OCCUPATIONAL CHOICE AND THE QUALITY OF ENTREPRENEURS

Eren Inci*
Boston College

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Abstract

This paper focuses on the quality of entrepreneurs when individuals, who differ in terms of entrepreneurial ability and wealth, choose between entrepreneurship and wage-earning. A loan is required to become an entrepreneur. Four wealth classes form endogenously. Banks' inability to identify the ability of individuals leads them to offer pooling contracts in the poor and the lower-middle classes. Regardless of ability, all poor class individuals become workers and all lower-middle class individuals become entrepreneurs. Banks are able to offer separating contracts in the upper-middle and the rich classes. High-ability individuals in these wealth classes become entrepreneurs and their low-ability counterparts become workers. Equilibrium contracts may entail cross-subsidies within or between occupations. In some economies, a small success tax on entrepreneurs used to subsidize workers can increase the average quality of entrepreneurs and welfare by changing the thresholds of the wealth classes.

Keywords: adverse selection; entrepreneurship; general equilibrium contract theory; moral hazard; occupational choice; success tax; wage subsidy

JEL Classification: D43; D82; H25; L26

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* *Tel.*: 1-617-552-3670; *fax*: 1-617-552-2308. *Address*: Boston College, Department of Economics, 140 Commonwealth Avenue, Chestnut Hill MA 02467-3806 USA. *E-mail address*: inci@bc.edu. I am grateful to David de Meza, Avinash Dixit, Nobuhiro Kiyotaki, Hi-Lin Tan, the dissertation workshop participants at Boston College (2005, 2005, 2006, 2006), session participants at the CEBR Conference on Entrepreneurship: Occupational Choice and Financing (2006), the Cambridge-MIT Institute Workshop on Regional Innovation (2006), the European Meeting of the Econometric Society (2006), seminar participants at the Center for European Economic Research (ZEW) (2006), Mannheim University (2006), Boston University (2006), and especially James Anderson, Richard Arnott, Susanto Basu, and Andrew Newman for helpful comments. Some of the ideas presented here were developed while I was attending three NBER Entrepreneurship Group Meetings in 2005. This research is financially supported by Paula and Daniel Greeley Award and Boston College Dissertation Fellowship Award. The travel grants given by the NBER Entrepreneurship Group and the Cambridge-MIT Institute are gratefully acknowledged. All errors are mine.

1 INTRODUCTION

Is the economy's creation of entrepreneurs desirable? Do markets sort individuals to entrepreneurship efficiently? These two questions, the central concerns in analyzing entrepreneurship, are sometimes mistakenly perceived as equivalent. However, the first one deals with the number of entrepreneurs in the economy whereas the second one focuses not only on the quantity but also the quality of entrepreneurs in the economy. Entrepreneurial entry is less of a concern so long as the existing wealth is available for lending in the financial markets or is used by its owners. But the quality problem in entrepreneurship still exists even given a fixed number of entrepreneurs. This paper focuses exclusively on this quality problem when individuals choose their occupations. An economy's allocation of individuals to entrepreneurship eventually determines who uses the wealth available in the economy: those who have better entrepreneurial abilities or those who do not. Markets often prevent some high-ability individuals from becoming entrepreneurs while they allow some low-ability individuals to become entrepreneurs. How can the government increase the average quality of entrepreneurs, and thus improve the performance of the economy in such situations?

Entrepreneurship is an outcome of an occupational choice process. The natural outside option to entrepreneurship is wage-earning. Almost every individual decides whether to start their own firm or work as a wage-earner at some point in their life. Unlike the usual outside option in contract theory, wage-earning is particularly interesting here since there are at least two further links between entrepreneurship and wage-earning besides one being the outside option of the other. First, workers are hired by entrepreneurs. Second, typically, wealth endowments of the workers are lent to entrepreneurs in the financial markets. These interlinkages between the two occupations are important since a change in one affects the nature of the other. The occupational decisions of individuals influence the structure of both options endogenously via their effects on the factor prices. Therefore, in the general equilibrium setting, it is less clear *ex ante* whether creating disincentives in one occupation would create better outcomes economy-wide and in that occupation. Indeed, this paper shows that, in a large class of economies, a tax on entrepreneurs used to subsidize workers can increase the average quality of entrepreneurs in the economy.

I focus on a simple occupational choice problem in which there are two types of agents that differ in terms of unobservable entrepreneurial abilities. I refer to them as high-type and low-type agents. Agents also differ with respect to their wealth (which is liquid and observable by banks). They decide whether to become entrepreneurs or workers. If they decide to become entrepreneurs, they have to borrow from banks since their wealth alone is not enough to fully finance their firms. Every agent has the same probability of success in entrepreneurship, but high-type agents may increase this probability by working hard. I focus on the most interesting case, in which the net present value of the projects of low-type and shirking high-type agents is negative but that of high-type agents who provide effort is positive. In a perfect world, low-type agents would have no incentive to apply for loans. In an imperfect world, however, they may try to get loans because of the cross-subsidization in the loan market triggered by adverse selection.

Equilibrium requires that entrepreneurs self-finance their firms with their own wealth as much as possible and borrow the rest from banks. All loanable funds come from those who become workers. Then, the number of entrepreneurs is simply the aggregate wealth available in the economy divided by the fixed capital requirement to start a firm.[1] This implies that the number of entrepreneurs in the economy is fixed, which allows me to explore the effects of policies on the quality of the entrepreneurs, in and of themselves, without having to worry about their number. Any policy in this paper may change the quality composition of entrepreneurs, but not their number. While abstracting from the number of entrepreneurs helps me highlight issues of quality in entrepreneurship, it also seems realistic that the entrepreneurial capacity of an economy is determined by the aggregate wealth available in the economy. In general, policies aimed at increasing the number of entrepreneurs cannot be very successful unless economy-wide policies to increase capital accumulation are employed.[2]

The paper first derives the contracts offered by banks and analyzes the decisions of the agents in a partial equilibrium when the factor prices are given. Different equilibrium contracts emerge in every wealth level due to the assumption that the wealth is observable by banks. The contractual structure endogenously forms four different wealth classes in the society: the poor, the lower-middle, the upper-middle, and the rich.

Banks have no choice but to offer pooling contracts to the poor and the lower-middle classes since it is always beneficial for low-type members of these wealth classes to misrepresent themselves as if they were high-type agents. A pooling contract requires that high-type agents cross-subsidize low-type agents in the loan market. The fact that only pooling contracts can be offered in these wealth classes affects the occupational structure in different ways. In the poor class, it distorts the occupational decisions downward by isolating high-type agents from the loan market, and thus, from entrepreneurship. The reason is that high-type agents in this class are so poor that they cannot both provide effort in entrepreneurship and also cross-subsidize low-type agents in the loan market. Having known this, banks set a high enough interest rate such that none of the agents in the poor class will prefer to apply for loans. Hence, all poor class agents, whether high- or low-type, become workers. However, in the lower-middle class, pooling contracts distorts occupational decisions upwards by allowing the low-type agents to become entrepreneurs. On the one hand, high-type agents in this wealth class can provide effort in entrepreneurship even though they have to cross-subsidize low-type agents in the loan market. On the other hand, cross-subsidies make loans attractive for low-type agents. As a result, both high- and low-type agents prefer becoming

[1] I use "aggregate wealth available" rather than "aggregate wealth" for two reasons. First, in general some of these resources might come from international financial markets. Nonetheless, even these resources are not infinitely supplied to any specific country. Second, it may well be the case that some of the aggregate wealth remains inactive. What matters is the available part of the aggregate wealth.

[2] There can, of course, be some real life complications. First, in reality, the project sizes of entrepreneurs vary, but this does not change the intuition. In this case, every entrepreneur may invest different units of capital but still the total value of investments by them can at most be the aggregate wealth available in the economy. What matters is not the head count of entrepreneurs but the *effective* number of entrepreneurs, which takes into account whether a given unit of wealth is used by a high-ability or a low-ability entrepreneur. Second, it can be argued that only a fraction of the aggregate wealth available in the economy can be lent to entrepreneurs due to various market failures and frictions. In this case, policies to get rid of them can increase the total number of entrepreneurs in the economy. However, these frictions and market failures are not particular to entrepreneurship, but rather economy-wide problems (e.g., increasing saving). The quality problem still persists even after these problems are fixed.

entrepreneurs in the lower-middle class.

In the upper-middle wealth class, banks can offer separating contracts that limit prices the loans. Thus, low-type agents become workers and high-type agents become entrepreneurs in this wealth class. There is still cross-subsidization even though separating contracts are offered, but they are in the form of information rents between the occupations. That is, the fact that the types cannot be observed causes transfers from high-type entrepreneurs to low-type workers. However, these information rents are efficient since they do not distort the occupational decisions, and hence, do not affect who uses the capital. Finally, banks offer first-best efficient separating contracts to the rich class agents. Rich low-type agents need to borrow less to start their firms, and thus, they would not benefit much from wrongfully revealing their types to be able to get loans. Hence, even a first-best efficient contract is incentive-compatible in this wealth class, and as a result, rich low-type agents become workers and their high-type counterparts become entrepreneurs.

After determining the equilibrium contracts and decisions of agents when the factor prices are given, I show that the equilibrium characterized in this partial equilibrium can exist in a general equilibrium, and then present a policy exercise in that setting when the labor and the credit markets are interlinked. This analysis demonstrates how a small tax on entrepreneurs used to subsidize workers may increase the average quality of the pool of entrepreneurs in the economy by changing the boundaries of the wealth classes. The intuition goes as follows. Although the tax-subsidy policy affects all agents, its magnitude varies in different groups. In the economies on which I focus, the policy restructures the incentive schemes in the markets in such a way that agents who switch from entrepreneurship to wage-earning as a result of the policy are relatively wealthier than agents who do the opposite. This increases the credit supply to the banks, and thus, decreases the risk-free interest rate. The decrease in the risk-free interest rate – equal to the cost of loanable funds – also means a decrease in the lending interest rate.

Cross-subsidies in the loan market are the only reasons why low-type agents may be attracted to entrepreneurship. Therefore, they prefer becoming entrepreneurs only if a sufficiently large portion of their projects are financed by banks. A decrease in the lending interest rate decreases the cross-subsidies per unit of loan borrowed by low-type agents. This lessens the distortions of the adverse selection by discouraging some low-type agents from becoming entrepreneurs. Those who change their occupational decisions from entrepreneurship to wage-earning are low-type agents with higher wealth in the lower-middle class. Since there is a fixed number of entrepreneurs in the economy, the entrepreneurship positions emptied by them must be filled up by some other agents. Who would they be? When the lending interest rate decreases, some of the poor high-type agents who used to be isolated from the loan market because they could not provide effort in entrepreneurship are now able to do so, and thus, banks can provide loans to them. However, when they become entrepreneurs, their low-type counterparts can also become entrepreneurs as a result of the pooling contracts offered in the lower-middle class. Thus, the overall effect of the policy is to swap some lower-middle class low-type entrepreneurs with an equal number of poor class high- and low-type workers. Given a fixed pool of entrepreneurs, the average quality of the entrepreneurs in the economy has to increase, and so does the welfare.

The model exhibits some empirical regularities, such as the fact that entrepreneurship is high in the countries where wages are higher, or the well-known fact that higher (lower) wages are associated with developed (developing) countries. It also shows at least one reason why policies for promoting entrepreneurship should be tailored to a country's specific context as is indicated in Global Entrepreneurship Monitor 2004 (Acs, *et al.*, 2005), which is the largest annual analysis of entrepreneurial activity worldwide.[3] The GEM suggests a "one size does not fit all" policy. For example, low-income nations need to increase family income before focusing exclusively on entrepreneurs. I show that the adverse selection problems in the credit market distort the economy only in the poor and the lower-middle classes. Since relatively more people live in these wealth classes in poor countries, the adverse selection problems of entrepreneurial sectors hit the poor nations more than the rich ones. As individuals accumulate wealth and move up in the wealth distribution, adverse selection either turns into an efficient information rent (as in the upper-middle class) or completely disappears (as in the rich class). This helps shed light on why entrepreneurial sectors improve in the later phases of economic development.

The paper is organized as follows. Section 2 provides a brief comparison of this paper with the current literature on entrepreneurship. Section 3 presents the model. Section 4 focuses on the partial equilibrium in the credit market. Section 5 extends the analysis to a general equilibrium. Section 6 explores the effects of success taxes and wage subsidies. Section 7 discusses some extensions, and section 8 concludes the paper. An appendix contains some of the proofs.

2 LITERATURE REVIEW

The literature on the economic theory of entrepreneurship has grown rapidly in the recent years. Here, I shall confine myself to a selection of papers that are closely relevant to mine. The idea behind this paper is motivated by de Meza and Webb (2000) who show that sometimes the most effective policy is to subsidize the (exogenous) outside option to entrepreneurship.

Earlier papers question if the aggregate level of investment by entrepreneurs is too high or too low in the partial equilibrium. Perhaps the most famous of them are Stiglitz and Weiss (1981) and de Meza and Webb (1987). When the cost of loanable funds is exogenous, Stiglitz and Weiss (1981) argue that lending interest rates can be inefficiently high, and thus, aggregate investment is inefficiently low. This calls for a subsidy to entrepreneurship. On the other hand, de Meza and Webb (1987) show that under other plausible assumptions there can be excessive lending to entrepreneurs, and thus, overinvestment in the aggregate. This calls for a tax on entrepreneurship. However, when the cost of loanable funds is endogenous, insufficient lending or excessive lending are not issues since the aggregate level of investment is fixed. Thus, the tax/subsidy policy in my paper increases welfare for a different reason than that of an overinvestment (or underinvestment) problem in the aggregate. Instead, it works by improving the quality composition of entrepreneurs in the economy.

[3] GEM hereafter.

Ghatak, *et al.* (forthcoming) develop another occupational choice model in which the labor and credit markets are interlinked and provide another reason why a tax on entrepreneurs might be desirable. In their base model, the "price" of loans depends on the average ability of active entrepreneurs. When there is an increase in the outside option, banks can offer lower prices. This, in turn, positively affects entrepreneurs. In their base model, a tax on entrepreneurs is always desirable. Since the risk-free interest rate is exogenous in Ghatak, *et al.* (forthcoming), the main channel through which the policy works is the adjustment in the labor demand and its repercussions for the rest of the economy. I endogenize the risk-free interest rate by taking workers to be the source of loanable funds. The policy in my model changes the wealth class thresholds endogenously. Thus, it works through an adjustment to the loan supply to the banks, which in turn affects the risk-free interest rate in the economy. Moreover, a tax on entrepreneurs is not always desirable in my model; it depends on the economic environment of the economy, such as its wealth distribution. Below I argue why I believe that the risk-free interest rate can adjust due to changes in occupational structure. Ghatak, *et al.* (forthcoming) extend their base model to allow for screening with collateral. The agents' use of their own wealth in their investments in my model has the similar role of collateral. In particular, full separation is possible at higher wealth levels in both settings.

One common assumption in the literature is that loans are infinitely supplied, possibly from international markets (see, for example, Ghatak, *et al.* (forthcoming), and de Meza and Webb (1987, 2000)). This means that the cost of funds to the banks, equal to the risk-free interest rate, is fixed. This partial analysis can be a good approximation when the entrepreneurial sector of the economy is relatively small and occupational choices do not have much effect on the factor prices (the risk-free interest rate and wages), which might happen in the short-run. My focus is the long-run. In my general equilibrium model, the occupational choices do affect the factor prices. The evidence in support of this argument is reported by Reynolds and White (1997): by the end of their working lives, about 2/5 of the U.S. workforce have had at least one spell of self-employment, which is quite enough to affect the factor prices in the long-run. Even for small open economies, occupational decisions of agents can affect factor prices in the long-run, owing to imperfect financial markets and limited lending to any specific country. Indeed, despite the globalization movements in the last decades, the Feldstein and Horioka Puzzle (1980) – which presents the empirical regularity that long-run average of national savings are highly correlated to domestic investment – is still out there as one of the six major puzzles in international macroeconomics (Obstfeld and Rogoff, 2000).

One other important aspect of the model presented here is that agents differ with respect to their wealth endowments. Previous work on the effects of asymmetric information on the aggregate level of investment, such as Stiglitz and Weiss (1981) or de Meza and Webb (1987), focus on the cases in which all agents have the same wealth endowment (but, see Ghatak, *et al.* (forthcoming)). Having heterogeneous wealth across agents has significant effects. In a model with homogeneous wealth, the wealth of an agent acts as a device to set the individual rationality by determining whether the agent enters into entrepreneurship or not. However, in a model with heterogeneous wealth, it also acts as a perfect signal of agents' type in some wealth levels. As I show later, in the upper-middle and the rich classes, due to the fact that they do not borrow much, low-type agents do not benefit from wrongfully revealing their types and applying for bank loans. In that sense, models with homogeneous wealth levels implicitly assumes that the wealth level is in a specific range in which only pooling contracts can be offered.

	Mean	Standard Deviation	Percentile 10th	25th	Median	75th	90th
Profits	344,127	8,790,767	0	1,000	10,000	50,000	160,000

Note: The entrepreneur is defined as the respondent if he/she is self-employed and the self-employed spouse otherwise.
Source: Moskowitz and Vissing-Jorgensen (2002), summary statistics on entrepreneurs from the Survey of Consumer Finances (average of 1989, 1992, 1995 and 1998).

Table 1: Profits of Entrepreneurs

On the empirical side, one might wonder whether income comparisons between entrepreneurs and wage-earners support my claim that wage-earning is the natural outside option to entrepreneurship[4]. Table 1 shows an excerpt from Moskowitz and Vissing-Jorgensen's (2002) summary statistics from Survey of Consumer Finances. According to these statistics the average profits of entrepreneurs between 1989-1998 is \$ 344,127, but half of them make less than \$ 10,000 and 90 percent of them make less than \$ 160,000. Although this does not show the expected incomes from an *ex ante* point of view, it clearly shows that wage-earning has been a serious outside option to entrepreneurship *ex post* over the last years. Looking at the situation from the opposite side, Evans and Leighton (1989), by using the National Longitudinal Survey of Young Men (1966-1981) and Current Population Surveys (1968-1987), and more recently Hurst and Lusardi (2004), by using Panel Study of Income Dynamics, show that agents with low wages are more likely to become entrepreneurs.

3 THE MODEL

I consider a one-period closed economy with many principals (banks) and many agents (individuals). Agents decide whether to become entrepreneurs (denoted by E) or workers (denoted by W).

3.1 Economic Environment

There are (at least two) banks (indexed by z) and a unit mass of agents (indexed by i). Agents are composed of h high types and $1 - h$ low types. They are assumed to be risk

[4] Note that the payoff of an agent in wage-earning includes not only the wage earned by supplying labor but also the interest income from bank deposits.

neutral, and hence, maximize their expected income by choosing their occupations. Type of an agent affects payoff from entrepreneurship, but all agents are identical in terms of their abilities in wage-earning. Low-type agents succeed in entrepreneurship with probability p_L. High-type agents, on the other hand, have two options. They may either provide effort or shirk. If they provide effort they can increase their success probability to p_H, but this comes with an effort cost of $e > 0$. If they shirk their success probability is p_L, and hence, is the same with the success probability of low type agents. Providing effort is prohibitively costly for low-type agents. Hereafter, high-type agents who choose to provide effort are denoted by H, and low-type agents and high-type agents who choose to shirk are denoted by L.

Every agent is endowed with one indivisible labor unit and wealth A. Wealth completely depreciates in one period when it stays unused. It is assumed that entrepreneurial ability is not correlated with wealth.[5] The population is described by a continuously differentiable distribution function $G(A)$, which gives the measure of the population with wealth less than A. The probability density function is given by $g(A)$ with support $[0, I]$, where I is the setup cost of starting a firm which is assumed to be the same for every agent. Aggregate wealth, which is also the average wealth, $\bar{A}$, is given by

$$\bar{A} = \int_0^I A dG(A) \quad . \tag{1}$$

3.2 The Sequence of Events

Figure 1 summarizes the sequence of the events. Everything happens in one period. Since everyone's wealth is less than I those who become entrepreneurs have to borrow from banks to start their firms.[6] At the beginning of the period (time-t^-), agents choose their occupations. Then, financial contracts are signed, investments are made, and production takes place. At the end of the period (time-t^+), payoffs are realized, and successful entrepreneurs pay wages to workers. Finally, agents pay off their loans and banks pay the interest rate for deposits in addition to principals.

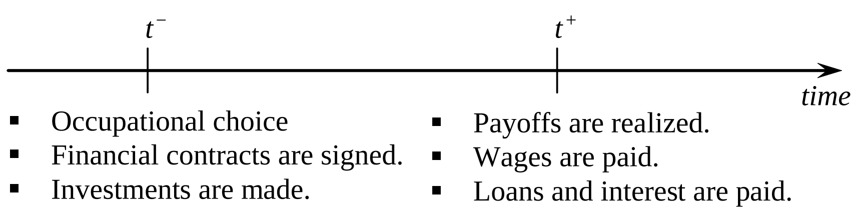

Figure 1: The Sequence of Events

[5] The model can easily be extended to the case in which wealth and ability are correlated. Section 7 briefly discusses this extension.

[6] The analysis can be straightforwardly extended to the case where some agents' wealth exceeds I. None of the qualitative results of the paper depends on this assumption.

3.3 Information

The types of agents are known only by them but the distribution of types in every wealth level is public information. Wealth is perfectly observable by banks. Workers can observe neither the wealth nor the success probability of their employers. They cannot see the financial contracts between their employers and banks either. However, they have rational expectations about the average success probability of the entrepreneurs in the economy. Output is verifiable, which implies that courts can enforce contracts.

3.4 Banks

Banks are risk-neutral and they compete in Bertrand fashion. They simultaneously form their beliefs and choose the contracts they will be offering, taking the risk-free interest rate, R, and the wage rate, w, as given. Since they observe the wealth levels, they may offer distinct contracts in every wealth level. Hence, given the factor prices, they offer contracts that are contingent on announced type and outcome (success or failure) in every wealth level. Let the repayment to the bank by agent i in the success state be $D_i^S(R,w,A)$ and $D_i^F(R,w,A)$ in the failure state.[7] The most general form of the contract offered by bank z is

$$\boldsymbol{C}_z(A) \equiv \begin{bmatrix} C_H \\ C_L \end{bmatrix} = \begin{bmatrix} D_H^S(R,w,A) & D_H^F(R,w,A) \\ D_L^S(R,w,A) & D_L^F(R,w,A) \end{bmatrix} \quad , \tag{2}$$

where C_H is the contract designed for high-type agents and C_L is that for low-type and shirking high-type agents.[8] I assume that there is limited liability. Therefore, the terms of contracts cannot leave agents with negative end-of-period payoffs:

$$Y_i^S \geq 0 \quad \text{and} \quad Y_i^F \geq 0 \qquad \forall i = H, L \quad , \tag{3}$$

where Y_i^S is the payoff of agent i in the success state and Y_i^F is the payoff of agent i in the failure state.

3.5 Occupational Classes

There are two occupational classes: entrepreneurs and workers.

3.5.1 Entrepreneurs

I define an entrepreneur as an individual who undertakes risky real investment in the form of starting a firm. Entrepreneurs are not only self-employed individuals but also employers. There is ownership, but no shareholdership.

[7] I do not put nonnegativity restrictions on repayments to banks. Later, I show that banks may offer contracts with $D_L^S(R,w,A) < 0$ and $D_L^F(R,w,A) < 0$ in some wealth levels. That is, they can give money to low-type agents to prevent them from applying loans.

[8] I shall drop subscript z whenever it does not cause any confusion.

Starting a firm requires at least I units of capital and labor is essential for production. Production is risky in the sense that it generates higher output only with probability p_i and lower output with probability $1 - p_i$ (lower output is normalized to zero). Therefore, the production technology is given by

$$f(k,l) = \left\{ \begin{array}{cc} \left\{ \begin{array}{cc} f(l) & \text{with probability } p_i \\ 0 & \text{with probability } 1-p_i \end{array} \right\} & \text{if } k \geq I \\ 0 & \text{otherwise} \end{array} \right\} \quad \forall i = H, L \quad , \tag{4}$$

where k is capital, l is labor, $f(l)$ is a strictly concave production function with diminishing marginal returns to labor (e.g., $f(0) = 0$, $f^{'}(l) > 0, f^{''}(l) < 0$). Production function is assume to satisfy the Inada conditions (e.g., $\lim_{l \to 0} f^{'}(l) = \infty$ and $\lim_{l \to \infty} f^{'}(l) = 0$).

With this technology capital is still a decision variable. However, the decision is a all-or-none decision in the sense that agents decide whether to invest or not to invest. The model can be extended to allow agents to choose the number of projects they would like to manage in a similar fashion with Banerjee and Newman (1993). Then, I can be interpreted as the unit project size. Doing so would obviously bring more results, but not alter the intuitions in the present paper.

Since A is not sufficient to fully cover the setup cost of a firm, entrepreneurs have to borrow a loan of $I - A$ from the bank.[9] Then, the expected payoff of an entrepreneur, $\Upsilon_i^E(R, w, A)$, is given by

$$\Upsilon_i^E(R,w,A) := p_i(f(l) - wl - D_i^S(R,w,A)) - (1-p_i)D_i^F(R,w,A) - m_i \qquad \forall i = H, L \quad , \tag{5}$$

where m_i is defined by

$$m_i = \left\{ \begin{array}{cc} e & \text{if } i = H \\ 0 & \text{if } i = L \end{array} \right. \quad . \tag{6}$$

An entrepreneur is going to be successful with probability p_i and produce $f(l)$. He pays wl to the workers and gives $D_i^S(R, w, A)$ to the bank. Thus, the expected net return in the success state is $p_i(f(l) - wl - D_i^S(R, w, A))$. When he is unsuccessful he produces something less than $f(l)$ (which is normalized to zero), pays something less than wl to the workers (which is normalized to zero), and gives D_i^F to the bank. However, limited liability prevents D_i^F to be higher than what the entrepreneur has. Since the output in case of a failure is normalized to zero, D_i^F is going to be zero as well, but for the sake of generality of the analysis, I start off without imposing the limited liability first.[10] For brevity, from now on, I shall denote net output in the success state with $\pi(w)$:

$$\pi(w) := \max_{\{l\}} [f(l) - wl] \quad . \tag{7}$$

[9] Later, it is shown that there has to be maximum self-finance in equilibrium.

[10] In a failure state, entrepreneurs pay neither the loans nor the wages in equilibrium. Thus, I do not need to make a statement about the seniority of the loan and wage payments.

3.5.2 Workers

An agent who chooses to become a worker is employed at an entrepreneur's firm. Given the information structure in section 3.3, there has to be a random matching between entrepreneurs and workers. The common wage rate is w, and is paid only if the entrepreneur is successful. Let the weighted average of the success probabilities of entrepreneurs in the economy be p^e. Then, a worker's expected wage income is given by $p^e w$. Workers can also deposit their wealth into a bank and receive a risk-free (gross) interest rate of R. Hence, the expected payoff of an agent who becomes a worker, $\Upsilon_i^W(R, w, A)$, is given by

$$\Upsilon_i^W(R, w, A) := p^e w + RA \qquad \forall i = H, L \quad . \tag{8}$$

Some of the risk of the firm is borne by the workers with this specification.[11] This is similar to an efficiency wage scheme. Firms pay w in a success state and a lower wage in a failure state where the lower wage is normalized to zero. This specification is consistent with the empirical findings that the returns to entrepreneurship vary more than returns to wage-earning.

As indicated before, this paper focuses on the occupational choice problem with the focus being on the entrepreneurs. As a natural simplification, I assume that all agents are equally able as workers. In the real world, however, agents differ in their abilities as workers as well. In such a world, an efficient allocation entails those who have comparative advantage in entrepreneurship becoming entrepreneurs. My assumption that all agents are equally able as workers eliminates the distinction between comparative and absolute advantage.[12]

4 PARTIAL EQUILIBRIUM

This section focuses on the decisions of agents and banks when w and R are given. In section 5, I shall endogenize them.

4.1 Equilibrium Definition

An equilibrium is a set of contract offers by banks which are consistent with each other. Each bank offers agents a set of contracts that maximizes their profits. Agents choose the best contract for them among all alternatives.[13] I impose a Wilson equilibrium concept (Wilson, 1977). In a Wilson equilibrium there is nonmyopic rationality in the sense that banks take into account the effects of their actions on the actions of the other banks when

[11] In an alternative setting, payoff of a worker can be interpreted as the expected return to market portfolio in which one part is the riskless return on, say, government bonds and the other part is the risky return to a portfolio of stocks, and the payoff of an entrepreneur is a share of a firm.

[12] Parker (2003) works on a model in which ability applies to both occupations. Agents might have various entrepreneurial skills as well. This problem has been studied by Lazear (2005) which states that entrepreneurs must be jacks-of-all-trades who need not excel in any one skill, but are competent in many.

[13] Assuming free entry or fixed number of banks do not make any difference.

they are deciding. That is, a bank would not offer a deviation contract that would make losses once the unprofitable contracts offered by all the other banks are withdrawn. This rules out potential nonexistence issues analyzed in Rothschild and Stiglitz (1976). Formally, an equilibrium in the credit market is defined as follows.

Definition 1 (Equilibrium Concept) *Assume that banks are nonmyopic Bertrand-Wilson players following pure strategies. Given w and R, a credit market equilibrium is a set of contract offers by banks such that all set of contracts earn nonnegative profits in every wealth level. There is no new set of contracts that could earn higher profits even after the elimination of all unprofitable set of contracts.*

A Wilson equilibrium can be obtained by changing the extensive form of a Nash game by allowing two rounds of play for banks, as is done in Hellwig (1987). First, banks announce the set of contracts they would like to offer. Then, they may withdraw as many contracts as they wish. Finally, agents choose the set of contracts they would like to take. In that sense the two conjectures differ from each other with their extensive forms. Otherwise, the solution concept is still subgame perfection. The equilibrium concept defined in Definition 1 is a short-cut to this extensive form. In that sense, every Nash equilibrium is also a Wilson equilibrium but there can be a Wilson equilibrium in cases in which there is no Nash equilibrium.

An equilibrium must be individually rational for every agent. Individual rationality asserts that agents choose an occupation only if it is better than staying inactive. With the assumption of complete depreciation, this means

$$\Upsilon_i^o(A) \geq 0 \qquad \forall i = H, L \ \wedge \ \forall o = E, W \tag{9a}$$
$$R \geq 0 \quad . \tag{9b}$$

An equilibrium has to be incentive compatible for every agent. Incentive compatibility assures that none of the agents has incentive to misrepresent his type:

$$\max\{\Upsilon_H^E(A), \Upsilon_L^E(A)\} \geq \max\{p_H Y_L^S - e + (1 - p_H)Y_L^F, \ \Upsilon_L^E(A)\} \tag{10a}$$
$$\Upsilon_L^E(A) \geq p_L Y_H^S + (1 - p_L)Y_H^F \quad . \tag{10b}$$

The first one says that none of the high-type agents would be attracted by the contracts designed for low-type agents regardless of whether they provide effort or not. The second one says the same for low-type agents.

In an equilibrium proper participation constraints must hold for every agent. Participation constraints guarantee that agents choose the occupation that makes them strictly better off:

$$\Upsilon_i^W(A) > \Upsilon_i^E(A) \ \forall i, j = H, L \iff W \succ_i E \ \forall i = H, L \tag{11a}$$
$$\Upsilon_i^W(A) < \Upsilon_i^E(A) \ \forall i, j = H, L \iff E \succ_i W \ \forall i = H, L \quad , \tag{11b}$$

where $W \succ_i E$ means that agent i *strictly* prefers wage-earning to entrepreneurship (similarly for $E \succ_i W$). It should also be specified what agents do when they are indifferent between the two occupations. Next assumption asserts that they choose wage-earning in such situations.

Assumption 1 (Occupational Indifference) $\Upsilon_i^W(A) = \Upsilon_i^E(A) \quad \forall i, j = H, L \iff W \succ_i E \;\; \forall i = H, L.$

I also need to specify what agents do when they are equally attracted to different contracts. As is stated in the next assumption, if agents have more than one best alternative, they choose one of them with equal probabilities.

Assumption 2 (Contractual Indifference) $\forall i = H, L \wedge \forall o = E, W \wedge \forall z, l = \{1, ..., n\}$ $\{\Upsilon_i^o(R, w, A) \mid C_{iz}(A)\} = \{\Upsilon_i^o(R, w, A) \mid C_{il}(A)\} \Longrightarrow \Pr\{C_{iz}(A) \succ_i C_{il}(A)\} = \frac{1}{n}.$

Assumption 2 is an assumption on the preferences of the agents over the set of contracts when they are indifferent between them. It states that they do not mind from whom they take the contract. However, Assumption 1 is an assumption on the preferences of the agents over occupations when they are indifferent between them. It worths mentioning that even a small degree of risk aversion would imply Assumption 1. That is, agents choose the less risky occupation when both occupations give the same expected payoff.

4.2 The Banks' Problem

I can now derive the set of contracts offered by banks. I start off by deriving the zero profit conditions for banks and the iso-profit lines for agents. The zero profit condition only with high-type agents who provide effort is

$$p_H(\pi(w) - Y_H^S) - (1 - p_H)Y_H^F = R(I - A) \quad , \tag{12}$$

and the same with low-type or shirking high-type agents is

$$p_L(\pi(w) - Y_L^S) - (1 - p_L)Y_L^F = R(I - A) \quad . \tag{13}$$

The corresponding iso-profit lines are given by

$$p_H Y_H^S + (1 - p_H)Y_H^F = \bar{Y}_H^E \tag{14a}$$
$$p_L Y_L^S + (1 - p_L)Y_L^F = \bar{Y}_L^E \quad , \tag{14b}$$

where $\bar{Y}_H^E$ and $\bar{Y}_L^E$ are levels of Y_H^E and Y_L^E, respectively. Note that both iso-profit lines are parallel to the corresponding zero profit conditions for banks. Finally, the zero profit condition with both types is

$$\bar{p}D^S + (1 - \bar{p})D^F = R(I - A) \quad , \tag{15}$$

where D^S is the repayment in the success state and D^S is the repayment in the failure state of a random loan applicant with wealth level A, and $\bar{p}$ is the Bayesian success probability of him:

$$\bar{p} = hp_H + (1-h)p_L \quad . \tag{16}$$

4.2.1 Possible Equilibria in the Partial Equilibrium

Four different equilibria may arise depending on the wealth of a given agent. Figure 2 illustrates the threshold levels that separates these different equilibria in the $Y^F - Y^S$ space with some abuse of geometry.[14] Limited liability requires that a contract lies in the first quadrant. ZP_H, ZP_L, and ZP_{HL} are the graphs of zero profit conditions (12), (13), and (15), respectively, for a particular value of A. An agent's payoff in case he becomes a worker is given by (8). Call this payoff as the *outside option* (to entrepreneurship).

There are low-type agents with a particular wealth level whose iso-profit lines that pass through their outside option also pass through the point where ZP_{HL} intersects the Y^S-axis. $L_1 L_1^{'}$ is an iso-profit line for such agents. Denote their wealth level with A_L. There are also agents with a particular wealth level whose iso-profit lines passing through their outside option also passes through the intersection of ZP_H and the Y^S-axis. $L_2 L_2^{'}$ is an iso-profit line for such agents and I denote the wealth level that represents them with $\tilde{A}$. I derive the expressions for A_L and $\tilde{A}$ when I analyze the decisions of agents.

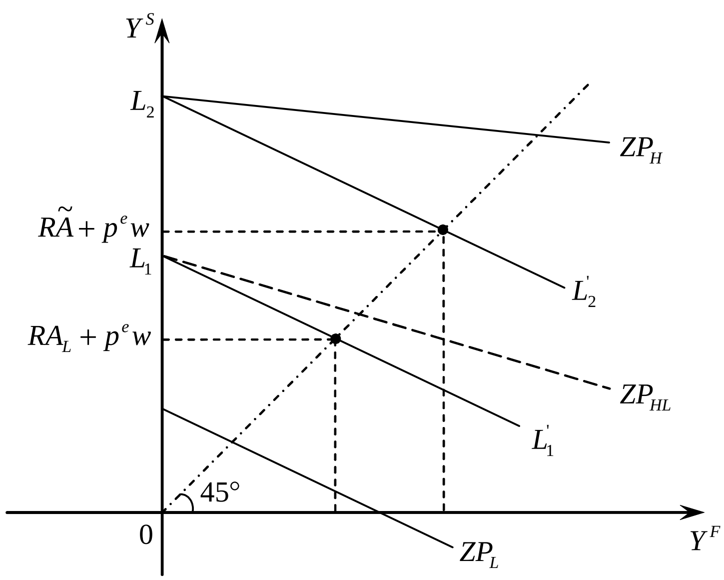

Figure 2: Contract Offers

Below, I show that for wealth levels between $[0, A_L]$, banks offer cross-subsidizing pooling contracts; for wealth levels between $[A_L, \tilde{A}]$, they offer cross-subsidizing separating con-

[14] The lines drawn are functions of A, and hence, the position of them are different for different values of A. For expositional convenience, I show all lines at once in one graph.

tracts; for wealth levels between $[\tilde{A}, I]$, they offer first-best efficient separating contracts which are accepted only by high-type agents who provide effort. All of these contracts assume that high-type agents provide effort. There is no adverse selection problem in the wealth classes in which they do not provide effort since whenever high-type agents do not provide effort they are no different than low-type agents in terms of their success probability. So, banks offer a pooling contract in these success-probability-wise homogenous wealth levels. Figure 2 does not show this possibility. Section 4.3 analyzes the effort decision of agents.

4.2.2 Cross-subsidizing Pooling Contracts

Figure 3 illustrates the equilibrium contract offers to agents with wealth levels between $[0, A_L]$. Assume a bank offers the contract C_1. As it can be easily seen from (14a) and (14b), the iso-profit line of low-type agents or shirking high-type agents are steeper than that of high-type agents who provide effort. The pair of iso-profit lines for a high-type agent who provides effort and for a low-type or a shirking high-type agent that pass through the point C_1 are shown in Figure 3. C_1 cannot be an equilibrium since there always exists a deviation contract C_2 at the north-west of C_1 that is preferable by effort providing high-type agents but not low-type or shirking high-type agents. Then, any such contract can be undercut unless it is on the Y^S-axis at a point such as C_3. However, since C_3 is below ZP_{HL}, it makes positive profits with both types. Then, it cannot be an equilibrium since other banks can undercut it until they make zero profits. This happens at C^* where an equilibrium is obtained. The iso-profit lines that pass through C^* are denoted by HH' and LL' for effort providing high-type agents and for low-type or shirking high-type agents, respectively. In contrast to classic Rothschild and Stiglitz's (1976) impossibility of a pooling contract, there cannot be a deviation contract at the north-west of this contract due to limited liability. Any contract outside the first quadrant is a *pound of flesh* contract that require payments more than the borrower currently has.[15]

Since C^* is on ZP_{HL}, (15) yields the following form for the pooling contract:

$$\boldsymbol{C}^*(A) \equiv \begin{bmatrix} C_H^* \\ C_L^* \end{bmatrix} = \begin{bmatrix} D_H^S(A) & D_H^F(A) \\ D_L^S(A) & D_L^F(A) \end{bmatrix} = \begin{bmatrix} \frac{R(I-A)}{\bar{p}} & 0 \\ \frac{R(I-A)}{\bar{p}} & 0 \end{bmatrix} \quad . \tag{17}$$

Banks offer the same contract for all types and they make zero profits. Effort providing high-type agents' expected repayment to the bank is higher than the repayment that is consistent with their risk levels whereas it is lower for low-type and shirking high-type agents. In that sense, effort providing high-type agents cross-subsidize all other loan applicants due to the fact that the types are not observable by the banks. The loan contract $\boldsymbol{C}^*(A)$ is preferred

[15] Pound of flesh is a reference to The Merchants of Venice of William Shakespeare. Bassanio gets a loan from a merchant called Shylock. The price for not repaying is a pound of flesh from his friend Antonio, but it founders on Shylock's inability to cut out exactly a pound. I thank David de Meza for pointing out this example to me. There may be some other non-monetary fines in case in which the repayment is not made. For example, before the Solonian Constitution, citizens could be sold as slaves when they were bankrupt in Athens.

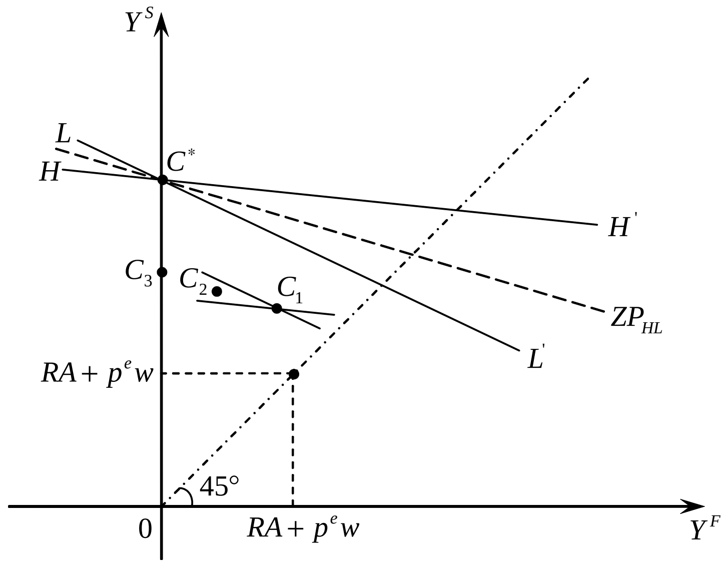

Figure 3: Cross-subsidizing Pooling Contracts

to outside option $(RA + p^e w)$ for every agent, and thus, all agents with these wealth levels apply for loans.

4.2.3 Cross-subsidizing Separating Contracts

Focus on the wealth levels between $[A_L, \tilde{A}]$. Now banks cannot offer pooling contracts of the kind that are analyzed in subsection 4.2.2. The reason is that now the outside option to entrepreneurship yields strictly better payoffs than any pooling contract that makes zero profits with both types. This is shown in Figure 4. The iso-profit line that passes through the outside option of low-type or shirking high-type agents is given by $L_1 L_1^{'}$, and that of effort providing high-type agents is given by $H_1 H_1^{'}$. Any contract has to be on or over the upper envelope of these two iso-profit lines. Since ZP_{HL} is below this envelope anywhere in the first quadrant, banks cannot design any pooling contract that can make nonnegative profits with both types.

The next point of concern is whether banks can design separating contracts. Start with the separating contract (C_1, C_2). Banks offer C_1 to high-type agents who provide effort (which is a standard loan contract). They offer C_2 to low-type and shirking high-type agents (which is somewhat different than a loan contract). C_2 is nothing but getting the initial endowment of low-type agents as deposits at the beginning of the period, and paying an interest rate of R at the end of the period. High-type agents strictly prefer C_1 over C_2, but low-type agents are indifferent between them which also makes them indifferent between becoming entrepreneurs and workers. By Assumption 1, they choose wage-earning in such situations, and hence, they would not apply for C_1.

Contract (C_1, C_2) provides loans to effort providing high-type agents and makes low-type

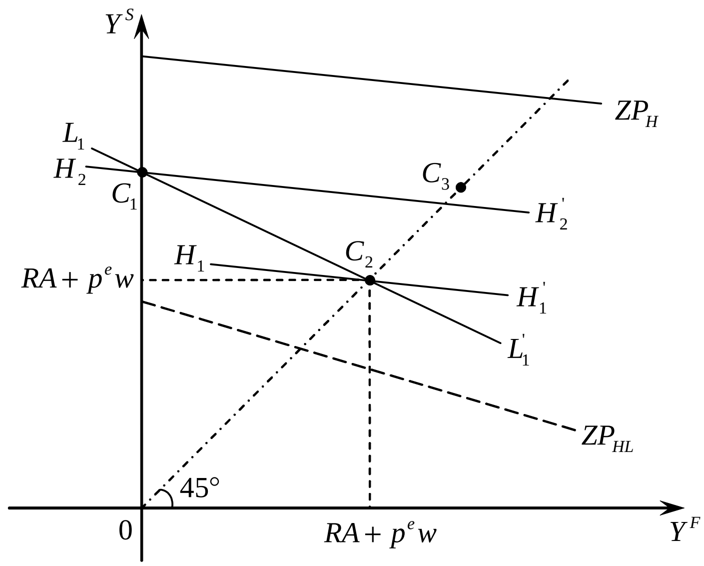

Figure 4: Positive Profits with a Restricted Strategy Space

agents just indifferent between the two occupations. By assumption, low-type agents choose the outside option, and therefore, stay out of entrepreneurship. At the end of the period, they receive RA from the bank and an expected wage of $p^e w$ from their employer. As far as the "loan contracts", which determine the *nonnegative* repayments to the banks at the end of the period, are concerned, (C_1, C_2) is an equilibrium in which banks make positive profits. However, the strategy space of banks is not limited with loan contracts only. A bank can undercut this contract by offering some amount of money to low-type agents in both states of the world in addition to the usual interest income it offers to the deposits. This would be a plausible deviation as long as the incentive compatibility condition for effort providing high-type agents is not violated (e.g., the deviation contract must be above $H_2 H_2'$). Such a contract is shown with (C_1, C_3) in Figure 4. There is always such a deviation contract in $[A_L, \tilde{A}]$ since ZP_H is always above and any contract on ZP_H makes zero profits with effort providing high-type agents.

Undercutting goes on until banks make zero profits with these contracts. Then, what would be the equilibrium? Start with (C_1, C_2) in Figure 5, and move the iso-profit line of low-type agents parallel to $L_1 L_1'$. There has to be a separating contract (C_H^{**}, C_L^{**}) in between $L_1 L_1'$ and ZP_H such that effort providing high-type agents strictly prefer C_H^{**}, and low-type and shirking high-type agents weakly prefer C_L^{**}. In such a situation, agents choose one of the contracts offered in the market with equal probabilities by Assumption 2. Banks make profits on C_H^{**} and losses on C_L^{**}. In the end, the equilibrium contract is the separating contract (C_H^{**}, C_L^{**}) that makes zero profits, but still requires cross-subsidization between the types.

The terms of contract C_H^{**} yields a payoff of some $y(A)$ dollars in the success state and nothing in the failure state. Meanwhile, contract C_L^{**} requires that agents deposit their money with the bank in consideration. At the end of the period, bank pays a regular RA

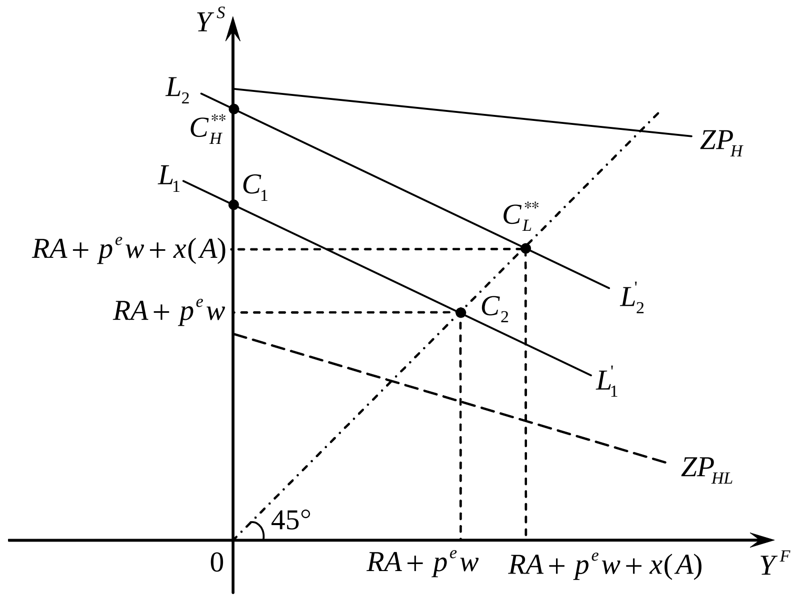

Figure 5: Cross-subsidizing Separating Contracts

plus an extra $x(A)$ dollars.[16] This is nothing but a higher interest payment to low-type and shirking high-type agents to prevent them applying to the loans designed for high-type agents who provide effort. Since low-type agents have to be indifferent between the two contracts

$$p_L y(A) = RA + p^e w + x(A) \quad . \tag{18}$$

Moreover, this contract has to yield zero expected profits to banks in Bertrand competition. Assume there are n such contracts offered in the market. Thus, the zero profit condition is given by

$$\frac{1}{n} h p_H(\pi(w) - y(A)) - \frac{1}{n}(1-h)x(A) = \frac{1}{n} hR(I-A) + \frac{1}{n}R(1-h)x(A) \quad . \tag{19}$$

All terms are multiplied by $1/n$ since agents choose one of the contracts with equal probabilities by Assumption 2. The first term on the left hand side of (19) is the total repayment of high-type agents in expected terms whereas the second term is the payment to low-type and shirking high-type agents to keep them out of loan market. $x(A)$ is indeed a pure informational rent that goes to low-type or shirking high-type agents and is financed by high-type agents who provide effort. The right hand side of the equation shows the cost of funds for banks. The first term is the cost of funds that are provided as loans to effort providing high-type agents and the second one is the cost of funds that are given to low-type agents as informational rents. Solving (18) and (19) for $x(A)$ and $y(A)$ yields the form of

[16] This scheme is similar to the bank promotions in which they promise to deposit $ 20 to the account of the individual if individuals open a savings account with them. Nonetheless, their motive for this is different.

the contracts for any wealth level between $[A_L, \tilde{A}]$:

$$\boldsymbol{C}^{**}(A) \equiv \begin{bmatrix} C_H^{**} \\ C_L^{**} \end{bmatrix} = \begin{bmatrix} D_H^S(A) & D_H^F(A) \\ D_L^S(A) & D_L^F(A) \end{bmatrix} = \begin{bmatrix} \frac{p_L\pi(w) - RA - p^e w - x(A)}{p_L} & 0 \\ -RA - x(A) & -RA - x(A) \end{bmatrix} \quad , \tag{20}$$

where

$$x(A) = \frac{h[p_H\pi(w) - \frac{p_H}{p_L}p^e w - RI - (\frac{p_H}{p_L} - 1)RA]}{(1-h)(1+R) + h\frac{p_H}{p_L}} \quad . \tag{21}$$

A Nash player would still deviate from $\boldsymbol{C}^{**}(A)$ simply by canceling C_L^{**}. Given all other banks are offering (C_H^{**}, C_L^{**}), all low-type and shirking high-type agents go to these banks, and the deviating bank would enjoy profits since only effort providing high-type agents apply it for loans. However, such a deviation would not occur with a Wilson player since they are nonmyopic rationals. A potential deviant knows that once other banks cancel C_L^{**}, it will incur losses. So, it would not deviate in the first place.[17] Wilson (1977) argues how this kind of expectations can arise in reality.

Unlike the conventional separating equilibria, here low-type or shirking high-type agents become workers but they are still cross-subsidized by effort providing high-type agents who actually become entrepreneurs. Moreover, unlike the pooling contracts of the previous subsection in which the cross-subsidization is within entrepreneurship, here the cross-subsidization is between the occupations. Literally, low-type and shirking high-type agents earn informational rents on their deposits. I shall record this result in the following proposition.

Proposition 1 (Occupational Cross-subsidies) *Low-type agents with wealth levels between $[A_L, \tilde{A}]$ gather informational rents even though they stay inactive in the loan market and become workers. This rent is financed by high-type agents who become entrepreneurs.*

Proof. The result directly follows from (20). ■

4.2.4 The First-best Efficient Separating Contracts

For wealth levels in $[\tilde{A}, I]$, agents are rich enough such that separation is possible even with a contract designed for all. The reason is that the rich low-type agents need to borrow less, and thus, they do not benefit from the cross-subsidies of the loans. Therefore, their outside option is attractive for them even with a first-best efficient contact offered in the market.

[17] Remember that this equilibrium can be supported as an PBE of a sequential game as explained in Section 4.1. If one does not buy this equilibrium concept, one is left with nonexistance. As an alternative solution to this nonexistance problem, I could impose a Nash equilibrium concept and restrict the strategy space to loan contracts only. Then, the rents are gathered by banks in the form of positive profits rather than by low-type and shirking high-type agents, and the equilibrium contract would be given by (C_1, C_2) in Figure 4. Whether I impose a Bertrand-Nash or a Bertrand-Wilson equilibrium concept, neither the nature of the model nor the main results of this paper does not change. There is still a fix pool of entrepreneurs and the problem is still how to increase the number of effort providing high-type agents in this pool.

Figure 6 illustrates the equilibrium contract in these wealth levels. As before, HH' shows the iso-profit line for high-type agents, LL' is that for low-type and shirking high-type agents, and ZP_H is the zero profit line for banks with high-type agents. In a similar fashion to cross-subsidizing pooling contracts, it can be shown that any contract such as C_1 cannot be an equilibrium since there always exist a deviation contract (such as C_2) at the north-west of it which is preferred only by effort providing high-type agents. This time, however, any contract in between $[C^{***}, C_3]$ is an equilibrium since they are not preferred by low-type and shirking high-type agents, and they make zero profits with high-type agents. That means there is a continuum of equilibria. Then, the problem is now determining which one is a reasonable one to focus on.

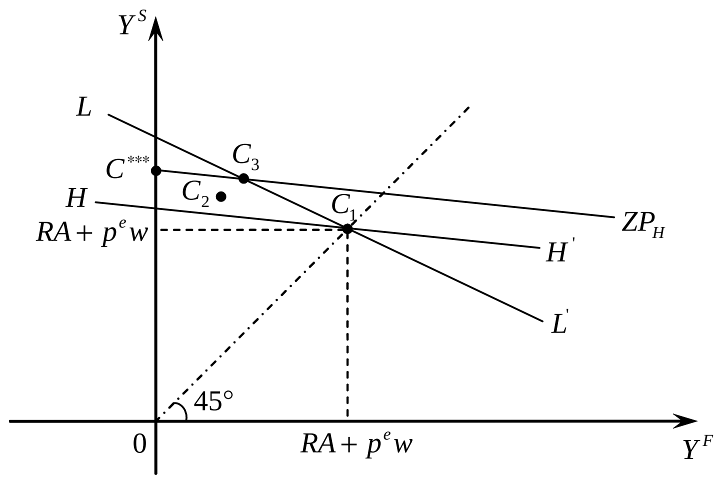

Figure 6: The First-best Efficient Separating Contracts

It turns out that, for my purpose, it does not make any difference on which equilibria I focus since in all of them neither who becomes an entrepreneur nor do the expected payment of the loan applicants changes. The only difference between different equilibria is the payment scheme in both states of the world. Nonetheless, even a small degree of risk aversion would imply C^{***} as the unique equilibrium. Thus, I can restrict my attention to C^{***} as an equilibrium contract for wealth levels between $[\tilde{A}, I]$. In that case, the equilibrium contract takes the following form.

$$\boldsymbol{C}^{***}(A) \equiv \begin{bmatrix} C_H^{***} \\ C_L^{***} \end{bmatrix} = \begin{bmatrix} D_H^S(A) & D_H^F(A) \\ D_L^S(A) & D_L^F(A) \end{bmatrix} = \begin{bmatrix} \frac{R(I-A)}{p_H} & 0 \\ \frac{R(I-A)}{p_H} & 0 \end{bmatrix} \quad . \tag{22}$$

Note that $\boldsymbol{C}^{***}(A)$ is efficient because it can separate effort providing high-type agents from other agents. Moreover, the price of the loan is such that there is no cross-subsidies.

4.2.5 No-effort Pooling Contracts

The discussions of the equilibrium contracts above neglects the point that there can be wealth levels in which high-type agents do not provide effort in entrepreneurship. They are no different than low-type agents when they do not provide effort. For such wealth levels there is no adverse selection problem since banks can infer the success probability of any applicant, which is p_L for all agents, with certainty. I discuss the effort decision in detail when I analyze the decisions of agents. However, it worths mentioning that, in such situations, banks would offer the pooling contract that is consistent with the risk level of the pool:

$$\boldsymbol{C}^{****}(A) \equiv \begin{bmatrix} C_H^{****} \\ C_L^{****} \end{bmatrix} = \begin{bmatrix} D_H^S(A) & D_H^F(A) \\ D_L^S(A) & D_L^F(A) \end{bmatrix} = \begin{bmatrix} \frac{R(I-A)}{p_L} & 0 \\ \frac{R(I-A)}{p_L} & 0 \end{bmatrix} \quad , \tag{23}$$

and make zero profits.

4.2.6 Contract Offers

I record some of the results found above in the following proposition and lemma.

Proposition 2 (Contracts) *Assuming that high-type agents provide effort in entrepreneurship, banks offer the cross-subsidizing pooling contract $\boldsymbol{C}^{*}(A)$ to agents with wealth levels between $[0, A_L]$, cross-subsidizing separating contracts $\boldsymbol{C}^{**}(A)$ to agents with wealth levels between $[A_L, \tilde{A}]$, the first-best efficient separating contracts $\boldsymbol{C}^{***}(A)$ to agents with wealth levels between $[\tilde{A}, I]$. When high-type agents do not provide effort, banks offer the pooling contract $\boldsymbol{C}^{****}(A)$.*

Proof. See subsections 4.2.2, 4.2.3, 4.2.4, and 4.2.5. ■

Above analysis highlights another important finding. When the strategy space of banks is large enough they can always find a set of deviation contracts such that positive profits are competed away. Positive profits arise only when the strategy space is restricted. For example, restricting the strategy space to loan contracts in which banks cannot give out money to the agents at the end of the period would result in positive profits. Given that agents produce nothing in the failure state and banks cannot give out money, the rents given to the low-type and shirking high-type agents and some portion of the end-of-period payoff of effort providing high-type agents are emitted by banks in the form of positive profits. This possibility is shown in Figure 4. Other than the cases in which there are such restrictions on the strategy space, there is always zero profits in this and similar games.

Lemma 1 (Banking Profits) *When banks' strategy space is large enough, they make zero profits from every set of contract they offer.*

Proof. See subsections 4.2.2, 4.2.3, 4.2.4, and 4.2.5. ■

4.3 The Agents' Problem

Having analyzed various kinds of contract offers by banks and derived the lending interest rates, I now focus on the decisions of agents. I assume that if agents had enough wealth to self-finance their firms it would be profitable for high-type agents who provide effort, but not for low-type or shirking high-type agents. This also means that the economic activity of low-type or shirking high-type agents are socially inefficient. However, they may still want to become entrepreneurs to make use of cross-subsidization in the loan marker induced by pooling contracts. The assumption below formalizes these statements by determining the net present value (NPV) of the projects.

Assumption 3 (NPV of Projects) $p_H\pi(w)-e > p^e w+RI > p_L\pi(w) > p^e w+(p_L/\bar{p})RI.$

Note that Assumption 3 asserts that the cost of effort is low enough for an effort providing high-type agent such that providing effort is profitable (e.g., $(p_H - p_L)\pi(w) > e$). I also make the assumption that cost of effort is not too low.

Assumption 4 (Cost of Effort) $e > (p_H - p_L)w.$

Reorganizing this assumption gives $p_L w > p_H w - e$. From an *ex ante* point of view, this means that the opportunity cost of an entrepreneur forgone by not hiring himself as a worker in his firm is higher when he shirks than when he provides effort.

Before solving the agents' problem, I shall note that there has to be maximum self-finance in equilibrium. The reason is that low-type and shirking high-type agents can become entrepreneurs only with contracts that require cross-subsidization. If all types have incentive to apply for loans, high-type agents who provide effort have to cross-subsidize the other loan applicants. As indicated in de Meza and Webb (1987), in such a case, they would prefer to self-finance themselves as much as possible since self-financing has better terms than any cross-subsidizing contract offered by banks. This, in turn, implies that if there are agents who are not using all of their wealth in their firms, they must be either low-type or shirking high-type agents. However, this is inconsistent with the equilibrium in the sense that banks would not offer the same pooling contract to them but a different one that discourages them from applying for loans. This means that all agents use their wealth in their firms. This also guarantees simultaneously borrowing and lending makes no difference.

To start, consider the agents' problem given that pooling contracts that make zero profits are offered by banks. For a given R and w, high-type agents would like to become entrepreneurs if

$$p_H(\pi(w) - \frac{R}{\bar{p}}(I - A)) - e > p^e w + RA \quad , \tag{24}$$

and they provide effort in entrepreneurship if

$$p_H(\pi(w) - \frac{R}{\bar{p}}(I - A)) - e > p_L(\pi(w) - \frac{R}{\bar{p}}(I - A)) \quad . \tag{25}$$

Low-type agents would like to become entrepreneurs if[18]

$$p_L(\pi(w) - \frac{R}{\bar{p}}(I - A)) > p^e w + RA \quad . \tag{26}$$

Solving (24) and (25) for A reveals that high-type agents prefer becoming entrepreneurs if their wealth is *higher* than a threshold wealth level A_H, which is defined by

$$A_H := \frac{p^e w - p_H(\pi(w) - \frac{R}{\bar{p}} I) + e}{R(\frac{p_H}{\bar{p}} - 1)} \quad , \tag{27}$$

and they provide effort if their wealth is *higher* than a threshold wealth level A_e, which is defined by

$$A_e := I - \frac{\pi(w) - \frac{e}{p_H - p_L}}{\frac{R}{\bar{p}}} \quad . \tag{28}$$

In a similar fashion, solving (26) for A reveals that low-type agents prefer to become entrepreneurs if their wealth is *lower* than a threshold wealth level A_L, which is defined by

$$A_L := \frac{p_L(\pi(w) - \frac{R}{\bar{p}} I) - p^e w}{R(1 - \frac{p_L}{\bar{p}})} \quad . \tag{29}$$

This means that low-type agents prefer becoming entrepreneurs only if a significant portion of their firms is financed by the bank. Alternatively, they prefer applying for loans only when they can enjoy large enough cross-subsidies. The situation is different for high-type agents. They prefer self-financing their projects as much as possible since they have to cross-subsidize low-types for every penny they borrow. Hence, high type agents prefer becoming entrepreneurs only if they can self-finance sufficiently large portion of their project.

It can be shown that $A_L > 0$ by Assumption 3. In this paper, I neglect some uninteresting cases by assuming that $A_e > 0$ and that $A_L > A_e$. The first one rules out the case in which all high-type agents provide effort when they become entrepreneurs, and the second one rules out the case in which there is no adverse selection problem.[19] Note that $A_L > A_e$ implies $A_H < A_e$ which in turn implies that, in principle, there can be high-type agents who would not provide effort had they become entrepreneurs. However, later I show that

[18] Note that the expected payoff of high-type agents who provide effort dominates the expected payoff of low-type or shirking high-type agents in the FOSD sense (see de Meza and Webb (1987) with a continuum of types). With this assumption the projects can be classified with respect to their expected payoffs. An alternative assumption is to assume mean preserving spreads, as is done in Stiglitz and Weiss (1981). In that case, projects can be ranked in the SOSD sense. In other words, the projects with the same expected payoffs can have different riskiness. It has been argued that FOSD and SOSD are the fundamental reasons for excessive or insufficient lending, respectively. However, these differences arise only in the partial equilibrium in which loans are supplied to banks with an infinite elasticity. Even if I had imposed SOSD, the aggregate level of investment would still be the same and there would still be a fixed pool of entrepreneurs in the case in which the risk-free interest rate is endogenous. Moreover, I would still get the result that a tax on entrepreneurs may be desirable for some economies. In that sense, my results are not imposed by the assumption of FOSD of the projects.

[19] The analysis of these cases is trivial and left to the reader.

there cannot be any shirking high-type entrepreneurs in equilibrium.

4.4 Limit Pricing to Lending

In the previous sections, I derive the contracts offered by banks and analyzed the decisions of agents given these contracts. This section recasts contracts in terms of lending interest rates. This provides an overview of the loan market and allows me to summarize all loan contracts in one figure. I begin with showing that the optimal way of financing is debt in this model.

Lemma 2 (Form of Lending Contracts) *Whenever agents borrow money from banks, it takes the simple debt form. Moreover, debt is the optimal way of financing in this model.*

Proof. The first part of the lemma directly follows from Proposition 2. For the second part, the intuitive proof follows from the fact that low-type agents have more probability weight on the failure state outcome than high-type agents. Then, they always prefer equity-form contracts. Having known this, it is not optimal for banks to offer neither equity-form nor a mixture of equity- and debt-form contracts. Hence, debt is the optimal way of financing in this model. Technically, the expected payoffs of agents can be ranked in the FOSD sense, and for a two-point payoff distribution, FOSD always implies the monotone likelihood ratio property. It is shown by Innes (1993), in this case, with limited liability and risk neutrality the optimal way of financing has to take the debt form. ■

By Proposition 2, there can be four (potential) different loan applicant pools depending on the wealth level. First, there are wealth levels in which all types of agents apply for loans. In that case, the risk of the loan applicant pool is $\bar{p}$. The lending interest rate implied by the terms of this pooling contract can be derived from (17) and is simply $R/\bar{p}$. Second, banks offer a loan contract that makes low-type and shirking high-type agents just indifferent between the two occupations to agents with wealth levels between $[A_L, \tilde{A}]$. Let $\tilde{R}_L(A)$ be such a lending interest rate. A low-type or a shirking high-type agent is indifferent between the two occupations if

$$\Upsilon_L^E(A) = \Upsilon_L^W(A) \quad . \tag{30}$$

By making use of (20) and (30), $\tilde{R}_L(A)$ can be written as

$$\tilde{R}_L(A) = \frac{p_L \pi(w) - p^e w - RA - x(A)}{p_L(I - A)} \quad \forall A \in [A_L, \tilde{A}] \quad , \tag{31}$$

where $\frac{\partial \tilde{R}_L(A)}{\partial A} < 0$ and $\lim_{A \to I} \tilde{R}_L(A) = -\infty$. Third, there are wealth levels in which only high-type agents who provide effort have incentive to apply for loans. The risk of the applicant pool is thus p_H, and (22) shows that the lending interest rate implied by the equilibrium contract is R/p_H. Finally, whenever high-type agents do not provide effort, the equilibrium contract is given by (23) and the corresponding lending interest rate is R/p_L. Next proposition formally proves this by incorporating the threshold wealth levels.

Proposition 3 (Lending Interest Rates) *Banks offer a lending interest rate of* R/p_L *in* $[0, A_e]$*,* $R/\bar{p}$ *in* $[A_e, A_L]$*,* $\tilde{R}_L(A)$ *in* $[A_L, \tilde{A}]$*, and* R/p_H *in* $[\tilde{A}, I]$ *where* $\tilde{A}$ *is*

$$\tilde{A} := \frac{p_L(\pi(w) - \frac{R}{p_H}I) - p^e w}{R(1 - \frac{p_L}{p_H})} > 0 \quad . \tag{32}$$

Proof. Focus on Figure 7 and Figure 8. For wealth levels in $[0, A_e]$, if banks offer a lending interest rate of $R/\bar{p}$, low-type agents prefer becoming entrepreneurs and high-type agents do not provide effort. Thus, the average risk of the applicant pool in $[0, A_e]$ is indeed p_L, and thus, banks set a lending interest rate of R/p_L. Any interest rate below R/p_L would make losses and any interest rate above is undercut by Bertrand competition. When banks sets R/p_L, both low-type and high-type agents with these wealth levels prefer being workers. Remember from section 4.2 that a pooling contract is offered in $[0, A_e]$ but none of the agents accepts it.

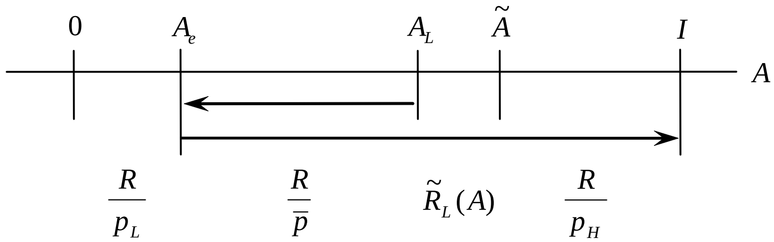

Figure 7: Threshold Wealth Levels

Consider now the wealth levels between $[A_e, A_L]$. I have already shown that both high-type and low agents prefer becoming entrepreneurs and high-type agents with these wealth levels provide effort. The risk of the applicant pool is thus $\bar{p}$, and banks may offer a lending interest rate of $R/\bar{p}$. Any interest rate lower than $R/\bar{p}$ is loss-making for banks, and any interest rate above $R/\bar{p}$ is undercut by the Bertrand competition. Here, contracts are pooling and both types of agents apply for loans.

For wealth levels in $[A_L, I]$, only high-type agents prefer becoming entrepreneurs and one might be tempted to think that banks should offer the lending interest rate R/p_H. However, with that interest rate, the participation constraint is violated for some low-type agents whose wealth is slightly more than A_L. That is, they no longer prefer wage-earning to entrepreneurship. Formally, with a lending interest rate of $R/\bar{p}$ the participation constraint of low-type agents with wealth exactly equal to A_L is binding:

$$p_L(\pi(w) - \frac{R}{\bar{p}}(I - A_L)) = p^e w + RA_L \quad . \tag{33}$$

Now focus on the participation constraint of agents with wealth $A_L + \varepsilon$? Given the lending interest rate offered by banks is R/p_H, I get

$$\begin{aligned} p_L(\pi(w) - \frac{R}{p_H}(I - A_L - \varepsilon)) &\approx p_L(\pi(w) - \frac{R}{p_H}(I - A_L) \\ &> p_L(\pi(w) - \frac{R}{\bar{p}}(I - A_L)) \\ &= p^e w + RA_L \\ &\approx p^e w + R(A_L + \varepsilon) \quad . \end{aligned}$$

This means

$$p_L(\pi(w) - \frac{R}{p_H}(I - A_L - \varepsilon)) > p^e w + R(A_L + \varepsilon) \quad , \tag{34}$$

and therefore, the participation constraint is violated for low-type agents within the band $[A_L, \tilde{A}]$, where $\tilde{A}$ is defined by[20]

$$p_L(\pi(w) - \frac{R}{p_H}(I - \tilde{A})) = p^e w + R\tilde{A} \quad . \tag{35}$$

The bank cannot offer a lending interest rate of R/p_H to the agents within this band. Otherwise, low-type agents would be attracted by the contract in addition to high-type agents.

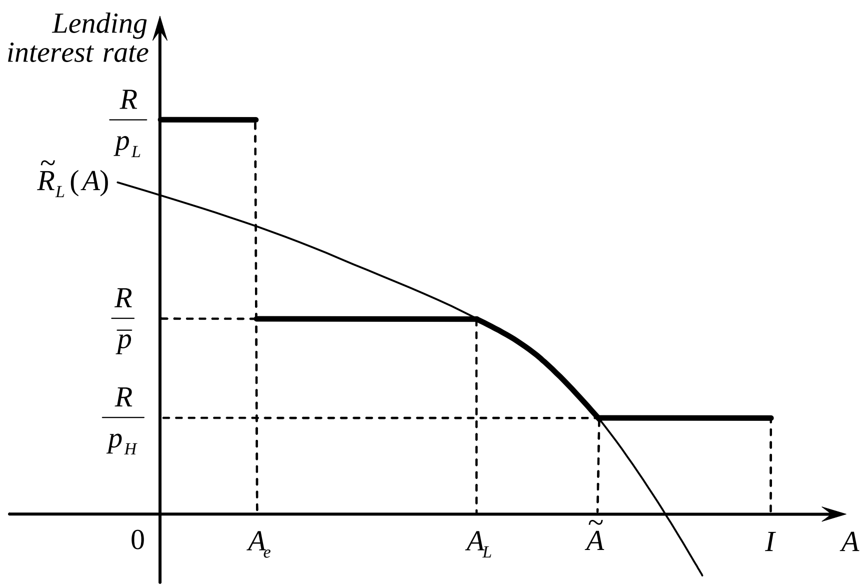

Figure 8: Lending Interest Rates

Then, what is the lending interest rate in $[A_L, \tilde{A}]$? Assume for the moment that the banks offer $\tilde{R}_L(A)$ in those wealth levels, and thus, makes low-type agents just indifferent between

[20]Note that Assumption 3 guarantees that $\tilde{A} < I$. Combining this with $0 < A_L < \tilde{A}$ yields $0 < A_L < \tilde{A} < I$.

the two occupations. Given this contract, I now check if there is any deviation contract in any wealth level between $[A_L, \tilde{A}]$. By Assumption 1 low-type agents choose to become workers when they are indifferent between the two occupations. Start with the case in which all banks offer the lending interest $\tilde{R}_L(A)$ and one bank deviates by offering an interest rate just below it. That deviation contract would attract both high- and low-type agents. When both types with these wealth levels apply for loans, nonnegative profits are possible only with an interest rate higher than or equal to $R/\bar{p}$. Therefore, any interest rate below $\tilde{R}_L(A)$ is loss making. Given the interest rate offered by the other banks is $\tilde{R}_L(A)$, none of the banks would like to deviate by offering a higher interest rate since none of the agents would be attracted by that contract. Then, banks offer $\tilde{R}_L(A)$ in $[A_L, \tilde{A}]$. Remember from section 4.2 that contracts offered to these wealth levels are separating, and thus, only high-type agents apply for loans.

Finally, focus on the wealth levels between $[\tilde{A}, I]$. Any loan applicant with these wealth levels must be a high-type agent since none of the low-type agents prefer becoming entrepreneurs in these wealth classes. The equilibrium lending interest rate is then R/p_H. Any interest rate below R/p_H is loss making, and any interest rate above is undercut by Bertrand competition. Here, contracts are separating and only high-type agents apply for loans.

The resulting lending interest rate scheme is shown in Figure 8. Since there is no possible deviation, if there exists an equilibrium, it must be characterized by the interest rate scheme shown in this figure. ■

Note that the lending interest rate is a mark-up on the cost of loanable funds. For wealth levels between $[0, A_L]$ and $[\tilde{A}, I]$, the mark-up is constant and directly associated with the risk of the pool of loan applicants. It is still associated with the risk of the pool in $[A_L, \tilde{A}]$, but it also depends on wealth levels. It also worths mentioning that in $[A_L, \tilde{A}]$ banks follow a limit pricing strategy of the loans by making low-type agents just indifferent between the two occupations. Nonetheless, as is discussed before, these contracts banks give information rents to low-type agents just to keep them inactive in the loan market.

Previous literature largely assumes that everyone has the same level of wealth, and hence, implicitly restricts the attention to certain wealth levels (e.g., $A \in [A_e, A_L]$). Then, banks offer only $C^*(A)$ with an implied lending interest rate of $R/\bar{p}$. As I have already shown, in this setting wealth can act as a perfect signal of type for some wealth levels. Therefore, banks would not straightforwardly choose $R/\bar{p}$ for every contract they offer for every wealth level. They know that low-type agents with certain wealth levels never want to become entrepreneurs; in some others, neither low-type agents choose entrepreneurship nor high-type agents provide effort had they become entrepreneurs.

4.5 Decisions of Agents

The results emerge from the above analysis regarding the decisions of agents are summarized in two propositions: one regarding the occupational decisions and the other regarding the effort decision of high-type entrepreneurs.

Proposition 4 (Occupational Decisions) *All agents in* $[0, A_e]$ *prefer becoming workers. All agents in* $[A_e, A_L]$ *prefer becoming entrepreneurs. High-type agents in* $[A_L, I]$ *prefer becoming entrepreneurs and their low-type counterparts prefer becoming workers.*

Proof. See subsections 4.2.2, 4.2.3, 4.2.4, 4.2.5 and 4.3. ■

Given the contracts and factor prices in the market, any high-type agent who prefers becoming an entrepreneur provides effort in entrepreneurship and any high-type agent who does not provide effort cannot become an entrepreneur. Figure 8 illustrates that in $[0, A_e]$, high-type agents do not become entrepreneurs either because they do not want to or because they do not provide effort. However, both of these are induced by the low wealth endowments of these agents in this range. Had they become entrepreneurs, they have to cross-subsidize low-type agents which they cannot afford at the same time that they provide effort. Hence, they don't provide effort and cannot become an entrepreneur. Nonetheless, with a lower risk-free interest rate, they would be willing to provide effort in entrepreneurship and this would enable banks to offer loans to them. This intuition forms the base of the policy I propose in section 6.

Proposition 5 (Effort Decision) *High-type entrepreneurs provide effort in equilibrium.*

Proof. See subsections 4.2.2, 4.2.3, 4.2.4, 4.2.5 and 4.3. ■

This result does not simply follow from the assumption on the position of the threshold wealth level A_e. Wherever A_e lays, the average risk of the pool of the applicants under this threshold is p_L. Then, banks offer a lending interest rate of R/p_L which effectively discourages shirking high-type agents from entrepreneurship under Assumption 3. From now on, I do not need to identify between a high-type entrepreneur and a high-type entrepreneur who provides effort.

4.6 Endogenous Wealth Classes

The contractual structure in the lending market endogenously forms four different wealth classes in the economy: the poor, the lower-middle, the upper-middle and the rich class.

The poor class agents are the ones whose wealth levels are in between $[0, A_e]$. They are all isolated from the loan market due to the facts that only pooling contracts can be offered and high-type agents do not provide effort in entrepreneurship in this wealth class. Once they do not provide effort, their success probability in entrepreneurship is the same with the success probability of low-type agents. This makes banks to offer an interest rate of R/p_L to the poor class. It is sufficient to discourage all poor agents from applying loans, and becoming entrepreneurs. So, the source of the market failure in the poor class is the downward distortion in the occupational decisions. That is, high-type agents do not become entrepreneurs due to wealth constraints.

I call the wealth class $[A_e, A_L]$ as the lower-middle class. As in the poor class, banks are able to offer only pooling contracts in this wealth class. However, now the source of the market failure is the upward distortion in the occupational decisions. The fact that high-type agents cannot be separated from the low-type agents results in a situation where low-type agents are attracted to the bank loans. Consequently, both type of agents become entrepreneurs in the lower-middle wealth class, and high-type members of this wealth class cross-subsidizes the low-type members. However, note that the cross-subsidies are within entrepreneurship.

The wealth class in $[A_L, \tilde{A}]$ is called the upper-middle class. In this class, banks are able to offer separating contracts. As a result, low-type agents become workers and high-type agents become entrepreneurs. As I have shown before, high-type agents still need to cross-subsidize low-type agents in the loan market. However, this time the cross-subsidies are between the occupations.

Finally, I call the wealth class in $[\tilde{A}, I]$ as the rich class. They need to borrow less to be able to become entrepreneurs. This means that the low-type agents do not benefit the cross-subsidies in the same extent that some other low-type agents with lower wealth levels. They are not attracted to the bank loans even when banks offer an efficient contract with an interest rate of R/p_H. Then, they all become workers whereas their high-type counterparts become entrepreneurs. This contract does not entail any cross-subsidies among loan applicants.

An important point to note is that none of the entrepreneurs have incentives to destroy their wealth to be able to get a loan in a poorer wealth class. This can simply be understood from the derivation of equilibrium contracts in section 4.2 which shows that equilibrium contracts for higher wealth levels are associated with higher iso-profit lines for entrepreneurs.

4.7 Entrepreneurship and Economic Development

It is known as a stylized fact that entrepreneurship is better in developed countries than in developing countries. This section provides one explanation for this. Figure 8 reflects that adverse selection hits the economy at relatively lower wealth levels: in the poor class (i.e., $A \in [A_e, A_L]$) and the lower-middle class (i.e., $A \in [A_e, A_L]$). The cross-subsidies do not change with the wealth level in these wealth classes. In the upper middle-class (i.e., $A \in [A_L, \tilde{A}]$), there are transfers between occupations in the form of efficient information rents. However, there is no adverse selection problem in this class since these transfers do not distort the occupational decisions. Moreover, cross-subsidies decrease with the wealth level and ultimately becomes zero at $\tilde{A}$. Finally, there is no problem in both occupational decisions and the pricing of the loans in the rich class (i.e., $A \in [\tilde{A}, I]$).

These contractual differences between wealth classes provide some insights about the phases of development in economies. It is well-evidenced that there are more people in the poor and the lower-middle classes in a developing country than in a developed country. This means that adverse selection is more of an issue for a developing country than for a developed country. As agents start accumulating wealth, more and more of them are expected to move from the poor and the lower-middle classes to upper-middle class. Thus, in the development process of an economy, the problems in the entrepreneurial sectors erected by adverse selection become less and less severe since some of them turns into transfers between occupations in the form of efficient information rents. This is at least one reason why entrepreneurial sectors of the developed countries are better.

The thresholds A_e, A_L, and $\tilde{A}$ are presumably different in different countries. However, the intuition still applies. What matters in general is whether there are relatively more people in the poor and the lower-middle classes in which adverse selection distorts occupational decisions. In this model, it happens in relatively lower wealth classes, but this seems realistic, too. The poor and lower-middle classes are usually the major population in developing countries. This, in turn, implies that adverse selection is more of a problem in these countries than the rich ones. In such situations, implementing the labor market policies I propose in this paper becomes more compelling. In contrast, there are relatively fewer people in the lower parts of the income distribution in rich countries which makes adverse selection problems relatively less important. This result is consistent with the GEM's public policy prescription that poor countries should focus on improving the general business environment before focusing exclusively on entrepreneurs. In particular, the GEM suggests that the family income should be increased. Subsection 5.2.1 discusses some other stylized facts.

5 GENERAL EQUILIBRIUM

The analysis so far has focused on the partial equilibrium in which the wage and the risk-free interest rates are given. This section carries the analysis to a general equilibrium by endogenizing the wage and the risk-free interest rates. The purpose of the general equilibrium analysis is two fold. First, it shows that there are economies in which assumptions of the previous sections are satisfied. Second, for the various reasons explained before, this paper does the public policy analysis when the labor and credit markets are interrelated.

In this section, I modify the equilibrium definition slightly to allow for market clearing conditions. Let E be the number of entrepreneurs in the economy. Denoting the equilibrium values of variables with superstars, the equilibrium is defined as follows.

Definition 2 (Equilibrium Concept) *Assume that banks are nonmyopic Bertrand-Wilson players following pure strategies. An equilibrium is a quadruple* $\mathbf{\Delta} = (R^*, w^*, p^{e*}, E^*)$ *such that banks earn nonnegative profits in every wealth level. There is no new set of contracts that could earn higher profits even after the elimination of all unprofitable set of contracts. In an equilibrium, both credit and labor markets clear.*

5.1 Equilibrium Conditions

As indicated in Definition 2, an equilibrium is characterized by the quadruple $\mathbf{\Delta}$. It still needs to be incentive compatible, individually rational, and it is still the case that proper participation constraints must still hold in an equilibrium. I have already imposed them in partial equilibrium. Below I analyze the remaining equilibrium conditions to solve for the quadruple $\mathbf{\Delta}$ under Assumption 3.

5.1.1 The Number of Entrepreneurs

By Proposition 4, the number of high-type entrepreneurs, E_H, and the number of low-type entrepreneurs in the economy, E_L, are given by

$$E_H(R,w) = h \int_{A_e(R,w)}^{I} dG(A) \tag{36a}$$

$$E_L(R,w,p^e) = (1-h) \int_{A_e(R,w)}^{A_L(R,w,p^e)} dG(A) \quad , \tag{36b}$$

respectively. The total number of entrepreneurs in the economy, E, is then given by

$$E(R,w,p^e) = E_H(R,w) + E_L(R,w,p^e) \tag{37}$$

or

$$E(R,w,p^e) = h \int_{A_e(R,w)}^{I} dG(A) + (1-h) \int_{A_e(R,w)}^{A_L(R,w,p^e)} dG(A) \tag{38}$$

in the long form.

5.1.2 The Average Success Probability

The weighted average of the success probabilities of all entrepreneurs in the economy, p^e, is given by

$$p^e = \frac{p_H E_H(R,w) + p_L E_L(R,w,p^e)}{E(R,w,p^e)} \quad . \tag{39}$$

5.1.3 The Credit Market Clearing Condition

Workers are the source of the loanable funds in the economy. Their supply of credit, B^S, is given by

$$B^S(R,w,p^e) = \int_{0}^{A_e(R,w)} A dG(A) + (1-h) \int_{\tilde{A}(R,w,p^e)}^{I} A dG(A) \quad . \tag{40}$$

Entrepreneurs are the ones who demand for loans. Their demand for credit, B^D, is given by

$$B^D(R,w,p^e) = h \int_{A_e(R,w)}^{I} (I-A) dG(A) + (1-h) \int_{A_e(R,w)}^{A_L(R,w,p^e)} (I-A) dG(A) \quad . \tag{41}$$

Credit market clears when $B^S = B^D$. This boils down to the following simple form:

$$E = \frac{\bar{A}}{I} \quad . \tag{42}$$

This means that the number of entrepreneurs in the economy is the aggregate wealth available in the economy divided by the project size, and thus, is fixed. As the number of entrepreneurs, E, is fixed, the number of workers, $1 - E$, is also fixed. Any policy provided in this model cannot change these numbers which allows me to focus exclusively on the quality of entrepreneurs. That is, what matters in this model is not the size of the set E, but its composition ($E_H + E_L$). It worths mentioning here that Gale (1991) finds that credit subsidies appear to have important effects on the allocation of credit but do not change the aggregate economic activity. This is consistent with the credit market clearing condition here. Moreover, Raynold (1995) shows that credit subsidies do not have a positive effect on the output. Thus, the success taxes may be needed instead of credit subsidies.

Notice that the fixed number of entrepreneurs and workers does not mean that the credit supply to the banking system is fixed. It can change as a result of a change in the composition of the entrepreneurs in the economy. For example, if you swap a low-type rich entrepreneur with a high-type poor worker, the supply of loans to banks increases even though the number of entrepreneurs is still the same. As I show later, the policy can change who owns the funds and who supplies them in a way to increase the loan supply to banks. This, in turn, decreases the risk-free and the lending interest rates. Then, it is sufficient to show that this can improve the self-selection in the economy. Often times this requires extreme policies (such as complete redistribution) whereas I show in this paper that a small tax and subsidy policy can improve the economy extensively by changing the occupational choice decisions of agents in different wealth classes.

5.1.4 The Labor Market Clearing Condition

The labor demand by each entrepreneur is

$$l = l(w) := f'^{-1}(w) \quad . \tag{43}$$

Aggregate supply of labor by workers, L^S, is given by

$$L^S(R, w, p^e) = \int_0^{A_e(R,w)} dG(A) + (1-h) \int_{\tilde{A}(R,w,p^e)}^{I} dG(A) \quad , \tag{44}$$

and aggregate demand for labor by entrepreneurs, L^D, is given by

$$L^D(R, w, p^e) = \left[h \int_{A_e(R,w)}^{I} dG(A) + (1-h) \int_{A_e(R,w)}^{A_L(R,w,p^e)} dG(A) \right] l(w) \quad . \tag{45}$$

Labor market clears when $L^S = L^D$. This boils down to

$$E(w) = \frac{1}{1+l(w)} \quad . \tag{46}$$

5.2 Equilibrium

Eqs. (38), (39), (42), and (46) form a system of four equations in four unknowns, namely R, w, p^e, and E. Moreover, this system has a separable structure. First, eqs. (42) and (46) form a module from which E^* and w^* can be found. Then, after substituting for E^* and w^*, eqs. (38) and (39) gives R^* and p^{e*}.

5.2.1 The Number of Entrepreneurs and the Wage Rate

One point of concern is whether there is a unique equilibrium in the $w - E$ module of separable system of equations. Next proposition rules out the possibility of a multiple equilibria under the plausible assumptions of subsection 3.5.1 on the production function.

Proposition 6 (Uniqueness – w) *Assume the production function is strictly concave and satisfies Inada conditions. Then, there exists a unique wage rate of w^*.*

Proof. It has to be true that $f^{'}(l) - w = 0$. Then, by implicit differentiation

$$\frac{\partial l(w)}{\partial w} = -\frac{\frac{\partial(f'(l)-w)}{\partial w}}{\frac{\partial(f'(l)-w)}{\partial l}} = \frac{1}{f''(l)} > 0 \text{ since } f''(l) < 0 \text{ by strict concavity.}$$

One of the Inada conditions asserts that $\lim_{l\to\infty} f'(l) = 0$. This condition implies $\lim_{w\to 0} l(w) = \infty$. On the other hand, (46) yields

$$\frac{\partial E(w)}{\partial w} = -\frac{\frac{\partial l(w)}{\partial w}}{(1+l(w))^2} \quad .$$

Since $\partial l(w)/\partial w < 0$, $E(w)$ is an increasing function, and $\lim_{w\to 0} l(w) = \infty$ implies $E(0) = 0$. Then, (42) has to cut (46) once and only once. Figure 9 shows the uniqueness of equilibrium graphically. ■

As shown in Figure 9, when there is an increase in the aggregate wealth available in the economy, E^* is going to increase, but this results in an increase in the wage rate, too. This implies that higher wages are associated with developed countries and lower wages are associated with developing countries, which is consistent with the stylized facts listed in Lloyd-Ellis and Bernhardt (2000). An objection to this reasoning could be that the average project size indifferent countries could be different. It is certainly true, but still the same intuition applies due to the fact that everything is scale invariant in terms of

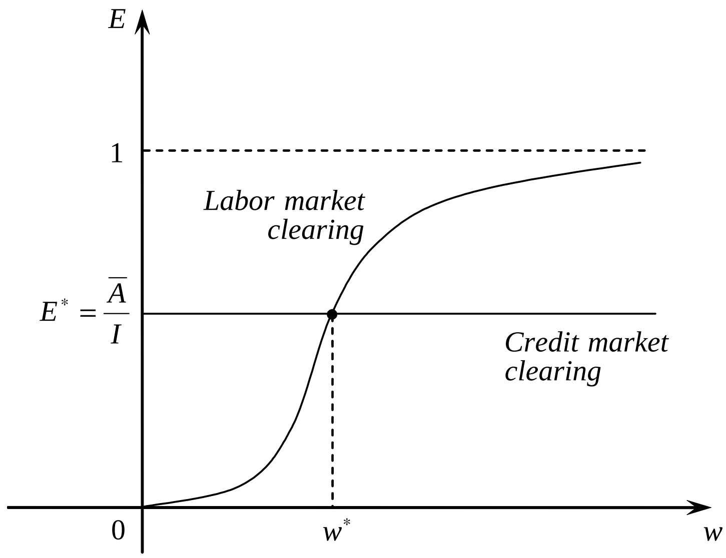

Figure 9: The Number of Entrepreneurs and the Wage Rate

investment in this model. Therefore, all results can be interpreted per unit of investment. This requires scaling the wealth distribution to take into account that, which can be done without affecting the results. Then, I can write the production function in the intensive form as is done for any neoclassical constant returns to scale production function. The only difference is, this time, everything is written per unit of investment rather than per unit of effective labor. Then, $f(l)$ is indeed in the intensive form, and there is no loss of generality in interpreting $\bar{A}/I$ in Figure 9 as aggregate wealth per unit of investment rather than aggregate wealth divided by fixed project size.

Figure 9 depicts another important relation between the number of entrepreneurs and the wage rate. Any increase in the number of entrepreneurs must be associated with a wage increase.[21] If you look at the situation from the other side of the coin, an increase in the number of entrepreneurs cannot be done without increasing the wage levels. This is consistent with the policy prescription of the GEM that underlines the fact that, to improve the entrepreneurial sectors, developing countries (almost all of which have lower wage levels) should design policies to have family incomes to grow.

5.2.2 Possible Equilibria in the General Equilibrium

Assumption 3 asserts that the NPV of the projects of high-type agents is positive, and that of low-type agents is negative in equilibrium. Thus, low-type agents have socially inefficient projects but they may still apply for loans due to cross-subsidizing contracts.

[21] By looking at the curve in Figure 9, one should not make the conclusion that the number of workers is inversely related to the wage rate in the economy. This curve is neither the labor supply nor the labor demand curve. It is just an equilibrium condition derived in (46) that takes into account both labor supply and labor demand.

The analysis here tries to find ways of improving average success probability of the pool of entrepreneurs and welfare in such situations. The first point of concern is if there is any equilibrium satisfying the assumptions imposed in partial equilibrium. The following lemma shows that, for every given wage rate, there exists a subspace in which my assumptions are satisfied and it is not measure zero.

Lemma 3 (Equilibrium Subspace) $\forall w^* \; \exists \; (\overset{\triangle}{ABC})$ *in which Assumption 3, Assumption 4, and* $0 < A_e < A_L$ *are satisfied.*

Proof. See Appendix A.1. ■

I make the policy analysis under the assumption that the equilibrium occurs in the triangle $(\overset{\triangle}{ABC})$. There are, of course, other settings with respect to the NPV of the projects. In alternative settings NPV of projects of both types are either negative or positive in equilibrium. In the former, since all loan applicants have negative NPVs none of the banks would provide loans to them. This is inconsistent with the equilibrium since firms (or entrepreneurs) are necessary for production, and therefore, factor prices must adjust. In the latter, even though high-type agents are cross subsidizing low-type agents, both types prefer becoming entrepreneurs regardless of their wealth levels. Then, all agents under the threshold over which high-type agents provide effort become workers and all of those under it become workers. I shall not analyze this situation due to two reasons. First, in this case, the only reason there are workers in equilibrium is moral hazard, not adverse selection. With pure adverse selection, all of both types prefer becoming entrepreneurs which is inconsistent with the equilibrium since production requires labor. Second, this assumption simply says that everyone is a good entrepreneur but some of them are much better. This can be a plausible assumption for the analysis of other economic questions (see for example Inci (2006)), but not for the particular problem of this paper.

5.2.3 Interest Rates and the Average Success Probability

I have already found the equilibrium number of entrepreneurs E^*, and the equilibrium wage rate w^*. Putting these into (38) and (39) and solving for R and p^e gives the equilibrium level of risk free interest rate, R^*, and equilibrium level of average success probability of the entrepreneurs in the economy, p^{e*}.

To simplify things, after substituting for E^* and w^* in (37) and (39), I solve for E_H and E_L, and get

$$E_H(R, w^*) = \left(\frac{p^e - p_L}{p_H - p_L}\right)\frac{\bar{A}}{I} \tag{47a}$$

$$E_L(R, w^*, p^e) = \left(\frac{p_H - p^e}{p_H - p_L}\right)\frac{\bar{A}}{I} \quad . \tag{47b}$$

Define the following functions from (47a) and (47b):

$$\phi_H(R, p^e) \quad : \quad = E_H(R, w^*) - \left(\frac{p^e - p_L}{p_H - p_L}\right)\frac{\bar{A}}{I} = 0 \tag{48a}$$

$$\phi_L(R, p^e) \quad : \quad = E_L(R, w^*, p^e) - \left(\frac{p_H - p^e}{p_H - p_L}\right)\frac{\bar{A}}{I} = 0 \quad . \tag{48b}$$

$\phi_H(R, p^e) = 0$ implicitly defines R as a function of p^e by taking into account only high-type agents. Call this as the *high-type locus*. $\phi_L(R, p^e) = 0$ does the same thing taking into account only low-type agents. Call this as the *low-type locus*. It can be shown that high-type locus is downward sloping for every wealth distribution but low-type locus can be downward or upward sloping. It can be shown that whenever the low-type locus is upward sloping, an equilibrium has to be unique if it exists. The next proposition proves this formally.

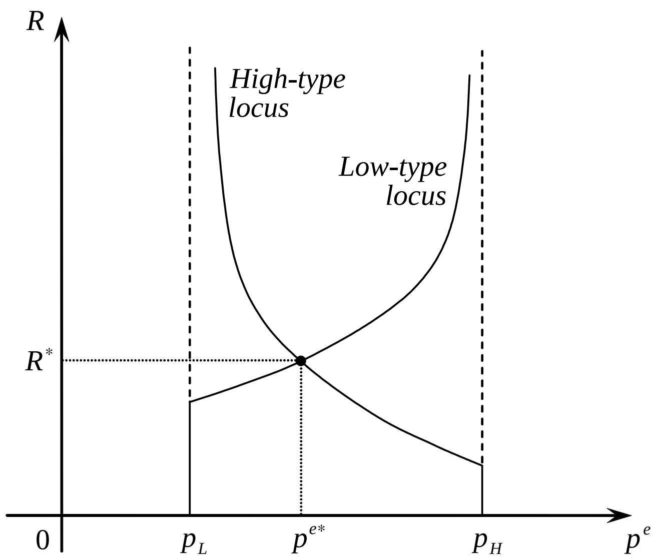

Figure 10: The Risk-free Interest Rate and the Average Success Probability

Proposition 7 (Uniqueness of R and p^e) *For a large class of economies, if an equilibrium exists, it is unique in R^* and p^{e*}.*

Proof. See Appendix A.2. ■

Figure 10 illustrates high-type and low-type loci when the latter is upward sloping. As far as the high-type locus is concerned, more and more high type agents would enter into entrepreneurship when interest rate decreases gradually. This, in and of itself, will increase the average success probability of entrepreneurs in the economy. After some point, however, entrepreneur pool will be composed of all high-type agents. Then, any decrease in the interest rates would not increase p^e beyond p_H. Going against is the low-type locus. As far as this locus is concerned, when the interest rate decreases gradually, more and more low type agents would enter into entrepreneurship. This gradually decreases the average success probability until all the entrepreneurs are of low type agents. After then, any decrease in interest rates cannot pull p^e down below p_L. The equilibrium occurs where these two opposing forces meets. Care should be taken in interpreting this graph, which shows the both loci for all (R, p^e) pair, since the equilibria I focus must satisfy the conditions Lemma 3. That is, the equilibrium must be in $(\overset{\triangle}{ABC})$ since the loci are defined only in it.

For the sake of highlighting the result, the analysis below focuses on the economies characterized with the two curves shown in Figure 10, but the result that a tax on entrepreneurs may be desirable can still be gotten even when the low-type locus is downward sloping. One case in which a tax on entrepreneurs is desirable is sufficient to make the point of this paper.

Corollary 1 (Uniqueness of $\mathbf{\Delta}$) *If a general equilibrium exists, it is defined with a unique and stable quadruple $\mathbf{\Delta} = (R^*, w^*, p^{e*}, E^*)$ for a large class of wealth distributions.*

Proof. This result directly follows from Proposition 6 and Proposition 7. ■

6 SUCCESS TAXES AND WAGE SUBSIDIES

This section makes the policy analysis. The government cannot distinguish between types any better than the banks can. Nonetheless, it can design policies to improve the welfare, which is defined to be total expected output in the economy in this paper. The only reason that low-type agents would like to become entrepreneurs is that types are hidden, and thus, they may get loans with better terms which they would have not gotten if there were perfect information. The government should design a tax-subsidy policy such that the economy becomes better informed about the types after the policy. Given the information structure, this is possible only self-selection improves in the economy.

The source of the market failure in this model is the banks inability to observe the types of loan applicants in the poor class ($A \in [0, A_e]$) and the lower-middle class ($A \in [A_e, A_L]$). In poor class high-type agents are prevented from entrepreneurship due to asymmetric information, and in lower-middle class, low-type agents can become entrepreneurs due to the same reason. These distortions in the occupational decisions in turn negatively affect who uses the capital available in the economy, and hence, prevents the economy from outcomes that can be reached otherwise.

A policy that increases the quality of the pool of entrepreneurs in the economy is sufficient to increase the expected output. When p^e is increasing, that means the number of high-type entrepreneurs is increasing, too. This also means that the number of low-type entrepreneurs is decreasing since the number of entrepreneurs in the economy is fixed. As a result, total expected output increases. Then, the government's problem is how to change the thresholds

A_e and A_L, which are endogenously determined in the general equilibrium, in a way that the welfare increases.

It is better for the society if a high-type low-wealth worker becomes an entrepreneur instead of a low-type high-wealth entrepreneur. This is desirable not only because high-type agents have higher success probabilities (and thus, can produce more) but also because the supply of loanable funds to the financial intermediation increases when that happens, which eventually decreases the cost of loans. I shall focus on a policy in which the government gives small wage subsidies to workers and finances them by small taxes on entrepreneurs that are paid only in a success state. In that case, the problem that agents (who may become entrepreneurs) solve is modified in the following way:

$$p_H(\pi(w) - t - \frac{R}{\bar{p}}(I - A)) - e \quad \lesseqqgtr \quad p^e(w + s) + RA \tag{49a}$$

$$p_L(\pi(w) - t - \frac{R}{\bar{p}}(I - A)) \quad \lesseqqgtr \quad p^e(w + s) + RA \quad , \tag{49b}$$

for a high- and a low-type agent, respectively. Here, t is the tax on entrepreneurs, and s is the wage subsidy to workers, both of which are assumed to be very small. The government operates under a balanced budget regime, and hence, uses all of the tax revenue to finance wage subsidies to workers. Then, the relationship between t and s is given by

$$s = \frac{\bar{A}}{I - \bar{A}} t \quad . \tag{50}$$

After substituting for s, (48a) and (48b) are now given by $\phi_H(R, p^e, t)$ and $\phi_L(R, p^e, t)$, and thus, both high-type and low-type loci become functions of not only p^e but t as well. I start off with determining the effects of the tax-subsidy policy on these loci.

Proposition 8 (Policy – Loci) *The tax-subsidy policy shifts both high-type and low-type loci down.*

Proof. See Appendix A.3. ■

Corollary 2 (Policy – Lending Interest Rate) *Lending interest rate for every contract decreases.*

Proof. The result directly follows from Proposition 8. If both loci shift down, risk-free interest rate – which is nothing but the cost of loanable funds – must decrease. If cost of loanable funds decrease lending interest rates in every wealth level must decrease as well. ■

The way of change in the equilibrium level of risk-free interest rate is determinate as shown in Corollary 2. However, the way of change in the equilibrium level of average success probability of entrepreneurs in the economy, p^e, is ambiguous, and in general, depends on the wealth distribution. Banerjee and Newman (1993) show how occupational choice, and

Legros, Newman, and Proto (2006) show how relative scarcity of entrepreneurs and workers can be dependent on the initial wealth distributions. Thus, the result that the policy is contingent on the wealth distribution is not surprising. The next proposition characterizes the cases in which the proposed policy increases the equilibrium level of p^e.

Proposition 9 (Policy) *Assume ex ante the number of workers is sufficiently large than the number of entrepreneurs. There exist economies in which a small tax on entrepreneurs used to subsidize workers increases the average quality of the entrepreneurs. This policy is welfare improving in such economies.*

Proof. See Appendix A.4. ■

It is evident from Figure 11 that there are cases in which a tax on entrepreneurs used to subsidize workers can increase the average quality of entrepreneurs. Before the policy, equilibrium is given by the pair (R^*, p^{e*}). After the policy, new loci are given by the dotted curves and the new equilibrium occurs at $(R^*_{tax}, p^{e*}_{tax})$. The rest of this section is devoted to explain this result?

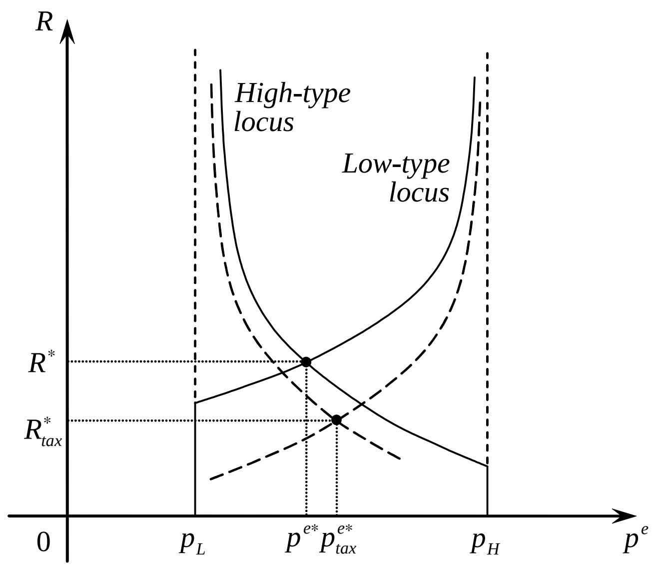

Figure 11: The Tax-Subsidy Policy

Once a small tax on entrepreneurs is imposed, the total cost of starting a firm increases for all entrepreneurs. However, as shown in Corollary 2, the lending interest rate decreases as a result of the policy. This means the borrowing costs of all entrepreneurs decreases. Thus, low-type agents cannot enjoy the cross-subsidies in the financial markets in the same extent they had before the policy. Therefore, the tax on entrepreneurs affects low-type agents more than it affects high-type agents. Remember that cross-subsidization in the financial market is the only reason that makes low-type agents attempt to become entrepreneurs. It converts some of borrowing costs (which are subject to adverse selection) into tax costs (which are not subject to adverse selection), and this disproportionately discourages low-type agents from entrepreneurship.

The government uses the tax revenue to subsidize workers which creates even more incentives for all types to become workers. Since the aggregate wealth is fixed, the number of entrepreneurs is going to be the same before and after the policy. Then, the question is which agents would switch from entrepreneurship to wage-earning, and which agents are going to fill up these entrepreneurship positions as a result of the tax-subsidy policy?

Figure 12 illustrates a situation in which the tax-subsidy policy increases p^e. An increase in t decreases R. At the same time, both affect A_L and A_e. Start with the before-the-policy thresholds A_e and A_L. The effects of the tax on the wealth thresholds are given by Δt, and the effects of changes in R on them are shown by ΔR. Imposing a tax of t, in and of itself, shrinks the adverse selection area by increasing A_e and decreasing A_L. The temporary thresholds in the transition are now given by $A_e^{'}$ and $A_L^{'}$. However, it will eventually decrease R. The change in R, in turn, widens the adverse selection area. The thresholds for wealth classes moves to $A_e^{''}$ and $A_L^{''}$ after the policy.

The overall change in A_L is a decrease. On the right side of A_L only high-type agents may become entrepreneurs due to cross-subsidizing separating contracts. Therefore, the decrease in A_L gets rid of some low-type agents from entrepreneurship. The overall change in A_e is also a decrease. On the left side of this threshold high-type agents do not provide effort which consequently isolates those wealth classes from the loan market. Thus, anyone in these wealth classes has no chance but become workers. When A_e moves down, more high-type agents can provide effort in entrepreneurship, and thus, banks are able to offer loans to them. However, low-type counterparts of them can also become entrepreneurs due to cross-subsidizing pooling contracts on the right side of A_e. As a result, the average quality of entrepreneurs increases in the economy since some low-type entrepreneurs are swapped with an equal number of low- and high-type workers.

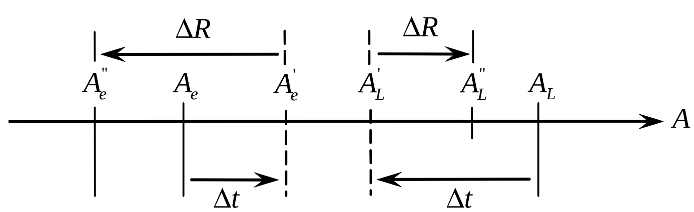

Figure 12: Effects of Changes in R and t on the Wealth Thresholds

The ones who change their decision from wage-earning to entrepreneurship are relatively poor than the ones who do the opposite, and that is why the interest rate decreases. Remember that wage-earners are the sources of the loanable funds in the economy. Subsidizing wage-earning creates further incentives for all types to become entrepreneurs. Nonetheless, as is explained above, it is more pronounced for the low-type agents since they enjoy smaller cross subsidies when they borrow to become entrepreneurs after the tax.

Low-type agents prefer becoming entrepreneurs if their wealth is less than A_L. In other words, they become entrepreneurs only if sufficiently large portion of their investments are financed by banks. Thus, low-type agents who change their occupational decisions in the margin due to a tax must be the ones who have relatively higher wealth. They are the ones who borrow relatively less and enjoy relatively small cross-subsidies. Once the government introduces the tax-subsidy policy they enjoy even less cross-subsidies, which are the only reasons why they prefer becoming entrepreneurs. Meanwhile, relatively bigger portions of the projects of the poorer low-type entrepreneurs are still financed by the banks. Therefore, rich low-type entrepreneurs are the ones who switch to wage-earning in the margin.

High-type agents provide effort in entrepreneurship only if they are sufficiently rich (e.g., if $A > A_e$). The part of the investments of high-type agents financed by a bank is subject to cross-subsidies. A poor high-type agent cannot afford both providing effort and cross-subsidizing low-type agents. Then, among the high-type agents, the ones who switch from wage-earning to entrepreneurship in the margin are the ones who are relatively poor. As explained above, when A_e changes some low-type agents can become entrepreneurs in addition to high-type agents. Then, the overall effect of the policy is to get rid of some rich low-type entrepreneurs and get some poor agents of both types into entrepreneurship.

This is one possibility in which a tax on entrepreneurs increase the average quality of them. As stated in Proposition 9, the policy requires that the number of workers in the economy is sufficiently larger than the number of entrepreneurs. The reason is that in order to have the policy work, the drop in the risk-free interest rate should be sufficient. Given a balanced budget scheme this can happen if the number of those who are going to be subsidized are high in number. Finally, it should be noted that there are other cases in which a subsidy to entrepreneurs is required to increase average quality of them in the economy.

7 EXTENSIONS

The model above does a good job in explaining how a tax on entrepreneurs might be desirable in improving the average quality of entrepreneurs in the economy. Below I consider some extensions to the base model.

Equivalent Policies: This paper presents a model in which wages are subsidized. However, there are other policies that are equivalent to a wage subsidy policy. For example, taxing the entrepreneurs and using the proceeds to subsidize lending to the banks can also work:

$$p_H(\pi(w) - t - \frac{R}{\bar{p}}(I - A)) - e \quad > \quad p^e w + (R + r)A \tag{51a}$$

$$p_L(\pi(w) - t - \frac{R}{\bar{p}}(I - A)) \quad > \quad p^e w + (R + r)A \quad , \tag{51b}$$

where r is the lending subsidy. This is important since even though both policies can have the same effects on the economy, one or the other might be easier (or less costly) to implement in practice or ideologically more plausible in different societies. So, governments have the option to choose one over the other under the constraints of their particular environments.

Correlation between wealth and ability: In the present model, I assume that the ratio of high types is the same in every wealth level. In reality there is correlation between wealth and ability. In that case, wealth is going to be a noisy signal of the ability, and thus, banks should update their beliefs for every wealth level (possibly in a Bayesian sense). Let $g_H(A)$ be the wealth density for high-type agents and $g_L(A)$ be the wealth density for low-type agents. Then, in the extended model, the probability that a given agent is a high-type is

$$\hat{h}(A) = \frac{hg_H(A)}{hg_H(A) + (1-h)g_L(A)} \quad . \tag{52}$$

Multi-period game: The basic model of this paper is very useful in understanding the simple relations between the credit and labor markets, and hence, analyzing the quality of the entrepreneurs in the economy. However, its static nature is a limitation. The model can be extended to incorporate dynasties of individuals (e.g., an overlapping generations setting) to analyze the stationary distribution of wealth and occupations over agents (if they can be stationary). The multi-period model can also give insights about what happens in the transition period. In this period, there will be temporary wealth class thresholds as shown in Figure 12, but it is less clear who benefits and who does not in the transition. Aoki, *et al.* (2006) works on such dynamics in a capital liberalization framework.

Informational problems in wage-earning: The model here do not consider the employment contracts between entrepreneurs and workers by assuming that all agents are the same in terms of their abilities in wage-earning. The main source of market failure in this paper is the asymmetric information in the credit market. Banks do not know the success probabilities of particular loan applicants, and write contracts under that constraint. The model can be extended to incorporate the contracts between employers and employees. See Parker (2003) for a model in which ability applies to both occupations such that it is possible to get greater separation in wage-earning than in entrepreneurship.

Screening: There are two potential ways of incorporating screening into the model. First, random contracts *à la* Arnott and Stiglitz (1988) can be introduced to the model. Banks offers two kinds of contracts: one with a low and another with a high interest rate. If a loan applicant chooses the contract with the higher interest rate, banks grant the loan with certainty. However, if he chooses the contract with the lower interest rate, banks grant the loan with some probability. Although random contracts can be efficient they are hardly used in practice, as is acknowledged by Arnott and Stiglitz (1988). I rule out random contracts in the equilibrium definition by assuming that banks follow pure strategies. Second, in the standard adverse selection models, financial intermediaries may ask for collateral. If the collateral is high enough, there can be a separating equilibrium. In my model, agents' use of their wealth in their firms acts as a collateral and this makes full separation possible in higher wealth levels. See Ghatak, *et al.* (forthcoming) for a nice analysis of screening with collateral when the wealth is illiquid.

Unemployment: For the various reasons explained before, the current paper focuses on the occupational choice between entrepreneurship and wage-earning. However, in the countries in which there are strong unemployment benefits, the occupational choice also includes the decision between entrepreneurship and unemployment. This is especially relevant for individuals who do not have very good prospects in the labor market due to lack of required skills or due to various kinds of discrimination based on sex, race, religion or nationality.

8 CONCLUSION

This paper explores the quality of entrepreneurs in an occupational choice model. The idea I highlight is that the common partial analysis of entrepreneurship might be misleading. Entrepreneurs are not merely the ones who make risky real investments or seek loans; they also create jobs. In addition, wage-earning is the natural outside option to entrepreneurship. A general theory of entrepreneurship should take into account all of these interlinkages between the labor and the credit markets.

I show that, for a large class of economies, it might be desirable to tax entrepreneurs and give the proceeds to workers. By doing so, the government can improve entrepreneurial self-selection. The tax converts some of the cross-subsidies in the financial intermediation into tax revenue. This revenue is then used to finance the wage subsidies. The overall effect of the policy is to exchange some rich low-type entrepreneurs with poor high- and low-type entrepreneurs. As a result, the average success probability of the entrepreneurs in the economy increases. Given that the aggregate wealth in the economy is fixed, this in turn increases the total expected output of the economy. Since the agents who switch from entrepreneurship to wage-earning are relatively wealthier than the agents who do the opposite, the credit supply to the banking system increases. This, in turn, decreases the risk-free interest rate, which is equal to the cost of loanable funds, as well as the lending interest rate.

It is worth mentioning that the policy I propose is a pure efficiency result. That is, in some economies, efficiency requires taxing entrepreneurs and giving the proceeds to workers to improve the welfare. The policy simply changes the threshold levels for wealth classes so as to increase the average quality of active entrepreneurs in the economy. In my view, this pure efficiency result enhances equity as well, since richer low-type entrepreneurs are swapped with poorer high- and low-type workers as a result of the policy.

The model stresses the role of unobserved success probability in the determination of the market outcome. This, of course, leaves out a number of other considerations that may be important. In that sense, the practical implication of this result might not be a tax entrepreneurs. However, as opposed to the common view in the media, it is at least clear that subsidies to entrepreneurs may not mitigate the market failures induced by asymmetric information, and thus, asymmetric information, in and of itself, is not sufficient to justify subsidy policies.

With some revisions, the results can be applied to a broad class of problems in which informational problems prevent some of the agents from undertaking one of the two options (e.g., becoming an entrepreneur is conditional on being financed). They may choose the other option whenever they cannot undertake the former (e.g., individuals may choose to become workers whenever they want). For instance, the results can be applied to the competition between private and public schools that offer scholarships on a merit basis. A student may always choose to go to a public school, but going to a private high school is possible only if one has enough income to pay for the tuition. Another example would be financing a high-risk invention that might lead to a marketable innovation only with some probability. Scientists can undertake the risky project only if they are financed. It also applies to the case in which individuals decide whether to buy or rent an apartment given a fixed stream of income. They can rent an apartment in any case, but buying one is contingent on mortgage financing, and to get the mortgage one needs to have certain qualifications. In the current paper, for the sake of simplicity, I have stuck to the occupational choice problem.

A APPENDIX

A.1 Proof of Lemma 3

The equilibrium I focus on in this paper must satisfy $0 < A_e < A_L < \tilde{A} < I$, Assumption 4, and $A_H < A_e$. It can be shown that $A_L < \tilde{A}$ holds by definition, $0 < A_L < \tilde{A} < I$ is implied by Assumption 3, and $A_e < A_L$ implies $A_H < A_e$. Then, it is sufficient to say that, in any equilibrium I focus on, Assumption 3, Assumption 4, and $0 < A_e < A_L$ must be satisfied.

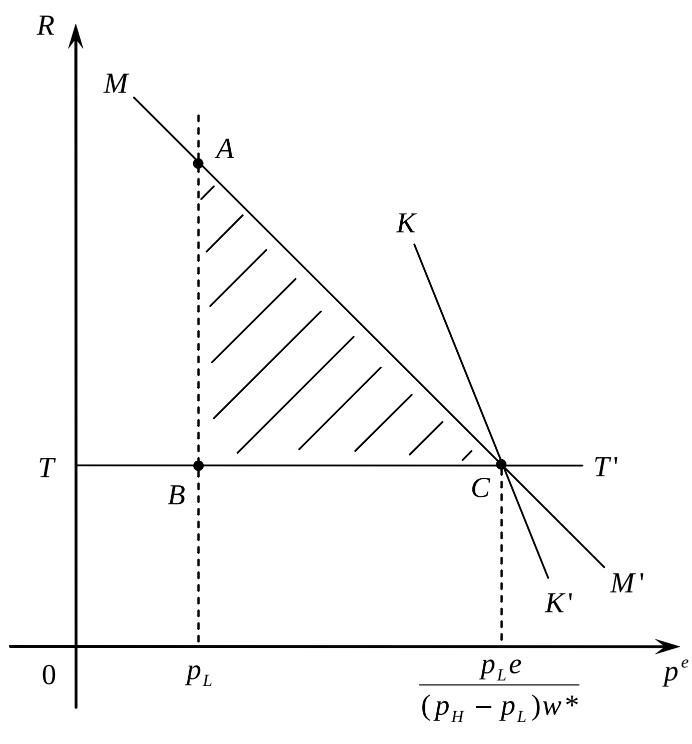

Figure 13: Possible Equilibria in the General Equilibrium

Assumption 3 requires

$$\begin{aligned} p_H\pi(w^*) - e &> p^e w^* + RI \quad , &\text{(A-1a)}\\ p_L\pi(w^*) &< p^e w^* + RI \quad , &\text{(A-1b)}\\ p_L\pi(w^*) &> p^e w^* + (p_L/\bar{p})RI \quad . &\text{(A-1c)} \end{aligned}$$

$0 < A_e < A_L$ implies

$$\begin{aligned} \bar{p}\pi(w^*) - \frac{\bar{p} - p_L}{p_H - p_L}e &> p^e w^* + RI \quad , &\text{(A-2a)}\\ \frac{\bar{p}(\pi(w^*) - \frac{e}{p_H - p_L})}{I} &< R \quad . &\text{(A-2b)} \end{aligned}$$

Assumption 4 indicates that

$$e > (p_H - p_L)w^* \quad .$$

When (A-1c), (A-2a), and (A-2b) are satisfied, (A-1a) and (A-1b) are satisfied as well. Given w^*, Figure 13 shows where the possible equilibria must lie in general equilibrium. (A-1c) says that equilibrium must lie under KK', and (A-2a) says it must lie under MM', whereas (A-2b) indicates that the risk-free interest rate has to be above TT'. Then, any equilibria satisfying Assumption 3, Assumption 4, and $0 < A_e < A_L$ must be in $(\overset{\triangle}{ABC})$. Note, that Assumption 4 is needed to guarantee that $p_L < \frac{p_L e}{(p_H - p_L)w^*}$ in Figure 13.

A.2 Proof of Proposition 7

Note that $p^e \in [p_L, p_H]$. I prove the uniqueness of equilibrium in two steps. First, I show that high-type locus is always downward sloping in p^e between (p_L, p_H) and vertical at p_H. Second, I show that, for some wealth distributions, low-type locus is upward sloping in p^e between (p_L, p_H) and vertical at p_L. In such cases, the equilibrium must be unique simply because a downward sloping curve (high-type locus) intersect with an upward sloping curve (low-type locus).

Step 1: High-type locus is downward sloping in p^e between (p_L, p_H) and vertical at p_H.

By Implicit Function Theorem

$$\left.\frac{\partial R}{\partial p^e}\right|_{\phi_H(R,p^e)=0} = -\frac{\frac{\partial \phi_H(R,p^e)}{\partial p^e}}{\frac{\partial \phi_H(R,p^e)}{\partial R}}$$

$$\frac{\partial \phi_H(R,p^e)}{\partial p^e} = -\left(\frac{1}{p_H - p_L}\right)\frac{\bar{A}}{I} < 0$$

$$\frac{\partial \phi_H(R,p^e)}{\partial R} = \frac{\partial E_H(R,w^*)}{\partial R} = h\frac{\partial}{\partial R}\left[\int_{A_e(R,w^*)}^{I} dG(A)\right] \quad .$$

By Leibniz's Rule

$$h\frac{\partial}{\partial R}\left[\int_{A_e(R,w^*)}^{I} dG(A)\right] = -hg(A_e)\frac{\partial A_e}{\partial R} \quad .$$

By Assumption 3

$$\frac{\partial A_e}{\partial R} = \frac{\pi(w^*) - \frac{e}{p_H - p_L}}{\frac{R^2}{\bar{p}}} > 0 \quad .$$

Hence,

$$\left.\frac{\partial R}{\partial p^e}\right|_{\phi_H(R,p^e)=0} < 0 \quad .$$

Moreover, the right hand side of (47a) is a function of p^e only, and it is zero when $p^e = p_L$. Left hand side equals zero only when $A_e(R, w^*) = I$, which can happen only when $R = \infty$. Then, high-type locus has to be convex in p^e between (p_L, p_H).

The number of entrepreneurs can at most be $\bar{A}/I$. Then, theoretically, left hand side of (47a) can at most be $\bar{A}/I$. This happens when all the entrepreneur positions are filled up with all high-type agents with a positive interest rate. As far as high-type locus is concerned, any further decrease in R would not increase the average success probability since all the positions have been filled by high-type entrepreneurs. Then, p^e is fixed and equal to p_H for any interest rate smaller than this (positive) interest rate. The high-type locus is shown in Figure 10.

Step 2: For some wealth distributions, low-type locus is upward sloping in p^e between (p_L, p_H) and vertical at p_L.

By Implicit Function Theorem

$$\left.\frac{\partial R}{\partial p^e}\right|_{\phi_L(R,p^e)=0} = -\frac{\frac{\partial \phi_L(R,p^e)}{\partial p^e}}{\frac{\partial \phi_L(R,p^e)}{\partial R}}$$

$$\frac{\partial \phi_L(R,p^e)}{\partial p^e} = \frac{\partial E_L(R,w^*,p^e)}{\partial p^e} + \underbrace{\left(\frac{1}{p_H - p_L}\right)\frac{\bar{A}}{I}}_{(+)}$$

$$\frac{\partial E_L(R,w^*,p^e)}{\partial p^e} = (1-h)\frac{\partial}{\partial p^e}\left[\int_{A_e(R,w^*)}^{A_L(R,w^*,p^e)} dG(A)\right] \quad .$$

By Leibniz's Rule

$$\begin{aligned}\frac{\partial E_L(R,w^*,p^e)}{\partial p^e} &= (1-h)g(A_L)\frac{\partial A_L}{\partial p^e} \\ &= -(1-h)g(A_L)\frac{\bar{p}w^*}{R(\bar{p}-p_L)} < 0 \quad .\end{aligned}$$

Then,

$$\begin{aligned}\frac{\partial \phi_L(R,p^e)}{\partial p^e} &= \frac{\bar{A}}{(p_H - p_L)I} - \frac{\bar{p}(1-h)w^*}{R(\bar{p}-p_L)}g(A_L) \\ &= \frac{1}{(p_H - p_L)I}\int_0^I A dG(A) - \frac{\bar{p}(1-h)w^*}{R(\bar{p}-p_L)}g(A_L) \quad . \qquad \text{(A-3)}\end{aligned}$$

It is evident that for some wealth distributions $\frac{\partial \phi_L(R,p^e)}{\partial p^e} > 0$.[22] Now turn to $\frac{\partial \phi_L(R,p^e)}{\partial R}$.

$$\frac{\partial \phi_L(R,p^e)}{\partial R} = \frac{\partial E_L(R,w^*,p^e)}{\partial R}$$

$$\frac{\partial E_L(R,w^*,p^e)}{\partial R} = (1-h)\frac{\partial}{\partial R}\left[\int_{A_e(R,w^*)}^{A_L(R,w^*,p^e)} dG(A)\right] \quad .$$

By Leibniz's Rule,

$$\frac{\partial E_L(R,w^*,p^e)}{\partial R} = (1-h)\left[g(A_L)\underbrace{\frac{\partial A_L}{\partial R}}_{(-)} - g(A_e)\underbrace{\frac{\partial A_e}{\partial R}}_{(+)}\right] \quad ,$$

and $\frac{\partial A_L}{\partial R} < 0$ and $\frac{\partial A_e}{\partial R} > 0$. Then, whenever (A-3) is positive

$$\frac{\partial E_L(R,w^*,p^e)}{\partial R} < 0 \quad .$$

Hence,

$$\left.\frac{\partial R}{\partial p^e}\right|_{\phi_L(R,p^e)=0} < 0 \quad .$$

Moreover, in a similar fashion to the high-type locus, the left hand side of (47b) can at most be $\bar{A}/I$. This happens when all the entrepreneur positions are filled up with low-type agents, and where $p^e = p_L$. After then, any decrease in interest rate cannot decrease p^e more. Then, low-type locus must be vertical at $p^e = p_L$. The low-type locus is shown in Figure 10. In the case in which the low-type locus is upward sloping, two loci have to intersect once and only once.

A.3 Proof of Proposition 8

Focus on the economies that satisfy the conditions of Proposition 7. It is sufficient to show that

$$\left.\frac{\partial R}{\partial t}\right|_{\phi_H(R,p^e,t)=0} < 0 \text{ and } \left.\frac{\partial R}{\partial t}\right|_{\phi_L(R,p^e,t)=0} < 0 \quad .$$

In particular, note that I do not need to take into account a change in the wage rate. It is the same before and after the policy since neither the labor supply nor the labor demand has changed.

[22] For some other wealth distributions $\partial \phi_L(R,p^e)/\partial p^e < 0$, and the low-type locus is upward sloping. There can be multiple equilibrium in such cases, but a tax on entrepreneurs can still be obtained. For example, focus on a case in which there is unique equilibrium with an upward sloping low-type locus. Suppose the low-type locus cuts the high-type locus from above. Then, in a similar fashion to Proposition 9, if the policy shifts down the low-type locus more than it shifts down the high-type locus, taxing entrepreneurs is welfare improving.

Step 1: Show that $\left.\frac{\partial R}{\partial t}\right|_{\phi_H(R,p^e,t)=0} < 0$.

$$\left.\frac{\partial R}{\partial t}\right|_{\phi_H(R,p^e,t)=0} = -\frac{\frac{\partial \phi_H(R,p^e,t)}{\partial t}}{\underbrace{\frac{\partial \phi_H(R,p^e,t)}{\partial R}}_{(-)}} \quad .$$

I have already shown that $\frac{\partial \phi_H(R,p^e,t)}{\partial R} < 0$ for a small t. Now focus on the numerator.

$$\frac{\partial \phi_H(R,p^e)}{\partial t} = h\frac{\partial}{\partial t}\left[\int\limits_{A_e(R,w^*,t)}^{I} dG(A)\right] = -hg(A_e)\frac{\partial A_e}{\partial t} \quad ,$$

and

$$\frac{\partial A_e}{\partial t} = \frac{\bar{p}}{R} > 0 \quad .$$

Thus,

$$\frac{\partial \phi_H(R,p^e)}{\partial t} < 0 \;\text{ and }\; \left.\frac{\partial R}{\partial t}\right|_{\phi_H(R,p^e,t)=0} < 0 \quad .$$

Therefore, a tax-subsidy policy shifts the high-type locus down.

Step 2: Show that $\left.\frac{\partial R}{\partial t}\right|_{\phi_L(R,p^e,t)=0} < 0$.

$$\left.\frac{\partial R}{\partial t}\right|_{\phi_L(R,p^e,t)=0} = -\frac{\frac{\partial \phi_L(R,p^e,t)}{\partial t}}{\underbrace{\frac{\partial \phi_L(R,p^e,t)}{\partial R}}_{(-)}} \quad .$$

Similarly, I have already shown that $\frac{\partial \phi_L(R,p^e,t)}{\partial R} < 0$ for a small t. Now focus on the numerator.

$$\begin{aligned}\frac{\partial \phi_L(R,p^e,t)}{\partial t} &= (1-h)\frac{\partial}{\partial t}\left[\int\limits_{A_e(R,w^*,t)}^{A_L(R,w^*,p^e,t)} dG(A)\right] \\ &= (1-h)(g(A_L)\underbrace{\frac{\partial A_L}{\partial t}}_{(-)} - g(A_e)\underbrace{\frac{\partial A_e}{\partial t}}_{(+)}) < 0 \quad ,\end{aligned}$$

Then,

$$\left.\frac{\partial R}{\partial t}\right|_{\phi_L(R,p^e,t)=0} < 0 \quad .$$

Therefore, a tax-subsidy policy shifts the low-type locus down.

A.4 Proof of Proposition 9

Focus on the wealth distributions that satisfy Proposition 7. Let the high-type locus be $R_H(p^e, t)$ and the low-type locus be $R_L(p^e, t)$. In equilibrium

$$R_H(p^{e*}, t) - R_L(p^{e*}, t) = 0 \quad . \tag{A-4}$$

Total differentiation of (A-4) around the equilibrium yields

$$\frac{\partial p^e}{\partial t} = -\frac{\frac{\partial R_H}{\partial t} - \frac{\partial R_L}{\partial t}}{\frac{\partial R_H}{\partial p^e} - \frac{\partial R_L}{\partial p^e}} \quad .$$

On the other hand, $\frac{\partial R_H}{\partial p^e} < 0$ and $\frac{\partial R_L}{\partial p^e} > 0$. Hence, the denominator is negative. Then, it is sufficient to show that

$$\frac{\partial R_H}{\partial t} - \frac{\partial R_L}{\partial t} > 0 \quad . \tag{A-5}$$

Since both terms in (A-5) are negative it boils down to

$$\left|\frac{\partial R_H}{\partial t}\right| < \left|\frac{\partial R_L}{\partial t}\right| \quad . \tag{A-6}$$

In words, if the public policy is going to increase p^e, it must shift down low-type locus more than it shifts down the high-type locus. The expressions for these have already been derived in (A-6):

$$\left|\frac{\partial R_H}{\partial t}\right| = \frac{hg(A_e)\frac{\partial A_e}{\partial t}}{hg(A_e)\frac{\partial A_e}{\partial R}} = \frac{\frac{\partial A_e}{\partial t}}{\frac{\partial A_e}{\partial R}} \quad ,$$

and

$$\left|\frac{\partial R_L}{\partial t}\right| = \frac{(1-h)(g(A_L)\frac{\partial A_L}{\partial t} - g(A_e)\frac{\partial A_e}{\partial t})}{(1-h)(g(A_L)\frac{\partial A_L}{\partial R} - g(A_e)\frac{\partial A_e}{\partial R})} = \frac{g(A_L)\frac{\partial A_L}{\partial t} - g(A_e)\frac{\partial A_e}{\partial t}}{g(A_L)\frac{\partial A_L}{\partial R} - g(A_e)\frac{\partial A_e}{\partial R}} \quad .$$

Then, after some manipulation, the problem is whether the following inequality is satisfied or not:

$$\frac{\frac{\partial A_e}{\partial t}}{\frac{\partial A_e}{\partial R}} \stackrel{?}{<} \frac{g(A_L)\frac{\partial A_L}{\partial t} - g(A_e)\frac{\partial A_e}{\partial t}}{g(A_L)\frac{\partial A_L}{\partial R} - g(A_e)\frac{\partial A_e}{\partial R}} \quad .$$

This boils down to

$$\underbrace{\frac{\partial A_e}{\partial t}}_{(+)}\underbrace{\frac{\partial A_L}{\partial R}}_{(-)} \stackrel{?}{<} \underbrace{\frac{\partial A_L}{\partial t}}_{(-)}\underbrace{\frac{\partial A_e}{\partial R}}_{(+)} \quad , \tag{A-7}$$

where

$$\begin{aligned}
\frac{\partial A_L}{\partial t} &= -\frac{p_L + \frac{\bar{A}}{I-\bar{A}}p^e}{R(1-\frac{p_L}{\bar{p}})} < 0 \\
\frac{\partial A_L}{\partial R} &= -\frac{p_L(\pi(w^*)-t) - p^e(w^* + \frac{\bar{A}}{I-\bar{A}}t)}{R^2(1-\frac{p_L}{\bar{p}})} < 0 \\
\frac{\partial A_e}{\partial t} &= \frac{\bar{p}}{R} > 0 \\
\frac{\partial A_e}{\partial R} &= \frac{\pi(w^*) - t - \frac{e}{p_H - p_L}}{\frac{R^2}{\bar{p}}} > 0 \quad .
\end{aligned}$$

Substituting these values into the inequality (A-7)

$$\frac{\bar{p}}{R}\frac{p_L(\pi(w^*)-t)-p^e(w^*+\frac{\bar{A}}{I-\bar{A}}t)}{R^2(1-\frac{p_L}{\bar{p}})} \overset{?}{>} \frac{\pi(w^*)-t-\frac{e}{p_H-p_L}}{\frac{R^2}{\bar{p}}}\frac{p_L+\frac{\bar{A}}{I-\bar{A}}p^e}{R(1-\frac{p_L}{\bar{p}})}$$

$$p_L(\pi(w^*)-t)-p^e(w^*+\frac{\bar{A}}{I-\bar{A}}t) \overset{?}{>} (\pi(w^*)-t-\frac{e}{p_H-p_L})(p_L+\frac{\bar{A}}{I-\bar{A}}p^e) \quad .$$

Then, (A-7) holds if

$$p^{e*} < \tilde{p} := \frac{\frac{p_L e}{p_H-p_L}}{\frac{\bar{A}}{I-\bar{A}}(\pi(w^*)-\frac{e}{p_H-p_L})+w^*} \quad .$$

Note that $p^e < \tilde{p}$ is likely because the downward sloping high-type locus, R_H, tends to be very steep due to the facts that $\lim_{R\to\infty} R_H = \infty$ and $\lim_{p^e\to p_H} R_H$ is finite. I still need to check if $p^{e*} < \tilde{p}$ can hold in $(\overset{\triangle}{ABC})$. In $(\overset{\triangle}{ABC})$, at least

$$p_L \le p^{e*} \le \frac{p_L e}{(p_H-p_L)w^*}$$

has to be satisfied. Then, $\tilde{p} < \frac{p_L e}{(p_H-p_L)w^*}$. Moreover, $p_L < \tilde{p}$ when

$$\frac{\bar{A}}{I-\bar{A}}\pi(w^*)+w < \frac{I}{I-\bar{A}}\frac{e}{p_H-p_L}$$

or

$$E^*\underbrace{[(p_H-p_L)\pi(w)^*]}_{>e \text{ by Assumption 3}} + (1-E^*)\underbrace{[(p_H-p_L)w^*]}_{<e \text{ by Assumption 4}} < e \quad .$$

This inequality holds if $E^* \gg 1-E^*$ since the expression in the square brackets in the first term is higher than e by Assumption 3 and the one in the second term is lower than e by Assumption 4. Therefore, this inequality hold if the number of workers in the economy is sufficiently large than the number of entrepreneurs. This completes the proof that there are large class of economies in which tax-subsidy policy can increase p^e and, moreover, in such economies this policy is welfare improving.

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