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Abstract: This paper addresses one of the core questions in developing entrepreneurship theory, i.e. why and when do some choose to become entrepreneurs. Differing from other research efforts on it, we look at entrepreneurial decision making as population behavior and the individuals' strategy of human capital investment to realize latent ability constrained by certain environmental context. Assuming that individuals with/without latent innovative or/and entrepreneurial ability might make corresponding human capital investment and become different kind of employees or entrepreneurs, we bring forward an evolutionary stable model of the individuals' entrepreneurial human capital investment from the society lay. We further develop an evolutionarily game model of the individuals' human capital investment decision-making from the point of those who would be an entrepreneur applying replicator dynamics equation. The analysis and calculation result of the models show that entrepreneurship is contingent upon environmental context, there will be different entrepreneurial distribution when individuals are aware of their latent ability or not, and a government can always improve the entrepreneurial level via paying more attention to education and changing the environmental context.

Keywords

Entrepreneurship, Evolutionary game theory, Human capital

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1. Introduction

Why and when do some choose to become entrepreneurs is one of the core questions in developing entrepreneurship theory (Shane 2002, Amit 1993, 1995). For answering this kind of questions, Robert A. Baron (2004) proposed a cognitive perspective recently. Mariassunta Giannetti and Andrei Simonov (2003) modeled the determinants of entrepreneurial choices so as to investigate whether social norms play an important role in the decision to become an entrepreneur. Minniti (2003) investigated the relative role played by alertness and asymmetric information on entrepreneurial decisions at the same time and presented a spin-glass model in which an individual decides whether to become an entrepreneur based on her alertness and on the information available in her environment. Another model of the choice to become an entrepreneur is also presented by Lacear (2003), through which the author got the primary conclusion that individuals with balanced skills are more likely than others to become entrepreneurs. Earlier, Baumol (1990) and Murphy, Shliefer and Visny (1991) argued, institutions that affect occupations' relative payoffs or access to credit influence occupational choices. In fact, social scientists have long recognized the importance of social factors in occupational choice. For example, Balazs (1964) explained that perhaps the supreme inhibiting factor resulting in the low level of entrepreneurship in old China was the overwhelming prestige of the state bureaucracy, which is indeed a profound insight even today. Other scholars (Evans and Leighton, 1989; Evans and Jovanovic, 1989) contribute to the topic of entrepreneurial choices by analyzing the characteristics of individuals who are likely to become self-employed. Additionally, Lucas (1978) ever offered a model of where an individual can choose to work for someone or to be an entrepreneur.

Although we understand entrepreneurial decision more and more via the interesting scholastic pursuits as above, there still is a long way to go for this. In our opinion, it's a pity that almost no literature regards entrepreneurial choice as a kind of population behavior and evolutionary game phenomenon. The decision-making of individuals' choices to become entrepreneurs is not only based on individuals themselves but is also based on the context of entrepreneurs as a social lay. On the other hand, it's more like the process of "trial and error" than individuals' optimal option when they decide to startup or not. This article contributes to our understanding of entrepreneurship by analyzing the games of individuals' human capital investment as well as entrepreneurial decision making and correspondingly setting up an evolutionary framework. Primarily, we develop an evolutionarily stable model of the individual's human capital investment from society lay; we further study an evolutionarily game model of the individual's human capital investment decision-making from the point of those who would to be an entrepreneur; then, we get results and analyze them by putting concrete value in the models. We mainly find or prove that, entrepreneurship is contingent upon environmental context, there will be different entrepreneurial distribution when individuals are aware of their latent ability or not, and governments or societies can always improve the level of entrepreneurship via paying more attention to education and changing the environmental context.

We study the decision-making equilibrium of the individual willing to be an entrepreneur applying evolutionary game theory, which has been widely used to explain the evolutionary process and result of population behavior in Ecology, Sociology, and Economics (Friedman, 1998). The use of game theory to model (some) aspects of entrepreneurship behavior was introduced by Littlechild (1979) who argued that cooperative game theory could be used to model the entrepreneurial process. Game theory makes it possible to model a limited version of novelty, for example by letting entrepreneur introduce actions that are novel to the other agents being modeled (Littlechild 1979, Fisher 1983). Young (1996) suggested that repeating coordination games, in which there may be multiple equilibria, is a way to make sense of entrepreneur since it can be thought of as selecting a specific equilibrium. Introducing multiple equilibrium mean that there may be a room for the entrepreneur who is broadly understood as the agent who helps pushing the system from one equilibrium to another. Schumpeter addressed this aspect of entrepreneurship as follows "The entrepreneur destroys the equilibrium which is the basis of economic theories".

2. The models

Assume there are two types of industries in society, i.e. new, emerging firms (N) and established, traditional firms (T), and two types of occupations, i.e. entrepreneurs (E) and employees (L). Individuals choose certain occupation/jobs (J) in certain industry. Therefore there are four types of occupations to be chosen in a society: innovative entrepreneur, imitative entrepreneur, innovative/expert employee and common employee, indicated as a job choosing collective J=$\{NE, TE, NL, TL\}$. Because if individuals want to take up certain occupation in certain industry, they must make an individual human capital investment, such as learning specialized knowledge, acquiring professional training and accumulating experience via "learning by doing", and they should pay for cost which we subdivide into industry-entering investment cost and job-choosing investment cost. We standardize human capital investment cost of entering traditional firms C_{TI} and those of choosing common employees C_{LI} as 0, indicate innovative human capital investment cost of entering emerging firms as $C_{NI}(d)$ ($C_{NI}(d)>0$), and common entrepreneurial human capital investment cost of choosing entrepreneurs as $C_{EI}(?)$ ($C_{EI}(?)>0$). $C_{NI}(d)$ and $C_{EI}(?)$ depend on individual latent innovative ability (d) and latent entrepreneurial (carving out) ability $(?)$, and are their decreasing function respectively. Herein, $(d, ?)$ is the distinct parameter of individual latent ability, and we assume that d and $?$ follow even (two-point) distribution in [0, 1]. Therefore, each individual has four human capital investment strategies, indicated as investment strategy collective as I=$\{I_j \mid j=NE, TE, NL, TL\}$. We consider that human capital investments are inter-independent and investment costs are addable, i.e. $C_{NE}(d, ?) = C_{NI}($

d) + C_{EI} (?) , C_{TE} (d , ?) = C_{EI} (?) , C_{NL} (d , ?) = C_{NI} (d) , C_{TL} (d , ?) =0, This means that the investment cost of individuals with the same latent ability choosing to become entrepreneurs in emerging firms is the highest, whereas that of becoming common employees in traditional firms is the lowest.

2.1 Evolutionary stable model of the individuals' human capital investment from society lay

Let's consider a two-stage game model above all. In the first stage of the game, individuals with latent ability (d , ?) invest certain type of human capital I_j ($j\in J$) in some way. In the second stage, they take certain occupation of certain firms according to their human capital reserve and social demands and supplies. If every type of individuals wants to choose certain occupation j , they must acquire corresponding human capital I_j or human capital at more advanced level. There are two types of this acquisition: the first is to acquire human capital before occupation choosing, but they may not obtain their expected occupation. The other is to supplement corresponding human capital after obtaining the occupations, that is, when they obtain the occupation which need more human capital than that they own, they supplement their deficient human capital investment.

If individuals with certain latent ability want to realize their potential values, they must obtain an occupation corresponding to their latent ability. We assume that they should make corresponding human capital investment to obtain certain type of occupation and pay for working costs on the post. Therefore, cost C_j (I, d , ?) for individuals with latent ability (d , ?) engaged in an occupation $j\in J$ consists of three parts: (1) working cost C(j, d , ?) ($j\in J$) for this occupation. It relates to latent ability and we assume that it is independent and addable to d and ? , i.e. C(NE, d , ?) =C(N, d) +C(E, ?) , and so on. (2) Investment cost C_j (d , ?) of human capital I_j ($j\in J$) corresponding to the occupation. (3) Transferring cost C (d , ? , I_j) for the difference from qualified human capital I_j ($j\in J$) in this occupation. Therefore the cost C_h(I_j , d , ?) of individuals with latent ability (d , ?) engaged in an occupation $h\in J$ after acquiring human capital I_j ($j\in J$) is indicated as details in table 1.

Now we standardize total population as 1, q_j indicates the population engaged in a job j($j\in J$) and we have $q_{NE}+q_{NL}+q_{TE}+q_{TL}=1$. Entrepreneurs compose enterprises randomly through employing employees, the latter get competitive fixed salary W_{NL} or W_{TL} ($W_{NL}>W_{TL}$) , and the former get entrepreneurial profit income. Then we bring in two hypotheses: (1) the proportion of expenses that the whole society pays for the products of the two types of industries is fixed. Assume the proportion of expenses for N industry is a , and that of T industry is b ,$a+b=1$; (2) Take the income of the whole employees in this type of industry out of the total income, then divide it evenly among the whole entrepreneurs and thus we get the entrepreneurial income. Furthermore, we standardize the wages W_{TL}

of employees in traditional firms as 1 and the expected social output as y, thus, the expected incomes of emerging industry and traditional industry are a y and b y respectively. The entrepreneurial expected income is:

$$\text{ER}_{NE} = \frac{ay - w_{NL} q_{NL}}{q_{NE}} \qquad \text{ER}_{TE} = \frac{by - w_{TL} q_{TL}}{q_{TE}}$$

Therefore, when individual with latent ability (d , ?) choose to invest human capital I_j ($j \in J$) and obtain relevant position j, in the state of q_{NE} , q_{NL} , q_{TE} , q_{TL} , the expected net income is:

$$u_{TL} = w_{TL} \tag{2.1}$$

$$u_{NL} = w_{NL} - C_{NI}(d) - C(N, d) \tag{2.2}$$

$$u_{TE} = \frac{by - w_{TL} q_{TL}}{q_{TE}} - C_{EI}(?) - C(E, ?) \tag{2.3}$$

$$u_{NE} = \frac{ay - w_{NL} q_{NL}}{q_{NE}} - C_{EI}(?) - C_{NI}(d) - C(E, ?) - C(N, d) \tag{2.4}$$

For individuals with latent ability(d , ?) , if there is discrepancy in the payoffs of choosing strategies, strategies should be adjusted. In short-term situations, human capital owners will re-choose occupations to adjust the discrepancy in the payoffs of various strategies. But the long-term evolutionary stable consequence is that the payoffs of strategies for individuals with the same abilities to make human capital investment are the same. Because of the influence of occupational inertia, psychological pressure and transferring cost, there are only part of individuals re-choosing their occupations even there is a large discrepancy in the payoffs. Thus, the probability of individual adjustment is in direct proportion to the discrepancy of the payoffs of two strategies.

To be succinct, we bring in the following hypothesis here: (1) the cost for individual without some latent ability to acquire relevant human capital is high. Even if he acquires relevant human capital, because the cost to undertake the occupation is rather high, it is profitless to make relevant human capital investment on individual without some latent ability. (2) Individuals with some kind of human capital must obtain corresponding occupations. In fact, this hypothesis acknowledges that high level human capital is deficient and high human capital owners will not take low-level occupations. These two hypotheses mean that individual decisions of occupation choosing attribute to whether to make human capital investment.

When reaching dynamics equilibrium after long-term adjustment, every type of population has its optimal human capital investment strategy and relevant occupation choice, i.e. (1) for individuals with different latent abilities, they should have their optimal human capital investment strategies and therefore their optimal occupation choice in equilibrium. (2) For individuals with same latent abilities, they can get relevant occupations when making some kind of human capital investment. If they choose to invest in high-level human capital, the payoffs will not be less than that before human capital investment. (3) For individuals with same latent abilities, there is no discrepancy in the payoffs of different human capital investment strategies; otherwise, individuals will only choose those with higher payoffs.

Because the distribution of latent ability (d , ?) in the whole population is random and the distribution of innovative ability and entrepreneurial ability is independent, with d and ? follows two-point distribution (0 and 1 represent without latent ability and with latent ability respectively) hypothesis, the whole population is divided into four types: (1) latent innovative entrepreneurs: d =1, ? =1; (2) latent expert employees: d =1, ? =0; (3) latent imitative entrepreneurs: d =0, ? =1; (4) latent common employees: d =0, ? =0.

In an original state (q_{NE} , q_{NL} , q_{TE} , q_{TL}) when deciding whether to make some human capital investment (make latent ability change into real ability), if there is discrepancy in the payoffs between two strategies, individuals with latent ability d or/and ? will adjust strategies. At last the payoffs of strategies, which individuals with same latent abilities choose, are the same. However, due to the discrepancy in natural endowment, individuals without any latent ability have to receive common employee income, though the ability rent is high.

The point of the above-modeled dynamics stable equilibrium is the state of the unchanged proportion of any type of population. It is expressed in mathematical patterns $q^*=(q^*_{NE}, q^*_{NL}, q^*_{TE}, q^*_{TL})$, for all $j\in J$, t as time and when the formula is set up as follows:

$$\frac{dq_j}{dt}=o$$

We summarize the calculated dynamics stable fixed equilibrium points in table 2. Within the types of equilibrium in it, equilibriums 1, 2, 3 and 4 are the types of equilibrium that individuals can obtain innovative entrepreneurial ability rent; equilibriums 1, 2, 5, 6, 7 and 9 are the types of equilibrium that individuals can obtain common entrepreneurial ability rent while in equilibrium 10, nobody can obtain any ability rent.

In equilibrium 1, individuals with some latent ability make relevant human capital investment, undertake relevant occupations and obtain corresponding ability rent. This is a kind of Pareto optimal equilibrium, i.e. individuals with higher ability obtain more ability rent making the best possible use of human and material resources and bringing the motivation of individuals with different latent abilities into full play. This is a period that innovative ability and entrepreneurial ability can be brought into full play.

In equilibrium 2, it makes no difference for individuals with only latent innovative ability whether to make relevant human capital investment. Individuals with only latent innovative ability cannot obtain corresponding ability rent, and this is equilibrium that is unhelpful for innovative talents and therefore constrains their motivation. However, individuals with latent entrepreneurial ability can still obtain their ability rent.

In equilibrium 3, it makes no difference for individuals with only latent entrepreneurial ability whether to make relevant human capital investment. Individuals with only latent entrepreneurial ability cannot obtain corresponding ability rent, and this is equilibrium that is unhelpful for entrepreneurial talents and therefore constrains their motivation. However, individuals with latent innovative ability can still obtain their ability rent.

In equilibrium 4, it makes no difference for individuals with only latent entrepreneurial ability or only latent innovative ability whether to make relevant human capital investment. Neither individuals with only latent entrepreneurial nor those with only latent innovative ability can obtain corresponding ability rents, and this is equilibrium that is unhelpful for these two types of talents and therefore constrains their motivation. However, individuals with both latent innovative ability and latent entrepreneurial ability can obtain innovative entrepreneurial ability rent.

2.2 Evolutionary stable strategies of the individuals' human capital investme nt game

In the process of the above equilibrium analyses, we do not take it into consideration whether the individual with latent ability himself or his family can afford the human capital investment, and put it under the hypothesis that he who invests human capital is certain to get the corresponding post, which may not be satisfied in reality. We ignore the first case because the individual with latent ability whose family cannot afford the human capital investment can accumulate his human capital slowly through the experience called "learning by doing". For the second case, we can transform it into the following probability matrix (in table 3). Also, we can bring in the probability matrix that shows kinds of individuals with latent ability investing different human capitals. Then after the previous work, we can analyze the evolutionarily stable strategies of an individual with the latent ability(d , ?) in choosing kinds of human capital investments by introducing the analysis of expected reward.

We record the probability of an individual with human capital I_j ($j \in J$) taking up a job $h \in J$ as $p(I_j, h)$ ($h, j \in J$) , which is unconcerned with individuals' latent ability. We know from the context that the cost $C_h(I_j, d, ?)$ of an individual with human capital I_j ($j \in J$) , and latent ability (d , ?) taking up a job $h \in J$ is made up of three parts: (1) working cost of undertaking the job $C(h)$ ($h \in J$) , which is assumed has nothing to do with individuals' latent ability; (2) obtained human capital investment cost $C(I_j, d, ?)$; (3) And the supplementary human capital investment cost when obtaining a job that demands more human capital than one has had. The specific forms are as follows:

$$C_h(I_j, d, ?) = \begin{cases} C(h)+C(I_j,d,\Phi) & j \succ h \\ C(h)+C(I_h,d,\Phi) & h \succ j \\ C(h)+C(I_j,d,\Phi)+C(I_h,d,\Phi) & \text{other} \end{cases}$$

In the first case, $j \succ h$ indicate the surplus human capital that one has more than the occupation demands, and it is an idle waste of human capital investment to the certain individual. Such case happens as individuals with innovative entrepreneurial human capital can take up only innovative employees' work or common employees' work. The second case is just contrary to the first one i.e. lack of human capital investment. Here $h \succ j$ means that the obtained occupation demands so much that the available human capital is not qualified to it, but the existing human capital is also required, so they just add the lacking investment. Such cases happen as individuals with only common entrepreneurial human capital taking up innovative entrepreneurial jobs. In the third case, the obtained human capital has nothing to do with one's job, so he could do nothing but set the available human capital idle and add new human capital investment suitable for his job.

During the time t, the reward function when an individual becomes an innovative or imitative entrepreneur is determined by profit function $f_{NE}(d, ?, K, r_t, s_t)$ or $f_{TE}(?, K, r_t', s_t)$, minus entrepreneurs' human capital investment cost and working cost of choosing entrepreneurs, in which the profit function is determined by individuals' latent ability$(d, ?)$ or $?$, the capital K that he can employ (reflecting management scale), the ratio of this kind of entrepreneurial human capital owners in the whole population $r_t = r_t(NE)$ or $r_t' = r_t(TE)$ (reflecting degrees of competition), and microeconomic situation s_t. We suppose that s_t follows the same independent two-point distribution array and $P\{s_t=1\}=h_0$, $P\{s_t=0\}=1-h_0$, in which $s_t=1$ indicates the good microeconomic situation while $s_t=0$ indicates the bad one. Specific forms are as follows ($b \geq a>1>c>0$):

$$f_{NE}(?, d, K, r_t, s_t) = a^{s_t} b^{\Phi+d} K^c (1-r_t)$$

$$f_{TE}(?, K, r_t', s_t) = a^{s_t} b^{\Phi} K^c (1-r_t')$$

Individuals obtain competitive salary reward when becoming some kind of employees, besides which, innovative employees share another part of profit concerning economic situation and their latent ability. Competitive salary reward means that the salary of some kind of employees depends on the ratio of employee reserve of the industry in the whole population i.e. $x_t(N)$ (or $x_t(L)$), and is a strictly decreasing function of $x_t(N)$ (or $x_t(L)$, i.e. x_t'). As for the salary we adopt the following linear supposition:

$$f_{NL}(t) = w_{NL}(t) = w_0 - a\, x_t(N) + b\, g(s_t, d)$$

$$f_{TL}(t) = w_{TL}(t) = w_0' - a\, x_t(L)$$

In them, $a>0$, $b=0$, b is the dependent coefficient of the function of innovative employees' salary to the economic situation and individuals' latent ability. Therefore, the reward $R_h(I_j, d, ?)$ of individuals with latent ability$(d, ?)$ and obtained human capital I_j ($j \in J$) taking up occupations $h \in J$ can be shown by the following math's formula:

$$R_h(I_j, d, ?) = f_H(s_t, d, ?) - C_h(I_j, d, ?)$$

$$= \begin{cases} f_h(s_t, d, \Phi) - C(h) - C(I_j, d, \Phi) & j \succ h \\ f_h(s_t, d, \Phi) - C(h) - C(I_h, d, \Phi) & h \succ j \\ f_h(s_t, d, \Phi) - C(h) - C(I_j, d, \Phi) - C(I_h, d, \Phi) & \text{other} \end{cases}$$

We use $E_s f_j(s_t, d, ?)$ to indicate the expected reward function of individuals with latent ability $(d, ?)$ toward the economic situation s_t when taking up a job j during the time t. Then the expected reward $E_s R_i(I_j, d, ?)$ to individuals with latent ability $(d, ?)$ and obtained human capital I_j $(j \in J)$ taking up occupations $h \in J$ is:

$$E_s R_h(I_j, d, ?) = E_s f_h(s_t, d, ?) - C_h(I_j, d, ?)$$

$$= \begin{cases} E_s f_h(s_t, d, \Phi) - C(h) - C(I_j, d, \Phi) & j \succ h \\ E_s f_h(s_t, d, \Phi) - C(h) - C(I_h, d, \Phi) & h \succ j \\ E_s f_h(s_t, d, \Phi) - C(h) - C(I_j, d, \Phi) - C(I_h, d, \Phi) & \text{other} \end{cases}$$

The specific forms of expected reward in any cases can be classified into Table 4.

Then we can get the expected reward $E_j[E_s R_h(I_j, d, ?)]$ of individuals with latent ability $(d, ?)$ and obtained human capital I_j $(j \in J)$ during the time t:

$$E_h[E_s R_h(I_j, d, ?)] = \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h)$$

During the time t, individuals with latent ability $(d, ?)$ have four types of human capital investment strategies and we mark the probability of the investment I_j $(j \in J)$ as $p_t(I_j, d, ?)$. Then during the time t, the expected reward $E_I\{E_h[E_s R_h(I_j, d, ?)]\}$ when individuals with latent ability $(d, ?)$ invest human capital I_j under the probability $p_t(I_j, d, ?)$ is:

$$E_I\{E_h[E_s R_h(I_j, d, ?)]\} = \sum_{j \in J} \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h) \, p_t(I_j, d, ?)$$

Therefore, we can get the corresponding replicator dynamics equation:

$$\ln \dot{p}_t(I_j, d, ?) = v\{ \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h) - \sum_{j \in J} \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h) \, p_t(I_j, d, ?) \}$$

The following equation group determines the stable state points of the equation except the corner solution 0:

$$\begin{cases} \sum_{h \in J} E_s R_h(I_{TL}, d, \Phi) P(I_{TL}, h) - \sum_{j \in J} \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h) p_t(I_j, d, \Phi) = 0 \\ \sum_{h \in J} E_s R_h(I_{TE}, d, \Phi) P(I_{TE}, h) - \sum_{j \in J} \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h) p_t(I_j, d, \Phi) = 0 \\ \sum_{h \in J} E_s R_h(I_{NL}, d, \Phi) P(I_{NL}, h) - \sum_{j \in J} \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h) p_t(I_j, d, \Phi) = 0 \\ \sum_{h \in J} E_s R_h(I_{NE}, d, \Phi) P(I_{NE}, h) - \sum_{j \in J} \sum_{h \in J} E_s R_h(I_j, d, \Phi) P(I_j, h) p_t(I_j, d, \Phi) = 0 \end{cases}$$

We notice:

$$r_t = \sum_{d,\Phi} p_t(I_{NE}, d, \Phi) P(d, \Phi) \qquad r_t' = \sum_{d,\Phi} p_t(I_{LE}, d, \Phi) P(d, \Phi)$$

$$x_t(N) = \sum_{d,\Phi} p_t(I_{NL}, d, \Phi) P(d, \Phi) + p(I_{NE}, NL) \sum_{d,\Phi} p_t(I_{NE}, d, \Phi) P(d, \Phi)$$

$$x_t(L) = \sum_{d,\Phi} p_t(I_{TL}, d, \Phi) P(d, \Phi) + p(I_{TE}, TL) \sum_{d,\Phi} p_t(I_{TE}, d, \Phi) P(d, \Phi) +$$

$$p(I_{NE}, TL) \sum_{d,\Phi} p_t(I_{NE}, d, \Phi) P(d, \Phi) + p(I_{NL}, TL) \sum_{d,\Phi} p_t(I_{NL}, d, \Phi) P(d, \Phi)$$

Therefore, we can get the corresponding $p^*(I_j, d, ?)\ (j \in J)$. This is the evolutionarily stable strategy of kinds of latent individuals making types of human capital investments.

The above separating equilibrium is expressed under the hypothesis that each individual knows clearly about his own latent ability and the distribution of individuals' latent ability in society. Each individual type may choose any type of strategy suitable for him so individuals with different latent abilities have different equilibrium strategies. Nevertheless, when individuals are not aware of their own latent ability, the evolutionarily stable strategies of individuals' capital investment will be the same to them all, which means that the choice has nothing to do with the latent ability$(d, ?)$. This is a kind of pooling equilibrium. At this time, each individual will consider the average expected income of the whole society investing some kind of human capital as criterion whether the individual himself will invest human capital. When each individual invests human capital I_j under the probability $p_t(I_j)$ the average expected income of the whole society is:

$$E_{d\Phi}\{E_I\{E_h[E_s R_h(I_j, d, \Phi)]\}\}$$

$$= \sum_{d,\Phi=0,1} \sum_{j\in J} \sum_{h\in J} E_s R_h(I_j, d, \Phi) P(I_j, h) p_t(I_j) P(d, \Phi)$$

The corresponding raplicator dynamics equation is:

$$\ln \dot{p}_t(I_j, d, ?) = v\left\{ \sum_{h\in J} E_s R_h(I_j, d, \Phi) P(I_j, h) - \sum_{d,\Phi=0,1} \sum_{j\in J} \sum_{h\in J} E_s R_h(I_j, d, \Phi) P(I_j, h) p_t(I_j) P(d, \Phi) \right\}$$

Therefore, we can get the corresponding stable state point $p^*(I_j)$. The whole society reaches a stable state through investing the human capital I_j under the probability $p^*(I_j)$ in equilibrium.

3. Results of the analysis of the models & calculations

3.1 Calculation of the evolutionary stable equilibrium model

Assume the distribution probability of latent ability of individuals as P{ d =1} =P{ ? =1} =0.2, when W_{TL} =1 , W_{NL} =2 , the production of emerging and traditional industry is *a* y=1.2, *b* y=0.48 respectively. The cost quadratic function of equation (2.2) and (2.3) is:

C_{NI} (d)+C(N, d)=a-d ^{2}

C_{EI} (?)+C(E, ?)=b-? ^{2}

Here *a* and *b* represent the fixed cost of innovative work and imitative entrepreneurial work respectively, irrelevant to individual latent ability. It reflects the social system adapting cost of individuals engaged in innovative production and entrepreneurial work. The more the value, the more the social friction cost or the higher the working requirements. We can see that when *a* and *b* are given different values, there will be different kinds of equilibrium and it is their value that influences the choosing of strategies. We have to point out that this cost function is different from the requirements in equilibrium analysis chart. Here, for individuals without any latent ability, the cost for them to acquire relevant human capital and take up corresponding job is not too high. So it attracts individuals with low ability to take up this job when its rent is too high.

Under this hypothesis, the expected net income for individuals with latent ability (d , ?) to choose to invest human capital I_j ($j \in J$) is:

u_{TL} =1

u_{NL} =2- a+d ^{2}

$$u_{TE} = \frac{1.2 - q_{TL}}{q_{TE}} - b + ?^2$$

$$u_{NE} = \frac{0.48 - 2q_{NL}}{q_{NE}} - a + d^2 - b + \Phi^2$$

First, let's discuss equilibrium 1. We notice that the feature of this equilibrium is that individuals with some latent ability can fully make relevant human capital investment and undertake the occupation that can develop their latent ability. Thus, when P{ d =1} =P{ ? =1} =0.2, we can get q_{NE} =0.04, q_{NL} =0.16, q_{TE} =0.16, q_{TL} =0.64. Therefore, the expected net incomes for individuals with latent ability(d, ?) to adopt each human capital investment strategy is:

u_{TL} =1 $\quad$ u_{NL} =2- a+d ^{2}

u_{TE} =3.5- b+? ^{2} $\quad$ u_{NE} =4- a+d ^{2} - b +? ^{2}

For individuals who satisfy d =1, ? =1, because it is optimal to make innovative entrepreneurial human capital investment, the net income in equilibrium satisfies: $u^*_{NE} \rangle u^*_{TE}$, u^*_{NL}, u^*_{TL}. Therefore, we can get:

$a<1.5,\ b<3,\ a+b<5$

For individuals who satisfy d =1, ? =0, because it is optimal to make innovative human capital investment, the net income in equilibrium satisfies: $u^*_{NL} \rangle u^*_{TE}$, u^*_{NE}, u^*_{TL}. Therefore, we can get:

$a<2,\ 2<b,\ 0.5<b-a$

For individuals who satisfy d =0, ? =1, because it is optimal to make imitative entrepreneurial human capital investment, the net income in equilibrium satisfies: $u^*_{TE} \rangle u^*_{NE}$, u^*_{NL}, u^*_{TL}. Therefore, we can get:

$0.5<a,\ b<3.5,\ b-a<2.5$

For individuals who satisfy d =0, ? =0, because it is optimal to make common employee human capital investment, the net income in equilibrium satisfies: $u^*_{TL} \rangle u^*_{TE}$, u^*_{NL}, u^*_{NE}. Therefore, we can get:

$1<a,\ 2.5<b,\ 3<a+b$

Thus, we can get the satisfactory condition for equilibrium 1:

$1<a<1.5,\ 2.5<b<3,\ 3<a+b<5,\ 0.5<b-a<2.5$

This means that when *a* and *b* satisfy the above conditions, we can reach the optimal equilibrium, all of the individuals with some latent ability can change it into real ability and obtain relevant occupations. We will discuss when *a* and *b* are beyond the boundary, how the equilibrium will evolve.

When a=1.5 and b=3, at the upper boundary, if individuals d =1, ? =1 make both innovative ability and entrepreneurial ability investment or either, the net income is the same, but they should invest both human capital. This is because if some of them only invest one kind of these two human capitals, they will be far from this strategy. In fact, if some individuals d =1, ? =1 only invest entrepreneurial human capital, there will be u_{TE} reduction and u_{NE} increase and as a result they have to invest both human capital. In the same way, if some individuals d =1, ? =1 only invest innovative human capital, with u_{NL} being the same, q_{NL} increases and q_{NE} reduces. As a result, u_{NE} increases and this also leads them to invest both human capitals. Therefore, any individual with latent ability will invest relevant latent ability human capital at this time. This still belongs to equilibrium 1, but this is special, although individuals with latent ability d =1, ? =1 have three kinds of strategies without discrepancy, only one is practicable. When either variable *a* or *b* is at or within the upper boundary, the other goes on and beyond the critical value, there will be discrepancy in the scores of different investment strategies and the strategies will be adjusted. For example, when b= 3 is set up, if 1.5<a<2, we might as well make a=1.8, $u_{TE}=4.5-b>u_{NE}=4.2-b$ for individuals d =1, ? =1. It is more worthwhile for this kind of individuals to only invest imitative entrepreneurial human capital rather innovative entrepreneurial human capital. Some individual with latent ability d =1, ? =1 will adjust strategies, only to invest imitative entrepreneurial human capital. This will influence q_{NL} and q_{NE}, lead to u_{TE} reduction and u_{NE} increase and finally reach new equilibrium again. Suppose individuals who change to only invest imitative entrepreneurial human capital among those d =1, ? =1 as x, u_{TE}=u_{NE} in new equilibrium. Therefore, we can get:

$$\frac{1.2-0.64}{0.16+x}-2=\frac{0.48-0.32}{0.04-x}-2.8$$

Thus, the solution x=0.0025, and the adjusted probability is 6.25%, that is, only 6.25% of individuals with latent ability d =1, ? =1 only invest imitative entrepreneurial human capital. This is equilibrium 5 that we have analyzed before.

Furthermore, when a=2, it makes no difference for individuals with only innovative latent ability whether to invest relevant human capital or not. If a goes upward a>2 (b unchanged), this kind of individuals will not make any human capital investment because the society cannot go without innovative talents, a=2 is the utmost upper boundary. At this time, individuals with only latent innovative ability can only get the same net reward as those without any latent ability; individuals with both innovative latent ability and entrepreneurial ability can only get the same net income as those with only imitative entrepreneurial latent ability. This is equilibrium 6 that we have analyzed before.

Similarly, if a satisfies 1<a<1.5 or a=1.5 and b goes beyond as 3<b<3.5, for individuals with latent ability d =1, ? =1, a certain proportion of individuals will only make innovative human capital investment. This is equilibrium 7 that we have analyzed. If b changes further as b= 3.5 (a unchanged), this corresponds equilibrium 8, individuals with only common entrepreneurial latent ability cannot obtain any rent reward and meantime those with both types of latent ability can only obtain creative ability rent reward.

There is an exceptional situation, when either a or b is at upper boundary and the other is within, and we might as well suppose that a satisfies 1<a<1.5, b=3. For individuals with innovative entrepreneurial latent ability, their ability rent is the same as that of individuals with only innovative latent ability, but the latter will invest innovative entrepreneurial human capital. This is because if some individuals d =1, ? =1 only invest innovative human capital, with u_{NL} being the same, q_{NL} increases and q_{NE} reduces. As a result, u_{NE} increases and they will make innovative entrepreneurial human capital investment again. This still belongs to equilibrium 1. When a=1.5 and 2.5<b<3, the discussion can go on in the same way.

When variables both a and b go beyond the critical value, there are several following situations:

(1) If 1.5<a= 2, 3<b<3.5 and a+b= 5, individuals with latent ability d =1, ? =1 can obtain part of ability rent reward when they invest any one kind of latent ability or two at the same time. Because of the available selections, they will adopt the investment strategy with high human capital investment rent

reward. Therefore, when u_{NE} >u_{NL} and u_{TE}, this corresponds to equilibrium 1; when u_{NL} >u_{NE} and u_{TE}, this corresponds to equilibrium 7; when u_{TE} >u_{NL} and u_{NE}, this corresponds to equilibrium 5.

(2) If 1.5<a= 2, 3<b<3.5 and a+b>5, this is equilibrium 9. Individuals with both innovative latent ability and common entrepreneurial latent ability can obtain part of ability rent. They have three kinds of strategies to choose. When reaching equilibrium, they can obtain the same rent reward as those with either innovative latent ability or entrepreneurial ability.

(3) If a= 2 and b= 3.5, this is equilibrium 10, this is the worst equilibrium. No individual can obtain extra ability rent reward. This is a tragedy for the whole society. So, we should guarantee that individuals with ability have motivation to develop their latent ability through system, which requires reducing social cost for individuals to undertake complicated work.

We have discussed upper boundary conditions above. Similarly, we can discuss lower boundary.

All the above equilibrium analyses are concluded under the hypothesis that an individual's latent ability (d , ?) respectively follows the distribution of the two independent points. We can easily popularize it to the case that individual's latent ability(d , ?) respectively obeys the even distribution on[0, 1] independently. In equilibrium the line of demarcation of the latent ability (d *, ? *) will separate the whole population into four types: (1) latent innovative entrepreneurs { (d , ?) | d = d *, ? = ? *} ;(2) Latent imitative entrepreneurs { (d , ?) | d <? *, ? = ? *} ; (3) Latent innovative employees{ (d , ?) | d = d *, ? <? *} ; (4). latent common employees{ (d , ?) | d <d *, ? <? *} .

Because the cost of acquiring human capital is in inverse proportion to one's ability, it is different from the two-point distribution hypothesis that in spite of the existing high working cost such as system, environment and so on. Individuals with the two high abilities(i.e. (d , ?) >(d *, ? *)) obtain their ability rent as innovative entrepreneurs in equilibrium. As one declines below the critical ability, the individual can still obtain the rent for the other ability, that is, above the critical one; as both decline below the critical, he only becomes a common employee. As for individuals with the critical ability (i.e. meeting the conditions { (d , ?) | making(d , ?) =(d *, ? *) , or d =d *, ? <? *, or d <d *, ? =? *} , it makes no difference whether they invest human capital or not, so they cannot obtain the corresponding ability rent.

We can get(d *, ? *) specifically. Choose the following quadratic functions of cost in formulae(2.2) and (2.3):

C_{NI} (d)+ C(N, d)=a- d ^{2}

C_{EI}(?) +C(E, ?) =b- ? ^{2}

In equilibrium(d *, ? *) , it makes no difference to carry on types of strategies of human capital investment, that is, the expected reward is the same for individuals with latent ability (d *, ? *) in choosing the four types of human capital investment strategies, so we have:

u_{TL} (d *, ? *) $=u_{TE}$ (d *, ? *) $=u_{NL}$ (d *,? *) $=u_{NE}$ (d *, ? *)

Under the hypothesis of the even distribution of d , ? , we can get in equilibrium:

q_{NE} =(1- d *) (1- ? *) q_{NL} =(1- d *) ? *

q_{TE} =d *(1- ? *) q_{TL} =d *? *

Therefore, we can get the specific (d *, ? *) and y in equilibrium. We make w_{TL} =1, w_{NL} =2, a=1.64, b=2, a =0.3, b =0.7, and then can get:

u_{TL} =1

u_{NL} =2- 1.64+d ^{2}

$$u_{TE}=\frac{0.7y-q_{TL}}{q_{TE}}-2+\Phi^2$$

$$u_{NE}=\frac{0.3y-2q_{NL}}{q_{NE}}-1.64+d^2-2+\Phi^2$$

From the equilibrium conditions we get in equilibrium:

d *=0.8, y=1.6

And get the satisfactory conditions about ? *:

? ^{3}- ? ^{2}- 2? +1.6=0

Therefore, we can get the satisfactory conditions ? *=0.73.

We notice that y is the expected income of society. In equilibrium, the expected income for the individuals with latent ability (d *,? *) in choosing to become imitative entrepreneurs in traditional industries or innovative entrepreneurs in emerging industries are respectively:

ER_{TE} =2.48, ER_{NE} =3.48

However, if deducting the corresponding human capital investment cost and occupations' working cost, it makes no difference for the individuals to choose any type of the four human capital investment strategies at the critical point d *=0.8, ? *=0.73, and the net reward is always 1.

We reach the following conclusions about the distribution of individuals' latent ability.

(1) Individuals' latent ability can satisfy { (d , ?) | d >d *, ? >? *} . At this time, individuals will become innovative entrepreneurs in emerging industries through investing the two types of latent ability i.e. through innovative entrepreneurial human capital investment. Consequently, they can obtain innovative entrepreneurial ability rent and the higher one's ability is, the more rent he will obtain.

(2) Individuals' latent ability can satisfy{ (d , ?) | d <d *, ? >? *} . At this time, individuals will become entrepreneurs in traditional industries through investing only common entrepreneurial human capital, and obtain imitative entrepreneurial ability rent reward.

(3) Individuals' latent ability can satisfy { (d , ?) | d >d *, ? <? *} . At this time, individuals will become employees in newly emerging industries through investing only innovative ability, and obtain innovative ability rent reward.

(4) Individuals' latent ability can satisfy{ (d , ?) | d <d *, ? <? *} . At this time, individuals will become common employees in traditional industries without any human capital investment, because the strategy is optimal for them.

When some type of individuals' latent ability is at the critical point i.e. d =d * or ? =? *, it makes no difference whether we carry on the human capital investment of this ability.

3.2 Analysis and calculation of the replicator dynamics equation

We make such hypothesis: as in Table 5, the probability p(I_j , h) of an individual with human capital I_j ($j \in J$) taking up an occupation $h \in J$ is a symmetrical supposition and independent of the time t. The cost C_h(I_j , d , ?) of an individual (d , ?) with human capital I_j ($j \in J$) taking up an occupation $h \in J$ can be shown by Table 6 because we regard the cost function independent and separable. In Table 6, we make C (T) =C(L) =0, C(NE) =C(N) +C(E) +C(NE) , C(I_{NE} , d , ?) =C_{NI}(d) +C_{EI}(?) and so forth and so on. In Table 6, when we make C(N) =C(E) =1, C_{NI}(d) =2-d , C_{EI}(?) =2-? , and d , ? =0, 1, we can get the total cost C_h(I_j , d , ?) of an individual with latent ability (d , ?) and obtained human capital I_j ($j \in J$) engaged in different occupations $h \in J$.

We assume the probability of the latent ability distributing in the whole population P{ d =1} =P{ ? =1 } =0.2, and the probability of the microeconomic situation functioning well or badly P{ s_t=1} =P{ s_t=0} =0.5. We write down in Table 7 the probability p_t(I_j , d , ?) of an individual with latent ability (d , ?) investing human capital I_j during the time t.

We discuss a simple form first: assuming the enterprise managed by each individual has the same scale ; r_t and r_t' do not enter the entrepreneurial profit function directly and x_t(N) or x_t(L) do not enter the workers' salary profit either, as follows:

f_{NE}(? ,d , K, r_t ,s_t) =3 · 2^{s_t} $2^{\Phi+d}$ -5d ?

f_{TE}(? ,K, r_t' ,s_t) = 3 · 2^{s_t} $2^{?}$

f_{NL}(t)=3+2 ^{s_t} 2^{d}

f_{TL}(t)=2

Therefore, we can get the respective reward of an individual with the latent ability (d , ?) engaged in types of occupations when the microeconomic situation goes well (i.e. s_t=1) or when badly(s_t=0) . Applying the cost distribution shown in Table 6, we can get the income (net income) R_i (I_j ,d , ?) of individuals with latent ability (d , ?) and obtain human capital I_j ($j \in J$) engaged in different occupations $h \in J$ in different economic situations. Furthermore, we can use Table 5 to calculate the expected income ER^s(I_j , d , ?) of individuals with latent ability (d , ?) and obtain human capital I_j ($j \in J$) engaged in different occupations in different economic situations s_t and the results are recorded from Line 2 to Line 5 in Table 8 and Table 9 respectively. Also applying Table 7, we can get the average expected income E_I [ER^s(I_j ,d , ?)] of individuals with latent ability (d , ?) investing human capital I_j under the probability p_t(I_j ,d , ?) and the results are recorded in Line 6 of Table 8 and Table 9 respectively. When individuals with latent ability (d , ?) invest human capital I_j under the probability p_t(I_j ,d , ?) , their decision-making depends on the average expected income E_s{ E_I [ER^s(I_j ,d , ?)] } anticipated from economic situations because individuals can not predict exactly how the economic situation will when investing human capital. Applying the supposition P{ s_t=1} = P{ s_t=0} =0.5, we can get the expected income and record it in the last line of Table 9.

Now, we will discuss the replicator dynamics equation in two cases, which are divided according to whether an individual can distinguish his latent ability. First, let us discuss the case in which individuals are aware of which type he belongs to. We will discuss it in the following two ways:

The first way: assuming that individuals have no subjective predictions about the microeconomic situation, they make judgements purely under the probability P{ s_t=1} = P{ s_t=0} =0.5.

When d =0, ? =0, we can see that it is optimal to invest entrepreneurial human capital when the economic situations are sound, while it is optimal not to invest human capital when the economic situations are bad. Yet when they try to get expectations to the economic situations, the optimal choice is to invest no human capital. We apply replicator dynamics to the analysis:

From the replicator dynamics equation:

$$\ln \dot{p}_t (I_j ,d , ?) = v\{ \sum_{h\in J} E_s R_h (I_j, d, \Phi) P(I_j, h) -$$

$$\sum_{j\in J}\sum_{h\in J} E_s R_h (I_j, d, \Phi) P(I_j, h) \; p_t (I_j ,d , ?) \}$$

We can get the following replicator dynamics equation groups:

$$\begin{cases} \ln \dot{p}_{11}(t) = v\{1.9 - [1.9p_{11}(t) + 0.95p_{12}(t) + 0.95p_{13}(t) - 2.1p_{14}(t)]\} \\ \ln \dot{p}_{12}(t) = v\{0.95 - [1.9p_{11}(t) + 0.95p_{12}(t) + 0.95p_{13}(t) - 2.1p_{14}(t)]\} \\ \ln \dot{p}_{13}(t) = v\{0.95 - [1.9p_{11}(t) + 0.95p_{12}(t) + 0.95p_{13}(t) - 2.1p_{14}(t)]\} \\ \ln \dot{p}_{14}(t) = v\{-2.1 - [1.9p_{11}(t) + 0.95p_{12}(t) + 0.95p_{13}(t) - 2.1p_{14}(t)]\} \end{cases}$$

There is no other stable state except $p_{11}(t)$, $p_{12}(t)$, $p_{13}(t)$, $p_{14}(t)$ among which one corner point solution is 1 and the others are 0. From the first formula we know that the right side can never be less than 0, so $p_{11}(t)$ will not stop increasing until $p_{11}(t)=1$; whereas in the last there formulae, as $p_{11}(t)$ increases, $p_{12}(t)$, $p_{13}(t)$, $p_{14}(t)$ will be decreasing to 0. Therefore we get to know that $p_{11}(t)=1$, $p_{12}(t)=p_{13}(t)=p_{14}(t)=0$ is a stable state, while other states are unstable. For example, in the case that all individuals with latent ability (0, 0) invest entrepreneurial human capital i.e. when $p_{11}(t) = p_{13}(t) = p_{14}(t)$, $p_{12}(t)=1$ as long as only a few individuals do not invest human capital by changing their initial strategies i.e. $p_{11}(t)>0$, the proportion of such individuals will not stop increasing until no individuals of this type will invest any kind of human capital.

When d =0, ? =1, it is always optimal for each individual to invest entrepreneurial human capital. It is similar with the previous case because it also has four corner equilibrium, but only $p_{22}(t)=1$, $p_{21}(t)=p_{23}=p_{24}(t)=0$ are stable.

We can make the same discussion when d =1, ? =0 and d =1, ? =1. They all only have corner equilibrium, so it is optimal and evolutionarily stable equilibrium for individuals with some kind of latent ability to invest human capital of this type.

The second way: we take it to consideration that the microeconomic functioning is not completely random but dependent on inertia. Supposing the initial probability of the microeconomic situation as $P\{s_0=1\} = P\{s_0=0\} =0.5$, the probability that the microeconomic situation continues functioning in this period as well as in the last period as $P\{s_t=1| s_{t-1}=1\} =0.8$, the probability that the bad economic situation of last period turns good this period as $P\{s_t=1| s_{t-1}=0\} =0.2$, then from the point of the whole history, $EP\{s_t=1\} =EP\{s_t=0\} =0.5$ will be tenable in any period of time t. Since individuals' human capital investment strategies occur in a peculiar period, the economic situation of last period will determine the present choice of strategies. We suppose that each individual is near-sighted when making a decision and depends on the above probabilities of condition to make estimation i.e. each individual calculates the expected value of kinds of investment strategies under the probability of the microeconomic situation of last period and then makes a comparison with the average expected value: if the result of some strategy is better than the average expected value, individuals who choose the strategy will be increasing to reach the evolutionarily stable equilibrium at last , which makes individuals with each type of latent ability have the stable equilibrium human capital investment strategy dependent on the economic situation. Let us examine the equilibrium strategies of individuals with latent ability d , $?$. There are two cases:

When the economic situation of last period goes well, the expected reward of types of strategies of individuals of some type is:

$$E_s[ER^s(I_j, d, ?)] = P\{s_t=1 | s_{t-1}=1\} ER^1(I_j, d, ?) + P\{s_t=0 | s_{t-1}=1\} ER^0(I_j, d, ?)$$

$j \in J$

When the economic situation of last period goes badly, the expected reward of types of strategies of individuals of some type is:

$$E_s[ER^s(I_j, d, ?)] = P\{s_t=1 | s_{t-1}=0\} ER^1(I_j, d, ?) + P\{s_t=0 | s_{t-1}=0\} ER^0(I_j, d, ?)$$

$j \in J$

Now let's do a calculation when $d=1$, $?=1$. When the economic situation of last period goes well, the expected income of investing kinds of human capital is:

$E_s[ER^s(I_{TL},1,1)]=2.94$ $\quad$ $E_s[ER^s(I_{TE},1,1)]=8.3$

$E_s[ER^s(I_{NL},1,1)]=4.94$ $\quad$ $E_s[ER^s(I_{NE},1,1)]=10.42$

When the economic situation goes badly, the expected reward of investing kinds of human capital is:

$E_s[ER^s(I_{TL},1,1)]=2.46$ $\quad$ $E_s[ER^s(I_{TE},1,1)]=4.7$

$E_s[ER^s(I_{NL},1,1)]=3.26$ $\quad$ $E_s[ER^s(I_{NE},1,1)]=4.18$

Here, we can find that for individuals with latent ability $d=1$, $?=1$, it is an optimal strategy for each individual to invest innovative entrepreneurial human capital when the previous economic situation functions well; whereas when the previous economic situation functions badly, it is optimal for him to invest only imitative entrepreneurial human capital. Therefore, for individuals with latent ability $d=1$, $?=1$, the evolutionary stable equilibrium is a kind of investment strategy that depends on the previous economic situation: when it functions well, the individuals should invest the innovative entrepreneurial human capital; but when it functions badly, we should just invest imitative entrepreneurial human capital. Of course, it demands that individuals distinguish the economic situation so that they can make correct decisions. We can make similar discussions about individuals with other types of latent ability, so let us ignore it here.

In the above discussions we do think that individuals' human capital investment strategies do not affect the economic situation, but in fact the two may be interrelated to each other. For example, the booming economy can make human capital investment become a fashion, which in turn will promote the further prosperity of the economy. While the economy is deteriorating, individuals have no confidence in human capital investment, which may cause the economy to worsen further.

In the above two ways, the calculation we consider holds that the expected income of individuals investing some type of human capital has nothing to do with other one's choosing of strategies. It is a pure hypothesis to make the calculation easier, which cannot affect the conclusion.

Then we suppose individuals cannot distinguish their latent ability, so they must invest human capital through the mixed strategy. Supposing during the time t, each individual invests human capital I_j under the probability $p_t(I_j)$, recorded $p_t(I_{TL})=p_1(t)$, $p_t(I_{TE})=p_2(t)$, $p_t(I_{NL})=p_3(t)$, $p_t(I_{NE})=p_4(t)$, from Table 8 and Table 9, and the supposition $P\{d=1\}=P\{?=1\}=0.2$ and $P\{s_t=1\}=P\{s_t=0\}=0.5$, we can get the expected income $E_I[ER^s(I_j)]$ of each individual investing human capital I_j and the average expected income $E_s\{E_I[ER^s(I_j)]\}$ when individuals invest the human capital I_j under the probability $p_t(I_j)$:

Here we find that it is optimal for individuals to invest entrepreneurial human capital, but it violates the routine. The root lies in the hypothesis that the expected income of an individual investing some type of human capital has noting to with other individuals' choosing of strategy. Next, we will make the limiting conditions looser. We keep the cost hypothesis unchanged in the previous discussion but change the following profit functions:

$$f_{NE}(d,?,K,r_t,s_t)=3\cdot 2^{s_t}2^{d+\Phi}(1-r_t)$$

$$f_{TE}(?,K,r_t',s_t)=2^{s_t}2^{\Phi}3(1-r_t')$$

We take the following simple form from the employees' salary income:

$$f_{NL}(t)=4+s_t-x_t$$

$$f_{TL}(t)=2-x_t'$$

We notice: $x_t'=p_1(t)$, $r_t'=p_2(t)$, $x_t=p_3(t)$, $r_t=p_4(t)$. Therefore, we can get two kinds of reward $R^s(h,d,?)$ of individuals with latent ability $(d,?)$ engaged in kinds of occupations when the microeconomic situation functions well or badly. Similarly, we can work out the expected cost $EC(h,d,?)$ of individuals with latent ability $(d,?)$ engaged in kinds of occupations when investing human capital I_j under the probability $p_t(I_j)$:

$$EC(h,d,?)=\sum_{j\in J}P_t(I_j)C_h(I_j,d,\Phi)P(I_j,h)$$

In order to make the calculation easier, we make $p(I_j,j)=1$, $p(I_j,h)=0$, $h?j$. Then we can get the expected income $ER^s(h,d,?)$ of individuals with latent ability $(d,?)$ engaged in kinds of occupations after investing human capital I_j under the probability $p_t(I_j)$, the expected income $E_{d,\Phi}[ER^s(h,d,?)]$ that each individual expects from the occupation, the average expected income $E_I\{E_{d,\Phi}[ER^s(h,d,?)]\}$ that the whole society expects, and the comprehensive average expected reward $E_s\{E_I\{E_{d,\Phi}[ER^s(h,d,?)]\}\}$ that is expected to the economic situation. We record them in Table 11 and Table 12 respectively.

From the replicator dynamics equation, we know that the stable state in equilibrium satisfies:

$p_1(t)\{2-p_1(t)-[(2-p_1(t))p_1(t)+(2.6-5.4p_2(t))p_2+(1.7-p_3(t))p_3(t)+(-0.12-5.48p_4(t))p_4(t)]\}=0$

$p_2(t)\{2.6-5.4p_2(t)-[(2-p_1(t))p_1(t)+(2.6-5.4p_2(t))p_2+(1.7-p_3(t))p_3(t)+(-0.12-5.48p_4(t))p_4(t)]\}=0$

$p_3(t)\{1.7-p_3(t)-[(2-p_1(t))p_1(t)+(2.6-5.4p_2(t))p_2+(1.7-p_3(t))p_3(t)+(-0.12-5.48p_4(t))p_4(t)]\}=0$

$p_4(t)\{-0.12-5.48p_4(t)-[(2-p_1(t))p_1(t)+(2.6-5.4p_2(t))p_2+(1.7-p_3(t))p_3(t)+(-0.12-5.48p_4(t))p_4(t)]\}=0$

From the last formula, we know $p_4(t)=0$. Then we will work out the non-corner solutions (the solutions except 0,1) of $p_1(t)$, $p_2(t)$, $p_3(t)$. Simplify the above equation group and get:

$2-p_1(t)=2.6-5.4p_2(t)$

$2-p_1(t)=1.7-p_3(t)$

$p_1(t)+p_2(t)+p_3(t)=1$

Hence, we get $p_1^*=0.54$, $p_2^*=0.21$, $p_3^*=0.25$. That means, under the hypothesis, all individuals' mixed human capital investment strategies are investing in common employees under the probability of 0.54, in imitative entrepreneurs under the probability of 0.21, and in innovative employees under the probability of 0.25, but there is no individual to invest the corresponding innovative entrepreneurial human capital. There are two explanations for this: One may be that the working cost of innovative entrepreneurs is too high or the profit rent is too little; the essential reason is that individuals can not distinguish their own latent ability, which is extremely disadvantageous to individuals with innovative entrepreneurial talent. Although individuals of this type can obtain much high ability rent when taking up jobs as innovative entrepreneurs, great losses may be suffered because of lack of the relevant ability. The result of evolutionary stability is that no individuals should invest this type of human capital. Luckily, it will never occur in reality because each individual knows something about his latent ability and there are always such individuals as dare to take risks.

Now we will work out the separating equilibrium in this case. $P_h(t)=0.64p_{1h}(t)+0.16p_{2h}(t)+0.16p_{3h}(t)+0.04p_{4h}(t)$ $(h=1,2,3,4)$ indicate the probability of the whole society investing the human capital I_h on the condition that the probability of some type of individuals j investing human capital I_h and taking up the relevant jobs h is p_{jh}. We record in Table 13 the expected net income of each type of individual j toward the economic situation when taking up occupations h and the expected net income of this type of individuals investing the human capital I_h under the probability p_{jh}.

Therefore, applying the replicator dynamics equation, we can discuss the four cases. First, when $d=0$, $?=0$, because individuals of this type get the negative net reward when choosing NE, we get $p_{14}^{*}=0$; second, when $d=1$, $?=1$, applying $p_{14}^{*}=0$, $p_4(t)$ is no more than 0.36. Therefore, we can know that the optimal strategy is to choose NE for individuals of the type $d=1$, $?=1$, and now we have $p_{44}^{*}=1$. Then we get $p_{41}^{*}=0$, $p_{42}^{*}=0$, $p_{43}^{*}=0$. Similarly, because the individual type $d=0$, $?=0$ can not choose TE, it is optimal for the individual type $d=0$, $?=1$ to choose TE, and we get $p_{22}^{*}=1$, $p_{21}^{*}=0$, $p_{23}^{*}=0$, $p_{24}^{*}=0$; next, the individual type $d=1$, $?=0$ can not choose LE and TE, so they have two kinds of strategy choices NL and NE and then we have $p_{31}^{*}=0$, $p_{32}^{*}=0$; finally, let us see the individual type $d=0$, $?=0$. At present, there are still two possible choices TL, NL , and the corresponding probability are $p_{11}(t)$, $p_{13}(t)$. Therefore, we have:

$$p_1(t)=0.64\,p_{11}(t)$$

$$p_2(t)=0.16$$

$$p_3(t)=0.64\,p_{13}(t)+0.16\,p_{33}(t)$$

$$p_4(t)=0.16\,p_{34}(t)+0.04$$

Because in equilibrium, we have $2-p_1(t)=1.5-p_3(t)$, $2.5-p_3(t)=3-9p_4(t)$. Here we can get $p_{11}^{*}=0.99$, $p_{13}^{*}=0.01$, $p_{33}^{*}=0.81$, $p_{34}^{*}=0.19$.

Up to now we have already work out the separating equilibrium completely. We find that on the occasion that each individual type is aware of his latent ability, not only will the individuals with innovative entrepreneurial latent ability invest innovative human capital, but also some individuals with innovative latent ability will invest innovative entrepreneurial human capital. All of this shows that under our hypothesis, both types of talents can obtain the excess of rent reward of his ability and the society system can still be incentive for innovative entrepreneurs.

4. Generalization and Conclusions

If the ratio of the output of emerging firms to that of traditional firms does not change, and if the income that individuals get by taking up certain occupations has nothing to do with individuals' latent ability, the net income obtained from different occupations is determined solely by the human capital investment and the cost of obtaining a job. It is this kind of cost that determines the equilibrium strategy of entrepreneurial human capital investment and the equilibrium of choosing occupations. Under such circumstances, the state of equilibrium is determined by the distribution of human ability among the whole population, the cost of human capital investment involved in transforming latent ability into actual ability and institutions such as mainstream culture, political system that affect occupation's relative payoffs or cost. If the distribution of certain kind of ability among the whole population is improved, then the cost of human capital investment will increase and the cost involved in establishing institutional environment will also increase. Afterwards, the following result will arise: the rental benefit of this kind of ability will decrease, and the proportion of the human capital investment will be reduced, which is a loss the society must bear. Given the distribution of certain kind of ability among the population, with the cost of human capital investment increasing, it is necessary to reduce the institutional cost in order to enable the individuals with latent ability to get their rental benefit. The model shows that entrepreneurship is contingent upon social and institutional context and we can predict on the choice to become entrepreneur based on the model and some knowledge of the context.

Assuming that the income that individuals get by taking up certain occupations is related to their latent ability, and that the individuals are aware of if they themselves possess entrepreneurial ability, we can get the following quantify results: first, it is with high probability that individuals owing entrepreneurial ability invest entrepreneurial human capital; second, it is with very low probability that individuals owning no entrepreneurial ability invest entrepreneurial human capital; third, the average probability of society investing entrepreneurial human capital is relatively low. On the contrary, we assume that individuals are not aware of if they themselves possess entrepreneurial ability, then the average probability of society investing entrepreneurial human capital is relatively high. The average probability of investing entrepreneurial human capital in the former case is higher, which is the separate equilibrium in game theory. In the latter case, the probability of individuals with latent ability investing human capital is a bit too low, which is the pooling equilibrium in game theory. As far as the role of giving full play to individuals' ability, the state of separate equilibrium is inferior to that of pooling equilibrium because in the state of separate equilibrium, many individuals with entrepreneurial latent have no opportunity to figure out, and many people with no or little ability get more benefit than they deserve. The actual situation often lies between the states of separate equilibrium and that of pooling equilibrium, i. e. individuals know clearly only some of their ability, so with the whole society considered, the probability of investing entrepreneurial human capital also lies between the probabilities in the states of separate equilibrium and that of pooling equilibrium.

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Appendixes

Table 1: The cost of individual with latent ability (d , ?) and human capital I_j (j∈ J) engaged in a job h∈ J is C_h(I_j , d , ?) :

	TL	TE	NL	NE
I_{TL}	0	C(E,?) +C(? ,I_E)	C(N, d) +C(d ,I_N)	C(E, ?) + C(N, d) +C(? , I_{NE})
I_{TE}	0	C(E,?)	C(N,d) +C(d ,I_N)	C(E,?) + C(N,d) + C(d ,I_N)
I_{NL}	0	C(E,?) +C(? ,I_E)	C(N,d)	C(E,?) + C(N,d) + C(? ,I_E)
I_{NE}	0	C(E,?)	C(N,d)	C(E,?) +C(N,d)

Table2: Dynamics stable equilibrium of individual human capital investment and job choice (E=Equilibrium, HCI=Human capital investment, EF=Equilibrium Feature)

		d =1, ? =1	d =0, ? =1	d =1, ? =0	d =0, ? =0
E 1	HCI	I_{NE}	I_{TE}	I_{NL}	I_{TL}
	EF	$u^*_{NE} \rangle u^*_{TE}$, u^*_{NL} , u^*_{TL}	$u^*_{TE} \rangle u^*_{NE}$, u^*_{NL} , u^*_{TL}	$u^*_{NL} \rangle u^*_{NE}$, u^*_{TE} , u^*_{TL}	$u^*_{TL} \rangle u^*_{TE}$, u^*_{NL} , u^*_{NE}
E 2	HCI	I_{NE}	I_{TE}	I_{NL} , I_{TL}	I_{TL}
	EF	$u^*_{NE} \rangle u^*_{TE}$, u^*_{NL} , u^*_{TL}	$u^*_{TE} \rangle u^*_{NE}$, u^*_{NL} , u^*_{TL}	$u^*_{NL} = u^*_{TL} \rangle u^*_{NE}$, u^*_{TE}	$u^*_{TL} \rangle u^*_{TE}$, u^*_{NL} , u^*_{NE}
E 3	HCI	I_{NE}	I_{TE} , I_{TL}	I_{NL}	I_{TL}
	EF	$u^*_{NE} \rangle u^*_{TE}$, u^*_{NL} , u^*_{TL}	$u^*_{TE} = u^*_{TL} \rangle u^*_{NE}$, u^*_{NL}	$u^*_{NL} \rangle u^*_{NE}$, u^*_{TE} , u^*_{TL}	$u^*_{TL} \rangle u^*_{TE}$, u^*_{NL} , u^*_{NE}
E 4	HCI	I_{NE}	I_{TE} , I_{TL}	I_{NL} , I_{TL}	I_{TL}
	EF	$u^*_{NE} \rangle u^*_{TE}$, u^*_{NL} , u^*_{TL}	$u^*_{TE} = u^*_{TL} \rangle u^*_{NE}$, u^*_{NL}	$u^*_{NL} = u^*_{TL} \rangle u^*_{NE}$, u^*_{TE}	$u^*_{TL} \rangle u^*_{TE}$, u^*_{NL} , u^*_{NE}
E 5	HCI	I_{NE} , I_{TE}	I_{TE}	I_{NL}	I_{TL}
	EF	$u^*_{NE} = u^*_{TE} \rangle u^*_{NL}$, u^*_{TL}	$u^*_{TE} \rangle u^*_{NE}$, u^*_{NL} , u^*_{TL}	$u^*_{NL} \rangle u^*_{NE}$, u^*_{TE} , u^*_{TL}	$u^*_{TL} \rangle u^*_{TE}$, u^*_{NL} , u^*_{NE}
E	HCI	I_{NE} , I_{TE}	I_{TE}	I_{NL} , I_{TL}	I_{TL}

6	EF	$u^*_{NE} = u^*_{TE} \rangle u^*_{NL}, u^*_{TL}$	$u^*_{TE} \rangle u^*_{NE}, u^*_{NL}, u^*_{TL}$	$u^*_{NL} = u^*_{TL} \rangle u^*_{NE}, u^*_{TE}$	$u^*_{TL} \rangle u^*_{TE}, u^*_{NL}, u^*_{NE}$
E	HCI	I_{NE}, I_{NL}	I_{TE}	I_{NL}	I_{TL}
7	EF	$u^*_{NE} = u^*_{NL} \rangle u^*_{TE}, u^*_{TL}$	$u^*_{TE} \rangle u^*_{NE}, u^*_{NL}, u^*_{TL}$	$u^*_{NL} \rangle u^*_{NE}, u^*_{TE}, u^*_{TL}$	$u^*_{TL} \rangle u^*_{TE}, u^*_{NL}, u^*_{NE}$
E	HCI	I_{NE}, I_{NL}	I_{TE}, I_{TL}	I_{NL}	I_{TL}
8	EF	$u^*_{NE} = u^*_{NL} \rangle u^*_{TE}, u^*_{TL}$	$u^*_{TE} = u^*_{TL} \rangle u^*_{NE}, u^*_{NL}$	$u^*_{NL} \rangle u^*_{NE}, u^*_{TE}, u^*_{TL}$	$u^*_{TL} \rangle u^*_{TE}, u^*_{NL}, u^*_{NE}$
E	HCI	I_{NE}, I_{TE}, I_{NL}	I_{TE}	I_{NL}	I_{TL}
9	EF	$u^*_{NE} = u^*_{TE} = u^*_{NL} \rangle u^*_{TL}$	$u^*_{TE} \rangle u^*_{NE}, u^*_{NL}, u^*_{TL}$	$u^*_{NL} \rangle u^*_{NE}, u^*_{TE}, u^*_{TL}$	$u^*_{TL} \rangle u^*_{TE}, u^*_{NL}, u^*_{NE}$
E	HCI	$I_{NE}, I_{TE}, I_{NL}, I_{TL}$	I_{TE}, I_{TL}	I_{NL}, I_{TL}	I_{TL}
10	EF	$u^*_{NE} = u^*_{TE} = u^*_{NL} = u^*_{TL}$	$u^*_{TE} = u^*_{TL} \rangle u^*_{NE}, u^*_{NL}$	$u^*_{NL} = u^*_{TL} \rangle u^*_{NE}, u^*_{TE}$	$u^*_{TL} \rangle u^*_{TE}, u^*_{NL}, u^*_{NE}$

Table 3: The probability of human capital owners engaged in different occupations

	TL	TE	NL	NE
I_{TL}	P_{11}	P_{12}	P_{13}	P_{14}
I_{TE}	P_{21}	P_{22}	P_{23}	P_{24}
I_{NL}	P_{31}	P_{32}	P_{33}	P_{34}
I_{NE}	P_{41}	P_{42}	P_{43}	P_{44}

Table 4: the expected reward $E_s R_h(I_j, d, ?)$ of individuals with latent ability $(d, ?)$ and obtained human capital I_j $(j \in J)$ taking up a job $h \in J$

	TL	TE	NL	NE
$(I_{TL}, d, ?)$	$w_{TL}(t)$	$E_s f_{TE}(?, K, r_t', s_t)$-$C(I_{TE}, d, ?)$-$C(TE)$	$E_s w_{NL}(t)$-$C(NL)$-$C(I_{NL}, d, ?)$	$E_s f_{NE}(d, ?, K, r_t, s_t)$-$C(I_{NE}, d, ?)$-$C(NE)$
$(I_{TE}, d, ?)$	$w_{TL}(t)$-$C(I_{TE}, d, ?)$	$E_s f_{TE}(?, K, r_t', s_t)$-$C(I_{TE}, d, ?)$-$C(TE)$	$E_s w_{NL}(t)$-$C(NL)$-$C(I_{NE}, d, ?)$	$E_s f_{NE}(d, ?, K, r_t, s_t)$-$C(I_{NE}, d, ?)$-$C(NE)$
$(I_{NL}, d, ?)$	$w_{TL}(t)$-	$E_s f_{TE}(?, K, r_t', s_t)$-	$E_s w_{NL}(t)$-$C(NL)$	$E_s f_{NE}(d, ?, K, r_t, s_t)$-

	$C(I_{NL},d,?)$	$C(I_{NE},d,?)$-C(TE)	-$C(I_{NL},d,?)$	$C(I_{NE},d,?)$-C(NE)
$(I_{NE},d,?)$	$w_{TL}(t)$- $C(I_{NE},d,?)$	$E_s f_{TE}(?,K,r_t',s_t)$- $C(I_{NE},d,?)$-C(TE)	$E_s w_{NL}(t)$-C(NL) -$C(I_{NE},d,?)$	$E_s f_{NE}(d,?,K,r_t,s_t)$- $C(I_{NE},d,?)$-C(NE)

Table5: The probability $p(I_j, h)$ of an individual with human capital I_j ($j \in J$) taking up a job $h \in J$

	TL	TE	NL	NE
I_{TL}	0.8	0.1	0.1	0
I_{TE}	0.1	0.8	0	0.1
I_{NL}	0.1	0	0.8	0.1
I_{NE}	0	0.1	0.1	0.8

Table6: The total cost $C_h(I_j, d, ?)$ of an individual $(d, ?)$ with human capital I_j ($j \in J$) taking up a job $h \in J$

	TL	TE	NL	NE
$(I_{TL},d,?)$	0	C(E)+ C_{EI} (?)	C(N)+ C_{NI} (d)	C(NE)+C_{EI} (?)+ C_{NI} (d)
$(I_{TE},d,?)$	C_{EI} (?)	C(E)+ C_{EI} (?)	C(N)+ C_{EI} (?) + C_{NI} (d)	C(NE)+C_{EI} (?)+ C_{NI} (d)
$(I_{NL},d,?)$	C_{NI} (d)	C(E)+ C_{EI} (?)+ C_{NI} (d)	C(N)+ C_{NI} (d)	C(NE)+C_{EI} (?)+ C_{NI} (d)
$(I_{NE},d,?)$	C_{EI} (?)+ C_{NI} (d)	C(E)+ C_{EI} (?)+ C_{NI} (d)	C(N)+ C_{EI} (?) + C_{NI} (d)	C(NE)+C_{EI} (?)+ C_{NI} (d)

Table 7: the probability $p_t(I_j, d, ?)$ of an individual with latent ability$(d, ?)$ investing human capital I_j during the time t:

	I_{TL}	I_{TE}	I_{NL}	I_{NE}
d =0,? =0,	$P_{11}(t)$	$P_{12}(t)$	$P_{13}(t)$	$P_{14}(t)$
d =0,? =1	$P_{21}(t)$	$P_{22}(t)$	$P_{23}(t)$	$P_{24}(t)$
d =1,? =0	$P_{31}(t)$	$P_{32}(t)$	$P_{33}(t)$	$P_{34}(t)$
d =1,? =1	$P_{41}(t)$	$P_{42}(t)$	$P_{43}(t)$	$P_{44}(t)$

Table8: When s_t=1, the average expected reward E_l [ER^s(I_j, d ,?)] of individuals with latent ability (d ,?) investing human capital I_j under the probability p_t(I_j, d ,?) :

	d =0,? =0	d =0,? =1	d =1,? =0	d =1,? =1
$ER^1(I_{TL}$,d ,?)	2.1	2.8	2.4	3.1
$ER^1(I_{TE}$,d ,?)	2.3	8.7	3.0	9.5
$ER^1(I_{NL}$,d ,?)	1.5	2.2	4.7	5.5
$ER^1(I_{NE}$,d ,?)	-0.7	5.7	5.3	12.5
E_l [ER^1(I_j , d ,?)]	2.1p_{11}(t)+2.3p_{12}(t)+1.5p_{13}(t)-0.7p_{14}(t)	2.8p_{21}(t)+8.7p_{22}(t)+2.2p_{23}(t)+5.7p_{24}(t)	2.4p_{31}(t)+3.0p_{32}(t)+4.7p_{33}(t)+5.3p_{34}(t)	3.1p_{41}(t)+9.5p_{42}(t)+5.5p_{43}(t)+12.5p_{44}(t)

Table9: When s_t=0, the average expected reward E_l [ER^s(I_j, d ,?)] of individuals with latent ability(d ,?) investing human capital I_j under the probability p_t(I_j, d ,?) :

	d =0,? =0	d =0,? =1	d =1,? =0	d =1,? =1
$ER^0(I_{TL}$,d ,?)	1.7	2.1	1.9	2.3
$ER^0(I_{TE}$,d ,?)	-0.4	3.3	0	3.5
$ER^0(I_{NL}$,d ,?)	0.4	0.8	2.5	2.7
$ER^0(I_{NE}$,d ,?)	-3.5	0.2	0	2.1
E_l [$ER^0(I_j$,d ,?)]	1.7p_{11}(t)-0.4p_{12}(t)+0.4p_{13}(t)-3.5p_{14}(t)	2.1p_{21}(t)+3.3p_{22}(t)+0.8p_{23}(t)+0.2p_{24}(t)	1.9p_{31}(t)+2.5p_{33}(t)	2.3p_{41}(t)+3.5p_{42}(t)+2.7p_{43}(t)+2.1p_{44}(t)
E_s{ E_l [ER^s(I_j ,d ,?)]}	1.9p_{11}(t)+0.95p_{12}(t)+0.95p_{13}(t)-2.1p_{14}(t)	2.45p_{21}(t)+6.0p_{22}(t)+2.2p_{23}(t)+2.95p_{24}(t)	2.15p_{31}(t)+1.5p_{32}(t)+3.6p_{33}(t)+2.65p_{34}(t)	2.7p_{41}(t)+6.5p_{42}(t)+4.1p_{43}(t)+7.3p_{44}(t)

Table 10: the expected reward of individuals investing types of human capital and the average expected reward of investing human capital I_j under the probability $p_t(I_j)$:

	$ER^s(I_{TL})$	$ER^s(I_{TE})$	$ER^s(I_{NL})$	$ER^s(I_{NE})$	$E_I[ER^s(I_j)]$
$s_t=1$	2.3	3.724	2.284	1.812	$2.3p_1(t)+3.724p_2(t)+2.284p_3(t)+1.812p_4(t)$
$s_t=0$	1.82	0.412	0.892	-2.214	$1.82p_1(t)+0.412p_2(t)+0.892p_3(t)-2.214p_4(t)$
$E_s[ER^s(I_j)]$	2.06	2.068	1.588	-0.201	----
$E_s\{E_I[ER^s(I_j)]\}$	$2.06p_1(t)+2.068p_2(t)+1.588p_3(t)-0.201p_4(t)$				

Table 11: when $s_t=1$, the expected net reward and kinds of average expected reward of individuals with latent ability (d, ?) engaged in types of occupations:

	TL	TE	NL	NE
d =0,? =0	$2-p_1(t)$	$3-6p_2(t)$	$2-p_3(t)$	$-1-6p_4(t)$
d =0,? =1	$2-p_1(t)$	$10-12p_2(t)$	$2-p_3(t)$	$6-12p_4(t)$
d =1,? =0	$2-p_1(t)$	$3-6p_2(t)$	$3-p_3(t)$	$6-12p_4(t)$
d =1,? =1	$2-p_1(t)$	$10-12p_2(t)$	$3-p_3(t)$	$19-24p_4(t)$
$E_{d,\Phi}[ER^s(h,d,?)]$	$2-p_1(t)$	$4.4-7.2p_2(t)$	$2.2-p_3(t)$	$2.04-7.64p_4(t)$
$E_I\{E_{d,\Phi}[ER^s(h,d,?)]\}$	$(2-p_1(t))p_1(t)+(4.4-7.2p_2(t))p_2(t)+(2.2-p_3(t))p_3(t)+(2.04-7.64p_4(t))p_4(t)$			

Table 12: when s_t =0, the expected net reward and kinds of average expected reward of individuals with latent ability (d , ?) engaged in types of occupations:

	TL	TE	NL	NE
d =0,? =0	2-p_1(t)	-3 p_2(t)	1- p_3(t)	-4-3 p_4(t)
d =1,? =1	2-p_1(t)	4-6 p_2(t)	1- p_3(t)	-6 p_4(t)
d =1,? =0	2-p_1(t)	-3 p_2(t)	2- p_3(t)	-6 p_4(t)
d =1,? =1	2-p_1(t)	4-6 p_2(t)	2- p_3(t)	7-12 p_4(t)
$E_{d,\Phi}$ [ER^s(h, d ,?)]	2-p_1(t)	2.6-5.4 p_2(t)	1.7- p_3(t)	-0.12-5.48 p_4(t)
E_I{ $E_{d,\Phi}$ [ER^s(h, d , ?)]}	(2-p_1(t)) p_1(t) +(0.8-3.6p_2(t)) p_2(t) +(1.2-p_3(t)) p_3(t) +(-2.28-4.32p_4(t)) p_4(t)			
E_s{ E_I{ $E_{d,\Phi}$ [ER^s(h,d ,?)]} }	(2-p_1(t)) p_1(t) +(2.6-5.4p_2(t)) p_2(t) +(1.7-p_3(t)) p_3(t) +(-0.12-5.48p_4(t)) p_4(t)			

Table 13: the expected net reward of individuals with latent ability(d , ?) engaged in kinds of occupations and the expected reward of taking up jobs h when investing human capital I_h under the probability p_{jh}:

	d =0 ,? =0	d =0, ? =1	d =1, ? =0	d =1, ? =1
TL	2-p_1(t)	2-p_1(t)	2-p_1(t)	2-p_1(t)
TE	1.5-4.5p_2(t)	7-9p_2(t)	1.5-4.5p_2(t)	7-9p_2(t)
NL	1.5-p_3(t)	1.5-p_3(t)	2.5-p_3(t)	2.5-p_3(t)
NE	-2.5-4.5p_4(t)	3-9p_4(t)	3-9p_4(t)	13-18p_4(t)
E_I [ER(h,d , ?)]	(2-p_1(t)) p_{11}(t) +(1.5-4.5 p_2(t)) p_{12}(t) +(1.5-p_3(t)) p_{13}(t) +(-2.5-4.5p_4(t)) p_{14}(t)	(2-p_1(t)) p_{21}(t) +(7-9p_2(t)) p_{22}(t) +(1.5-p_3(t)) p_{23}(t) +(3-9p_4(t)) p_{24}(t)	(2-p_1(t)) p_{31}(t) +(1.5-4.5p_2(t)) p_{32}(t) +(2.5-p_3(t)) p_{33}(t) +(3-9p_4(t)) p_{34}(t)	(2-p_1(t)) p_{41}(t) +(7-9p_2(t)) p_{42}(t) +(2.5-p_3(t)) p_{43}(t) +(13-18p_4(t))p_{44}(t)