

# Credit Rationing, Wealth Inequality, and Allocation of Talent <sup>1</sup>

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This version: October 2002

## Abstract

We study an economy where agents are heterogeneous in terms of observable wealth and unobservable talent. Adverse selection forces creditors to ask for collateral. We study the two-way interaction between rationing in the credit market and the wages offered in the labor market. Both pooling and separating credit contracts can be offered in equilibrium. The minimum wealth needed to obtain a separating contract is decreasing in the wage, whereas the minimum wealth needed for a pooling contract is increasing in the wage. If the first effect dominates, the derived labor demand can be upward sloping, resulting in the possibility of multiple equilibria.

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

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<sup>1</sup>Ghatak and Morelli thank the Institute for Advanced Study, Princeton, where the first draft of this paper was completed, for providing an excellent research environment. E-mail: m.ghatak@lse.ac.uk, morelli.10@osu.edu, jts10@psu.edu.

# 1 Introduction

Starting with the classic work of Stiglitz and Weiss [20], a large literature shows how asymmetric information and transactions costs can lead to credit rationing (e.g., De Meza and Webb [8], Bester [6], and Besanko and Thakor [5]). A growing literature in development has studied the effect of credit rationing on the level of investment, employment, income and the distribution of wealth, and demonstrated the possibility of poverty traps (e.g., Banerjee and Newman [2], Galor and Zeira [10], Piketty [16]). However, in the former literature, the credit market is treated in isolation, and in the latter, the focus is on the effect of an exogenously given extent of credit rationing on the rest of the economy. The literature on interlinked contracts has studied the interaction between the credit market and other markets in the presence of asymmetric information, but only in a bilateral, partial equilibrium context (see Ray and Sengupta [19]). In this paper we propose a simple model that bridges these three strands of literature. Credit market imperfections are endogenized by assuming, realistically, that entrepreneurial talent is not possessed by everybody, and is private information. The extent of rationing in the credit market is influenced by what happens in other markets. In particular, the wages offered in the labor market affect the occupational choice decision (whether to be a worker or an entrepreneur). These occupational choices determine the quality of the banks' borrower pool, which in turn determines the lending policy and, therefore, the extent of credit rationing. The degree of credit rationing, in turn, determine the level of investment undertaken in the economy, which determines the wage rate in the labor market.

In our model, individuals differ in terms of entrepreneurial talent and wealth. Wealth is observable but illiquid. Talent is subject to private information. Economic efficiency requires that talent, and not ownership of wealth should determine whether an individual should become an entrepreneur. But entrepreneurship involves a set-up cost, so liquidity from the credit market is needed for an individual who has insufficient personal wealth. Since talent is private information, banks use collateral to screen borrowers as in standard models of financial contracting under adverse selection. If the collateral is large enough, the credit contract will be separating: it will attract only individuals with entrepreneurial talent. Individuals who have some collateral, but not enough to get a separating contract, may still obtain a pooling contract. Pooling contracts attract both talented and untalented individuals, and therefore have less favorable terms than separating contracts. Talented individuals who have insufficient collateral for a pooling as well as for a separating contract, will

be credit constrained, and unable to become entrepreneurs. All individuals who do not become entrepreneurs work for wages.

A change in the wage rate affects the composition of credit contracts that are offered and accepted. If the alternative to being an entrepreneur is to work for wages, then the amount of collateral needed to discourage untalented individuals from becoming entrepreneurs is *decreasing* in the wage rate. If the wage falls then even untalented individuals are tempted to try their luck as entrepreneurs. Lenders respond by asking for more collateral, which means more *talented* entrepreneurs become credit constrained. On the other hand, a fall in the wage rate reduces the entrepreneur's set-up cost, since the set-up cost includes an up front payment of wages. This makes it more profitable for banks to offer *pooling* contracts, i.e., small loans with a low collateral requirement that are accepted by *both* talented and untalented individuals. If the negative effect of a wage cut on the separating contracts dominates the positive effect on the pooling contracts, the contraction in investment will justify the initial wage cut. The net effect can produce an upward sloping demand for labor, which can lead to multiple equilibria.

Interventions in the labor market may raise total output by changing the threshold level of wealth needed to invest. In particular, a wage subsidy may lead banks to reduce the collateral required to get a loan. Also, public provision of cheap credit may have a justification in terms of coordinating the economy to a better equilibrium even though these programs might lose money during the transitional phase. In general, the impact of economic policy depends on the type of credit contracts (pooling or separating) that are offered in equilibrium, as well as on the correlation between wealth and talent. In equilibrium, the terms of a pooling contract will depend on the fraction of agents that are talented (because the talented must cross-subsidize the untalented), but the terms of a separating contract will not (because only those who are talented apply for a separating loan). If poor agents are offered pooling contracts in equilibrium, then education policies that increase the average entrepreneurial talent among the poor will reduce the interest rates and collateral requirements they face. However, such effects are absent if only separating contracts are offered in equilibrium. In this case, *redistribution of wealth* will be more effective at eliminating credit rationing. Since there may be multiple equilibria, only some of which involving pooling contracts, the effects of government policies will be different in different equilibria.<sup>1</sup>

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<sup>1</sup>Moreover, in reality there may exist additional links between the labor and credit markets,

Our paper is related to several existing strands of literature. The literature on occupational choice in the presence of credit market imperfections studies the effects of credit rationing on the rest of the economy (Banerjee and Newman [2], Galor and Zeira [10], Ghatak, Morelli, Sjöström [11], Bernhardt and Lloyd-Ellis [4], Mookherjee and Ray [14], and Piketty [16]). In contrast, we study the two-way interaction between the credit market and the labor market, emphasizing the effects of changes in the labor market on the composition of credit contracts and the level of investment. The classical literature on economic development, originating with Schumpeter, did emphasize entrepreneurial talent and ability to innovate as the key to economic development. However, the modern literature on occupational choice has viewed entrepreneurship as something akin to the monitoring of workers, a skill which everyone is equally good at. An exception is Bernhardt and Lloyd-Ellis [4], who allow for heterogeneous entrepreneurial talent. However, there is no asymmetric information and no adverse selection problem. The severity of credit rationing is exogenously determined and does not depend on the outside option of the borrowers. In contrast, the key feature of our model is asymmetric information about entrepreneurial talent, which endogenizes the credit market imperfections.

In the literature on adverse selection in credit markets it has been observed that the outside option of borrowers can have an important influence on credit market contracts (see for example, De Meza and Webb [9]). Our model differs in that the outside option is the wage which is endogenously determined in general equilibrium. The wage depends in particular on the interaction between the credit market and the labor market. Moreover, unlike De Meza and Webb [9] we allow banks to screen borrowers by asking for collateral. This allows the existence of both pooling and separating contracts in equilibrium. Changes in the outside option have very different effects depending on whether a contract is pooling or separating.

It is well known that with an imperfect credit market, redistribution of wealth can raise total output (see, for example, Chapter 7 of Ray [17]). The early literature on this topic simply incorporated a fixed threshold of wealth necessary to become entrepreneur. Redistributive policies help poor agents reach that threshold. Recently, Gruner [12] has showed that redistribution of wealth can also be beneficial

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which will make policy analysis even more difficult. Ray [17] (Chapter 7) points out that high business profits may induce good behavior by entrepreneurs if future business profits are seized in case of default. This suggests that low wages, although exacerbating adverse selection in the credit market, may actually reduce moral hazard. This does not happen in our model because we assume there is no moral hazard problem for talented entrepreneurs.

in a model of optimal contracting in the credit market where entrepreneurial talent is unobserved and the threshold level of wealth needed to get credit is endogenously determined by the banks. Our model of the credit market is similar to his, in the sense that entrepreneurial talent is unobserved but the level of wealth is observed. Our interest, however, concerns the interaction between the credit market and the labor market (which is not modeled by Gruner [12]).

Caballero and Hammour [7] studied the change in the selection of firms (in terms of quality) over the business cycle and argued that recessions have a cleansing effect by weeding out inefficient firms. Our model suggests the opposite possibility: during a recession, individuals who lack entrepreneurial talent are more likely to ask for a loan (because their opportunities on the labor market have deteriorated), which enhances the adverse selection problem. Through this interaction, a small negative shock to the labor market can have a large negative macroeconomic effect.

Murphy, Shleifer and Vishny [15] viewed the problem of development as a problem of selection among multiple *Pareto-ranked* equilibria. Under-development in their model is a pure coordination failure, and a “big push” to a better equilibrium is Pareto improving. In contrast, a key feature of our model is that agents who are both talented *and* rich prefer a low-wage equilibrium, while all other agents prefer a high-wage equilibrium. Thus, the equilibria are not Pareto-ranked, and there is an element of *conflict* as well as *coordination*. If the rich have sufficient political power they may be able to prevent a “big push” to a high-wage equilibrium.

The outline of the paper is as follows. The basic model is presented in Section 2. Section 3 shows how the labor market is linked to a competitive credit market. In Section 4, we show how occupational choice determines the full general equilibrium of the model. Section 5 shows that, since the labor and credit markets are interconnected, a monopolistic moneylender may benefit from becoming an employer as well. Finally, Section 6 contains a few remarks on the policy implications.

## 2 The Model

### 2.1 Endowments and Preferences

We consider a one-period competitive economy. There is a continuum of risk-neutral agents identified with the interval  $[0, 1]$ . Each agent is endowed with one unit of labor which she supplies inelastically, either as entrepreneurial labor or as ordinary labor. Consumption can take place at the beginning or at the end of the period.

End of period consumption is discounted by the factor  $1/\rho$ , where  $\rho \geq 1$ . Each agent is “born” at the beginning of the period with some initial wealth, denoted  $a$ . The cumulative distribution function for initial wealth is assumed to be continuous, and is denoted  $G$ . Wealth is observable but not liquid, and hence cannot be directly used to buy capital. This may be a reasonable assumption for village economies, where the wealth that is pledged as collateral consists of publicly observable objects such as houses, land etc. Our main arguments will still go through if the assumption of publicly observed wealth is dropped, or if some fraction of wealth is liquid. However, if wealth which is not publicly observable can be pledged as collateral, then there may be a problem of existence of equilibrium, at least if the solution concept is that of Rothschild and Stiglitz [19].<sup>2</sup> To guarantee existence, we would need a more sophisticated equilibrium concept. Since this would distract our attention from the issues we wish to focus on, we avoid these difficulties by assuming that any wealth that can be pledged as collateral is in fact publicly observed, so credit contracts can be conditioned on initial wealth levels.

In addition to having different initial wealth levels, agents also differ with respect to entrepreneurial skill. An agent with wealth  $a$  is *talented* with probability  $\alpha(a)$  and *not talented* with probability  $1 - \alpha(a)$ . We assume  $0 < \alpha(a) < 1$  for all  $a$ . Talented agents are called  $H$  types, and not talented agents are called  $L$  types. An agent’s type is her private information. Talent refers to entrepreneurial ability only: all agents are equally qualified to supply ordinary labor. It is realistic to suppose that agents who are born in rich families may receive a better education, which allows them to develop their entrepreneurial skills better. Therefore, we allow talent to be positively correlated with initial wealth,  $\alpha'(a) \geq 0$ .

## 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. By an accounting convention,  $\underline{w}$  is in beginning of period units, like any other wage. 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 output of an entrepreneurial project is measured in end-of-

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<sup>2</sup>Obviously, if the unobserved part of an agent’s wealth cannot be pledged as collateral, then it is irrelevant to the investment decision and does not change anything.

period units. The technology is fixed-coefficients type, and  $n$  and  $k$  are exogenously given. The market wage is denoted  $w$ . Wages are paid at the beginning of the period before production takes place. Thus, a person who wishes to become entrepreneur needs a loan of size  $nw + k$  at the beginning of the period. The capital depreciates completely at the end of the period.

If the entrepreneur is of type  $H$ , then the project yields a certain return  $R > 0$  at the end of the period. If instead the entrepreneur is of type  $L$ , the project will generate only a *private benefit*  $M > 0$  and no other output.<sup>3</sup> By convention, the private benefit occurs at the beginning of the period. Output is verifiable. If a project has produced surplus  $R > 0$ , then 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 any surplus can at most lose the assets she pledged as collateral. The private benefit  $M$  cannot be appropriated by the bank. This captures the idea that a bad entrepreneur cannot be prevented from consuming some part of the investment, and the diverted funds cannot be recovered by the bank. We focus on the adverse selection problem in the credit market, and assume there is no moral hazard facing type  $H$  entrepreneurs.

To avoid trivial cases, we assume that if potential entrepreneurs were rich enough to self-finance their entrepreneurship, then a talented agent would be willing to become an entrepreneur when the wage is the lowest possible ( $w = \underline{w}$ ), but an untalented agent would not.

**Assumption 1:**

$$\frac{R}{\rho} > (1 + n)\underline{w} + k > M.$$

Assumption 1 implies that when  $w = \underline{w}$  the value of the project is greater than its cost if the entrepreneur is type  $H$ , but less than the cost if the entrepreneur is type  $L$ . Since the entrepreneur foregoes her wage by not working for someone else, the term  $(1 + n)\underline{w}$  includes her opportunity cost  $\underline{w}$ . Notice that  $R$  has to be discounted because, unlike the other terms, it is in end-of-period units.

A piece of collateral (such as a house) is usually worth much more to the borrower than to the bank. Thus, we assume a piece of collateral worth  $c$  to the borrower is, if liquidated, worth only  $\phi c$  to the bank, where  $0 < \phi < 1$ . The difference between the value of the collateral to the borrower, and what the bank gets by liquidating it, is the “transaction cost” of liquidating the collateral.

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<sup>3</sup>What is important is that only type  $H$  agents can operate a firm profitably. Generalizing the production function, by for example allowing stochastic output, would not change our main results.

### 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. Each entrepreneur is able to hire  $n$  workers at the going market wage  $w$ . The supply and demand for labor are determined by the occupational choices of agents. Since any agent can use the subsistence technology, the equilibrium wage can never fall below  $\underline{w}$ . Banks have access to an international credit market where the supply of funds is infinitely elastic at the gross interest rate  $\rho \geq 1$ .

## 3 Credit Market Equilibrium

In this section, we take the wage rate  $w$  as given and study the partial equilibrium in the credit market. Banks compete by offering credit contracts. Borrowers accept the contract they prefer, if any. Since entrepreneurial talent is private information and type  $L$  entrepreneurs will never repay their loans, there is an adverse selection problem. As in Bester [6] and Besanko and Thakor [5], collateral can be used as a screening device. A partial equilibrium on the credit market consists of a set of contracts such that no contract makes losses, and no additional contracts can be introduced that will earn strictly positive profit, assuming the original contracts are left unmodified. As we will see, for any given  $w$  a unique credit market equilibrium always exists. The crucial assumption that guarantees existence is that wealth that can be pledged as collateral is publicly observable.

Since agents do not have any liquid wealth, an agent who wants to start a project needs a loan of size  $k + nw$ . A credit contract is a pair  $(c, r)$ , where  $c$  is the collateral pledged by the agent, and  $r$  is the gross interest rate on the loan. If the borrower does not repay the loan, the bank seizes the collateral and liquidates it.

The net payoff to a type  $L$  entrepreneur who accepts contract  $(c, r)$  will be  $\rho M - c$ , where  $c$  is the cost to her of losing her collateral  $c$  at the end of the period. (By convention, we measure payoffs in end-of-period units.) If instead she supplies ordinary labor she earns the wage  $w$  at the beginning of the period. If  $w \geq M$  then she will not want the loan even if  $c = 0$ . If  $M > w$ , then she prefers working for wages rather than taking the loan if and only if  $\rho M - c \leq \rho w$ . It follows that type  $L$  agents who are offered a contract  $(c, r)$  prefer working at the wage  $w$  rather than



taking the loan if and only if  $c \geq c^*(w)$ , where

$$c^*(w) \equiv \max(\rho(M - w), 0). \quad (1)$$

A credit contract  $(c, r)$  is said to be *separating* if  $c \geq c^*(w)$  and *pooling* if  $c < c^*(w)$ .<sup>4</sup> Notice that the level of collateral required to discourage  $L$  types from borrowing is decreasing in the wage rate. Also, the greater is  $M$ , the greater is the agency cost, so the greater is the required collateral.

Since wealth is observed, agents with different wealth levels can be offered different contracts. The contract offered to an agent of wealth level  $a$  is denoted  $(c(a), r(a))$ . However, only a small number of “standard” contracts will be offered in equilibrium. Consider first a *separating contract*  $(c(a), r(a))$ , with  $c(a) \geq c^*(w)$ , offered to borrowers with wealth  $a$ . The separating contract attracts no  $L$  types, by definition. There is no benefit from imposing a collateral requirement strictly higher than  $c^*(w)$ , so without loss of generality we set  $c(a) = c^*(w)$ .<sup>5</sup> A type  $H$  entrepreneur will repay  $r(a)(k + nw)$ . Therefore, the banks’ zero profit constraint implies  $r(a) = \rho$ . Thus, all separating contracts will be of the form  $(c^*(w), \rho)$ . They will, of course, only be offered to agents that have sufficient wealth  $a \geq c^*(w)$  to meet the collateral requirement. The net payoff for the type  $H$  borrower who accepts the separating contract is (in end-of-period units)

$$\pi(w) \equiv R - \rho(k + nw).$$

For a type  $H$  borrower to accept the contract, her participation constraint must be satisfied, i.e.,  $\pi(w) \geq \rho w$ .

Next, consider a *pooling contract*  $(c(a), r(a))$ , with  $c(a) < c^*(w)$ . This contract attracts both type  $L$  and type  $H$  borrowers with wealth  $a$ . With probability  $\alpha(a)$ , the borrower is of type  $H$ , in which case she repays the loan. With probability  $1 - \alpha(a)$ , the borrower is of type  $L$  and fails to repay, so the bank liquidates the collateral. Thus, the pooling contract yields zero expected profit to the bank if

$$\alpha(a)r(a)(k + nw) + (1 - \alpha(a))\phi c(a) = \rho(k + nw). \quad (2)$$

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<sup>4</sup>If  $c = c^*(w)$  then  $L$ -types are indifferent between becoming entrepreneurs and working for wages. We assume they work for wages in this case.

<sup>5</sup>We assume  $H$  types always repay, so it is in fact costless for them to provide excessive collateral. If we had assumed that  $H$  types fail with a small probability, then a contract with the minimal collateral level would *strictly* dominate contracts with excessive collateral, due to the transactions cost of liquidating the collateral.

Notice that the bank's cost of capital is  $\rho(k + nw)$ , and the expected collateral recovery from delinquent type  $L$  borrowers is  $(1 - \alpha(a))\phi c(a)$ . Only type  $H$  borrowers repay, so their repayment must equal

$$r(a)(k + nw) = \frac{1}{\alpha(a)} [\rho(k + nw) - (1 - \alpha(a))\phi c(a)] > \rho(k + nw). \quad (3)$$

The inequality is due to the fact that

$$c(a) < c^*(w) \leq \rho(M - w) < \rho(k + nw)$$

under Assumption 1. This implies that the interest rate under a pooling contract is higher than the interest rate under a separating contract.

An entrepreneur of type  $H$  who has accepted the pooling contract  $(c(a), r(a))$  will pay  $r(a)(k + nw)$  to the bank at the end of the period. Her net payoff is, using (3),

$$R - r(a)(k + nw) = R - \frac{\rho}{\alpha(a)}(k + nw) + \phi c(a) \frac{1 - \alpha(a)}{\alpha(a)}. \quad (4)$$

The expression in (4) is increasing in  $c(a)$ , so given a pooling contract, the type  $H$  agents prefer the maximum collateral level,  $c(a) = a$ . Therefore, competition for the type  $H$  borrowers forces all pooling contracts to satisfy  $c(a) = a$ . Intuitively, the  $H$ -types know they will get the collateral back, while higher collateral implies lower interest rates (because defaults are less costly to the bank). If  $c(a) < a$ , then the bank can raise the collateral, adjusting the interest rate so that (2) still holds, which makes the type  $H$  borrower strictly better off. The existence of such a deviation would be incompatible with equilibrium. So we must have  $c(a) = a$ , and (3) implies

$$r(a) = \frac{1}{\alpha(a)} \left[ \rho - (1 - \alpha(a))\phi \frac{a}{k + nw} \right].$$

We have

$$r'(a) = -\frac{1}{\alpha(a)}(1 - \alpha(a))\phi \frac{1}{k + nw} - \alpha'(a) \frac{1}{[\alpha(a)]^2} \left[ \rho - \phi \frac{a}{k + nw} \right] < 0.$$

The inequality is due to  $\rho(k + nw) > a\phi$  for  $a < c^*(w)$ , under Assumption 1. Notice that the expression for  $r'(a)$  has two components. The first represents the fact that, for a given wealth class, an increase in collateral lowers interest rates. The second term captures the fact that the higher the wealth, the greater is the *relative* proportion of talented agents (if  $\alpha'(a) > 0$ ). Notice that an increase in  $w$  raises  $r(a)$  for all  $a$ . This is because the bank makes a greater loss on loans to type  $L$  entrepreneurs, so more cross-subsidization from type  $H$  entrepreneurs is needed.

From (4), the (end-of-period) payoff for a type  $H$  entrepreneur with a pooling contract (with  $c(a) = a$ ) is

$$\pi^p(a, w) = R - r(a)(k + nw) = R - \frac{\rho}{\alpha(a)}(k + nw) + a\phi\frac{(1 - \alpha(a))}{\alpha(a)}. \quad (5)$$

Notice that  $\pi_w^p(a, w) = -\rho n/\alpha(a) < 0$ . As in standard models, an increase in  $w$  raises the cost of doing business and so lowers profits, but here the effect is multiplied by  $1/\alpha(a) > 1$  because the type  $H$  entrepreneurs have to cross-subsidize type  $L$  entrepreneurs. Moreover,  $\pi_a^p(a, w) > 0$  because  $r'(a) < 0$ . Therefore, there is a wealth cutoff-level  $\hat{a}(w)$  such that  $\pi^p(a, w) \geq \rho w$  if and only if  $a \geq \hat{a}(w)$ . Thus,  $\hat{a}(w)$  is the lowest wealth level consistent with a pooling contract. Specifically,  $\hat{a}(w) = 0$  if  $\pi^p(0, w) \geq \rho w$ , and otherwise,  $\hat{a}(w) > 0$  is determined by the equation  $\pi^p(\hat{a}(w), w) = \rho w$ . An increase in the wage raises the cost of doing business, as well as the opportunity cost of the entrepreneur's foregone wages, and both these effects raise  $\hat{a}(w)$ . Formally, we have

$$\frac{d\hat{a}(w)}{dw} = \frac{\rho - \pi_w^p(a, w)}{\pi_a^p(a, w)} > 0.$$

If types were directly observed by banks, an agent of type  $H$  would earn  $\pi(w)$  by becoming entrepreneur. With unobserved types, a type  $H$  agent with insufficient collateral to signal her type ( $a < c^*(w)$ ) earns strictly less from her pooling contract, because she must subsidize the losses the banks make on loans to type  $L$  agents. Indeed, for any  $w$  and any  $a \leq c^*(w)$ , we have

$$\begin{aligned} \pi(w) - \pi^p(a, w) &\geq \pi(w) - \left[ R - \frac{\rho}{\alpha(a)}(k + nw) + \phi c^*(w) \frac{(1 - \alpha(a))}{\alpha(a)} \right] \\ &= \frac{1 - \alpha(a)}{\alpha(a)} [\rho(k + nw) - \phi c^*(w)] > 0. \end{aligned} \quad (6)$$

Clearly, type  $H$  agents with  $a \geq c^*(w)$  prefer to get a separating contract.<sup>6</sup> Therefore, in equilibrium the contract offered to agents with wealth greater than  $c^*(w)$  must be separating.

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<sup>6</sup>Recall that with a pooling contract, type  $H$  agents prefer to raise the collateral as much as possible. The upper bound on the collateral in any pooling contract is  $c^*(w)$ . But, a separating contract with collateral  $c^*(w)$  is strictly better than a pooling contract with collateral slightly less than  $c^*(w)$ , since the interest rate is reduced by a discrete amount when the collateral reaches  $c^*(w)$  and the  $L$  types drop out. Thus,  $H$  types with  $a \geq c^*(w)$  strictly prefer a separating contract to any pooling contract.

The following proposition summarizes the above analysis.

**Proposition 1.** *For any given wage  $w \geq \underline{w}$ , there is a unique menu of equilibrium contracts on the credit market. If  $c^*(w) \leq \hat{a}(w)$  then agents with wealth  $a \geq c^*(w)$  are offered a separating contract, while agents with wealth  $a < c^*(w)$  get no credit. If  $c^*(w) > \hat{a}(w)$  then agents with wealth  $a \geq c^*(w)$  are offered a separating contract, while agents with wealth  $a$  such that  $\hat{a}(w) \leq a < c^*(w)$  are offered a pooling contract, and agents with wealth  $a < \hat{a}(w)$  get no credit.*

Notice that an equilibrium always exists for any given  $w$ . Pooling contracts, a separating contract, and credit rationing can co-exist in equilibrium. Agents with wealth less than  $c^*(w)$  are either rationed or receive a pooling contract where they put all their wealth as collateral. There is no possibility for a bank to break the pooling equilibrium by a deviation which attracts only  $H$ -types. Collateral cannot be used as a screening device to attract only type  $H$  agents, because the pooling contracts they currently receive requires them to put all their wealth down as collateral. Obviously, there is no way to screen by asking for more collateral than they have. Notice that this argument makes important use of the assumption of observable wealth. With unobserved wealth, pooling contracts are inconsistent with standard equilibrium notions, by an argument first made by Rothschild and Stiglitz [19].

Figures 1 and 2 show the dependence of collateral and interest rates on individual wealth when  $c^*(w) > \hat{a}(w)$ . Figure 1 shows the level of collateral as a function of  $a$ . For  $\hat{a}(w) \leq a < c^*(w)$  the agent gives up all her wealth as collateral for a pooling contract, while for  $a \geq c^*(w)$  the level of the collateral is constant at  $c^*(w)$ . Figure 2 shows how the interest rate varies with  $a$ . As  $a$  increases the interest rate falls,  $r'(a) < 0$ . At  $a = c^*(w)$  there is a discrete downward jump in the interest rate since the contract switches from pooling to separating. Note that the burden of the adverse selection always falls on poor ( $a < c^*(w)$ ) agents of type  $H$ , who are either rationed or receive a pooling contract where they cross-subsidize defaulting  $L$  types.

Our main interest is in the effect of changes in the wage rate on the equilibrium in the credit market. The effect of changes in the other parameters are straightforward. For example, an increase in  $M$  (a measure of agency costs), or an increase in  $\rho$  (the opportunity cost of capital), increases (weakly) the extent credit rationing by increasing  $c^*(w)$ . In contrast, an decrease in  $R$  or an increase in  $k, \rho$  or  $n$  (which

results in a decrease in the net value of the project) or a decrease in  $\phi$  (a measure of the efficiency of the collateral transfer technology) increases  $\hat{a}(w)$ , and therefore (weakly) increases the extent of credit rationing. It also follows from this discussion that the equilibrium in the credit market is more likely to be such that only separating contracts are offered (i.e.,  $c^*(w) < \hat{a}(w)$ ) if  $M, R$  and  $\phi$  are low and  $k$  and  $n$  are high.

It follows from Proposition 1 that agents with wealth below  $\min\{\hat{a}(w), c^*(w)\}$  have no access to credit. The amount of credit rationing therefore increases when  $\min\{\hat{a}(w), c^*(w)\}$  increases.<sup>7</sup> How does a change in the wage rate  $w$  affect the extent of credit rationing? We know that  $c^*(w)$  is decreasing in  $w$  and  $\hat{a}(w)$  is increasing in  $w$ . If  $\hat{a}(w) > c^*(w)$  then a wage increase leads to *less* credit rationing, because separation becomes easier and separating contracts are given to *more* agents. Since all these new borrowers are type  $H$  entrepreneurs, this has an unambiguously positive effect on net surplus.

If  $\hat{a}(w) < c^*(w)$  then a wage increase leads to *more* credit rationing, because pooling contracts become less profitable and are given to *fewer* agents ( $\hat{a}(w)$  is increasing). The marginal agent with wealth  $\hat{a}(w)$ , who now becomes rationed, is either of type  $H$  or of type  $L$ . In the former case, she was already indifferent between working for wages or becoming an entrepreneur ( $\pi^P(\hat{a}(w), w) = \rho w$ ) and suffers no (first order) loss. In the latter case, she strictly prefers to be an entrepreneur (because  $\hat{a}(w) < c^*(w)$ ). Since the banks make zero profit in any case, on this margin the increased credit rationing leads to a loss of surplus. However, because  $c^*(w)$  falls there is a counterbalancing effect on another margin: some agents who previously were offered pooling contracts (with wealth slightly below  $c^*(w)$ ) now receive separating contracts, which has a positive effect on net surplus (some type  $L$  entrepreneurs switch occupation and become workers, which raises surplus under Assumption 1). We make no more detailed analysis here because this type of welfare analysis is partial equilibrium (taking the wage as exogenously given). Below, we show that when the wage is endogenously determined, multiple equilibria can exist, one where the wage is high and one where the wage is low, but neither Pareto dominates the other.

Finally, it can be noted that if  $\hat{a}(w) < c^*(w)$  and  $\alpha'(a) > 0$ , then the *average*

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<sup>7</sup>We use the term credit rationing in the following sense - a person is credit rationed if she has insufficient collateral to obtain a loan, but would be able to borrow if there were no informational imperfections about her ability.

quality of the borrowers increases when  $w$  increases, because the marginal borrower (with wealth  $\hat{a}(w)$ ) is more likely to be of type  $L$  than the average borrower (when  $\alpha'(a) > 0$ ). This positive effect on the quality of the pool of borrowers when their outside option increases was pointed out by De Meza and Webb [9]. In their model all equilibria must be pooling because banks cannot screen borrowers using collateral, and the outside option is exogenously given. (In Gruner [12], there is collateral but the agents have no outside option except doing nothing.) We now turn to the endogenous determination of the outside option in our model.

## 4 Endogenous Wage Through Occupational Choice

In this section, we consider how the equilibrium wage  $w$  is determined by occupational choices. The lower bound for the wage is  $\underline{w}$ , since any agent can earn  $\underline{w}$  by using the subsistence technology on her own. The upper bound is the wage rate  $\bar{w}$  such that  $\pi(\bar{w}) = \rho\bar{w}$ . At this wage, type  $H$  agents who have enough wealth for a separating contract are indifferent between becoming entrepreneurs and working for wages (i.e., they make zero profit from entrepreneurship, when the opportunity cost of not working for wages is taken into account). Without loss of generality we restrict attention to  $w \in [\underline{w}, \bar{w}]$ . Notice that Assumption 1 implies that  $\bar{w} > \underline{w}$ .

It simplifies the exposition to define the demand and supply of labor to include entrepreneurial labor. With this convention, the supply of labor is 1 at any  $w \in [\underline{w}, \bar{w}]$ . Recall that the technology has fixed coefficients. Each firm demands  $n + 1$  units of labor at any  $w \in [\underline{w}, \bar{w}]$ , counting the entrepreneurial labor. How many firms operate depends on the extent of credit rationing. The demand for labor by entrepreneurs with separating credit contracts is

$$(1 + n) \int_{c^*(w)}^{\infty} \alpha(a) dG(a).$$

Since  $c^*(w)$  is decreasing in  $w$ , this component of labor demand is *upward sloping* (increasing in  $w$ ). The demand for labor by entrepreneurs with pooling credit contracts is zero if  $c^*(w) \leq \hat{a}(w)$ , otherwise it is

$$(1 + n) \int_{\hat{a}(w)}^{c^*(w)} dG(a) = (1 + n) [G(c^*(w)) - G(\hat{a}(w))].$$

Since  $\hat{a}$  is increasing in  $w$ , this component of labor demand is decreasing in  $w$ . The total labor demand by firms is

$$L^D(w) = (1 + n) \int_{c^*(w)}^{\infty} \alpha(a) dG(a) + (1 + n) [G(c^*(w)) - G(\hat{a}(w))]$$

if  $c^*(w) > \hat{a}(w)$ , and

$$L^D(w) = (1+n) \int_{c^*(w)}^{\infty} \alpha(a) dG(a)$$

if  $c^*(w) \leq \hat{a}(w)$ .

Special attention needs to be made to the cases where  $w$  is either  $\underline{w}$  or  $\bar{w}$ . If  $w = \underline{w}$ , the agents are indifferent between working independently with the subsistence technology, or being hired by a firm. Therefore, if  $L^D(\underline{w}) < 1$ , the labor market clears at the wage  $\underline{w}$  (there is not enough demand for labor from firms to hire all workers, but the workers who do not get employed by firms are perfectly happy to use the subsistence technology). If instead  $w = \bar{w}$ , then type  $H$  agents who are not credit constrained are indifferent between becoming entrepreneurs and working for wages. Therefore, if  $L^D(\bar{w}) > 1$ , the labor market clears at the wage  $\bar{w}$  (some type  $H$  entrepreneurs who are not credit constrained decide not to start a firm but to work for wages instead).

The slope of the firms' demand for labor is

$$\frac{dL^D(w)}{dw} = (1+n) \left[ (1 - \alpha(c^*(w))) G'(c^*(w)) \frac{dc^*(w)}{dw} - G'(\hat{a}(w)) \frac{d\hat{a}(w)}{dw} \right] \leq 0 \quad (7)$$

if  $c^*(w) > \hat{a}(w)$ , and

$$\frac{dL^D(w)}{dw} = -(1+n) \alpha G'(c^*(w)) \frac{dc^*(w)}{dw} \geq 0 \quad (8)$$

if  $c^*(w) < \hat{a}(w)$ .

The intuition for (7) and (8) is as follows. The marginal agent, who is just on the threshold of being credit rationed, has wealth  $a = \min\{c^*(w), \hat{a}(w)\}$ . If  $c^*(w) > \hat{a}(w)$  then the marginal agent receives a pooling contract. When  $w$  rises, entrepreneurship becomes less profitable, and the marginal agent can no longer get credit to start a firm. This standard effect causes labor demand to be decreasing in  $w$ . However, if  $c^*(w) < \hat{a}(w)$  then the marginal agent receives a separating contract. When  $w$  rises, less collateral is needed to credibly signal a high talent for entrepreneurship, so the credit rationing is relaxed on the margin. More agents obtain credit, so labor demand is increasing in  $w$ .

Recall that  $c^*(w)$  is decreasing in  $w$  and  $\hat{a}(w)$  is increasing in  $w$ . First consider the case where  $\hat{a}(\underline{w}) \geq c^*(\underline{w})$ . Then  $\hat{a}(w) \geq c^*(w)$  for all  $w \in [\underline{w}, \bar{w}]$ . By Proposition 1, at no wage would pooling contracts be offered on the credit market, and the demand for labor is upward sloping everywhere. It is not surprising that multiple equilibria may exist. We characterize this case in the following proposition

**Proposition 2.** *Suppose  $\hat{a}(\underline{w}) \geq c^*(\underline{w})$ . (a) If  $L^D(\bar{w}) < 1$  then the unique equilibrium wage is  $\underline{w}$ . (b) If  $L^D(\underline{w}) \leq 1 \leq L^D(\bar{w})$  then both  $\underline{w}$  and  $\bar{w}$  are equilibrium wages (in addition, if both inequalities are strict, then there is a third equilibrium wage  $w'' \in (\underline{w}, \bar{w})$ ). (c) If  $L^D(\underline{w}) > 1$  then the unique equilibrium wage is  $\bar{w}$ .*

*Proof.* When  $\hat{a}(\underline{w}) > c^*(\underline{w})$  the demand for labor is upward sloping everywhere. The three cases a, b and c correspond to Figures 3a,3b,3c. In Figure 3a, there is excess supply of labor at any wage greater than  $\underline{w}$ , and there is a unique equilibrium where the wage is  $\underline{w}$ . At this wage the labor market clears because some agents are willing to use the subsistence technology rather than working for wages. In Figure 3c, there is excess demand for labor at any wage lower than  $\bar{w}$ , and there is a unique equilibrium where the wage is  $\bar{w}$ . At this wage the labor market clears because even type  $H$  agents who are not credit constrained are willing to refrain from becoming entrepreneurs. In Figure 3b, both  $\underline{w}$  and  $\bar{w}$  are equilibrium wages. **QED**

The figures suggest that equilibrium wages  $\underline{w}$  and  $\bar{w}$  are stable under tatonnement-style dynamics. However, the third equilibrium wage  $w''$  in Figure 3b is unstable.

Proposition 2 assumed  $\hat{a}(\underline{w}) \geq c^*(\underline{w})$ . Now suppose  $\hat{a}(\underline{w}) < c^*(\underline{w})$ . By definition of  $\bar{w}$  and  $\hat{a}(\bar{w})$ ,

$$\pi(\bar{w}) = \rho\bar{w} = \pi^P(\hat{a}(\bar{w}), \bar{w}) \quad (9)$$

Therefore, we must have  $\hat{a}(\bar{w}) > c^*(\bar{w})$ , or else (6) would imply  $\pi(\bar{w}) > \pi^P(\hat{a}(\bar{w}), \bar{w})$  which contradicts (9). (Intuitively, at  $w = \bar{w}$  separating contracts are just barely viable, but since pooling contracts involve cross-subsidization of  $L$  types, they cannot be viable at  $w = \bar{w}$ ). By continuity, there is a unique  $w_0 \in (\underline{w}, \bar{w})$  such that  $\hat{a}(w_0) = c^*(w_0)$ . Then  $c^*(w) > \hat{a}(w)$  for  $w < w_0$  and  $c^*(w) < \hat{a}(w)$  for  $w > w_0$ . That is, labor demand is downward sloping for wages below  $w_0$ , and upward sloping for wages above  $w_0$ . The demand for labor is the minimum at  $w = w_0$ . At wages greater than  $w_0$ , pooling contracts are not viable, and a wage *increase* reduces credit rationing through  $c^*(w)$ . At wages below  $w_0$ , pooling contracts are viable and a wage *decrease* reduces credit rationing through  $\hat{a}(w)$ . Since the demand for labor has an upward sloping part, multiple equilibria can exist. The following proposition completes the characterization of equilibria:

**Proposition 3.** *Suppose  $\hat{a}(\underline{w}) < c^*(\underline{w})$ . If either  $L^D(\bar{w}) < 1$  or  $L^D(w_0) > 1$ , then there is a unique equilibrium. Otherwise, there are multiple equilibria.*



*Proof.* Suppose  $L^D(w_0) \leq 1 \leq L^D(\bar{w})$ . The situation is depicted in Figure 4 below. Clearly  $\bar{w}$  is an equilibrium wage. There are two other equilibrium wages,  $w'$  and  $w''$ . The lowest of the three equilibrium wages is actually  $\underline{w}$  if  $L^D(\underline{w}) \leq 1$ . The uniqueness of equilibrium when  $L^D(\bar{w}) < 1$  or  $L^D(w_0) > 1$  can be shown using similar figures. **QED**

Again, Figure 4 suggests that both  $\bar{w}$  and  $w'$  are stable under tatonnement-style dynamics (but  $w''$  is unstable).

Multiple equilibria are possible because the feedback from the credit market to the labor market implies a positive effect of wage increases on the demand for labor. When wages are high, pooling contracts are not profitable and are not offered. Banks can solve their screening problem with relatively low levels of collateral, because high wages mean type  $L$  agents are not inclined to become entrepreneurs. All entrepreneurs are of type  $H$ . As long as the wage is below  $\bar{w}$ , a wage increase does not cause type  $H$  entrepreneurs to switch occupation and become workers. The wage increase only lowers the collateral required to become entrepreneur, enabling poorer type  $H$  agents to become entrepreneurs, which raises labor demand.<sup>8</sup>

When wages are low, pooling contracts are viable, although they are made on less favorable terms than separating contracts (the bank must be compensated for the losses on loans to type  $L$  agents). The poorer is the entrepreneur, the lower is the collateral she can put up, and the more unfavorable will be the terms of the pooling contract. If the wage increases, then  $\hat{a}(w)$  increases which reduces the demand for labor. In addition,  $c^*(w)$  falls, so some marginal type  $H$  entrepreneurs will switch from a pooling to a separating contract. This does not raise labor demand because they were entrepreneurs in any case. However, the fall in  $c^*(w)$  means that some marginal type  $L$  entrepreneurs will switch occupation and become workers, which reduces the demand for labor. Thus, the labor demand function is downward sloping

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<sup>8</sup>The result is very stark due to the assumption of a fixed coefficients production function, which rules out any substitution of capital for labor. Suppose instead that the revenue  $R = R(n)$  is an increasing and concave function of the number of workers hired. Let  $n = n(w)$  be the maximizer of  $R(n) - \rho(k + nw)$ . The demand for labor is  $\alpha(1 + n(w))(1 - G(c^*(\bar{w})))$  and its slope with respect to  $w$  is  $\alpha(1 + n(w))(1 - G(c^*(\bar{w}))) \left[ \frac{n'(w)}{1 + n(w)} - \frac{g(c^*(\bar{w}))}{(1 - G(c^*(\bar{w})))} \frac{dc^*}{dw} \right]$ . The first term in parenthesis, which is negative, represents the standard negative impact of an increase in wages on labor demand. The second term is positive and captures the removal of credit constraints when the required level of collateral is reduced. The slope of labor demand is determined by the relative strengths of these two effects. To highlight our argument we have assumed fixed coefficients, so the first term is zero and labor demand is upward sloping when there are no pooling contracts.

at low wage levels. Notice that parameter changes that make pooling contracts less profitable, without influencing the profitability of separating contracts, will reduce the size of the downward sloping region (e.g., a decrease in  $\phi$ ). Notice also that, with multiple equilibria, small shocks to the parameters can have dramatic effects. For example, in Figure 4, shifting the demand curve to the right will at some point eliminate the equilibrium wages  $w'$  and  $w''$ , leaving only  $\bar{w}$  as an equilibrium wage. This suggests that the interaction between the labor and the credit market is likely to make employment (and output) more volatile with respect to productivity shocks.

## 5 Monopolistic moneylender and Interlinkage

Because of the linkage between the labor and credit markets, an actor in one market may benefit from influencing events in another market. In particular, a moneylender may benefit from a wage increase which alleviates his screening problem. To analyze this, suppose the economy is divided into many identical “villages”. Agents can take a job in any village they want, so there is in effect only one economy-wide labor market, which is perfectly competitive. But, in contrast to previous sections, the credit market is not competitive. In each village, there is a *monopolistic* moneylender. An agent can only get a loan from the moneylender in the village where she lives, so the local moneylender has a (local) monopoly. The distribution of wealth and talent in each village is the same as in the economy as a whole.

Consider first the moneylender’s problem when he takes the wage rate as exogenous. It is the same as that of a competitive bank, except that there is a participation constraint for the borrowers rather than a zero-profit condition for the bank. The moneylender will maximize profit, given the distribution of wealth and talent, and given the wage  $w$ . Since wealth  $a$  is observable, the moneylender’s problem can be solved separately for each wealth class. Suppose the moneylender offers a contract  $(c, r)$  to the agent with wealth  $a$ . The maximum interest rate the type  $H$  agent is willing to pay is the one that makes her indifferent between taking the loan and working for wages:

$$R - r(k + nw) = \rho w. \quad (10)$$

Thus, the moneylender’s profit from the type  $H$  agent is  $R - \rho(k + (1+n)w)$ . Suppose that the moneylender offers a pooling contract. If  $c < c^*(w)$  the contract will attract type  $L$  borrowers. On each type  $L$  borrower the moneylender makes a profit

$$\phi c - \rho(k + nw) < 0 \quad (11)$$

where the inequality is due to Assumption 1 and the fact that  $c < c^*(w) \leq \rho(M-w)$ . The moneylender's expected profit from a pooling contract is

$$\alpha(a) [R - \rho(k + (1+n)w)] + (1 - \alpha(a)) [\phi c - \rho(k + nw)] \quad (12)$$

which is clearly increasing in  $c$ . Thus, for pooling contracts the moneylender prefers the maximum collateral. This has two implications. First, if the borrower's wealth is  $a < c^*(w)$ , then if she is offered any credit at all, it is a pooling contract with  $c = a$ . Second, if the borrower's wealth is  $a \geq c^*(w)$ , then she will be offered a separating contract with  $c = c^*(w)$  (because the best pooling contract would involve collateral just below  $c^*(w)$ , but separating the agent at  $c = c^*(w)$  is clearly better than pooling at  $c$  just below  $c^*(w)$ , in view of (11)).

The only issue left to determine is, if the borrower's wealth is  $a < c^*(w)$ , will she be offered a pooling contract with  $c = a$ , or no contract at all? The answer depends on the sign of the expression in (12) when  $c = a$ . If it is non-negative, a pooling contract is profitable. But, it is easy to check that, if  $c = a$ , then (12) is non-negative if and only if  $a \geq \hat{a}(w)$ , where  $\hat{a}(w)$  is as defined in Section 3. Thus, the monopolistic moneylender offers pooling contracts to exactly the same set of agents that the competitive market would have offered pooling contracts to (namely, those with wealth  $a$  such that  $\hat{a}(w) \leq a < c^*(w)$ ). He also offers separating contracts to exactly the same set of agents as a competitive market would (namely, those with wealth  $a \geq c^*(w)$ ). So, for any wage  $w$ , the demand for labor is the same with monopolistic moneylenders as with a competitive credit market. Thus, the set of equilibrium wages will also be the same in the two cases. Of course, interest rates are higher in the monopolistic case, but this does not matter for labor demand, and hence not for equilibrium wages.

The moneylender makes a greater profit from separating contracts than from pooling contracts, because of (11). The better is the outside option of working for wages, the easier it is for the moneylender to screen the borrowers. In fact, the moneylender can always raise his profit by simply giving a "gift" to people in his village who choose *not* to take a loan, but work for a wage instead. One way in which the moneylender might implement this "gift" scheme is by becoming an employer himself, and then pay above market wages to workers from his own village (he should of course not pay above market wages to outsiders, since he will never lend money to them anyway). This is a different justification for interlinkage than those advanced in the literature (see Ray and Sengupta [19]). If the employer (landlord) and the moneylender are separate individuals, then the former does not internalize

the fact that the wages he pays affect the moneylender's adverse selection problem. A landlord-cum-moneylender can achieve higher joint profits by offering "efficiency" (i.e., higher than market) wages to its laborers. The high wages reduce his profits as a landlord, but he more than makes up for it as a moneylender. We will show this formally.

Suppose  $\hat{a}(w) \geq c^*(w) = \rho(M - w)$  so that no pooling contract would be offered by the moneylender. Now, let  $\varepsilon > 0$  be a small number, and fix a wealth level  $a$  such that

$$\rho(M - w - \varepsilon) \leq a < \rho(M - w). \quad (13)$$

Without "gifts", agents with such wealth levels would not get a loan, because their wealth is not enough to qualify for a separating contract, and the moneylender does not want to offer pooling loans by assumption. But now consider the following scheme. The borrower with wealth  $a$  is offered a loan with collateral  $a$ . But if the borrower chooses not to take a loan, then she receives a small gift of  $\varepsilon > 0$  from the moneylender, and takes a job at the market wage  $w$ . In effect, this raises the outside option from  $w$  to  $w + \varepsilon$ . The collateral required to separate the agents is now  $c^*(w + \varepsilon) = \rho(M - w - \varepsilon)$ . The agent has more than that when (13) holds. With collateral  $c = a \geq c^*(w + \varepsilon)$ , only the type  $H$  agent takes the loan, while the type  $L$  agent prefers to take the gift of  $\varepsilon$  and work for wages. On each type  $H$  agent of this wealth class, the moneylender's profit is  $R - \rho(k + (1 + n)w)$ . To each type  $L$  agent of this wealth class he pays  $\varepsilon$ . Thus, the expected gain to the moneylender from this scheme is

$$\alpha(a) [R - \rho(k + (1 + n)w)] - (1 - \alpha(a))\varepsilon$$

which, for small  $\varepsilon$ , is positive by Assumption 1. So the moneylender benefits by making these gifts.

The same argument goes through if the moneylender offers pooling contracts to agents with wealth just below  $c^*(w)$ , i.e., if  $\hat{a}(w) < c^*(w)$ . In this case, the moneylender can simply withdraw the pooling contract offered to borrowers in this wealth class. Instead, they are offered a choice between a loan with collateral  $a$ , or a gift  $\varepsilon$ . Type  $H$  agents prefer the loan, while the type  $L$  agents prefer the gift. Separating the borrowers using this strategy must, for small  $\varepsilon$ , be more profitable than the pooling contract.<sup>9</sup>

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<sup>9</sup>Competitive banks might also attempt to give the agents "gifts" if they do *not* apply for a loan,

## 6 Policy Implications

The standard models of credit rationing typically propose two broad types of policy interventions: credit subsidies, and redistribution of wealth that enables more individuals to become entrepreneurs. Our model, where the interaction of the labor and the credit market determines endogenously the threshold of wealth necessary for investment, suggests that these policy implications need to be modified.

Rather than helping poor individual cross a fixed threshold of wealth in order to become entrepreneurs, government policies might be aimed to change the threshold level of wealth required to qualify for a loan instead. To achieve this, credit subsidies are not the only possible instrument. Indeed, a lump sum loan subsidy to entrepreneurs will do nothing to eliminate credit rationing, unlike in standard models of poverty traps such as Banerjee and Newman [2]. The subsidy will attract untalented agents, so the banks will simply adjust the collateral requirements to neutralize the effect of the subsidy. In contrast, one possible way to reduce credit rationing is to subsidize agents who do *not* become entrepreneurs. This can be achieved by labor market policies (e.g., opening up of trade or migration possibilities, changes in labor laws such as those concerning minimum wages or wage subsidies).

Suppose the situation is as in Figure 3b, so there are two (stable) equilibrium wages,  $\underline{w}$  and  $\bar{w}$ . Total output is maximized at the wage  $\bar{w}$ . The most direct ways of selecting the high wage equilibrium are to either use labor market policies to drive the wage rate to  $\bar{w}$ , or to offer loans with collateral  $c^*(\bar{w})$  at an interest rate  $\rho$  (or encourage some private institution to do so). If the latter policy is adopted, the government may initially make losses because the pool of borrowers that will be attracted at  $w = \underline{w}$  will include many type  $L$  agents. But the increase in labor demand will eventually raise wages to  $\bar{w}$ , and from that point on these policies have no cost to the government. Even if government lending programs initially make losses and seem inefficient, they can have long-run general equilibrium effects on the credit market that improve efficiency.

Many governments use more indirect interventions, such as interest rate ceilings (especially in the agricultural sector).<sup>10</sup> Financial intermediaries often respond to interest rate ceilings by rationing credit, for example by increased collateral require-

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in order to alleviate the adverse selection problem. The obvious difficulty is that a borrower can take a gift from one bank and then go to another bank and collect another gift and so on.

<sup>10</sup>See Adams, Graham and Von Pischke [1].

ments or higher transactions costs to borrowers in the form of increased administrative hurdles. In our model, the interest rate on a pooling loan to wealth class  $a$  is  $r(a) > \rho$ . If the government regulates the interest rate to  $r_0$ , then agents with wealth  $a$  such that  $r(a) > r_0$  would no longer get loans. As a result, an interest rate ceiling can increase credit rationing. However, it raises the average quality of the entrepreneurial projects, by making pooling contracts with low collateral requirements unprofitable. This is intuitive, because untalented or risky types are typically the ones most willing to borrow at a high interest rate. This is in contrast with a well-known argument against interest rate regulation from the point of view of a classical supply-demand framework (Adams, Graham and Von Pischke [1].), namely, that forced low interest rates attracts borrowers with low quality.

Consider now policies that redistribute wealth. Unlike standard static models of credit rationing, small changes in the wealth distribution can have large effects on the equilibrium credit rationing by changing the threshold level of wealth needed to borrow.<sup>11</sup> Suppose the situation is as in Figure 3a, so the unique equilibrium wage is  $w = \underline{w}$ . As the gap between the demand for labor and supply of labor at  $w = \underline{w}$  is large, it would seem that only a massive amount of redistribution can raise output substantially. However, the gap between demand for labor and supply of labor at  $w = \bar{w}$  is small. A small amount of redistribution may increase the number of entrepreneurs who have wealth  $c^*(\bar{w})$  sufficiently so that, as a result, the situation becomes as in Figure 3b (i.e.,  $L^D(\bar{w}) \geq 1$ ). Now there are multiple equilibria, and credit or labor market policies described above can be used to move the economy to the high wage equilibrium.

Consider next the role of the correlation between wealth and talent. If the source of the positive correlation between wealth and ability is the fact that wealthy individuals receive a better education, which makes them more suitable for entrepreneurship, what will happen if government policy reduces this correlation, for example, by shifting resources from private to public schools? Suppose there is a cut-off level of wealth, say  $\tilde{a}$ , such that the policy *raises* skill levels for agents with wealth below  $\tilde{a}$  and *lowers* skill levels for agents with wealth above  $\tilde{a}$ . For example, suppose the probability of being talented is

$$\alpha(a) = \frac{\lambda + \beta a}{1 + \lambda + \beta a}$$

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<sup>11</sup>In *dynamic* models of credit rationing (e.g., Banerjee and Newman [2]) it is possible that small changes in the initial wealth distribution can have a large long-run effect on efficiency through mobility.

where  $\lambda > 0$  and  $\beta > 0$  are given parameters. If the policy raises  $\lambda$  to  $\lambda + \Delta\lambda$  and reduces  $\beta$  to  $\beta - \Delta\beta$ , then the cut-off level is  $\tilde{a} = \Delta\lambda/\Delta\beta$ . The policy in effect redistributes “talent” from those who have wealth above  $\tilde{a}$  to those who have wealth below  $\tilde{a}$ . The policy will not affect  $c^*(w)$ , because  $c^*(w)$  does not depend at all on the probability that an individual is talented. Clearly, if  $\hat{a}(w) > c^*(w)$  then the policy will not affect the amount of credit rationing. If  $\hat{a}(w) < c^*(w)$ , it will raise the interest rate for pooling contracts to agents with wealth levels above  $\tilde{a}$ , and reduce the interest rate for pooling contracts to agents with wealth levels below  $\tilde{a}$ . If  $\tilde{a} > \hat{a}(w)$ , the policy will reduce the amount of credit rationing by reducing the cutoff level of wealth for which borrowers get a pooling contract,  $\hat{a}(w)$ . By a similar argument, if  $\tilde{a} < \hat{a}(w)$  then the policy will increase the amount of credit rationing. Thus, the policy reduces credit rationing *if and only if* an agent of wealth  $\tilde{a}$ , whose talent is not affected by the policy by hypothesis, was not rationed in the first place, i.e.,  $\tilde{a} > \min\{\hat{a}(w), c^*(w)\}$ . If the education technology is such that the increased labor demand from entrepreneurs with wealth less than  $\tilde{a}$  more than compensates for the decreased labor demand from entrepreneurs with wealth greater than  $\tilde{a}$  after the policy, then the general equilibrium effects can further reduce credit rationing if  $c^*(w) < \hat{a}(w)$ . If  $\tilde{a} < \min\{\hat{a}(w), c^*(w)\}$  then the policy certainly reduces both labor demand and welfare.

The general equilibrium effects of economic policy depends on which equilibrium the economy is in, which indicates the difficulty of making policy recommendations in models of multiple equilibria. For example, when wages are high, all contracts will be separating. In particular, this is true when the wage is the highest possible,  $\bar{w}$ . In this case, there is credit rationing in the sense that agents with wealth below  $c^*(\bar{w})$  cannot get a loan. However, the equilibrium separating contract will be independent of the fraction of the agents that are untalented ( $c^*(\bar{w})$  does not depend on the probability that a given individual is talented). In this case, an educational policy such as the one discussed above, which raises the probability that a poor agent is talented, will not influence the amount of credit rationing at all. However, it will reduce the number of entrepreneurs if it reduces the probability that an agent with wealth greater than  $c^*(\bar{w})$  is talented. This shifts the labor demand to the left, for high wages, which may eliminate the high-wage equilibrium. On the other hand, redistributing *wealth* can reduce the amount of credit rationing if it raises the number of agents who have wealth  $c^*(w)$ . When the wage is so high that type  $L$  agents are not inclined to be entrepreneurs, the problem the poor are facing on the credit

market is not that they are not talented enough, but that they are not rich enough, so that it is wealth rather than “talent” that should be redistributed. Conversely, consider an equilibrium where the wage is low enough so that type  $L$  agents accept pooling contracts and become entrepreneurs. In this case, poor agents who cannot put up sufficient collateral will pay high interest rates (to cover the losses the banks incur on loans to type  $L$  agents). In this case, an educational policy that raises the skill level in their wealth class reduces interest rates on pooling loans, and reduces the collateral requirements, thereby reducing the amount of credit rationing. In terms of Figure 4, the net effect of the reform may be to pivot the labor demand function anti-clockwise, which may have a beneficial effect if the original equilibrium wage is low ( $w = w'$ ) but not if it is high ( $w = \bar{w}$ ).

## 7 Concluding Remarks

In this paper we have proposed a simple 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.

The model we presented is stylized and there are several directions in which it can be extended. For example, 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. Also, the assumption that workers have the same productivity is restrictive. One could allow workers to work and save up assets which can later be used as collateral (along the lines of Ghatak, Morelli, and Sjöström [11], Mookherjee and Ray [13]



who, however, do not consider the problem of adverse selection). If individuals with entrepreneurial talent also have higher productivity as workers then such a model would endogenously generate correlation between talent and wealth. For example, the incentives of talented individuals to signal their ability through their savings (which partly measures their labor market performance) would depend on the extent of credit rationing and expected profits in the future period, which in turn will affect the extent of credit rationing. In future work we hope to examine some of these issues.

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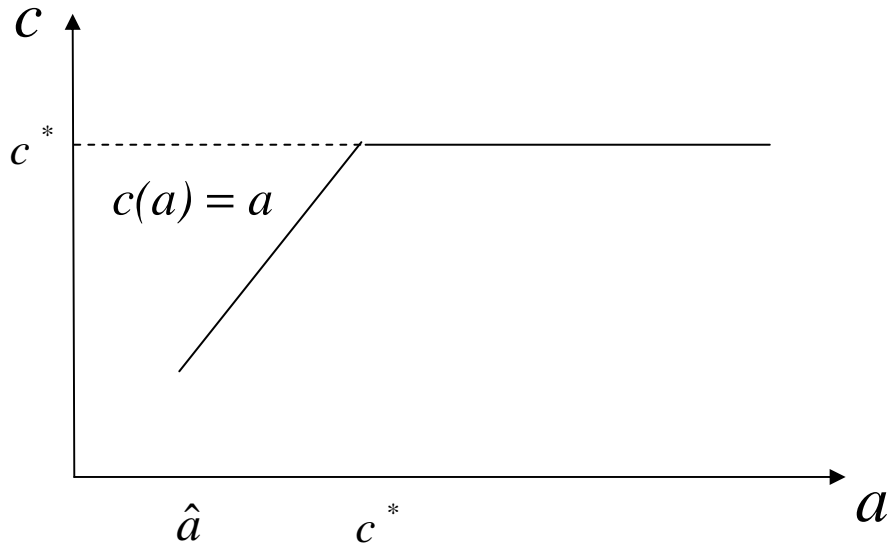


Figure 1

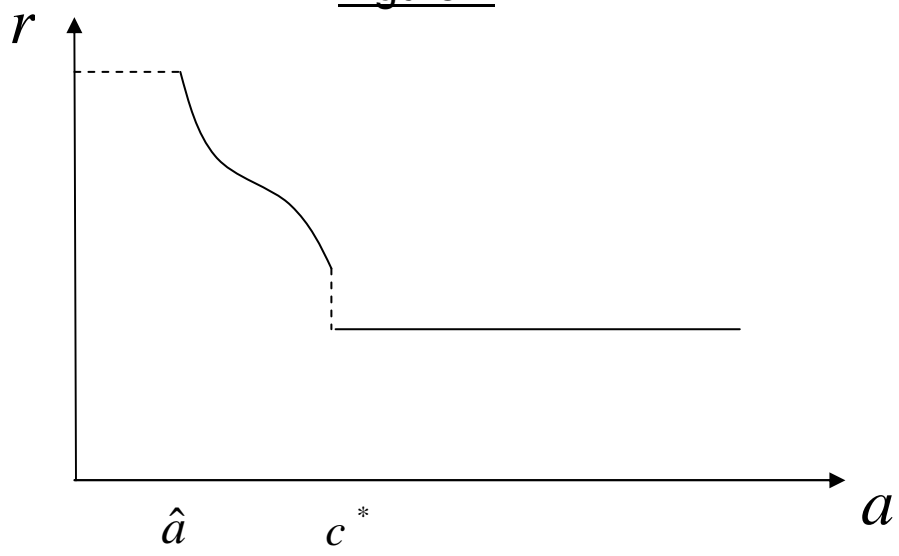


Figure 2

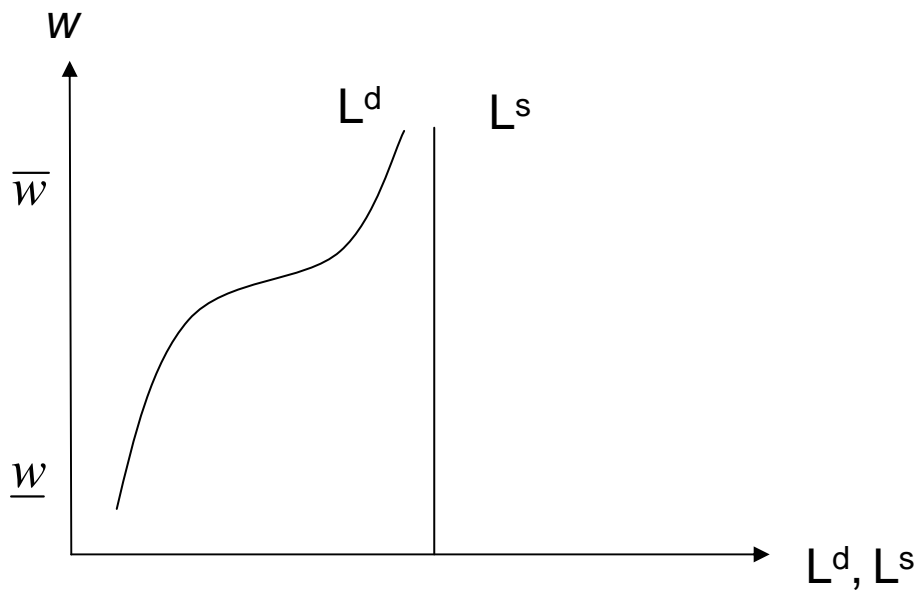


Figure 3a

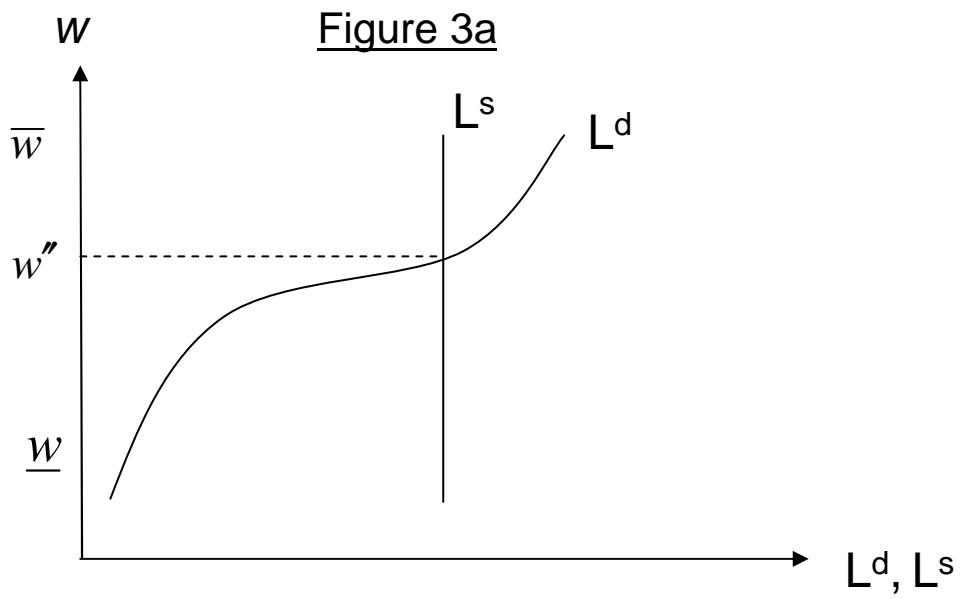


Figure 3b

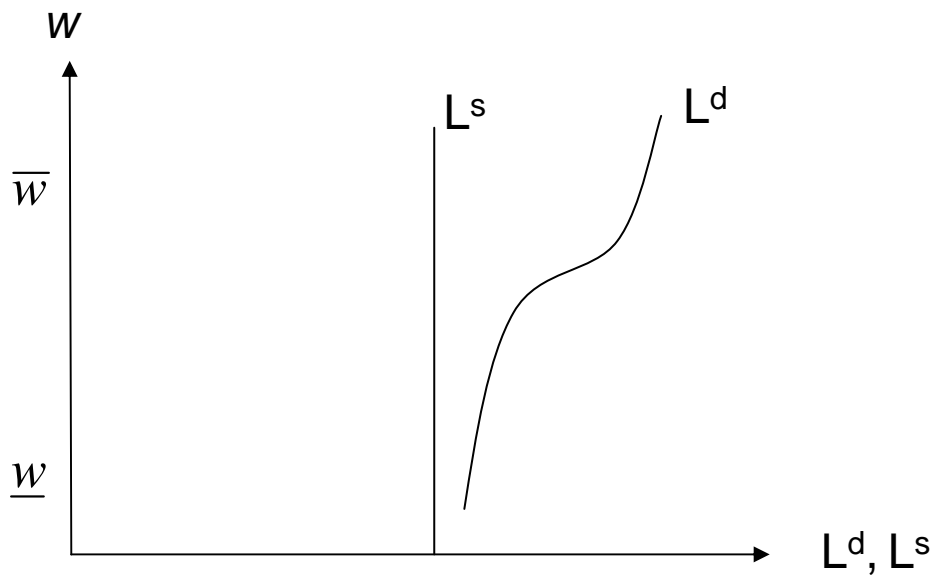


Figure 3c

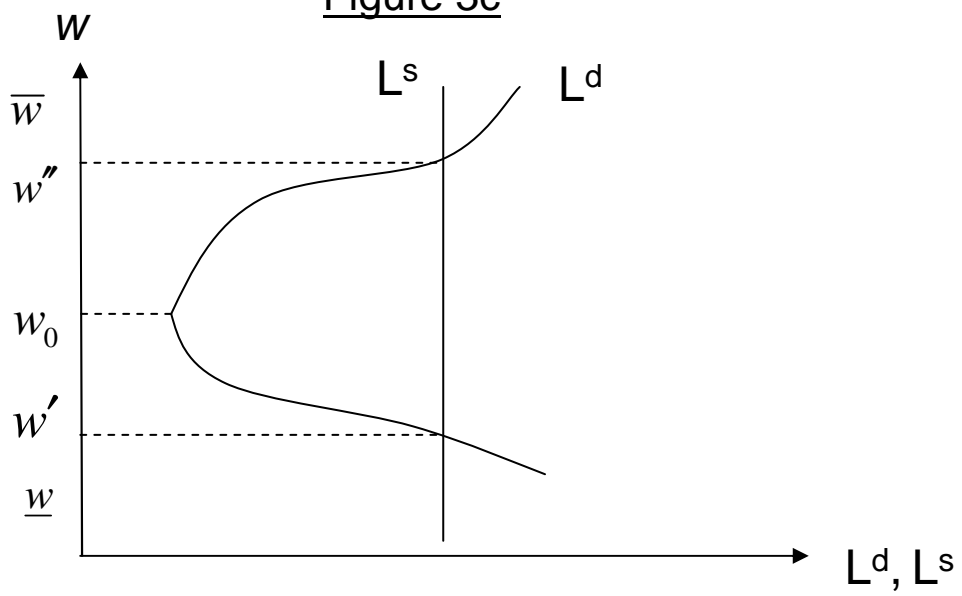


Figure 4