Financial Development with Credit Constrained Agents

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Abstract

This paper studies the effects of financial intermediation on aggregate levels and the distribution of resources in an economy with credit-constrained heterogeneous agents and occupational choice. Whether an agent becomes an entrepreneur depends on a realized entrepreneurial ability and accumulated assets needed to finance a business project with uncertain returns. I compare a steady state of an economy with financial intermediation to an economy in which entrepreneurs must finance their projects only from their savings. The efficiency and welfare gains from financial intermediation are large in the steady state as well as during the transition process that simulates the process of financial development.

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1 Introduction

> *We have entirely lost the idea that any undertaking likely to pay, and seen to be likely, can perish for want of money; yet no idea was more familiar to our ancestors, or is more common in most countries. A citizen of Long in Queen Elizabeth's time . . . would have thought that it was no use investing railways (if he could have understood what a railway meant), for you would have not been able to collect the capital with which to make them. At this moment, in colonies and all rude countries, there is no large sum of transferable money; there is not fund from which you can borrow, and out of which you can make immense works.*
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> *Walter Bagehot. Lombard Street (1873, pp. 3-4)*

One of the important differences between individual countries is the development of financial markets. In developed countries, and not in the underdeveloped ones, there typically exist a highly organized and broad system of financial intermediation designed to facilitate the flow of loanable funds between savers and entrepreneurs. The efficiency and sophistication of an economy's financial market is considered as one of the most important determinants of general economic activity and growth (see Levine (1997) for a survey of the literature). An access to and the cost of financial intermediation influence entrepreneurial choices of asset-constrained agents and determine whether good business ideas become implemented in practice.

Economic literature provides two main theories that link financial markets to economic activity and growth. The first one argues that the economic activity itself creates a demand for financial services. The second one sees financial services as a prerequisite for economic activity and development. In this paper, I build a model around the second hypothesis and study the effects of financial intermediation on aggregate levels and the distribution of resources in an economy with wealth-constrained heterogeneous agents and occupational choice.

I analyze and numerically simulate a dynamic, general equilibrium model with heterogeneous agents who differ in their accumulated assets and skills. Each agent faces the following option: to work as a worker or to become an entrepreneur. A worker receives a wage while an entrepreneur establishes a firm with capital investment, employs other agents as workers, and realizes profit from a decreasing returns to scale production technology. Each agent compares the value he or she would obtain from employment to the expected net value of the profits accruing from running a firm. However, entrepreneurship is not only a profitable but also a riskier occupation. Entrepreneurs in the model invest into one irreversible project with uncertain returns. In fact, if a risk-averse entrepreneur must invest disproportionately in the illiquid project, he may forgo the plan.

I study two economies that differ only in the existence of financial intermediation. The first economy is modelled as a developing economy without a banking sector so that entrepreneurs have to hire workers and finance their projects out of their own savings. In the second economy, there exists a competitive banking sector where agents deposit their assets. The banks in turn provide one period loans to entrepreneurs for whom it is optimal to borrow in order to run businesses at the optimal scale.

The existence of financial intermediation, a level of accumulated individual wealth and an idiosyncratic entrepreneurial ability are the decisive forces behind each agent's ability to finance and undertake an entrepreneurial project. Bank loans allow agents with high entrepreneurial skills to start a new business even if they could not finance the project from their own savings. In other words, financial markets serve to allocate resources to persons where the return is greatest. On the other hand, the absence of financial intermediation precludes agents with low savings from becoming entrepreneurs even if they have very good skills.

Thus there are two main incentives for the agents to accumulate wealth: first is the incentive to save in order to accumulate assets needed for undertaking a (potential) entrepreneurial project in the presence of credit constraints. The second incentive is the precautionary savings against uninsurable idiosyncratic risk. These two incentives lead to a distribution of wealth and income whose Gini coefficients match very well the data. The steady state of the economy with financial replicates the U.S. measures of inequality for wealth and income, the distribution of assets and income in the top percentiles, and the different shares of wealth and income of each occupation. This feature of the model contrasts with other heterogeneous agent models that cannot achieve the distribution of wealth unless they impose a very detailed life-cycle overlapping generation structure.

The existence or absence of financial intermediation results in dramatically different steady state allocations and distribution of resources. The economy with financial intermediation is about 20% more efficient and the average welfare gain equals 23%. Perhaps surprisingly, the gain is particularly large for workers: Financial intermediation improves efficiency in allocation of resources and the general equilibrium effects almost double their wages. Because workers constitute a vast majority of agents, wealth and income inequality is lower in the economy with financial intermediation, a feature found in the international data by Deininger and Squire (1996).

Finally, in order to evaluate the effects of a transition process of financial development, I sumulate a transition to the steady state of the economy with financial intermediation. In the transition, both occupations are better off: importantly, workers benefit much more (present discounted value increases by 50%) than entrepreneurs (by 5.3%). The Gini index for wealth inequality declines during the whole transition process. Except for a temporary small rise in income inequality, the transition makes the society

less unequal with no evidence of a pronounced, inverted-U shaped Kuznets curve. The subsequent sections analyze the results of the numerical simulation in great detail.

Overall, the modelling strategy departs from the neoclassical theory of investment with a representative agent and from the Modigliani-Miller theorem in which the firm's choice of the optimal capital stock could be solved without reference to financial factors. Instead, it follows the Lucas (1978) study of business firms' size and the Lucas (1990a) and Fuerst (1992) models of loanable funds. Compared to more recent models of occupational choice (Quadrini (1999a), Erosa (2001) or Gomes, Greenwood, and Rebelo (2001)) this model preserves the simplicity of the general equilibrium neoclassical models with added *ex ante* uncertainty related to returns on entrepreneurial projects. This *ex ante* entrepreneurial risk is well documented in data and differs from the *ex post* risk modelled by Cagetti and De Nardi (2001). The purpose of the model is to isolate the effects of financial intermediation without complicating the analysis with overlapping generations, default, or exogenously specified sectors of production.

The next Section briefly surveys the literature and empirical evidence on entrepreneurship and financial intermediation. Section 3 develops the main model and defines stationary recursive equilibrium. Characterization of occupational decisions are described in Section 4. Parameters and numerical results are presented in Section 5. Section 6 concludes.

2 Entrepreneurship and Financial Intermediation

First, I will briefly describe the relationship between financial intermediation and entrepreneurship in the developed economy, represented here by data from the United States. Second, I will discuss financial development in developing countries.

I follow Gentry and Hubbard (2000) and define entrepreneur as someone who combines upfront business investment with entrepreneurial skill to obtain the chance of earning economic profits. The average number of entrepreneurs in PSID between 1970 and 1994 was 12%.

Entrepreneurship is an important factor in wealth and income inequality. First, wealth is much more concentrated than income. The Gini coefficient for family wealth is between 0.78 and 0.83, depending on the year of PSID survey, the coefficient for family income is around 0.45. The top 1 percent of families owns around 29% of the total household wealth and around 8% of the total income. The top 5 percent owns already 50% of the wealth and receives 20% of the income. Finally, the top docile owns around 60% of the wealth and receives 31.5% of the income.

The percentage of business families increases in higher wealth classes: Quadrini

(1999a) documents that about half of the families in the top 5% are business families. and that while worker families tend to stay in or move to lower positions of wealth, business households tend to stay in or move to higher positions. Also, the longer the business life the higher the wealth accumulated by business families. However, the concentration of wealth among business families is not purely explained by the concentration of income. Entrepreneurs, being such a small fraction of the population, receive 22% of the total income and own 40% of the total wealth. In other words, entrepreneurial families own higher levels of wealth relative to their income than worker families: the ratio of wealth to income is about twice as large for business families. Quadrini (1999b) and Gentry and Hubbard (1999) find that entrepreneurs are wealthy because they not only earn more income but also save relatively more than workers.

Entrepreneurial income is more volatile than the labor income of workers. Heaton and Lucas (2000) found that the median standard deviation of the growth rate of nonfarm proprietary income is 64% annually, and the median standard deviation of the growth rate of real wage income is only 35% annually. Proportionately more entrepreneurs who run small firms receive all income from their firm's profit.[1]

Are entrepreneurs constrained by their wealth? Evans and Leighton (1989) in their study of entrepreneurship based on the National Longitudinal Survey find that men with greater assets are more likely to become self-employed all else being equal. Holtz-Eakin, Joulfaian, and Rosen (1994) document in their inheritance study that liquidity constraints exert a noticeable influence on the viability of entrepreneurial enterprises. The CBO 1992 shows that three-quarters of small firms use credit, almost 60% use traditional as well as non-traditional sources.[2]

As far as the sources of non-borrowed capital are concerned, almost half of the entrepreneurs use their own or family's savings and smaller entrepreneurs also use physical assets. Fazzari, Hubbard, and Petersen (1988) report that internal finance in the form of retained earnings generates the majority of net funds for firms of all size categories. The average retention ratio is largest for small firms (80%) and lowest for the largest firms (50%). Eisner (1978) finds that the timing of investment in small firms is more sensitive to profits than it is in large firms.

[1]According to The Bureau of the Census in the Characteristics of Business Owners and Employees (CBO 1992), around 35% of business owners received more than 75% of their total income from business.

[2]For both sources the usage of credit grows with firm size. In terms of the aggregate value of small firm debt, almost 90% of credit comes from traditional sources, mostly from lines of credit and loans. The Federal Reserve Survey of Terms of Business Lending reveals that small loans are more often secured by collateral. In 2000, for example, of all commercial and industrial loans made by all commercial banks in the United States, 83% required collateral for loans smaller than $99,000, 74% for loans smaller than $1 million, 46.9% for loans smaller than $10 million, and only 31.7% for loans greater than $10 million.

A firm's employment size affects the firm's dynamics. Davis, Haltiwanger, and Schuh (1996) show that the rates of job creation and job destruction in U.S. manufacturing firms decrease in firm size and that, conditional on the initial size, small firms grow faster than large firms. Evans (1987) shows that the growth rate of manufacturing firms and the volatility of growth is negatively correlated with firm size and age. Notably, 64% of owners have previous work experience in a managerial capacity and 34% as the owner of another business. The combination of low exit rates and high entrance rates of experienced business families implies their low turnover rate and high entrepreneurial persistence. This persistence allows business families to accumulate higher levels of wealth relative to workers.

The above data indicate that entrepreneurial activity is a very important feature of the U.S. economy. Accumulated experience and wealth, together with access to financial services, seem to be the main determinants of entrepreneurial activity. Especially small firms play an important role in innovation, technological change and productivity growth. In the 1990s, small businesses employed more than half of the workforce and created three-fourths of the new jobs. At the same time, the owners of small firms seem to be the most constrained by their wealth.

In the following Sections I will calibrate the economy with financial intermediation to replicate these data. In particular, I will model the business experience as a persistent Markov process of entrepreneurial ability. As entrepreneurs most often rely on commercial banks as their main source of borrowing, I will define financial intermediation as a competitive banking sector offering one period capital loans. In the United States, domestic credit provided by the banking sector is 164% of GDP, which is around five times more than in poor countries according to the surveys by the World Bank.

2.1 The Process of Financial Development

There is a large literature on the importance of financial markets for general economic activity and economic growth, for example Gertler (1988), Bencivenga and Smith (1991), and Greenwood and Jovanovic (1990). Financial markets affect agents' incentives to accumulate physical as well as human capital. They foster specialization in entrepreneurship, entrepreneurial development, and the adoption of new technologies, by making funds available to potential and incumbent entrepreneurs that are profitable on a larger scale than any small number of individuals can afford. Financial markets serve to allocate resources to the place or persons where the return is greatest. So does risk sharing in financial markets, since it allows agents to reallocate their savings towards more productive investment by eliminating idiosyncratic risk like in Greenwood and Smith (1997).

North (1981) argues that industrial revolution was not about developing new technologies but about making large-scale investments possible for capital-intensive processes. Levine (1997), King and Levine (1993a) and King and Levine (1993b) find that depth and liquidity of financial markets are statistically significant for real per capita GDP growth, the average rate of growth in the capital stock per capita, and total productivity growth. As far as the causality is concerned, King and Levine (1993a) suggest that the initial level of financial development is a good predictor of subsequent rates of economic growth, physical capital accumulation, and economic efficiency over the next 30 years even after controlling for income, education, political stability, and government policies. Rousseau and Wachtel (1998) find that intermediation measures Granger-cause real output, with little evidence of feedback from output to intermediation.

Financial development or reform can be interpreted as providing access to or reducing the cost of credit to agents with low level of accumulated wealth. These might include the development of micro-financing institutions, systems of credit ranking, credit history, or of recording property ownership, such as the Grameen bank of Bangladesh and Banco Sol of Bolivia that exploit social network to generate invisible collateral. That credit constraints are more prevalent in developing countries is shown in an important field study by Paulson and Townsend (2002) who find two-thirds of Thai business households financially constrained, mostly due to limited commitment problem faced by the poor entrepreneurs. During the process of financial development, Jeong and Townsend (2004) document an increase in financial participation rate among the economically active households in Thailand from 6% in 1976 to 27% in 1996.

Is the process of financial development welfare improving? Townsend and his coauthors study the economic development of Thailand in the last two decades. Townsend and Ueda (2004) estimate that barriers to financial deepening are associated with welfare loss of 7% of Thai GDP. In Gine and Townsend (2004), gains and losses to financial sector liberalization have been surprisingly large: The relatively low wealth but talented households experience mean gains from 69% to twice the average household annual income. On the other hand, liberalization delivers welfare losses of roughly 8% to 1.1 times the average yearly income of entrepreneurs. This fact suggests a plausible political economy rational for observed financial sector repression.

Banerjee and his coauthors study capital markets in India and they find that they are very far from the neoclassical ideal. Banerjee, Duflo, and Munshi (2003) estimate that the gap between the marginal product of capital and the market interest rate can be at least 70 percentage points, and the gap between the marginal product of capital and the savings rate even larger. Investors who are on average less productive but not constrained may invest as much as three times more than their more productive counterparts. The unconstrained investors own about twice as much capital stock and

maintain capital-production and capital-export ratios that are 1.5 to 2.5 times as high as the constrained ones. Banerjee and Duflo (2001) use a change in directed lending policies in India as a natural experiment to estimate the effect of greater access to working capital on profits. They find that an extra one rupee of credit increases profits, net of interest, by more than one rupee.

Quah (2003) summarizes the recent literature on inequality and growth. He finds that poor benefit more from increasing aggregate growth by a range of factors than from reducing inequality through redistribution. Only under inconceivably high increases in inequality would economic growth not benefit the poor. However, inequality might cause institutions and the political process to preclude growth (financial liberalization).

I will address these issues in the following sections.

3 The Model

In this Section I develop a model of the economy with functioning capital and labor markets and define a stationary recursive equilibrium. Later, I will modify this economy to that in which financial intermediation does not exist.

The economy is populated by a continuum of infinitely lived agents on a unit interval. Each agent has preferences over consumption given by a utility function

$$E\left[\sum_{t=0}^{\infty}\beta^t u(c_t)\right],$$

where $\beta \in (0,1)$ and $u : \mathbb{R}_+ \to \mathbb{R}$ is bounded, strictly increasing, strictly concave, and a twice differentiable continuous function that satisfies the Inada conditions.

In the beginning of a period each agent is identified by a level of accumulated assets $a \in A = [0, \infty]$ and by an idiosyncratic ability shock $z \in Z = [\underline{z}, \overline{z}]$. This initial ability shock z is carried from the previous period and is interpreted as a signal for an effective ability shock $z' \in Z$ that is realized later in the period. I assume that there are no markets in which the agents can perfectly insure against these shocks.

Given the individual state (a, z) at the beginning of the period, each agent decides whether to work as a worker or whether to become an entrepreneur. If the agent becomes a worker, he or she draws the effective ability shock z' from a fixed distribution ψ and receives labor income $z'w$, where w is the equilibrium wage.

Production occurs in a large number of firms. Each firm is owned and managed by one entrepreneur who uses capital input k and a labor input of n workers. An entrepreneur with effective ability z' produces output $y = z'f(k,n) = z'(k^\alpha n^{1-\alpha})^\theta$, where $\alpha \in (0,1)$ and $\theta < 1$. The production function exhibits decreasing return to managerial

control as in Lucas (1978). These assumptions preclude pyramidal managerial structure and ensure that even the best managers run projects of a finite size. Capital used in production depreciates at a rate $\delta \in (0, 1)$. In the whole paper I assume full information and no possibility of default. I also assume that a project's failure does not lead to a full depreciation of the capital used in production, or in other words, that the capital is not project-specific.

Importantly, each entrepreneur must decide how much capital, k, to use and how much labor, n, to contract *before* his or her effective ability shock z' is drawn. Given the decreasing returns to scale technology, the expected profit share is $1 - \theta$. However, if the effective ability shock turns out to be very low, the entrepreneur's profit might be negative. Because of the i.i.d. structure of workers' ability shocks, I assume that each firm hires workers of the same average effective ability $\int z' \, \psi(dz')$, normalized to one.

Positive profits represent the benefit side of entrepreneurship. However, there are also costs. The first one is the forgone wage, an endogenous entry cost for entrepreneurs: It might not be optimal to establish a firm of a very small size with expected profits much lower than the expected wage which could be earned by joining the labor force. Entrepreneurial risk is the second cost of establishing a business. Each entrepreneur faces a positive probability of realizing a very low effective ability shock and having a negative profit he or she must expense from accumulated assets. With the entrepreneurial project committed before the effective ability shock is realized, agents with a low level of assets will not take any or at least large entrepreneurial projects because they would not be able to cover the potential loss in the case of failure.[3]

Shocks for the entrepreneurs follow a first-order Markov process with a transition function $Q(z, z')$. The Markov structure of shocks to entrepreneurial ability reflects the learning aspect of entrepreneurial success as documented in Quadrini (1999a). I assume that Q is monotone and satisfies the Feller property.

I abstract from a fixed cost associated with operating a business modelled in Hopenhayn and Rogerson (1993), among others. Instead, I follow Veracierto (2001) in specifying the set of entrepreneurial ability shocks $Z = \{\underline{z}\} \cup [1, \overline{z}]$. To ensure that not all agents become entrepreneurs, I assume that $\underline{z} = 0$ is such a low entrepreneurial skill with $Q(\{\underline{z}\}, \{\underline{z}\}) = 1$ that agents with the lowest signal always prefer to become workers. Second, to guarantee the exit of entrepreneurs, I assume that $Q(z, \{\underline{z}\}) > 0$ for all $z \in Z$. The values of the shocks and the structure of the transition matrix will be

[3]Note that if the agents could choose their occupation after they observe the effective ability shock, as in Cagetti and De Nardi (2001), all agents with high shocks would become entrepreneurs and employ the profit-maximizing inputs regardless of their wealth. Since the purpose of this study is occupational choice for agents constrained by their wealth, I model the entrepreneurial decision as an *ex ante* commitment of resources with uncertain return.

specified in detail in the following Sections.

Finally, after the labor income or profits are realized, both workers and entrepreneurs decide on how much to consume and on the amount of assets invested to the next period. Without uncertainty, each agent carries his or her effective ability shock z' as the next period signal for future effective ability shocks.

3.1 The Economy with Financial Intermediation

In the economy with financial intermediation there is a competitive banking sector at which agents deposit their accumulated assets. As there is no cost of intermediation, the banks pay the same interest rate on deposits, r, as they receive for one period capital loans lent to the entrepreneurs. Financial intermediation enables the entrepreneurs to borrow more than capital they deposited at the bank.

The decision of an agent identified by the asset level and the ability signal, (a, z), can be formalized by the following recursive optimization problem,

$$v(a,z) = \max\left\{\int v^W(a,z')\,\psi(dz'), \max_{k,n}\int v^E(a,z')\,Q(z,dz')\right\}, \tag{1}$$

where the choice of being a worker who draws an effective ability shock $z' \in Z$ has a value

$$v^W(a,z') = \max_{c,a'}\{u(c) + \beta v(a',z')\}, \tag{2}$$

subject to a budget constraint

$$c + a' \leq (1+r)a + z'w. \tag{3}$$

Given the choice of capital investment, k, hired labor, n, and a realized effective ability shock, $z' \in Z$, entrepreneurship has a value,

$$v^E(a,z') = \max_{c,a'}\{u(c) + \beta v(a',z')\}, \tag{4}$$

subject to a budget constraint

$$c + a' \leq (1+r)a + \pi(k,n,z'), \tag{5}$$

where $\pi(k,n,z')$ is the entrepreneur's profit,

$$\pi(k,n,z') = z'f(k,n) - (r+\delta)k - wn. \tag{6}$$

Finally,

$$a \in A \text{ with } \underline{a} = 0, \text{ and } k,n \geq 0. \tag{7}$$

Note that it is optimal for an agent who decides to be a worker not to take any loan. The production technology implies that all entrepreneurs operate with the same capital-labor ratio.

The specification of the utility function together with the uncertainty in entrepreneurial profits imply that agents with a low level of accumulated assets can be constrained with respect to the size of the entrepreneurial project. In particular, entrepreneurs will not choose a too large project for which the repayment of the loan plus wages for contracted workers might lead to a non-positive consumption for each possible realization of output,

$$(r+\delta)k + wn \leq (1+r)a + z' f(k,n) \text{ for all } z' \in Z. \tag{8}$$

Since in each period $Q(z, \{\underline{z}\}) > 0$ for all $z \in Z$, the financing constraint must hold for the lowest effective ability shock, namely $z' = \underline{z} = 0$,

$$(r+\delta)k + wn \leq (1+r)a. \tag{9}$$

As this endogenous financing constraint depends only on the asset level and not on the effective entrepreneurial ability, poor agents—even with the best signalled ideas—might not be able to establish a firm or the firm size will be smaller than it would have been in an economy with complete markets.

3.2 Stationary Recursive Competitive Equilibrium

The concept of stationary recursive equilibrium requires that assets supplied by all agents equal the amount of capital demanded by the entrepreneurs, that labor supply by workers equal the labor hired by entrepreneurs, and that all allocations be feasible for a time invariant distribution of agents over their types.

The policy function for the next-period assets $a'(a,z)$ and the laws of motion for the ability shock process generate a law of motion for the endogenous distribution of agents over their individual states,

$$\lambda'(A', Z') = \int_{\{(a,z'):a'(a,z')\in A'\}} \Delta(z, dz')\, \lambda(da \times dz)$$

for all A' and Z', where $\Delta(z, dz') \equiv Q(z, dz')_{|E} + \psi(dz')_{|W}$ selects the law of motion for entrepreneurs' and workers' ability shocks. According to this law of motion, the fraction of agents that will begin next period with assets in the set A' and a signal of ability in the set Z' is given by all those agents that transit from their current shock z to a shock in Z' and whose optimal decision for assets accumulation belongs to A'.

Definition 1 *A stationary recursive competitive equilibrium is constant factor prices* (r, w)*, value functions* $\left(v, v^E, v^W\right)$*, policy functions* (k, n, c, a')*, a probability measure* λ*, a transition selector* Δ*, and aggregate levels* (A, K, L, N)*, such that*

1. *at prices* (r, w)*, the policy functions solve the optimization problem of each agent,*
2. *the probability measure* λ *is time invariant,*
3. *the capital and labor markets clear,*

$$A = \int a\, \lambda(da \times dz) = \int k(a, z)\, \lambda(da \times dz) = K,$$

$$L = \int z'\, \Delta(z, dz')\, \lambda(da \times dz) = \int n(a, z)\, \lambda(da \times dz) = N,$$

4. *and the aggregate feasibility constraint holds at equality*

$$\int \{c(a, z') + a'(a, z)\}\, \Delta(z, dz')\, \lambda(da \times dz) =$$
$$= \int z' f(k(a, z), n(a, z))\, Q(z, dz')\, \lambda(da \times dz) + (1 - \delta)K.$$

Note that the aggregate feasibility constraint is implied from the other conditions by the Walras' law and that the fraction of entrepreneurs is equal to $1 - L$.

3.3 The Economy without Financial Intermediation

The economy without financial intermediation differs from the above economy only in the absence of the banking sector. All agents have access to a storage technology that does not bring any return. Each entrepreneur must finance his or her project from accumulated assets. There still exists a labor market where workers can be hired at an equilibrium wage w. Otherwise, the structure of the two economies is identical and I continue to assume that assets used in production depreciate at a rate $\delta \in (0, 1)$.

A worker now faces a budget constraint

$$c + a' \leq a + z'w. \tag{10}$$

Similarly, an entrepreneur has a budget constraint

$$c + a' \leq a + \pi(k, n, z'), \tag{11}$$

with profit

$$\pi(k, n, z') = z' f(k, n) - \delta k - wn, \tag{12}$$

and a no-borrowing constraint

$$k \leq a. \tag{13}$$

The financing constraint is now for $z' = \underline{z} = 0$,

$$\delta k + wn \leq a.$$

Note that an entrepreneur might not find it optimal to use all assets in production. The definition of the *stationary recursive competitive equilibrium* is similar to that of the economy with financial intermediation except for the market clearing condition in the asset market. If the equilibrium exists, i.e., if there is a positive fraction of workers (entrepreneurs), the total amount of capital used in production is strictly smaller than the total amount of assets in the economy, $K < A$.

4 Characterization of Entrepreneurial Decisions

This Section partially characterizes occupational choices and entrepreneurial decisions. The occupational choice of each agent is based on the comparison of the expected present discounted value of each occupation. The existence of a stationary recursive equilibrium requires that there be a positive fraction of the population in each occupation. The following assumptions guarantee, first, that there exists a shock sufficiently high that some agents become entrepreneurs, and second, that for a shock sufficiently low each agent prefers to be a worker.

Assumption 1 *The signal ability shock $\overline{z}$ is such that there exists an asset level a^s for which $\int v^W(a, z')\,\psi(dz') \leq \int v^E(a, z')\,Q(\overline{z}, dz')$ for all $a \geq a^s$.*

Assumption 2 *The signal ability shock $\underline{z}$ is such that $\int v^W(a, z')\,\psi(dz') \geq \int v^E(a, z')\,Q(\underline{z}, dz')$ for all $a \in A$.*

Note that both assumptions are related to the opportunity cost of forgone wages and risk. The first assumption guarantees the entrepreneurs that in expectation the value of their occupation choice is greater than the value of choosing to work for wage, and vice versa for the second assumption.

The properties of value functions for each occupation follow the analysis in Stokey, Lucas, and Prescott (1989). The value function of workers $v^W(a, z')$ is strictly increasing in each argument since the utility function is strictly increasing and strictly concave and a worker's constraint set is strictly increasing in assets and the effective ability shock. The same properties apply to the value function of entrepreneurs for all (a, z').

The value function of workers, v^W, is independent of z and an increasing and continuous function of a. Due to the monotonicity of the transition matrix Q, the value function of entrepreneurs, v^E, is an increasing and continuous function of both a and z. Together, the value function, $v(a, z)$, is non-decreasing in z and strictly increasing in a.

Figure 1 displays values related to the occupational decision of agents with three levels of signal: low, z_L, medium, z_M, and high, z_H. It can be easily shown that for each z there is either none or at most one switching level of assets $a^s(z)$ and that $a^s(z)$ decreases in z.[4] In Figure 1, all agents below $a^s(z_H)$ are workers. Agents with the high signal ability shock switch to entrepreneurship at $a^s(z_H)$, agents with the medium signal shock at $a^s(z_M)$, while agents with z_L never become entrepreneurs. Thus signals z_H and z_M satisfy Assumption 1 and the signal z_L satisfies Assumption 2. At asset level a_1 only agents with z_H are entrepreneurs while at asset level a_2 agents with both z_H and z_M are entrepreneurs.

For a given level of signal ability shock $z \in Z$, agents identified by the switching level of assets $(a^s(z), z)$ are indifferent between working and undertaking an entrepreneurial project. Therefore, it must be the case that

$$\int v^W(a^s(z), z')\, \psi(dz') = \int v^E(a^s(z), z')\, Q(z, dz').$$

Assuming interior solutions with respect to agents' consumption and taking the usual first order and envelope conditions, this condition can be rewritten as

$$\int v_a(a'(a^s(z), z'), z')\, \psi(dz') = \int v_a(a'(a^s(z), z'), z')\, Q(z, dz'). \tag{14}$$

Note that the left-hand side is independent of z while the right-hand side is increasing in z due to the properties of Q. The different sources of income and the separate laws of motion of ability shocks imply that the policy functions $a'(a^s(z), z')$ are different for each occupation at the same effective ability shock z'.

If for some $z \in Z$

$$\int z'\, \psi(dz') < \int z'\, Q(z, dz'),$$

becoming an entrepreneur has a future value. In other words, marginal entrepreneurs are willing to sacrifice current consumption for having the opportunity to begin their

[4] All of the above properties hold in all numerical simulations of the model. However, the value function $v(a, z)$—the outer envelope for value functions at each shock level—may not be a concave function even if the value functions of workers and entrepreneurs are. Gomes, Greenwood, and Rebelo (2001) analyze a model of unemployment with a similar property. In the whole paper, possible gains from randomization are omitted.

business career.[5] Therefore, for such agents the expected current income from business is lower than the expected wage,

$$\int z' w \, \psi(dz') > \int z' f(k,n) \, Q(z,dz') - wn - (r+\delta)k.$$

It is the dynamic and learning aspect of entrepreneurship contained in the Markov process (the future value increases in its monotonicity) that precludes writing the within period break-even condition at equality as in Lucas (1978). This result corresponds to the finding that especially the entrants to entrepreneurial occupation have a lower income than if they continued to be workers.[6]

I now turn to the analysis of the optimal size of the entrepreneurial project measured in terms of employment level (similar results apply to the optimal levels of capital input). Whether entrepreneurs are financially constrained depends on their asset position, ability and the optimal size of the project. From the first order conditions with respect to committed capital and labor inputs, all entrepreneurs use the same optimal capital-labor ratio

$$x \equiv \frac{k(a,z)}{n(a,z)} = \frac{\alpha}{1-\alpha} \frac{w}{r+\delta}. \tag{15}$$

When the financial constraint is not binding at the optimal level of inputs, i.e., if

$$((r+\delta)x + w)n(a,z) < (1+r)a, \tag{16}$$

the hiring policy is independent of the entrepreneur's wealth and depends only on the signal ability z. Denote such unconstrained employment levels as $n^u(z)$. When the financial constraint (16) binds, entrepreneurs are not able to run a project at the optimal size and their hiring decisions depend on their wealth. A binding financial constraint (16) can be solved for a level of $n^b(a)$ independent of the signal ability shock. Note that due to the properties of the production technology, the capital-labor ratio continues to hold at the same level.

In general, an optimal hiring policy must satisfy

$$n(a,z) \leq \min\left\{n^u(z), n^b(a)\right\}.$$

The actual employment size is a function of the expected marginal utilities and productivity for all levels of the effective ability shocks. Figure 2 shows an example of hiring

[5]This result also holds for some non-marginal entrepreneurs: due to the continuity of the value functions, entrepreneurs with assets $[a^s(z), a^s(z)+\epsilon)$ where $\epsilon > 0$ also sacrifice current consumption for the future flow of profits.

[6]For a detailed empirical investigation see Hamilton (2000) and for implications in this model see Bohacek (2003).

constraints for the three shock levels used in Figure 1. The unconstrained policies are horizontal lines $n^u(z)$, while the asset-constrained hiring policy lies on the increasing concave function $n^b(a)$. The employment levels of entrepreneurs with the high ability signal must lie below the thick line $n(a, z_H)$. It is apparent that wealthy agents are more likely to be unconstrained than poorer agents.

When entrepreneurial decisions are not constrained by wealth, the size of business projects is optimal and the allocations efficient. This applies to asset level a_2 at which agents with high and medium signal shocks become entrepreneurs. At a_1 agents with a medium signal shock choose to be workers. Finally, agents with a low signal shock are always workers with $n(a, z_L) = 0$.

Agents with accumulated assets a_1 and the high signal shock cannot hire the optimal employment level $n^u(z_H)$ but must use at most a lower, inefficient level $n^b(a)$. Clearly, an opportunity to borrow from financial intermediaries would be efficiency enhancing.

Similar results apply to the economy without financial intermediation. For $k \leq a$, all entrepreneurs now face the cost of the capital project δk instead of receiving the non-negative income $(r + \delta)(a - k)$. As all projects with $k > a$ are not possible, the occupational choice of agents with good entrepreneurial ideas but low assets is restricted.

5 Results

In this Section I present the results of numerical simulations of the stationary equilibria of the two economies. Finally, I simulate a transition between these two steady states to illustrate the process of financial development.

5.1 Parameterization

The parameterization shown in Table 1 is standard for the U. S. economy as in Cooley (1995). The span of managerial control θ set at 0.85, a level close to the one estimated by Burnside (1996). The utility has the logarithmic form.

The transition matrix for entrepreneurial skills has important implications for the degree of business persistence and accumulation of wealth by business families. I set the values of Q and the levels of shocks Z so that the model is able to replicate the first and second moments of the distribution of wealth. Similarly to Veracierto (2001), I choose the effective ability shocks for the entrepreneurs $Z = \{0\} \cup [1/2, \overline{z}]$ with $Q(\{0\}, \{0\}) = 1$ so that an entrepreneur who fails with the lowest effective ability shock will prefer to be a worker in the following period. Also, $Q(z, \{0\}) > 0$ for all $z \in Z$ implies that all entrepreneurs terminate their businesses in finite time. The workers draw their effective

ability shocks from a fixed distribution ψ with a lowest possible value equal to one half. This specification of shocks and their laws of motion imposes the financing constraint in each period and satisfies the assumptions on the existence of a stationary equilibrium. Both transition processes are specified so that the entrepreneurs constitute 13.5% of the population and the exit and entry rate is around 7% (see Evans (1987)).

The algorithm for finding the steady state of each regime is relatively simple. To solve for the occupational decision, expected values of both options are computed first. I iterate on the wage and the interest rate until both markets are cleared and the conditions of the stationary recursive competitive equilibrium are satisfied. For the economy without financial intermediation the interest rate is fixed at zero. Finally, I set the maximal level of assets high enough so that the upper bound of the stationary distribution of resources is endogenous.

5.2 Steady State with Financial Intermediation

Because the parameters are chosen to match the data for the U.S. economy, I first describe the steady state of the economy with financial intermediation, which is the second column of Table 2.

Importantly, this model with entrepreneurial choice replicates Gini coefficients for wealth, 0.83, and income, 0.37, inequality. The top percent of the agents own more than 20% of the total wealth and receive almost 10% of the total income. The match with the U.S. data for the top 5% is even better.

Table 3 shows average levels and shares for each occupation. While the wealth/assets ratios of entrepreneurs and workers match the data well (twice as high as for entrepreneurs than for workers), the workers' shares of wealth and income are too low. This is because entrepreneurs receive all profits. If workers could hold shares of the firms, this statistics would improve. Thus in this model the entrepreneurs hold eight times more assets, receive four times more income, and consume three times more than the workers. The wealth/income ratio is 4.57 for entrepreneurs and 2.68 for the workers (the first number is lower than in the data).

Entrepreneurs are the investors in the economy. As in the data analyzed by Quadrini (1999a), entrepreneurs are heavily over-represented in the top wealth docile, with 50%, as well as in the second top docile, with 25%. Their total investment is 28% of the total assets and the average entrepreneur invests almost 9% of assets he owns.

The average entrepreneurial return on projects is 11% (see Table 4), five times as much as the risk-free interest rate, 3.2%.[7] A vast majority, 87%, of entrepreneurs are net borrowers, using on average 1.66 times more capital than they hold assets. The

[7]For the evidence on the effects of firm size on interest rate see Petersen and Rajan (1994).

total credit in the economy is 140% of the output, close to the same statistics for the U.S. economy. The share of small firms (under 10 employees) is 74% and the average exit rate is 7 percent. Small entrepreneurs borrow from the banks more frequently than large entrepreneurs, which is also consistent with the data.

5.3 Steady State Without Financial Intermediation

The average per-capita levels in the economy without financial intermediation are shown in the first column of Table 2. The third column calculates the change of these levels with respect to the steady state with financial intermediation.

Without financial intermediation, output is lower by 22.1% and the agents suffer a welfare loss equal to 24%. Efficiency, measured as output per effective labor, falls by 20.5%. As there is no borrowing and lending, only 62.3% of aggregate assets are used in production, which is about 16.8% less than in the economy with financial intermediation. At the same time, however, the aggregate stock of assets is now greater. This result suggests two things.

First, it coincides with De Soto (2000) claim that substantial parts of the populations of developing countries lack access to credit not because they lack assets but because these assets cannot be collateralized without a formal title.[8] As in this model, entrepreneurs must finance their projects out of their own savings. A financial reform can be interpreted as formal titling, i.e., transformation of property into collateral, collateral into credit, and credit into capital income.

Second, insurance seems to be an extremely important market for the poor households because they may be very vulnerable to changes in their consumption: their wages fall dramatically and assets do not bring any returns. The absence of complete insurance markets in the face of idiosyncratic shocks leads to a precautionary demand for assets.

These phenomena have direct implications for distribution of wealth, prices and aggregate economic activity. While the fraction of agents in each occupation is almost unchanged, inequality measures are worse: 0.90 for wealth and 0.45 for income, respectively (inequality rises also within each occupation). Accordingly, agents in the top percentiles own much more wealth and receive more income than in the economy with financial intermediation.

The main reason for the widening inequality is the deteriorated situation of workers. Inefficiency in investment halves the equilibrium wage compared to the developed economy. Remarkably, the wage is so low despite the higher capital stock. Only at this level

[8] A common feature of models of inequality and growth in the literature has been that inequality hampers growth because loans cannot be collateralized because a large part of the population lacks assets.

are the entrepreneurs willing to hire workers and undertake their business projects.

Lower labor income worsens the position of workers relative to entrepreneurs, as shown in Table 3. Workers' share of wealth declines to one third, income to 43%, and consumption to 58%. Workers' average consumption is substantially lower than in the steady state with financial intermediation. On the other hand, consumption of entrepreneurs is 4.5% higher. This is due to the fact that, although they do not receive interest on their assets, they pay much lower wages to hired workers and demand more than twice the return on their projects.

As in data, the fraction of entrepreneurs is higher than in the financially developed economy.[9] In Table 4 one can read that the projects are smaller on average: Entrepreneurs now use on average only 94% of their own assets and substitute towards cheaper labor. As the share of small firms grows to 85% the exit rate increases to 9%. The quality of entrepreneurial projects, measured by the average entrepreneurial effective ability, decreases by only around 4 percent. These results suggest that the main effect of absent financial intermediation is through the binding financial constraint rather than the selection of best ideas into practice.

5.4 The Process of Financial Development

Because a pure steady state analysis might be very misleading especially for welfare comparisons, I simulate a transition process from the steady state of the economy without financial intermediation to the benchmark steady state, shown in Figures 3 and 4. The transition allocations are based on the optimal behavior of agents after an unanticipated introduction of financial intermediation into the original steady state. The economy converges from the inherited steady state without financial intermediation, namely its distribution of assets, to the steady state of the economy with financial intermediation. The markets clear in each period and the evolution of the distribution is based on the optimal investment decisions of all agents. Computationally, I fix the number of transition periods, T, and guess the evolution of prices, $\{r_t, w_t\}_{t=0}^{T}$, where λ_0 and (λ_T, r_T, w_T) are known from the two steady states. I iterate on these paths and a sufficient length of the transition until convergence.

In Figure 3, the time paths of the market clearing prices are shown in the right panels, the levels of aggregate capital (now equal to the aggregate assets) and labor (fraction of workers in the population) are in the left panels. The interest rate rises monotonically, assuring that in each period of the transition the capital stock demanded by entrepreneurs equals the stock of assets in the banks. The inefficiently high stock of

[9] Cagetti and De Nardi (2001) find that tighter borrowing constraints generate not only more wealth inequality but also fewer entrepreneurs.

assets declines smoothly to the new equilibrium level, together with the capital/labor ratio. Wage jumps immediately to a level even higher than that in the final steady state. [10] The high wage forces the the less efficient entrepreneurs to exit. Agents with good skills are less constrained, can borrow and enter or run their firms closer to the optimal size.

In its bottom panels, Figure 4 shows the evolution of the Gini coefficients of inequality for wealth and income. Wealth inequality declines monotonically during the whole transition. All agents now receive a return $(r_t + \delta)$ on their deposits and have more incentives to save (especially the workers with higher wage). On the other hand, the Gini index for income falls in the first period of transition, then it rises up for three periods and only then very quickly falls to the new steady state level. The temporary rise of income inequality coincides only with the initial dramatic wage adjustment and fast reallocation process. Overall, the transition makes the society less unequal with no evidence of a pronounced, inverted-U shaped Kuznets curve.[11]

In its top panels, Figure 4 shows the change in output and consumption for both occupations with respect to the original steady state levels. With the appearance of the banking sector, output per capita increases immediately by 30% and consumption of workers increases by more than 55%. Entrepreneurs benefit initially from consuming accumulated assets, later their consumption decreases due to lower profits. However, the introduction of financial intermediation makes *both* occupations better off in terms of expected discounted present value. Welfare of the average worker increases by 50%, that of the average entrepreneur by 5.3%, and that of the average agent by 28.5%, all relative to the original steady state levels.[12]

The development of financial markets would be supported by both occupation groups. This is not the case in Gine and Townsend (2004) who find that financial liberalization delivers welfare losses to entrepreneurs of roughly 8% to 1.1 times the average yearly income. Their result suggests a plausible political economy rational for observed financial sector repression. Rajan and Zingales (2003) argue that in an economy with underdeveloped financial markets, incumbent firms enjoy some rents in the markets they operate in, but they also end up appropriating most of the returns from

[10] Jeong and Townsend (2004) find that during the rapid growth and financial deepening in Thailand, growth in wages was the highest during the whole 1976-1996 period, while profits did grow only in the last decade.

[11] This contrasts with Greenwood and Jovanovic (1990) or Jeong and Townsend (2004) who find the Kuznets curve for Thailand during its rapid growth and financial deepening in 1970-1990s. Inequality increased within all occupational groups studied.

[12] The welfare gain is so large compared to other papers like Lucas (1990b) or Domeij and Heathcote (2004) because the agents do not need to save additional capital. Similarly, Townsend and Ueda (2004) estimate gains to financial deepening at 7% of GDP in Thailand.

new ventures. These rents will be impaired by financial development, mostly by the entrance of new and more productive firms. From the perspective of the incumbents, the effect of a more efficient financial intermediation system can offset the other benefits that financial development brings. In such a case, incumbents as a collective have a vested interest in preventing financial development. At the same time, incumbent industrialists and financiers may have enough political and economic power to collectively decide the development of the economy's financial system. Financial development may take place only when the country's political structure changes dramatically, by external forces (international institutions) or when the incumbents do not loose in the process.

The last possibility is the result in my paper. Both workers and entrepreneurs support financial development, gaining in terms of expected discounted present value. Entrepreneurs would vote for the reform—despite having lower consumption in the final steady state of the financially developed economy.

7. Conclusions

This paper evaluated the effect of financial intermediation on economic activity and distribution of resources. The absence of financial intermediation represents a constraint on all agents' allocations and must be inefficient. Numerical simulations showed that the efficiency and welfare losses amount to more than 20%, magnitudes not usually found in other models studying, for example, inefficiencies in government policies.

What is important with respect to economic development, financial intermediation improves not only the aggregate levels of output or welfare but also alleviates inequality, both of wealth and income. Both occupation groups benefit from financial development. Perhaps surprisingly, the process of financial intermediation dramatically improves the wellbeing of workers and of poor agents in relative as well as in absolute terms.

This paper also shows that modelling occupational decisions of heterogenous agents is important for matching the U.S. distributional data. In particular, entrepreneurial choice and profit are able to generate a very unequal distribution of wealth. There is no need for a detailed modelling of overlapping generations and life-cycle earning processes to achieve these results. What is crucial is the occupational heterogeneity of agents and credit constraints.

The assumptions in this paper are few and the model displays simplicity of the basic neoclassical macroeconomic models. I have abstracted from modelling growth, institutional development, human capital and technological innovation, population growth and other phenomena that are very important for studying financial markets in developing countries. Of the usual functions of financial systems surveyed in the above literature,

I have limited my attention to financial intermediation by a competitive banking sector. The effects of other important features of financial intermediation—asymmetric information, possibility of default, collateral requirements or property rights—on the allocation and distribution of resources are left for future research.

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Parameters of the Model

Technology and Preferences

α	θ	δ	β
0.34	0.85	0.06	0.95

Ability Shocks Z

0	0.50	1.00	1.25	1.50	1.75	2.00	2.25	2.50	3.00

Distribution ψ of Workers' Ability Shocks

0	0.04	0.89	0	0.04	0	0.02	0	0.01	0

Transition Matrix Q for Entrepreneurs' Ability Shocks

1	0	0	0	0	0	0	0	0	0
0.2250	0.7500	0.0250	0	0	0	0	0	0	0
0.1000	0.0750	0.8000	0.0250	0	0	0	0	0	0
0.0500	0	0.0750	0.8500	0.0250	0	0	0	0	0
0.0250	0	0	0.1000	0.8500	0.0250	0	0	0	0
0.0125	0	0	0	0.1125	0.8500	0.0250	0	0	0
0.0125	0	0	0	0	0.1125	0.8500	0.0250	0	0
0.0125	0	0	0	0	0	0.1125	0.8500	0.0250	0
0.0125	0	0	0	0	0	0	0.1125	0.8500	0.0250
0.0125	0	0	0	0	0	0	0	0.1375	0.8500

Table 1: Parameters of the model.

Results of Numerical Simulation
Steady State Aggregate Levels and Distribution

	Financial Intermediation		Change
Average	No	Yes	(in %)
Output	0.95	1.16	22.1
Consumption	0.77	0.95	23.4
Assets	4.78	3.48	-28.2
Capital in Production[a]	2.98	3.48	16.8 (62.3)
Efficiency[b]	1.07	1.29	20.5
Credit/GDP	—	1.41	—
Interest rate	—	2.4%	—
Wage	0.39	0.63	61.4
Workers (%)	86.0	86.5	0.6
Entrepreneurs (%)	14.0	13.5	-3.6
Gini Index			
Wealth	0.90	0.83	-7.8
Income	0.45	0.37	-17.8
Top Percentiles (%)			
Wealth			
1%	29.4	21.8	-25.9
5%	64.6	54.1	-16.3
10%	82.5	75.0	-9.1
Income			
1%	14.2	9.4	-32.9
5%	33.0	25.6	-22.5
10%	44.3	37.9	-14.6

Notes: [a]The first number in the last column represents the change in capital level used in production in the economy. The number in parenthesis is the percentage of the total assets used in production in the economy without financial intermediation. [b]Efficiency measured as output per effective labor.

Table 2: Steady State Aggregate Levels and Distribution

Results of Numerical Simulation Entrepreneurs and Workers						
	Average Levels			Shares (%)		
	Fin. Inter.		Change	Fin. Inter.		Change
	No	Yes	(in %)	No	Yes	(in %)
Wealth						
Entrepreneurs	21.70	14.96	-31.1	66.1	59.0	-10.7
Workers	1.89	1.64	-13.2	33.9	41.0	20.9
Income						
Entrepreneurs	2.96	3.47	17.2	57.0	41.1	-27.9
Workers	0.40	0.79	97.4	43.0	58.9	36.9
Consumption						
Entrepreneurs	2.22	2.12	-4.5	42.0	31.0	-26.2
Workers	0.53	0.76	43.4	58.0	69.0	18.9

Table 3: Entrepreneurs and Workers

Results of Numerical Simulation Firms Statistics			
	Financial Intermediation		Change
Average	No	Yes	(in %)
Output	6.57	8.38	27.5
Capital	20.43	24.94	22.1
Employment	5.90	6.25	5.9
Profit	2.97	2.22	-25.2
Return (%)	26.0	11.1	-57.3
Capital/Assets	0.94	1.66	76.6
Capital/Eff. Labor	3.34	3.85	15.3
Capital/Output	3.11	2.97	-4.5
Output/Eff. Labor	1.07	1.29	20.5
Quality[a]	1.35	1.41	4.4
Exit (%)	9.50	7.00	-26.3
Small Firms[b] (%)	85.0	74.0	-12.9
Borrowing (%)			
All Firms	—	87.6	—
Small Firms	—	92.1	—

Notes: [a]Quality measured as entrepreneurial effective ability per firm. [b]Small firms defined by employment lower than 10 units of effective labor.

Table 4: Firms Statistics

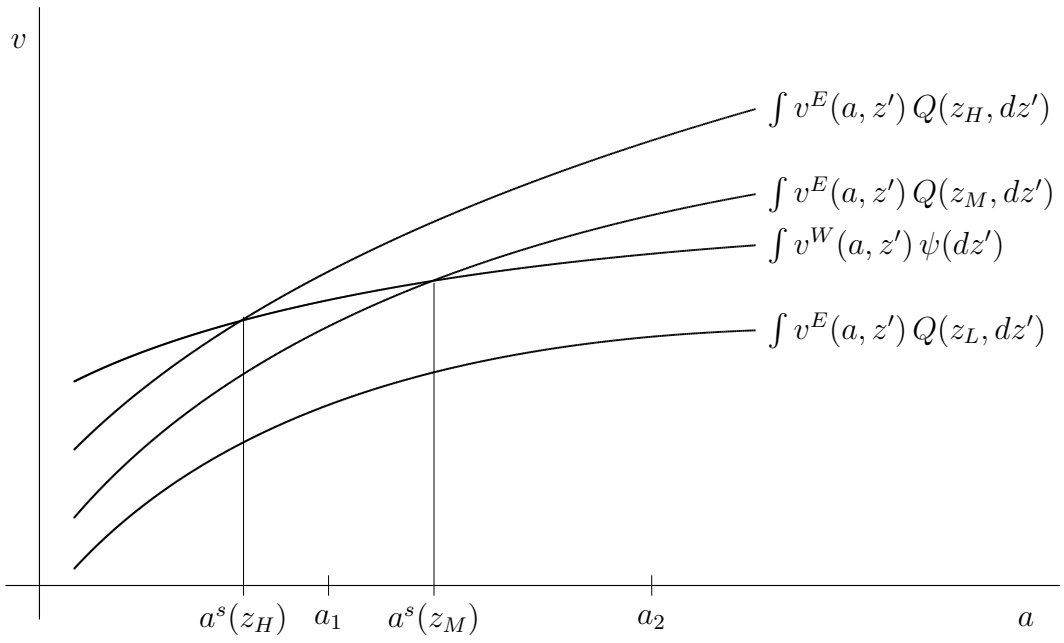


Figure 1: Value functions of entrepreneurs and workers

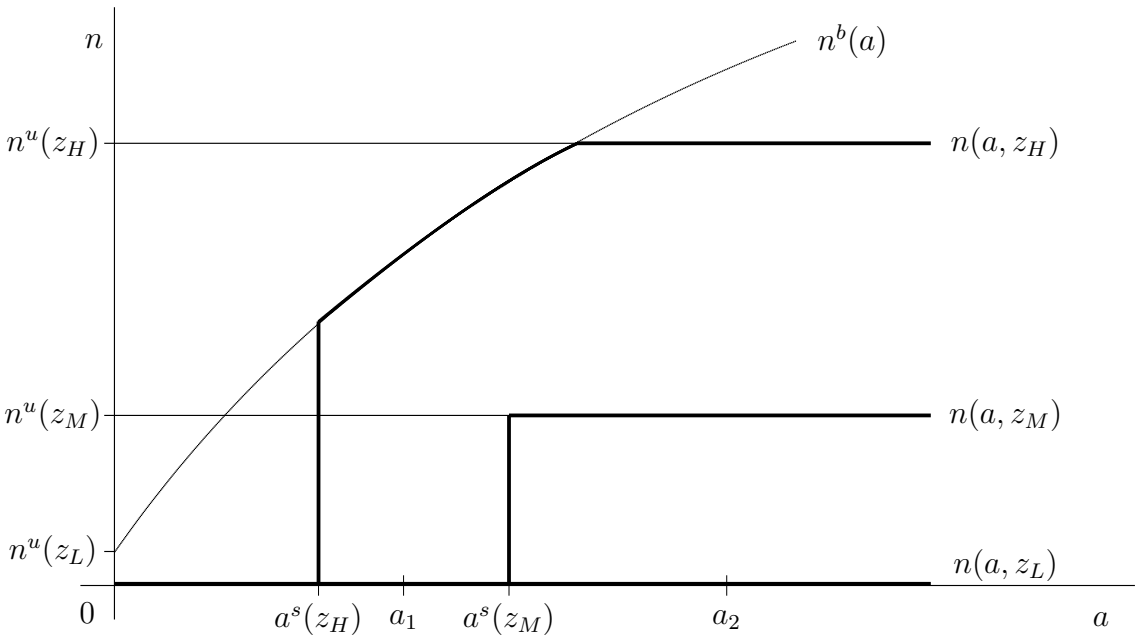


Figure 2: Hiring policies of entrepreneurs

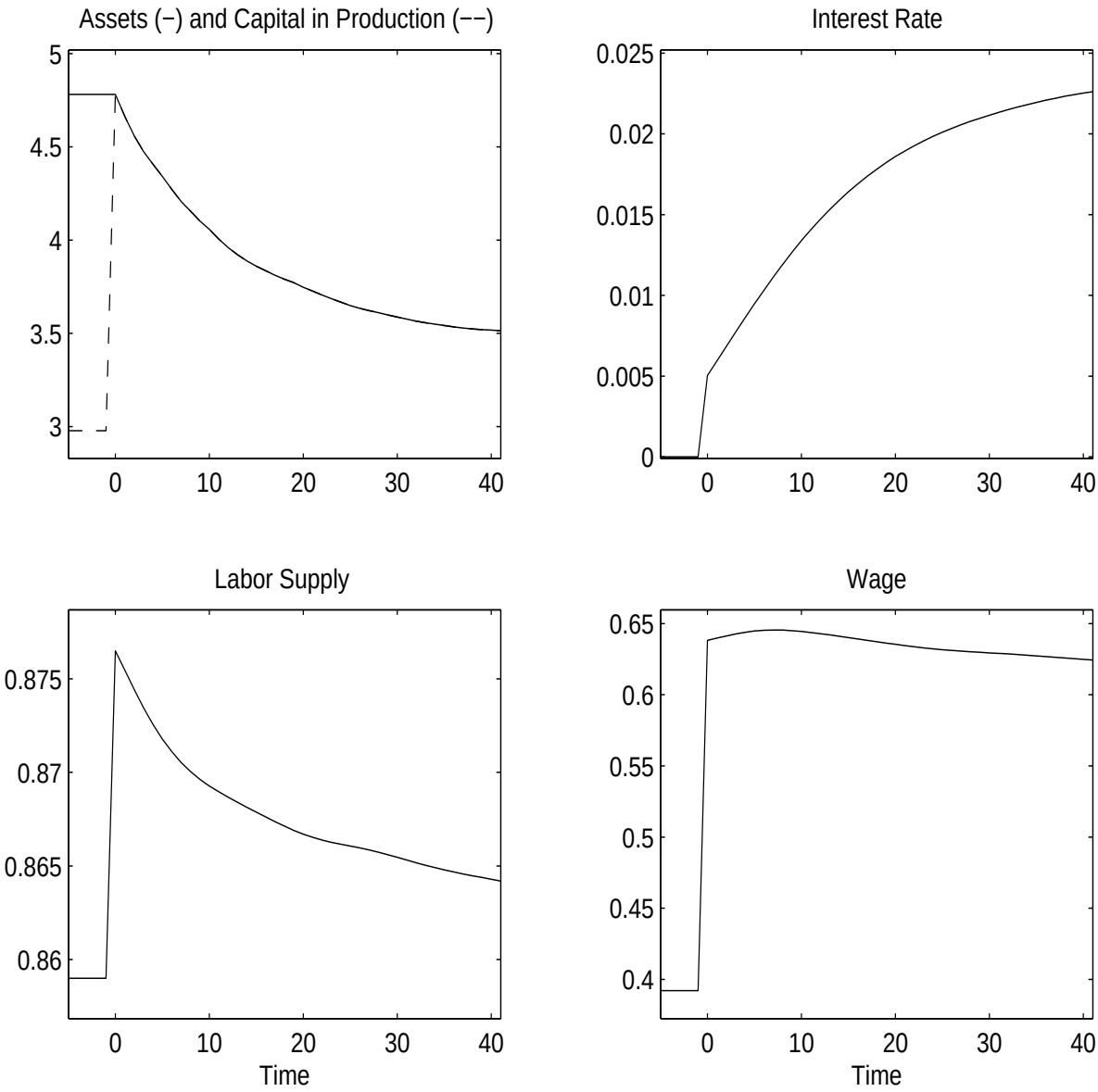
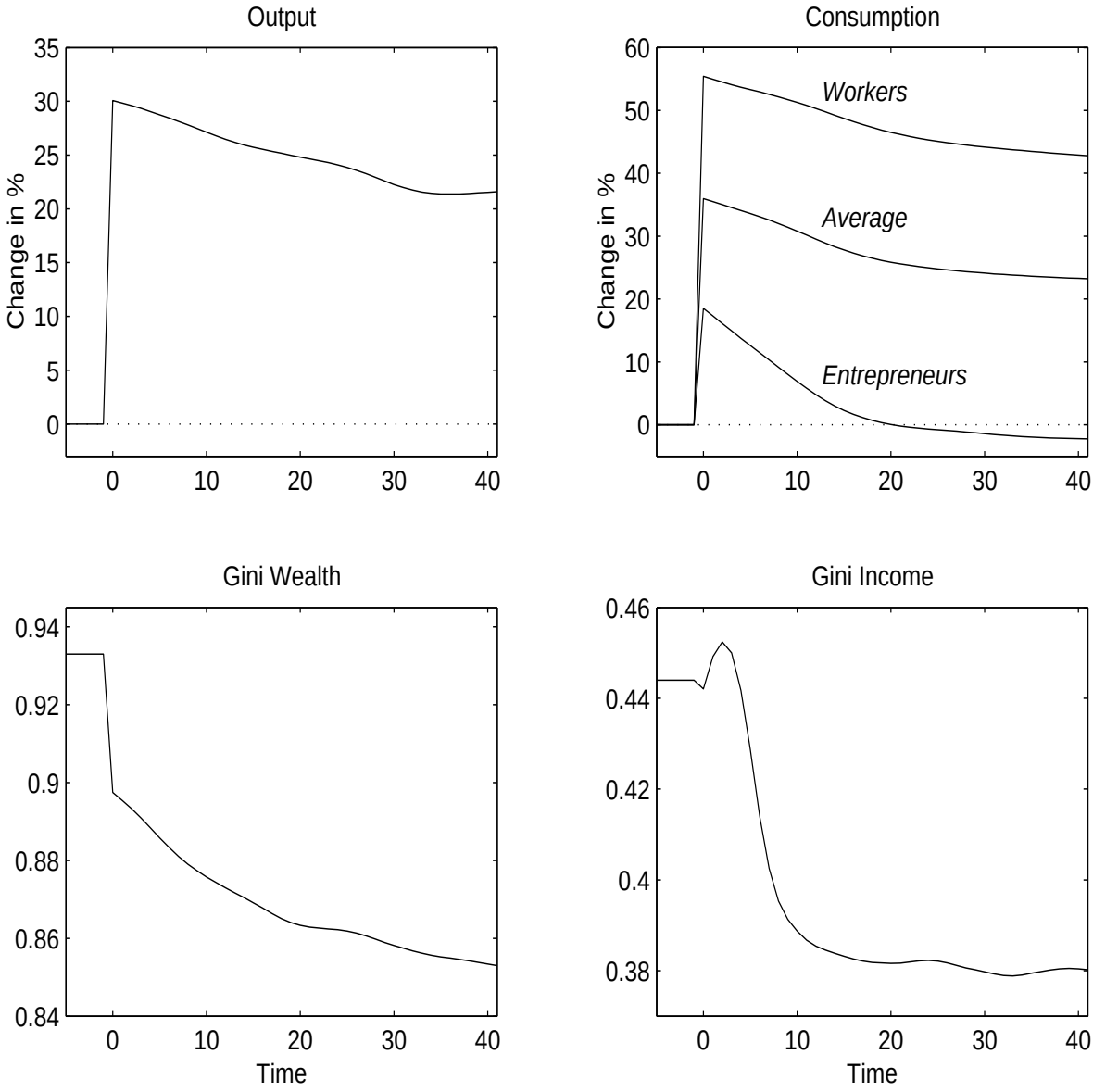


Figure 3: Transition: Capital and Labor Markets.



Output and consumption percentage changes with respect to the original steady state without financial intermediation. Gini coefficients of wealth and income inequality.

Figure 4: Transition: Allocations and Inequality.