Intermediation Costs, Investor Protection, and Economic Development

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Abstract

This paper studies the effects of financial intermediation costs and investor protection on productivity and economic development. In order to investigate this question we construct and solve a general equilibrium model with heterogeneous agents, occupational choices and financial frictions (investor protection and intermediation costs). Occupational choices and the size of each project are determined endogenously. They depend on the agent's "type" (wealth and project), and credit market frictions. Different levels of intermediation costs and limited enforcement generate not only differences in the occupational choice, but also differences in total factor productivity (TFP). Our quantitative experiments based on the empirical evidence on spread rates and the degree of enforcement across countries suggest that financial frictions have an important effect on output per capita and productivity. For instance, if the American economy had a level of financial contracts enforcement and intermediation costs similar to those observed in Brazil, output per capita would be about 23-30% lower. Financial frictions, therefore, explain roughly 1/3 of the observed difference in output per capita between Brazil and the United States. We also show that enforcement in financial contracts has a stronger effect on output per capita and productivity than intermediation costs.

JEL Classification: E60; G38; O11

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1 Introduction

Economists are increasingly interested on how government policies and institutions toward the financial system are related to the level of economic development and growth across countries.[1]

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[1]See, for instance, Levine (1997) for an overview.

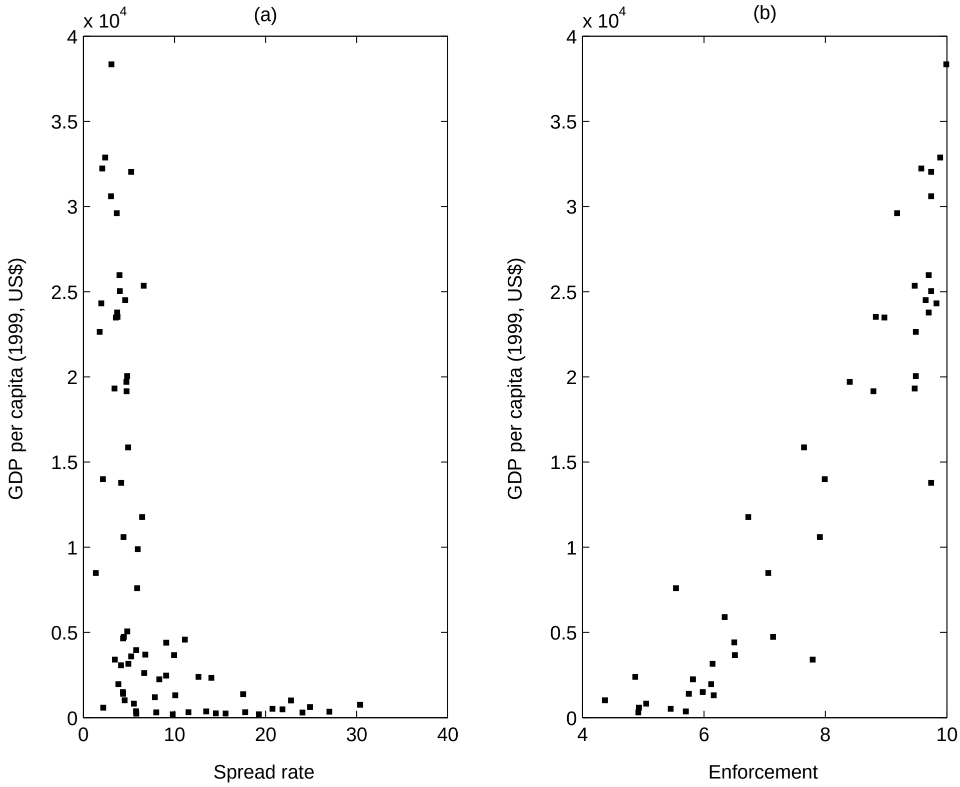

Figure 1: Financial frictions and development. Table 1 contains information about the variables in panel (a) and (b).

Financial intermediation costs and investor protection varies considerably across countries and with the level of economic development. According to Demirgüç-Kunt, Leaven and Levine (2004), for instance, net interest margin[2] is over 10% in countries such as Belarus, Burundi, and Ghana, whereas countries like Netherland and Switzerland have very low margins of less than 2%. Data from the International Financial Statistics report that spread rates vary from 1.97% in Netherland to 48% in Brazil (see table 1 and panel (a) of figure 1 for data of spread rates for some countries). Net interest margin and spread rates might reflect explicit and implicit financial sector taxes (e.g., tax on financial transactions, on intermediary profits, or inflation), bank regulation (e.g., barriers to entries and non-interest-bearing reserve requirements) and institutions. On the other hand, La Porta, Lopes-de-Silanes, Shleifer and Vishny (1998) indexes show how national institutions associated with the protection of private property rights are correlated with the level of development (see table 1 and panel (b) of figure 1) .

In this paper we study the effects of financial intermediation costs and investor protection on productivity and economic development. What are the effects of intermediation costs and limited enforcement on occupational choices, productivity and output per capita? In order to investigate this question we construct and solve a general equilibrium model with heterogeneous agents, occupational choices and financial frictions (investor protection and intermediation costs). Agents in our framework can choose to be either a worker or an entrepreneur. In this

[2]Net interest margin is defined as the difference between interest income and interest expense divided by interest-bearing assets.

respect, this paper is related to Lucas' (1978) "span of control" model. Agents are differentiated by entrepreneurial ability and initial wealth. They care about their own consumption and the initial wealth of their offspring. In order to open a business, agents must buy capital in advance to finance their project. Capital markets are imperfect and therefore the best project will not necessarily be undertaken. This interaction between wealth distribution and capital market imperfection is based on Banerjee and Newman (1993).[3]

The theoretical environment, therefore, considers two occupational choices (worker and entrepreneur), inequality in wealth and in entrepreneurial ideas, intermediation costs, and limited enforcement. Occupational choices and the size of each project are determined endogenously. They depend on the agent's "type" (wealth and project), and credit market frictions. Different levels of intermediation costs and limited enforcement generate not only differences in the occupational choice, but also differences in total factor productivity (TFP). Our model therefore provides a theory of differences in TFP, as required by Prescott (1998), that maps differences in credit market frictions into differences in observed TFP.[4]

Our quantitative experiments based on the empirical evidence on the spread rates and the degree of enforcement across countries suggest that financial frictions have an important effect on output per capita and productivity. For instance, if the American economy had a level of financial contracts enforcement and intermediation costs similar to those observed in Brazil, output per capita would be about 23-30% lower.[5] Our experiments also suggest that enforcement in financial contracts has a stronger effect on output per capita and productivity than intermediation costs. When intermediation costs increases roughly 15 times from its baseline value, output decreases by *at most* 10% (see table 4). On the other hand, when investor protection decreases by less than a half of its baseline value, output decreases by *at least* 11% (see table 5).

2 The model

Consider an economy inhabited by a continuum of measure one of individuals who live for only one period. Each individual reproduces another one such that population is constant. Time is discrete and the economy lives forever ($t = 0, 1, 2, ...$). There is only one good that can be used for consumption or production, or left to the next generation as bequest.

[3]See also Lloyd-Ellis and Bernhardt (2000) for a close framework which studies the macroeconomic and distributional dynamics associated with the process of economic development. They develop important tools that we use to characterize the long-run dynamics of our model economy.

[4]Amaral and Quintin (2004), Antunes and Cavalcanti (2003), Erosa (2001) and Erosa and Cabrillana (2004) also develop model economies where capital market imperfections and regulation costs endogenously generate differences in TFP.

[5]Output per capita in Brazil is about 1/6 of the United States output level. Therefore, financial frictions alone explain about 1/3 of the difference in output per capita between Brazil and the United States.

2.1 Preferences, endowments and technology

2.1.1 Preferences

Agents care about their own consumption and leave bequests to their offspring. Let c_t^i and b_{t+1}^i denote consumption and bequests, respectively, by agent i in period t. Preferences are represented by

$$U^i = (c_t^i)^{\gamma}(b_{t+1}^i)^{1-\gamma}, \quad \gamma \in (0,1). \tag{1}$$

This utility function implies that agents are risk-neutral with respect to income as the indirect utility function is linear in wealth. This implies that any additive punishment or reward in utility may be measured in terms of income. Notice that, for tractability, we assume that preferences are for the bequest and not the offspring's utility.[6]

2.1.2 Endowments

Each individual can be either a worker or an entrepreneur. Entrepreneurs create jobs and manage their labor force, n. As in Lucas (1978), each individual is endowed with a talent for managing, x^i, drawn from a continuous cumulative probability distribution function $\Gamma(x)$ with finite support $[\underline{x}, \overline{x}]$, where $\underline{x} \geq 0$. Therefore, in each period agents are distinguished by their initial wealth and ability as entrepreneurs, (b_t^i, x_t^i). We assume that the agent's talent for managing is not hereditary. For notational convenience, in the remainder of the paper we drop agent superscript i.

2.1.3 Production sector

Managers operate a technology that uses labor, n, and capital, k to produce a single consumption good, y, that is represented by

$$y = xk^{\alpha}n^{\beta}, \quad \alpha,\ \beta\ > 0, \quad \text{and} \quad \alpha + \beta < 1. \tag{2}$$

Capital fully depreciates between periods. Managers can operate only one project.

2.2 The capital market

We model the capital market as follows. Agents may choose two investment opportunities to their initial wealth. They can competitively rent capital to financial intermediaries and earn an endogenously determined interest rate of r. Alternatively, they can use their own capital as part of the amount of resource required to start a business.

In addition, agents can borrow capital from the financial intermediaries in order to run a business. Competition among lenders implies that the borrowing effective interest rate is $r_B = r + \tau$, where τ reflects transaction costs such as explicit and implicit financial sector taxes

[6] For a similar formulation, see Banerjee and Newman (1993) and Lloyd-Ellis and Bernhardt (2000).

(e.g., tax on financial transactions, on intermediary profits, or inflation), or bank regulations (e.g., reserve and liquidity requirements).

For expositional and computational purposes, we shall use the equivalent setting where all agents deposit their initial wealth in financial intermediaries and earn a return r. Financial intermediaries take these resources and hire them to entrepreneurs. Entrepreneurs use their initial wealth as collateral for loans. The part of the loan fully collateralized costs r, while the remainder costs r_B.

We assume that borrowers cannot commit *ex-ante* to their individual promises and can avoid the repayment obligation by defaulting on their debt. Those that renege on their debt incur a cost equal to fraction ϕ of output net of wages. This is equivalent to an additive utility punishment. This cost reflects the strength of contract enforcement in the economy.[7]

3 Optimal behavior and equilibrium

3.1 Entrepreneurs

Agents who have enough resources and managerial ability to become entrepreneurs choose the level of capital and the number of employees to maximize profit subject to the technological constraint and credit market frictions. Since financial markets are imperfect, let us first present the problem of an entrepreneur for a given level of capital k:

$$\pi(k, x; w) = \max_{n} xk^{\alpha}n^{\beta} - wn, \tag{3}$$

which yields the labor demand of each entrepreneur:

$$n(k, x; w) = \left(\frac{\beta x k^{\alpha}}{w}\right)^{\frac{1}{1-\beta}}. \tag{4}$$

Substituting (4) into (3) yields the entrepreneur's profit function for a given level of capital,

$$\pi(k, x; w) = (1-\beta)(xk^{\alpha})^{\frac{1}{1-\beta}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\beta}}. \tag{5}$$

In an environment where initial wealth is sufficient for the agent to start her own business without resorting to credit finance, managers will solve problem

$$\max_{k \geq 0} \pi(k, x; w) - (1+r)k. \tag{6}$$

[7]We chose a proportional punishment for convenience. This follows the literature. See Krasa and Villamil (2000) and Krasa, Sharma and Villamil (2004) for extended analysis of enforcement and debt contracts.

This gives the optimal physical capital level:

$$k^*(x;w,r) = \left(x \left(\frac{\beta}{w}\right)^{\beta} \left(\frac{\alpha}{1+r}\right)^{1-\beta} \right)^{\frac{1}{1-\alpha-\beta}}. \tag{7}$$

Since agents cannot commit to their promises, debt contracts must be self-enforcing. Let a be the amount of self-financed capital (or, equivalently, the fully collateralized loan), and l be the amount of funds raised with the financial intermediaries (or, equivalently, the amount of the loan not collateralized). The income from running a project is

$$V(b,x;w,r) = \max_{b \geq a \geq 0,\ l \geq 0} \pi(a+l,x;w) - (1+r)a - (1+r+\tau)l \tag{8}$$

subject to

$$\phi\pi(a+l,x;w) \geq (1+r+\tau)l. \tag{9}$$

The restriction states that the amount the financial intermediary seizes in case of default is higher than the repayment obligation. This problem yields optimal policy functions $a(b,x;w,r)$ and $l(b,x;w,r)$ that define the size of each project,

$$k(b,x;w,r) = a(b,x;w,r) + l(b,x;w,r).$$

Restriction (9) is an incentive compatibility constraint, which guarantees that individual promises will be fulfilled (Kehoe and Levine, 1993). We can rewrite this constraint as

$$l(b,x;w,r) \leq \frac{\phi}{1+r+\tau}\pi(k(b,x;w,r),x;w).$$

It can be shown that entrepreneurs put their entire wealth up in the project as long as $b \leq k^*(x;w,r)$. This follows immediately from the fact that the cost from self-financing is lower than using a financial intermediary.[8] This implies that the size k of a project of an entrepreneur (b,x) is such that

$$k \leq b + \frac{\phi}{1+r+\tau}\pi(b+l,x;w), \tag{10}$$

where we have omitted the arguments of k and l for readability. Therefore, projects are limited by the agents' inheritance and the frictions in the capital market. The following lemma summarizes the value of undertaking an entrepreneurial project:

Lemma 1 *For any $x \in [\underline{x}, \overline{x}]$, and $w, r > 0$, the value function $V(b,x;w,r)$ and the associated policy function $l(b,x;w,r)$ have the following properties:*

1. *$V(b,x;w,r)$ is continuous and differentiable in x, w and r. If $x > 0$, it is also strictly increasing in x and strictly decreasing in w and r.*

[8] See appendix A.

2. *For $b < k^*(x;w,r)$, $V(b,x;w,r)$ is continuous, differentiable and strictly increasing in b. For $b > k^*(x;w,r)$, $V(b,x;w,r)$ is constant in b.*

3. *$l(b,x;w,r)$ is strictly increasing for $b < k^*(x;w,r)$ and $l(b,x;w,r) = 0$ for $b > k^*(x;w,r)$.*

Proof. See appendix B. ■

It is important to highlight that qualitatively intermediation costs and investor protection have different effects on entrepreneurs' optimal choices. In order to see this, notice that when agents are not credit constrained and self finance their projects, then neither ϕ nor τ have any effects on entrepreneurs' firm size (see appendix A, case 1). When agents are credit constrained, that is, $a = b$, but the incentive compatible constrain is not binding (case 2), then only intermediation costs τ have negative effects on the optimal project size and profitability. When the incentive compatible constraint is binding (case 3), then both enforcement and intermediation costs affect entrepreneurs' optimal choices. Moreover, it can be shown that

$$\frac{\partial l}{\partial \phi}\left|\frac{\partial l}{\partial \tau}\right|^{-1} = \frac{\pi}{l} > \frac{1+r+\tau}{\phi} > 1,$$

where we have omitted arguments for readability. This implies that investor protection has a stronger effect on the optimal project size than intermediation costs.

3.2 Occupational choice

The occupational choice of each agent defines his lifetime income. Define $\Omega = [0,\infty) \times [\underline{x}, \overline{x}]$. For any $w, r > 0$, an agent (b,x) will become an entrepreneur if $(b,x) \in E(w,r)$, where

$$E(w,r) = \{(b,x) \in \Omega : V(b,x;w,r) \geq w\}. \tag{11}$$

Let $E^c(w,r)$ denote the complement set of $E(w,r)$ in Ω. Obviously, if $(b,x) \in E^c(w,r)$, then agents are workers. The following lemma characterizes the occupational choice for a given bequest and entrepreneurial ability.

Lemma 2 *Define $b_e(x;w,r)$ as the curve in set Ω such that $V(b,x;w,r) = w$. Then there exists an $x^*(w,r)$ such that $\frac{\partial b_e(x;w,r)}{\partial x} < 0$ for $x > x^*(w,r)$ and $\frac{\partial b_e(x;w,r)}{\partial x} = -\infty$ for $x = x^*(w,r)$.*

1. *For all x, if $b < b_e(x;w,r)$, then $(b,x) \in E^c(w,r)$.*

2. *For all x, if $b \geq b_e(x;w,r)$, then $(b,x) \in E(w,r)$.*

Proof. See appendix C. ■

Figure 2 illustrates this lemma. It shows the occupational choice in the (b,x) space for the baseline economy (see parameters in section 4). Lemma 2 and figure 2 suggest that agents are workers when the quality of their project is low, i.e., $x < x^*(w,r)$ (the lightest shaded area). For

$x \geq x^*(w,r)$, then agents might become entrepreneurs depending if they are credit constrained or not (notice that for very low bequests agents are workers even though their entrepreneurial ability is higher than $x^*(w,r)$). The negative association between $b_e(x;w,r)$ and x suggests that managers with better projects need a lower level of initial wealth to run a project. This is rather intuitive since profits are increasing in the quality of the project.

3.3 Consumers

In period t, the lifetime wealth of an agent characterized by (b_t, x_t) is given by

$$Y_t = Y(b_t, x_t; w_t, r_t) = \max\{w_t, V(b_t, x_t; w_t, r_t)\} + (1 + r_t)b_t. \tag{12}$$

Lifetime wealth is thus a function of agent-specific b_t and x_t, and economy-wide w_t and r_t. Given lifetime wealth, (12), agents choose consumption and bequests to maximize preferences (1). This problem defines the optimal consumption, $c_t = c(Y_t)$, and bequest, $b_{t+1} = b(Y_t)$, policies. The functional form of (1) implies that agents leave a proportion $1-\gamma$ of their lifetime wealth as a bequest. Notice that bequests cannot be negative because every agent is allowed to become a worker.

3.4 Competitive equilibrium

Let W_t be the bequest distribution at period t.[9] Define $z_t = (b_t, x_t)$.

Definition 3 *Given (τ, ϕ), Γ and W_t, equilibrium at date t is a list w_t, r_t, $n(x; w_t, r_t)$, $l(b, x; w_t, r_t)$, $a(b, x; w_t, r_t)$, $k(b, x; w_t, r_t)$, $c_t = c(\cdot)$, $b_{t+1} = b(\cdot)$, such that:*

A. Given the wage and interest rates and credit market frictions, an agent of type (b, x) chooses his occupation to maximize his lifetime wealth, (12).

B. Given the wage and interest rates, technology constraint, credit frictions, and government policies, entrepreneurs select their labor force to maximize profits, (3).

C. $l(b, x; w_t, r_t)$ and $a(b, x; w_t, r_t)$ solve (8), and $k(b, x; w_t, r_t) = a(b, x; w_t, r_t) + l(b, x; w_t, r_t)$.

D. Given the lifetime wealth, (12), each agent maximizes utility, (1).

E. The labor market clears:

$$\iint_{z \in E(w_t, r_t)} n(x; w_t, r_t) W_t(db_t)\Gamma(dx_t) = \iint_{z \in E^c(w_t, r_t)} W_t(db_t)\Gamma(dx_t). \tag{13}$$

F. The aggregate supply of funds for investment is given by initial wealth:

$$\iint b_t W_t(db_t)\Gamma(dx_t) = \iint_{z \in E(w_t, r_t)} k(b_t, x_t; w_t, r_t) W_t(db_t)\Gamma(dx_t).$$

[9] See more on the definition of W_t in appendix D.

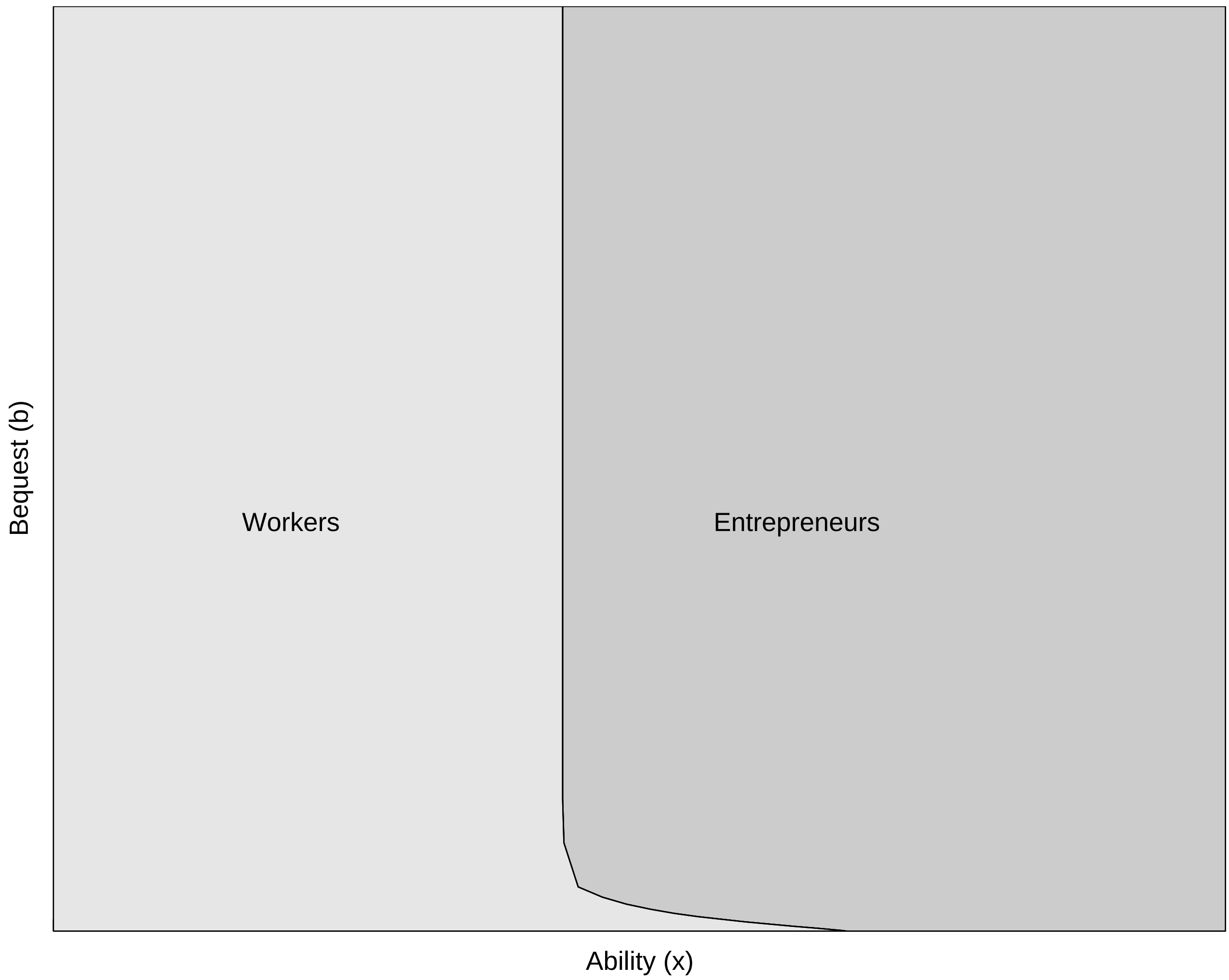

Figure 2: Occupational choice.

In the quantitative exercises it is important to evaluate policy experiments in "stable" economies, where, for instance, the real wage and income distribution are not changing significantly over time. Indeed, it is possible to show that when policies and institutions are stationary a unique steady-state equilibrium exists (i.e., an equilibrium with constant real wage and interest rate, w and r, and invariant distribution, $H = W\Gamma$) and from any initial condition the economy converges to this equilibrium.

Proposition 4 *There exists a unique stationary equilibrium with $0 < w, r < \infty$ and invariant distribution W. In addition, for any initial bequest distribution W_0 and stationary credit market frictions (τ, ϕ), the bequest distribution converges to W.*

Proof. See appendix D. ■

In the calibration and quantitative experiments we will study the economy in this particular equilibrium and therefore we will consider the long run impact of changes in policies and institutions.

4 Quantitative results

4.1 Parameterization

In order to proceed with our quantitative exercises we need to define a functional form for the ability distribution an assign values to the parameters of the model. Our strategy is to parameterize the model economy such that in long run equilibrium it matches some key statistics of the United States economy.

We assume that that the entrepreneurial cumulative distribution $\Gamma(x) = Ax^{\frac{1}{\epsilon}}$ and normalize the support of this distribution to the interval $[0, 1]$, such that $A = 1$. We define the model period to be 35 year. It remains to determine six parameter values $(\gamma, \alpha, \beta, \epsilon, \phi, \tau)$. We set α and β such that about 55 percent of income is paid to labor, 35 percent is paid to the remuneration of capital, and 10 percent are profits. We set α and β such that about 55 percent of income is paid to labor, 35 percent is paid to the remuneration of capital, and 10 percent are profits.[10] We choose γ and τ such that the interest rate, r, and the spread rate are equal to 1 and 3.302%, respectively. Since the model period is 35 years this implies a yearly real interest rate of roughly 2 percent. The spread rate is the average spread rate in the United States from 1995 to 2003 (see table 1). We finally choose ϕ and ϵ such that the fraction of entrepreneurs over the total population is roughly 9% and the entrepreneurs' income Gini is about 45%.[11] Table 2 summarizes the parameter values of the baseline economy

[10] Gollin (2002) argues that it is important to adjust factor income shares by the entrepreneurial income, which is often treated incorrectly as capital income share. If we input entrepreneurial profits as labor income as suggested by Gollin, then the effective labor and capital income shares will be 0.65 and 0.35, respectively. These income shares are those that map our model to those observed in national accounts. If we use another adjustment also suggested by Gollin, which assume that entrepreneurial income is a mix of labor and capital income as the rest of the economy, then the effective labor and capital income shares will roughly be 0.61 and 0.39, respectively. In any case, the effective labor income share will be in the range estimated by Gollin, which

Table 1: Selected Statistics. Sources: GDP per capita is the Gross Domestic Product per capita in U.S. dollars in 1999 (World Bank, 2001). Spread rates correspond to the difference between lending and deposit rate. The numbers on column (2) are the average rate from 1995 to 2003 (International Financial Statistics). Efficiency of the judicial system, protection against expropriation, rule of law, and risk of contract repudiation are from La Porta et al. (1998, table 5, columns 1, 2, 4, and 5). The last column is the average from columns 5 to 8.

Country	GDP per capita (1)	Spread rates (2)	Efficiency of judicial sytem (3)	Protection against expropriat. (4)	Rule of law (5)	Risk of contract repudiat. (6)	average enforc. (7)
United States	30,600	3.30%	10.00	9.98	10.00	9.00	9.74
Germany	25,350	6.62%	9.00	9.90	9.23	9.77	9.47
Netherland	24,320	1.97%	10	9.98	10	9.35	9.83
France	23,480	3.57%	8.00	9.65	9.05	9.19	8.97
Canada	19,320	3.43%	9.25	9.67	10.00	8.96	9.47
Italy	19,710	4.74%	6.75	9.35	8.33	9.17	8.40
Israel	15,860	4.90%	10	8.25	4.82	7.54	7.65
Spain	14,000	2.15%	6.25	9.52	7.80	8.40	7.99
Greece	11,770	6.46%	7.00	7.12	6.18	6.62	6.73
Portugal	10,600	4.42%	5.50	8.90	8.68	8.57	7.91
Argentina	7,600	5.90%	6.00	5.91	5.35	4.91	5.54
Mexico	4,400	9.10%	6	7.29	5.85	6.55	6.4
Brazil	4,420	48.00%	5.75	7.62	6.32	6.30	6.50
Venezuela	3,670	9.96%	6.50	6.89	6.37	6.30	6.51
Peru	2,390	12.65%	6.75	5.54	2.50	4.68	4.87
Zimbabwe	520	21%	7.50	5.61	3.68	5.04	5.45
Nigeria	310	8.00%	7.25	5.33	2.73	4.36	4.92

Table 2: Parameter values, baseline economy.

γ	0.94	τ	0.03302
β	0.55	ϕ	0.25
α	0.35	ϵ	4.4

Table 3: Basic statistics, US and baseline economy. Sources: Demirgüç-Kunt et al. (2004), Cagetti and De Nardi (2002) and Quadrini (1999); all figures in percentage.

	US economy	Baseline economy
Spread rate	3.302%	3.302%
% of entrepreneurs	9	9
Entrepreneurs' income Gini	45	45.9
Income Gini	40–44	30

Notice that the model economy matches well key empirical statistics of the United States economy (see table 3), such as the net interest margin, the fraction of entrepreneurs over the total population, an the entrepreneurs' income Gini. The only exemption is the income Gini. However, since every worker receives the same equilibrium wage rate in the model economy, we have that it should underestimate its real world counterpart.[12]

4.2 Intermediation Costs

Given the parameter values we evaluate the impact of the interest rate spread on the economy. We gathered data from the *International Financial Statistics* to map observed cross countries spread rates on our model economy (see table 1). In order to focus only on the effects of the spread rate we kept the other parameters constant.

Table 4 contains policy experiments with an exogenous and endogenous interest rate. When the interest rate is exogenous we observe that an increase in the spread rate decreases output per capita, and productivity (the capital to output ratio decreases over time). Inequality decreases both in total and in entrepreneurial income. When the spread rate increases entrepreneurs invest less since the cost of outside finance increases. There are more projects but less productive projects. Notice, however, that the effects are not quantitatively very important. When the spread rate increases from the United States level (3.3%) to a level similar to the one observed in Mediterranean Europe (5%), output per capita decreases by less than 1%.[13] When the spread rate increases further to a level observed in Brazil of about 50%, output decreases by roughly 10%.[14]

goes from 0.60 to 0.80.

[11]See Cagetti and De Nardi (2002) and Quadrini (1999).

[12]We could have added labor income shocks to increase the income Gini. This would increase the complexity of the model without adding any new insights to the results.

[13]Output per capita in Mediterranean Europe is roughly 1/2 to 2/3 of the United States output per capita (see table 1).

[14]Output per capita in Brazil is about 1/6 of the United States output per capita.

Table 4: Policy Experiments: Spread Rates.

	Output per capita, % baseline	capital to output ratio	% of entrepreneurs	Income Gini	Entrepreneurs' income Gini	Interest rate
			Exogenous interest rate, r			
Baseline	100.00	2.45	9.00	30.00	45.90	1
$\tau = 5.00\%$	99.30	2.40	9.01	29.55	45.72	1
$\tau = 10.00\%$	98.22	2.36	9.10	29.49	45.68	1
$\tau = 30.00\%$	93.77	2.17	9.2	29.34	45.55	1
$\tau = 50.00\%$	89.85	2.03	9.3	29.24	45.04	1
			Endogenous interest rate, r			
$\tau = 5.00\%$	99.65	2.41	9.01	29.53	45.91	0.98
$\tau = 10.00\%$	98.28	2.36	9.10	29.80	45.87	0.97
$\tau = 30.00\%$	97.31	2.32	9.15	30.03	46.00	0.85
$\tau = 50.00\%$	95.60	2.29	9.20	30.05	46.02	0.67

Table 5: Policy Experiments: Property Rights.

	Output per capita, % baseline	capital to output ratio	% of entrepreneurs	Income Gini	Entrepreneurs' income Gini	Interest rate
			Exogenous interest rate, r			
Baseline	100.00	2.45	9.00	30.00	45.90	1
$\phi = 0.20$	91.04	1.97	9.56	30.56	46.12	1
$\phi = 0.14$	78.61	1.46	10.62	31.48	46.07	1
$\tau = 0.05$ and $\phi = 0.20$	91.03	1.96	9.62	31.00	46.36	1
$\tau = 0.5$ and $\phi = 0.14$	71.53	1.26	11.09	31.09	45.41	1
			Endogenous interest rate, r			
$\phi = 0.20$	99.01	2.39	9.39	31.49	46.83	0.67
$\phi = 0.14$	88.52	1.83	10.18	32.37	47.11	0.50
$\tau = 0.05$ and $\phi = 0.20$	98.74	2.31	9.40	31.48	46.84	0.66
$\tau = 0.5$ and $\phi = 0.14$	77.67	1.48	10.73	31.85	46.42	0.50

Notice that the effects on output per capita are milder when the interest rate is endogenous. The reason is that when intermediation costs τ increases, the demand for outside financial loans decreases. The interest rate r therefore decreases. A lower interest rate implies lower costs for those entrepreneurs that self-finance their project, compensating part of the increase in the spread rate. Quantitatively we notice that, when intermediation costs increases from the United States level of 3.3% to a level similar to the one observed in Brazil, output per capita decreases by less than 5%, while the interest rate on deposits decreases by more than 30%. The capital to output ratio decreases by roughly 7%.

4.3 Investor Protection

We now investigate the effects of our institutional parameter ϕ. We map linearly the last column of table 1 to ϕ, assuming that the US case corresponds to $\phi = 0.25$ and a zero level of enforcement corresponds to $\phi = 0$. Mediterranean Europe (Italy, Portugal, Spain, and Greece) has a value of ϕ of roughly 0.20, while for Latin American countries this figure is 0.14.

Notice that as the level of enforcement decreases (ϕ decreases), output per capita and productivity decreases (see the capital to output ratio). There are more entrepreneurs in the economy, but they are less productive. The effects are again stronger when the interest rate is exogenous. For instance, when the level of enforcement decreases from the United States level ($\phi = 0.25$) to a level similar to the Latin American countries ($\phi = 0.14$), then output per capita decreases by roughly 21% and 11% when the interest rate is exogenous and endogenous, respectively. We also investigate two limiting cases with $\phi = 0$ (no enforcement) and $\phi = 1$. An economy with no enforcement of financial contracts $\phi = 0$ has an output per capita of roughly 30-32% of the baseline economy, while in an economy with full enforcement $\phi = 1$ this figure is about 128%. Therefore, a typical agent in an economy with full enforcement is about 5 times richer than a typical agent living in an economy with no enforcement of financial contracts. Although property rights in financial contracts, ϕ, can generate important variations in output per capita they cannot account for observed differences in living standards across countries.[15]

Observe that enforcement ϕ has a stronger effect on output per capita and productivity than the spread rate τ. When the spread rate increases roughly 15 times from its baseline value, output decreases by *at most* 10% (see table 4). On the other hand, when ϕ decreases by less than a half of its baseline value, output decreases by *at least* 11% (see table 5).

We finally run experiments by changing investor protection (ϕ) and intermediation costs (τ) simultaneously. When, for instance, ϕ and τ change from their baseline values to the values observed in Mediterranean Europe and some Latin American countries (such as Brazil), output per capita decreases by at most 9% and 29%, respectively. In other words, if the American economy had a level of financial contracts enforcement and intermediation costs similar to those observed in Brazil output per capita would be about 23-30% lower.

5 Concluding remarks and policy implications

This paper developed a framework to study qualitatively and quantitatively the effects of financial frictions (intermediation costs and enforcement of financial contracts) on development (output per capita, productivity and inequality). We gathered data on spread rates and enforcement to map observed cross countries financial frictions into our model economy. We show that:

- Although spread rates vary substantially across countries (the spread rate in Brazil is roughly 15 times the spread rate in the United States), they have a minor effect on output and productivity. When the spread rate varies from the US level to the Brazilian level, output decreases by about 4-10%, depending whether the interest rate is endogenous or exogenous.

- Investor protection has a stronger effect on output per capita than the spread rate. When the level of enforcement of financial contracts varies from the US l to the Brazilian level (a

[15] Output per capita in rich countries, such as the United States or Switzerland, is twenty to thirty time higher than in poor countries, such as Nigeria (Parente and Prescott (2000)).

variation of less than 50% in the enforcement index), output decreases by about 11-21%, depending whether the interest rate is endogenous or exogenous. Notice that as the level of enforcement decreases inequality increases.

- Overall, if the American economy had a level of financial contracts enforcement and intermediation costs similar to those observed in Brazil output per capita would be about 23-30% lower. Financial frictions, therefore, explain roughly 1/3 of the observed difference in output per capita between Brazil and the United States.

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A Kuhn-Tucker conditions for problem (8)

The Lagrangean associated with problem (8) is

$$\begin{aligned} L =& \pi(a+l,x;w) - (1+r)a - (1+r+\tau)l \\ &+ \lambda(\phi\pi(a+l,x;w) - (1+r+\tau)l) + \chi(b-a). \end{aligned}$$

The Kuhn-Tucker conditions are:

$$\begin{aligned} \frac{\partial L}{\partial l} =& \pi_1(a+l,x;w) - (1+r+\tau) \\ &+ \lambda(\phi\pi_1(a+l,x;w) - (1+r+\tau)) \leq 0, \end{aligned} \tag{14}$$

$$\frac{\partial L}{\partial a} = \pi_1(a+l,x;w) - (1+r) + \lambda\phi\pi_1(a+l,x;w) - \chi \leq 0, \tag{15}$$

$$\lambda(\phi\pi(a+l,x;w) - (1+r+\tau)l) = 0, \tag{16}$$

$$\chi(b-a) = 0, \tag{17}$$

$$l \geq 0, \quad \frac{\partial L}{\partial l} l = 0, \quad a \geq 0, \quad \frac{\partial L}{\partial a} a = 0, \quad \lambda \geq 0, \quad \chi \geq 0,$$

plus the incentive compatible constraint (9) and constraint $b \geq a$. Constrained entrepreneurs are those for which $l > 0$ holds. We want to show that they put their entire wealth in the project. To see this, assume that constrained entrepreneurs do not put their entire wealth in the project, that is, $0 \leq a < b$. Then, from (17), $\chi = 0$, and from (14) in equality and (15) we have that $(1+r)\lambda + (1+\lambda)\tau \leq 0$, which is a contradiction. Therefore, if entrepreneurs are credit constrained, then $a = b$.

There are four cases to consider:

1. $0 < a < b$, and $l = 0$. Then, from (16) and (17), $\chi = \lambda = 0$ and

$$a = k^*(x; w, r) = \left(x \left(\frac{\beta}{w} \right)^{\beta} \left(\frac{\alpha}{1+r} \right)^{1-\beta} \right)^{\frac{1}{1-\alpha-\beta}}.$$

2. $0 < a = b$, and $l = 0$, but $\phi\pi(a + l, x; w) - (1 + r + \tau)l > 0$. This case arises because intermediation implies a discrete jump in costs. We have $\lambda = 0$ and χ (which is non-negative) given by equation (15) in equality:

$$\chi = \pi_1(a + l, x; w) - (1 + r).$$

   The interpretation is straightforward: while the entrepreneur would invest more if she had a higher bequest, the incremental profit from borrowing is still non-positive, as can be seen in equation (14). The entrepreneur's marginal profit exceeds $1 + r$ but is smaller than $1 + r + \tau$.

3. $0 < a = b$, and $l > 0$, but $\phi\pi(a + l, x; w) - (1 + r + \tau)l > 0$. Then, from (16), $\lambda = 0$, and by (14) and (15) in equality we have that $\chi = \tau$. Therefore,

$$l + b = k^{**}(x; w, r) = \left(x \left(\frac{\beta}{w} \right)^{\beta} \left(\frac{\alpha}{1+r+\tau} \right)^{1-\beta} \right)^{\frac{1}{1-\alpha-\beta}},$$

   where $k^{**}(x; w, r)$ is an unconstrained maximizer of π if the interest rate were r_B.

4. $0 < a = b$, and $l > 0$, but $\phi\pi(a + l, x; w) - (1 + r + \tau)l = 0$. This is the credit-constrained case. The total loan $l(b, x; w, r)$ is given by the solution of the previous equation with a substituted by b.

B Proof of lemma 1

Continuity of $V(b, x; w, r)$ follows from the *Maximum Theorem* and differentiability from Theorem 4.11 of Stokey and Lucas (1989). From the envelope theorem it is easily seen that, provided

$x > 0$,

$$V_2(b, x; w, r) = \pi_2(b + l, x; w)(1 + \lambda\phi) > 0,$$
$$V_3(b, x; w, r) = \pi_3(b + l, x; w)(1 + \lambda\phi) < 0,$$
$$V_4(b, x; w, r) = -a - (1 + \lambda)l < 0,$$

where we have omitted the arguments of a, l and λ for readability. If $b \leq k^*(x; w, r)$, then

$$V_1(b, x; w, r) = \pi_1(b + l, x; w)(1 + \lambda\phi) + \chi > 0.$$

When $b > k^*(x; w, r)$, then by definition of $k^*(x; w, r)$ the net income from entrepreneurship cannot increase and $V_1(b, x; w, r) = 0$ and $l = 0$. When agents are credit constrained, the incentive compatible constraint holds with equality and

$$\phi\pi(b + l, x; w) = (1 + r + \tau)l.$$

Thus,

$$\frac{\partial l}{\partial b} = \frac{\phi\pi_1(k, x; w)}{1 + r + \tau - \phi\pi_1(k, x; w)}.$$

By condition (14), we have that $(1 + r + \tau) - \phi\pi_1(k, x; w) = \frac{\pi_1(k,x;w)-(1+r+\tau)}{\lambda}$. Since this is for constrained agents, $\lambda > 0$ and $\pi_1(k, x; w)$ is greater than $1 + r + \tau$. Therefore,

$$\frac{\partial l}{\partial b} = \lambda\frac{\phi\pi_1(k, x; w)}{\pi_1(k, x; w) - (1 + r + \tau)} > 0.$$

C Proof of lemma 2

If agents have "sufficiently" high b and

$$V(b, x; w, r) \geq w,$$

there is an $x^*(w, r)$, such that for $x < x^*(w, r)$ agents prefer to be workers rather than managers and

$$x^*(w, r) = \left(\frac{\beta}{1 - \alpha - \beta}\right)^{1-\alpha-\beta} \left(\frac{1 + r}{\alpha}\right)^{\alpha} \left(\frac{w}{\beta}\right)^{1-\alpha}.$$

$x^*(w, r)$ is independent of b. For constrained agents with $x \geq x^*(w, r)$, we have that $V(b, x; w, r) = w$ defines $b = b_e(x; w, r)$, such that

$$\frac{\partial b_e}{\partial x}(x; w, r) = -\frac{V_2(b, x; w, r)}{V_1(b, x; w, r)},$$

in all points where $b_e(x; w, r)$ is differentiable. This is negative from lemma 1 (see figure 2).

D Proof of proposition 4

Here we provide the sketch of the proof. For a complete argument see Antunes and Cavalcanti (2005). This proof is an application of theorem 2 of Hopenhayn and Prescott (1992). The first step is to show compactness of the state space (b, x). Entrepreneurial ability is bounded by assumption. It can be shown that, from any initial bequest distribution with bounded support, the equilibrium wage rate lies in a compact set, that is, $w \in [\underline{w}, \overline{w}]$, with $\underline{w} > 0$ and $\overline{w} < \infty$. The same happens for r. This in turn implies that $b \in [\underline{b}, \overline{b}]$, with $\underline{b} > 0$ and $\overline{b} < \infty$. Then, $Z = [\underline{b}, \overline{b}] \times [0, \overline{x}]$ is compact. The bequest distribution evolves according to

$$(T^* H_t)(A) = \int P_t(z_t, A) H_t(dz_t), \tag{18}$$

where P_t is the endogenous transition function and H_t is a probability measure. This operator is increasing. Intuitively, this means that, given the equilibrium wage and interest rates, w_t and r_t, an agent would never be worse off in terms of the expected value of b_{t+1} if, for any $\varepsilon > 0$, his state were $z_t + \varepsilon$ instead of z_t. Since the ability distribution is independent among generations, the model displays income mobility and the Monotonic Mixing Condition is satisfied. Therefore, by theorem 2 of Hopenhayn and Prescott (1992), there exists a unique time invariant distribution W and associated equilibrium wage and interest rates, w and r, such that from any initial distribution W_0, the operator $T * H_t$ converges to W.