

The Analysis on the Decisive Factors of China's Total Investment: 1978-2010*

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Abstract:

Based on literature review, the cost of capital and the expected rate of return are the factors that influence the total investment. During the economic transformation of China, economic growth is always pulled by investment. In turn, the market capacity resulted by economic growth always influence the investor's decisions, then affect the amount of investment besides the costs of capital and labor. By establishing the nonlinear model, this paper aims to analyse influence decisions about the total amount of investment of China, by using the China macro economic data of 1978-2010.

Key Words: Investment, Capital cost, Labor costs, Market capacity

* This paper is supported by Social Science Foundation of the Education Ministry of China (10YJC790111) and Yangtze University.

1. INTRODUCTION

Investment is always conducted under certain economic system, investment decision is various in different economic system. According to the different economic system, investment decisions can be divided into two basic types: the investment decision under the condition of planned economy and the market economy. In the economic transformation process, since 1978, China's investment decision types gradually experienced a condition transition from planned economic to the market one. It appeared such new pattern in the investment field as the diversification of investment subject, the multi-channel investment source, multi-level investment decision, and the investment scope extended from domestic to abroad.

Since the economic reforms in 1978, China's total investment measured with the fixed assets has been exponentially increasing. Although people have different views on if the total investment is a driving force for China's recent economic growth, the importance of investment in the fields of creating the total demand and improving the infrastructure has been widely recognized (Chow, 1993; Sun, 1998). The expansion of the total investment by pulling the total demand of building products, machinery, equipment and other durable goods, has become one of the important economic growth sources which in turn led to the demand of consumer goods and services.

The investment behavior and capital allocation of Chinese enterprise has significant different before and after the reform. According to Sun (1998), before 1978, the investment decisions of enterprises (especially state-owned enterprise) do not follow the law of profit maximization or cost minimization, so there is an investment system producing the "investment hunger". China's economy began to transform from the planned economic to the market economy in 1978, the proportion of collective enterprise, town enterprise and joint venture enterprise in the national economy rose significantly in the aspect of output and employment. More ever, with the introduction of all kinds of profits stimulation reform plan, it changed enterprise's investment decision-making behavior. In the long-term and short-term production plan of enterprise, profitability and investment cost become the most important factors that enterprise should consider (Song Haidan, 2003).

Before 1978, the enterprise investment funds mainly came from the enterprise's internal capital and the budget fund of central and local governments. After 1978, due to the availability of internal and external funding increasing, enterprises had more decision-making power for investment. In addition, the introduction of the profit retention system and the contract responsibility system also expanded the number of internal capital. And urban and rural residents savings significantly increased during this period, which also made the improvement of enterprise's external investment capital possible. The reform of the banking system, such as credit right transferred to the lower level and the development of other financial institutions provided more departments in the economy with financial channel.

Therefore, with the transformation of investment decision model, the factors influencing the investment decision has changed that the market factors would gradually increase its influence on the investment decisions. Therefore, this paper based on the transformation of the economic conditions, researched the factors influencing investment demand its effect.

2. LITERATURE REVIEW

In the Modern economics, the development of investing theory generally experienced four stages: The first phase of the theory is called total investment theory, including the Accelerator theory put forward by Clark (1917), the interest theory put forward by Elvin Fisher in 1930, and Internal rate of return theory put forward by John Maynard Keynes in 1936; The second stage of the investment theory is called the neoclassical, developed in the 1960s by the economists with Jorgenson (1963, 1969) as a representative, it's about under the stable state, the ideal capital level and the relationship between its decisive factors, among which the major variable is output and use cost of funds; the formation of the third stage symbolized with q-theory, which set up in the late 1970s and early 80s. It was firstly proposed by Tobin (Tobin, 1969, then called the Tobin's q), after developed by Abel (1979), Yoshikawa (1980) and Hayashi (1982), the strict model of q theory formed. The investment decision in the Q theory of is not dependent on the past variables, but depends on the expectation for the future, connecting the evaluation of expected benefits in the future with the financial market valuation, provides great convenience for testing the theory; the fourth stage of investment theory was developed in the In the 80s and 90s in 20 century, including irreversible investment theory and internal cash flow theory.

2.1 Accelerator Theory

Accelerated several model was firstly put forward by Clark (1917), then DE Leeuw (1962), Evans (1967) and Koyck (1954) developed it. The accelerator model research in the investment decision-making issues of enterprise, under the condition of non-full-employment, believing that the enterprise's investment decision is decided by the change of the demand for its products.

Due to the condition of the non-full-employment, when demand increases, the quantity adjustment is better than the price adjustment, so the supply increases, namely $I_t = K_t - K_{t-1} = Y_t - Y_{t-1}$. And because the demand shock is not permanently positive, which also can have negative impact, so $I_t = K_t - K_{t-1} = V(Y_t - Y_{t-1})$ is reasonable, where $0 < V < 1$, called accelerator coefficient, $V = K/Y$, Y is the output. Make $I_t^* = K_t^* - K_{t-1}$, I_t^* is the Desired investment, It is the real investment, $I_t = K_t - K_{t-1}$, and $I_t = \mu I_t^*$, where $0 < \mu < 1$, then $K_t = \mu K_t^* + (1 - \mu)K_{t-1}$, and $I_t = \mu V \sum_{i=0}^{\infty} (1 - \mu)^i (Y_{t-i} - Y_{t-i-1})$.

This function indicates that , the investment caused by a new Desired Capital Stock, through Keynes multiplier, will lead to higher income level, which will make the marginal productivity

curve of capital move to the right, to speed up the capital accumulation, resulting in a higher mind capital level (K^*). The lag form declining geometrically suggests that The earlier the changes happen, the smaller the influence to the current desired investments is, which ensures that the actual capital stock only gradually close to the desirable capital stock. So, as long as they raise consumption demand, investment and capital stock can increase, to make capital stock close to the desirable capital stock, so as to promote employment and economic growth.

One of the important meanings of the Accelerated several model is that the scale of investment of an enterprise is in proportion to its output. At the macro level, the investment model is usually set as the total investment is related to total output in the current period and lagphase and the capital stock in the lagphase. The length of the lagphase is determined by the character of the investment project. There are two issues relevant to this model: (1) the Lag Structure which is not restricted easily causes the multiple linear resulting in the misleading; (2) the capital goods prices, wages, tax and interest rates are not included in the investment decision, so it's not convincing in both the theory and practice. In the study of China's national income decision, Chow (1985), on the basis of accelerated several hypothesis, estimated a total investment model. The conclusion is, although the estimated Accelerated several model can well fitting the data during 1952-1983, due to the data limitations and the political influence during the sample period, we still should be cautious to explain the estimating results.

2.2 Fisher's Investment Model

Fisher puts forward the theory of the second approximation theorem interest" in its "interest theory in 1930, In which the enterprise investment decision is set as a cross time issues. Fisher assumed that all the capital is flowing capital, such capital stock k doesn't exist, all the capital is equal to investment. According to that, assumes output is related to the investment instead of capital, namely $Y = f(N, I)$. In the two period ($t = 1, 2$), $Y_2 = f(B, I_1)$. Assume that the employment is full, N is constant, then, $f' > 0$, $f'' < 0$, that investment boundary is a concave function. R is for Interest rates, the total cost of investment I_1 is $(1 + r)I_1$, and the total revenue is equal to the product between output Y_2 and the product price P_{Y_2} , make $P = 1$, Y_2 is for gross income. Investment profit $\pi = Y_2 - (1 + r)I_1$

Therefore, according to the optimization theory, the condition of the optimal investment decision-making is $f' I = (1 + r)$. Fisher defined $f' I - 1$ as the ratio that income exceeds the marginal cost, known as Keynes's marginal efficiency of investment MEI , so $MEI = f' I - 1$. When $MEI = r$, namely marginal efficiency of investment is equal to the rates, enterprise's investment decision reaches the optimal. However, fisher's model assumes there is no fixed capital, which doesn't exist in the real economy.

2.3 Internal Yield Rate Model

Internal yield rate, Keynes defined it as capital marginal efficiency, it equals to the discount rate, which will make from the capital asset life of the expected revenue decided to the present

value of the annuity series is equal to the supply price. AbbaLerner (1953) more accurately defined it as "marginal efficiency of investment" (MEI).

Make $a_1, a_2, a_3, \dots, a_n$ as an expected revenue stream for certain particular investment project, C is the cost of the implementing project. Internal yield rate, or the marginal efficiency of investment, δ^* is the discount rate, then $C = \sum_{t=1}^n \frac{a_t}{(1+\delta^*)^t}$. For a given interest rate in the bond market, if $\delta^* > r$, the project is executed; If $\delta^* < r$, the project is not implemented, i.e. not investing.

Keynes argued that, as long as the marginal efficiency is worked out, or internal yield rate, and then compare it with the given interest rate r , so as to make a judgment. But the problem is the calculation of internal yield rate is based on the expected revenue stream of investment projects, Eisner and Strotz believe that the decisive factors of these expected profit and revenue are taken for granted, making the internal yield rate based on above as the basis for the investment decisions is a great risk. Asimakopulos (1991) pointed out, in the condition of non-full-employment, if any investment is implemented, through the multiplier effect, the total demand and output will increase. According to John Maynard Keynes's idea that the marginal efficiency of investment multiplier depends on the expected return, the increased income and total demand mean higher future expected benefits, so as to make MEI function move to the right, which means that investment should be increased. Such circulation will make all the investment project $\delta^* > r$, namely all the investment project will finally be implemented. Therefore, making the internal yield rate theory as the basis for the investment decisions is rough.

2.4 Q-theory model

Q-theory was first put forward by Tobin (1969), also known as Tobin-q, after developed by Abel (1979), Yosbikawa (1980) and Hayashi (1982), it became the mainstream of investment theory in the 70s to the 80s of 20 century. Q-theory connects the evaluation for the expected benefits for the future with the valuation of financial securities market, and fixes the issues that the expected future revenue stream in the internal yield rate theory.

Assume that enterprise's production function, namely $Y_t = F(K_t, L_t)$ (where, the F is continuously differentiable concave function, capital K and labor L); The real price of investment good is Pt, the actual level of wage is Wt; The adjustment cost of the fixed assets is C (It, Kt) and meet: C (It, Kt) is two times continuously differentiable and strict rising convex function of It. When It increases, the C (It, Kt) increases, so in the short term, gradually adjusting is a priority.

According to the above assumptions, the net profit of enterprise in the period t is: $R_t = F(k_t, L_t) - W_t L_t - P_t I_t - C(I_t, K_t)$, based on the optimization method and the first-order conditions are: $q_t = \int_t^{\infty} [F'_k(k_s, L_s) - C'_k(I_s, K_s)] e^{-\delta(s-t)} ds$. Assume that: $C(I_t, K_t) = g(I_t - \delta K_t)$, then: $g'(I_t - \delta K_t) = q_t - P_t$ and $I_t - \delta K_t = G(q_t - P_t)$. This is the core of the q-the theory. It shows that the net investment of fixed assets is the strictly increasing function of the shadow price qt of the capital.

The greater the q_t is, the greater the amount of net investment is. If define $q_t = V_t / (P_t K_t)$, that is the value of the enterprise in t period is divided by the fixed assets value of enterprise, or the stock market value of the enterprise is divided by the asset replacement cost of enterprise, this is also known as the "average q ". When $q_t > 1$, we can make the decision to increase investment, which is very convenient in the aspect of experience research and investment decisions.

According to Tobin (1969), a q value which is close to 1 or bigger encourages the investment, while a low q value is not good for investment. The market value of the commercial capital is famous for its demanding price of the assets, and the Replacement Value suggests the supplying price. In equilibrium, the supply and demand price of the commercial capital shall be the same. However, if the market power creates profitable investment opportunities, the demand price will be higher than the supply price, then the enterprise will increase investment. In a competitive market, once the investment profits vanish through the competition, the demand and supply price will return to the equilibrium level. The demand price of assets is determined by the value of enterprise's assets in the stock market. Although q model has a good theory frame, BlanChard and Wyplosy (1981) think the explanation power of average q for investment is very limited, and the average q and marginal q are different, and can't be replaced. In addition, because there exist the constraints on the financial ability and capacity of enterprises, as well as the different preference to the use of internal capital and the attitudes towards to the risk, even if the average q is high, we may not be able to make investment decisions according to that.

In addition, due to the following reasons, it can't be a useful tool for the study of Chinese investment modeling. First of all, q model requires enterprise's capital assets is determined in the financial markets, but just as Song, Liu and Romilly (1998) pointed out, China's two stock market (Shenzhen and Shanghai) were just started in 1992, the number of the listed companies is quite limited, so it is difficult to estimate the enterprise's capital asset value through the two markets. Secondly, q model assumes that enterprise decision-making behavior is based on a perfectly competitive market, where all the enterprises can fairly compete for the investment opportunities. Obviously, this assumption is not established in China.

2.5 Irreversible Investing Model

The irreversible investment refers to during the investing process of fixed asset or industry, there always exists the sunk cost, which cannot be recovered when the investment decision changes, that is the investment is reversible. The irreversible investing theory was firstly put forward by Arrow and Kurz in 1970, then developed by McDonald and Siegel (1985), Pindyck (1991).

For the decision with one-time investment cost K , according to the manufacturer theory of Marshall, if the product price is higher than the long-term average cost, or based on the theory that if the present value of the expected gross income is bigger than K , the investment shall be made immediately. Namely the profit R_t gained from the cost K in unit time, when the discount

rate is P , if $R_t / \rho > K$ or $R_t - \rho K > 0$, we shall make the investment at once, therefore P_k can also be called the "trigger" of the Marshall investment. However, considering about the irrepressibility of the investment, observation and waiting may be better choice. According to the inference and demonstration of Wang Rui (2000), the trigger of irreversibility is:

$$r = \frac{\beta}{\beta-1} \rho K, \quad \beta = \frac{1}{2} \left(1 + \sqrt{1 + \frac{8\rho}{\sigma^2}} \right) > 1$$

Where, σ is the investment risk coefficient, and $0 < \sigma < 1$.

For the irreversible profit theory with one-time profit decision, the biggest problem of it is how to make sure the investment risk coefficient, at present, there is no any document or material to demonstrate it, in the experience study, we just assume that $a = 0.2$, which also limits its application in the model in the transforming process.

2.6 Cash Flow Model

The cash flow model is always related to the study of Duesenberry (1958) and Meyer and Kuh (1957). It was started from the empirical study for the Japanese enterprises conducted by Fazzari, Hubbard & Petersen (1988), Takeo Hoshi, Kashyap and Scharfstein (1991). Kaplan and Zingales (1997) studied that in different investment period, the sensibility of investment on the cash flow is not necessarily weakening as the financial restrain level weakening, while Cleary, Povel and Raith (2004) believe the opposite.

The assumption of cash flow model is the investment expenditure of an enterprise is determined by its internal cash flow. Cash flow is measured by the enterprise profit minus tax, then plus the discounted allowance. Familiar with the, this model use the variable of cash to take the place of output in the current period and lag phase, so it has the same problem that Accelerated several model does. Even though china started to experience the transformation from the central economic to the market economic at the beginning of the 70s and the end of the 80s, the main problem during the process is that the state-owned enterprises are hard to be changed. Deficit is still the main concern in many state-owned enterprises during the transformation period, however, the investment expenditure of enterprises with deficit always comes from the outside, such as the government allowance and the enterprise liabilities. Even the profit-making enterprise, no matter it's state-owned or collective, both intend to ask for the bank loan and other financial resource to make investment. Therefore, the cash flow model is not suitable for explaining Chinese enterprise's investing behavior, especially the state-owned ones. But, for those which have developed significantly at present, because the external financial restrain or high cost, the cash flow is still able to explain the investing behavior of Chinese non-state-owned enterprises in the process of transforming. It's just the data, which is hard to obtain, that counterworks the empirical study of cash flow model.

2.7 Jorgenson's Optimization Theory

The concept of optimal capital stock was firstly made by Clark, Remsy and Knight, then developed by Hayek, Abba Lerner, Lutz and Haavelmo, and continuously improved by

Jorgenson, in 1963, 1967 and 1971, Eventually a optimization investment theory which is different from the early formed, this theory is also known as the new classic investment theory.

Jorgenson assumes: output is the function of labor and capital, that is, $Y = F(L, K)$, P for prices, w for the unit labor price, S for the unit capital price, the net income for the moment t is:

$$R_t = P_t Y_t - S_t I_t - W_t L_t$$

The enterprise value function is:

$$V = \int_t^{\infty} R e^{-rt} dt = \int_t^{\infty} [P_t Y_t - S_t I_t - W_t L_t] e^{-rt} dt$$

Define the total investment $I_t = \frac{dK_t}{dt} + \delta K_t$ (δ for depreciation rate), tectonic the Hamilton equation based on the optimization methods, according to the one order conditions we can get $S = \lambda$, $\frac{dS_t}{dt} = \frac{d\lambda}{dt}$ and is thus: $\frac{dS_t}{dt} - r\lambda = -P_t F_k + S_t \delta$ (r for interest rates). Define the cost of the real user of the capital $C = S[\delta + r - S'/S]$, the: $P F_k = C$. That is, when the value of marginal products of the capital $P F_k$ equals to its real users' cost C , the capital stock of enterprise reaches the equilibrium level.

Through the Cobb-Douglas production function $Y = K^\alpha L^{(1-\alpha)}$, with the assumption of constant returns to scale $F_k = \alpha(Y/K)$, any, the optimal capital stock. $K^* = P\alpha Y/C = f(Y, P, C)$. Define $I = dK^* + \delta K$, then $I = f(dY, dP, dC) + \delta K$. Model assumes that an enterprise's optimal capital stock is in proportion to its output divided by users' capital cost. This means that the increasing demand of the final product will encourage the expansion of fixed assets, while the increase of the interest rate, the tax rate and the capital depreciation rate is against the investment. In the new classical investment model, the users' capital cost and the expected demand in the future are regarded as the major determinants for investment decisions, while the cost is ignored.

In this study, we put such three factors like the capital cost, labor costs and the expected demand in the future these into China's total investment decision-making model, on the basis of the internal cash flow theory, according to the new classical model framework, we studied the deciding factors for the total investment during the transition period.

3. HYPOTHESES AND THEORETICAL MODEL

According to John Maynard Keynes's theory, investment is proportional to the expected yield rate, and in inverse proportion to the interest rate, the expected yield rate is determined by the expected income, labor cost and capital cost.

Hypothesis1. During the process of the economic transformation of China, due to the advantage of the late-developing, it's easy for enterprises to reach a consensus for promising industry, leading to the "wave phenomenon" (Lin Yifu,2007) in the aspect of investment, therefore the expected yield rate can be determined by the expected demand of the market.

Hypothesis2. The enterprise's investment decision is determined by the estimation of the market demand (Y_t^*), the labor cost c_{lt} and capital cost c_{kt} used in the production process.

Therefore, The total investment model in this study is set up based on the two assumptions:

$$I_t = f(Y_t^*, c_{kt}, c_{lt}) \tag{1}$$

Where, It is the total investment measured by fixed assets at the moment of t. Y_t^* is the expected output, c_{lt} and c_{kt} can be seen as an element pulled by demand, and cost constraint factors. These three factors are close related to Chinese situation, because in China, there exist the systematic investment hunger caused by the release of the inhibiting consumption demand, as well as the elements constraints. Assume that the relationship between the investment and its deciding factors obey the following nonlinear process (Song ,2003):

$$I_t = B Y_t^{*a} c_{kt}^b c_{lt}^d u_t \tag{2}$$

Where, u_t is disturbance, describing all the other influencing factors not included in the model, and it's subject to the assumption of the normal distribution with the zero mean, same variance, non-serial correlation with, namely to obey the classic assumption. And B, a, b and d is the estimated constraints parameters.

There are two estimation method for the labor and investment cost as followings:

The first one is the direct estimation methods. The users' capital cost are often determined by the following factors: the opportunity cost of using the investment capital (r_t); the depreciation rate of new capital (δ); the change of Asset price (P_{kt}); the Effective capital income tax rate (TX_t); And the cost for searching for the investment funds (S_t). Because the credit and financial market in china is not perfect, the final factor is especially important to China. So, the users' capital costs can be written as:

$$c_{kt} = f(r, \delta, P_{kt}, TX, S_t) = TX_t (P_{kt} r_{t-1} + \delta P_{kt} - \Delta P_{kt}) S_t, \quad \Delta P_{kt} \text{ for the change of asset prices.}$$

The Labor cost mainly includes the laborers' salary (w_t), social insurance (ϕw_t), training fee (TR_t) and the cost for searching for the labor force or the recruitment fees. So, the labor cost of the investment can be written as:

$$c_{lt} = f(\pi_t, w_t, \phi, TR_t, S_{lt}) = (w_t + \phi w_t + TR_t + S_{lt}) / (1 + \pi_t), \quad \pi_t \text{ for inflation.}$$

The second one is the production function estimation. Based on the law that marginal benefit equals the marginal cost, to estimate the cost of the investment. The capital used in the Production is determined by manufacturers' goal for maximizing profit, the manufacturer must balance the contribution and the cost of using more capital. That is, the marginal benefit of the capital equals to the rent of capital cost, $MP_k =$ Therefore, when all the manufacturers in the market reach the equilibrium, the capital rent costs at the total level can be derived through

the capital marginal productivity in the total production function. By the same principle, we can get the labor cost $MPL = c_{lt}$.

Due to the data limitations of the first method, the precise c_{lt} and c_{kt} are hard to get. Therefore, we chose the second method, obtain the estimated value of c_{lt} and c_{kt} through the following form of cobb-douglas production function.

$$Q_t = AK_t^\alpha L_t^\beta R_{dt}^\gamma \tag{3}$$

Equation (3) is different from the Cobb-Douglas production function used in the new classic investment model, since we introduced the additional R&D input (including education input) R_{dt} . Cobb-Douglas production function assumed that constant returns to scale, the marginal output of every element is diminishing. When the expected marginal return on investment is equal to the marginal cost of the investment, the optimal capital stock forms. Which means that there is a constant investment-output ratio, any investment that is more than the optimal level is inefficiency. According to this view, the economic growth is independent on the investment, growth can only be obtained through the exogenous progress of technology. Song and Fu (2001) found that in China than the investment-output ratio before and after the reform was not constant, and confirmed that the investment-output ratio is proportional to the economic growth rate . Therefore, the assumption that the economic growth is independent on the investment in the new classic investment model, (constant investment-output ratio assumption) may not be effective in China. On the other hand, the new classical exogenous growth model developed by Rebelo (1991) assumed, the production function presents the constant returns to scale for the generalized capital accumulation (including r&d investment representing the technological progress).

According to study conducted by Chai (1998) and Song Haidan (2003) about the target function enterprise's investment during the transformation process assumed, the net income (π) of enterprise in the period of t is defined as follows:

$$\pi = P_t Q_t - c_{lt} L_t - c_{kt} K_t - m R_{dt} \tag{4}$$

$$\text{Or } \pi = Y_t - c_{lt} L_t - c_{kt} K_t - m R_{dt} \tag{5}$$

Where, P_t is the price of output, Q_t is the quantity of final product , Y_t is the output measured with monetary, c_{lt} is labor costs, L_t is the labor input, c_{kt} is users' capital cost, K_t is the capital stock, m represents the unit cost of the technology innovation. At the moment t, the enterprise is facing the optimization problem as following:

$$\max V_t = \int_t^\infty \pi_t e^{-rt} dt \tag{6}$$

$$s.t., \quad \frac{dK_t}{dt} = I_t - \delta K_t \quad (\delta \text{ for Depreciation rate}) \tag{7}$$

Then we got the Hamilton equation

$$H_t = \pi_t + q_t \cdot \frac{dK_t}{dt} = Y_t - c_{lt} L_t - c_{kt} K_t - m R_{dt} + q_t (I_t - \delta K_t) \tag{8}$$

Use and solve the usual Lagrange multiplier, so as to get the first order conditions of maximum:

$$c_{lt} = \frac{\partial Y_t}{\partial L_t}, \quad c_{kt} = \frac{\partial Y_t}{\partial K_t}$$

On the basis of equation (4), we can gain the users' capital and labor costs:

$$c_{kt} = P_t \frac{\partial Q_t}{\partial K_t} = P_t (A \alpha K_t^{\alpha-1} L_t^\beta R_{dt}^\gamma) = \alpha P_t Q_t / K_t = \alpha Y_t / K_t \tag{9}$$

$$c_{lt} = P_t \frac{\partial Q_t}{\partial L_t} = P_t (A \beta K_t^\alpha L_t^{\beta-1} R_{dt}^\gamma) = \beta P_t Q_t / L_t = \beta Y_t / L_t \tag{10}$$

Through the equation (4) estimate the values of parameters, then we can take advantage of equation (9) and (10) to get users' capital and labor costs.

Meanwhile, nonlinear relationship in the equation (2) can be linearized through the logarithmic conversion:

$$\ln I_t = \ln B + a \ln Y_t^* + b \ln c_{kt} + d \ln c_{lt} + \ln u_t \tag{11}$$

Assume that enterprise develops the expected output in a process of adaptability, namely:

$$\ln Y_t^* - \ln Y_{t-1}^* = \lambda (\ln Y_t - \ln Y_{t-1}^*)$$

$$\text{Or} \quad \ln Y_t^* = (1 - \lambda) \ln Y_{t-1}^* + \lambda \ln Y_t \tag{12}$$

This is the expected value of current period is the weighted sum of the actual value and the expected value in the prophase, indicating that the enterprise will modify the expected output based on past experience. λ is the Expected coefficient and $0 \leq \lambda \leq 1$, Use the equation (12) into the equation (11), to get

$$\ln I_t = \ln B + a[(1 - \lambda) \ln Y_{t-1}^* + \lambda \ln Y_t] + b \ln c_{kt} + d \ln c_{lt} + \ln u_t \tag{13}$$

And lag a period of the equation (13) and multiply it by (1- λ), to get:

$$\begin{aligned} (1 - \lambda) \ln I_{t-1} &= (1 - \lambda) \ln B + a(1 - \lambda)[(1 - \lambda) \ln Y_{t-2}^* + \lambda \ln Y_{t-1}] \\ &+ b(1 - \lambda) \ln c_{kt-1} + d(1 - \lambda) \ln c_{lt-1} + (1 - \lambda) \ln u_{t-1} \end{aligned} \tag{14}$$

Use the equation (13) minus the equation (14), to get

$$\ln I_t = \lambda \ln B + a \lambda \ln Y_t + (1 - \lambda) \ln I_{t-1} + b \ln c_{kt} - b(1 - \lambda) \ln c_{kt-1} + d \ln c_{lt} - d(1 - \lambda) \ln c_{lt-1} + v_t \tag{15}$$

$$\text{Or} \quad \Delta \ln I_t = \lambda \ln B + a \lambda \ln Y_t + \lambda \ln I_{t-1} + b \Delta \ln c_{kt} - b \lambda \ln c_{kt-1} + d \Delta \ln c_{lt} - d \lambda \ln c_{lt-1} + v_t$$

$$\Delta \ln I_t = a \lambda \Delta \ln Y_t + b \Delta \ln c_{kt} + d \Delta \ln c_{lt} - \lambda [\ln I_{t-1} - \ln B - a \ln Y_{t-1} - b \ln c_{kt-1} - d \ln c_{lt-1}] + v_t$$

$$\text{Or} \quad \Delta \ln I_t = a \lambda \Delta \ln Y_t + b \Delta \ln c_{kt} + d \Delta \ln c_{lt} - \lambda ecm_{t-1} + v_t \tag{16}$$

This is the error correction model (ECM), where:

$$\text{Error perturbation terms or interference item: } v_t = \ln u_t - (1 - \lambda) \ln u_{t-1}$$

$$\text{Ecm for the error correction items, } ecm_{t-1} = [\ln I_{t-1} - \ln B - a \ln Y_{t-1} - b \ln c_{kt-1} - d \ln c_{lt-1}]$$

If $\ln I_{t-1} > \ln B + a \ln Y_{t-1} + b \ln c_{kt-1} + d \ln c_{lt-1}$, $ecm_{t-1} > 0$, then, $-\lambda ecm_{t-1} < 0$, leading to the reduction of $\Delta \ln I_t$; in the opposite situation, $\Delta \ln I_t$ will increase, which shows that long-term unbalanced error controls the investment.

There are many advantages to set the invest model to equation (15). First of all, investment responses to the change of the deciding factors that have time lag, the change of business confidence will cause the change of the expected sales and profitability of investment in the future, thus change the level of investment. Secondly, according to Hendry (1995), the ADL model set actually contains all the types of measurement model, through the model parameters and conducting the hypothesis testing, we can search for the best model setting. Thirdly, the methodology about from the general to the specific of Hendry and Richard (1982) and the error correction technology of Engle and Granger (1987) can be used directly to estimates the ADL model.

If the investment function can be written as equation (16), then we can simultaneously test the long-term elastic (a, b, d) and short-term elastic ($a\lambda$) of investment to different factors. If long-term Investment elastic is the homogeneous, that is, the long-term elastic of investment on the investment output and cost are both one, it shows that the responds of investment is in proportion to the changes of its determining factor. Finally, the equation (16) can be directly applied to estimate the long-term co-integrating relationship and short-term dynamic relations. This process may avoid the inherent problem while prechecking the unit root before testing the co-integration relationship, which means that we don't have to know order of every single variables in the model co-integration.

4. DATA COLLECTION AND EMPIRICAL ANALYSIS

4.1 Data Collection and Sample

This part of the empirical analysis is based on macro data of china during 1978-2010. The Data is from the "China statistical yearbook" published by China's national bureau of statistics in different period, as well as the statistical database of national bureau of statistics. The Output is GDP measured by the constant prices before 1978, labor is measured by total employment, r&d investment sums up the total amount of the Scientific research spending published in the past statistical yearbook and the higher education funds during 1991-2010, adjusted by the consumer price index.

4.2 Estimation for Total Amount of Capital Stock

For the estimation of total amount of capital stock in China, the major supplement and adjustment of the history data had happened twice in the history of national income accounting. The first time is to supplement the data during 1978 to 1984 after the reform, which was conducted between 1986 and 1988; The second time is to adjust the Statistical Caliber about the social fixed assets investment data conducted by national bureau in 2006. Therefore, with reference to the estimation method of capital stock from zou zhizhuang (Chow, 1993), Li

ZhiGuo and Tang Guoxing (2003) and Guo YuQing (2006), this article estimated China's capital stock during 1978 to 2007.

At present, the perpetual inventory method developed by Gordon Smith (Goldsmith) in 1951, has been widely used to measure the capital stock. The basic formula is:

$$K_t = I_t / P_{kt} + (1 - \delta_t) K_{t-1} \tag{17}$$

Where, K_t for the capital stock in the year of t, I_t for the fixed assets investment, P_{kt} for the price index of fixed assets investment, δ_t for capital depreciation rate .

About initial capital stock at the end of 1978, we used the initial capital of \$1.4112 trillion accounted by zou zhizhuang (Chow, 1993), the depreciation rate is 5% (Wang Xiaolu, Fan gang, 2000; 2000; Guo Qingwang, Jia Junxue, 2004; Ma Shuanyou, 2001; Guo Yuqing, 2006), the fixed assets investment at that time is the social fixed assets investment (Zhang Jun and Zhang Yuan 2003; GuoYuqing, 2006), the investment price index consists of the index released in statistical yearbook after 1991, the consumer price index before 1991, and the adjusted data after 1991 (Huang Yongfeng, Ren Ruoen 2002; Sun Linlin, Ren Ruoen, 2003), use the equation (17) to obtain the capital stock K in each period.

4.3 Model testing

To get uses' capital and labor costs in equation (9) and (10), we should first estimate equation (3) representing the production function, with its coefficient, we may get the investment cost. We transformed the production function (3) to the following linear form:

$$\ln Y_t = \ln A + \alpha \ln K_t + \beta \ln L_t + \gamma \ln R_{dt} + \varepsilon_t \tag{18}$$

Where, the interference item ε_t is subject to the normal distribution with zero mean, same variance and non-serial correlation. For the time series data, first estimate the interference item in equation (18): $\hat{\varepsilon}_t = \ln Y_t - \ln A - \hat{\alpha} \ln K_t - \hat{\beta} \ln L_t$, conduct the unit root test (choose the level value equations without intercept or time trend), so as to test whether there exist co-integration relationship among these three sequence , see the results in table 1.

Table 1 Co-integration test results of GDP, capital, labor and scientific research

			T statistic	probable value (P value)
ADF statistic			-3.17	0.03
Significance	1%	Inspection	-3.70	
Level	5%	critical value	-2.98	
	10%		-2.63	

From the results, we can see that the estimation of interference item reject the assumption of unit root under the significant level of 5%, which is the stationary series, so there exist co-integration relationship among $\ln Y_t$, $\ln K_t$ and $\ln L_t$ (probability value $P = 0.03 < 5\%$), which can be directly regressed, see the results in table 2.

Table 2 The regression results of production function

Dep.Variable	Const	LO	LO	LO	Γ	λ	AD	F-
	ant	G(K)	G(L)	G(Rd)	W		R^2	Stat
	-5.95***	0.96***	0.70***	0.60***				
LOG(Y)	(-4.44)	(8.82)	(3.81)	(6.56)	0.53	0.99	0.98	578.82
Sample	1978-2010							

From the regression result of least square method we can see that, both capital and labor stock have important influence on output, while the Scientific research input coefficient representing the progress of technology is more significant, this is because, our country has the advantages of the late-developing in the process of development, we can lower the cost of technology imitating, to make effect of the output of the scientific research quite significant. The regression results of capital output elasticity and labor output elasticity are both significant at the level of 1%, with good effect, but the problems about self-correlation of the residual cannot be solved by iterative method, of course, there's no fully effective solution to this problem yet.

From the regression results, we can obtain that the estimated capital output elasticity $\hat{\alpha}$ is 0.96 and the estimated labor output elasticity $\hat{\beta}$ is 0.70, use $c_{kt} = \hat{\alpha}Y_t / K_t$ and $c_{lt} = \hat{\beta}Y_t / L_t$, to get investment capital cost and labor costs.

4.4 Empirical results

We know that the capital cost structurally changed before and after 1995. Before 1995, the cost of capital had been high, but trended to drop after 1995. This is because: (1) after nearly 20 years of development, the scarce degree of domestic capital has been improved; (2) the reform of the investment system, increased the investment decision-making power of enterprise and local government; (3) as the buyer's market appeared in domestic products market, where the supply is greater than demand, product market "farewells shortage", the opportunity cost of capital or the expected yield declined. Also, in the labor market, the same structural changes happened before and after 1995. before 1995, the labor cost had been low, and later been on the high level and slowly rising, of which the main reason is the wage reform started in 1994.

With the investment cost, as well as the output and investment sequence, first we conducted the co-integration test to judge long-term equilibrium between investment function represented by

equation (15), and the results showed the existence of co-integration relation (table 3). Then use the above sequence to estimate the investment function respectively (15) and (16), see the estimation results in table 4.

The simplified Investment equation model can be used to test the homogeneous balance correction mechanism, use Wald statistics $\chi^2(1)$ to test the null hypothesis: $a\lambda + b + d - \lambda = 1$. The calculated Wald statistics is $\chi^2(1) = -0.8664$, the results showed that the produce process of the total investment data of China can be represented very well by homogeneous balance correction model in equation (16).

5. CONCLUSIONS

The theoretical contribution of this paper is to analyze the investment decisions by introducing the variables of the capital cost, labor costs and market capacity. First, the analysis and research will no doubt provide some useful insight into that in the long-term process, including output, investment level that lagging a period, capital cost and its lagging behind a period, labor costs time lags take a decisive effect on current investment in the 1% significant level, the current labor costs have a remarkable influence on investment effect in the level of 5%. In the short term, capital cost and error correction items are all significant in the 1% level except output, and labor costs is significant in the 5% level.

The second, the empirical analysis is presented evidence that, it's different between long term and short term that output has an effect on investment. In the long term, if expected output is increased, the expected market demand and investment will increase. But in the short term, output has no influence on investment, it depends on elements input production function. It's the same at the influence of capital cost to investment in the long term and short term, if capital cost is increased, the investment will reduce. But capital cost elastic is significantly different between long-term and short-term. In short-term, the absolute number of elastic is 0.5, which is less than 0.97 in long-term, that is, it has more effect in long-term than short-term about the investment constraint from capital cost. In the long term and short term, the influence of labor cost to investment is positive, it explains that labor costs is increased, then the investment increases, it's opposite with the normal cost influences effect. According to the internal cash flow theory, the labor cost will increase the enterprise internal cash flow, thus increasing investment. But the regression results show that labor costs increased lead to a increased investment. This one looks "paradox", mainly because short-term labor costs increased, which is expressed as the expected increase market demand and an increase in investment. If we eliminate the labor cost, regressing short term investment by output, capital cost and error correction items (the results see table 6 the third column), we will see the short term output and the capital cost have a significant influence on the investment, and the investment elasticity of the output and the capital cost changed, which indicates that there exists linear relationship between the labor costs and output, that is the increase of labor costs is proportional to the expected market size or benefits.

Table 3 Co-integration test results of GDP, investment, labor costs and capital cost

			T statistic	probable value (P value)
ADF statistic			-3.98	0.0057
Significance	1%	Inspection	-3.74	
Level	5%	critical value	-2.99	
	10%		-2.64	

Table 4 The regression results of investment function

Dependent Variable	LOG(I) (OLS)	DLOG(I) (WLS)	DLOG(I) (WLS)
C	1.93*** (3.16)	0.10 (6.79)	0.09*** (10.27)
LOG(Y)	0.96*** (3.52)		
LOG(I(-1))	0.64*** (6.26)		
LOG(CK)	-2.69*** (-4.07)		
LOG(CK(-1))	2.31*** (3.55)		
LOG(CL)	1.12** (2.59)		
LOG(CL(-1))	-2.09*** (-4.32)		
DLOG(Y)		-0.01 (-0.06)	0.44*** (3.81)
DLOG(CK)		-0.50*** (-5.25)	-0.50*** (-7.16)
DLOG(CL)		0.52** (2.73)	
ECM		0.13*** (6.79)	0.18*** (7.21)
R-squared	0.99	0.99	0.99

Adjusted R-squared	0.99	0.99	0.99
Durbin-Watson stat	2.09	0.95	0.95
F-statistic	1012.91	38.85	208.79
Sample	1979 – 2010		
Elasticity	Production: 0.96	Production: -0.01	Production: 2.44
	capital cost: -0.97	capital cost: -0.50	capital cost: 0.50
	Labor cost: 0.40	Labor cost: 0.52	

The last, the analysis is proved that, the error correct item is at least higher than the significant level of 1%, and the response parameter changes from 0.13 to 0.18, it shows that the enterprise changed the previous decision error in order to obtain the desirable balanced investment level, in these investment model, the smaller response parameter indicates that the adjustment process of investment is slow and within a small range. This may be related to the characteristics of the fixed assets, once the investment decision has been made and implemented, it's very hard to reverse investment decision, that is to say, the investment is irreversible.

The practical contribution of this paper is to provide a reference for policy makers to control the scale of total investment. First of all, financial constraints and the investment hunger caused by the consumer demand both determine the investment level of China. In order to improve the economic growth rate, we need further financial reform to develop the channels through which enterprise can obtain investment funds, especially for the small and medium-sized enterprises. Second, China's rapid economic expansion has produced huge demand for the future investment. The existing homogeneous balance correction mechanism in the Total investment function shows that long-term economic growth can lead to the investment growth with the same degree. Finally, because the labor cost is related to the investment, the expected market scale or expected output, government can build a healthy social security system through the wage reform, to improve the social welfare, and change the distortions of elements market. In that way, not only can we expand the expected market size or expected output, but also can control the scale of total investment.

The limitation of this paper is that empirical research is not sufficient and the perfect market hypothesis is discrepant with the economy. During the economic transformation, there are market distortions in the capital and labor markets that led to the markets are not perfect. So, it is worth exploring the decisive factors of investment under the conditions of factor price distortion.

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