Credit Rationing, Wealth Inequality, and Allocation of Talent [1]

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Abstract

We provide a simple model of credit rationing with endogenous occupational choice. Entrepreneurial talent is subject to private information and to screen borrowers banks ask for collateral. The interplay between the labor market and the credit market leads to multiple equilibria in a natural way. The higher is the wage rate, the lower is the collateral needed to discourage less talented agents from borrowing. This allows a greater number of poor but talented agents to become entrepreneurs, thereby increasing labor demand and justifying the wage increase. We discuss the implications of our model for economic policy which are very different from those suggested by models that focus on the credit market only.

Keywords: Occupational Choice, Adverse Selection, Wealth Distribution, Credit Rationing.

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1 Introduction

A well-functioning credit market allows those who have surplus savings to lend it to those who have skills, talents and ideas. In addition it allows those who are born poor to acquire skills through education and move up the economic ladder. However, there may be transactions costs due to the necessity to screen and monitor borrowers to ensure repayment. The use of collateral might reduce the transaction costs, but those who need capital most are poor and unable to pledge collateral. Thus, capital may not flow freely to those who need it most, and projects with a high potential rate of return may never be realized.[1] Starting with the classic work of Stiglitz and Weiss (1981) there is now a large literature on the effects of asymmetric information on credit markets, and their implications for macroeconomic phenomena such as business cycles (e.g., Bernanke and Gertler, 1990), and economic development (Banerjee and Newman, 1993 and Piketty, 1997).

However, the credit market does not operate in isolation. The extent of credit rationing is likely to be determined by what is going on in the rest of the economy, and in turn, it will affect other markets, such as the labor market, through the level of investment that is financed. In this paper we study the two-way interaction between the credit market and the labor market in the presence of asymmetric information. The extent of credit rationing determines the level of investment undertaken in the economy, which affects the wage rate in the labor market. The wage rate in turn affects the occupational choice decisions of individuals who differ in terms of entrepreneurial ability, namely, whether to be a worker or an entrepreneur. The resulting effect on the quality of the borrower pool affects the lending policy of banks, and therefore, the extent of credit rationing. We show that this mechanism of interaction between the credit and the labor markets generates multiple equilibria in a very natural way and suggests policies that differ greatly from those that focus on the credit market only.

[1]The role of credit market constraints in limiting entry to entrepreneurship is a well documented phenomenon at the micro-level (see Evans and Leighton, 1989, Evans and Jovanovic, 1989, and Blanchflower and Oswald, 1998).

A key element of our model is the fact that individuals differ in terms of *both* entrepreneurial talent and wealth. Economic efficiency requires that a shortage of personal wealth should not stop an individual who has talent from becoming an entrepreneur. But talent by its very nature is likely to be subject to asymmetric information and so our starting point is the standard model of financial contracting under adverse selection, where competitive lenders use collateral to screen borrowers. For simplicity we assume that talent and wealth are uncorrelated, so talented agents exist in the same proportion for every wealth level. Each agent can choose among three occupations: entrepreneurship, wage labor, or a subsistence technology that requires no capital. The wage rate is determined in the labor market and entrepreneurial rents adjust accordingly. All individuals are equally skilled at providing ordinary labor, hence all workers earn the same wage. Entrepreneurship involves a set-up cost, so individuals with insufficient wealth who want to become entrepreneurs must borrow from a bank. A talented entrepreneur produces a net surplus large enough to cover the set-up cost. An untalented entrepreneur cannot produce any surplus, and obtains only private benefits from being an entrepreneur. Thus, if the collateral required by banks is large enough, untalented individuals are unwilling to give up collateral, since they know they would not be able to repay the loan.

We show that the amount of collateral sufficient to discourage untalented individuals from becoming entrepreneurs is *decreasing* in the wage rate, which is the endogenous outside option to bank-financed entrepreneurs. If the wage rate is low, being a worker is not an attractive option and so individuals who do not have entrepreneurial talent will try their luck in the credit market. Lenders will respond by raising the collateral level, which means fewer talented entrepreneurs will be funded. The resulting excess supply of labor will justify the initial low wage rate. Similarly, a high wage rate will increase the attractiveness of being a worker to individuals without entrepreneurial talent, which will induce banks to lower the collateral level. This will lead to greater investment and greater demand for labor, justifying the high wage rate.

The model provides a link between credit market imperfections and underdevelopment and how they can mutually reinforce each other. There is considerable macro-level evidence on the relationship between the degree of financial development and economic growth (e.g., King and Levine, 1993, Rajan and Zingales, 1998). There is also some evidence to suggest that higher wages are associated with lower transactions costs in the credit market.[2] While there is a large literature starting with the "big push" model of Murphy, Shleifer and Vishny (1989) that views the problem of economic development as coordinating to a good equilibrium in the presence of multiple equilibria, there is a key feature that distinguishes our model. Those who are talented *and* rich enough to become entrepreneurs in a low-wage equilibrium prefer this equilibrium, while all other agents prefer a high-wage equilibrium. Therefore the multiple equilibria of our model have elements of *conflict* as well as *coordination*, like in the "battle of the sexes". While aggregate output is higher in a high wage equilibrium, if the rich have sufficient political power they may be able to block it. In contrast in pure coordination failure models such as Murphy, Shleifer and Vishny (1989) a good equilibrium Pareto dominates a bad equilibrium. As a result, it is hard to explain the persistence of a bad equilibrium - economic policy which aims to coordinate on a good equilibrium will be opposed by nobody.

Our model also suggests a mechanism by which a small exogenous shock in the labor or credit market can have a large macroeconomic effect through the mutual interaction of these two markets. This is in contrast with the findings of Caballero and Hammour (1994) who study the change in the selection of firms (in terms of quality) over the business cycle and argue that recessions have a cleansing effect by weeding out inefficient firms. Our argument is, to the contrary, that recessions worsen the adverse selection problems in the credit market, which reinforces the

[2] Harrison, Sussman and Zeira (2000) use US state-level data to show that higher real wages are associated with lower operational costs of banks (excluding the costs due to writing off bad loans), controlling for state and year fixed effects. They conclude from this that economic development reduces costs of financial intermediation. While not directly comparable to our set up (since we focus on the size of collateral) this provides some suggestive evidence regarding the effect of economic development on the degree of credit market imperfections.

recession.

Some interesting implications regarding economic policy to deal with credit rationing can be drawn from our model. Even if credit subsidies cannot improve efficiency in the standard partial equilibrium model of the credit market, they can have general equilibrium effects that improves efficiency. Also, policies that target the labor market can alleviate credit rationing. Because the wealth threshold for borrowing is endogenous, small changes in the wealth distribution can have a large effect on efficiency in the short-run by setting off market forces that reinforce the effect of these policies.

While our paper has links to several literatures as mentioned above, such as those on financial contracting with asymmetric information, macroeconomic implications of agency costs, and coordination failure models of economic development, it is most closely related to the literature on occupational choice and credit market imperfections, and in particular, to the important paper by Banerjee and Newman (1993).[3] As in this literature, our focus too is on the endogenous determination of returns to different occupations in the presence of imperfect credit markets and set-up costs. However, there are several features that distinguish our paper. First, we study the *two* way interaction between the credit market and the labor market whereas Banerjee and Newman (1993) study only the one-way effect of credit rationing on the labor market. As a result, in the static version of Banerjee and Newman (1993) the equilibrium is unique, whereas in the static version of our model there can be multiple equilibria. Second, in the dynamic version of the Banerjee and Newman (1993) model there can be multiple steady states, and which one is reached depends on the initial distribution of wealth. However, once the initial distribution of wealth is known, the long term outcome of the economy is perfectly known.[4] In the dynamic extension of our model, for a given initial distribution of wealth there can be multiple dynamic equilibria due to the interaction of multiple markets. In one such dynamic equilibrium the wage will be high in each period and

[3]See Galor and Zeira (1993), Ghatak, Morelli, Sjöström (2001), Lloyd-Ellis and Bernhardt (2000), Mookherjee and Ray (2000), and Piketty (1997) for related contributions.

[4]See Ray (2000) for a discussion of this point.

in the other one the wage will be low in every period. The wealth distribution will converge to different limiting distributions in the two cases. Finally, while the classical literature on economic development originating with Schumpeter emphasizes entrepreneurial talent and ability to innovate as the key to economic development, the literature on occupational choice typically views entrepreneurship as involving monitoring other workers, a skill that can be picked up easily by anybody and as a result, everyone is equally good at it. An exception is Lloyd-Ellis and Bernhardt (2000) who allow entrepreneurs to have heterogeneous talent. However, there is no asymmetric information about it in their model, and the severity of credit rationing does not depend on the outside option of the agents. In contrast, heterogeneity of individuals in terms of entrepreneurial talent and asymmetric information about it are key features of our model and as a result of these features, the extent of credit market imperfections is endogenous.

The plan of the paper is as follows. In section 2 we describe the set up of the model and in section 3 analyze the equilibrium in the static model where we take the wealth distribution as exogenous and characterize conditions under which multiple equilibria could arise. In section 4 we discuss the implications of our model regarding economic policy. In section 5 we carry out a simple dynamic extension of our basic model allowing the wealth distribution to evolve over time through bequests and show that starting with the same initial distribution of wealth two economies can converge to two different stationary equilibria, one with the low wage in each period, and the other with the high wage. Section 6 makes some concluding remarks and some technical proofs are presented in the appendix.

2 The Static Model

2.1 Endowments and Preferences

We consider a one-period competitive economy with a continuum of risk neutral agents identified with the interval $[0, 1]$. Each agent i is born with initial wealth a_i. The initial distribution of wealth is $G(\cdot)$, which we take as given exogenously. All agents are born with an endowment of one unit of labor which they supply inelastically, either as entrepreneurial labor or as ordinary labor. An agent is *talented* with probability α and *not talented* with probability $1-\alpha$. We will refer to talented and not talented agents as h and l types, respectively. Talent refers to entrepreneurial ability only: all agents are equally qualified to supply ordinary labor. An agent's type (talent) is private information. Wealth and ability are independently distributed. Consumption can take place at the beginning or at the end of the period. End of period consumption is discounted by the factor $1/\rho$, $\rho \geq 1$.

2.2 Technology

The economy produces one homogenous good, a numeraire commodity referred to simply as output. Output can be consumed or used as capital. There is a subsistence technology that requires no capital and one unit of labor to produce $\underline{w} > 0$ units of output. There is an entrepreneurial technology called a *project*. Each project requires $k > 0$ units of capital, one unit of entrepreneurial labor, and $n \geq 1$ units of ordinary labor. The technology is fixed-coefficients type, and n and k are given exogenously. The capital depreciates completely at the end of the period, and can be interpreted as human capital. If a h type agent is the entrepreneur, then the project yields a certain return $R > 0$. If instead the entrepreneur is not talented, the project will generate only a *private benefit* $M > 0$ and no other output. The private benefit cannot be appropriated by a lender, which captures the idea that an entrepreneur cannot be prevented from diverting some part of the investment into his own benefit. In order to focus on the interesting cases, we make the following assumptions on the exogenous parameters.

Assumption 1. $R - n\underline{w} - \rho k > \underline{w}$.

Assumption 2. $M - \rho k < \underline{w} < M$.

Assumption 3. $(1-\alpha)M + \alpha\left(R - n\underline{w}\right) < \underline{w} + \rho k$.

Assumption 1 says that when the wage is at the lowest possible level R is sufficiently big, so that a talented individual strictly prefers to be an entrepreneur rather than being a worker, after making wage and interest payments. Assumption 2 says that the private benefit of being entrepreneur to a l-type borrower, M, exceeds the income from the subsistence technology, $\underline{w}$. Therefore, l type agents could potentially gain from becoming bank-financed entrepreneurs. However, when the set-up cost ρk is subtracted from the private benefit, the subsistence technology dominates, so l type agents never want to become *self financed* entrepreneurs. To interpret Assumption 3, suppose an agent is picked at random from the population and made an entrepreneur. The random agent is type h with probability α, in which case she produces R and pays wages $n\underline{w}$.[5] If the agent is type l then she receives the private benefit M and foregoes the $\underline{w}$ units of output she could have produced using the subsistence technology. The set up cost of a project is ρk. Thus, Assumption 3 guarantees that the expected social cost of a project exceeds the expected social gain if the entrepreneur is randomly chosen. Notice that Assumption 3 is satisfied if α is low enough, since $M < \underline{w} + \rho k < R - n\underline{w}$ from Assumptions 1 and 2. As is standard in competitive screening models that use the equilibrium concept of Rothschild and Stiglitz (1976), an equilibrium will not exist if the fraction α of "good types" is too large, because separating equilibria will be destroyed by deviations where banks offer "pooling" contracts that attract both types of borrowers. To ensure the existence of a Rothschild-Stiglitz equilibrium, we need α to be not too large. Assumption 3 guarantees it.[6]

[5] If the entrepreneur is type l, she does not produce any output. We may assume that she does not hire any workers, or we can assume that she hires n workers and defaults on their wages. What we assume is irrelevant for our results because type l agents will not become entrepreneurs in equilibrium.

[6] If we drop Assumption 3 then a Rothschild-Stiglitz equilibrium may no longer exist. The literature contains several alternative equilibrium concepts that have been proposed as solutions to this existence problem (e.g., Wilson, 1977, Riley, 1979 and Hellwig, 1987) but none of these are uncontroversial. As a result we restrict our attention to parameter values for which the Rothschild-Stiglitz equilibrium exists.

2.3 Markets

All markets are perfectly competitive. Every individual has the same skill as a worker, and there is no moral hazard with respect to effort. Wages adjust without any frictions to clear the labor market. As a result there is no involuntary unemployment, and each entrepreneur is able to hire n workers at the going market wage. The supply and demand for labor are determined by the occupational choices of agents (entrepreneurship versus wage labor). Notice that since any agent can use the subsistence technology, wages can never fall below $\underline{w}$.

Since entrepreneurial talent is private information and type l entrepreneurs will never repay their loans, there is an adverse selection problem on the credit market which will be discussed in the next section. Banks have access to an international credit market where the supply of funds is infinitely elastic at the gross interest rate $\rho \geq 1$. Agents who have a positive amount of wealth can deposit any portion of it and earn the gross interest rate ρ. Since the discount factor for end of period consumption is $1/\rho$, agents are indifferent between consuming immediately, or saving and consuming later.

3 Equilibrium in the Static Model

3.1 Partial Equilibrium Credit Contracts

Banks compete by offering credit contracts. Borrowers accept the contract they prefer, if any. All take the labor market wage as given. Since borrowers' types are private information, the market is subject to an adverse selection problem. As in Bester (1987) and Besanko and Thakor (1987), collateral can be used as a screening device. Following Rothschild and Stiglitz (1976), an equilibrium consists of a set of contracts such that no contract makes losses, and no additional contracts can be introduced that earns profits if the original contracts are left unmodified. A standard argument shows that each contract that is offered in equilibrium will yield zero expected profit, and there can be no pooling of types. Moreover, an equilibrium may not exist if α is close to one.[7]

We assume that no transaction costs are involved in pledging or liquidating the collateral. Introducing such costs would not add anything to the analysis. Output is verifiable so if a project has produced a surplus, the borrower can be forced to repay her loan out of her project's earnings. However, there is limited liability in the sense that an entrepreneur who did not produce a sufficient surplus can at most lose the assets she had pledged as collateral. Moreover, the private benefit M cannot be appropriated by the bank. Without loss of generality we consider credit contracts of the following form. The bank makes a loan of size k to finance a project, but asks for collateral c. The gross interest rate on the loan is $r \geq 1$. Thus, a contract can be written as (c, r). An agent can accept the contract (c, r) only if her initial wealth is at least c. The bank holds on to the collateral c until the end of the period, and hands ρc back to the agent if and only if the loan is repaid in full (the required repayment is rk). If the borrower does not repay the loan, the bank keeps the collateral plus the interest earned on it, ρc. Note that this contract is equivalent to one where the bank requires borrowers to contribute c to the project while contributing $k - c$ itself.

While type h entrepreneurs care about the interest on the loan as well as the collateral, type l entrepreneurs care only about the collateral requirement since they will never repay their loans. Thus, collateral can be used to screen the borrowers, which by a standard argument guarantees that an equilibrium (if one exists) must be "separating". But if type l agents are separated out they must in fact be completely shut out from the credit market, for they will always default on their loans. Thus, the minimum collateral requirement must be high enough to deter type l agents from becoming bank-financed entrepreneurs.[8]

A contract (c, r) that attracts only type h borrowers will yield zero profit to the

[7] For a discussion of these and other results for the standard competitive screening model, see chapter 13 of Mas-Colell, Whinston and Green (1995).

[8] If type l agents borrow at all, then only banks with the lowest collateral requirement in the market, say (c', r'), will attract them. If the contract (c', r') attracts both h and l types and breaks even, there exists a nearby contract (with slightly higher c and lower r) which attracts only h types and yields a strictly positive profit for the bank that offers it, but this is inconsistent with equilibrium. Thus, there cannot be any pooling in equilibrium.

bank if

$$r = \rho \tag{1}$$

since their project never fails. The type h entrepreneur who has accepted the contract (c, r) will pay wages nw to her n workers and she will pay rk to the bank at the end of the period. Her net payoff[9] is, therefore,

$$\pi(w) = R - nw - \rho k. \tag{2}$$

Notice that the only endogenous variable that appears in (2) is w. Indeed, (2) gives the payoff for a *self-financed* type h entrepreneur as well. Assumptions 1 and 2 imply that $\pi(\underline{w}) > \underline{w}$.

A type h entrepreneur with wealth a will be indifferent between all loans that have collateral requirement $c \leq a$, since all such loans will give him payoff (2). As long as the bank's zero profit condition is satisfied, the entrepreneur will be precisely compensated for "renting" excess collateral to the bank for one period with no change in the interest rate. This serves no useful screening purpose and is completely neutral.[10] Therefore, without loss of generality, we can assume that type h borrowers always choose the contract with the lowest collateral requirement. So we can just as well assume that *only one* credit contract is offered in equilibrium. The level of collateral c must be the minimum level that prevents type l agents from wanting a loan.[11] The net payoff to a type l entrepreneur who accepts contract (c, r) will be $M - \rho c$, where ρc is the cost to her of losing her collateral. If instead she supplies ordinary labor she earns the wage w. If $w \geq M$ then she will not want

[9] We will measure payoffs in end of period units of utility for convenience. The discounted value of being an entrepreneur would be π^h/ρ.

[10] If some transactions cost was involved in transferring the collateral back and forth between the bank and the borrower, then only the smallest level of collateral necessary to screen the borrowers would be used.

[11] If the required level of c were strictly higher than necessary to deter type l agents from borrowing, then some collateral level $c^* < c$ would also be high enough to deter type l agents. A bank which deviates and offers a contract with a collateral level c^* would be able to make positive profits from those type h agents that have initital wealth between c^* and c, since these borrowers would not be served by any other bank. This would be incompatible with equilibrium.

a loan even if $c = 0$. If $M > w$, then to prevent type l agents from borrowing we need $M - \rho c \leq w$. Thus, the equilibrium level of collateral must be

$$c^*(w) \equiv \max\left(\frac{M-w}{\rho}, 0\right). \tag{3}$$

Any lower level of collateral would attract type l agents. By Assumption 2, $c^*(\underline{w}) > 0$ and $c^*(w) \leq k$ for any $w \geq \underline{w}$. Also, (3) implies that the level of collateral required to discourage l types from borrowing is decreasing in the wage rate ($dc^*/dw \leq 0$).

The intuition for this result is as follows. Think of banks being on one side of a street, and the factories being on the other side of the street. Borrowers line up in front of banks and workers in front of factories. If news comes in that the wage rate went up, this means lower profit margins and a higher opportunity cost of being an entrepreneur for everybody. But it would affect people who have different abilities for entrepreneurship differently. In particular, people who have the most to gain from being an entrepreneur, the h types, would be relatively less induced to walk to other side of the street. For l types it is just the opposite: the opportunity cost of trying to make some quick money at the bank's expense just went up, and so they leave. But the banks realize this (even they cannot tell who is who) and reduce the amount of collateral they charge. This means some poor h types who were standing in the line for workers can now cross the street and apply for a loan since they can afford the collateral.

We have shown that, given a labor market wage w, the only[12] candidate for an equilibrium on the credit market is the contract (c, ρ) with $c = c^*(w)$. To show the existence of equilibrium, we need to show that if (c, ρ) with $c = c^*(w)$ is offered, no bank has any incentive to deviate to a *pooling* contract with a lower collateral level. This deviation could potentially be profitable since it would attract h types whose wealth is below $c^*(w)$, and the gain from lending to them could exceed the cost of

[12]More precisely, if any equilibrium exists, then there also exists an equilibrium where the only contract on the market is (c, ρ) with $c = c^*(w)$. Other equilibria could exist where some banks offer contracts (c, ρ) with $c > c^*(w)$. However, the existence of these other contracts would not change anybody's welfare, and this trivial non-uniqueness is eliminated by assuming without loss of generality that borrowers always choose the lowest collateral on the market.

lending to l types who would also be attracted by the loan. Suppose a deviating bank offers a contract (c', r') with $0 \leq c' < c^*(w)$. This contract will attract all type l agents with wealth at least c'. They are of measure $(1-\alpha)(1-G(c'))$. In particular it includes all l agents with wealth above $c^*(w)$. On each loan to a type l agent the bank loses $\rho\,(k-c')$. To be profitable, it must be the case that $r' > \bar{r}(c)$. Therefore, type h agents with wealth $a \geq c^*(w)$ will not be attracted by the new contract (they prefer $(c^*(w), \rho)$ to (c', r')). Type h agents with initial wealth between c' and $c^*(w)$ might be attracted, however, since they cannot get any other loan. The measure of high types with wealth between c' and $c^*(w)$ is $\alpha\{G(c^*(w))-G(c')\}$. Since attracting these h types is necessary for the new contract to be profitable, the highest interest rate r' the bank can charge is the one that extracts all the surplus from the type h borrowers:

$$R - nw - r'k \;= w$$

Here the left hand side is the type h entrepreneurs payoff when he gets the loan, and the right hand side the opportunity cost of not working for wages. Using this, the deviating bank's profit is at most

$$\Pi^B = \;\alpha\left(G(c^*(w)) - G(c')\right)\left(R-(n+1)w-\rho k\right) - (1-\alpha)\left(1-G(c')\right)\rho\left(k-c'\right).$$

Since $G(c^*(w)) \leq 1$ and

$$c' < c^*(w) = \frac{M-w}{\rho}$$

we have

$$\begin{aligned} \Pi^B \;&<\; \left(G(c^*(w)) - G(c')\right)\left[\alpha\left(R-(n+1)w-\rho k\right) - (1-\alpha)\rho\left(k - \frac{M-w}{\rho}\right)\right] \\ &= \left(G(c^*(w)) - G(c')\right)\left[(1-\alpha)M - \rho k - w + \alpha\left(R - nw\right)\right] \leq 0 \end{aligned}$$

for any $w \geq \underline{w}$, by Assumption 3. Thus, no deviation to a contract that attracts both l and h types will be profitable.[13] So we have established the following.

[13] If the deviating bank could observe borrowers' wealth levels directly, it would know that any client with wealth above $\bar{c}(w)$ would be type l, since no type h agents with wealth above $\bar{c}(w)$ would be attracted by the pooling contract. However, even if the deviating bank could refuse to lend to individuals with wealth above $\bar{c}(w)$, the pooling deviation would still be unprofitable under Assumption 3.

Proposition 1. *For a given labor market wage $w \geq \underline{w}$, there exists a unique equilibrium on the credit market. The equilibrium credit contract is $(c^*(w), \rho)$, where $c^*(w) = \max\left(\frac{M-w}{\rho}, 0\right)$.*

This proposition gives a version of the standard result for the existence of a unique separating (partial) equilibrium in a credit market where banks compete by offering contracts that differ in terms of the interest rate and the collateral requirement (see Bester 1985).[14] Given that our model is very simple – high type borrowers never default and low type borrowers always do – this contract turns out to be very simple. In particular, it involves charging the same interest rate as the opportunity cost of capital to the bank and demanding a collateral that discourages low types from borrowing. The interesting feature of the model is the negative relationship between the collateral requirement and the outside option of borrowers, namely, the wage rate. In the next section we endogenize the wage rate and show that the interaction of the labor and credit markets has some novel implications relative to the partial equilibrium model of the credit market.

3.2 General Equilibrium through Occupational Choice

Let us begin by defining the highest equilibrium wage level that could prevail in the labor market. This is the wage rate such that h type agents who have enough wealth to become entrepreneurs, either through self-financing or bank-financing, are indifferent between becoming entrepreneurs and working for wages. This wage rate is given by the condition $\pi(w) = w$, i.e., if $w = \overline{w}$ where

$$\overline{w} \equiv \frac{R - \rho k}{1 + n} \tag{4}$$

This is the wage that yields a zero profit to entrepreneurs, net of the opportunity cost of not working for wages. Assumptions 1 and 2 imply that $\overline{w} > \underline{w}$. Clearly, $\underline{w}$ is a lower bound on the wage since any agent can earn $\underline{w}$ by using the subsistence

[14] As mentioned earlier, there is uniqueness in the sense that any set of contracts offered in any equilibrium would yield the same level of welfare for everybody as the equilibrium described in Proposition 1.

technology on his own, and $\overline{w}$ is an upper bound (no agent would want to be an entrepreneur if the wage rate is $w > \overline{w}$, but all agents would want to be hired by one).

As a benchmark, let us begin with the perfect information case. All h type agents whose wealth is less than k get a loan and no l type agent is able to borrow. All h type agents become entrepreneurs and all l type agents become workers or engage in subsistence. Since each entrepreneur can hire n workers and the population size is normalized to one, the measure of entrepreneurs that is needed for full employment in the non-subsistence sector is $\frac{1}{1+n}$. Since all h type agents can become entrepreneurs, the measure of potential entrepreneurs in the economy is α. If $\alpha \geq \frac{1}{1+n}$ then the supply of entrepreneurs exceed than the number needed to maintain full employment in the non-subsistence sector. To maintain equilibrium in the labor market the wage rate therefore must go up to $\bar{w}$ at which point some h type agents are indifferent between being entrepreneurs and workers. Similarly, if $\alpha < \frac{1}{1+n}$ the equilibrium wage rate will be $\underline{w}$. Technological parameters are the only determinant of aggregate surplus and the wealth distribution does not have any role to play in this case.

Now let us consider the second best environment, where a borrower's type is private information. Given the wage rate w from the labor market, anybody who has initial wealth higher than $c^*(w)$ is able to get a loan on the credit market. No l type agent wants to borrow on such terms, hence entrepreneurs consist of h type agents with wealth $a \geq c^*(w)$. Given the results of the previous section, we know that the maximum possible collateral level compatible with equilibrium is $c^*(\underline{w})$, which is strictly greater than 0 by Assumption 2. On the other hand, the minimum collateral level that could be compatible with equilibrium is $c^*(\overline{w})$ which is > 0 or $= 0$ according as $\overline{w} < M$ or $\overline{w} \geq M$. If $w < \overline{w}$, then $\pi(w) > w$ so *all* type h agents with wealth $a \geq c$ will want to become entrepreneurs. The measure of such a set of agents who want to become entrepreneurs (i.e., the supply of entrepreneurs) is $f(c) \equiv \alpha\left[1 - G(c)\right]$. The higher is the level of collateral, the greater is the degree of credit rationing and so the supply of entrepreneurs $f(c)$ is decreasing in c. The lower and upper bounds of $f(c)$ are $f(c^*(\overline{w}))$ and $f(c^*(\underline{w}))$.

The equilibrium collateral requirement and the equilibrium wage are determined by comparing the supply of entrepreneurs and the number of entrepreneurs needed for full employment in the non-subsistence sector, i.e., $\frac{1}{1+n}$. If for a given w and the corresponding equilibrium collateral level $c^*(w)$, $f(c^*(w)) > \frac{1}{1+n}$ then there is excess supply of entrepreneurs, which is equivalent to excess demand for workers. As a result the wage rate is going to rise, which will further reduce the collateral level and increase the extent of excess supply of entrepreneurs. This process will stop and an equilibrium will be reached when $w = \bar{w}$. Similarly, if $f(c^*(w)) < \frac{1}{1+n}$ then the equilibrium wage will be $w = \underline{w}$. Suppose $f(c^*(w)) = \frac{1}{1+n}$ for some $w = w^* \in (\underline{w}, \bar{w})$. If $f(.)$ is strictly decreasing in the neighborhood of w^* (which means $G'(.) > 0$ at $w = w^*$) then this equilibrium is unstable in the following sense: If the expected wage w' were slightly above w^*, then the collateral requirement would be $c^*(w') < c^*(w^*)$. There will be an excess supply of entrepreneurs as $f(c^*(w')) > f(c^*(w^*)) = \frac{1}{1+n}$ which will push the wage rate all the way up to $\bar{w}$. Symmetrically, a slight decrease in the wage below w^* leads to an excess demand for entrepreneurs, pushing the wage rate down to $\underline{w}$. So $(c^*(w^*), w^*)$ is a knife-edge equilibrium in the sense that if individuals make an epsilon mistake in their expectations, the wage goes to one of the two extreme values $\underline{w}$ or $\overline{w}$. On the other hand, if people make epsilon mistakes around $w = \underline{w}$ or $w = \bar{w}$ the economy returns back to them. We will focus on the stable equilibria in our subsequent analysis.

The equilibria are depicted in Figures 1 to 3, and are characterized as follows.

Proposition 2.

(i) *If*

$$f(c^*(\bar{w})) < \frac{1}{1+n} \tag{5}$$

then the unique equilibrium collateral level is $c^*(\underline{w})$ and the corresponding equilibrium wage is $\underline{w}$. The number of entrepreneurs is $f(c^*(\underline{w}))$.

(ii) *If*

$$f(c^*(\underline{w})) \leq \frac{1}{1+n} \leq f(c^*(\bar{w})) \tag{6}$$

then both $(c^*(\underline{w}), \underline{w})$ *and* $(c^*(\bar{w}), \overline{w})$ *are equilibria. In addition, if both inequalities in (6) are strict and if* G *is continuous, then there is a third, unstable, equilibrium* $(\hat{c}, w^*)$, *which satisfies*

$$\begin{aligned} f(\hat{c}) &= \tfrac{1}{1+n} \\ w^* &= M - \rho\hat{c}. \end{aligned} \tag{7}$$

(iii) *If*

$$f(c^*(\underline{w})) > \frac{1}{1+n} \tag{8}$$

then the unique equilibrium collateral level is $c^*(\overline{w})$ *and the corresponding equilibrium wage is* $\overline{w}$. *The number of entrepreneurs is* $1/(1+n)$.

In the figures we have c on the horizontal axis and the demand for and supply of entrepreneurs, $\frac{1}{1+n}$ and $f(c)$, on the vertical axis. For ease of comparability, in all the figures, we restrict attention to the case where $\alpha \geq \frac{1}{1+n}$ where all three cases can happen. If $\alpha < \frac{1}{1+n}$ then the low wage equilibrium is the only possibility - even if no collateral is asked for the supply of entrepreneurs is too low to sustain full employment in the non-subsistence sector.

In case (i) which is depicted in Figure 1, $f(c^*(\bar{w})) < \frac{1}{1+n}$ and so there are never enough entrepreneurs to obtain full employment in the non-subsistence sector even when the collateral level is at the lowest possible level. So the wage must equal the lowest possible, $\underline{w}$, and the collateral is the highest possible, $c^*(\underline{w})$, regardless of the wealth distribution. The wealth distribution still matters for aggregate welfare, however, since the number of entrepreneurs when the wage is $\underline{w}$ is

$$\alpha\left(1 - G(c^*(\underline{w}))\right) = \alpha\left(1 - G\left(\frac{M - \underline{w}}{\rho}\right)\right).$$

If $G\left((M - \underline{w})/\rho\right) > 0$, that is, if some individuals have initial wealth below $(M - \underline{w})/\rho$, then not all talented individuals will become entrepreneurs.

In case (ii), which is depicted in Figure 2, $f(c^*(\underline{w})) \leq \frac{1}{1+n} \leq f(c^*(\bar{w}))$ and so multiple equilibria are possible. As $f(c^*(\underline{w})) \leq \frac{1}{1+n}$, if $w = \underline{w}$ there are not enough entrepreneurs to ensure full employment in the non-subsistence sector and the excess supply of labor at any wage above the subsistence wage implies that the low wage persists as an equilibrium wage. However, if the economy starts out with a high wage then the resulting decrease in the collateral relaxes credit constraints and increases the supply of entrepreneurs to such a degree that the high wage persists as an equilibrium wage. There is also a third, interior equilibrium, which as we argued is unstable.

Finally, case (iii) is depicted in Figure 3. Here $f(c^*(\underline{w})) > \frac{1}{1+n}$. In this case even if the collateral is at the highest possible level, there is an excess supply of entrepreneurs at any wage below $\bar{w}$. As a result the wage rate will rise, and the economy will move to the unique equilibrium $(c^*(\overline{w}), \overline{w})$.

A key force driving our results is that the supply of entrepreneurs (or equivalently, the demand for labor) is *increasing* in the wage rate. This is generated by a combination of three features of the model: (i) the fact that supply and demand in the labor market are not independent but tightly connected by occupational choice - for example, an increase in the supply of labor is exactly matched by a decrease in the supply of entrepreneurs; (ii) the general equilibrium effect of wages on the collateral requirement; and (iii) the fixed coefficients production function. While the first two features add richness to the standard textbook model of the labor market, the last one is clearly restrictive. Suppose we relax it by letting revenue R to be an increasing and concave function of the number of workers hired, i.e., $R = R(n)$ and allow entrepreneurs to choose the number of workers they want to hire in response to the wage rate. Let $n = \phi(w)$ be the value of n that maximizes $R(n) - nw - \rho k$. Then the demand for labor would be $\alpha(1+\phi(w))(1-G(c^*(\overline{w})))$ and its slope with respect to w would be $\alpha(1+\phi(w))(1-G(c^*(\overline{w})))\left[\frac{\phi'(w)}{1+\phi(w)} - \frac{g(c^*(\overline{w}))}{(1-G(c^*(\overline{w})))}\frac{dc^*}{dw}\right]$. The first term within parenthesis is the elasticity of demand for labor which is negative under our assumptions and the second term, which is positive, measures the effect of a change in the wage rate in removing credit constraints faced by h type agents by reducing the required level of collateral. In the paper we assume the first term is zero and so labor demand is upward sloping. In practice the slope of the demand curve will be determined by the relative strength of the standard substitution effect and the labor-credit market interaction effect emphasized in the paper.

4 Economic Policy

In the case depicted in the figures (namely, $\alpha \geq \frac{1}{1+n}$), with symmetric information the high wage equilibrium would be the unique equilibrium and per capita income would be $\overline{w}$. In the presence of asymmetric information, banks ask for collateral and this prevents some poor talented individuals from becoming entrepreneurs. If sufficiently many talented individuals are credit rationed, the drop in the supply of entrepreneurs may push the economy to a low wage equilibrium. Since the entrepreneurial technology yields a higher level of surplus than the subsistence technology, and there are more entrepreneurial firms when the wage is $\overline{w}$ than when it is $\underline{w}$, national income is higher under the high wage equilibrium. In particular, in the high wage equilibrium there is an excess supply of entrepreneurs and everyone in the economy earns an income of $\overline{w}$, the same outcome as in the case of symmetric information. In this section we discuss the following question: starting with a low wage equilibrium, what policies can improve efficiency?

Credit Market Policies

We begin with discussing direct interventions in the credit market. We show that even though government lending (or subsidies) cannot improve efficiency in the partial equilibrium version of our model, if multiple equilibria exist, such policies have the potential of coordinating the economy to the better equilibrium. This shows that even if lending programs run by the government or non-governmental organizations make losses or require subsidies and may seem inefficient, they can have general equilibrium effects on the credit market that improve efficiency.[15]

[15] See Hoff and Stiglitz (1997), Bose (1998) and Jain (1999) on alternative views on the efficiency implication of the effect of government lending on the private credit market.

Start with a situation where the low wage is prevailing and banks require a collateral of $c^*(\underline{w})$. Suppose the government offers loans with collateral $c^*(\bar{w})$ at an interest rate $r \geq \rho$ or encourages some private institution to do so by promising to subsidize it. Borrowers of type h who have enough wealth to meet the collateral requirement $c^*(\underline{w})$ will (weakly) prefer to borrow from private lenders. All type l borrowers with $a \geq c^*(\bar{w})$ and a fraction of the initially credit rationed type h borrowers (with $c^*(\bar{w}) \leq a < c^*(\underline{w})$) will prefer to borrow from the government. From the proof of Proposition 1 (using Assumption 3) we know that there does not exist $r \geq \rho$ such that type h borrowers participate and the government breaks even (i.e., $\alpha \{G(c^*(\underline{w})) - G(c^*(\bar{w}))\} (r - \rho)k - (1 - \alpha) \{1 - G(c^*(\bar{w}))\} \rho k \leq 0$). If the unique equilibrium is $(c^*(\underline{w}), \underline{w})$ (when $f(c^*(\bar{w})) < \frac{1}{1+n}$) then such a policy cannot change things. The losses of the government lending operation would not be compensated by anything. Consider the case where multiple equilibria are possible, i.e., $f(c^*(\underline{w})) \leq \frac{1}{1+n} \leq f(c^*(\bar{w}))$. Starting with a situation where the economy is in a low wage equilibrium this policy will cause labor demand to rise as all type h agents now can start businesses. This will push the wage rate up to $\bar{w}$ since $\alpha [1 - G(c^*(\overline{w}))] \geq \frac{1}{1+n}$ in this case. But this will reduce the collateral level in the private credit market to $c^*(\overline{w})$, at which point l type borrowers would be indifferent between borrowing and being workers. In the new equilibrium, the government lending operation will break even, and indeed can be discontinued.

Many governments in developing countries use indirect interventions in the credit market such as interest rate ceiling policies on commercial lending institutions to keep the interest rate low especially in the agricultural sector.[16] Financial intermediaries often respond to interest rate ceilings by increasing credit rationing in various forms that is hard for the government to monitor. This includes increased collateral requirements and raising transactions costs to borrowers in the form of increased administrative hurdles. Our model indicates how such policies can have a negative effect on efficiency. Allow a small probability ε of projects of h type borrowers failing, i.e., earning a return of 0 instead of R. For a given wage rate w, the required

[16]See Adams and Graham (1981) and Adams, Graham and Von Pischke (1984).

collateral level to discourage l type borrowers from borrowing is $c^*(w)$. Then the zero profit condition of banks for h type borrowers is $rk(1-\varepsilon)+\rho c^*(w)\varepsilon = \rho k$. If r is fixed by regulation to $r_1 < \frac{\rho}{1-\varepsilon} - \rho\frac{c^*(w)}{k}\frac{\varepsilon}{1-\varepsilon}$ then banks are going to respond by raising the collateral requirement from $c^*(w)$ to $c_1 > c^*(w)$ such that they continue to make zero profits. This would make some poor high type agents unable to borrow, and reduce the number of projects undertaken, and hence the demand for labor. For a sufficiently large increase in c, and starting with a high wage equilibrium it is possible that wage rate could fall from $\overline{w}$ to $\underline{w}$, leading further increases in c and pushing the economy to a low wage equilibrium.

There is a well-known argument that was very influential in the World Bank until very recently which criticized interest rate regulation from the point of view of a classical supply-demand framework.[17] The argument is that forced low interest rates lead to bad selection of projects and high unregulated interest rate policies lead to the selection of better projects. With credit market imperfections this is no longer true - bad or risky types may be willing to borrow under the highest interest rates. The above argument shows that the main cost of such a policy comes from altering other contracting instruments, such as collateral that screens out good but poor borrowers.

Labor Market Policies

Next consider policies that do not target the credit market directly and are aimed at the labor market. From the incentive compatibility constraint of l type borrowers, any policy that affects w will affect the amount of collateral charged for a loan. This could result from the opening up of trade or migration possibilities, changes in labor laws such as those concerning minimum wages or unemployment benefits, or policies that raise the wage rate in non-industrial sectors, such as a subsidy to small scale industries. If the economy is in a low wage equilibrium, such a policy will reduce the extent of credit rationing and improve efficiency.

Total income in a low wage equilibrium is the sum of the income of workers

[17] See Adams, Graham and Von Pischke (1984).

and those engaged in subsistence, i.e., $(1 - f(c^*(\underline{w})))\,\underline{w}$, and profit income, i.e., $f(c^*(\underline{w}))(R - \rho k)$. An increase in $\underline{w}$ will have a direct positive effect on the former category of income by the amount $(1 - f(c^*(\underline{w})))\,\Delta\underline{w}$, but by relaxing credit constraints and increasing the number of entrepreneurs, it will also increase profit income by the amount $\frac{\alpha}{\rho}\frac{dG(c^*(\underline{w}))}{d\underline{w}}(R - \rho k - \underline{w})\Delta\underline{w}$. If we interpret changes in $\underline{w}$ as arising from technological shocks instead of economic policy, our model provides a different mechanism that shows how agency costs can amplify the effect of productivity shocks in the course of a business cycle compared to the one provided by Bernanke and Gertler (1990). Also, the fact that talented but wealth-constrained entrepreneurs may face more severe credit constraints after a negative technological shock would work against any "cleansing effect" of recessions as discussed by Caballero and Hammour (1994).

If instead of trying to change $\underline{w}$ if economic policy consists of giving a lump sum transfer to anybody who wants to become an entrepreneur, it will have no real effect and only a distributional effect. The banks will adjust the collateral upwards, but since poor h type borrowers also have extra money there is no real effect. Notice that in contrast if the government rewards people for not being an entrepreneur - this is how we can interpret a wage subsidy - that can have a positive effect on output.

Redistributive Policies

If $\underline{w}$ is the unique equilibrium wage (i.e., (5) holds), then redistribution of wealth can improve output efficiency. Taking wealth away from any i with $a_i > k$ or, alternatively, organizing lotteries among individuals with wealth $a < c^*(\underline{w})$, are examples of redistributive policies that would increase the total number of entrepreneurs and hence output, even if the low wage equilibrium is still the unique equilibrium after the redistribution of endowments.[18] On the other extreme, if $\overline{w}$ is the unique equilibrium (i.e., if (8) holds), then small redistributions of wealth (in any direction) have

[18]Note that the former type of redistribution reduces inequality by all measures of it, whereas the second type of redistribution increases inequality. Combinations of these two types of policies could of course achieve the same goal.

no effect on output efficiency. It would take a substantial redistribution – say, a few people get all the wealth – to make the economy drop into a low-wage equilibrium.

The fact that redistributive policies that enable more individuals to become entrepreneurs improve efficiency is common to all models of credit rationing. What distinguishes the potential role of redistributive policies in our model is the fact that the degree of credit rationing is endogenous. As a result small changes in the wealth distribution can have a large effect on efficiency in the short-run by setting off market forces that reinforce the effect of these policies.[19] Consider case (6) of Proposition 2, i.e., $f(c^*(\underline{w})) \leq \frac{1}{1+n} \leq f(c^*(\bar{w}))$ and assume that $\frac{1}{1+n} - f(c^*(\underline{w}))$ is small. Suppose initially the economy is in a low wage equilibrium. As mentioned above, a small amount of redistribution that increases the number of entrepreneurs will improve efficiency, but only to a small extent. However, if as a result of redistribution $f(c^*(\underline{w}))$ exceeds $\frac{1}{1+n}$, the demand pressure in the labor market will push the economy to a situation where the unique equilibrium is a high wage equilibrium and borrowing thresholds are low. Another implication of having endogenous wealth thresholds for borrowing is that the existing equilibrium wealth threshold for borrowing may not be the relevant one for the design of redistributive policies. Intervening at a different region of the wealth distribution can achieve the same results at a lower cost. Consider the case where there the unique equilibrium is the low wage equilibrium (i.e., $\frac{1}{1+n} > f(c^*(\bar{w}))$, as in Figure 1. In this case pushing the economy from a low wage equilibrium to a high wage equilibrium would seem like an uphill task given that the wealth threshold for borrowing and the number of individuals whose wealth is less than it are both large. However, if $\frac{1}{1+n} - f(c^*(\bar{w}))$ is small then a limited redistribution of wealth so that $f(c^*(\bar{w}))$ exceeds $\frac{1}{1+n}$ implies that multiple equilibria becomes possible. Now using credit or labor market policies described above the economy can be moved from a low wage to a high wage equilibrium.

[19] In contrast, in Banerjee and Newman (1993) where the degree of credit rationing is exogenous, small changes in the initial wealth distribution can have a large effect on efficiency through mobility, but these effects are realized only in the long run.

Will Efficient Policies be Chosen?

Which policies are chosen (if any), depends on the relative political power of the rich and talented individuals with respect to the rest of the population. If the poor make up a large fraction of the population and can vote, they can push through policies such as redistribution that eliminates the low wage equilibrium. Cross country evidence suggest that democracies tend reduce extreme disparities in wealth and have a positive effect on both efficiency and equity (see Benabou, 1996). However, not all developing countries have a democratic regime, and democracy often takes the form of indirect democracy. Under this more plausible scenario, if multiple equilibria are possible (i.e., if (6) holds), then even if there exists policies that guarantee coordination on the high-wage high-output equilibrium, ranging from credit subsidies, to minimum wage laws or redistribution of wealth, they may not be adopted. This is because, unlike simple coordination failure models, such as Murphy, Shleifer and Vishny (1989), the equilibria cannot be Pareto ranked in general, since talented individuals whose wealth exceeds $c^*(\underline{w})$ prefer the low-wage equilibrium.[20]

5 Extension: Some Simple Dynamics

So far in this paper we have taken the wealth distribution as exogenous. In this section we consider the long run equilibrium of the economy where the wealth distribution evolves endogenously. We will restrict attention to stationary equilibria, where the wage rate is the same over time, and examine how the wealth distribution evolves. In particular, we are interested in finding out if for the same initial conditions an economy could have two dynamic equilibria, one with the low wage prevailing in the labor market in each period, and the other with the high wage, with

[20]The only case in which the high wage equilibrium Pareto dominates the low wage equilibrium is case 2, but only if, in addition, $G(c^*(\underline{w})) = 1$ and $c^*(\bar{w}) = 0$ (i.e., $\bar{w} > M$). If the economy starts off with a low-wage equilibrium, there are no entrepreneurs and everyone is engaged in the subsistence activity. If the economy starts off with a high-wage equilibrium, however, every talented agent will be able to become an entrepreneur (since by assumption $c^*(\overline{w}) = 0$ in this case) and everyone will be better off.

the wealth distribution converging to two different limiting distributions in the two cases. Following the occupational choice literature (e.g., Banerjee and Newman, 1993, Galor and Zeira, 1993, and Piketty, 1997) we assume the following simple dynamic framework. Each person lives for one period, and is replaced by another person at the end of the period, who is identical in all respects, except possibly for talent. A person has a probability α of being talented irrespective of the parent's talent.[21]

When an individual is born, she inherits some wealth $a \geq 0$, makes her occupational choice, and at the end of the period saves a constant fraction s of total income that is passed on as bequest to the next generation. We now derive the equations of motion that determine the initial wealth of a period $t+1$ individual belonging to dynasty i whose parent had wealth a_i^t. If the parent supplied ordinary labor (either to an entrepreneur, or using the subsistence technology) she earned some labor income w^t, where w^t is the period t wage rate. The inherited wealth a_i^t grows to ρa_i^t (principal plus interest) and the labor income is $w^t \geq \underline{w}$. Hence her descendant starts with a wealth endowment of

$$a_i^{t+1} = s\left(w^t + \rho a_i^t\right).$$

Suppose instead the parent was an entrepreneur. If $a_i^t \geq k$ then the parent was self-financed and bequeaths

$$a_i^{t+1} = s\left(R - nw^t + \rho\left(a_i^t - k\right)\right).$$

If $c^*(w^t) \leq a_i^t < k$ then the parent was bank-financed and bequeaths

$$a_i^{t+1} = s\left(R - nw^t - rk + c^*(w^t) + \rho\left(a_i^t - c^*(w^t)\right)\right) = s\left(R - nw^t + \rho\left(a_i^t - k\right)\right)$$

using the bank's zero profit constraint. Thus, the transition equation is the same for bank-financed and self-financed entrepreneurs.

[21]The case where talent is perfectly inherited is straightforward to analyze and we briefly discuss it at the end of this section.

5.1 Long Run Equilibria with Stationary Wages

We first want to characterize equilibria in the dynamic model that involve a stationary profile of wages (e.g., $w^t = \underline{w}$ for all t). Given a stationary profile of wages, we find out the corresponding sequence of wealth distributions, and the limiting wealth distribution. In turn, we make sure that the demand and supply of labor generated by the sequence of wealth distributions and the limiting wealth distribution all generate the stationary wage profile we started out with as an equilibrium in the labor market. Of particular interest is the question if starting with same initial conditions, it is possible to have two types of dynamic equilibria, one involving high wages and one involving low wages. In general, it is possible to have non-stationary equilibria where the wage rate changes over time, but we will restrict attention to stationary wage equilibria (i.e., dynamic equilibria such that the wage rate does not change over time) only.

Consider a dynasty that starts with zero wealth in period 0. The period 1 wealth will be at least $s\underline{w}$, period 2 wealth will be at least $s(\underline{w} + \rho s\underline{w}$) and period t wealth is at least

$$s\underline{w} \ \left(1 + \rho s + (\rho s)^2 + ... + (\rho s)^{t-1}\right). \tag{9}$$

We assume that $\rho s < 1$ so that this expression has a finite limit. Then the long run *minimum* wealth level of a dynasty is

$$\frac{s\underline{w}}{1 - \rho s}.$$

If this wealth level is at least as large as $c^*(\underline{w})$ then no dynasty will be capital constrained in the long run. In other words, if the bequest fraction is at least $\underline{s} = \frac{c^*(\underline{w})}{\underline{w}+\rho c^*(\underline{w})}$, in the long run all talented individuals will have the opportunity of becoming entrepreneurs. If instead $\frac{s\underline{w}}{1-\rho s} < c^*(\underline{w})$ (see Figure 4) we have the following result.

Lemma 1: *Suppose that*

$$\frac{s\underline{w}}{1 - \rho s} < c^*(\underline{w}) = \frac{M - \underline{w}}{\rho} \tag{10}$$

or, $\frac{\underline{w}}{1-\rho s} < M$*. If there is a period* T *such that the wage in each period* $t \geq T$ *is* $w^t = \underline{w}$*, then the economy will converge to a state where there are no entrepreneurs at all.*

The proof is in the appendix. The intuition is, however, very simple: if the bequest fraction is less than $\underline{s}$ and talents cannot be transmitted to offsprings, then a finite number of negative talent shocks are enough to make a dynasty fall below threshold $c^*(\underline{w})$, no matter where they start from. Since finite numbers of talent shocks happen with probability 1, all dynasties will fall below that threshold. The crucial assumption for this "convergence to subsistence" result is that the bequest fraction is the same for every individual and talent shocks are independent across different generations of a dynasty.[22]

Now suppose $w^t = \overline{w}$ for all t. By definition, $\overline{w}$ satisfies

$$\overline{w} = R \ - n\overline{w} - \rho k$$

so that bequests at the end of period t are independent of the occupation of the generation t individual:

$$a_i^{t+1} = s\left(\overline{w} + \rho a_i^t\right)$$

Notice that for each dynasty,

$$a_i^t \rightarrow \frac{s\overline{w}}{1-\rho s}$$

if $w^t = \overline{w}$ for all t. Since entrepreneurs and workers will receive the same income in a high-wage equilibrium, each dynasty will converge to the steady state wealth level $\frac{s}{1-\rho s}\overline{w}$ if $w^t = \overline{w}$ for all t. This immediately leads to the following result:

Lemma 2*: If* $\frac{s\overline{w}}{1-\rho s} < c^*(\overline{w})$ *then a high wage equilibrium cannot be sustained in the long run.*

[22] If there is heterogeneity in the bequest fraction (or dynasty saving rate), then all the dynasties with $s < \underline{s}$ eventually are unable to operate as entrepreneurs, whereas the talented offsprings of dynasties with high bequest rate will keep entrepreneurial production alive in the long run.

Consider the opposite case where $\frac{s\overline{w}}{1-\rho s} \geq c^*(\overline{w})$. Figure 5 depicts this case. Let G_t denote the wealth distribution in period t. We show that two conditions must hold for a high-wage stationary path to be feasible. First, the initial wealth distribution G_0 must be such that a high-wage equilibrium exists in the first period, that is,

$$\alpha \left[1 - G_0\left(c^*(\overline{w})\right)\right] \geq \frac{1}{1+n}$$

Second, since entrepreneurs and workers will receive the same income in the high-wage equilibrium, and since a dynasty of workers will converge to the steady state wealth level $\frac{s}{1-\rho s}\overline{w}$, this steady state wealth level must be bigger than the required collateral:

$$\frac{s\overline{w}}{1-\rho s} \geq c^*(\overline{w}).$$

The following result formalizes this (the proof is in the appendix).

Lemma 3: *There exists an equilibrium with $w^t = \overline{w}$ for all $t \geq 0$ if and only if*

$$\frac{s\overline{w}}{1-\rho s} \geq c^*(\overline{w}) \tag{11}$$

and

$$\alpha \left[1 - G_0\left(c^*(\overline{w})\right)\right] \geq \frac{1}{1+n} \tag{12}$$

both hold.

Now we are ready to characterize stationary wage equilibria in the dynamic version of our model. Notice that if $M > w$, $c^*(w) \equiv \frac{M-w}{\rho} > 0$. As a result, the condition $\frac{sw}{1-\rho s} \geq c^*(w)$ is equivalent to $\frac{w}{1-\rho s} \geq M$. If $M \leq w$, which is ruled out for $w = \underline{w}$ by Assumption 2 (but not for $w = \overline{w}$), then $c^*(w) \equiv 0$ and so $\frac{sw}{1-\rho s} > c^*(w)$ trivially holds. As $\frac{w}{1-\rho s} > w$, in this case $\frac{w}{1-\rho s} > M$ hold as well. Using this fact (and that $\underline{w} < \overline{w}$) we can conveniently partition the parameter space into the following three cases:

Case 1. $\frac{\overline{w}}{1-\rho s} < M$. From Lemma 2 we immediately see that for this case the long run equilibrium of the economy must involve subsistence irrespective of the initial wealth distribution. The required collateral level is greater than the steady wealth level of any dynasty in the high-wage equilibrium (where aggregate income is the highest). As a result, even if the economy starts off with $w^0 = \overline{w}$, there exists $T > 0$ such that $w^t = \underline{w}$ for $t \geq T$. Since $\frac{s\underline{w}}{1-\rho s} < M$ in this case as well, using Lemma 1 we see that the only stationary wage profile that can exist is $w^t = \underline{w}$ for all t but eventually all agents will be engaged in subsistence.

Case 2. $\frac{\overline{w}}{1-\rho s} \geq M > \frac{\underline{w}}{1-\rho s}$. From Lemma 3 we know that if $\alpha\left[1 - G_0\left(c^*(\overline{w})\right)\right] \geq \frac{1}{1+n}$ then an equilibrium with $w^t = \overline{w}$ for all $t \geq 0$ exists. However, if $\frac{1}{1+n} > \alpha\left[1 - G_0\left(c^*(\underline{w})\right)\right]$ then $w^t = \underline{w}$ for $t = 0$ is also an equilibrium in the labor market. Since $\frac{s\underline{w}}{1-\rho s} < c^*(\underline{w})$ in this case, from Lemma 1 we know if $w^t = \underline{w}$ for all t then the economy will converge to a long run equilibrium where there is no entrepreneurial activity. We know that for the special case $\alpha\left[1 - G_0\left(c^*(\overline{w})\right)\right] \geq \frac{1}{1+n} > \alpha\left[1 - G_0\left(c^*(\underline{w})\right)\right]$ both $w^t = \underline{w}$ and $w^t = \overline{w}$ are possible equilibrium wages in the labor market for $t = 0$. Since $\frac{s\overline{w}}{1-\rho s} \geq c^*(\overline{w})$ and $\frac{s\underline{w}}{1-\rho s} < c^*(\underline{w})$, by Lemma 1 and Lemma 3 two stationary profiles of wages can be sustained in equilibrium. If $w^t = \underline{w}$ for all t the economy will converge to a long run equilibrium where everyone is engaged in the subsistence activity and will have the same wealth level (namely, $\frac{s\underline{w}}{1-\rho s}$). If instead $w^t = \overline{w}$ for all t, the economy will converge to a long run equilibrium where everyone is engaged in the entrepreneurial activity and will have the same wealth level (namely, $\frac{s\overline{w}}{1-\rho s}$). Therefore for Case 2 the wealth distribution matters. In addition, for the same initial wealth distribution two different stationary equilibrium wage profiles can be supported even when we allow the wealth distribution to be endogenous.

Case 3. $M \leq \frac{\underline{w}}{1-\rho s}$. In this case the lowest possible steady state wealth level of a dynasty (i.e., $\frac{s\underline{w}}{1-\rho s}$) exceeds the highest possible level of collateral that banks can ask for (i.e., $c^*(\underline{w})$) and so no dynasty can be capital constrained in the long run. Irrespective of the prevailing wage rate, $G_t(c^*(\underline{w}))$ will approach 0 as $t \to \infty$, and since $c^*(\underline{w}) > c^*(\overline{w})$, $G_t(c^*(\overline{w}))$ will approach 0 as $t \to \infty$ as well. If $\alpha \geq \frac{1}{1+n}$ then from Lemma 3 we know that a high-wage stationary equilibrium will exist. Also, this will be the unique stationary wage profile, since even if the economy starts off with $\alpha\{1 - G_0(c^*(\underline{w}))\} < \frac{1}{1+n}$ and so $w^0 = \underline{w}$, there exists a finite time after which the wage will switch to $\overline{w}$. If $\alpha < \frac{1}{1+n}$ a low wage stationary equilibrium will result. Also, this will be the unique stationary wage profile since it is not possible to have $\alpha\{1 - G_t(c^*(\overline{w}))\} \geq \frac{1}{1+n}$ for any $t \geq 0$. While $w_t = \underline{w}$ for all t in this case, unlike in Cases 1 and 2, there is entrepreneurial activity in long run equilibrium – all talented agents get to be entrepreneurs, but there is not enough of them to absorb the entire labor force. In Case 3 there is no room for policy – the economy achieves the same allocation as the first-best (i.e., with no private information).

We summarize the characterization of stationary wage profiles in Proposition 3.

Proposition 3.

(i) *Suppose* $M > \frac{\overline{w}}{1-\rho s}$. *The unique stationary equilibrium wage profile is* $w^t = \underline{w}$ *for all* t. *There is no entrepreneurial activity in the long run.*

(ii) *Suppose* $\frac{\overline{w}}{1-\rho s} \geq M > \frac{\underline{w}}{1-\rho s}$. *If* $\alpha \left[1 - G_0\left(c^*(\underline{w})\right)\right] \geq \frac{1}{1+n}$ *then the unique stationary equilibrium wage profile is* $w^t = \overline{w}$ *for all* t.

If $\alpha \left[1 - G_0\left(c^*(\overline{w})\right)\right] < \frac{1}{1+n}$ *then the unique stationary equilibrium wage profile is* $w^t = \underline{w}$ *for all* t *and there is no entrepreneurial activity in the long run. If* $\alpha \left[1 - G_0\left(c^*(\overline{w})\right)\right] \geq \frac{1}{1+n} \geq \alpha \left[1 - G_0\left(c^*(\underline{w})\right)\right]$ *then it is possible to support both* $w^t = \overline{w}$ *for all* t *and* $w^t = \underline{w}$ *for all* t *as stationary wage profiles, there being no entrepreneurial activity in the long run in the latter case.*

(iii) *Suppose* $M \leq \frac{\underline{w}}{1-\rho s}$. *If* $\alpha < \frac{1}{1+n}$ *the unique stationary equilibrium wage profile is* $w^t = \underline{w}$ *for all* t *but there is some entrepreneurial activity in the long run. If* $\alpha \geq \frac{1}{1+n}$ *then the unique stationary equilibrium wage profile is* $w^t = \overline{w}$ *for all* t. *The economy achieves the first-best allocation.*

An important implication of the dynamic extension of the model is that starting with the same initial wealth distribution two economies can converge to different equilibrium wages, outputs and long run wealth distributions. This is very different from the predictions of the existing literature on dynamic models of credit rationing and wealth inequality (Banerjee and Newman, 1993 and Piketty, 1997) and arises because of the possibility of multiple equilibria in the static version of our model.

The assumption that talent shocks are independent across generations for a given dynasty is of course an extreme one as assumed in this section. However, our results do not seem to depend crucially on it. Consider the other extreme case where talent is perfect transmitted across generations for a given dynasty. The only aspect of the above analysis that will change now is the fact that starting with a low wage equilibrium the economy need not converge to subsistence in the long run. Dynasties that are talented and rich (i.e., $a \geq c^*(\underline{w})$) will continue to stay rich in the long run so long as their steady state wealth in a low wage equilibrium is enough to put up the required collateral (i..e., $\frac{s(R-n\underline{w})}{1-\rho s} \geq c^*(\underline{w})$).

6 Concluding Remarks

In this paper we have proposed a simple general equilibrium model of financial contracting in the presence of adverse selection that focuses on the interaction between the credit and the labor market. In the absence of any frictions the relationship between these two markets is governed by a standard negative feedback mechanism. For example, a positive demand shock in the labor market that raises wages and reduces profits would reduce the demand for credit by firms. In the presence of information asymmetries in the credit market, we show that there is also a positive feedback mechanism that affects the relationship between these two markets. A positive demand shock in the labor market that raises wages would lead to a better selection of borrowers in the credit market, which would cause banks to reduce the degree of credit rationing, which could reinforce the positive demand shock in the labor market by expanding investment. To highlight this effect we have presented a model where this positive feedback mechanism dominates, and this naturally leads to multiple equilibria.

A limitation of the current model is that capital depreciates after one period. As a result we cannot examine topics such as capital accumulation, and the resulting dynamic relationship between development and inequality (as in the theoretical literature on the Kuznets-curve, such as Bernhardt and Lloyd-Ellis, 2000). Moreover, since firms live for one period only, we cannot address interesting questions such as the bank's choice between financing a new firm (a "start-up") whose quality is uncertain (and possibly subject to asymmetric information) or an old firm whose quality may be much better known but whose capital is likely to be subject to depreciation, diminishing returns or obsolescence. The next step of our research agenda is to examine some of these issues.

Appendix

Proof of Lemma 1.

Take $T = 0$ without loss of generality, i.e., suppose $w^t = \underline{w}$ for all t. Consider a dynasty that starts with wealth $a_i^0 < c^*(\underline{w})$ in period 0. The period 1 wealth will be $s\left(\underline{w} + \rho a_i^0\right)$. As long as everybody in this dynasty remains a worker, the period t wealth is

$$s\underline{w}\ \left(1 + \rho s + (\rho s)^2 + ... + (\rho s)^{t-1}\right) + (\rho s)^t a_i^0 = \left(1 - (\rho s)^t\right) \frac{s\underline{w}}{1 - \rho s} + (\rho s)^t a_i^0$$

Assuming (10) holds, this expression is always strictly smaller than $c^*(\underline{w})$. Thus, a dynasty that starts with wealth below $c^*(\underline{w})$ will never give rise to any entrepreneurs. By the same argument, if at any period t a dynasty's wealth falls below $c^*(\underline{w})$, their wealth will be below $c^*(\underline{w})$ forever. To avoid this, the dynasty must maintain wealth level above $c^*(\underline{w})$ forever. The steady state wealth of a dynasty where *each* generation happens to be type h, has enough wealth to finance their own project or use as collateral to borrow, and the wage happens to be $\underline{w}$ in every period is $\frac{s}{1-s\rho}\left(R - n\underline{w}\ - \rho k\right)$. This is the upper bound to the long run wealth level of any dynasty in a low wage steady state. Since this is a finite number, there exists a finite integer t' such that if there is a series of $t \geq t'$ talent shocks to successive generations (who all will be workers), the dynasty will have an initial wealth level lower than $c^*(\underline{w})$ in period $t' + 1$. That is, if such a dynasty starts with wealth $a_i^0 \leq \frac{s}{1-s\rho}\left(R - n\underline{w}\ - \rho k\right)$, after t' untalented generations the dynasty will have wealth

$$\left(1 - (\rho s)^{t'}\right) \frac{s\underline{w}}{1 - \rho s} + (\rho s)^{t'} a_i^0.$$

Since this is an infinite horizon model any dynasty will receive t' successive negative talent shocks at least once with probability 1. >From that point on, all members of the dynasty must remain workers forever. Thus, in the long run, all dynasties will have wealth levels converging to $\frac{sw}{1-\rho s}$ (with probability 1), and there will be no entrepreneurship in equilibrium. **QED**.

Proof of Lemma 3.

First notice that

$$c^*(\overline{w}) = \max\left\{0, \frac{M - \overline{w}}{\rho}\right\} = \max\left\{0, \frac{\rho k + (1+n)M - R}{\rho(1+n)}\right\}$$

using the definition of $\overline{w}$. If $R > \rho k + (1+n)M$ then $c^*(\overline{w}) = 0$ and so (11) holds. Hence if (12) holds in this case (i.e., $\alpha \geq \frac{1}{1+n}$ since $G_0\left(c^*(\overline{w})\right) = 0$) then by Proposition 2 there is an equilibrium where $w^t = \overline{w}$ for each t, regardless of the income distribution in period t.

Thus, we only need to consider the case $R < \rho k + (1+n)M$, where

$$c^*(\overline{w}) = \frac{M - \overline{w}}{\rho} = \frac{\rho k + (1+n)M - R}{\rho(1+n)} > 0 \tag{13}$$

By Proposition 2, $w^t = \overline{w}$ can be part of an equilibrium if and only if

$$\alpha\left\{1 - G_t(c^*(\overline{w}))\right\} \geq \frac{1}{(1+n)}$$

and this condition needs to be satisfied for each t to guarantee that $w^t = \overline{w}$ is part of an equilibrium. For any a, $w^t = \overline{w}$ implies

$$\begin{aligned} G_{t+1}(a) &= \Pr\{a_i^{t+1} \leq a\} = \Pr\left\{s\overline{w} + \rho s a_i^t \leq a\right\} \\ &= \Pr\left\{a_i^t \leq \frac{a}{\rho s} - \frac{\overline{w}}{\rho}\right\} = G_t\left(\frac{a}{\rho s} - \frac{\overline{w}}{\rho}\right) \end{aligned}$$

Iterating on this expression, we find that

$$G_t(a) = G_0\left(\frac{1}{(\rho s)^t}\left[a - s\overline{w}\frac{1-(s\rho)^t}{1-s\rho}\right]\right)$$

Therefore,

$$\begin{aligned} G_t\left(c^*(\overline{w})\right) &= G_0\left(\frac{1}{(\rho s)^t}\left[c^*(\overline{w}) - s\overline{w}\frac{1-(s\rho)^t}{1-s\rho}\right]\right) \\ &= G_0\left(\frac{1}{(\rho s)^t}\left(c^*(\overline{w}) - \frac{s\overline{w}}{1-s\rho}\right) + \frac{s}{1-s\rho}\overline{w}\right) \end{aligned}$$

The necessary and sufficient condition for $w^t = \overline{w}$ to be possible for each t is, therefore,

$$1 - G_0 \left(\frac{1}{(\rho s)^t} \left(c^*(\overline{w}) - \frac{s\overline{w}}{1 - s\rho} \right) + \frac{s}{1 - s\rho} \overline{w} \right) \geq \frac{1}{\alpha(1+n)} \tag{14}$$

for all t. For $t = 0$, it reduces to

$$\alpha \left\{ 1 - G_0 \left(c^*(\overline{w}) \right) \right\} \geq \frac{1}{(1+n)} \tag{15}$$

The expression

$$\frac{1}{(\rho s)^t} \left(c^*(\overline{w}) - \frac{s\overline{w}}{1 - s\rho} \right) + \frac{s}{1 - s\rho} \overline{w}$$

decreases monotonically as $t \to \infty$ if (11) holds, otherwise it goes to $+\infty$ as $t \to \infty$. If it does go to $+\infty$ as $t \to \infty$ then the left hand side of (14) would be close to zero for large t, hence the inequality (14) must eventually be violated for large t. Conversely, if it decreases monotonically to in t then the left hand side of (14) would be monotonically increasing in t, hence (14) would hold for all t provided that (15) is satisfied. **QED**.

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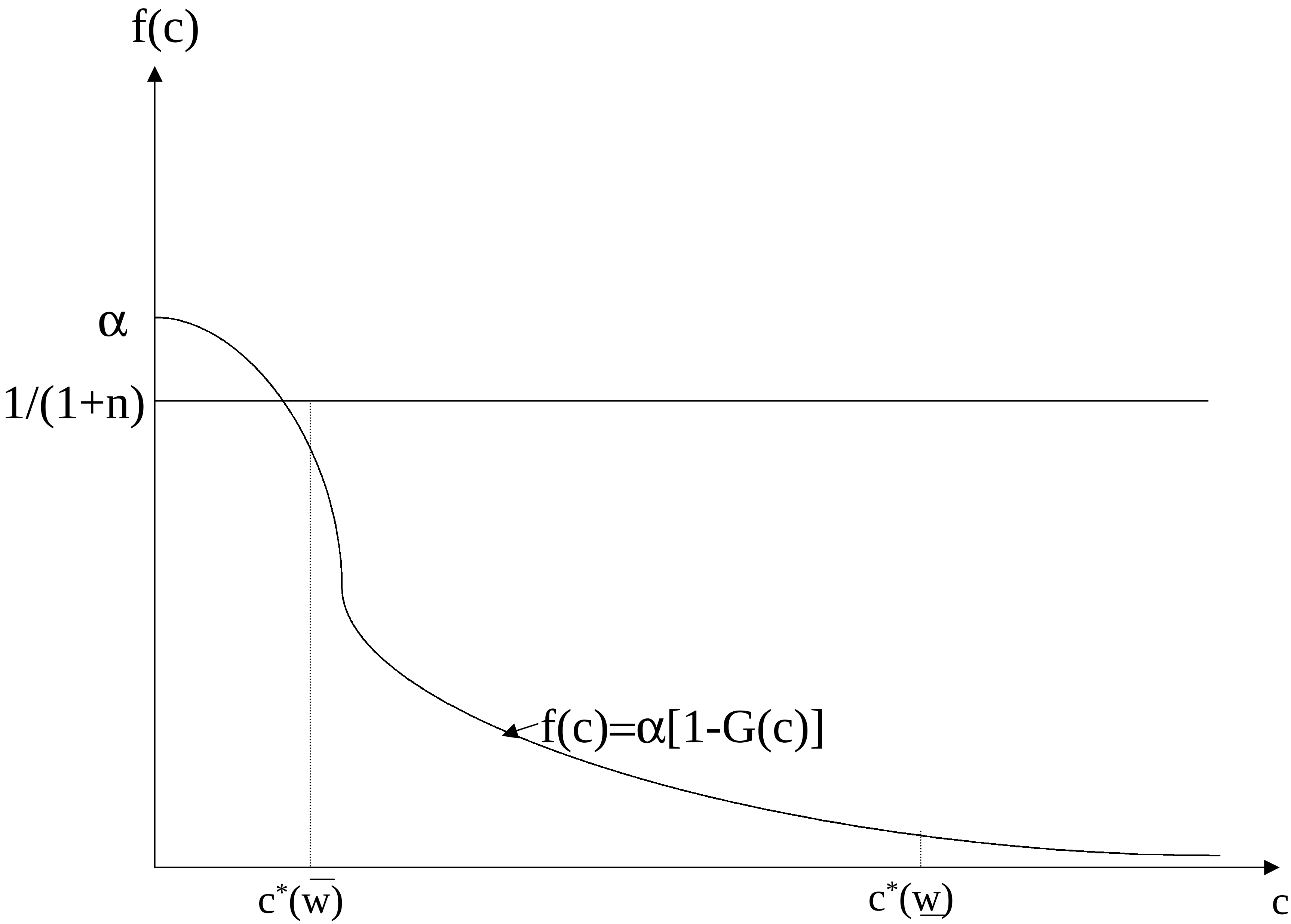

Figure 1 : Unique low wage equilibrium

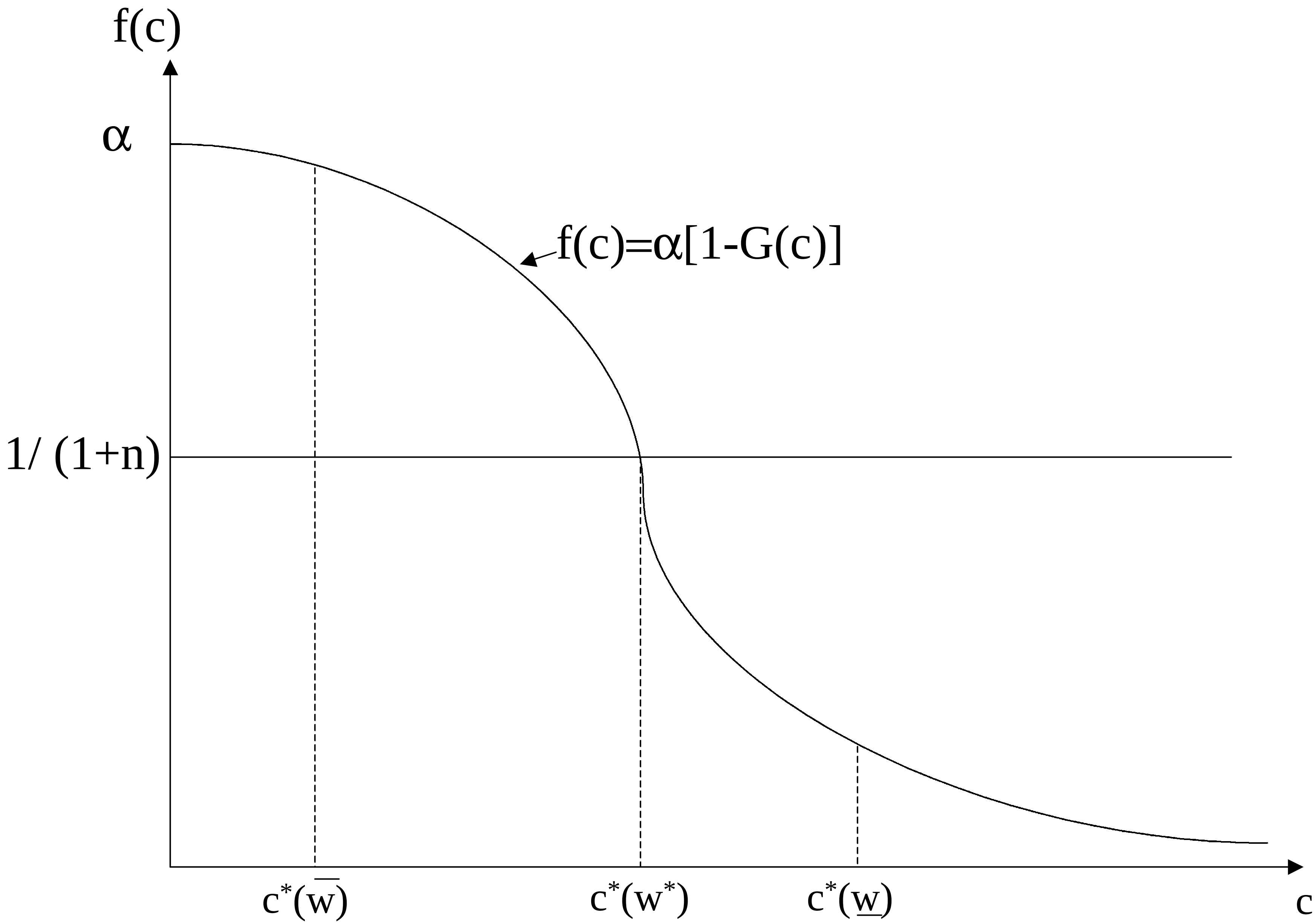

Figure 2 : Multiple Equilibria

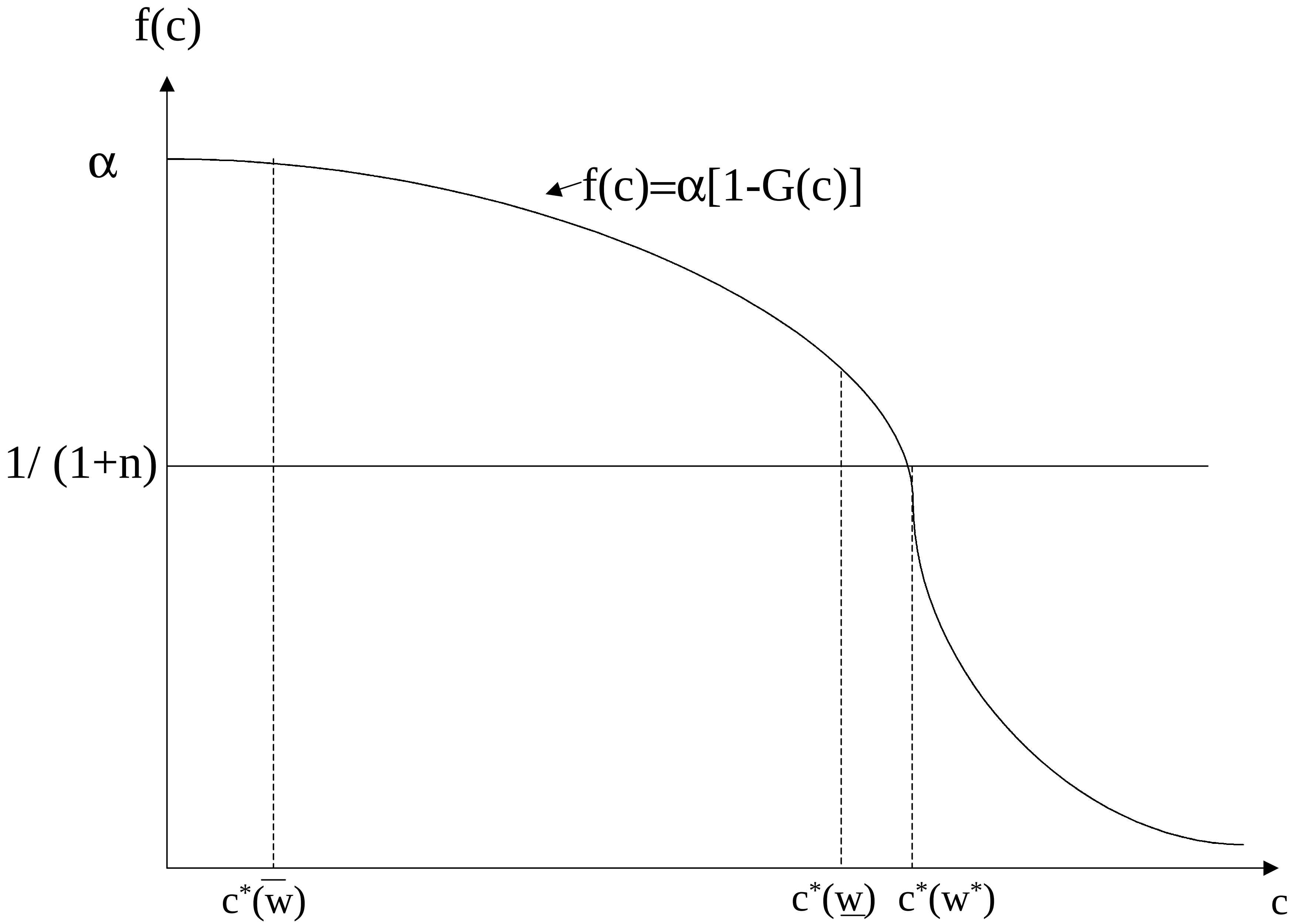

Figure 3 : Unique high wage equilibrium

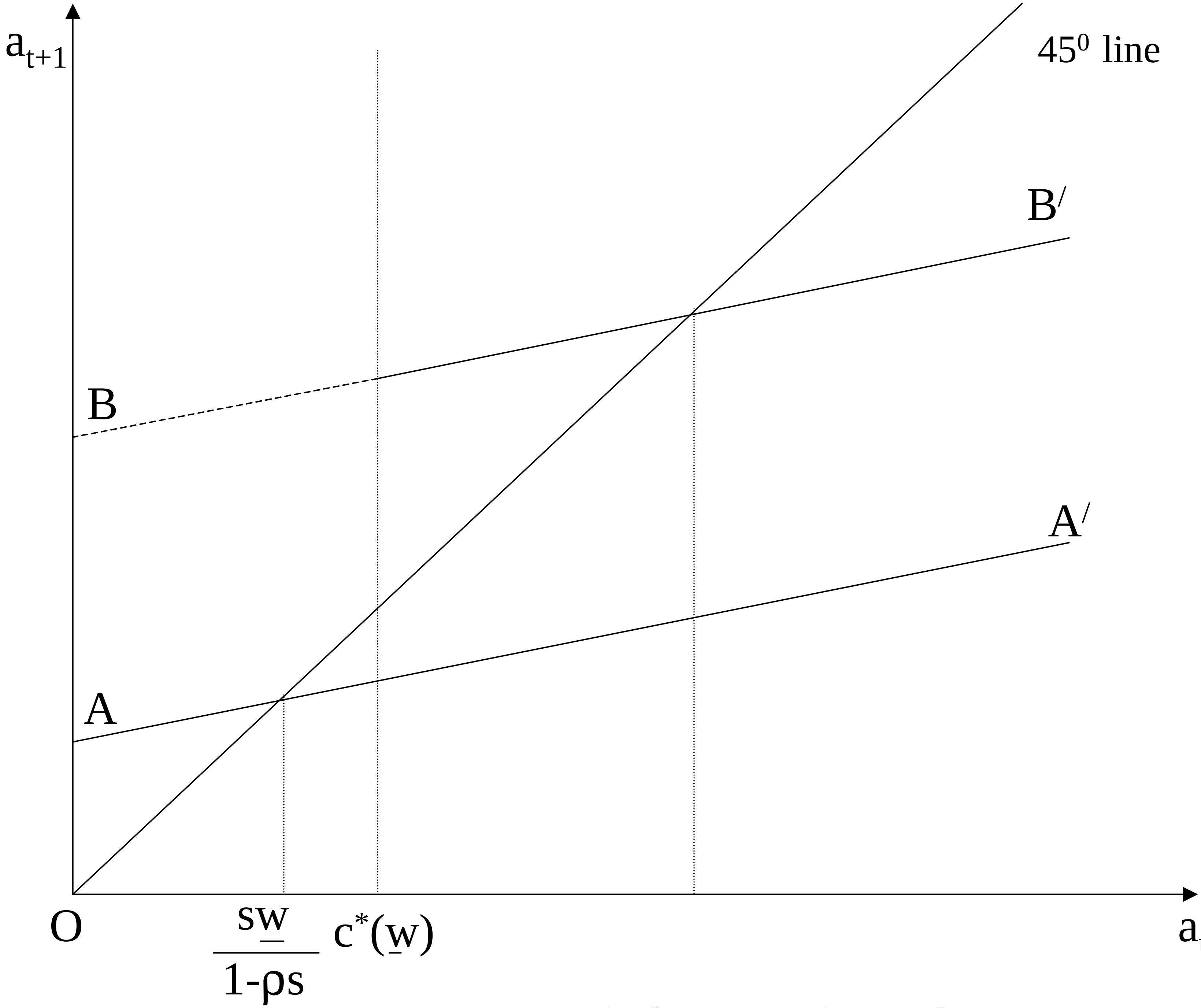

Figure 4: Low wage (subsistence) steady state

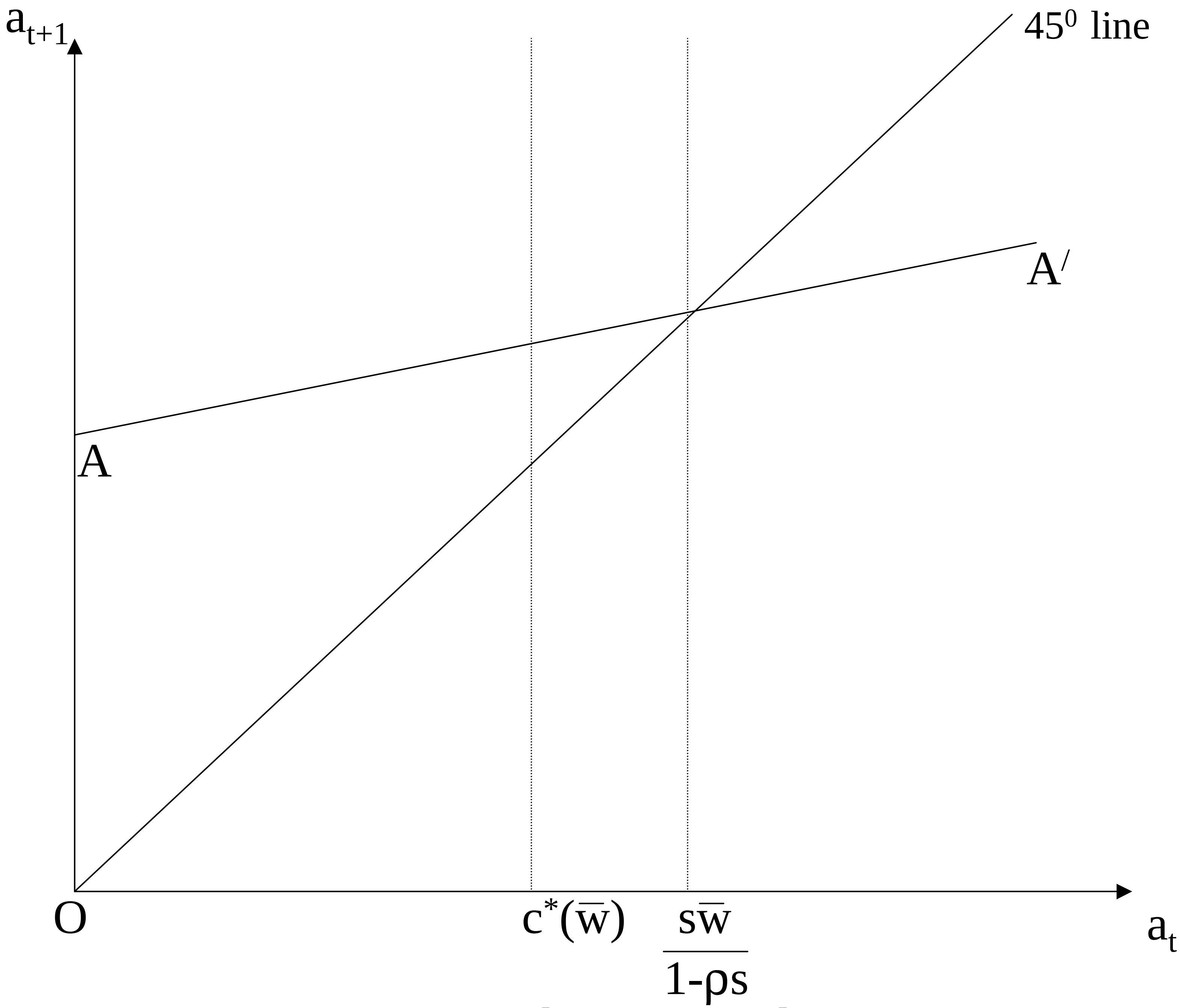

Figure 5: High wage steady state