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http://nubs.nju.edu.cn/jxjw.php/e

7 January 2008

IED

讨论稿 No.014

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2008-02-20

DISCUSSION PAPER SERIES

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Entrepreneurship, Innovation and Economic Growth

-----The Case of Yangtze River Delta in China

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Abstract: This paper firstly discusses why the economic growth in the Yangtze River Delta has been slowed down recently and suggests a need to transform the current input-based economic growth pattern into an innovation-based one. Next, through our theoretical analysis, we find that the change of current economic growth pattern is just the innovative reallocation of production factors, and the new economic growth driven by innovation is mainly initiated by the transmutation of entrepreneurship. Finally, we test our belief with real-world evidence. It shows that the Delta has formed a mechanism in which entrepreneurship and human capital mutually promote each other. However, the interactive relationship between R&D expenditure and entrepreneurship has not been developed in general. In addition, excessive government interventions will do harm to the growth of entrepreneurs and economic development.

Key Words: entrepreneurship, innovation and economic growth pattern

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Acknowledgement: The authors are grateful for helpful suggestions from the participants at 82nd annual conference of Western Economic Association International in 2007. All errors are ours.

1 Introduction

Yangtze River Delta (the Delta in short), also called as Chang Jiang Delta, is situated in east China and generally includes the city of Shanghai, southern Jiangsu province, and northern Zhejiang province (Figure 1). It is very strong in economic power and the most important manufacturing base in China. While it covers less than 1% of the total area of China and houses 5.8 % of the nation's population, Yangtze River Delta contributes about 20% of China's GDP, 22% of taxation, and 35% of imports and exports in 2005.[1]

In recent years, however, the economic growth in the Delta has been slowing down considerably. For instance, in the year 2005, the economic growth rate of Yangtze River Delta was 13.5%, down 1.9 percentage points year-on-year. Foreign trade volume of Yangtze River Delta in 2005 increased by 25.2% over previous year, but 19.6 percentage points lower than the growth rate of 2004. The fixed assets investment of this region in 2005 increased by 18.6%, even lower than the national average level (25.7%).[2]

Why has the Delta suffered a downturn recently? Through our research study, we come up with the following two major reasons. First, supply of production factors has been insufficient in the Delta recently. Labor input serves as a good example. Although the Delta has attracted a large amount of labor from west-central China, it is

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[1] China Daily (2006), "CEOs focus on Yangtze River Delta". http://www.chinadaily.com.cn/bizchina/2006-04/20/content_572557.htm

[2] Yang, Jingying, Zheng Zexiang, and Ren Xiaoyan (2006), "Comparative Study on Yangtze River Delta and Pearl River Delta Economic Development in 2006". http://www.stats.gov.cn/tjfx/fxbg/t20061025_402360163.htm October 26th, 2006

still short of skillful workers. According to statistics, among 70,000,000 industrial workers in China, senior mechanics only account for 3.5%. In contrast, senior mechanics make up about 40% in the developed countries. Among 1,200,000 enterprises in 16 cities of the Delta (known as the most advanced manufacturing cities), the inadequate percentage of senior mechanics and engineers is as high as 68%. The second example relates to land investment. Since the quotas of construction land in a lot of local areas have been used to

the full, many enterprises have to move part of their industries to other areas with land quotas still available, in order to attract high-class industrial investment. To some extent, the relocation results in a slower growth of foreign investment. In summary, the above examples indicate that the economic growth pattern heavily driven by production factors in the Delta will come to an end soon when the supply of production factors drains out. Second, when a large amount of foreign capital flows into foreign-owned businesses, local industries face more challenges and restrictions in terms of marketing and production technology. According to Jiangsu Statistics Bureau, foreign investment accounts for over 40% of total investment, in the fields of chemical raw materials, chemical manufacturing, plastic manufacturing, non-metallic mineral product manufacturing, special equipment manufacturing, transportation & communication equipment manufacturing, electric machine & equipments. Additionally foreign investment takes 86.2% in the industries of communication, computer and other electronic equipment manufacturing[3]. Caused by the insufficiency

[3] Liu, Zhaoheng (2006), "Analysis on Foreign Investment's Influence on Industrial Development from the Report of Economic Investigation, Jiangsu statistics and Analysis Data", Vol.22. May 23rd 2006 ,

in the input of production factors, the marginal contribution of foreign investment has declined. Meanwhile, local industries have suffered from the limits of technological capability and market space. Thus, it is hard for the local industries to become a dominant power in the economic growth of the Delta.

The above problems suggest a need to change the existing economic growth pattern in the Delta. How to make a change? To answer this question, we first examine economic performance in the Yangtze River Delta from 1990-2004 in part 2, and provide a literature review in part 3. Then we develop and analyze a theoretical model in part 4, which proposes that the change of current economic growth pattern is just the innovative reallocation of production factors, and the new economic growth pattern driven by innovation is mainly initiated by the transmutation of entrepreneurship. The above relationship between innovation and entrepreneurship, therefore, implies if governments relax their regulations or provide more favorable treatment, entrepreneurs can invest more time and efforts into productive activities rather than rent-seeking activities.

To support our theoretical points of view, in part 5, we collect data on investment, R&D expenditures and entrepreneurship, which are believed to be important determinants for the economic growth of the Delta. In the final part of this article, we draw several interesting conclusions based on the empirical study. We find that the Delta has owned a transition mechanism for new economic growth pattern, under which entrepreneurship and human capital can affect each other in a significant way.

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However, the interactive relationship between entrepreneurship and R&D expenditures has not well developed. Furthermore, local governments are still strengthening their controls over local economies, therefore, to a certain extent, weakening the R&D basics that play an important role in transforming economic growth pattern in the Delta.

2 Economic Performance in the Delta during 1990-2004

Since China's reform and opening, the growth rate of the Delta has been remarkable. GDP per capita of this region was only 1,050 RMB (Chinese Yuan) in 1978. It reached 3,323 RMB in 1990 and even accelerated after then. In 1995, GDP per capita soared to 11,439 RMB, 3.4 times as much as that achieved five years ago, and it reached 33,502 RMB in 2004. Figure 2 reveals the growth rates of secondary and tertiary industries in the Delta between 1990 and 2004. At the end of the 20th century (around 1998), Zhejiang's growth rate of secondary and tertiary industries surpassed Jiangsu's and Shanghai's. However, very quickly Jiangsu caught up and became number one in 2004.

In order to examine what factors cause the Delta to grow so quickly and whether there exists a possibility to change the current economic growth pattern, we plot and analyze the following factors that are believed to be attributable to economic growth. As shown in Figure 3, the change in labor input（$dL/dt/L$）, the growth rate of labor in the Delta was slow in general. Figure 4 illustrates, the average labor growth rates in Jiangsu, Zhejiang and Shanghai were slightly different, with 0.44%, 1.4%, and 0.42% respectively from 1990 to 2004. Among these three areas, Zhejiang had the highest labor growth rate.. Figure 5 indicates that salaries measured as the percentage of total output had decreased year by year. Although Shanghai had a comparative advantage of modern service industry, it could not prevent the percentage of salary from decreasing. As a major manufacturing province, the decline of salary percentage in Jiangsu was more remarkable. Comparatively, Zhejiang stopped its decrease in 2000, and had displayed an upward trend since 2003. Figure 6 shows that the annual growth rate of salary in Zhejiang was in fluctuation but had tended to rise since 1995, while Jiangsu and Shanghai both had a declining pattern in general. After 2000, the decrease of salary growth rate in Shanghai was the largest. Putting Figures 4, 5, and 6 together, we find when the growth rate of labor input in Zhejiang increased, the growth rate of salary accordingly increased too. This might imply that the demand for skilled workers in the secondary and tertiary industries increased in our sample period.

Figure 3 reveals how the growth rate of capital input (dK/dt/K) had changed during 1990-2004. The year of 1999 was an exception that the growth rate of capital was lower than the growth rate of technological progress and almost equal to the growth rate of labor. For the rest of the years, the growth rate of capital was relatively higher than that in 1999. After 1999, the growth rate of capital showed an obviously increasing tendency. One of the major reasons was because of large-scale foreign direct investment. Among Jiangsu, Zhejiang and Shanghai, average growth rates of capital were quite different at 18.4%, 22.3%, and 17.42% respectively. The capital growth rate in Zhejiang had been higher than those in Jiangsu and Shanghai since 2000. But shown in Figure 7, the growth rate of capital in each area had slowed down since 2004. If measuring the contribution of the growth rate of capital to economic growth, the figures were 89.66%, 90.09% and 84.18% respectively in Jiangsu, Zhejiang and Shanghai, with Zhejiang the highest[4]. It turns out that the existing economic growth pattern in the Delta was still primarily driven by large-scale factor inputs during 1990-2004.

The above figures show that economic growth in the Delta was mainly achieved by the input of capital during the 1990s, while technological progress was still rather slow. However, the input of capital never grows without limit. The shortage of production resources in the Delta determines that such a high growth rate of capital input will not be sustained too long. To keep up with the high growth of capital input, the ratio of capital to labor will have to further increase, which leads to an inevitable decrease in the marginal efficiency of capital. Only technological progress can reverse this course. In the sample period from 1990-2204, the growth rates of technological progress and labor input in Shanghai had been higher than the other two areas since 2002. As such, it seemed easier for Shanghai to start a transition of economic growth pattern. But the proportion of salary in total output in Shanghai tended to decrease.

[4] The contribution of labor growth rate to economic growth in Jiangsu ,Zhejiang and Shanghai, denoted by ω, was 10.34%、9.91%、15.82% respectively. Derived from the following equation $\frac{dY/dt}{Y} = \frac{dA/dt}{A} + (1-\omega_l)\frac{dK/dt}{K} + \omega_l \frac{dL/dt}{L}$, the figure of 1－ω is the contribution of the growth rate of capital input.

This may lead to an insufficient refilling of human resources in the process of technological progress.

Paul Krugman (2000), in his new book entitled *The Return of Depression Economics*, made a point that Asia achieved remarkable rates of economic growth without achieving accordingly remarkable increases in productivity. The growth in Asia was the product of resource mobilization rather than efficiency. In the past decade, the Delta has attracted a great deal of international manufacturing capital. It remedies the inadequacy of investment and helps to improve domestic industrial technology. However, the key technologies and equipments are still under control by foreign enterprises, causing domestic enterprises to keep staying at the stage of producing low value-added products. This situation calls for a need to transform the current economic growth pattern in the Delta, which requires an improvement in total factor productivity and domestic innovation.

How to start a technological innovation? We propose that it depends on the transmutation of entrepreneurship and the innovative reallocation of production factors such as labor, capital (including human capital) and technology. The following literature review and our theoretical analysis nicely support this point of view.

3 Literature Review

The concept of entrepreneurship has a wide range of meanings. The definitions include the carrying out of new combination of production resources (Schumpeter, 1934), the ability of entrepreneurs to fill market deficiencies through input-completing activities (Leibenstein, 1968), the bearing of uncertainty (Knight, 1921), and the ability to deal with disequilibria (Shultz, 1975). In summary, entrepreneurship is often viewed as a function which involves the exploitation of opportunities existing within a market. Such exploitation is most commonly associated with the direction and/or combination of productive inputs. Hence, entrepreneurs are often related to creative and innovative actions.

There is plenty of literature that studies why and how innovation, resource allocation and entrepreneurship determine economic growth. The literature helps us to develop a theoretical framework in Part III that brings together technological innovation, reallocation of production resources and entrepreneurship. The following review divides the existing literature into four broad categories.

3.1 Technological Innovation

Schumpeter (1934) links the entrepreneurial initiatives of individuals to the creation and destruction of industries as well as to economic development, while Romer (1990) clearly attributes economic growth to technological progress. Since technological progress is endogenous, it does not come as "manna from heaven, but is driven by investment in R&D. Romer believes that technological progress is not dependent of capital, production, population and labor. The technological progress relies on the amount of researchers who invent new ideas and spur on technological advancement.

Aghion and Howitt (1992) acknowledge the contributions of Romer, and emphasize that economic growth mainly results from the firm’s research activity. They also agree with Schumpeter that endogenous innovations yield creative destruction. Specifically the creator of a new innovation gets some monopoly rents until next innovation comes along, at which point, the knowledge underlying the rents becomes obsolete. The incentives for investment in R&D and thus growth are impacted by this process of creative destruction.

3.2 Reallocation of Labor

When new firms either completely eliminate the old businesses or force them to restrict their operations, it will create a new demand for labor that outweighs the unemployment. In another words, when labor transfers from old firms to new firms, under certain circumstances, it accelerates the process of creative destruction in which innovation incessantly revolutionizes the economic structure by destroying old firms and creating new firms.

Evidence has proved that the reallocation of workers across firms and establishments is an important source of economic growth. For instance, Bartelsman and Doms (2000) and Foster et al. (2000) survey much of the literature on the relationship between micro and macro productivity dynamics, including the contribution of entry and exit to productivity growth. Bartelsman and Doms (2000) find that an increase in productivity growth mainly results from worker reallocation. Foster et al (2000) discover that in the United States, during 1977 to 1987, 34% of productivity growth was the result of new entry, and 24% came from the reallocation of workers among different firms. Moreover, Lentz et al (2005) use a quantitative model to show that the reallocation of workers from less to more productive surviving firms accounts for more than 2/3 of aggregate productivity growth.

3.3 Entrepreneurship

From various definitions of entrepreneurship, we can recognize that entrepreneurship has a unique and critical role in the development process (Leibenstein, 1968). Audretsch et al. (2006) explain why entrepreneurship plays a vital role in generating economic growth. They believe that entrepreneurship is the missing link between investments in new knowledge and economic growth. By serving as a conduit for knowledge spillovers, entrepreneurship is an important mechanism permeating the knowledge filter to facilitate the spill over of knowledge and ultimately generate economic growth.

Leibenstein (1968) thinks that Entrepreneurship is frequently a scarce resource because entrepreneurs are gap-fillers and input-completers and these are scarce talents. But Schultz (1975) views entrepreneurship as human capital—skills that can be obtained through education and training. He says "the ability to deal successfully with economic disequilibria is enhanced by education and this ability is one of the major benefits of education accruing to people privately in a modernizing economy". If we define entrepreneurship as abilities to imitate and innovate, education does contribute to improving entrepreneurial abilities. Baumol (2004) further confirms the role of education by saying "the design of the educational process has significant consequences for two highly pertinent, but very different, capabilities of the individuals engaged in innovative activities. On one side, education provides technical competence and mastery of currently available analytic tools to future entrepreneurs and others who will participate in activities related to innovation and growth. On the other side, education can stimulate creativity and imagination and facilitate their utilization."

3.4 Entrepreneurship and Economic Growth Pattern

The shift of economic growth pattern is often referred to a change from the growth of factor inputs to the growth of productivity as a driving force. The former pattern is related to the increase in capital investment and called as Marxian Growth, while the latter pattern depends on technological progress and innovation, and is called as Kuznets Growth or Modern Economic Growth. In our paper, we are more interested in discussing how to transform economic growth into Kuznets pattern. Japan, Korea and Taiwan are successful cases. They tried to facilitate innovative activities of entrepreneurs by freeing them from undue regulations and controls on product and factor markets. Meanwhile, governments increased their investments for the provision of research, education and other public infrastructures. By contrast, a large number of developing countries, including China, are facing the problems with the lack of self R&D and large-scale foreign investment. Meanwhile, these countries are challenged by globalization of production value chain. Therefore, the transition to modern economic growth has been delayed and even endangered.

From the perspective of entrepreneurship, the sequence of economic growth from input-based to innovation-based is, in fact about how to choose entrepreneurs and managers. The answer key lies on a sorting mechanism to get rid of low-skill entrepreneurs. Acemoglu et al. (2006) emphasize "the selection of high-skill managers is more important for innovation activities. As the economy approaches the technology frontier, selection becomes more important. As a result, countries that are far away from the technology frontier pursue an investment-based strategy, with long-term relationships, high average size and age of firms, large average investments, but little selection. Closer to the technology frontier, there is less room for copying and adoption of well-established technologies, and consequently, there is an equilibrium switch to an innovation-based strategy with short-term relationships, younger firms, less investment and better selection of managers”.

4 Theoretical Analysis

4.1 Framework of the Basic Model

In our model, we assume that there are two kinds of activities in the economy: manufacturing activities and R&D activities. R&D activities influence manufacturing activities, but not vice versa. The increase of R&D output enhances the level of manufacturing technology and thus increases the demand for capital and labor in the manufacturing activities (Dias, 2006). In the manufacturing activities, we denote the technological level as A, capital input as K_P, labor input as L_P, human capital possessed by each worker as h, and the growth rate of human capital as $\dot{h}$. In the R & D activities, we denote the capital input of R&D as K_R, the growth rate of capital input as $\dot{K}_R$, the amount of labor as L_R and the number of entrepreneurs as E. The total human capital hired by a representative enterprise is denoted by Z. We assume that with an increase in the number of entrepreneurs, human capital follows to accumulate for the following reasons. On one side, entrepreneurs hire the workers who possess of human capital to participate in the R&D activities. Without the help of entrepreneurs, those workers will only participate in the manufacturing activities. On the other side, entrepreneurs encourage workers to get more labor education and accumulate their human capital.

In the manufacture activities, the production function is given by:

$$Y_P = AK_P^{1-\alpha} L_P^{\alpha} \quad , \qquad (1)$$

s.t. $$A = \phi h^{\gamma} , \qquad (2)$$

$$\dot{h} = f(E)h \, . \qquad (3)$$

In the R&D activities, the production function takes the following form:

$$Y_R = \theta K_R^{\beta} + A_R z^{\varepsilon} , \qquad (4)$$

s.t. $$z = L_R h , \qquad (5)$$

$$\dot{K}_R = g(E) K_R , \qquad (6)$$

where θ、ϕ are constants, α、β、γ、ε are output elasticity coefficients. Assume that $0<\beta<1$、$\varepsilon>1$, $0<\gamma<1$[1]. $f\left(E\right)$ shows the effect of entrepreneurs on human capital. Assume that $f'(E)>0$, $f''(E)\leq 0$. Given the above assumptions, $f(E)$ can be simply written as $f(E) = -a + \log_b E$, where $a>0$, $b>1$. Similarly, $g\left(E\right)$ shows the effect of entrepreneurs on the accumulation of R&D capital. Assume that $g'(E)>0$, $g''(E)\leq 0$ and $g(E) = -c + \log_d E$, where $c>0$, $d>1$.

[1] In the R&D activities, if a team with workers having strong scientific and research abilities exists, its influence will be imponderable. Hence assuming $\varepsilon > 1$ means human capital has an increasing return to scale with respect to output in the R&D activities. It is practical. Assuming $0<\gamma<1$ means human capital has a decreasing return to scale with respect to output in the manufacturing activities. It is also practical. For example, in the Delta, the resources of current direct investment mainly come from international advanced manufacturing capital. Although human capital stock is highly valued, workers holding human capital still are treated as senior labor in the process of manufacturing. They do not participate in technological innovation.

In addition, we assume that there are two groups in the economy: workers and managers. They are not transferable. However, workers can be divided into workers without owning human capital in the manufacturing activities and workers owning human capital in the R&D activities. To transfer workers from the manufacturing activities to the R&D activities, education investment is needed so as to accumulate the human capital. Managers can choose to become either renters or entrepreneurs. Renters do not take part in the manufacturing activities and their income just relies on the transfer income of entrepreneurs, while entrepreneurs participate in the manufacturing activities and receive a certain amount of revenues.

Capital can be divided into manufacturing capital and R&D capital. Assume that the capital market is perfectly competitive without constraints on capital acquisition. For the convenience of analysis, we also assume that manufacturing capital and R&D capital are non-transferable.

4.2 Reallocation of Capital

According to the above basic setup, the profit of the R&D activities is given by ：

$$\pi_R = \theta K_R^{\beta} + A_R z^{\varepsilon} - w_R z - \rho_R K_R , \qquad (7)$$

where w_R is the wage per unit of human capital, and ρ_R is the rate of return to R&D capital.

To maximize the profit of the R&D activities, we set $\frac{d\pi_R}{dK_R} = 0$ ， which gives:

$$\rho_R = \beta\theta K_R^{\beta\text{-}1} \quad .$$

（8）

The profit of the manufacturing activities is defined as follows ：

$$\pi_P = AK_P^{1-\alpha} L_P^{\alpha} - w_P L_P - \rho_P K_P \quad ,$$

（9）

According to first order condition $\frac{d\pi_P}{dK_P} = 0$ ， it satisfies:

$$\rho_P = (1-\alpha)A\left(\frac{K_P}{L_P}\right)^{-\alpha} \quad .$$

（10）

By defining $\frac{K_P}{L_P} = k$ ， equation（10）can be rewritten as

$$\rho_P = (1-\alpha)Ak^{-\alpha} \quad .$$

（11）

If the entrepreneurs want to transfer the newly increased capital from the manufacturing activities to the R&D activities, the follow condition must hold：

$$\int_t^{+\infty} \rho_R e^{-r(x-t)} dx > \int_t^{+\infty} \rho_P e^{-r(x-t)} dx \quad ,$$

（12）

where r is the rate of discount.

Replacing the left-hand side equation (12) with equation (8) and replacing the right-hand equation (12) with equations (10) and (2), we obtain：

$$\frac{\beta\theta K_R^{\beta\text{-}1}}{r-(\beta-1)g(E)} > \frac{(1-\alpha)\phi k^{-\alpha} h^{\gamma}}{r-\gamma f(E)} \quad . \qquad (13)$$

When equation (13) holds, the newly increased capital is R&D capital. Otherwise, the newly increased capital will flow into the manufacturing activities. To satisfy this inequality, when E increases, on the left-hand side, the increase of $g(E)$ must be larger than that of $f(E)$ on the right-hand side as much as possible. In another word, we can obtain $(\beta-1)g'(E) > \gamma f'(E)$. Since $f(E) = -a + \log_b E$ and $g(E) = -c + \log_d E$, after arrangement, we have:

$$\frac{1-\beta}{\gamma} < \frac{\ln d}{\ln b}. \qquad (14)$$

Proposition 1**:** Equation (14) can be much easily satisfied (i.e. entrepreneurs can much easily reallocate capital into the R&D activities) under the following conditions. (1) Given that $\frac{1-\beta}{\gamma}$ and the number of entrepreneurs are constant, the smaller the number of b, the higher demand for knowledge and technology when taking technological innovation (derived from the equation $f(E)$), and the higher demand for the increase of human capital as well (derived from Equation (3)). [2] (2) Given that $\frac{1-\beta}{\gamma}$ and the number of entrepreneurs are constant, the bigger the number of d , the less dependency of technological innovation on R&D capital (derived from the equation $g(E)$), and the lower demand for the increase of R&D capital (derived from Equation (6)).[3] (3) Given that $\frac{\ln d}{\ln b}$ is constant, the larger the output elasticity of R&D capital, the bigger the number of β . (4) Given that $\frac{\ln d}{\ln b}$ is constant, the

[2] There is a higher requirement on education and vocational skill training. When the requirement is satisfied, the above condition will hold more easily.

[3] It can be easily realized only when the government increases R&D input, raises the proportion of R&D expenditure in GDP, or when there exists a sound risk capital market or patent system.

larger the contribution ratio of human capital to technological progress in the manufacturing activities, the bigger the number of γ.

4.3 Reallocation of Labor

If entrepreneurs gradually transfer the newly increased capital to the R&D activities, the attraction degree of R&D activities is changing too. The reallocation condition that causes workers to move to another place is that wage level in the R&D activities should be higher than that in the manufacturing activities. It can be further discussed as follows:

With regard to the manufacturing activities, deriving from first order condition $\frac{d\pi_p}{dL_p}=0$, we get $w_P=\alpha A(\frac{K_P}{L_P})^{1-\alpha}=\alpha Ak^{1-\alpha}$. Regarding the R&D activities, deriving from first order condition $\frac{d\pi_R}{dz}=0$, we solve $w_R=\varepsilon A_R z^{\varepsilon-1}$.

Before workers flow from the manufacturing activities to the R&D activities, they need to acquire a certain amount of human capital which can be gained from labor education. Hence education investment is needed. We assume that the cost function of education investment is $C_M=\psi h^{\sigma}$ where $\sigma>1$.

Thus, the condition of labor transfer can be written as:

$$\int_t^{+\infty} w_R h e^{-r(x-t)}dx - C_M > \int_t^{+\infty} w_P e^{-r(x-t)}dx \tag{15}$$

Simplifying equation (15), we get

$$\frac{\varepsilon A_R L_R^{\varepsilon-1} h^{\varepsilon}}{r-\varepsilon f(E)} > \frac{\alpha\phi k^{1-\alpha} h^{\gamma}}{r-\gamma f(E)} + \psi h^{\sigma}$$

（16）

Proposition 2: In equation (16) with $\varepsilon > 1, 0 < \gamma < 1$, given that all other variables are constant, when E increases, the left-hand side of equation (13) will be greater than its right-hand side (i.e. $\varepsilon > \gamma$). Therefore, there must exist an E^*. When $E > E^*$, labor begins to flow from the manufacturing activities to the R&D activities.

4.4 Reallocation of Entrepreneurship

In reality, governments can control a lot of economic resources in the process of industrial development, such as land, taxation and finance. When performing their functions, entrepreneurs inevitably have to make their efforts to dealing with governments, or even demonstrate a rent-seeking behavior. When governments control economic resources on a relatively large scale and scope, entrepreneurs may lose their opportunities to discover or make productive profits (i.e. innovation), and just become rent-seekers. This is harmful for economic development. Thus, in order to help entrepreneurs more engage in innovation, it requires governments to relax their control and reduce the cost of organizing resources by entrepreneurs. One of the simplest solutions is a cut in taxation. Here, in the paper, we denote tax rate as τ . For the purpose of convenience, entrepreneurship is composed of two parts: the ability to seek rents, denoted by R, and the ability to produce, denoted by E. Under a certain circumstance, the entrepreneurial ability can be embodied by innovative activities, for instance, through innovatively reallocating capital and labor. In practice, these innovative activities can be accomplished by establishing new firms, setting up a new office or department on the current enterprise's basis, or changing the way to implement strategies. We assume all of such activities lead to an increase in the number of entrepreneurs. Thus, E is exactly the number of entrepreneurs required in the process of reallocating labor and capital, as discussed in the above sections.

The condition to transform entrepreneurship is the rate of return to the productive ability should be larger than that of the rent-seeking ability. However, the transfer between these two types of ability requires a cost (C_T). The profit from entrepreneurs' rent-seeking can be treated as part of the income gained from taxation. Hence, the condition to get entrepreneurs more involved in production can be expressed as:

$$\int_0^{+\infty}(1-\tau)(\pi_P+\pi_R)e^{-rt}dt - C_T \geq \int_t^{+\infty}(1-\tau)\frac{(\pi_P+\pi_R)E}{R+E}e^{-rt}dt + \int_t^{+\infty}\tau\frac{(\pi_P+\pi_R)R}{R+E}e^{-rt}dt \qquad (17)$$

Simplifying equation (17) gives the following equation:

$$E \leq \left[\frac{(1-2\tau)(\pi_P+\pi_R)}{rC_T}-1\right]R \qquad (18)$$

Since π_P depends on h , K_P and L_P , while π_R relies on h 、 K_R , when newly increased capital and labor move from the manufacturing activities to the R&D activities, the demand for entrepreneurial abilities or the number of entrepreneurs in the transfer process can be written as:

$$E^* = E^*(\tau, h, K_P, L_P, K_R, C_T)$$

As time passes, the growth rate of E is given by：

$\dot{E} = \theta_E[E^*(\tau, h, K_P, L_P, K_R, C_T) - E]$， where θ_E is a parameter, and $\dot{E}$ depends on τ、 h、 K_P、 L_P、 K_R and C_T.

Proposition 3： According to equation (18), holding all else constant, (1) with the decrease of τ, entrepreneurship E becomes larger; (2) when the transfer cost C_T from developing the rent-seeking ability to the productive ability is lower, entrepreneurship E also gets larger. If either of the above two conditions holds true, it would be easier for entrepreneurs to get more involved in productive innovation.

5 Empirical Analysis

5.1 Model Description

According to Propositions 1 to 3, when the economic growth pattern shifts from the manufacturing based to the R&D based, it seems to only depend on the reallocation of capital and labor. But in fact, the shift also depends on the demand of entrepreneurs for high-quality human capital such as knowledge and skills, as well as the demand for R&D input. In turn, the transmutation of entrepreneurship is influenced by the reallocation of capital and labor. More importantly, if governments relax their control or opt for open policies, it would encourage entrepreneurs to invest more of their time, efforts and abilities from rent-seeking into productive innovation.

In order to measure the relationship between entrepreneurship, reallocation of production factors and R&D input, we consider the entrepreneurs' demand for human capital and R&D expenditure. Meanwhile, the transformation of entrepreneurship is regarded as the result of reallocation of production factors and the result of the adjustment in policy environment. Hence, we set up the following three separate equations:

$$\mathrm{HC} = \mathrm{c}_1 + c_2 ENTR + c_3 X + \varepsilon \quad , \tag{19}$$

$$ETD = c_1 + c_2 ENTR + c_3 X + \varepsilon \quad , \tag{20}$$

$$ENTR = c_1 + c_2 HC + c_3 ETD + c_4 X + \varepsilon \quad . \tag{21}$$

In the above equations, HC represents the amount of human capital, measured by the percentage of students at universities and vocational schools in total employment. ETD represents R&D expenditure as the percentage of GDP. ENTR represents the percentage of a population of entrepreneurs in the total population. In Equation （19）, variable X includes average per capita spending on education (EHPC）, average per capita medical care (HPC ） , and the expenditure on culture, education, science and public health[4] (CECHC). In Equation (20), variable X includes local

[4] The expenditure on culture, education, science and public health refers to the expenses appropriated from the government budget on the causes of culture, publication, cultural relics, education, public health, traditional Chinese medical science, free medical services, sports, archives, earthquake, ocean, communications, broadcasting, film and television, family planning; expenditure for training of cadres of government, party and mass organization etc.

fiscal revenue (LFR）[5], expenditures of science and technology (STP）[6], and innovation funds of enterprises (TUTE）[7]. In Equation (21), variable X includes local fiscal revenue (LFR). The factors included in variable X in each equation are all measured as the percentages of GDP. In the above equations, c_i is the i^{th} coefficient and ε is residual. It's easy to find that the first two equations measure the demand for the reallocation of labor and capital factors by entrepreneurs, while the third equation measures how the reallocation of factors and the government policy environment affect entrepreneurship.

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[5] local fiscal revenue is measured by the proportion of GDP. The revenue of the local governments includes business tax, income tax of the enterprises subordinated to the local government, personal income tax, tax on the use of urban land, tax on the adjustment of the investment in fixed assets. Tax on town maintenance and construction, tax on real estates, tax on the use of vehicles and ships, stamp tax, slaughter tax, tax on agriculture and animal husbandry, tax on special agricultural products, tax on the occupancy of cultivated land, contract tax, 25% of the value added tax, 50% of the tax on stock dealing (stamp tax) and tax on resources other than the ocean petroleum resources.

[6] Expenditures for science and technology promotion refer to the expenses appropriated from the government budget on the scientific and technological activities, including new products development expenditure, expenditure for intermediate trial and subsidies on important scientific researches.

[7] Innovation funds of enterprises refer to the funds appropriated from the government budget to help enterprises to develop latent power, upgrade technology and carry out innovation, including loan of the enterprises on innovation, subsidies on the innovation of small fertilizer plant, small cement plant, small coal mines, small machinery plant and small steel plant.

5.2 Data and Descriptive Statistics

The data are collected from Statistical Yearbook of Jiangsu Province（1990~2004）, Statistical Yearbook of Zhejiang Province（1990~2004）, Statistical Yearbook of Shanghai （1990~2004）and Statistical Yearbook of China （1990~2004）.We make statistical analyses based on the data over the past 15 years and provide a statistical description on human capital, R&D expenditure and growth of entrepreneurship as well as its growth environment in the Delta, from Figure 8 to Figure14.

(1) Concerning human capital, as shown in Figure 8, the percentage of human capital stock in the total employment in Jiangsu, Zhejiang and Shanghai showed an increasing trend Human capital stocks were 4.13 times, 3.92 times, 1.86 times respectively in Jiangsu, Zhejiang and Shanghai over the period of 1990 to 2004. Among these three economic areas, Jiangsu enjoyed the highest growth rate, with Zhejiang the second and Shanghai the lowest. But the average human capital stock in the total employment in Shanghai was still far higher than those of Jiangsu and Zhejiang, even higher than the sum of the human capital stock in Jiangsu and Zhejiang. It demonstrates that shanghai has a relatively solid foundation of human capital stock and is rich in workers owning human capital to take part in technological innovations. Regarding the change of the investment expenditure on human capital[1], as shown in Figure 9, the human capital investment in shanghai had a similar increasing trend as Jiangsu and Zhejiang had, but the investment magnitude in Shanghai was lower than the other two areas. After 2002,

[1] Expenditure of human capital investment is represented by the sum of average per capital education expenditure and its proportion in GDP.

the proportion of the investment expenditure on human capital in GDP in these three areas all decreased at a different rate.

(2) Concerning the R&D capital input of enterprises, as shown in Figure10, Shanghai kept the highest R&D expenditure, with Jiangsu the second and Zhejiang the lowest between 1990 and 2004. Generally speaking, these three areas all had an upward increasing tendency. Since 1996, R&D expenditure in Jiangsu and Zhejiang had begun to grow, while the rise in shanghai had started since 1999. As shown in Figure 11, the average growth rate of R&D expenditure in Zhejiang was 8.9% between 1996 and 2004. Comparatively, the average growth rate was 7.8% in Jiangsu and 5.1% in Shanghai.

(3)With regard to the increase of the number of entrepreneurs, as shown in Figure12, Zhejiang had the largest entrepreneur population, measured as the percentage of the total population. The increase was quite stable before 1999. However, when it reached the peak at 7.6%, it started to decrease. In general, it still remained an increasing tendency and had the highest percentage among the three areas. Generally speaking, the proportions of entrepreneurs in Shanghai and Jiangsu rose up year by year, and they shared a similar increasing ratio. The growth rates of the number of entrepreneurs in Jiangsu, Zhejiang and Shanghai were 2.7 times, 1.5 times, 2.1 times respectively from 1990 and 2004, while average annual growth rates were 7.4%, 3.1% and 5.3 % respectively. After 2004, the growth rates gradually slowed down. It was more apparent in Shanghai and Zhejiang. This corresponded to a stable period when the economic growth was not primarily because of capital expansion but the promotion of industrial technology on the basis of the current level of investment.

(4) Regarding the environment that encourages the performance of entrepreneurs, we consider the local fiscal revenues collected from each enterprise in the three areas, as shown in Figures 13 and 14. Enterprises' contribution to local fiscal revenue displayed an increasing tendency in general, at a different degree though. It demonstrates the tax burden on entrepreneurs became increasingly heavier to some extent and it diminished the enthusiasm of entrepreneurs in the transition of economic growth pattern.

The average level of local fiscal revenue collected in Shanghai was the highest among these three areas, even higher than the sum of local fiscal revenue collected from both Jiangsu and Zhejiang. It implies that entrepreneurs in Shanghai were usually in a relatively weak position and more intervened by governments. To some degree, this disadvantage offsets the advantage that shanghai has a solid foundation of technological innovation. Compared to Shanghai and Jiangsu, entrepreneurs in Zhejiang were better off.

5.3 Analysis on Regression Results

According to the above regression equations, we use the Least Square Method[2] to test for the relationship between entrepreneurship and reallocation of factors in the Delta.

In Table 1, Panel (1) shows a positive relationship between the number of entrepreneurs and human capital in employment. The relationship is statistically significant. When the number of entrepreneurs changes, there is a need to readjust human capital such as knowledge and skills. Regarding the independent variables EDPC

[2] The problems of heteroskedasticity and autocorrelations have been controlled. To solve for the problem of multicollinearity, we use Factor Analysis approach by transforming the relevant variables into two factors.

and CECHC, t statistics show that they have significant effects on human capital. This implies that investment spending on human capital out of the fiscal expenditure significantly affects the quantity of human capital.

Panel (2) shows that, the R&D expenditure in the Delta is not generally influenced by the number of entrepreneurs, local fiscal revenue and expenditure on science and technology. The result in Panel (3) confirms what has been obtained in Panel (1) by showing that the amount of the human capital and the number of entrepreneurs are significantly positively correlated. This result indicates that a change in the amount of human capital increases the number of entrepreneurs. Furthermore, it implies that the increases of knowledge and skills in human capital have a positive influence on transmutation of entrepreneurship. In addition, the number of entrepreneurs and local fiscal revenue are negatively correlated. When there is an increase in the level of fiscal revenue collected by local governments, it would produce a negative impact on entrepreneurship.

Table 2 supplements the report of Table 1 by investigating the relationship between the change of entrepreneurship and reallocation of production factors Jiangsu, Zhejiang and Shanghai one by one. Panel (1) shows a significant and positive relationship between human capital and the number of entrepreneurs in all of these three areas. Concerning the independent variable CECHC, in Zhejiang and Shanghai, the expenditure on culture, education, science and public health appears to be significantly positively correlated with human capital. It indicates the great efforts that the governments in Zhejiang and Shanghai have contributed to promoting cultivation of human capital.

In Panel (2), the independent variables in the case of Jiangsu are all significant, which means the number of entrepreneurs, local fiscal revenue、the expenditure of science and technology, and innovation funds of enterprises are highly correlated with the R&D expenditure. However, the number of entrepreneurs negatively affects the R&D expenditure in Jiangsu. This reveals that the entrepreneurs in Jiangsu do not pay a high attention to the expenditure on R&D. By contrast, entrepreneurs in Zhejiang emphasize the role science and technology. In Shanghai, the R&D expenditure directly reflects the demand of enterprises. But it is negatively correlated with the local fiscal revenue. This verifies that the influence of shanghai governments on the local economy has endangered the foundation of technological innovation.

In Panel (3), we find that human capital in Jiangsu, Zhejiang and Shanghai positively affects the number of entrepreneurs. But the magnitude of the effects coming from human capital is relatively smaller in Jiangsu. We also find that all of the other variables in Jiangsu are not significant. This confirms that in practice although the local fiscal revenue in Jiangsu tended to increase after 1994, it did not have a significant effect on the number of entrepreneurs. In both Zhejiang and Shanghai, the relationship between the local fiscal revenue and the number of entrepreneurs is significant. The result implies that the environment beneficial for the growth of entrepreneurs in Zhejiang was over- influenced by local governments. In Shanghai, the influence on economic activities by local governments seems more severe than the other economic areas. Since the excess government control is not a favorable factor in the process of transformation of entrepreneurship and the promotion of technological innovation, Shanghai is still unable to create an ideal environment for entrepreneurs to develop.

6 Conclusion

The economic growth pattern driven by extensive production inputs in the Delta has suffered from the short supply of production factors in recent years. It has lead to a fluctuation or even a decline in economic growth. With a large amount of foreign investment flowing into advanced-level and intermediate-level industries, local manufacturing industries are challenged by foreign investments in terms of industrial technology and market space. Hence the current economic growth pattern in the Yangtze River Delta needs a change. Based on the theories of economic growth pattern, we propose that the transition of input-intensity growth pattern is actually the change of the combination of production factors. A new innovation-based economic growth pattern is initiated by the transmutation of entrepreneurship.

By developing a theoretical model, we find that the transfer from input-based economic growth to technology-based economic growth, in fact, depends on the demand of entrepreneurs for high-quality human capital such as knowledge and skills and high demand of R&D expenditure. In turn, the transmutation of entrepreneurship is influenced by the reallocation of capital and labor. But the most important determinant for entrepreneurship is government policies. For instance, if governments loosen their restrictions or opt for more open policies, it helps entrepreneurs to invest more of their time, effort and ability from rent-seeking behavior to the productive innovation.

To support our points of view, we test the implications of our theoretical model with real world evidence. We collect data on factor inputs, R&D expenditure and entrepreneurship which are believed to be important to economic growth in the Delta. Through different statistical analyses, we find that the Delta has formed a mechanism in which entrepreneurship and human capital can mutually promote each other. However, the interactive relationship between R&D expenditure and entrepreneurship has not been developed in general. In addition, the influence from local governments becomes stronger, which weakens the foundation of R&D expenditure in the transition of economic growth pattern. In the Delta, Shanghai has laid a foundation for transition of economic growth pattern. But the relatively strong influence from Shanghai governments is harmful to the transition of economic growth pattern. In Zhejiang, the local governments have done too much intervention and already made a negative impact on the transition of economic growth pattern. However, the support to the technological innovation from Zhejiang governments offsets the above negative effect to some extent. Comparatively, the transition of economic growth pattern in Jiangsu is not worth praising. Luckily, the impact of Jiangsu governments on the local economy is still unstable, that's why it has not made a negative impact on the transmutation of entrepreneurship. In summary, the transition of economic growth pattern needs to strengthen a system of interactive promotion between R&D expenditure and the transformation of entrepreneurship. More importantly, reducing the intervention from different governments would offer a better environment for growth of entrepreneurs and the increase in the R&D expenditure.

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Appendix: Figures and Tables

Figure 1 The Map of Yangtze River Delta

Note: In the following figures, SH stands for Shanghai, JS stands for Jiangsu, and ZJ stands for Zhejiang.

Figure 2 Growth Rate of the Second and Tertiary Industries

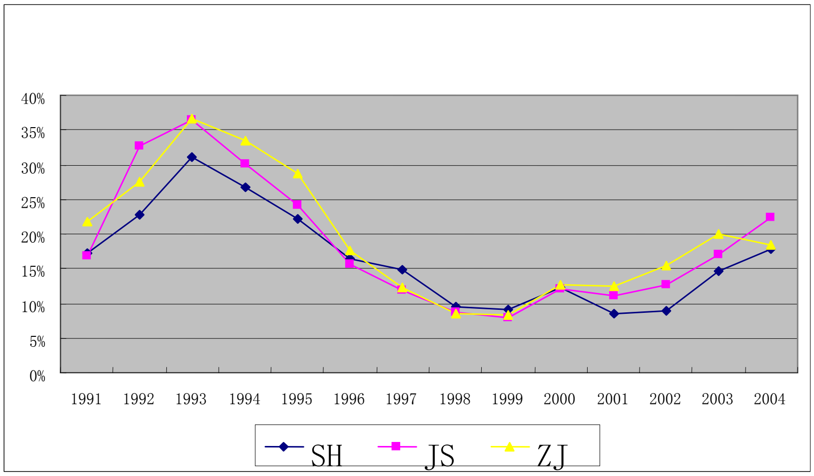
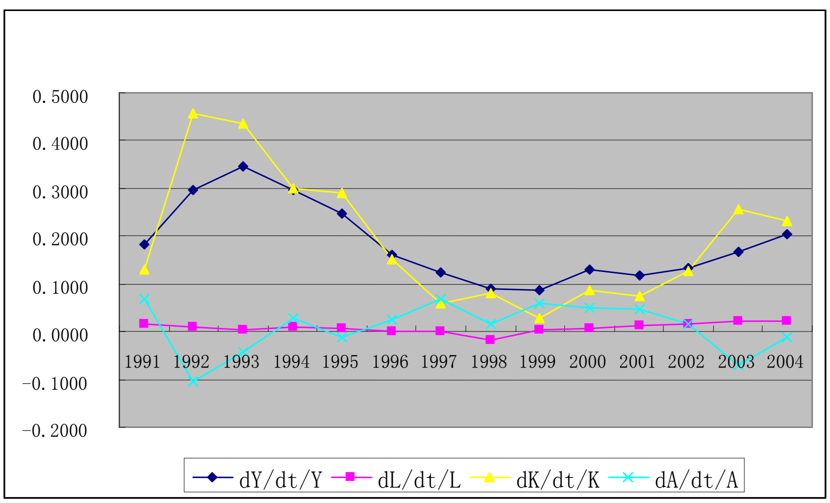


Figure 3 Growth Rate for Each Production Factor in the Delta



Note: dY/dt/Y stands for the growth rate of total production, dL/dt/L stands for the growth rate of labor input, dK/dt/K stands for the growth rate of capital input, dA/dt/A stands for the growth rate of technological progress.

Figure 4 Growth Rate of Labor

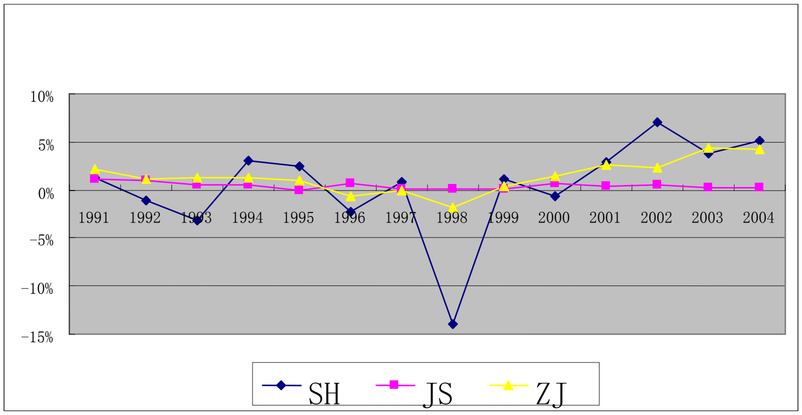
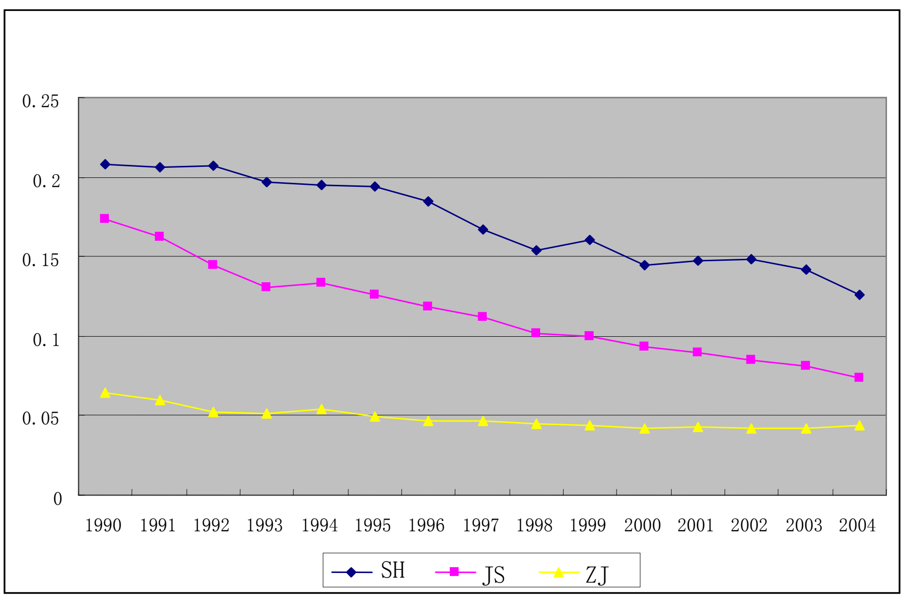


Figure 5 Salary Measured as Percentage of Total Output[3]



[3] The total output was obtained from the total output value of the second and tertiary industries.

Figure 6　Growth Rate of Salary

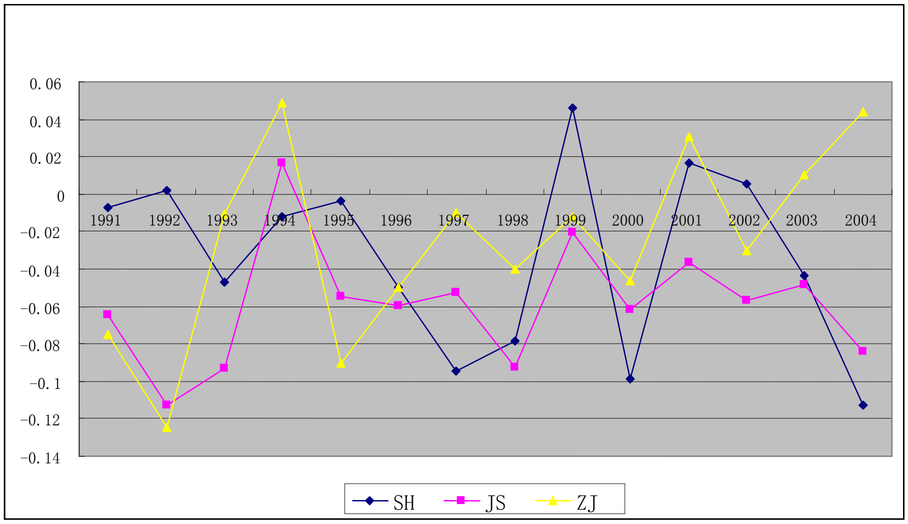


Figure 7　Growth Rate of Capital

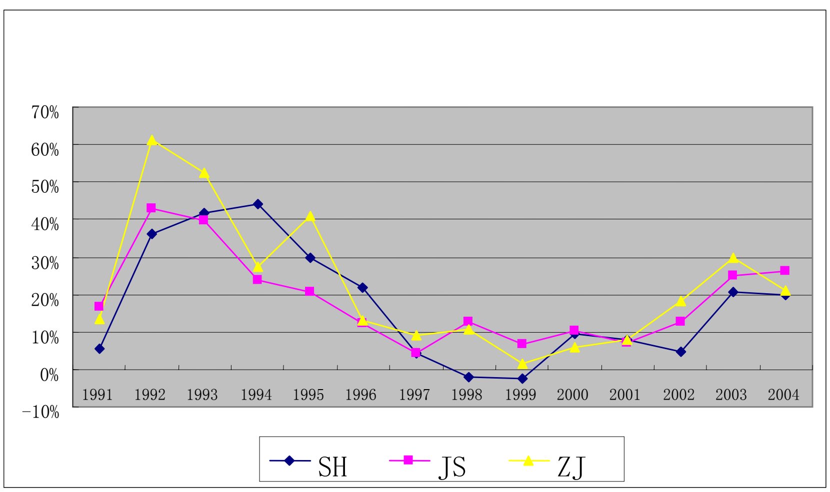


Figure 8　Human Capital Stock

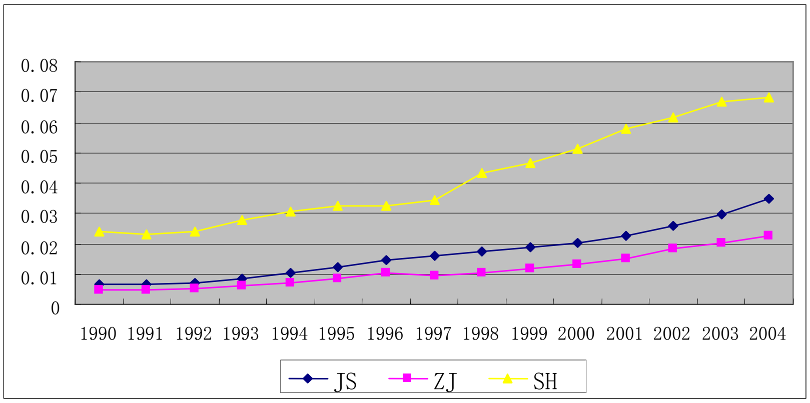


Figure 9　Change of Investment Expenditure on Human Capital

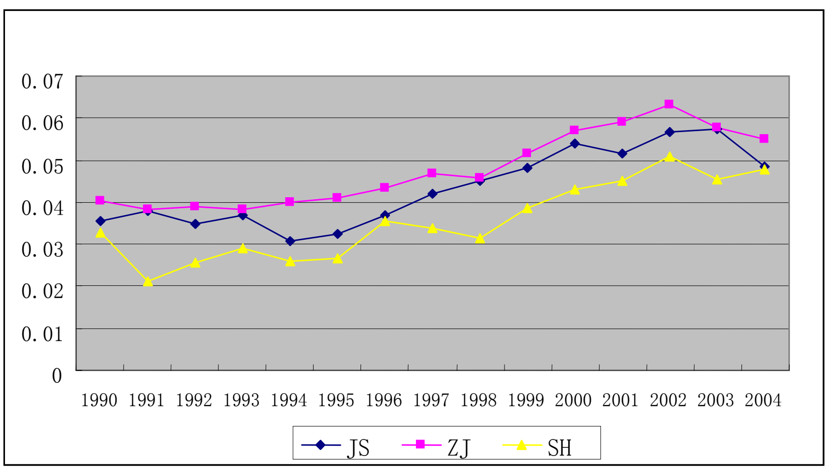


Figure 10　Growth Rate of R&D Input

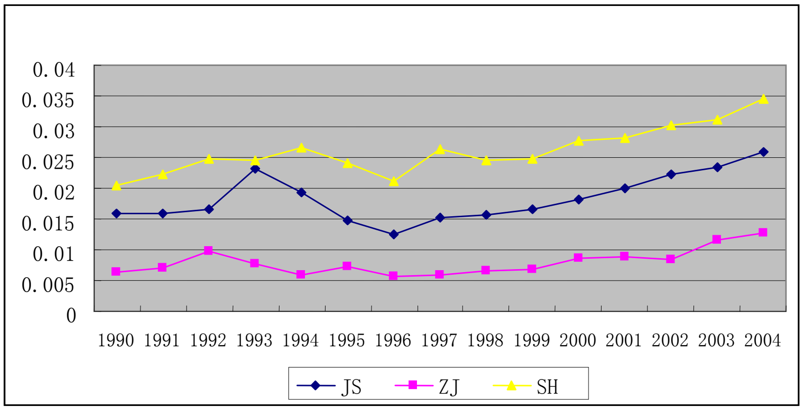


Figure 11　R&D Expenditure

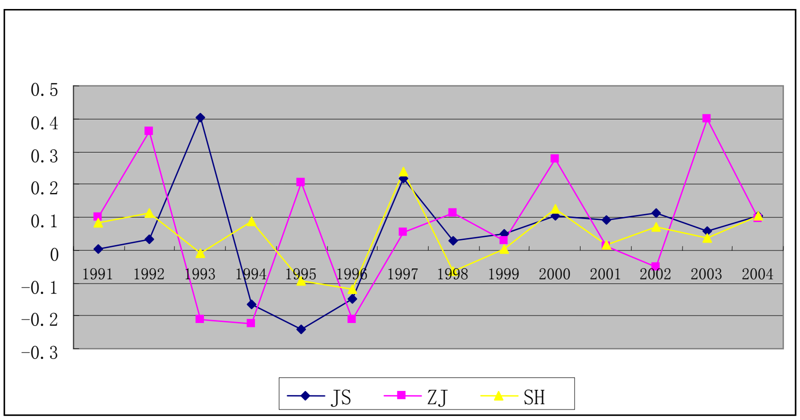


Figure 12 Number of Entrepreneurs

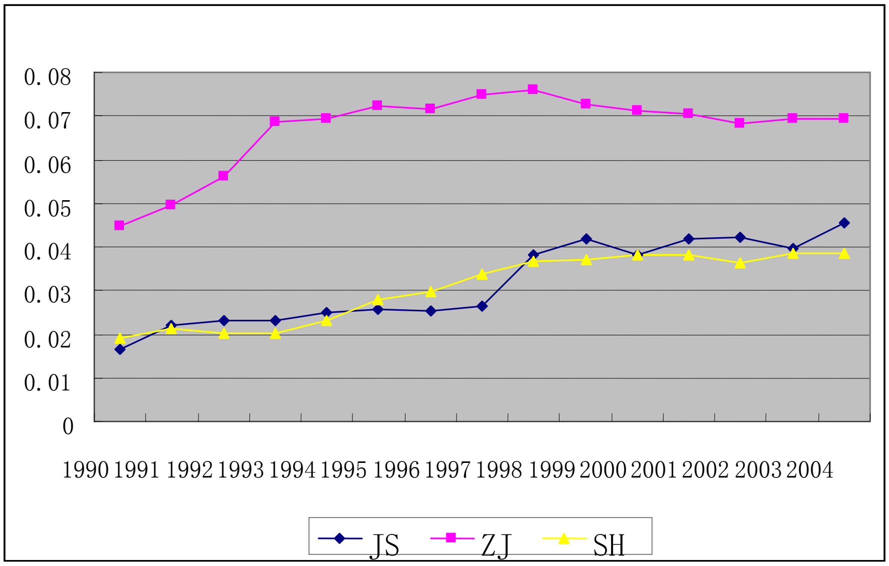
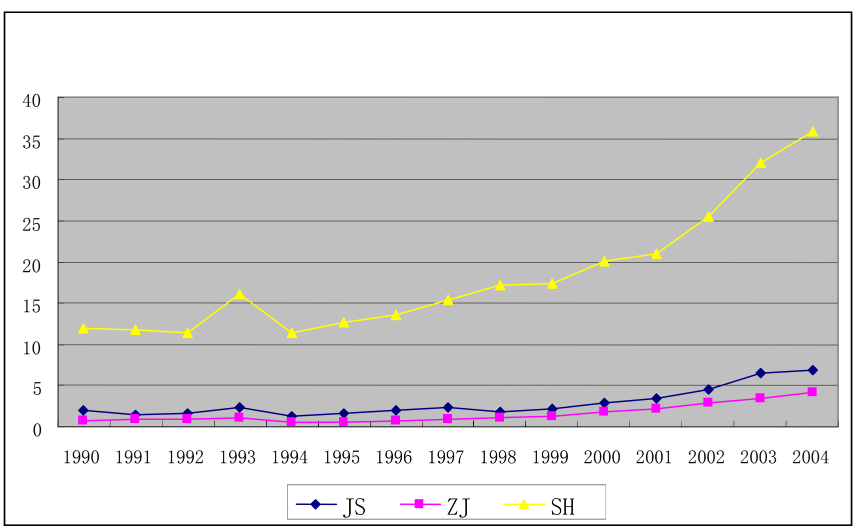


Figure 13 Enterprises' Contribution to Local Fiscal Revenue



<u>Figure 14 Growth Rate of Enterprises' Contribution to Local Fiscal Revenue</u>

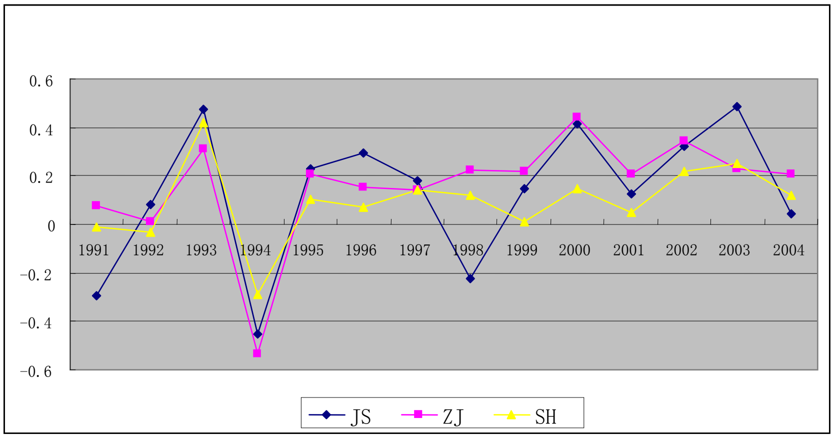


Table1　　Regression Result of the Yangtze River Delta

（1）Dependent Variable (*HC*)		（2）Dependent Variable (*ETD*)		（3）Dependent Variable (*ENTR*)	
Independent Variable	Result	Independent Variable	Result	Independent Variable	Result
Factor 1[4]	0.006570*** (9.92609)	*ENTR*	-0.138980 (-0.171315)	*LFR*	-0.072938*** (-5.270139)
Factor 2[5]	0.004217 (3.442762)	*TUTE*	-1.440434 (-0.903219)	*ETD*	-0.05879 (-0.556680)
		STP	16.80085 (0.997019)	*HC*	0.587923*** (11.25756)
		LFR	-0.101387 (-0.665375)		
Constant	0.017065*** (27.42861)	Constant	0.025950 (0.2963)	Constant	0.023066*** (11.21418)
Adjusted R^2	0.968105	Adjusted R^2	-0.09117	Adjusted R^2	0.928847
Sample Size	11	Sample Size	15	Sample Size	15

Note：Figures in brackets are t test statistics. *，**，*** represent the statistics under the levels 10％，5％，1％ respectively.

[4] Factor1=0.861ENTR-0.394CECHC+0.336EHPC

[5] Factor2=-0.404ENTR+0.944CECHC+0.251EHPC

Table 2 Regression Results in Jiangsu , Zhejiang and Shanghai

（1）Dependent Variable (*HC*)[6]				（2）Dependent Variable (*ETD*)[7]				（3）Dependent Variable (*ENTR*)			
Independent Variable	Jiangsu	Zhejiang	Shanghai	Independent Variable	Jiangsu	Zhejiang	Shanghai	Independent Variable	Jiangsu	Zhejiang	Shanghai
Factor1	0.007*** (6.879)	0.004*** （6.149）	0.011*** (7.122)	*Factor3*	0.001 (1.437)	0.001*** （3.211 ）	0.003*** (4.107)	*LFR*	-0.374 (-1.597)	-0.307*** （-6.446）	-0.034* (-1.856)
Factor2	-0.003*** (-3.167)	0.004*** （5.622）	0.011*** (6.895)	*Factor4*	0.003*** (3.926)	-0.000295 （-0.67）	-0.00031 (-0.4369)	*ETD*	0.245 (0.497)	-0.987 （-1.327）	-0.825* (-2.181)
								HC	1.514** (2.978)	1.376*** （5.771）	0.606*** (6.663)
Constant	0.017*** (16.564)	0.011*** (18.281)	0.042*** (28.00)	Constant	0.019*** (29.86)	0.008*** （18.711）	0.026*** (38.054)	Constant	0.023*** (3.647)	0.077*** （23.283）	0.03*** (4.088)
Adjusted R^2	0.798106	0.828043	0.87304	*Adjusted R^2*	0.815913	0.385	0.518	*Adjusted R^2*	0.832951	0.920458	0.890904
Sample Size	15	15	15	Sample Size	13	15	15	Sample Size	11	15	15

Note：Figures in brackets are t test statistics.*，**，*** represent the statistics under the levels 10%，5%，1%respectively.

[6] Independent variables in the regression of HC：
Jiangsu： Factor1=0.4171ENTR+0.300CECHC+0.456EHPC. Factor2=-0.540ENTR+0.981CECHC+0.251-0.152EHPC
Zhejiang： Factor1=0.684ENTR-0.181CECHC+0.424EHPC. Factor2=-0.215ENTR+0.713CECHC+0.395EHPC
Shanghai：Factor1=1.032ENTR+0.894CECHC-1.185EHPC. Factor2=-0.677ENTR-0.514CECHC+1.908EHPC

[7] independent variables in the regression of ETD：
Jiangsu： Factor3=0.463ENTR+0.179STP+0.484TUTE-0.198LFR.
Factor4=-0.010ENTR+0.460STP-0.140TUTE+0.624LFR
Zhejiang: Factor3=0.192ENTR+0.172LFR+0.534STP+0.471TUTE.
Factor4=0.578ENTR-0.477LFR+0.125STP-0.035TUTE
Shanghai: Factor3=0.489ENTR+0.486TUTE+0.147STP-0.108LFR；
Factor4=-0.011ENTR+0.072TUTE+0.579STP+0.529LFR