose to increase interest rates on average (see Appendix).

[3]We only consider transitory productivity shocks and firms that do not differ permanently in terms of their productivity levels; our setup addresses firm liquidity issues, akin to accidental default, as opposed to solvency issues, which are more likely to trigger strategic default.

higher probability of default, i.e. a lower probability of obtaining higher profits in the future. Highly productive firms benefit from expanding current production and reaping higher profits immediately. Low-productivity firms on the other hand mostly derive value from expected future productivity growth. They react to lower interest rates by reducing their current scale, thus lowering their probability of default. Most of the productivity gains from increasing court efficiency are hence achieved through the reallocation of resources from low- to high-productivity firms.

We propose a novel channel to explain the aggregate implications of court efficiency. We also propose a mechanism to distinguish the effects of increasing recovery rates vis-à-vis reducing the length of proceedings. Our paper is related to the quantitative macro literature on the misallocation of resources. More specifically, we are close in spirit to articles that have recently analyzed the quantitative effects of credit and financial frictions on endogenous productivity (e.g Buera et al., 2011; Midrigan and Xu, 2014; Buera and Moll, 2015; Gopinath et al., 2017). This paper contributes to the literature by micro-founding financial frictions through a specific channel, that of court efficiency. In technical terms, our model is related to the literature on firm dynamics (e.g. Jovanovic, 1982; Hopenhayn, 1992; Clementi and Palazzo, 2016), though we incorporate a borrowing constraint for firms, as well as loan default in equilibrium. Most quantitative models of bankruptcy (e.g. Cooley and Quadrini, 2001; Chatterjee et al., 2007), sovereign default (e.g. Arellano, 2008) and, more recently, monetary policy (Ottonello and Winberry, 2018) consider strategic default, whereas we introduce accidental default. This constitutes an innovation with respect to canonical firm dynamics models, as well as the macro-finance literature (e.g. Cagetti and De Nardi, 2006, and others cited above), both theoretically and computationally.[4] Additionally, we propose a methodological contribution to the literature on the macroeconomic consequences of competition in the banking sector (e.g. Cetorelli and Gambera, 2001; Cetorelli, 2004; di Patti and Dell'Ariccia, 2004) by letting the market structure in the banking sector play a central role in determining the effects of improving court efficiency on the real economy.

Finally, our paper is related to a strain of academic (e.g. Chemin, 2010; Giacomelli and Menon, 2017) and policy papers (e.g. Giacomelli et al., 2017, 2018) which have empirically investigated the micro-level effects of improving court efficiency. Contrary to this line of work, which has mostly focused on the length of proceedings as the main policy parameter of interest, our model suggests that the recovery rate on defaulted loans can outweigh the length of trials in the discounted present value of banks' recovery values from defaulted loans. Although further work needs to be done in order to confirm said result, it could prove to be of utmost policy relevance.

The paper is organized as follows: Section 2 provides an empirical overview of the state of court efficiency and of competition in the banking sector in Italy; Section 3 describes the firm dynamics model we build to conduct our aggregate measurements and quantitative experiments; Section 4 describes the procedure we follow to parametrize the model; Section 5 describes our policy experiments and the results we draw therefrom; and finally Section 6 concludes.

2 Court Efficiency and Bank Competition in Italy

In this section we present some stylized facts regarding the functioning of the civil court system in Italy. We document a high level of inefficiency in enforcing credit contracts from an international perspective. Additionally, we find a high level of variability across different Italian regions. We also provide the summary statistics we use to calibrate the parameters representing court efficiency in the quantitative model. To motivate the assumption of perfect competition in the banking sector, we then document that competition in the banking sector in Italy is relatively high by international standards.

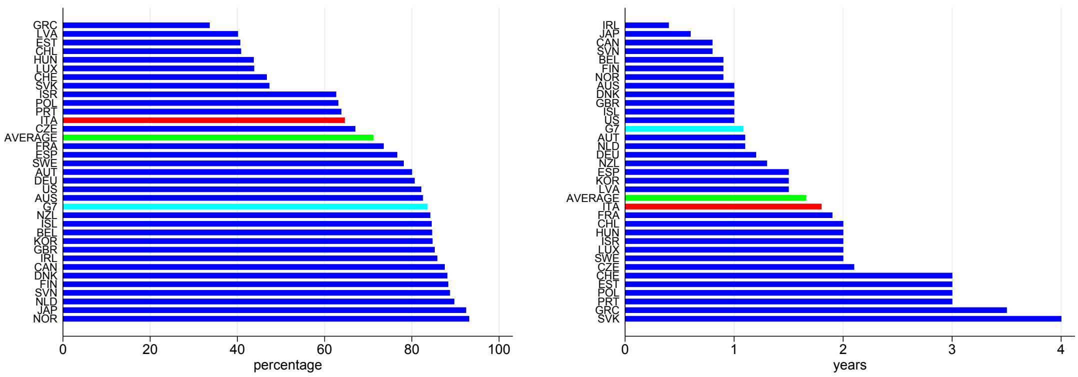
[4] The latter literature often includes a simplified, off-equilibrium strategic default option, governed by a portion of output which the firm retains in case of defaulting. Our model can be seen as a special case in which said portion is zero.

2.1 Italian Courts

Italian courts are rather inefficient by international standards. According to the World Bank's *Doing Business* report for 2018, Italy ranks 24th out of 190 countries in *Resolving Insolvency* (21st among 33 high income OECD countries).[5]

Figure 1: Court efficiency across countries (2018)

(a) Recovery rate (b) Time for recovery



Source: Wolrld Bank, *Doing Business*, 2018, Resolving Insolvency. High income - OECD countries.

We concentrate on two measures of judicial efficiency: recovery rates and the length of bankruptcy proceedings. Data from the World Bank *Doing Business* report on *Resolving Insolvency* show that Italian courts produce lower recovery rates (Figure 1a) and longer proceedings (Figure 1b) than both the average OECD and G7 country, excluding Italy. In particular, the recovery rate is almost 20 percentage points lower than that of the average G7 country, while the recovery time is 66% higher than that of the average G7 country.[6]

Table 1: Court efficiency

	Mean	Median.	Std.Dev.	25th pct	75th pct	Obs.
Recovery rate	0.62	0.67	0.24	0.50	0.79	51262
Length of proceedings (years)	9.35	8.58	5.46	5.17	12.58	51262

Source: ISTAT data on all bankruptcy proceedings closed in the period 2000-2007 in Italy.

We exploit a unique data set from the national statistical office (ISTAT), containing detailed information on all bankruptcy proceedings closed in Italian courts from 2000 to 2007. We have information for more than 55,000 proceedings (about 7,000 per year).[7] We observe, among other things: each firms' total assets and total debts; the amount recovered by debtors; the opening and closing date of the proceedings; and the court the trial took place in. We define the length of proceedings as the time passed between the opening- and closing date of the proceeding. We define the recovery rate as the sums paid to creditors at the end of the proceeding over the firm's total available assets at the start of the proceedings. Table 1 shows some descriptive statistics for

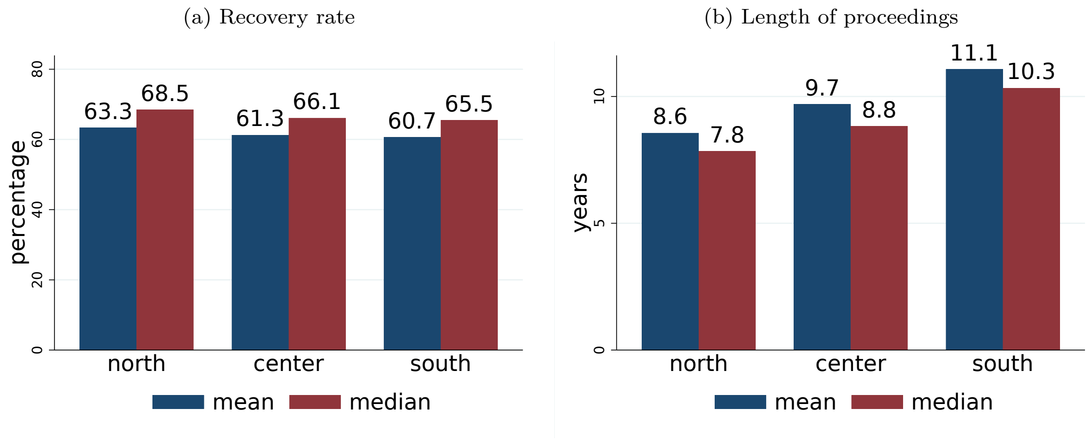
[5]Italy is also 108th, out of 190 countries (30th out of 33 high income OECD countries), in *Enforcing Contracts*.

[6]The length of proceedings in Italy is even longer if we consider the time of *Enforcing contracts*, which in Italy is more than twice that of the average G7 country.

[7]We exclude proceedings for which the defaulting firm had no assets at the start of the trial from the sample. While they account for about 40% of all cases, they are rather different from the rest. Not surprisingly, they are characterized by lower recovery rates and shorter duration.

the two main variables of interest.[8] On average, bankruptcy proceedings last about 9 years[9] with a recovery rate of about 62%.

Figure 2: Court efficiency in Italy (2000-2007, by geographical areas)



Source: ISTAT data on all bankruptcy proceedings closed in the period 2000-2007 in Italy.

We find substantial heterogeneity in court efficiency across different geographical areas within Italy, both in recovery rates (Figure 2a), as well as in the length of the proceedings (Figure 2b). These regional differences suggest that there is significant scope for improvement in court efficiency. This is confirmed by Giacomelli et al. (2017) with more recent data from the Italian Ministry of Justice. They document similar differences not only across geographical areas, but also across courts within the same regions. They additionally show that these differences partly reflect organizational inefficiencies. Furthermore, Giacomelli et al. (2018) show that the length of the initial and sale phases of real estate foreclosures in Italy have been substantially reduced following recent regulatory changes in 2015 and 2016. From our understanding, both the descriptive and the reduced form empirical evidence suggest that there is wide scope for improving court efficiency in Italy, and that carefully implemented reforms have a good chance to further do so.

2.2 Bank Competition in Italy

Our model allows for different levels of competition among banks, which determine how they price loans. We assume a perfectly competitive banking sector in our baseline model, based on the empirical evidence we present. This implies that banks set interest rates to break even in expected terms when taking into account the probability of a loan defaulting and judicial efficiency.[10] Figure 3 reports two concentration indexes from the ECB *Report on financial structures* (ECB, 2017) for some European countries in 2016. Both the Herfindhal concentration index (Figure 3a) and the share of total assets of the five largest credit institutions (Figure 3b) show that the Italian credit sector is characterized by a substantially higher level of competition than most European countries, and higher than the EU and Euro Area averages.

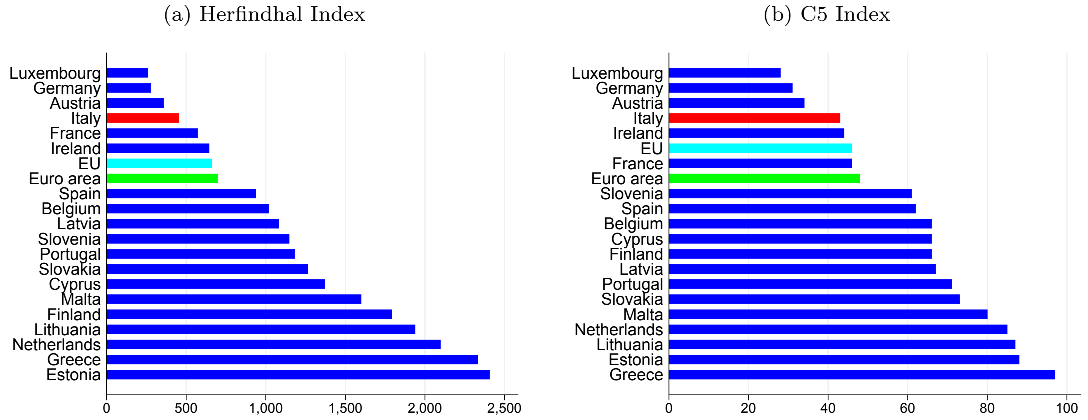
This evidence is confirmed by other measures of competition. Using the H-statistic (Panzar and Rosse, 1987), Bikker and Haaf (2002), and Claessens and Laeven (2004) show that the Italian

[8]The numbers in Table 1 differ from the ones reported by World Bank *Doing Business* in Figures 1a) and 1b. In order to ensure the comparability across different countries, *Doing Business* focuses on a very specific type of bankruptcy case, which is rather different from the typical bankruptcy case in Italy. It is however related to what is known as *amministrazione straordinaria*, a particular portion of bankruptcy legislation applied to big firms.

[9]These numbers are the same order of magnitude as the length of bankruptcy proceedings documented in Giacomelli et al. (2017) for 2015.

[10]Coincidentally, it is also a standard assumption in quantitative models with endogenous default (e.g. Chatterjee et al., 2007). In the Appendix, we also present the case of a monopolist bank that sets the interest rate to maximize its expected profits.

Figure 3: Bank competition measure (selected European countries, 2016)



Source: *Report on financial structures* (ECB, 2017). (a) The *Herfindahl Index* refers to the concentration of banking business. The index ranges from 0 to 10000. (b) The *C5 Index* is the share of total assets of the five largest individual credit institutions on an unconsolidated basis.

banking sector was more competitive (both in 1997 and over the period 1994-2001) than the average of other G7 countries; using the Boone index (Boone, 2008), van Leuvensteijn et al. (2011) classifies Italy's banking market (together with Germany's and Spain's) as comparatively more competitive than other major countries in the Euro Area for the period 1992-2004.

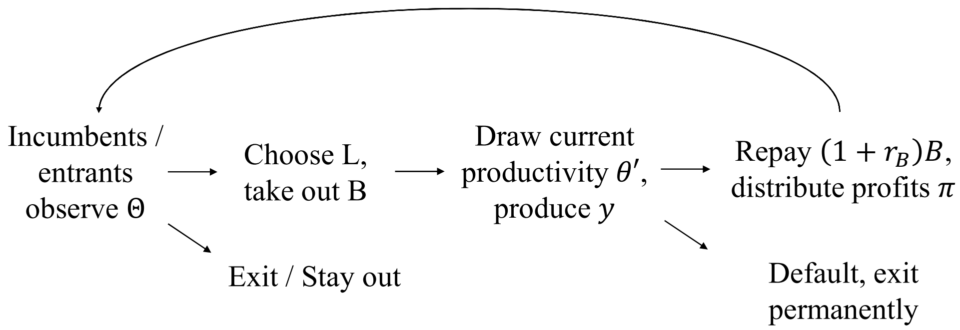
3 Model

In this section we present the firm dynamics model based on Hopenhayn (1992) we use to conduct our quantitative exercises. The economy is populated by a continuum of heterogeneous firms and potential entrants. Firms differ in terms of their transitory productivity and there is no aggregate uncertainty in the economy. Firms face short-term liquidity needs in order to finance their operations. As they cannot save, firms that cannot meet their financial obligations when a lower than expected productivity shock hits, default in equilibrium. Court efficiency is summarized in the model by the recovery rate from defaulted loans and the length of proceedings; together they determine the expected recovery value on defaulted loans. Banks price their loans taking court efficiency into account, together with a firm's probability of default, which banks infer from the firm's past productivity.

Events in the model, summarized in Figure 4, evolve as follows: at the beginning of a period, both incumbents and potential entrants observe their current state Θ, which contains information on the distribution of their yet unknown current-period productivity shock, as described by Equation 2. Given that information, each individual firm decides whether to partake in the market in the current period, or not. New firms that decide to enter the market bear the sweat cost χ, whereas incumbents don't. Firms that decide to stay out of the market, receive a zero payoff and are not allowed to reenter in future periods.

Firms that decide to participate in the market, need to finance a sunk cost f and the wage bill wL corresponding to the amount of labor they wish to hire. They thus borrow B at an interest rate $r_B(L;\Theta)$, determined by the bank given the firm's type Θ. Only afterwards does each individual firm discover its current-period productivity θ'. At that point, they produce final output, using the production function detailed in Equation 1. Firms that make sufficient revenues honor their debts; those that default, exit the market permanently. At that point, a new period starts and the events in the model economy repeat themselves from the start.

Figure 4: Timing of the Model



3.1 Technology

We assume that there is a continuum of incumbents firms. Each firm can produce a homogeneous good using labor after paying a fixed cost f. They use the following production technology:

$$y = \theta' L^{\alpha} \tag{1}$$

where $\theta' \in \mathbb{R}_+$ is a firm's current, idiosyncratic productivity. It is unknown at the moment firms make their labor (and debt) decisions. The productivity of incumbent firms evolves according to the following AR(1) process: $\log \theta' = \rho \log \theta + \epsilon$ where ϵ is *i.i.d.* across firms and time and it is normally distributed with mean zero and variance σ_ϵ^2. We denote the distribution of current productivity θ' conditional on past productivity θ as $F(\theta'|\theta)$.

In addition to incumbent firms, there is a continuum of potential entrants, which pay a "sweat" cost χ to enter the market. Firms that enter the market draw their current productivity from the unconditional distribution of θ, that is: $\log \theta' \sim \mathcal{N}\left(0, \sigma_z^2\right)$ where $\sigma_z^2 = \left(1 - \rho^2\right)^{-1} \sigma_\epsilon^2$. We denote the current productivity distribution for entrants as $G\left(\theta'\right)$.

A firm's type Θ summarizes its individual state. It takes the value of the firm's previous period productivity $\Theta = \theta$ for incumbents, and the value $\Theta = E$ for entrants. The only difference between incumbents and entrants is the distribution of their current period productivity shock (θ'); we thus define a unique distribution function $H\left(\theta'|\Theta\right)$ for either firm type Θ as follows:

$$H\left(\theta'|\Theta\right) = \begin{cases} F\left(\theta'|\theta\right) & \text{if } \Theta = \theta \\ G\left(\theta'\right) & \text{if } \Theta = E \end{cases} \tag{2}$$

In addition to the sunk cost f, firms have to pay wages wL in advance before current productivity θ' is realized. All firms, both incumbents and entrants, are cashless and thus have to borrow an amount $B = wL + f$ at the beginning of the period.[11] Banks price loans taking into account a firm's type Θ. They present firms a menu of contracts that associates an interest rate $r_B\left(L; \Theta\right)$ to whatever loan size B a firm might chose. Banks set their interest rates by taking into account the firm's default probability and court efficiency. Given the menu of contracts $\{L, r_B\left(L; \Theta\right)\}$ firms choose how much labor L to hire in the given period.

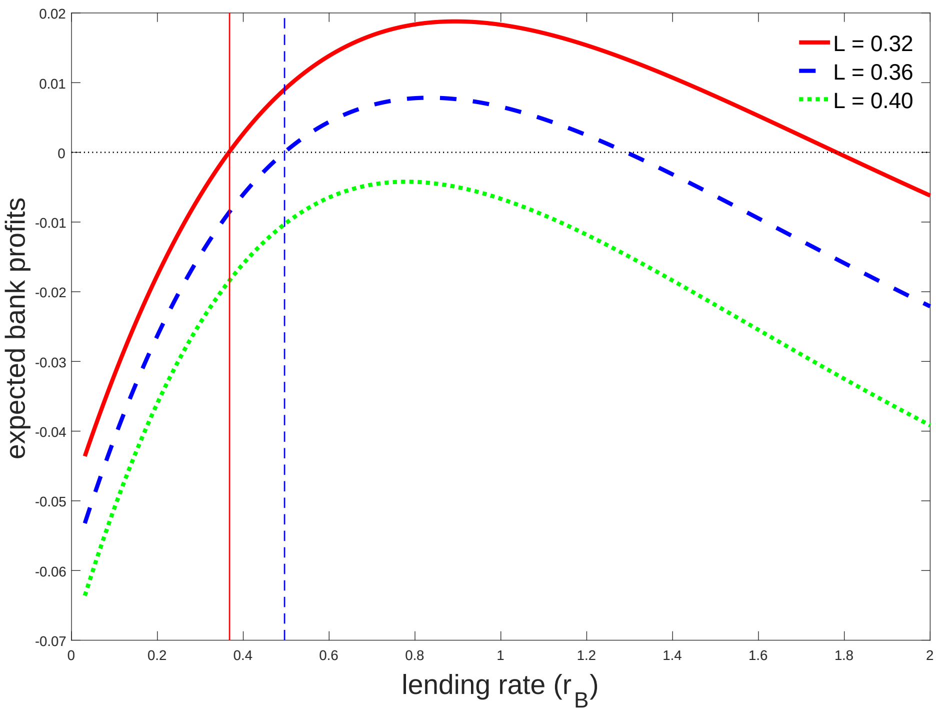
3.2 Banks

Information is symmetric across all agents in the model. Banks observe each firm's type Θ, as well as the distribution of its current productivity shock $H\left(\theta'|\Theta\right)$. Banks offer firms a menu of contracts conditional on the latter's type: in exchange of a loan of size $B = wL + f$ at the beginning of the period, firms promise to pay $B\left(1 + r_B\left(L; \Theta\right)\right)$ at the end of the period. For any given loan size B to a type Θ firm, the loan rate set by banks $r_B\left(.\right)$ determines the firm's probability of default.[12]

[11] Firms are not allowed to borrow for other purposes, nor can they save their realized profits across periods.

[12] The absence of strategic default implies that the states of the world in which firms do not repay their debts only depend on their employment choices, which firms choose statically. As illustrated by Equation 3, firms' value

Figure 5: Bank expected profits



Bank expected profits $\pi^B(L, r_B; \Theta)$ as a function of interest rate r_B, for a given firm type Θ for three levels of labor demand, L. The vertical lines represent the interest rate set by perfectly competitive banks as a function of labor, $r_B(L; \Theta)$.

Equation 3 represents expected bank profits from lending a type Θ firm $wL + f$ at a rate $\tilde{r}_B$. The first two elements represent expected revenues: once the firms draws their current productivity shock θ', they produce output $y = p\theta' L^\alpha$ and face liabilities $B\left(1 + r_B(.)\right) = (wL + f)\left(1 + r_B(.)\right)$. A firm repays its debts whenever it produces enough resources to do so, i.e. when $p\theta' L^\alpha \geq (wL + f)\left(1 + r_B(.)\right)$. This implicitly defines a productivity threshold $\theta_d\left(L, r_B(.)\right)$ such that firms repay their debts whenever $\theta' \geq \theta_d\left(L, r_B(.)\right)$. In that case, banks receive $(wL + f)\left(1 + r_B(.)\right)$. In case of default, banks recover a fraction γ of firms' output in T years. We denote the discounted recovery rate as $\Gamma(\gamma, T) \equiv \frac{\gamma}{(1+r)^T}$. The final term that makes up bank expected profits represents banks' opportunity cost per unit of loan r, multiplied by the size of the loan.

$$\begin{aligned}\pi^B\left(L, \tilde{r}_B; \Theta\right) = &\int_0^{\theta_d(.)} \Gamma(\gamma, T)\, p\theta' L^\alpha dH\left(\theta' | \Theta\right) + \int_{\theta_d(.)}^{\infty} \left[(wL + f)\left(1 + \tilde{r}_B\right)\right] dH\left(\theta' | \Theta\right) \\ &- (1 + r)(wL + f)\end{aligned} \tag{3}$$

As illustrated in Figure 5, bank expected profits are concave in $\tilde{r}_B$, conditional on firm characteristics Θ, for any given loan size $B = wL + f$. Charging a higher loan rate increases a bank's pay-off in case a firm is able to repay, while at the same time increasing the probability of default. Additionally, banks are unable to make positive expected profits for large enough loans at any loan rate $\tilde{r}_B$. Under perfect competition, banks offer a menu of contracts consisting of the lowest possible lending rate $r_B(.)$ such that bank profits are zero in expectation, as illustrated by Equation 4.[13]

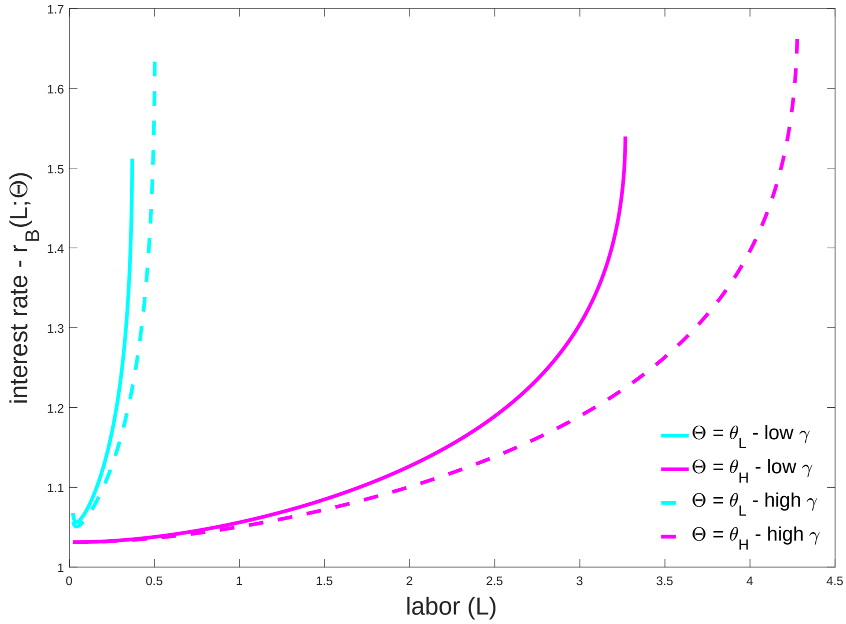
$$r_B(L; \Theta) : \pi^B\left(L, \tilde{r}_B; \Theta\right) = 0 \tag{4}$$

functions don't enter bank expected profits. Contrary to models with endogenous default choices, the interest rate function can thus be computed outside the loop that solves the firm problem.

[13]Note that expected bank profits on any given loan B, assuming it is profitable for some $\tilde{r}_B$, are zero for two different values of $\tilde{r_B}$. We assume that undercutting naturally leads banks to choose the lower value.

The resulting $r_B(.)$ is increasing in loan size.[14] As shown in Figure 6, for a given level of labor, loan rates are decreasing in a firm's past productivity θ. Past productivity reduces a firm's probability of default, *ceteris paribus*. This increases bank expected profits and reduces the loan rate at which they break even. Similarly, higher past productivity grants firms access to larger loans. Improving

Figure 6: Credit supply and court efficiency



Contracts $\{L, r_B(L;\Theta)\}$ the bank offers to incumbent firms with low ($\Theta = \theta_L$, cyan lines) and high ($\Theta = \theta_H$, magenta lines) past productivity, both with low (solid lines) and high (dashed lines) recovery rate, γ

court efficiency, i.e. either increasing the recovery rate γ or reducing the length of proceedings T, increases banks' discounted recovery rate $\Gamma(\gamma, T)$. As bank expected profits $\pi^B(L, \tilde{r}_B; \Theta)$ shift upwards, they reduce loan rates $r_B(L;\Theta)$ offered to firms. We call this the credit channel of court efficiency.

3.3 Firm Recursive Problem

At the beginning of a period firms decide whether to participate in the market; if so, they pay the fixed cost f, plus a sweat cost χ if they are first-time entrants. Market participants observe the menu of loans $\{L, r_B(L;\Theta)\}$ supplied by banks and consequently choose labor to maximize their total value $V(\Theta)$.

Equation 5 represents the problem of a firm which has chosen to participate in the final goods market in a given period. β represents the firm's discount factor. In case of repaying, the firm obtains current profits $p\theta' L^\alpha - (wL + f)(1 + r_B(L, \Theta))$, where p represents the price of the final good. A firm's expected continuation value is $\int_{\theta_d(.)}^{\infty} \max\{0, V(\theta')\}\, dH(\theta'|\Theta)$. The expected continuation value reflects the option value of exiting at the beginning of the following period. In the event of default, firms exit the market, permanently obtaining a zero payoff.

$$V(\Theta) = \max_L \int_{\theta_d(.)}^{\infty} \left[p\theta' L^\alpha - (wL + f)(1 + r_B(L, \Theta)) + \beta \max\{0, V(\theta')\}\right] dH(\theta'|\Theta) \quad (5)$$

We denote firms' maximized value function as $V^*(\Theta; p)$.[15] The solution to the firm problem

[14] For sufficiently small loans, the fixed cost of production grants firms increasing returns to labor, making the probability of default decrease with loan size. Both factors make r_B decreasing in L for very small loan sizes.

[15] Henceforth we will include the final good price p as an argument to the solution of a firm's problem, thus making this aggregate channel explicit.

provides the optimal choice of labor $L^*(\Theta; p)$. We can also derive a type Θ firm's supply function $Y^*(\theta', \Theta; p) = \theta' [L^*(\Theta; p)]^\alpha$, which depends on the realization of the current productivity shock. Taking the lowest productivity shock for which a firm is able to repay its debts $\theta_d(L, r_B)$ as defined above, we can plug in the optimal labor choice to obtain $\theta_d^*(\Theta; p) = \theta_d(L^*(\Theta; p), r_b(L^*(\Theta; p), \Theta))$. We thus define the default function as $D(\theta', \Theta) = \mathbb{1}\{\theta' < \theta_d^*(\Theta)\}$, which takes the value one for all states of current productivity such that a type Θ firm defaults at the end of the period.[16]

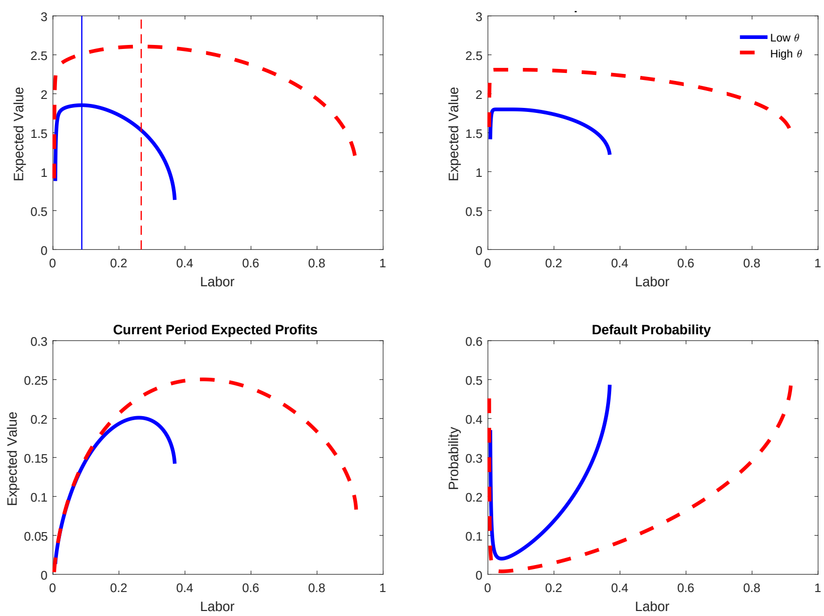
We define $\theta_e(p) = \sup\left\{\theta : V(\Theta = \theta) - \tilde{f} < 0\right\}$ as the exit productivity threshold, i.e. the largest value of productivity for which firms decide to exit at the end of the period. Consequently, we also define the following exit function, $\xi(\theta) = \mathbb{1}\{\theta \leq \theta_e(p)\}$, which is defined for incumbents only and keeps track of voluntary endogenous exit by incumbents at the beginning of each period.

Note that the exit decision is independent of the amount of labor a firm chooses in the present period.[17] Given $\theta_d(L, r_B(.))$ is increasing in loan size (except when $r_B(.)$ is decreasing in L, i.e. for small loan sizes), for small enough loan sizes $\theta_d(L, r_B(.)) \leq \theta_e(p)$, i.e. a productivity shock low enough to trigger default would also induce a firm to exit endogenously at the end of the period. Consequently, for loans such that $L \leq \tilde{L}(\Theta)$, as defined in Equation 6, firms don't not internalize increases in their default probability from taking out larger loans, making continuation value flat for such values of L.

$$\tilde{L}(\Theta) \equiv L : \theta_d(L, r_B(.)) = \theta_e(p) \tag{6}$$

Define the region left of $\tilde{L}(\Theta)$ as the default insensitivity region. Note that it shrinks with θ, because banks offer higher productivity firms lower borrowing rates: neither $\theta_d(L, r_B(.))$ nor $\theta_e(p)$ are functions of the firm's previous period productivity level, but the lowest future productivity realization for which a firm survives, given a certain loan size, is decreasing in the price of the loan. Therefore, any policy intervention that lowers borrowing rates for any given level of θ, implies a smaller default insensitivity region for those levels of previous period productivity.

Figure 7: Firm Value for Low- and High-Productivity Firms



Firm value decomposed into expected continuation value, current period expected profits, and default probability for two levels of previous productivity θ.

Figure 7 decomposes a firm's total value into its components described in Equation 5, for two incumbents with different levels of past productivity θ. Several properties stand out. First, total

[16] The notation $\mathbb{1}\{.\}$ represents an indicator function.

[17] As firms do not carry assets across periods, the amount of profits they make, which can depend on the inputs they hire, does not alter their financial needs at the beginning of the following period.

value is largely shaped by a firm's continuation value, i.e. by the discounted stream of expected future profits. This implies that firms are more reactive to movements in continuation value, than they are to changes in the other components. Second, total value is increasing in θ: given the persistence of productivity, firms with higher past productivity face a lower probability of default, higher expected profits in the current period, and most notably, higher continuation value. Third, expected continuation value—and thus also total value—is weakly concave in L: the fixed cost of production implies increasing returns to labor at small scales, thus rendering a firm's default probability decreasing with loan size for small loan values, and therefore increasing its expected continuation value. Once decreasing returns on labor kick in, the probability of default becomes increasing in loan size, hence lowering expected continuation value as the firm increases its hiring.

3.4 Steady State Equilibrium

In what follows we consider a stationary equilibrium in which all prices, aggregate quantities, and the distribution of firms across individual states, including the mass of entrants, are constant. Individual firms can nonetheless change their states every period in the stationary equilibrium. Furthermore, entry in and exit out of the market happen constantly. As in Hopenhayn (1992) we assume free entry and clearing in the final good market.

The Ergodic Distribution of Firms We denote the distribution of incumbent firms with past productivity θ in period t as $\mu_t(\theta)$. These are measured at the moment they choose labor, after the endogenous exit decision. Every period there is a mass M of entrants, which we assume constant in a stationary equilibrium. Intuitively, the mass of incumbent firms with past productivity θ' in $t+1$, is composed of all incumbents firms in t (with past productivity θ) and all entrants in t that *i)* receive a current productivity in t equal to θ', *ii)* do not default at the end of period t, and *iii)* do not exit voluntarily at the beginning of period $t+1$.

$$\mu_{t+1}(\theta') = (1-\xi(\theta'))\left(\int_0^\infty (1-D(\theta',\theta))\, dF(\theta'|\theta)\,\mu_t(\theta) + M(1-D(\theta',E))\,G(\theta')\right) \tag{7}$$

We define $\Omega(\mu_t(\theta); M, p)$ as the mapping illustrated in Equation 7. It describes how the distribution of incumbents in a certain period, given a mass of entrants and a final good price, transitions into the distribution of incumbents in the following period, $\mu_{t+1}(\theta)$. $\Omega(\mu_t(\theta, M, p); M, p)$ depends on the current mass of incumbent firms, the endogenous exit and default decisions (and therefore on prices), the exogenous evolution of productivity of incumbents $F(\theta'|\theta)$, and the distribution of the current productivity of entrants $G(\theta')$.

$$\mu^*(\theta; M, p) = \Omega(\mu^*(\theta; M, p); M, p) \tag{8}$$

Finally, Equation 8 describes the invariant distribution of incumbent firms over past productivity $\mu^*(\theta; M, p)$ which the steady state equilibrium produces.

Free Entry There is an infinite mass of potential entrants. Free entry implies that new firms will join the market as long as their expected future profits exceed the cost of setting up shop. In equilibrium, the free entry condition implies that the sweat entry cost be at least as large as the value of entering the market.

$$V^*(\Theta = E; p) \leq \chi \tag{9}$$

In an equilibrium with a positive the mass of entrants M, the equilibrium price in the economy p^* is determined by solving Equation 9 with equality.[18] An improvement in court efficiency that increases entrants' expected profits will thus tend to lower p^* in order for the free entry condition to hold.

[18] In section 5.3 we solve an alternative specification of the model in which we normalize the price of the final good and clear the labor market instead.

Market Clearing We assume a perfectly elastic labor supply; the wage rate is fixed and normalized to 1. We close the model by clearing the consumption good market. Aggregate demand is exogenous and determined by Equation 10, where η represents the constant elasticity of aggregate demand.

$$AD\left(p\right)=\frac{\bar{D}}{p^{\eta}} \tag{10}$$

The aggregate quantity of consumption good demanded in equilibrium, $AD\left(p^{*}\right)$, is determined by the free entry condition as described above. The supply of goods is given by aggregating all incumbents' and entrants' supplied quantities. It therefore depends on the optimal choice of individual firms, the stationary distribution of incumbents, and the mass of entrants, as summarized by Equation 11.

$$\begin{aligned} AS\left(M,\mu^{*}\left(\theta;M,p^{*}\right),p^{*}\right)=&\int_{\theta}\left\{\int_{\theta'}Y^{*}\left(\theta',\Theta=\theta;p^{*}\right)dF\left(\theta'|\theta\right)\right\}d\mu^{*}\left(\theta;M,p^{*}\right) \\ &+M\int_{\theta'}Y^{*}\left(\theta',\Theta=E;p^{*}\right)dG\left(\theta'\right) \end{aligned} \tag{11}$$

Market clearing is achieved by finding the mass of entrants M that sets $AS\left(M,\mu^{*}\left(\theta;M,p^{*}\right),p^{*}\right)$ equal to the predetermined level of aggregate demand. Note that the value of η plays a central role in determining the effects of any policy in equilibrium on aggregate output and labor. Given the model is not designed to effectively estimate aggregate demand, we discuss the robustness of our main results to different values of η in Section 5.3.

Solution Algorithm Given the definition of a stationary equilibrium described above, we divide the solution algorithm in two steps. First, we find the consumption good price p^{*} that satisfies Equation 9, the free entry condition. This step involves solving firms' recursive problem, Equation 5, conditional on the menu of loan contracts offered by banks, determined by Equation 4. This step yields the policy functions $L^{*}\left(\Theta;p\right)$, the exit decision $\theta_{e}\left(p\right)$, and the default threshold $\theta_{d}\left(\Theta;p\right)$, in addition to the equilibrium price p^{*}. In the second step, given the equilibrium price p^{*}, we find the equilibrium mass of entrants M^{*} that clears the consumption good market, using Equations 10 and 11. We additionally find the ergodic steady state distribution of incumbent firms $\mu^{*}(\theta;M^{*},p^{*})$, given the mass of entrants M^{*}, in this step.

4 Calibration

This section describes how we choose the values for the different parameters in the model described above. We divide the parameters into three groups: policy parameters, which we measure directly in our data; fixed parameters, which we take from the literature or normalize without loss of generality; and our endogenously calibrated parameters. Table 2 reports the value for all parameters in the model.

The first two parameters that need to be assigned values are the policy parameters that represent court efficiency. Using data on all the bankruptcy procedures closed in the period 2000-2007 in Italy (see Section 2.1), we set the recovery rate γ equal to 62% and the length of proceedings equal to 9 years.

As per the literature, we set certain parameters following previous papers. We set banks' cost of funds to 3.1% and firms' discount factor $\beta=1/r=0.97$. The elasticity of firm-level output with respect to labor, α, is set to 2/3. We normalize the mean of the productivity process, μ, and the aggregate demand shifter, $\bar{D}$, to 0 and 100 respectively. Changing their values shifts the model's equilibrium without affecting any of our quantitative results. We set the elasticity of aggregate demand η to 1. We document the robustness of our main results to different values of η in Section 5.3. It does not affect any of the relevant targets, as it only affects the aggregate scale of the economy (output and labor).

The 4 remaining parameters (the persistence ρ and dispersion σ_{ϵ}^{2} of the productivity process, entrants' sweat cost χ, and incumbents' fixed cost of production f) are calibrated by requiring

Table 2: Parameters

Panel A: Policy Parameters

Parameter	Symbol	Value
Recovery rate	γ	0.62
Length of proceedings	T	9.0

Panel B: Fixed Parameters

Parameter	Symbol	Value
Bank cost of funds	r	0.031
Firms discount factor	β	0.97
Coefficient of production function	α	0.66
Mean of productivity process	μ	0
Demand shifter	$\bar{D}$	100
Demand elasticity	η	1

Panel C: Calibrated parameters

Parameter	Symbol	Value
Persistence of productivity process	ρ	0.65
Variability of productivity process	σ_ϵ^2	0.54
Sweat entry cost	χ	4.31
Fixed cost of production	f	0.020

Panel A: policy parameters parameters, taken from bankruptcy data. Panel B: fixed parameters, normalizations or taken from relevant literature. Panel C: calibrated parameters (see text for details).

Table 3: Calibration

	Italian Data	Model
Aggregate exit rate (%)	7.3	7.3
Mean to median firm size	3.4	3.0
Borrowing interest of firms (%)	8.0	8.0
Misallocation contribution (%)	35.0	32.9

All Italian data come from balance sheet from Cerved data matched with INPS data for 2006, with the exception of interest rate data that comes from Central Credit Register data and of with the exception of "Misallocation contribution" that comes from Linarello and Petrella (2016) (see main text for details).

Table 4: Non targeted statistics

	Italian Data	**Model**
Relative size of entrants	36.0	23.3
Share of entrants (%)	9.0	8.5
Share of labor by entrants (%)	3.4	1.9
Share of output by entrants (%)	2.1	2.6
Share of labor by exiters (%)	5.1	6.5
Share of output by exiters (%)	3.6	2.7
Exit rate of new entrants	10.0	9.9
10th percentile/median	0.2	0.6
25th percentile/median	0.4	0.8
75th percentile/median	2.4	2.7
90th percentile/median	5.6	4.7
Gini of firm size distribution	70.0	60.7

All Italian data come from balance sheet from Cerved data matched with INPS data for 2006.

the model to replicate some stylized facts on firm dynamics, the firm size distribution, credit market conditions, and input misallocation for the Italian economy. We target the following data: the aggregate exit rate, equal to 7.3%; the ratio of mean to median firm size in terms of employment, which is 3.4; firms' average borrowing rate, equal to 8%; and the share of weighted average productivity accounted for by the OP covariance, which is 35% in the Italian data for 2005 (Linarello and Petrella, 2016). Following Bartelsman et al. (2013), we measure the misallocation of inputs across firms using the OP covariance between firm size and productivity.[19] We use the median interest rate on credit lines for Italian corporations from the Bank of Italy Central Credit Register for the last target. All other targets are taken from balance sheet data for the universe of non-farm, non-financial private Italian corporations (from Cerved Group), merged with social security data (INPS) for employment, for the year 2006.

Table 3 shows that our stylized model is able to reproduce our chosen targets fairly well, despite being relatively parsimonious. Furthermore, the model is able to replicate other non targeted features of the Italian economy, as shown in Table 4. The model matches the share of entrants, their relative size, their share of output, their exit rate, labor over total output, and total labor fairly well.[20] The model additionally matches the aggregate exit rate, as well as exiters' share of total output and labor right before leaving the economy. The model captures the entire firm size distribution fairly well.[21] This is particularly true at the upper end (ratios of 75^{th} and 90^{th} percentiles to the median), though less so at its lower end. In particular, it is not able to replicate the large number of very small firms in the data. The Gini index of the firm size distribution in the model is quite close to the one in the data, which confirms the model's good fit.

5 The Policy Experiment

To analyze the aggregate effects of improving court efficiency on the economy we conduct two policy experiments. First we increase the recovery rate from the baseline level of 62% to 80%, close to the 75^{th} percentile of the distribution of recovery rates in Italian data. Then we reduce

[19] Olley and Pakes (1996) show that weighted average productivity can be decomposed into the unweighted average productivity of market participants and the covariance between firm size and productivity (OP covariance). The latter can be interpreted as an inverse measure of misallocation of resources: the more inputs are allocated to more productive firms on average, the higher OP covariance.

[20] We define entrants as firms with less than two years of age, though the targets do not vary significantly when choosing alternative definitions.

[21] The literature often targets the firm size distribution to directly calibrate the parameters of the firm productivity shock distribution. We take the fact that we are able to replicate the former, in spite of not targeting it, as validation for our choice of not choosing direct targets for the productivity shock distribution.

the length of proceedings from the baseline level of 9 years to 5 years, which is the 25$^{\text{th}}$ percentile of the distribution of the length of Italian bankruptcy proceedings.[22]

5.1 Inspecting the Mechanism

Before presenting the quantitative results of the policy experiment, we discuss the mechanisms at play in the model. Improving court efficiency, i.e. either increasing the recovery rate or reducing the length of proceedings, affects the present value of the amount recovered by banks in the event of default. $\Gamma(\gamma, T)$ is an increasing function of γ and a decreasing function of T, so that both policy parameters act through the same channel. We can thus focus solely on increasing the recovery rate γ without loss of generality.

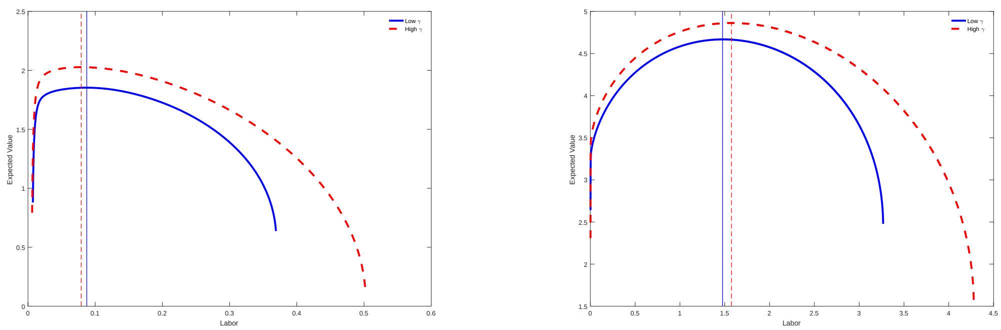
The aggregate effects of improving court efficiency are composed of i) the partial equilibrium effects of the change of the recovery rate (γ) on bank and firm decisions, given the price of the consumption good and the distribution of firms; ii) the general equilibrium effects due to the consumption good price adjusting to restore the free entry condition ($V^*(\Theta = E) = \chi$); and iii) the effects of firm dynamics due to changes in the mass of entrants and on the distribution and number of incumbents. Next we analyze each of these effects separately.

Partial Equilibrium Effects Increasing the recovery rate on defaulted loans γ improves banks' pay-offs in case of default. Given banks face perfect competition, they utilize the higher expected revenues to undercut competitors, while simultaneously extending larger loans. Offered rates $r_B(.)$ therefore pivot downward and towards the right, as illustrated in Figure 5.

Facing lower loan rates and higher borrowing limits, firms' expected current profits, as well as their continuation value, rise. In addition, the default insensitivity region shrinks, for all levels of θ. This creates a trade-off when determining how to adjust their scales: on the one hand, rising expected current profits incentivize firms to expand their current operations; on the other hand, the expectation of higher future profits, as well as their increased sensitivity to default, advises firms to decrease their probability of default in order to increase the probability of materializing potentially higher future proceeds, by decreasing their current borrowing.

Figure 8: Firm profits, labor choice and court efficiency

(a) Low past productivity ($\Theta = \theta_L$) (b) High past productivity ($\Theta = \theta_H$)

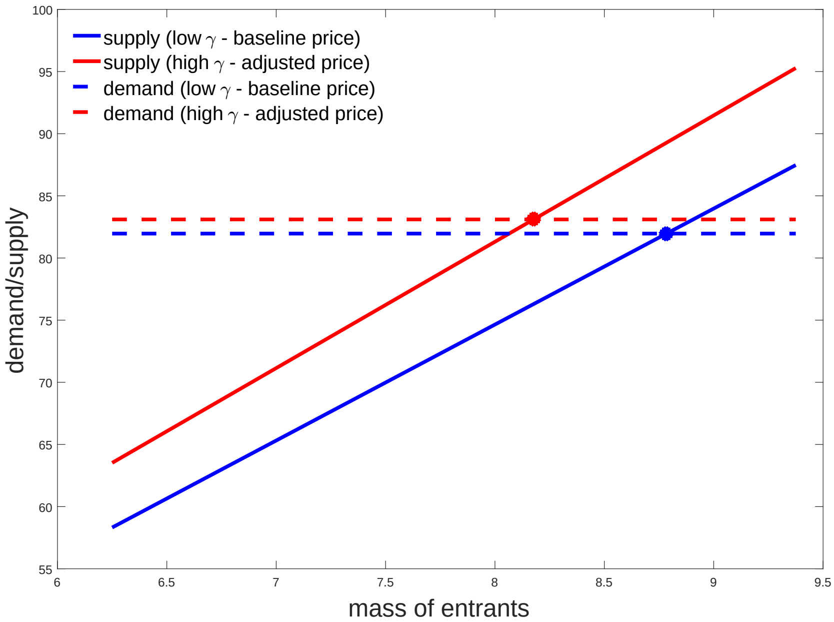


Expected discounted present value of profit as a function of labor, for low (left panel) and high (right panel) past productivity firms, for low (blue solid lines) and high (red dashed lines) recovery rate, γ. The vertical lines represent the optimal labor choice under both level of judicial efficiency.

Figure 8 illustrates how hiring decisions might go in opposite directions for low- and high-productivity firms respectively. Given continuation value weighs significantly more than expected current period profits for a low-productivity firm, these decide to cut their hiring in the current

[22] Giacomelli et al. (2018) find that regulatory changes to real-estate foreclosures in Italy in 2015 and 2016 reduced the length of the preliminary phases of the proceedings by almost 50%.

Figure 9: Equilibrium in the goods market



Aggregate demand (dashed, horizontal lines) and aggregate supply (solid, upward sloping) for low (blue) and high (red) court efficiency as a function of the mass of entrants. Demand and supply for high court efficiency are considered after price have adjusted to satisfy the free entry condition.

period. On the other hand, the potentially higher profits in the current period are large enough for high-productivity firms to increase their hiring. In the aggregate, the latter firms hold a larger share of the market, thus increasing labor demand as well as the supply of consumption good.

General Equilibrium Effects: Price Adjustment An increase in the recovery rate γ causes the value of entry $V(\Theta = E)$ to increase by virtue of the lower borrowing rates faced by all firms. Consequently, the price of the consumption good p falls in order to restore the free entry condition. This in turn increases the probability of default, as firms produce less revenue per unit of good sold, and reduces the amount banks recover in the event of default.[23] Perfectly competitive banks are thus forced to increase loan rates $r_B(.)$ for all loan sizes. The increased loan rates, higher probability of default, and the direct effect of a reduction in price reduce both the expected continuation value and expected current period profits. As discussed above, these changes have countervailing effects on firms' optimal labor choices; even though the direct effect of a lower consumption good price dominates for all firm types, it does not reverse the partial equilibrium effects lead by high-productivity firms.[24]

While the aggregate quantity of consumption good supplied remains higher than initially for any given number of entrants, the aggregate quantity of consumption good demanded also increases after p falls. Under our benchmark calibration the overall shift of the aggregate supply schedule is larger than that of the aggregate demand schedule, as shown in Figure 9. The mass of entrants must therefore decrease for the consumption good market to clear.

The Effects of Firm Dynamics The combination of a lower mass of entrants and lower exit rate has two effects on the steady state distribution of incumbents. While the number of incumbents

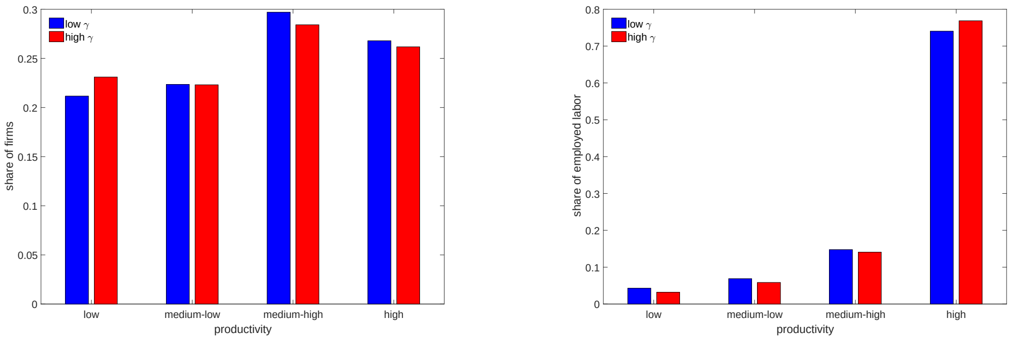
[23] For any firm type Θ, any level of labor L, and any loan rate $r_B(.)$, a lower price increases the current productivity threshold $\theta_d(.)$ for which the firm doesn't default.

[24] The increase in the discounted recovery rate affects entrants indirectly through lower borrowing rates, whilst a fall in prices has both direct effects on the value of entry, as well as indirect effects through higher borrowing rates; the elasticity of the value of entry to price changes is thus higher than its elasticity with respect to the discounted recovery rate, thus making a price fall large enough to reverse the partial equilibrium effects unlikely.

Figure 10: Firm and labor distribution and court efficiency

(a) Share of firms by productivity

(b) Share of labor by productivity



Distribution of firms and labor by productivity levels, with low (blue bars) and high (red bars) recovery rates.

increases for any given productivity level, their distribution becomes more skewed towards less productive firms. Figure 10a shows the share of firms grouped by productivity level, under low and high recovery rates.[25] As a higher recovery rate γ improves financial conditions, the value of operating $V(\Theta)$ increases for any productivity level. This decreases the threshold productivity for which firms exit the market, $\theta_e(.)$. Additionally, given less-productive firms decide to cut back hiring, their probability of default in equilibrium is overall lower. Consequently, some low-productivity firms that would have exited under the initial level of γ, continue to operate.

The preponderance of low-productivity firms prompts the unweighted average productivity of the economy to fall. However, given they choose to downsize while high-productivity firms expand, the share of labor held by the latter increases, as seen in Figure 10b. This induces an increase in the OP covariance (i.e. an improvement in the allocation of labor) and in labor-weighted average productivity.

5.2 The Quantitative Effects of Improving Court Efficiency

The aggregate effects of increasing the recovery rate γ from the baseline value of 62% to 80% are reported in columns 2 and 3 of Table 5. Column 2 reports the final steady state values of selected variables in the economy, while column 3 shows their differences with respect to the baseline equilibrium.[26]

As discussed above, the increase in the recovery rate γ reduces loan rates $r_B(.)$ for all firms. In the new equilibrium, borrowing rates are on average 6.87% compared to a baseline level of 8.04%. Prices are about 1.4% lower, due to the higher entry incentives induced by lower borrowing costs. Clearing in the consumption good market, $Y = AD(p) = \bar{D}/p$, implies an increase in total output. The aggregate exit rate decreases from 7.3% to 6.9%, while that for entrants decreases from 9.95% to 8.7%. Overall, the total number of firms increases by about 6.75%. Following these adjustments in the economy, average weighted firm productivity grows by about 2%.

Average weighted productivity is affected by two opposing forces. Given the lower borrowing rates, less-productive firms are more likely to survive, as well as re-enter the market at the end of each period. This negative selection at exit is reflected in the unweighted average productivity of firms, which falls by more than 1%. On the other hand, the OP covariance between firm size and productivity, which is inversely related to misallocation of inputs across firms, increases by about 8%. The latter is due to relatively productive firms increasing the quantity of labor demanded, while less productive firms reduce it—including entrants, who are relatively unproductive and whose share of labor falls from 1.9% to 1.4%.

[25] We group firms by approximating the quartiles of the productivity distribution under the baseline scenario.

[26] We report the percentage changes for all absolute magnitudes (e.g. output). For variables expressed in percentages (e.g. exit rate) we report absolute differences in percentage points.

Table 5: Results of the policy experiments

	Baseline	**High γ**	Δ_γ	**Low T**	Δ_T
γ	0.62	0.80		0.62	
T	9.00	9.00		5.00	
Price	1.22	1.20	-1.37	1.21	-0.77
Output	81.95	83.09	1.39	82.58	0.76
Total Employment	42.82	43.13	0.73	42.81	-0.04
Average Borrowing Rate (%)	8.04	6.87	-1.17	7.40	-0.64
Mass of Entrants	8.78	8.18	-6.91	8.40	-4.38
Exit Rate (%)	7.29	6.88	-0.41	6.90	-0.39
Entrants Exit Rate (%)	9.95	8.66	-1.29	8.87	-1.08
Productivity (weigthed)	1.90	1.94	2.20	1.93	1.57
Productivity (un-weigthed)	1.27	1.26	-1.04	1.27	-0.69
Olley - Pakes covariance	0.63	0.68	8.79	0.66	6.18
Mass of firms	112.18	119.75	6.75	117.88	5.08
Share of entrants (%)	7.83	6.83	-1.00	7.12	-0.70
Share of entrants labor (%)	1.94	1.37	-0.57	1.50	-0.45

The Δ's in columns 3 and 5 are taken with respect to the Baseline. The differences are percentage changes for all absolute magnitudes (e.g. Output) and they are absolute differences for variables expressed in percentage (e.g. Exit Rate).

Reducing the length of proceedings T from 9 to 5 years yields qualitatively similar results to increasing the recovery rate, as shown in columns 4 and 5 in Table 5. However, the effects of reducing the length of proceedings are somewhat smaller in magnitude. Average weighted productivity increases by about 1.6%. The qualitative result is not surprising. Both the recovery rate γ and resolution time T act through the same channel, i.e. by increasing banks' discounted recovery rate $\Gamma(\gamma, T)$. In our baseline calibration, increasing γ boosts $\Gamma(\gamma, T)$, from 47.1% to 60.8%. Halving T instead increases $\Gamma(\gamma, T)$ by about 6 percentage points, from 47.1% to 53.2%. From a policy perspective, it is nonetheless crucial to understand what determines the quantitative difference between the effects of either policy. On the one hand, delaying the resolution of bankruptcy cases might have costs beyond the opportunity cost of re-investing whatever is recovered, e.g. litigation fees, or having to increase one's capital buffers; on the other hand, it might also be the case that shorter resolution times come at the cost of lowering recovery rates, thus rendering the measure counterproductive.[27]

5.3 Robustness

In this section we study the robustness of our main results—the effects of improving court efficiency on aggregate productivity—to our modelling choices and to the calibration. First, we explore what consequences the elasticity of aggregate demand has on our economy. We find that the effects on misallocation and aggregate productivity are invariant to the choice of the parameter η. This is due to the fact that, in our model, rates and prices, whose movements generate the credit channel response leading to the reallocation of inputs, help regulate firms' incentives to enter the final good market, rather than being determined by market clearing. In the model, elasticity of demand affects the adjustment in the mass of entrants necessary to restore the equilibrium in the goods market, thereby affecting aggregate output and input usage. In a second robustness exercise, we explore the effects of using wages, as opposed to the final good price, to determine the adjustment of the value of entry. Our results on misallocation and productivity are again robust— though not identical—due to wages entering the problems of both firms and banks differently than prices, while output and input usage again only follow suit qualitatively. In a final robustness check we extend the basic model to allow for a stigma cost related to default. This helps us replicate the share of endogenous exit, as opposed to due to defaulting, in the Italian economy. Given the simplicity of our framework, this calibrated version of the model features substantially lower default risk than in the baseline version. This leads to a significantly lower borrowing rate compared to the data. This

[27] The effect of a reduction in the length of proceedings on recovery rates could go either way empirically. Faster proceedings might reduce the depreciation of collateral, thus increasing its sale value. However if courts try to sell the collateral faster, they might lower the going price in the auctions, negatively affecting the amount recovered.

Table 6: Results with low elasticity of demand ($\eta = 0.5$)

	Baseline	**High** γ	Δ_γ	**Low** T	Δ_T
γ	0.62	0.80	29.03	0.62	0.00
T	9.00	9.00	0.00	5.00	-44.44
Price	1.22	1.20	-1.37	1.21	-0.77
Output	81.95	82.52	0.70	82.26	0.38
Average Borrowing Rate (%)	8.04	6.87	-1.17	7.40	-0.64
Productivity (weigthed)	1.90	1.94	2.19	1.93	1.58
Productivity (un-weigthed)	1.27	1.26	-1.04	1.27	-0.69
Olley - Pakes covariance	0.63	0.68	8.77	0.66	6.22
Mass of firms	112.18	118.99	6.07	117.42	4.66

The Δ's in columns (3) and (5) are taken with respect to the Baseline. They are absolute differences for the Average Borrowing Rate and percentage changes for all other variables.

in turn makes the results of the policy exercises quantitatively smaller, but qualitatively similar to those obtained in the main version of the model.

The Elasticity of Demand We take aggregate demand as exogenous to the model, with an elasticity of demand of 1. On top of lacking reliable estimates for aggregate demand elasticity, our model concentrates on the supply side of the economy. We can therefore not discipline it with respect to the elasticity of demand. However, the elasticity of demand affects the consumption good market equilibrium, and therefore, the mass of entrants and total output in our policy experiments. The more elastic aggregate demand is, the more it increases for a given fall in the consumption good price that follows a change in banks' discounted recovery rate $\Gamma(\gamma, T)$. The more elastic aggregate demand is, the stronger the response of the mass of entrants and output in equilibrium.

In order to asses whether our parametric assumption affects the main results of the paper, we re-run our experiments with a low elasticity of demand ($\eta = 0.5$), and a high elasticity of demand ($\eta = 3$) respectively. In both cases we re-normalize the parameter $\bar{D}$ to render each alternative baseline economy identical to the original. We show the results in Tables 6 and 7 where we report selected outcomes, for both our main policy experiments, for both low- and high-elasticity of demand cases. The first column contains the baseline economy for the new values of η. Notice the re-normalization of $\bar{D}$ reproduces the outcomes of the original baseline economy ($\eta = 1$) exactly. Columns 2 and 3 report the effects of increasing the recovery rate γ (column 2 shows the new levels, column 3 the changes with respect to the new baseline) while columns 4 and 5 show the outcomes of lowering the length of proceedings T.

As expected, the change in price induced by the policy experiment is not affected by the elasticity of demand, as it depends only on the free-entry condition. However, that same fall in prices produces different effects on aggregate demand and therefore on output. When the elasticity of demand is low, as shown in Table 6, the increase in aggregate demand is smaller, and so is the effect on output — a 0.7% increase, compared to 1.39% when $\eta = 1$. When the elasticity of demand is high instead, the same fall in the consumption good price results in a significantly larger increase in output of about 4.2%. Qualitatively and quantitatively, however, the main results of the paper about productivity are confirmed. Increasing the recovery rate or decreasing resolution times both improve the allocation of labor. The former boosts aggregate TFP by 2.2%, while the latter increases weighted productivity by 1.6%.

Alternative Market Clearing In the main version of the model, emulating Hopenhayn (1992), we assume a perfectly elastic labor supply, normalize the wage rate to 1, and let the consumption good price clear the output market. However, the model can also be closed by reversing the clearing assumptions in both markets. Assuming a perfectly elastic demand for goods, we can use wages to restore free-entry condition. In this alternative configuration, the mass of new firms adjusts to

Table 7: Results with high elasticity of demand ($\eta = 3$)

	Baseline	**High γ**	Δ_γ	**Low T**	Δ_T
γ	0.62	0.80	29.03	0.62	0.00
T	9.00	9.00	0.00	5.00	-44.44
Price	1.22	1.20	-1.37	1.21	-0.77
Output	81.95	85.42	4.23	83.88	2.36
Average Borrowing Rate (%)	8.04	6.87	-1.17	7.40	-0.64
Productivity (weigthed)	1.90	1.94	2.19	1.93	1.58
Productivity (un-weigthed)	1.27	1.26	-1.04	1.27	-0.69
Olley - Pakes covariance	0.63	0.68	8.77	0.66	6.22
Mass of firms	112.18	123.16	9.78	119.73	6.72

The Δ's in columns (3) and (5) are taken with respect to the Baseline. They are absolute differences for the Average Borrowing Rate and percentage changes for all other variables.

Table 8: Calibration with labor market clearing

	Italian Data	**Baseline**	**Labor market**
Aggregate exit rate (%)	7.3	7.3	7.5
Mean to median firm size	3.4	3.0	2.4
Borrowing interest of firms (%)	8.0	8.0	8.2
Misallocation contribution (%)	35.0	32.9	30.2

All Italian data come from balance sheet from Cerved data matched with INPS data for 2006, with the exception of interest rate data that comes from Central Credit Register data and of with the exception of "Misallocation contribution" that comes from Linarello and Petrella (2016) (see Section 4 for details).

clear the labor market. Labor supply in this case is an exogenous function of the wage rate:

$$L^s = \bar{L} w^{\phi}$$

where $\bar{L}$ is a labor supply shifter, normalized to 1, and ϕ is the elasticity of labor supply with respect to wages. We exogenously set ϕ to 1.5 and we experiment with a lower value of 0.8 as a robustness check.[28]

The new model is calibrated following the same procedure as in the baseline specification. Table 8 reports the calibrated targets, while Table 9 reports the newly calibrated parameter as well as the original model ones. They are remarkably similar.

The results for our main policy experiments are reported in Table 10 for a high labor supply elasticity, and Table 11 for a low labor supply elasticity. The channel through which an improvement in court efficiency operates is similar to that of the baseline model. An increase in banks' discounted recovery rate, $\Gamma(\gamma, T)$, lowers borrowing rates $r_B(.)$ for all firms and loan sizes. Firms' present value of profits increases, as does the aggregate quantity of labor demanded. In order to satisfy free-entry condition, the wage rate has to increase. This in turn increases the quantity of labor supplied. In order to restore the equilibrium in the labor market, the mass of entrants

Table 9: Parameters of labor market clearing model

Parameter	**Symbol**	**Baseline**	**Labor market**
Persistence of productivity process	ρ	0.65	0.72
Variability of productivity process	σ_ϵ^2	0.54	0.50
Sweat entry cost	χ	4.31	3.76
Fixed cost of production	f	0.020	0.026

[28]These value are in the range of elasticities provided in the literature (e.g Rogerson and Wallenius, 2009; Fiorito and Zanella, 2012).

adjusts; the direction of adjustment depends on the relative shift of aggregate labor demand and aggregate labor supply and increases in both cases.

Table 10: Results with labor market clearing (high labor supply elasticity, $\phi = 1.5$)

	Baseline	**High γ**	Δ_γ	**Low T**	Δ_T
γ	0.62	0.80	29.03	0.62	0.00
T	9.00	9.00	0.00	5.00	-44.44
Wage	0.82	0.84	2.23	0.83	0.61
Output	130.01	137.87	6.05	132.26	1.73
Total Employment	74.38	76.89	3.37	75.08	0.94
Average Borrowing Rate (%)	8.18	6.67	-1.51	7.42	-0.76
Mass of Entrants	11.77	11.85	0.67	11.55	-1.87
Exit Rate (%)	7.50	6.63	-0.87	7.01	-0.48
Entrants Exit Rate (%)	13.18	10.63	-2.55	11.85	-1.34
Productivity (weigthed)	1.82	1.85	1.81	1.83	0.76
Productivity (un-weigthed)	1.27	1.25	-1.07	1.26	-0.55
Olley - Pakes covariance	0.55	0.60	8.48	0.57	3.79
Mass of firms	149.16	171.79	15.17	156.48	4.91
Share of entrants (%)	7.89	6.90	-0.99	7.38	-0.51
Share of entrants labor (%)	2.40	1.67	-0.73	2.06	-0.34

The Δ's in columns (3) and (5) are absolute differences for all magnitudes expressed in percentage (%) and percentage changes for all other variables.

The main results of the paper are robust to the alternative model specification. A higher recovery rate raises aggregate productivity by about 1.2% (1.18 in the low labor supply elasticity case). These gains are attained through a better allocation of labor across firms. The effects of reducing the length of proceedings instead are quantitatively smaller, 0.8% (0.2% in the low elasticity case).

Table 11: Results with labor market clearing (low labor supply elasticity $\phi = 0.8$)

	Baseline	**High γ**	Δ_γ	**Low T**	Δ_T
γ	0.62	0.80		0.62	
T	9.00	9.00		5.00	
Wage	0.82	0.84	2.23	0.83	0.61
Output	130.01	134.88	3.74	130.81	0.61
Total Employment	74.38	75.70	1.78	74.75	0.49
Average Borrowing Rate (%)	8.18	6.82	-1.36	7.68	-0.51
Mass of Entrants	11.77	11.99	1.87	11.87	0.83
Exit Rate (%)	7.50	6.96	-0.54	7.46	-0.04
Entrants Exit Rate (%)	13.18	11.85	-1.34	13.18	0.00
Productivity (weigthed)	1.82	1.84	1.18	1.82	0.16
Productivity (un-weigthed)	1.27	1.26	-0.62	1.27	-0.03
Olley - Pakes covariance	0.55	0.58	5.34	0.55	0.61
Mass of firms	149.16	163.79	9.81	150.68	1.02
Share of entrants (%)	7.89	7.32	-0.57	7.87	-0.01
Share of entrants labor (%)	2.40	2.02	-0.38	2.42	0.02

The Δ's in columns (3) and (5) are absolute differences for all magnitudes expressed in percentage (%) and percentage changes for all other variables.

Alternative targets While replicating several stylized facts of the Italian economy, the baseline calibration of our model does not match some important aspects of firm dynamics in Italy. In particular, all firms exit by defaulting in our baseline economy, whereas only 18% of Italian firms do so in the data.[29] Furthermore, our baseline model is not able to match the rate of exit through

[29] We define an exit as being due to default if, at the time of exiting, a firm is either involved in a bankruptcy procedure, or liable for a non performing loan with respect to the banking system.

Table 12: Parameters to match defaulters

Parameter	**Symbol**	**Baseline**	**Match defaulters**
Persistence of productivity process	ρ	0.65	0.587
Variability of productivity process	σ_ϵ^2	0.54	0.501
Sweat entry cost	χ	4.31	1.251
Fixed cost of production	f	0.020	0.013
Stigma cost of defaulting	Σ	0.0	14.943

Table 13: Calibration to match defaulters

	Italian Data	**Baseline**	**Match defaulters**
Aggregate exit rate (%)	7.3	7.3	6.8
Mean to median firm size	3.4	3.0	3.1
Borrowing interest of firms (%)	8.0	8.0	3.9
Misallocation contribution (%)	35.0	32.9	29.5
Share of exits by default	18.0	100.0	18.8

All Italian data come from balance sheet from Cerved data matched with INPS data for 2006, with the exception of interest rate data that comes from Central Credit Register data and of with the exception of "Misallocation contribution" that comes from Linarello and Petrella (2016) (see Section 4 for details).

default, even when specifically calibrating it to target the latter.[30]

We therefore introduce an additional feature in the model: a non-pecuniary stigma cost (Σ) borne by a defaulting firm before exiting the economy for good. A sufficiently high stigma cost (see Table 12) reduces the charter value of the firm by making default states costly for firms. This leads to increased endogenous exit, thus reducing the percentage of defaulting exiting firms, as shown in Table 13. However, the lower rate of defaults, as compared to the baseline version of the model, implies that lending to firms reduces banks' risk. Given the perfectly competitive banking sector, this in turn is reflected in significantly lower borrowing rates, compared to both the baseline calibration and our data for the Italian economy.

When we run the same policy experiments as with the baseline calibration, we obtain qualitatively similar results, even though somewhat smaller in magnitude (Table 14). The fall in the interest is only by 16 basis points when we increase the recovery rate (and 7 basis points when we decrease the length of bankruptcy), much more muted than in the baseline scenario. Correspondingly, the effects on the entry of new firms, the improved resources allocation and the growth in average TFP are smaller than in the baseline model: the increase in productivity is about 0.4% when we increase the recovery rate in bankruptcy and 0.17% when we reduce the length of trials. However the qualitative mechanism is exactly the same as in the baseline model: the overall increase in productivity comes from an improved resource allocation (measured by the in the OP covariance) that outweighs the entry of relatively inefficient firms.

6 Conclusions

This paper provides a simple theoretical framework to analyze how court efficiency can affect firm dynamics, resource allocation and aggregate productivity. It focuses on a specific transmission channel: credit contract enforcement shapes credit supply by altering banks' expect gains from lending funds to firms. The baseline specification of the paper suggests that improving court efficiency lowers the cost of credit faced by firms, which lets more productive firms increase their scales, while inducing less productive ones to downsize. From a quantitative point of view, increasing the recovery rate from 62% to 80% would increase average productivity by about 2.2%.

[30] In order to match this target the calibration reports values of the borrowing and exit rates that completely miss the mark.

Table 14: Results when matching defaulters

	Baseline	**High γ**	Δ_γ	**Low T**	Δ_T
γ	0.62	0.80	29.03	0.62	0.00
T	9.00	9.00	0.00	5.00	-44.44
Price	1.32	1.32	-0.19	1.32	-0.08
Output	75.49	75.64	0.20	75.57	0.10
Total Employment	33.59	33.81	0.66	33.68	0.29
Average Borrowing Rate (%)	3.88	3.73	-0.16	3.81	-0.07
Mass of Entrants	13.62	13.58	-0.29	13.60	-0.18
Exit Rate (%)	6.76	6.58	-0.19	6.68	-0.09
Entrants Exit Rate (%)	10.40	10.14	-0.26	10.28	-0.12
Productivity (weigthed)	1.73	1.73	0.40	1.73	0.17
Productivity (un-weigthed)	1.22	1.22	-0.00	1.22	0.00
Olley - Pakes covariance	0.51	0.52	1.34	0.51	0.56
Mass of firms	189.28	188.66	-0.33	189.05	-0.12
Share of entrants (%)	7.20	7.20	0.00	7.19	-0.00
Share of entrants labor (%)	1.34	1.33	-0.01	1.33	-0.00

The Δ's in columns (3) and (5) are absolute differences for all magnitudes expressed in percentage (%) and percentage changes for all other variables.

Reducing the length of proceedings from 9 to 5 years would instead increase productivity around 1.6%.

This result could have substantial policy implications. In the recent policy debate about judicial inefficiency in Italy, the reduction of the length of proceedings has received a lot of attention. The model suggests that taking into account recovery rates is crucial. For example, Giacomelli et al. (2018) documents that the 2015-2016 regulatory changes to real-estate foreclosures in Italy seem to have substantially reduced the length of proceedings. However, the results in this paper suggest that, if this reduction in times was associated with a decrease in the recovery rates of the foreclosures, the overall effect of these regulatory changes on productivity could have been dampened. Recently, the ECB (ECB, 2018) and the European Commission (EC, 2018) introduced new rules for timely provisioning and write-off practices related to non-performing loans (so called *calendar provisioning*). These new rules might induce banks to quickly sell their Non-Performing Loans (NPL) portfolio and to lower the discounted present value of the amount recovered, in order to satisfy the regulatory constraints.[31] This, according to the model, could have negative effects on the aggregate productivity of the economy.

The results in this paper are based on a stylized model which focuses on a specific transmission channel. The model provides a streamlined representation of credit supply, leaving out several aspects that might be affected by judicial inefficiency, such as the use of collateral, or any direct and recurrent costs related to open recovery proceedings. Given the difference in recovery rates between secured and unsecured claims, this aspect warrants further analysis.[32] Moreover, there are other potential ways for court efficiency to affect credit supply. The length of proceeding might for example affect the difference between banks' valuation of NPL's and that of potential investors in NPL markets (Ciavoliello et al., 2016). This might reduce the price a bank might be able to attain when selling its NPLs, potentially affecting the supply of credit. Additionally, the monopolistic banking sector model (see Appendix) shows that banks' responses to improvements in court efficiency need to be further explored empirically, as they could give further clues on the aggregate mechanisms we explore. Finally, firms in our model exclusively use a non-accumulable input. If firms had capital at their disposal, or could invest in innovation instead, lowering borrowing rates might not induce lower-productivity firms to downscale. This might affect the reallocation of resources after an improvement in court efficiency, thus changing our main results. We therefore believe that the current research path warrants future work.

[31] Evidence for Italian Banks shows that in 2016, the recovery rate for bad loans sold by banks is on average substantially lower (23.5%) than when positions are not sold (43.5%). See Conti et al. (2017).

[32] In the bankruptcy data of Section 2.1, the recovery rate of privileged credit is 47% while that of junior credit is 6%

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Appendix

The Monopolist Banking Sector

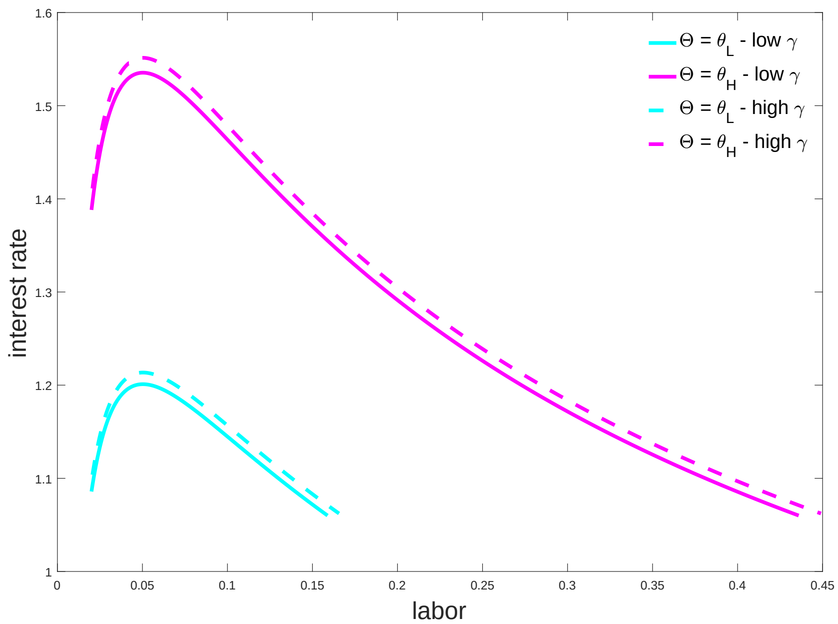
In this appendix we present an alternative version of our model in which banks exert market power by setting borrowing rates so as to maximize the expected profits on any given loan. We limit the analysis of this alternative market structure to theoretical grounds, given the scope is solely that of further illustrating the mechanics of the credit transmission channel.

Inspecting the Mechanism For a monopolistic bank lending a type Θ firm an amount $B = wL + f$, profits are equivalent to those attained by competitive banks, as described by Equation 3. Contrary to perfectly competitive banks, a monopolist bank sets its loan rates so as to maximize its expected profits, as illustrated by Equation 12. Just like competitive banks in the main model, the monopolistic bank offers a menu of credit contracts $\{L, r_B(L;\Theta)\}$ to any type Θ firm.

$$r_B\left(L;\Theta\right) = \arg\max_{\tilde{r}_B} \pi^B\left(L, \tilde{r}_B;\Theta\right) \tag{12}$$

Figure 11 shows the credit supply faced by firms with different past productivity levels, under low and high court efficiency, respectively. The monopolist bank's ability to extract rents from firms produces four differences that stand out with respect to the competitive bank case considered in the main version of the model. First, the monopolist bank decreases its rates with loan size, except for very small loans. Second, firms with higher past productivity face higher borrowing rates for any given loan size. Third, the largest loan size offered to any given firm of type Θ is smaller than under a competitive bank; this in particular implies that firms are borrowing constrained under the monopolist bank and thus operating below their optimal scales. Finally, the borrowing rate faced for any loan size is higher under the monopolist bank.

Figure 11: Credit supply and court efficiency (monopolist bank)

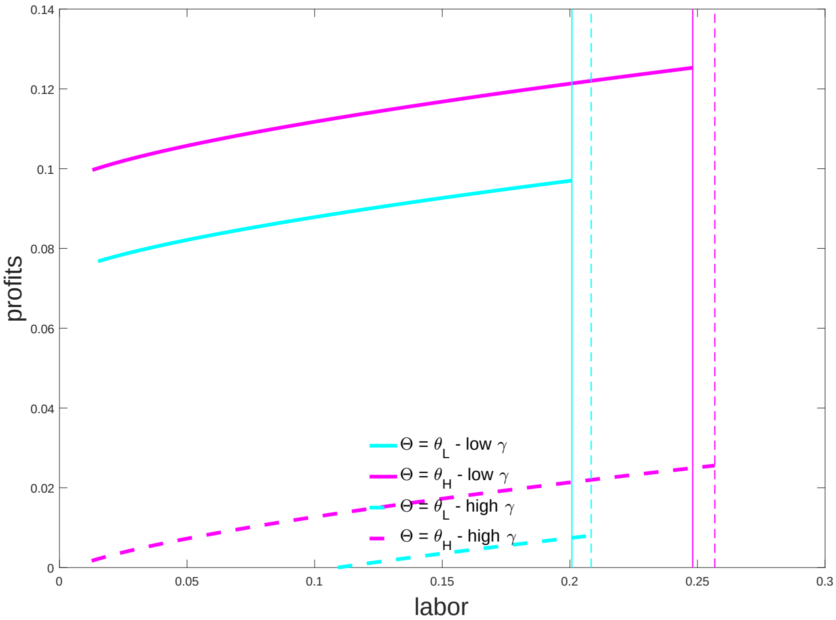


Contracts $\{L, r_B(L;\Theta)\}$ the monopolist bank offers incumbent firms with low ($\Theta = \theta_L$, cyan lines) and high ($\Theta = \theta_H$, magenta lines) past productivity, both with low (solid lines) and high (dashed lines) recovery rate, γ

As discussed in Section 5, an improvement in the discounted recovery rate $\Gamma\left(\gamma, T\right)$, increases the expected payoff for the bank when the firm defaults. Contrary to a perfectly competitive bank that would decrease its loan rate, the monopolist bank increases its rates for all labor choices, increasing thereby the probability of default, knowing that its pay-off is larger in case of default.

Figure 12 reports the charter value of a low- and a high-productivity incumbent firm, under a low and a high recovery rate respectively. The dashed lines illustrate the effects of improving court efficiency. As court efficiency increases, higher borrowing rates lower the charter value of all firms. However, improved court efficiency also extends firms' borrowing limits. Overall, firms' charter values are lower, yet their scales increase as the credit constraints are relaxed. The lower charter value for all firms imply an increase in price of the consumption good in order for the free entry condition to be satisfied. Labor demand increases for all firms, as the increase in price boosts bank profits at all loan rates.[33] Consequently, the bank extends its credit limits on all firms, further relaxing their credit constraint.

Figure 12: Court efficiency and firm value



Firm profits under low (solid lines) and high (dashed lines) recovery rate, for low (cyan) and high (magenta) past productivity firms, as a function of labor demand. The vertical lines correspond to the optimal labor choice by the firms.

The increase in price reduces aggregate demand while labor supply barely falls. In order to clear the consumption good market, the mass of entrants falls. This leads to a reduction in the number of firms. The productivity level for which firms do not exit the market increases. This implies a selection towards higher-productivity firms. The entire distribution of firms is shifts towards higher productivity. Unweighted average productivity therefore increases, as does the share of labor employed by higher-productivity firms. These changes suggest an improvement in the allocation of resources. However, given the share of entrants—which on average have lower productivity—as well as the share of labor they employ, are substantially boosted, misallocation ends up rising.

[33] Higher prices imply lower probability of default and lower losses in case of default.

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