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Why Are Entrepreneurs Liquidity-Constrained?

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Why are entrepreneurs liquidity-constrained? The existing literature has almost exclusively focused on incentive problems associated with choices of work efforts and of project qualities. This paper shifts attention to the effect of liquidity-constraints on the quality of the entrepreneurial pool. Assuming that entrepreneurial ability is private information while personal wealth is public information, the paper shows that entrepreneurs are liquidity-constrained because the critical ability for one to choose being an entrepreneur rather than a wage worker increases with his personal wealth and therefore markets read low wealth of a would-be entrepreneur as a signal of low entrepreneurial ability and high probability of default. A normative implication is that liquidity constraints may be socially desirable since they work as a mechanism to guarantee that only high-ability people will be selected for entrepreneurship.

Key Words: Entrepreneurial ability; Asymmetric information; Liquidity constraints.

JEL Classification Numbers: D28, P16.

1. INTRODUCTION

Both casual observations and recent empirical studies suggest that entrepreneurs are liquidity-constrained and that a person has to be wealthy enough before he or she can start a business. For instance, using data from the National Longitudinal Survey of Young Men (USA), Evans and Jovanovic (1989) find that liquidity constraints bind and a would-be entrepreneur must bear most risk inherent in his business. Particularly, they

find that on average, a person cannot use more than 1.5 times his or her initial assets for starting a new venture. Blanchflower and Oswald (1990), with three sets of U.K. survey data, suggest that the probability of self-employment depends sensitively upon whether the individual ever received a gift or inheritance. They find that those who received 5,000 pounds, for example, were approximately twice likely, ceteris paribus, to set up a business. Liquidity constraints are not only of central importance for the entry into entrepreneurship, but also a major factor determining the likelihood of entrepreneurial failure. Using U. S. data consisting of the 1981 and 1985 federal individual income tax returns of a group of people who received inheritances in 1982 and 1983, Holtz-Eakin, Joulfaian and Rosen (1994) find that liquidity constraints exert a noticeable influence on the viability of entrepreneurial enterprises. For example, a $15,000 inheritance increases the probability that an individual will continue as a sole proprietor by 1.3% points, and if the enterprise survives, its receipts increase by 20%.[1]

The question is, why are liquidity constraints there in the first place? Since liquidity constraints imply that only those sufficiently wealthy people can set up enterprises and hire labour, this question can be re-interpreted as broader one: why does capital hire labour rather than labour-hiring-capital? The question has puzzled economists for long time. In the past two decades, economists have begun to address this question with formal models. The existing models, however, have almost exclusively focused on incentive problems associated with choices of work efforts and of project qualities. For instance, under the assumption of asymmetric information about the mean of the project return between the entrepreneur and outsiders, Leland and Pyle (1977) show that the entrepreneur's own stake in the project can fully reveal his belief about the mean return of the project and a higher stake of the entrepreneur signals a higher project quality. Stiglitz and Weiss (1981) argue that lenders have the incentive to ration credit rather than raise the interest rate because otherwise adverse selection and moral hazard problems would lead to too much project risk.[2] In Eswaran and Kotwal (1989), due to limited liability of the borrower, the borrower-entrepreneur effectively faces a lower price for capital than he would under full liability. Since his effort is not observable, he substitutes hired capital for his effort and consumes an amount of leisure which is in excess of what he would under full liability. This distortion in the input mix results in a bankruptcy probability which, from the point of view of the creditor, is larger than it should be. This, in turn, provides the capitalist with the incentive to undertake production himself. Following

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[1] For more empirical results, also see Evans and Leighton (1989).

[2] I share Stiglitz and Weiss's arguments. However, their downplay of the role of the collateral is problematic. The problem is their curious assumption that the individual's wealth is not observable to lenders.

Holmstrom's (1982) argument that efficiency in team production can be restored if a third party's joins the team as a principal to break the budget constraint, Valsecchi (1995) shows that *ex ante* specific investments are necessary to make the third party's principalship incentive compatible. He therefore argues only those sufficiently wealthy people can be entitled to be the principal.[3]

In this paper, we shift attention from incentive problems to the problem of selecting high-quality entrepreneurs. Assuming that entrepreneurial ability is private information while personal wealth is public information, we show that liquidity constraints can work as a mechanism to guarantee that only those with sufficiently high ability will be selected for entrepreneurship. The basic arguments are as follows. An individual can choose to be a wage worker or to be an entrepreneur. The return for being a worker is independent of entrepreneurial ability, while the (expected) return for being an entrepreneur is positively dependent on entrepreneurial ability. (More precisely we assume that the probability of entrepreneurial success is determined by entrepreneurial ability.) Thus one will choose to be an entrepreneur if and only if his entrepreneurial ability is equal to or above a critical level which is determined by equality of the return for being a worker and the return for being an entrepreneur. We find that the critical ability for one to choose being an entrepreneur rather than a wage worker increases with his personal wealth. The reason is that under limited liability (or more generally a non-negative consumption constraint), the opportunity cost of being an entrepreneur increases with personal wealth. For instance, an individual with fully self-financed investment has to take full risk of failure, while the penniless benefits from success but suffers little when business fails. Thus, for a given entrepreneurial ability, a poor person has more incentive to choose being an entrepreneur than a rich one. However, other people are more reluctant to follow a poor would-be entrepreneur since the market reads his low personal wealth as a signal of low (expected) entrepreneurial ability and therefore a high probability of default. As a result, the rich would-be entrepreneurs are selected by the market while the poor would-be entrepreneurs are rejected by the market.

The underlying assumption of the paper is that entrepreneurial ability is private information while personal wealth is common knowledge.[4] We

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[3]Also see Dow (1993) for a model of capital-hiring-labour based on asset specificity and incomplete contracts. For a survey of the earlier informal argument on the related topics, see Putterman (1984). Zhang (1994) contains a comprehensive review of related literature.

[4]This assumption can be replaced by a more general assumption that observing a person's entrepreneurial ability is much more difficult and much more costly than observing his personal wealth. Lucas (1978) assumes that each individual has full knowledge of his own managerial ability. In contrast, Kanbur (1979) assumes that nobody knows his own entrepreneurial ability. Although it might be correct to say that even an individual

believe that this assumption is a very close approximation of reality. In reality, people not only differ in their entrepreneurial ability but also entrepreneurial ability is at most only partially observable. Entrepreneurial ability greatly depends upon the person's "alertness" (Kirzner 1979), "imagination" (Shackle 1979) and "judgment" (Casson 1982). All these characteristics are at least partially innate and ineducable and cannot be indexed by hard indicators. Although some information such as education, background, work experience, may be available, a person's entrepreneurial ability cannot be accurately judged until he has been in business for some years.[5] What he says about his own ability may not be very useful unless convincing evidence is produced. In contrast, personal wealth is easy to observe and to reveal. It is almost impossible for the poor to pose as the rich; similarly, it is difficult and very costly (if not impossible) for the rich to evade their responsibility (e.g., for paying debts) by hiding personal wealth.

The basic idea of the paper follows Frank Knight (1921), one of the most prominent contributors to the study of entrepreneurship. As pointed out by LeRoy and Singell (1987), Knight did not only emphasize the primary importance of entrepreneurship, but also apparently recognized that because of moral hazard and adverse selection problems, the function of entrepreneurship is uninsurable and consequently entrepreneurs must finance themselves and bear the risk of failure. Knight writes: "We have assumed ....that each man in society knows his own powers as entrepreneur, but that men know nothing about each other in this capacity....The presence of true profit, therefore, depends on the absence of the requisite organization for combining a sufficient number of instances to secure certainty through consolidation. With men in complete ignorance of the powers of judgment of other men it is hard to see how such organization could be effected" (pp.284-85). In other words, any attempt to insure the outcome of entrepreneurship would fail because of the impossibility of excluding entrepreneurial lemons. As LeRoy and Singell commented, it is true that Knight did not explicitly discuss adverse selection here, but he did explicitly assume asymmetric information (as in the preceding passage), and he appears to have regarded adverse selection as an obvious consequence. In this sense, this paper can be thought as a formalization of Knight's original idea.

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himself cannot be fully sure about his own ability, it is too extreme and unrealistic to assume that he is as equally ignorant as outsiders.

[5]In reality, for some occupations such as lawyer, teacher, medical doctor and so on, a certificate is needed; but not for entrepreneurship. I conjecture that the reason for this difference is that entrepreneurial ability is much more difficult to measure than other ability.

Our theory has both positive and normative implications. The two positive implications are as follows. First, since liquidity constraints at least partly result from asymmetric information about entrepreneurial ability, we shall predict that the constraints will be diminishing as other signals about entrepreneurial ability become available. Education is one such signal, which may reveal some information on entrepreneurial ability and therefore help some MBA-holders set up their own business.[6] However, if we believe that entrepreneurial ability is some kind of innate ability which is not entirely educable, capital will still play an important role in signaling information about a person's ability. Second, our theory implies that those who have built up good business records are less liquidity-constrained than beginners, since the former's ability has been better revealed. This is quite coincident with observations. For example, a successful businessman whose factory has just been destroyed by a fire can easily to restart his business through borrowing.[7]

The normative implications of our theory are as follows. First, the liquidity constraint might be *socially* desirable since it can help to exclude unqualified people from entrepreneurial markets. Many observers have sympathy for those who wanted to set up their own business but failed to do so because of liquidity constraints. But one needs to realize that if there were no liquidity constraints, there would be too many unqualified people running businesses. Second, private property rights and capitalists are of central importance for ensuring that only high ability people be entrepreneurs. Without capitalists, it might be very hard to distinguish between low ability would-be entrepreneurs and high ability would-be entrepreneurs. This has been perfectly proved by socialist experiences.[8] Third, government assistance programs to small business as adopted in U.S., U.K. and other countries may have some adverse effect on the quality of small business-

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[6]Education signals not necessarily because it improves one's ability, but because the cost of education is lower for high ability people than for low. See Spence (1973).

[7]Evidence shows that within an industry, small firms grow faster and are more likely to fail than large firms. Jovanovic (1982) proposes a theory of "noisy" selection to explain evidence: Firms learn about efficiency as they operate in the industry. Efficient firms grow and survive; inefficient firms decline and fail. Firms differ in size because some discover that they are more efficient than others. Our theory can be extended to provide a complementary explanation for the evidence: markets reveal performers entrepreneurial ability; those markets with high ability are less liquidity-constrained and therefore expand faster than others.

[8]My research work on this topic was partly motivated by my personal experience of socialist China where because of lack of capitalists, most management posts of the state-owned enterprises were occupied by lemons. In 1980s, the Chinese government once tried to select managers based on professional exam scores. But the result seems unsuccessful. Fortunately, more and more capitalists are emerging in China as the reform proceeds, which is certainly helpful in improving the average quality of managers.

men.[9] The rationales for such programs are that capital markets do not provide adequate funds for new businesses. However, this kind of programs may drive too many low-ability people into business.

The paper is organized as follows. In Section 2, the basic model will be set up. Section 3 will be concerned with the relationship between personal wealth and the critical ability for someone to become an entrepreneur. In Section 4, we discuss how the market infers a would-be entrepreneur's ability from his personal wealth so that the rich become the winners of the competition for entrepreneurship. Wealth-dependent interest rates and wages as a mechanism of separating high ability from low ability are discussed in Section 5, where we also show why this mechanism may not work when bankruptcy incurs verification costs. Section 6 concludes the paper with a brief review of the existing models.

2. THE MODEL

The economy consists of many individuals differing in their entrepreneurial ability $\theta \in [0, 1]$ and personal wealth $W_0 \geq 0$. We assume that W_0 is known to all individuals of the economy but θ is known only to an individual himself.[10] Each individual is assumed to be a risk-neutral expected utility maximizer with a utility function $U = W_1$, where W_1 is his final wealth. There are two types of occupations available for all individuals to choose: an entrepreneur or a worker. An entrepreneur runs the firm and earns the residual return, while a worker earns the contractual market wage in return for his service in the firm. Being a capitalist is not an occupation which can be chosen by anyone since it depends on personal wealth endowment.[11] We make a distinction between *active* capitalists and *passive* capitalists. A capitalist is called *active* if he chooses to be an entrepreneur, and *passive* if he chooses to be a worker. The capital owned by the active capitalist earns a residual return, while the capital owned by the passive capitalist earns a contractual market interest rate. We shall assume that an individual with

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[9]For example, the U.S. Small Business Administration provides subsidized loans and loan guarantees to small business for start-up and expansion. Great Britain, France, Belgium, and the Netherlands have adopted financial assistance programs for unemployed workers who start a business. Bendick and Egan (1987) suggest that the unemployment programs may not be efficient. I conjecture that one of the reasons for the inefficiency might be their adverse effects on the quality of entrepreneurship.

[10]We shall assume that θ is drawn from a common distribution which is known to all individuals in the economy.

[11]"Capitalist" is loosely used in the text since we assume that personal wealth is continuously distributed between zero and a large amount. The reader can easily understand its different meaning in the different contexts.

W_0 is free to guarantee himself a *riskless* return equal to W_0 by holding the money without depreciation.[12]

Assume that an entrepreneur has a liability for repaying all his debts to lenders and the contractual wages to workers of the firm until his personal wealth becomes zero (in a one-period model, we must assume that he cannot repay debts by further borrowing). We call this "limited liability".[13] Enforceability of liability is dependent on observability of personal wealth. The implications of *limited liability* assumption are as follows. First, it does not make any sense to distinguish between the residual return from the entrepreneurial function and the residual return from his personal wealth as capital investment, and therefore we shall summarize them into a single term called "profit".[14] Second, although the entrepreneur is called "the residual claimant", he may not need to be fully responsible for all costs of his business in the case of bankruptcy if his personal wealth is not sufficient to cover all the contractual payments. In other words, there may be a difference between his promised payment and his actual payment. It is this difference that generates both the moral hazard problem and the adverse selection problem in the entrepreneurial choice. Third, related to the second, because the contractual payment cannot be riskless due to the probability of default by the entrepreneur, from the point of view of workers and passive capitalists, it matters with which entrepreneur they should match. This is the underlying force of an entrepreneurial selection mechanism in the market. Given the market wage and the market interest rate, a passive capitalist worker's expected return depends negatively on the probability of default by the entrepreneur he matches with. The intuition suggests that other things being equal, the more wealthy is his matched entrepreneur, the more secure is a passive capitalist worker's contractual payment, and therefore he should choose to match with the rich rather than the poor. But our results are much stronger than this. Because other things are not equal, wealth itself may not suffice for a low probability of default. In particular, given that entrepreneurial activities dominate the uncertainty of the firm's return, we may assume that the entrepreneur's ability is crucial for business success. If people prefer to follow the rich to enter the firm, there must be something linking personal wealth with (expected) ability of a would-be entrepreneur, from an outsiders' point of view.

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[12] This assumption can be replaced by a riskless interest rate.

[13] More accurately, this should be called "unlimited liability with non-negative consumption". Such an assumption underlies most agency-type models on capital markets; e.g., see Stiglitz-Weiss (1981) for a credit-rationing model, Eswaran-Kotwal (1989) for a capital-hiring-labour model, Leland and Pyle (1977) for a capital structure model, Aghion and Bolton (1992) for a control allocation model, Diamond (1984), and Gale and Hellwig (1985), among others.

[14] This might be the source of the long-running debate over what the profit is.

An individual faces the choice first of whether he should be an entrepreneur or a passive capitalist/wage worker, and second, if the latter, to which entrepreneur he should lend his capital (if he has any) as well as to whom he should sell his labour.[15] A complete analysis of the individual choice requires us to model both the capital and the labour market. However, most insights of the analysis can be derived from modeling one market alone.[16] Since what we are interested in is the relationship between capitalists and entrepreneurs, we shall limit ourselves to the capital market by assuming that a contractual wage is paid prior to production so that workers face no default.[17] This implies that the entrepreneur must finance the hiring of labour before any physical investment takes place, and his total financial capital requirement is equal to the sum of physical investment and hired labour cost (wage times the number of workers). If his personal wealth is not sufficient for both physical investment and labour cost, he must borrow from some passive capitalists. Passive capitalists cannot avoid the probability of default and therefore it matters which borrower they choose.[18]

Assume that everyone has access to a production technology which requires a fixed amount of *aggregated* capital comprised of both physical capital investment and labour cost, denoted by K.[19] The business can be either a success or a failure. If a success, it will yield a return $y = f(K) > 0$; if a failure, it yields a zero return. Denote by r the market interest rate and by w the market wage. We shall assume that $f(K) \geq (1 + r)K + w$. In other words, we assume that in the case of success, the total return will be sufficiently large to cover both the contractual payment and the entrepreneur's opportunity cost (otherwise there will be nobody choosing to be an entrepreneur). In the following, we normalize $w = 0$.

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[15] A passive capitalist does not need to lend capital and sell labour to the same entrepreneur.

[16] In an earlier version of this paper, I modeled both the labour market (the choice of workers) and the capital market (the choice of lenders). I found the marginal benefit of modeling more than one is little more than making the description more like reality.

[17] Therefore they do not care about which entrepreneur they should match with. Alternatively, we can assume that the lowest return of the firm (in the worst state) is not less than labour cost.

[18] The assumption of the wage being paid prior to production is equivalent to workers delegating their choice of match to passive capitalists. In reality, workers normally have priority when the entrepreneur cannot pay all contractual payments, even if they are paid at the end of the period. An interesting question is why workers have priority in most cases.

[19] It is convenient to refer to K simply as "capital". If k is physical investment, w is wage per worker and l is the number of workers, $K = k + wl$. We implicitly assume that the entrepreneur always chooses an optimal combination of k and l. In addition, K can be a variable (see Zhang, 1994).

The importance of entrepreneurial ability is that it determines the probability of success p. In particular, for simplicity, we assume that $p = \theta$.[20] This implies that the probability of default by an entrepreneur is uniquely determined by his entrepreneurial ability, given that his personal wealth is not sufficient to finance all investment. More notably, if entrepreneurial ability were public information, we shall expect that there would be a cut-off point of entrepreneurial ability such that all individuals with ability greater than the cut-off would become entrepreneurs, as in Lucas (1978), regardless of their personal wealth. In such a case, entrepreneurs would be ability-constrained, rather than liquidity-constrained.

The total expected return of the firm is a linear increasing function of the entrepreneur's ability defined as follows:

$$Ey = \theta f(K). \tag{1}$$

Because of the limited-liability constraint, the entrepreneur's expected personal return, denoted by W_1^e, depends on whether his wealth endowment W_0 is smaller or bigger than capital investment K. W_1^e can be defined as follows: [21]

(i) If $W_0 < K$,

$$W_1^e = \theta \left(f(K) - (1 + r)(K - W_0) \right). \tag{2}$$

(ii) If $W_0 \geq K$,

$$W_1^e = \begin{cases} \theta f(K) + \delta_K (1 + r)(W_0 - K), & \text{if lending out excess funds} \\ \theta f(K) + (W_0 - K), & \text{if holding excess funds} \end{cases} \tag{3}$$

where δ_K denotes the (weighted) expected probability of success of the entrepreneur(s) to whom the excess funds of the entrepreneur concerned are lent.

Note we have implicitly assumed that the entrepreneur makes investment first with his own assets before he can borrow from passive capitalists, and that he will not lend out his excess assets unless $W_0 > K$. This assumption is not necessary for the results.[22] In fact, under our definition of limited liability and the assumption that personal wealth is public information, it does not make any difference whether the entrepreneur invests first with his own funds or he puts his own funds into banks and invests with borrowed funds.

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[20] Recall that we have normalized entrepreneurial ability to be distributed between zero and one.

[21] Note that we have normalized wage to zero for convenience.

[22] In the literature, the assumption is called "*maximum equity participation*" (MEP) (e.g., Gale and Hellwig, 1985).

If an individual with W_0 chooses to be a passive capitalist/wage worker, his expected return, denoted by W_1^l, is

$$W_1^l = \begin{cases} \delta_K(1+r)W_0, & \text{if lending out his wealth} \\ W_0, & \text{if holding his wealth} \end{cases} \tag{4}$$

δ_K can be defined as follows:

$$\delta_K = E\theta^B, \tag{5}$$

where E is the expectation operator, and superscript B denotes the entrepreneur to whom the funds are lent ("borrower"). The entrepreneur borrows from the outsiders if and only if $W_0 < K$, which implies that $\delta_K = 1$ if and only if $E\theta^B = 1$. In other words, the lender has to bear risk for default unless he is certain that the borrower has the highest entrepreneurial ability ($\theta^B = 1$).

An individual will choose to be an entrepreneur if and only if the following condition holds:

$$W_1^e \geq W_1^l, \tag{6}$$

where W_1^e and W_1^l are defined by (2)-(3), and (4), respectively.

Given his personal wealth W_0, the individual's choice of being an entrepreneur or a worker depends not only on his own entrepreneurial ability θ, but also on his expectations of the potential borrower's entrepreneurial ability $E\theta^B$ which determines δ_K. Given δ_K, (6) defines a critical value θ^* such that he will choose to be an entrepreneur if and only if $\theta \geq \theta^*$. We call θ^* "the individual critical ability" for being an entrepreneur. How does θ^* depend on W_0? How is $E\theta^B$ related to W_0^B?

3. CRITICAL ENTREPRENEURIAL ABILITY AND PERSONAL WEALTH

In this section and next section, we shall assume that all entrepreneurs face a uniform interest rate (and market wage) independent of their personal assets. We will relax this assumption in Section 5. In this section, we shall focus on the relationships between an individual's critical entrepreneurial ability θ^* and his personal wealth W_0, and between θ^* and δ_K.

Case (i): If $W_0 < K$, θ^* is defined by the following equality:[23]

$$\theta^* \left(f(K) - (1+r)(K - W_0) \right) \equiv \delta_K(1+r)W_0. \tag{7}$$

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[23]We assume that δ_K is big enough that the individual prefers to lend out his asset rather than hold it when he chooses to be a worker. If this is not the case, we replace $\delta_K(1+r)$ with 1.

Rearranging (7), we obtain

$$\theta^* = \frac{\delta_K(1+r)W_0}{f(K) - (1+r)(K - W_0)}. \tag{8}$$

Differentiating θ^* with respect to W_0 and rearranging gives

$$\frac{\partial \theta^*}{\partial W_0} = \frac{\delta_K(1+r)(f(K) - (1+r)K)}{(f(K) - (1+r)(K - W_0))^2} > 0, \tag{9}$$

since $(f(K) - (1+r)K) > 0$.

That is, the individual's critical ability for being an entrepreneur increases with his personal wealth.

Case (ii): If $W_0 > K$, θ^* is defined by [24]

$$\theta^* f(K) + \delta_K(1+r)(W_0 - K) = \delta_K(1+r)W_0. \tag{10}$$

Rearranging gives

$$\theta^* = \frac{\delta_K(1+r)K}{f(K)}. \tag{11}$$

Therefore

$$\frac{\partial \theta^*}{\partial W_0} = 0. \tag{12}$$

In summary, we have

PROPOSITION 1. *(i) an individual will choose to be an entrepreneur if and only if his entrepreneurial ability is greater than his individual critical level; and (ii) the individual critical ability for being an entrepreneur is increasing with personal wealth until personal wealth is greater than the capital requirement.*

Roughly speaking, proposition 1 says that, at any given ability level, a poor person has more incentive to be an entrepreneur than a rich man. The intuition behind this result is that the opportunity cost of being an entrepreneur is higher for the rich than for the poor. For those with little personal wealth, the opportunity cost of being an entrepreneur is nothing

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[24]Here we assume that the individual faces the same expected probability of success of the potential borrowers regardless of whether he is lending out excess funds (when he himself is also an entrepreneur) or lending out all funds (when he chooses to be a worker).

more than the market wage of a worker (here normalized to zero), while for those with large personal wealth, being an entrepreneur incurs a large wealth loss if the business is not successful. Because the cost of being an entrepreneur increases with personal wealth, the optimum requires the return to increase too, which implies that the critical entrepreneurial ability must be higher as he becomes richer. An implication of the proposition is that the poor person is more likely to over-report his entrepreneurial ability than the rich; or to put it differently, the entrepreneurial choice of the rich person is more informative in signaling entrepreneurial ability than the choice of the poor. We will see that this is the fundamental reason why capitalist would-be entrepreneurs succeed in the competition for entrepreneurship.

We now turn to the relationship between θ^* and δ_K. It is easy to show that:

(i) If $W_0 < K$,

$$\frac{\partial \theta^*}{\partial \delta_K} = \frac{(1+r)W_0}{f(K) - (1+r)(K - W_0)} > 0; \tag{13}$$

(ii) If $W_0 \geq K$,

$$\frac{\partial \theta^*}{\partial \delta_K} = \frac{(1+r)K}{f(K)} > 0. \tag{14}$$

PROPOSITION 2. *The individual critical ability for being an entrepreneur is increasing with the expected probability of success of the potential borrower.*

Proposition 2 says that an individual is more likely to choose to be an (self-employed) entrepreneur when otherwise he has to lend to an entrepreneur(s) with low probability of success than when he can lend to those with a high expected probability of success. The argument is quite intuitive. The probability of success of the matched entrepreneur determines the riskiness of the contractual return for being a passive capitalist/wage worker (or more generally the expected return of the contractual return). A higher expected probability of success implies a higher expected contractual return, which in turn implies that it is less necessary for someone to be a self-employed entrepreneur.

4. LIQUIDITY CONSTRAINTS AND MARKET SELECTION FOR ENTREPRENEURSHIP

According to each individual wishes, the population is divided into two sets: the set of would-be entrepreneurs (active capitalists) and the set

of would-be workers (passive capitalists). In an economy where individuals have free choice of which entrepreneur to match with, a would-be entrepreneur can become an actual entrepreneur if and only if he can successfully raise the required capital. With propositions 1 and 2, we now show why the rich would-be entrepreneurs are more likely to be successful than their poor fellows (to put it differently, why passive capitalists are reluctant to lend their capital to the poor would-be entrepreneurs), given that entrepreneurial ability is private information. The basic argument is that although an individual's actual entrepreneurial ability might be independent of his personal wealth, from the point of view of outsiders the expected ability of a would-be entrepreneur is not independent of his personal wealth.

Denote by $\phi(\theta)$ and $\Phi(\theta)$ the density function and the distribution function of entrepreneurial ability among population, with support $[0, 1]$, which are assumed to be independent of the distribution of personal wealth W_0.[25] Then, from the point of view of outsiders, the expected ability of a would-be entrepreneur, conditional on his personal wealth W_0^B, can be defined as follows:[26]

$$E\theta^B(W_0^B) = E\left(\theta^B \mid W_0^B\right) = \frac{\int_{\theta^*}^1 \theta\phi(\theta)d\theta}{1 - \Phi(\theta^*)}, \qquad (15)$$

where θ^* is defined by (8), or (11), depending on $W_0^B < (\geq)K$.

Differentiating (15) with respect to W_0^B and rearranging, we have

$$\frac{\partial E\theta^B\left(W_0^B\right)}{\partial W_0^B} = \frac{\phi\left(\theta^*\right) \frac{\partial \theta^*}{\partial W_0^B} \int_{\theta^*}^1 \left(1 - \Phi(\theta)\right) d\theta}{\left(1 - \Phi(\theta^*)\right)^2}. \qquad (16)$$

Then, by (9), and (12), we have

$$\frac{\partial \theta^B(W_0^B)}{\partial W_0^B} \begin{cases} > 0 & \text{if } W_0^B < K, \\ = 0 & \text{if } W_0^B \geq K. \end{cases} \qquad (17)$$

Therefore, we have

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[25] One may like to argue that the distribution of ability and the distribution of personal wealth is positively correlated either because of dynamic effects (today's wealthy people are yesterday's successful businessmen) or because the wealthier people have better opportunities for good education. If this is the case, wealth itself signals ability.

[26] Since θ^* is dependent on δ_K, an outsider must base his judgment of a would-be entrepreneur's θ^* on the δ_K in the latter's conditional expectation (that is, to know person A's θ^*, an outsider has to know A's expectation of his potential borrower's probability of success if he chooses to be a worker). But given that the only available information is personal wealth, rational expectation implies that the outsider will hold the same expectation of all would-be entrepreneurs' δ_Ks. In the following, we shall make this assumption.

PROPOSITION 3. *The expected ability of a would-be entrepreneur is an increasing function of his personal wealth for $W_0^B < K$ and constant for $W_0^B \geq K$.*

Proposition 3 says that although outsiders have no accurate information about the ability of a particular would-be entrepreneur, they can be sure that, on average, a would-be entrepreneur with large personal wealth has higher ability than one with small personal wealth. It is rational to infer entrepreneurial ability according to personal wealth. Immediately, we have

COROLLARY 1. *The expected probability of default by the borrower is a strictly decreasing function of his personal wealth.*

Note that here the link between personal wealth and the probability of default is not direct, but rather indirect: personal wealth affects the individual's choice of being an entrepreneur which in turn determines the expected probability of default.

A would-be entrepreneur's personal wealth not only affects his perceived entrepreneurial ability and therefore his attractiveness to a potential lender, but also affects others' entrepreneurial choices at the margin. By proposition 2, we know that an individual's critical entrepreneurial ability is increasing with the expected probability of success of his potential borrower. Combining this with corollary 1, we have

PROPOSITION 4. *(i) An individual's critical ability for becoming an entrepreneur increases with the potential borrower's personal wealth; and (ii) the slope of this relation depends positively on his own personal wealth.*

Part (i) says that given his personal wealth and entrepreneurial ability, an individual is more likely to choose to be a passive capitalist worker when he can lend his wealth to a wealthier person than when he can only lend it to a less-wealthy person; part (ii) says that the rich are more sensitive to potential borrowers' personal wealth than the poor in making choices between being an entrepreneur or a worker. The intuition is that larger personal wealth of a potential borrower or employer signals a higher expected entrepreneurial ability and a lower expected probability of default, and therefore a higher expected contractual payment.

The strong implication of the preceding discussion is that although an individual with lower personal wealth has greater incentives to choose being an entrepreneur, other people are more reluctant to accept him, since they read his low personal wealth as a signal of low (expected) entrepreneurial ability and therefore of high probability of default. From the point of view of would-be lenders, a rich would-be entrepreneur is always more attractive

than a poor one; and it is always in their self-interest to lend to the former rather than the latter. Because a would-be entrepreneur can become an actual entrepreneur (materialize his dream) only if there are sufficient numbers of lenders (if he needs external funds) who voluntarily lend to him, we predict that only those would-be entrepreneurs who have sufficiently large personal wealth will succeed in the competition for entrepreneurship.

PROPOSITION 5. *Given that entrepreneurial ability is private informa-tion and personal wealth is public information, market competition for en-trepreneurship implies that a would-be entrepreneur can become an actual entrepreneur only if his personal wealth is greater than some specified level.*

To be concrete, assume that entrepreneurial ability is uniformly dis-tributed in the population. It is easy to show that:

$$E\left(\theta^B \,\middle|\, W_0^B\right) = \frac{1}{2} + \frac{1}{2}\theta^* = \begin{cases} \frac{1}{2} + \frac{1}{2}\frac{\delta_K(1+r)W_0^B}{f(K)-(1+r)(K-W_0^B)} & \text{if } W_0^B < K, \\ \frac{1}{2} + \frac{1}{2}\frac{\delta_K(1+r)K}{f(K)} & \text{if } W_0^B \geq K. \end{cases} \tag{18}$$

That is, in the case of uniform distribution of ability, the expected ability of a would-be entrepreneur is a weighted average of the highest ability ($\theta = 1$) and the critical ability (θ^*), with equal weights.

What does the market mechanism for entrepreneurial selection look like? If we rank all would-be entrepreneurs in terms of their personal wealth from the highest to the lowest, it is like a "pecking order". The first group of would-be entrepreneurs to be successfully selected by the market are those whose personal wealth is sufficiently large to cover both physical investment and the *riskless* contractual payment for workers, that is, $W_0 \geq K$.[27] This group of entrepreneurs are perceived by the market to be those with the highest expected entrepreneurial ability among all would-be entrepreneurs, equal to[28]

$$E\theta = \frac{1}{2} + \frac{1}{2}\frac{\delta_K(1+r)K}{f(K)}. \tag{19}$$

Since capital itself is productive, an economy in which entrepreneur is restricted only to this group cannot be in equilibrium. The second group selected for entrepreneurship consists of would-be entrepreneurs whose per-sonal wealth is sufficiently high to cover labour costs, but is not sufficient for covering the full costs (physical investment plus labour costs). The third

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[27]These would-be entrepreneurs do not depend on external funds, and are "selected" by workers.

[28]In the following analysis, for concreteness, we assume that marketing ability is uniformly distributed among population.

group consists of those would-be entrepreneurs who need to borrow both for physical investment and labour payment. The last two groups are the most interesting cases since the existence of these groups is a precondition for capital markets to occur.[29]

A general result is that the set of all would-be entrepreneurs is cut into two subsets by a lower-bound of personal wealth: those whose personal wealth is equal to or greater than the bound become actual entrepreneurs, and others rejected. To plot the equilibrium lower-bound, we need a general equilibrium model. Nevertheless, the following partial equilibrium analysis can provide some insights.

First note that since the decision to be an entrepreneur is made after comparing with the expected return from being a passive capitalist/wage worker, the following inequality must hold:

$$
\begin{aligned}
E\theta^B &= \frac{1}{2} + \frac{1}{2} \frac{\delta_K(1+r)W_0^B}{\left(f(K) - (1+r)(K - W_0^B)\right)} \\
&\leq \frac{1}{2} + \frac{1}{2} \frac{(1+r)W_0^B}{\left(f(K) - (1+r)(K - W_0^B)\right)}.
\end{aligned}
\tag{20}
$$

That is, the expected ability of the would-be entrepreneur with W_0^B cannot be greater than in the case where the contractual return for his lending is riskless ($\delta_K = 1$).

For a potential lender, the possibility of holding wealth instead of lending out implies that the following condition must hold for lending to take place:

$$
\delta_K(1+r) = E\theta^B(1+r) \geq 1, \text{ or } E\theta^B \geq \frac{1}{1+r}.
\tag{21}
$$

Thus, a necessary (but not sufficient) condition for a potential lender to meet the would-be entrepreneur's borrowing requirement is

$$
\frac{1}{2} + \frac{1}{2} \frac{(1+r)W_0^B}{\left(f(K) - (1+r)(K - W_0^B)\right)} \geq \frac{1}{1+r}.
\tag{22}
$$

By rearranging (22), we have

$$
W_0^B \geq \frac{(1-r)}{2r(1+r)} \left(f(K) - (1+r)K\right).
\tag{23}
$$

---

[29]In the previous analysis, we have implicitly assumed the existence of these groups; otherwise, we should replace $\delta_K(1+r)$ with 1. Since we have assumed that workers are paid before production, we shall not make a distinction mathematically between the second and the third groups.

This is the lower-bound of personal wealth imposed by the potential lenders. Potential lenders will reject the borrowing request if the would-be entrepreneur's personal wealth is smaller than this bound.

To give a concrete example, let us assume that $K = 50$, $r = 0.1$, and $f(50) = 60$. Then, the bound imposed by potential lenders is:

$$W_0^B \geq 20.5.$$

That is, a lender will never lend to a would-be entrepreneur whose personal wealth is less than 20.5. If capital of $K = 50$ is necessary for the firm to be profitable, we shall expect that there will be no person in the entrepreneurial team whose personal wealth is smaller than 20.5.

5. INTEREST RATES AS MECHANISMS FOR SELECTION OF ENTREPRENEURS

So far we have assumed that the interest rate (and wage) is fixed at a uniform level. The preceding analysis shows that the uniform rate cannot be in equilibrium, since this implies that different lenders earn different expected returns (different borrowers are perceived with different expected probability of default). In this section, we relax this assumption to discuss how changes in the interest rate (and wage) affect the critical ability for one to choose to be an entrepreneur, and in particular how the interest rate (and wage) may be used to some extent as mechanisms to restrict low-wealth people from being entrepreneurs.[30] Discussions are focused on the case of $W_0^B < K$.

First consider effects of changes in the interest rate on the critical entrepreneurial ability. Differentiating θ^* with respect to r, we have

$$\frac{\partial \theta^*}{\partial r} = \frac{\delta_K W_0 f(K)}{(f(K) - (1+r)(K - W_0))^2} > 0. \tag{24}$$

We have

PROPOSITION 6.   *The critical entrepreneurial ability increases with the interest rate for all individuals.*

The reason behind this argument is simple: increases in the interest rate will increase both direct costs and opportunity costs of being an entrepreneur, and therefore raise the marginal level of entrepreneurial ability at which being an entrepreneur is more profitable than being a worker.

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[30]The following arguments about changes in the interest rate also apply to changes in wages.

Although a change in the interest rate affects the *average* ability of the pool of would-be entrepreneurs, it does not change the fact that among all would-be entrepreneurs, those with low personal wealth have lower average ability than those with high personal wealth, since proposition 1 applies to all levels of interest rates (up to a upper bound[31]). Therefore we claim that a *uniform* interest rate (and wage) cannot be an effective mechanism for separating low ability would-be entrepreneurs from high ability would-be entrepreneurs.

Second, we show how *wealth-dependent* interest rates (and wages) may work as a mechanism to stop penniless lemons from choosing being entrepreneurs. By wealth-dependent, we mean less wealthy people have to pay higher interest rates (and higher wages) than the wealthier people if they choose to be entrepreneurs.[32]

By propositions 1 and 5, for a given critical (or expected) entrepreneurial ability, the following condition holds:[33]

$$\frac{\partial r}{\partial W_0}\bigg|_{\theta^*} = -\frac{\frac{\partial \theta^*}{\partial W_0}}{\frac{\partial \theta^*}{\partial r}} < 0. \tag{25}$$

PROPOSITION 7. *A necessary condition for maintaining the same critical ability among all people is that the interest rates to be charged depend negatively on the borrower's personal wealth.*

The essence of wealth-dependent interest rates is that under such a system, the less wealthy incur a higher borrowing cost for being entrepreneurs so that penniless lemons will "voluntarily" withdraw from being would-be entrepreneurs. This kind of discrimination is one of the most important characteristics of capital markets. In the literature, it has been called an "imperfection" of capital markets. But this imperfection should be understood as a mechanism for selecting entrepreneurs, and it operates against high-ability, low-wealth would-be entrepreneur.

In reality, this mechanism is introduced by high ability-but-low-wealth would-be entrepreneurs as well as potential lenders. Under the system of uniform interest rates, the would-be entrepreneurs whose personal wealth is below some critical level will be rejected by potential lenders, regardless of

---

[31] In the present model, this upper bound is an interest rate $\bar{r}$ (or wage $\overline{w}$) at which only those with the highest ability ($\theta = 1$) can be indifferent between being entrepreneurs and being workers and all others strictly prefer being workers, that is, $f(K, L) - (1 + \bar{r})(K - W_0) - \overline{w}L - \overline{w} \equiv 0$. This requirement is too strong to hold in reality.

[32] Since, given capital investment, one's demand for borrowing is decreasing with initial personal wealth, this means the interest rate charged to a borrower is an increasing function of the borrowing amount.

[33] Technically we shall assume that the particular individual's expected return on lending and expected wage from being a passive capitalist worker are given.

their individual entrepreneurial ability. Since the rejected high-ability people have a greater (expected) loss, it is worthwhile for them to pay higher interest rates in order to be entrepreneurs instead of enforced workers. By so doing, they can partially separate themselves from rejected low-ability people since the latter can not afford to mimic them. On the other hand, for potential lenders, what matters is the *expected* returns ($\delta_K(1+r)$). Although matching with the less wealthy would-be entrepreneurs incurs a higher probability of default, the expected return may not be lower if the interest rate and wage to be paid are sufficiently higher in the case of success. Therefore it may pay to trade off with a high probability of default. As a result, the average entrepreneurial ability of the group of low wealth would-be entrepreneurs is also increased.

One problem is that if the wealth-dependent interest rates and wages can be effective in stopping low-ability people from being entrepreneurs, why in reality are some would-be entrepreneurs rejected by potential lenders even when they wish to pay higher interest rates and higher wages? There are several possible reasons for this. One reason, provided by Stiglitz and Weiss (1981), is that an increase in the interest rate may affect the quality of projects itself through both adverse selection and moral hazard effects on the borrower's choices of risky projects so that the lender's expected return may decrease rather than increase as a result of interest rate increases. Another reason, provided by Eswaran and Kotwal (1989), is that an increase in the interest rate may have a negative effect on the entrepreneur's (borrower's) work incentives and therefore increase the probability of default. In our simple model, to focus on the relationship between entrepreneurial ability and personal wealth, we have ignored these two effects. Although we believe that the informativeness of wealth in signaling entrepreneurial ability is more fundamental in explaining liquidity constraint, the two arguments above can be complementary to our model.[34] Nevertheless, by extending our model to a more general case in which the number of states is more than two, we can offer an alternative explanation for why wealth-dependent interest rates and wages may eventually force all the poor to drop out from entrepreneurship because of bankruptcy costs for the lenders.

Consider a continuum of states of nature $s \in [0, 1]$. Assume that the return of the firm is strictly increasing with s for any given capital input and labour input: $\frac{\partial f(K,s)}{\partial s} > 0$ for all K, s. Let $G(s, \theta)$ be the distribution of

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[34] In fact, these two arguments can be incorporated into our model simply by assuming that the distribution function $\Psi(y)$ of the return is a function of entrepreneurial ability θ, work effort a as well as a parameter of riskiness α: $\Psi(y; \theta, a, \alpha)$. If we assume that $\Psi(.)$ satisfies the first-order stochastic condition over θ and a, and α is the mean-preserving parameter (that is, a higher α represents higher riskiness), we can show that: (i) the critical ability is an increasing function of W_0, r; (ii) the optimal effort is increasing with W_0, but decreasing with r (given marginal disutility of effort increases); (iii) the choice of α increases in r.

states of nature parameterized by entrepreneurial ability θ. Assume that $G(s,\theta)$ satisfies the first-order stochastic dominance condition in θ, i.e., $\frac{\partial G}{\partial \theta} < 0$ for $s \in [0,1)$, which means that the high entrepreneurial ability makes states in the upper tail of the probability distribution more likely to occur.[35] Denote by s^* the critical state of bankruptcy such that

$$f(K, s^*) \equiv (1+r)(K - W_0),$$

$$f(K, s) \leq (1+r)(K - W_0) \text{ for all } s \leq s^*.$$

Then, s^* is an increasing function of the interest rate paid by the entrepreneur. So is the probability of bankruptcy $G(s^*, \theta)$. Since under wealth-dependent interest rates, within a group of entrepreneurs of a given ability, those with low wealth pay higher interest rates than those with high wealth, the probability of bankruptcy by the former will be further increased.[36] Assume that when the firm goes bankrupt, it costs x for the lender to verify. Thus the expected bankruptcy cost for the lender, $G(s^*, \theta)x$, is increased by the interest rate increase. As a result, if x is big, the potential lender may prefer to simply reject lending to the less wealthy borrower rather than charge a higher interest rate. Alternatively, even if the lender can be compensated by further increasing the interest rate, the high ability-less wealthy people may find it no longer profitable to be entrepreneurs. That is, the wealth-dependent interest rate itself may force all less-wealthy people to drop out from entrepreneurship.[37]

In summary, we can predict that capital markets are characterized by both wealth-dependent interest rates and credit-rationing. This prediction is coincident with casual observation.

6. CONCLUDING REMARKS

This paper formalized an idea pioneered by Frank Knight (1921) that any attempt to insure the outcome of entrepreneurship would fail because of the impossibility of excluding entrepreneurial lemons. Assuming that entrepreneurial ability is private information while personal wealth is public information, the paper shows that entrepreneurs are liquidity-constrained because the critical ability for one to choose being an entrepreneur rather

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[35] In the two-state case, this simply means that the probability of success is increasing with entrepreneurial ability.

[36] The effect on the probability of bankruptcy of higher debt has already been taken into account by the lenders.

[37] Theoretically credit-rationing can be interpreted as the borrower has to pay an extremely high interest rate so that even if the best state occurs, the return cannot cover the cost.

than a wage worker increases with his personal wealth and therefore markets read low wealth of a would-be entrepreneur as a signal of low entrepreneurial ability and high probability of default. The model can explain why capital markets cannot be *perfect* in the sense that wealth-dependent interest rates and credit-rationing, instead of uniform rates and free borrowing, are present, and why would-be lenders are keen to embrace rich rather than poor would-be borrowers. Furthermore, such imperfectness may be socially preferred for excluding low-ability would-be entrepreneurs from the entrepreneurial pool.[38] Since the capitalists' priority in being entrepreneurs comes from the information asymmetry about entrepreneurial ability, an implication of the model is that high-ability people whose ability has been revealed through their previous successes are less constrained by their personal wealth endowments when they want to expand their businesses. This implication is consistent with casual observation. It is promising to extend the present model to a dynamic context to see how liquidity constraints change with business experiences.

Insofar as the problem of why entrepreneurs are liquidity-constrained is concerned, this paper is complementary with the existing models, which, as pointed out earlier, focus on the entrepreneur's incentive problems associated with choices of work efforts and project qualities. In fact both types of the models can be thought of, in some sense, as formalizations of Knight's original ideas that the outcome of entrepreneurship is not insurable because of moral hazard and adverse selection problems. However, we believe that our theory about the informativeness of wealth in signaling the entrepreneurial ability of the would-be entrepreneur may be more fundamental in explaining why entrepreneurs are liquidity-constrained and why capital hires labour. Entrepreneurship is the primary function of the enterprise (Knight, 1921). What distinguishes entrepreneurs is their innate ability of making decisions and of capturing profitable opportunities. Everyone can work hard, but only a small fraction of population can manage the firm well. Some capitalists lend out their capital instead of doing businesses themselves not because they believe that the borrower will work harder or less inclined to choose risky projects than they themselves would, but because they believe that the borrowers are more competent than they are in capturing business opportunities and making decisions. The incentive problem of borrowers such as developed by Eswaran and Kotwal (1989) may explain why some "marginal" lenders take over supervision of production, but it cannot explain at all why there are pure lenders.[39]

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[38]We should be cautious in this point since liquidity constraints also exclude high-ability but low-wealth people from entrepreneurship.

[39]According to the Eswaran-Kotwal (1989) model, a capitalist will lend out only when his total capital exceeds the amount of his own investment; and he always invests more than borrower-entrepreneurs.

Although we have focused on the classical entrepreneurial firm, the model may provide a new explanation for the occurrence of joint-stock companies in an economy. Assume that the distribution of ability and the distribution of wealth in the population are not symmetric, that is, rich people are not necessarily high-ability and high ability people are not necessarily rich.[40] Then there inevitably exist two potential earning gaps, one between different providers of capital, and the other between different abilities. The capital owned by the more able will earn its factor price plus a "pure" rent from signaling, while the capital owned by the less able will earn only its factor price because its owner has no ability to signal; on the other hand, the ability of the rich will yield a residual rent, while the ability of the poor will yield only a "market wage", because the poor have no capital with which to signal. In particular, "entrepreneurs" may use their monopoly market power to exploit other capital and other ability by pushing down factor prices. These possible earnings gaps make it profitable for both ability and capital to look for possible cooperation with each other. In particular, possession of some personal information about others' ability might be profitable for capitalists. Although a rich person with low ability cannot make a profit by being an entrepreneur himself, he may increase his return by using his capital to signal other people's ability, if he knows some high ability people (e.g., his relatives), or if search for high ability is not too costly; on the other hand, a high ability person can also increase his return if he can convince some rich person that he is really good at marketing. Furthermore, the incentive for each side to search is an increasing function of their respective resources (ability or wealth), because the more personal wealth (ability) someone has, the more rent he can earn, if search is successful. As a result, they become a *joint* entrepreneur: the high ability person is called the manager by doing marketing, and the wealthy are called "shareholders" by claiming the residual and taking responsibility for selection of the qualified manager. This is the origin of the joint-stock company. In such an joint-stock company, the primary function of shareholders is to select high ability managers, rather than to monitor managers' activities as widely assumed.

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[40]In the earlier discussion, we have assumed that they are independent.

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