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The Flexible Acceleration Mechanism of China's Capital Adjustment with the Goal of Consumption-Driven Sustainable Growth

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Abstract: China has had an investment-led growth pattern that is unsustainable. It is struggling to shift to a consumption-driven economy, and capital adjustment is crucial to the transition. In response, the principal objective of this study is to analyze the internal market mechanism of China's capital adjustment. Due to the imperfections of the market, we use the flexible acceleration model, which we put in an IS (Investment—Saving equation)—LM (Liquidity preference—Money supply equation) framework in order to reflect the guiding role of demand. The results show that the flexible acceleration model fits China's investment well, and the demand-oriented market mechanism of capital adjustment has been formed; however, China's market adjustment ability is not strong. The adjustment coefficient is only 0.22, and shows a decreasing trend. So, in the capital optimization process, relying on the market alone is not realistic. Furthermore, the calculated replacement rate is up to 0.429, which indicates that China's capital is less efficient, and there are duplicated assets, idle assets, and wasted investments. The error correction model's results show that the impact of the interest rate on the investments is not significant in the short term, so the existence of invalid capital is more likely to stem from the soft budget constraints, which require attention.

Keywords: sustainable growth; capital adjustment; consumption-driven; flexible acceleration; IS-LM model

1. Introduction

Capital formation is crucial to economic growth. According to Solow's theory [1], even if the technology does not change, as long as the per capita capital continues to improve, which is called the "capital deepening process", the economy will continue to grow. According to the data from the World Bank, China's capital formation rate has been maintained at over 40% since the 1978 reform, which has sustained its high rate of growth. Capital accumulation has been widely regarded as an important factor in China's phenomenal economic growth [2,3]. In view of the important role that investment has played, the government has always taken it as the main means of macroeconomic regulation.

However, some scholars have questioned the sustainability of this "high investment–high growth" mode. Young [4] pointed out that this mode is not sustainable due to the lack of an internal incentive mechanism for continuous improvement. Qin and Song [5] also believed that this mode is difficult to sustain after finding that the annual growth rate of fixed asset investment in China is higher than the average annual gross domestic product (GDP) growth rate. Since 2007, China's economic growth rate has continued to decline. Can China's economy regain fast growth, or will it continue to decline? The answer to this question is important to both China and the world economy.

Before answering this question, we need to first think theoretically about what level of capital stock is most suitable for China, and how to adjust the capital in order to achieve the best level. Only on

this basis can we judge whether there are problems in the current growth rate, and then find ways to amend them. Therefore, this article advocates relying on the endogenous driving force of the market to achieve sustainable growth instead of pursuing a government-led increase in investment. The purpose of this study is to analyze the internal mechanism of China's capital adjustment. As long as the rule of China's capital adjustment is understood, the unsustainable problems of the existing mode can be solved.

China's economy is in transition. The market mechanism is not sound, so the problems encountered have a certain particularity. For example, China's high investment has always been accompanied by overcapacity. Under a complete market mechanism, excess capacity will force rational investors to reduce investment; that is, investors will receive timely feedback on market demand. In China, even if there is a surplus in some industries, there is still a constant increase in investment, which indicates a distortion of the relationship between investment and demand.

Therefore, this study takes the economic growth that fully satisfies the consumption demand as the best standard, and the capital stock that is required by the optimal output as the best. Economic growth theory tells us that the use of consumption to stimulate economic growth is more stable and sustainable than the investment-driven mode, and this is the main goal of the economic transformation that the Chinese government is seeking. That is, only investment that meets consumer needs is effective and achieves the requirements of sustainable growth. According to Armeanu et al. [6], we know that sustainable development endeavors to satisfy the demands of current generations without undermining the ability of later generations to accomplish their own necessities, which include three related pillars, namely: economic, environmental, and social. The concept of sustainable growth in this study is relatively more narrow, because it does not consider the sustainability of the ecological environment. However, in a market economy system with the ultimate goal of satisfying consumer demand, if the residents all have a strong sense of environmental protection, this will naturally be reflected in their consumption decisions, since the environmental and social externalities would be taken into account when making consumer decisions. Therefore, consumer-led sustainable growth is also able to reflect the meaning of other aspects of sustainable development.

In addition, the maintenance of high investment is bound to be inseparable from sufficient and cheap financial resources. The growth rate of China's money supply is not only far higher than that of developed countries, it is even higher than the nominal GDP growth rate. At the same time, the real interest rates of bank loans are lower than the levels that are prevailing in developed countries. As China's consumer credit is still in its infancy, the main channel for credit funds is investment. This shows that China's loan supply is cheap and easy to obtain, especially for the state-owned enterprises that play a leading role in the Chinese market. Thus, the discussion of China's investment problem cannot be separated from the currency market.

As to the two characteristics of Chinese investment mentioned above, one reflects the imbalance between demand and investment in the commodity market, and the other reflects the distortion of the currency market. In order to take the two features into consideration, this study will discuss China's capital adjustment mechanism in the IS-LM framework. It is well known that this model can depict both the commodity market and the currency market at the same time. Further, the deviation degree of real capital from its optimal level can measure the distortion degree of the market, and at the same time, the adjustment speed of capital close to its optimal level can measure the maturity of the market mechanism. Accordingly, this study selects the flexible acceleration model of investment to simulate the adjustment mechanism of China's capital, which can capture the main features of the imperfect market in China's transition economy [7].

The main innovation of this study is to examine the flexible acceleration mechanism of China's capital adjustment under a framework of IS-LM. The investment acceleration model and the IS-LM model both embody classical Keynesian thought, so the two are essentially unified. The IS-LM model is a general equilibrium model, which can make full use of the information of the macroeconomic

system. This provides a guarantee for the in-depth discussion of China's capital adjustment problem under the goal of sustainable consumption-driven growth.

The related research on capital adjustment has a long history, and it basically revolves around two problems in the theory [8]. One is the determination of the optimal capital stock; that is, seeking the potential capital demand under the condition of maximizing profit. The other is the setting of the adjustment mechanism; that is, how to adjust the current capital stock to the optimal capital stock. At first, the classical investment theory [9] held that capital stock and output are in a fixed proportion; under the assumption of $K_t = \nu Y_t$, the original acceleration model $\Delta K_t = I_t = \nu \Delta Y_t$ is constructed, in which investment can be adjusted instantaneously with demand, ΔY_t is the change of output, and ν is the acceleration factor. The meaning of "acceleration" is two-way; that is, a small increase or decrease in output will cause a large increase or decrease in total investment, so $\nu > 1$. The original model assumed that investment depends only on output growth, and the optimal capital stock in each period can be realized. This model ignored the impact of uncertainty, the financing cost, and the macro environment, which need to be particularly emphasized in the analysis of the investment behavior in developing countries [10,11].

Due to the inadequacy of the instantaneous adjustment of the investment with the output, Chenery [12] and Koyck [13] improved the model from the angle of the output adjustment and expressed the current output as the distribution lag of the previous output. Koyck also transformed the indefinite distributed lag model into a finite order autoregressive model in order to solve the econometric problem of the distributed lag acceleration model, which laid the foundation for the extensive application of the acceleration model. Cagan [14] made the acceleration theory more explanatory with regard to reality by introducing the adaptive expectation mechanism of output adjustment into the model. However, the above improvement from the perspective of output adjustment did not fundamentally solve the problem of immediate satisfaction of the optimal level in capital adjustment. Instead, it only improved the anticipation of the output. As for how to meet the capital level of the expected output, the instantaneous realization is still assumed. The discussion on the determination of the optimal capital always stayed at the macro level, and lacked a microcosmic basis.

From the micro perspective of the enterprise, and under the hypothesis of the maximization of profit, Jorgenson [15] established the neoclassical investment theory model by using the optimization method. The theory proved that the optimal capital level of a manufacturer depends on factors such as the output, price of the product, and cost of capital use. However, the capital adjustment was subjectively set as the distribution lag of the optimal capital stock, and did not give a perfect theoretical explanation. In this regard, Eisner and Strotz [16] introduced the concept of the capital adjustment cost, by which they proved that the optimization path of the enterprise investment is in line with the flexible acceleration mechanism of the capital stock adjustment. Subsequently, Lucas [17] and Tybout [18] analyzed the impact of demand uncertainty and credit rationing on the adjustment cost, respectively, which further expanded the flexibility of the model.

At this point, the flexible and accelerated investment model based on the adjustment cost had been basically formed, which laid a theoretical foundation for a follow-up study [19–21] about investment. The so-called flexibility is embodied in two aspects. One is the irreversibility of capital and the transaction cost caused by incomplete information being introduced into the adjustment cost. The other is that the approaching of optimal capital is no longer realized immediately, but rather a partial adjustment process. Of course, in addition to the accelerator theory, there is still Tobin's q theory [22], the cash flow theory [23], and other investment models. Investment theory is explained in Qin and Song [5], Song et al. [7] and Twine et al. [11].

The structure of this article is arranged as follows. The construction of the IS-LM framework for China's capital adjustment path is completed in the second section. The data description is set out in the third section. In the fourth section, based on 1978–2015 data in China, we conduct an empirical analysis to test whether the flexible acceleration mechanism of capital adjustment exists, and measure

its role. In the fifth section, we discuss investment problems such as overinvestment and soft budget constraints. Finally, the full text is summed up, and the conclusions are set out in the sixth section.

2. Theoretical Model and Analytical Framework

This section will be divided into three parts. First, we discuss how to decide the optimal level of a demand-oriented capital stock; second, we introduce the flexible acceleration mechanism of capital adjustment; and finally, the IS-LM framework is integrated.

2.1. The Decision of Demand-Oriented Optimal Capital

One general principle of economics is that the formation of capital or investment is caused by demand. In the ideal state of complete information, given a demand Y_t^D , with the aim of profit maximization, there will be a corresponding optimal capital stock K_t , which can produce Y_t^S to exactly meet the demand Y_t^D in a timely manner. Unfortunately, in reality, it is often difficult to accurately match the output and demand, so if the optimal capital stock is directly set as:

$$K_t^* = vY_t^S, \quad (1)$$

There will be a mistake in theory, because the supply may be too much or too little sometimes, which is an inefficiency situation. The key to avoiding mistakes is to identify the effective components of the supply that meet the needs; however, this is difficult to directly observe and empirically capture.

To tackle this question, the study uses the state-space model in econometrics to extract and incorporate the unobservable variables (state variables, SV), such as expectation and long-term income, into the observable model and obtain the estimation result. The state-space model is estimated by the Kalman filter, which is a powerful iterative algorithm [24]. A state-space model consists of a signal equation and a state equation. The output expectation is introduced and used as a latent state variable, and its adaptive improvement mechanism is used as the state equation. Furthermore, the consumption equation is introduced as a signal equation to reflect the consumption-driven sustainability.

Let Y_t^e denote the expectation for the output of phase t , then the optimal capital stock is:

$$K_t^* = vY_t^e, \quad (2)$$

and the output expectation Y_t^e is determined by the following state-space model:

$$\text{Signal Equation : } C_t = \alpha_0 + \alpha_1 C_{t-1} + \alpha_2 Y_t^e + \omega_t, \quad (3)$$

$$\text{State Equation : } Y_t^e = \rho Y_{t-1}^e + (1 - \rho) Y_{t-1} \quad (4)$$

The consumption Equation (3) introduces the lag phase of consumption to represent the consumption inertia, and ω_t is the random interference term. The equation of state is transformed by the adaptive expectation equation $Y_{t+1}^e - Y_t^e = (1 - \rho)(Y_t - Y_t^e)$, where the $(1 - \rho)$ is the adjustment factor to improve the expectation.

The reasons for choosing the adaptive expectation are as follows. On the one hand, the expectation of output is often related to all aspects of the market, and China's market economy is not perfect, so most Chinese scholars choose adaptive expectation [25] in the output expectation setting. On the other hand, it is difficult to form rational expectations. The real rational expectations have high requirements for information and information-processing capabilities. The rules used for predictions are also very complex, and in reality, there will inevitably be information omissions in predictions [26]. In most cases, all that can be used is the information of the past, which can prove that the rational and adaptive expectation at this time is equivalent [27].

2.2. Capital Adjustment Mechanism

For the last part, the optimal capital stock K_t^* is obtained under the condition of sustainable consumption-driven growth. However, in reality, K_t cannot jump to K_t^* directly because of the adjustment cost of capital. Eisner and Strotz proved that the optimal investment path is in accordance with the flexible acceleration model [16]; that is, the capital can only be partially adjusted in a period:

$$K_t - K_{t-1} = (1 - \lambda)(K_t^* - K_{t-1}), \quad (5)$$

where the $(1 - \lambda)$ is the adjustment coefficient, and $\lambda \in (0, 1)$.

Considering depreciation $\delta \in (0, 1)$, the investment I_t of each period includes two parts: net investment $(K_t - K_{t-1})$ and replacement investment δK_{t-1} , so:

$$I_t = (K_t - K_{t-1}) + \delta K_{t-1}. \quad (6)$$

By Equations (2), (5), and (6), the total investment I_t is:

$$I_t = (1 - \lambda)vY_t^e - (1 - \lambda - \delta)K_{t-1}, \quad (7)$$

Then, the differential operation of time t is done at the two ends of Equation (7), so we have:

$$I_t - I_{t-1} = (1 - \lambda)v\Delta Y_t^e - (1 - \lambda - \delta)\Delta K_{t-1}. \quad (8)$$

By Equation (5), we know:

$$\Delta K_{t-1} = (1 - \lambda)(K_{t-1}^* - K_{t-2}), \quad (9)$$

and it is easy to get $K_{t-1}^* = vY_{t-1}$ and $(1 - \lambda - \delta)K_{t-2} = (1 - \lambda)vY_{t-1} - I_{t-1}$, so:

$$I_t = (1 - \lambda)v\Delta Y_t^e + (1 - \lambda)v\delta Y_{t-1}^e + \lambda I_{t-1}. \quad (10)$$

Equation (10) is the basic model for the flexible acceleration of investment. Although the model reflects the relationship between investment and expected output better, it still ignores other investment costs outside of depreciation, and does not consider the influence of macroeconomic environment variables, which limits its application. These application limits result in an empirical failure of the model, especially for developing countries such as China. Therefore, it is necessary to expand the flexible acceleration model in order for it to more closely reflect empirical practice.

2.3. Consider the Use-Cost of Capital

For the use-cost of capital, the main economic insights came from Jorgenson [15]. He argued that the cost of capital includes not only the obvious depreciation, but also the interest on the loan to purchase the equipment, and the loss caused by the change in the equipment price. As a result, the cost of increasing a unit of capital input is $(\delta + r_t - \Delta p_t^k / p_t^k)$. Li and Tang [28] argued that China's fixed asset price index changes little relative to the consumer price index, and thus it can be ignored. In the modeling embodied in this study, the authors did consider the change in the price of capital goods, but the results of the follow-up regression were not significant. Therefore, only the interest rate is introduced here.

Twine et al. [11] argued that the effect of the interest rate on the investment is mainly reflected in its influence on the capital adjustment coefficient, so this study introduces the linear expression of the adjustment coefficient:

$$(1 - \lambda) = a_0 + a_1 r_t / (I_t^* - I_{t-1}), \quad (11)$$

and $I_t = (K_t - K_{t-1}) + \delta K_{t-1} = (1 - (1 - \delta)L)K_t$, where L is the lagging operator. According to the partial adjustment Formula (5) of the stock, we can get:

$$I_t - I_{t-1} = (1 - \lambda)(I_t^* - I_{t-1}), \quad \lambda \in (0, 1). \quad (12)$$

Considering $I_t^* = (1 - (1 - \delta)L)K_t^* = (1 - (1 - \delta)L)vY_t^e$, and combining Equations (11) and (12), the following expression is obtained:

$$I_t = (1 - a_0)I_{t-1} + a_0v\Delta Y_t^e + a_0v\delta Y_{t-1}^e + a_1r_t. \quad (13)$$

For real interest rates, it is necessary to distinguish between the ex ante interest rate and ex post interest rate. The ex ante interest rate is the difference between the nominal interest rate and the expected rate of inflation; whereas, the ex post interest rate is the difference between the nominal interest rate and the real inflation rate. As the expected inflation rate is hard to observe, the ex ante interest rate will not be obtained directly. However, since the adjustment of capital needs to be made in advance, the interest rate must be expected to be as accurate as possible before making a decision.

Gottschalk [29] decomposed the nominal interest rate into the ex ante real interest rate and the expected inflation rate based on the Fischer equation, and completed the measurement of the ex ante real interest rate with the help of the structural vector autoregression (SVAR) model. In this study, the same decomposition method is used, but we chose the state-space model to measure it. Let R_t express the nominal interest rate, r_t^e express the ex ante interest rate, and π_t^e express the expected inflation rate, so:

$$R_t = r_t^e + \pi_t^e. \quad (14)$$

The inflation rate π_t is subtracted on both sides of Equation (14); then, the observable ex post interest rate r_t is:

$$r_t = R_t - \pi_t = (R_t - \pi_t^e) + (\pi_t^e - \pi_t) = r_t^e + \varepsilon_t, \quad (15)$$

where $\varepsilon_t = \pi_t^e - \pi_t$ is the prediction error of the inflation rate. Equation (15) establishes a connection between the observable variable r_t and the unobservable r_t^e ; however, the constant term is generally considered when the econometric regression is used, so the following equivalent form:

$$r_t = r_t^e + \varepsilon_t = E(r_t^e) + [r_t^e - E(r_t^e)] + \varepsilon_t = c + \tilde{r}_t^e + \varepsilon_t \quad (16)$$

is used in the regression, which can be used as the signal equation of the state-space model.

In order to obtain the state transition equation of the ex ante interest rate, it is necessary to analyze the state change law of the rate π_t^e . After comparing the rational expectation and the adaptive expectation, Sabrowski [30] concluded that the adaptive expectation is more suitable for estimations of Germany's inflation rate. The study of Huang and Deng [31] also showed that the residents' expectation of inflation is irrational in China. Therefore, this study assumes that the inflation expectation is adaptive; that is, $\pi_t^e - \pi_{t-1}^e = (1 - \eta)(\pi_t - \pi_{t-1}^e)$. From iterative derivation, it is easy to obtain:

$$\pi_t^e = [(1 - \eta)/(1 - \eta L)]\pi_t \quad (17)$$

Here, L is the lagging operator. Replacing the π_t^e in Equation (14) produces:

$$r_t^e = \eta r_{t-1}^e + R_t - \eta R_{t-1} - (1 - \eta)\pi_t. \quad (18)$$

Most of the studies in China show that there is a stable cointegration relationship between the nominal interest rate and inflation rate, and the cointegration vector is $(1, 1)'$. The cointegration regression for $R_t = \eta R_{t-1} + (1 - \eta)\pi_t$. It is easy to guess that the estimated value of parameter η

should be very close to 1, so the state transition equation is set to the recursion $r_t^e = r_{t-1}^e$. Therefore, the state-space model to measure r_t^e is:

$$\text{Signal Equation : } r_t = r_t^e + \varepsilon_t = c + \tilde{r}_t^e + \varepsilon_t, \quad (19)$$

$$\text{State Equation : } \tilde{r}_t^e = \tilde{r}_{t-1}^e, \quad (20)$$

by which $r_t^e = c + \tilde{r}_t^e$ can be calculated, and Equation (13) will be transformed into the following form:

$$I_t = (1 - a_0)I_{t-1} + a_0v\Delta Y_t^e + a_0v\delta Y_{t-1}^e + a_1r_t^e. \quad (21)$$

The final expression of the flexible acceleration equation for capital accumulation has now been obtained, and it is then placed under the IS-LM framework to complete its estimation. The IS-LM model can provide more abundant information about the macroeconomic system, such as the influence of the money market, which is a factor that must be considered for the sustainable growth of a modern economy. The more information we get, the more accurately we can depict the path of China's capital accumulation.

2.4. Construction of IS-LM Framework

The IS-LM model is an economic analysis framework outlined on the basis of Keynes' macroeconomic theory [32]. It is an important tool to describe the interrelation between the product market and the money market. We need to first establish the liquidity preference-money supply (LM) equation that characterizes the money market. Bean [33] argued that under the IS-LM framework, the demand for money is affected by nominal interest rates, whereas the demand for goods is affected by real interest rates. The scholars have reached a consensus on this [34,35], so here, we choose to establish the LM equation based on nominal interest rates. Following the previous research, when the money market is balanced, the equilibrium interest rate R_t is mainly determined by the output expectation Y_t^e , the change of the money supply ($\Delta m_t/m_t$), and the interest rate in the previous period R_{t-1} , so:

$$R_t = b_0 + b_1Y_t^e + b_2(\Delta m_t/m_t) + b_3R_{t-1} + w_t, \quad (22)$$

where w_t is the error term, and it covers all of the information about the uncontrollable factors. Therefore, in order to reflect the uncertainty of the currency market and better fit the foresight of the investment behavior, the LM Equation (22) should be adopted to predict the nominal interest rate R_t^e before the prediction of the ex ante interest rate r_t^e , which is based on the state-space model; that is:

$$R_t = \hat{R}_t = \hat{b}_0 + \hat{b}_1Y_t^e + \hat{b}_2(\Delta m_t/m_t) + \hat{b}_3R_{t-1}, \quad (23)$$

where \hat{R}_t is the fitting values of the linear regression based on Equation (22), and then, we replace all of the previous R_t with \hat{R}_t . This treatment is actually close to the rational expectation. The meaning of rational expectation, as defined by Lucas [17], is that people do not make systematic mistakes with their expectations. From the point of view of the probability theory, the expected value of the difference between the expected value and the actual value should be equal to zero; that is, $E[w_t] = 0$, and this is exactly what the measurement model requires. In addition, the adjustment of the nominal interest rate in China is generally from a policy regulation. Before it is adjusted, the society is able to form a consistent expectation that easily aligns with the government. Therefore, the consistency expectation of the linear regression for the nominal interest rate R_t is reasonable.

Based on the above consumption equation, the investment equation, and the interest rate equation, the following IS-LM framework is collated:

$$\begin{cases} Y_t = C_t + I_t + \overline{G}_t + \overline{NX}_t \\ C_t = \alpha_0 + \alpha_1 C_{t-1} + \alpha_2 Y_t^e + \omega_t \\ I_t = \beta_0 + (1 - a_0) I_{t-1} + a_0 v \Delta Y_t^e + a_0 v \delta Y_{t-1}^e + a_1 r_t^e + \zeta_t \\ R_t = b_0 + b_1 Y_t^e + b_2 (\Delta m_t / m_t) + b_3 R_{t-1} + w_t \end{cases} \quad (24)$$

The first equation in the framework is the demand identity, in which the government expenditure \overline{G}_t and net export \overline{NX}_t as exogenous policy variables are introduced, but it is still listed only for the completeness of the model. The investment - saving (IS) equation can be derived from the first three equations, representing the equilibrium of the commodity market, while the last equation is the LM equation, which represents the equilibrium of the money market.

Finally, as the objective of this study is to analyze the internal market mechanism of China's capital adjustment, the completion of the estimation of the investment equation is the end point. The steps for the estimation of the investment equation under the IS-LM framework are as follows:

- First, based on Equations (3) and (4), the output expectation Y_t^e is estimated with the aid of the state-space model.
- Second, the fitted value of the nominal interest rate \hat{R}_t is obtained by the regression of the nominal interest rate from Equation (22).
- Third, set $r_t = \hat{R}_t - \pi_t$ and $r_t^e = \hat{R}_t - \pi_t^e$, then finish the estimation of the state-space model, consisting of Equations (19) and (20), and get the estimated value of the ex ante interest rate r_t^e .
- Finally, by using the obtained sequence Y_t^e and r_t^e , complete the estimation of the capital adjustment Equation (21) to achieve the final econometric target of this study.

3. Data

This study uses the data for the years 1978 to 2015 in China. If there are no special instructions, the data are all derived from the CEInet Statistics Database [36] and adjusted to 1978 as the base year.

The output Y_t is represented by the actual GDP; however, there is no GDP deflator in China, only the GDP index, and the conversion relationship between the two is:

$$GDP \text{ deflator}_t = GDP_t / (GDP_{base\ year} \times GDP \text{ index}_t), \quad (25)$$

So, the real GDP can be calculated by using the GDP deflator and the nominal GDP data. The consumption item of GDP, which is accounted for by the expenditure method, is C_t , and it is converted by the GDP deflator. The rate of inflation rate π_t is also measured by the change rate of the GDP deflator:

$$\pi_t = (GDP \text{ deflator}_t - GDP \text{ deflator}_{t-1}) / GDP \text{ deflator}_{t-1}. \quad (26)$$

China's actual GDP, GDP deflator, and inflation rate are then shown in Figure 1.

For the investment I_t , we choose the total fixed assets formation data, and adopt the price indices of the investment in fixed assets to eliminate the impact of the price. However, these price indices in China are counted from 1991. To overcome this problem, Li [37] considered the implicit investment deflator constructed by Zhang [38] to be optimal after comparing a variety of remedial measures. So, we will also adopt the data of Zhang to supplement the price indices of the investment in fixed assets between 1978–1990. The investments and their price indices are displayed in Figure 2.

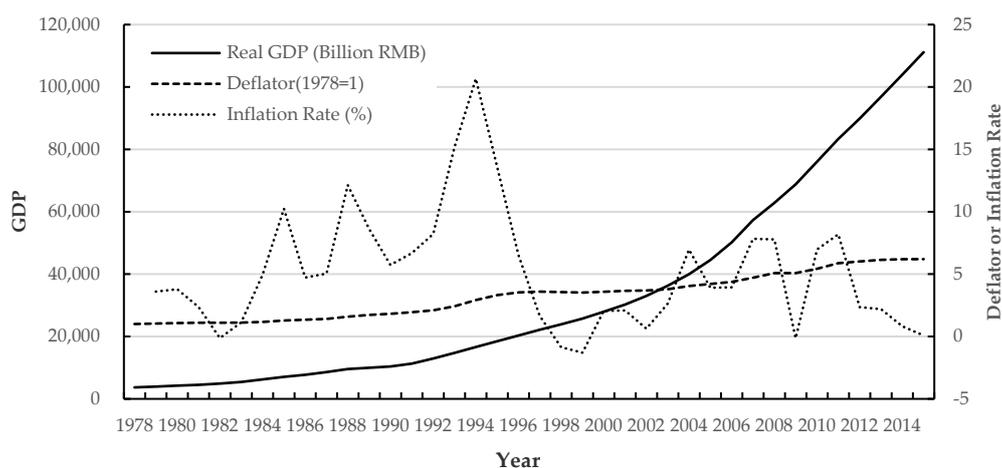


Figure 1. China's real gross domestic product (GDP), GDP deflator, and inflation rate between 1978–2015.

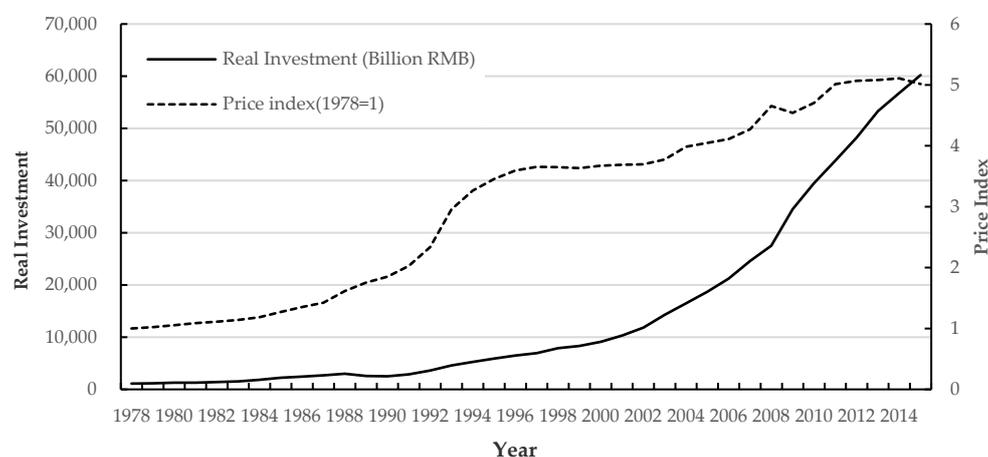


Figure 2. China's fixed asset investments and their price indices between 1978–2015.

The benchmark one-year lending rate is used to represent the nominal interest rate R_t ; in fact, this is also the average interest rate, because the state only announces the date of each adjustment, and its corresponding interest rate. If the state announces more than one interest rate in a year, we calculate the weighted average according to the number of days per interest rate. However, there was no official announcement of the benchmark one-year lending rate before 1990. Fortunately, the deposit interest rate data in China have been recorded in detail since 1971. Although the interest rates of deposits and loans have been adjusted many times, the balance between the two has always been relatively stable. Furthermore, the nominal interest rate and the inflation rate have a strong correlation according to the Fisher equation. Therefore, this study first uses these two variables to carry on the linear fitting of the loan interest rate before 1990; then, based on the regression results, the loan interest rates for the years 1978 to 1990 are fitted. The regression equation is:

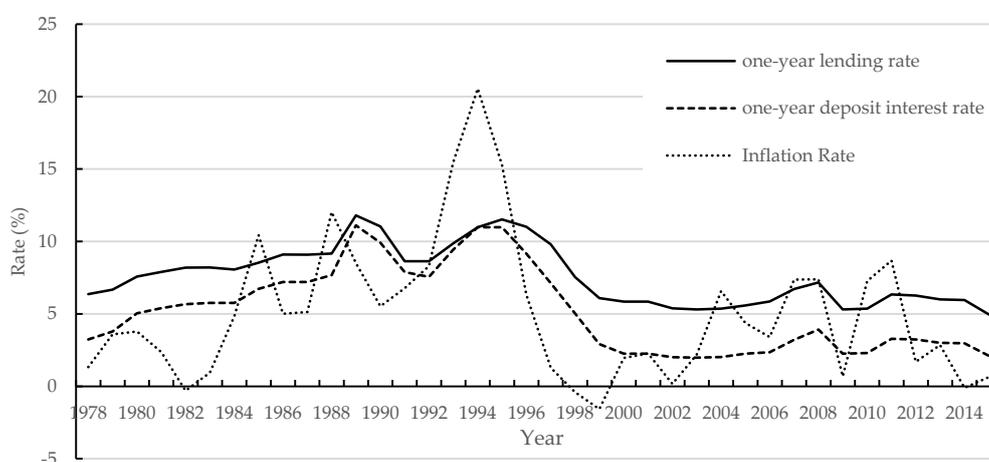
$$R_t = \beta_0 + \beta_1 R_t^{\text{deposits}} + \beta_2 \pi_t + \mu_t, \quad (27)$$

and its results are shown in Table 1. Here, we only pay attention to the predictions of the data as a whole, and ignore the multiple collinearity between the deposit interest rate and the inflation rate.

Table 1. Results of ordinary least squares (OLS) regression for R_t between 1991–2015.

Dependent Variable: R_t	Coefficients	Standard Errors	T-Statistic	p -Value
Independent Variables				
<i>constant</i>	4.072 ***	0.135	30.078	0.0000
$R_t^{deposits}$	0.725 ***	0.038	19.225	0.0000
π_t	−3.910 *	2.050	−1.908	0.0702
R-squared: 0.971 F-statistic: 349.840 *** Sum squared resid: 2.892				
Adjusted R-squared: 0.968 P (F-statistic): 0.000 Durbin–Watson stat:				
Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels, respectively.				

The results of Table 1 show that the R-squared value for measuring the overall fitting degree is 0.971. This ensures the credibility of predicting interest rates for the 1978–1990 years, and the results are shown in Figure 3.

**Figure 3.** China's one-year lending rate, one-year deposit interest rate, and inflation rate between 1978–2015.

4. Results

4.1. Estimation of Expected Output

This section uses the state-space model expressed by Equations (3) and (4) to estimate the output expectations. Using the state-space estimation method provided by the Eviews software, two estimation strategies are deployed in this study. One is to estimate the expected output Y_t^e directly as a latent variable by using the time-varying parameter model constructed by the state-space model. The model is set as follows:

$$\begin{cases} C_t = c(1) + c(2)C_{t-1} + c(3)sv1 + [var = exp(c(4))] \\ sv1 = c(5)sv1(-1) + (1 - c(5))Y_t \end{cases}, \quad (28)$$

where obviously, $sv1$ is the time-varying expression of Y_t^e compared with Equations (3) and (4), and $sv1(-1)$ is its first-order lag. The expression $[var = exp(c(4))]$ is a set of error variance, which is set as an exponential form to ensure that it is non-negative.

The above method is based on a consumption equation with constant marginal propensity. However, due to the influence of economic reform and various external shocks and policy changes, China's economic structure is constantly changing, and the consumption equation is no exception.

The use of constant marginal propensity cannot show this change; therefore, this study will use the state-space time varying model twice.

Equation (4) can be rewritten as:

$$Y_t^e = [(1 - \rho)/(1 - \rho L)]Y_t. \tag{29}$$

Substituting this formula for the signal in Equation (3), we have:

$$C_t = \alpha_0(1 - \rho) + (\alpha_1 + \rho)C_{t-1} - \alpha_1\rho C_{t-2} + (1 - \rho)\alpha_2 Y_t + \zeta_t, \tag{30}$$

where the error term is $\zeta_t = \omega_t - \rho\omega_{t-1}$. Since the coefficient α_2 is the marginal propensity to consume in the original consumption equation, we use it as the time-varying state variable bv ; that is:

$$\begin{cases} C_t = c(1)(1 - c(3)) + (c(2) + c(3))C_{t-1} - c(2)c(3)C_{t-2} + bv(1 - c(3))Y_t + [var = exp(c(4))] \\ bv = bv(-1) \end{cases} \tag{31}$$

and the estimated result is shown in Figure 4. It shows that the overall trend of the marginal propensity for consumption is decreasing, especially after 2000, which is basically in line with the current situation of insufficient consumption in China.

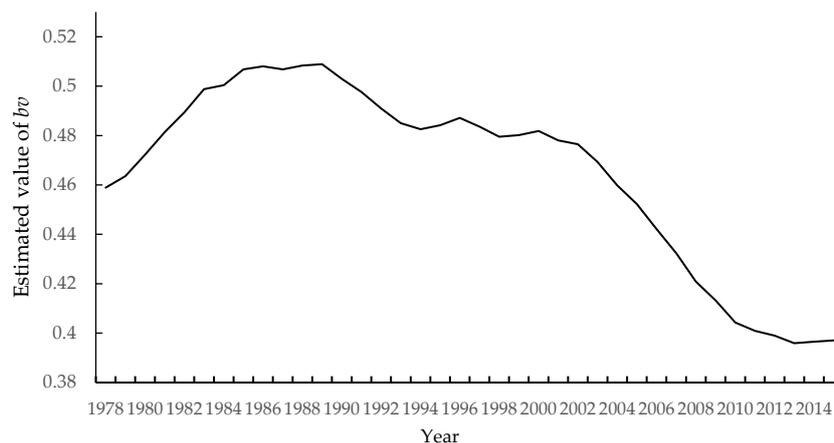


Figure 4. Time-varying value of the marginal propensity to consume.

We then take this estimated value of bv to replace the parameter $c(3)$ in Equation (28), and get:

$$\begin{cases} C_t = c(1) + c(2)C_{t-1} + bv \cdot sv1 + [var = exp(c(4))] \\ sv1 = c(5)sv1(-1) + (1 - c(5))Y_t \end{cases} \tag{32}$$

Equation (32) is estimated by the state-space model, and the expected output Y_t^e (see Figure 5) is obtained. In order to enable a comparison, the results of the first method are also given in Figure 5. The results show that the second method is significantly better than the first one for the expected output. Compared with the real output, error 2 (corresponding to method 2) is significantly less than error 1 (corresponding to method 1), especially in the second half.

Furthermore, it is obvious that the expected output is less than the actual output, regardless of the method; that is, the optimal output value expected under the consumption orientation is lower than the actual output. We can infer from this that China’s actual output is not fully oriented to the demand, because the manufacturers continue to increase their investment and expand production without considering what consumers really need. This is obviously unsustainable, because there will inevitably be a surplus of products and a consequent inefficiency of the investment that was originally

used to produce these excess products. Therefore, the question of ineffective investment will be further discussed in this study.

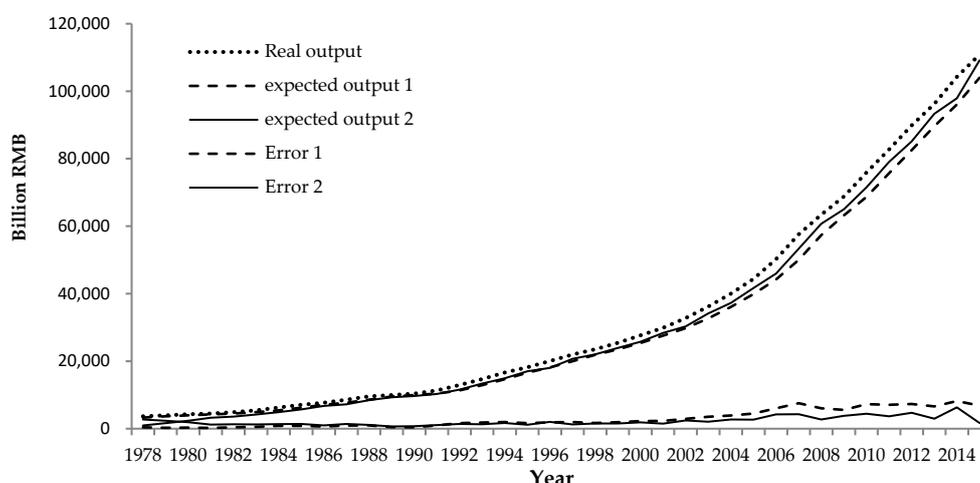


Figure 5. Real output, expected output, and prediction error.

4.2. Estimate the Ex Ante Interest Rate

As mentioned earlier, the anticipation of the ex-ante interest rate is carried out in two steps. First, based on the LM in Equation (22), we estimate the linear ordinary least squares (OLS) expectation of the nominal interest rate \hat{R}_t in order to eliminate the influence of uncertainty. Second, we establish the state-space model (19–20) to get the ex ante real interest rate. Remember that the real interest rate $r_t = \hat{R}_t - \pi_t$, so the ex ante expected real interest rate is $r_t^e = \hat{R}_t - \pi_t^e$, and the state variable is \tilde{r}_t^e , by which $r_t^e = c + \tilde{r}_t^e$ can be calculated. We first give the regression results to the LM in Equation (22) in Table 2:

Table 2. Regression results of liquidity preference-money supply (LM) equation for \hat{R}_t

Dependent Variable: R_t	Coefficients	Standard Errors	T-Statistic	p-Value
Independent Variables				
<i>constant</i>	0.077 ***	0.019	4.109	0.0002
$\ln(Y_t^e)$	-0.005 ***	0.038	-3.589	0.0011
$\Delta m_t / m_{t-1}$	-0.065 ***	2.050	-4.042	0.0003
R_{t-1}	0.779 ***	0.074	10.544	0.0000
R-squared: 0.871 F-statistic: 349.840 *** Sum squared resid: 0.002				
Adjusted R-squared: 0.859 P (F-statistic): 0.000 Durbin–Watson stat: 1.652				

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels, respectively.

From the above results, $R^2 = 0.871$ shows that the overall fitting degree is better, and each parameter is significant at the 1% level. Based on this, the OLS prediction value of the nominal interest rate \hat{R}_t is obtained, as shown in Figure 6a. The consistency of the actual value and the fitted value, with the error always being in the confidence band, show that the fitted value we get is reliable. Besides, the LM equation here is more for considering the influence of the money market on capital accumulation or investment, so the economic meaning of the regression results will not be discussed any further.

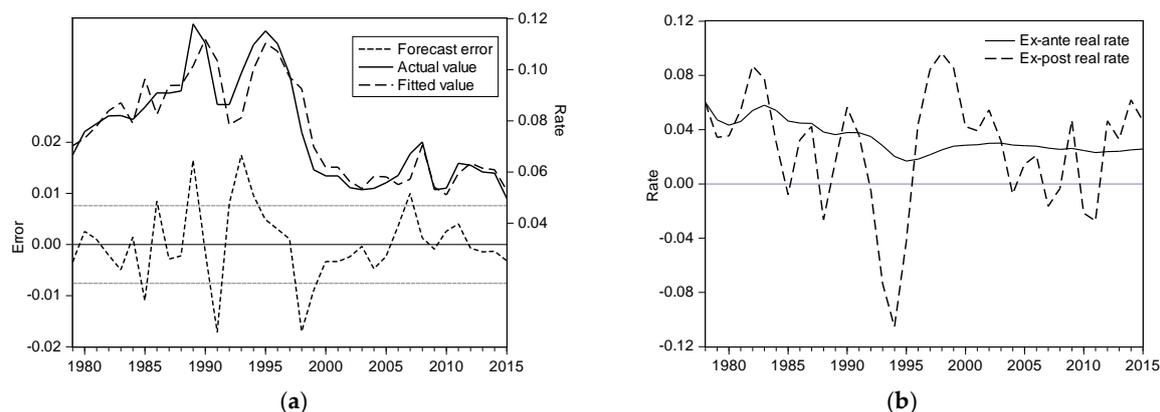


Figure 6. (a) The OLS fitted value of the nominal interest rate \hat{R}_t and its error. (b) The results of the ex ante real interest rate and ex post real interest rate.

Further, the expected ex ante real interest rate r_t^e will be estimated by the following state-space time-varying parameter model:

$$\begin{cases} \tilde{r}_t = c(1) + sv2 + [var = exp(c(2))] \\ sv2 = sv2(-1) \end{cases}, \quad (33)$$

where $r_t^e = c(1) + sv2$, and the results are shown in Figure 6b. The results show that in most cases, the expected ex ante real interest rate is greater than the ex post real interest rate, and sometimes the ex post real interest rate is less than 0, which has also led to a gradual reduction of the expected real interest rates. This means that the actual cost of using capital for investors is smaller than that which is expected before the investment, so the investors have a soft budget constraint of financing in China. The bank debt soft constraint in the financial system is another key issue in the follow-up discussion.

4.3. Regression of the Capital Adjustment Equation

Based on the sequences of the expected output Y_t^e (unit: billion RMB), the ex ante real interest rate r_t^e (unit: %) and the real investment I_t (unit: billion RMB), we estimate the capital adjustment of Equation (21) by robust OLS regression, and the results are shown in Table 3.

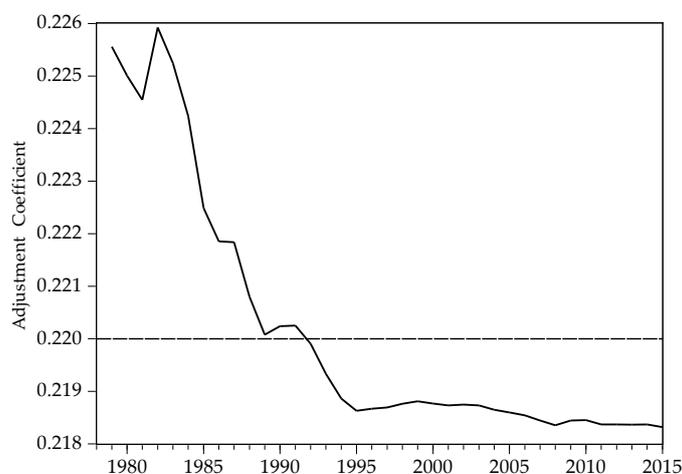
The results show that the overall estimation of the model is ideal; the values of the R-squared and adjusted R-squared are both 0.998, and the F-statistic value is also significant at the 1% level. For each parameter, the coefficient of I_{t-1} reflects the influence of investment inertia. At the 1% confidence level, the correlation of the investment between the two periods is as high as 0.782; that is, the investment in the previous period increased by 1 billion RMB, and the average investment in the current period increased by 0.782 billion RMB. The impact of the expected output changes is not significant at the 10% level. On average, when the expected output to meet the demand increases by 1 unit, the investment will increase by 0.38. The expected output in the early stage is significant at the 10% level, and its marginal effect is 0.163. With an expected interest rate increase of 1 percentage point, the current investment will increase by 316.897 units, but the significance level is only 10%. The fitting effect of the model is good, which indicates that China's market demand-oriented capital adjustment flexible acceleration mechanism has basically formed, but the adjustment intensity still needs further calculation.

Table 3. Regression results of the capital adjustment equation.

Dependent Variable: I_t	Coefficients	Robust Standard Errors	T-Statistic	p-Value
Independent Variables				
<i>constant</i>	−2103.332 *	1122.257	−1.874	0.0701
I_{t-1}	0.782 ***	0.132	5.909	0.0000
ΔY_t^e	0.380	0.257	1.477	0.1495
Y_{t-1}^e	0.163 *	0.088	1.851	0.0734
r_t^e	316.897 *	179.501	1.765	0.0870
R-squared: 0.9983 F-statistic: 4837.259 *** Sum squared resid: 18,779,193				
Adjusted R-squared: 0.9981 P (F-statistic): 0.000 Durbin–Watson stat: 1.406				

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels, respectively.

The strength of the adjustment is determined by the capital adjustment coefficient $(1 - \lambda)$, and $(1 - \lambda) = a_0 + a_1 r_t^e / (I_t^* - I_{t-1})$, so comparing the estimated results of Table 3 with Equation (21), it is easy to get $a_0 = 0.218$, $v = 1.743$, $\delta = 0.429$, and $a_1 = 316.897$. With the $I_t^* = (1 - (1 - \delta)L)vY_t^e$, the $(1 - \lambda)$ is calculated, and the result is shown in Figure 7. From the overall trend, China's capital adjustment coefficient is decreasing; that is, in the process of approaching the optimal capital stock K_t^* , the speed of the capital adjustment is decreasing. This also indicates that the difficulty of the capital adjustment is increasing. The corresponding value of the horizontal dotted line in the graph is 0.22, which is the mean of the adjustment coefficient, so on average, we have $K_t - K_{t-1} = 0.22(K_t^* - K_{t-1})$.

**Figure 7.** The estimated value of China's capital adjustment coefficient for 1978–2015.

Although China's capital adjustment has shown a flexible acceleration mechanism, the effect is not very strong. On average, China's capital adjustment can only offset the difference between the optimal capital and the actual capital of 0.22 per year. In combination with the current situation of China's surplus in Figure 5, we can ascertain that 22% of the current excess capacity can be removed per period. We further expand on these findings through employing Klepsch and Elsas' concept of the half cycle [21]. The time needed to achieve half of the capital adjustment goal is calculated, and its calculation formula is $\ln(0.5)/\ln(\lambda)$; so, here we get $\ln(0.5)/\ln(0.78) = 2.79$, which suggests that it will take at least 2.79 years to remove half of the current excess. The flexible acceleration mechanism of the capital adjustment essentially embodies the self-balanced sustainability of the market economy. When Klepsch and Elsas studied the investment behavior of German enterprises, the adjusted coefficient estimated was 0.684, which is much larger than that of China, so the investment behavior could be

self-adjusted by the market. However, China's market economy is not yet perfect, and its capability to repair itself is limited. Therefore, under the demand-oriented sustainable growth target, especially in the process of removing excess capacity, the capital adjustment should not be entirely dependent on the market. In the short term, we still need the government to use its "visible hand" to assist. At the same time, it is also important for the supply side reform and the formulation of relevant industrial policies to be market-oriented, so as to ensure the steady growth of China's market mechanism, and enable it to strive for the driving force of sustainable economic growth.

5. Discussion

5.1. Explanation for the High Rate of Depreciation: Ineffective Investment

The depreciation rate δ in this study is up to 0.429, which is obviously far higher than the depreciation rate used in the related research of China's capital stock estimate. According to the summary of Jiang and Wang [39], the depreciation rate used in domestic-related research is between 0.032 and 0.100. The depreciation rate is also considered to be the most important part of the perpetual inventory method, which is widely used to estimate the stock of capital [37]. However, the depreciation rate that is currently used in China, the rate experienced in other countries, and the rate based on the weighted average of the life span of different types of assets, are all easily influenced by human subjective factors.

However, the depreciation rate estimated in this study is completely endogenous, and avoids the interference of human factors. In essence, the key to the 0.429 depreciation rate is that the consumption of residents is taken as the initial driving force of the entire IS-LM system used. When the output is expected, the resident consumption equation is used as a signal equation. The consumption of the residents is the embodiment of the social effective demand, and is also the embodiment of the social welfare. Therefore, the expected output and its corresponding investment are both effective parts related to consumption.

In the formula $I_t = (K_t - K_{t-1}) + \delta K_{t-1}$, it is implicitly assumed that I_t is the effective investment. However, in China's accounting, the effective part of the investment is not distinguished. Ignoring inefficient investment will lead to an overestimation of China's capital stock. In practice, due to the lack of prior scientific planning and feasibility studies, cases of investment failure and idle capital can be found everywhere in China. If the ineffective part of the investment is taken into account, China's depreciation rate is likely to be higher than 10%, which is the upper limit for the scope of the depreciation rate used. According to the calculations of Lin and Zhang [40], the average rate of invalid assets in China was 40.23% in 1978–2005. Excluding the idle and invalid parts, we consider the remaining 60% to be the effective part of the total capital, and set the natural depreciation at 5%. It still has 3% ($0.03 = 0.6 * 0.05$) overall depreciation, so the depreciation rate in China is about 43% ($=40\% + 3\%$), which is basically the same as the result of this study.

In addition, the δ in δK_{t-1} essentially represents the replacement rate. Under the drive of profit maximization, there is little difference between the replacement rate and the depreciation rate of the capital for foreign enterprises. However, in China, due to a large number of ineffective investments, the replacement rate may be far higher than the depreciation rate, and the assumption that the two parts are equal will also overestimate the capital stock of China. Therefore, the measurement results of the consumption-oriented investment behavior can identify the invalid investment in China, and make the depreciation rate of the capital up to 42.9%. The reasons for the existence of blind and invalid investments in China are considered to be related to the soft budget constraints of financing, which are discussed below.

5.2. Soft Budget Constraints of Financing

In the long run, investors tend to be rational. Irrational invalid investing is more likely to be short-term behavior, so interest rates will have different effects on long-term and short-term

investments. Based on this, the discussion of the soft budget constraints will adopt the error correction model (ECM) for the comparative analysis of Equation (21) in the long term and short term.

For Equation (21), the equivalent form is set as follows:

$$I_t = \beta_0 + \beta_1 I_{t-1} + \beta_2 Y_t^e + \beta_3 Y_{t-1}^e + \beta_4 r_t^e + v_t. \quad (34)$$

When we subtract I_{t-1} on both sides, and add and subtract $\beta_2 Y_{t-1}^e$ and $\beta_4 r_{t-1}^e$ on the right, then:

$$\Delta I_t = (\beta_1 - 1)ecm_{t-1} + \beta_2 \Delta Y_t^e + \beta_4 \Delta r_t^e + v_t, \quad (35)$$

where $ecm_{t-1} = I_{t-1} - \beta_0 / (1 - \beta_1) - (\beta_2 + \beta_3) Y_{t-1}^e / (1 - \beta_1) - \beta_4 r_{t-1}^e / (1 - \beta_1)$. Equation (35) is the error correction form of Equation (21), and ecm_{t-1} is the error correction term. If the long-term equilibrium relation $I_t = k_0 + k_1 Y_t^e + k_2 r_t^e + u_t$ is established, ecm_{t-1} reflects the short-term deviation of the investment's long-term equilibrium path, and its coefficient $(\beta_1 - 1)$ indicates the adjustment speed. Therefore, the ECM model combines the long-term horizontal equation and short-term difference equation, thereby enabling us to make a complete analysis of the long-term trend and short-term volatility of the capital adjustment.

In order to estimate Equation (35), the error correction term ecm_{t-1} is needed. So, the cointegration regression of the long-term equilibrium $I_t = k_0 + k_1 Y_t^e + k_2 r_t^e + u_t$ is first carried out. The estimated results are shown in Table 4.

Table 4. Results of the cointegration regression.

Dependent Variable: I_t	Coefficients	Robust Standard Errors	T-Statistic	p-Value
Independent Variables				
<i>constant</i>	−8775.217 ***	1062.278	−8.261	0.0000
Y_t^e	0.631 ***	0.010	60.946	0.0000
r_t^e	1361.754 ***	219.956	6.191	0.0000
R-squared: 0.9933 F-statistic: 2579.850 *** Sum squared resid: 7,795,4673				
Adjusted R-squared: 0.9929 P (F-statistic): 0.000 Durbin–Watson stat: 0.417				

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels, respectively.

The R-squared value of the estimated results is 0.9933, which indicates that the overall fitting degree of the equation is very high, and the parameters are all significant at the 1% significance level. The marginal impact of the expected output on investment is 0.631, and that of the expected interest rate is 1361.754. In the long run, China's investments have a significant response to the market demand and cost, and thereby show a certain market efficiency.

Further, the Augmented Dickey-Fuller (ADF) unit root test for the residual sequence u_t is carried out, and the result (see Table 5) shows that only 0.5% of the probability accepts the original hypothesis that sequence u_t has a unit root. That is, at the significant level of 1%, the sequence u_t does not have a unit root and is a stationary sequence; so, the cointegration relationship between the variables in the regression equation is established.

The residual sequence of the long-term cointegration equation is used as the error correction term $ecm_t = \hat{u}_t$, and the estimated result of the error correction from Equation (35) is shown in Table 6. In the short term, the flexible acceleration mechanism of China's capital accumulation is statistically significant, and the adjustment coefficient is −0.207, which is basically the same as the capital adjustment coefficient that was obtained before, which was 0.22. In the short-term investment adjustment, demand still plays a significant role. The change of expected demand increased by 1 unit, and the change of investment increased by 0.641 units. This shows that the market demand oriented mechanism of China's investment has been formed in the short term. However, the impact of interest

rates is not significant, and we all know that the interest rate is the main cost of financing, so it proves that there is a soft budget constraint on the financing of enterprises in China in the short term. The empirical research of Qin and Song [5] also pointed out that the cost of capital has had almost no impact on China's investment, and investment demand is more induced by the policy that is conducive to achieving the soft budget constraint.

Table 5. Unit root test of residual sequence u_t

	T-Statistic	p-Value	Critical Value		
			1%	5%	10%
ADF test	−2.8989 ***	0.0050	−2.6308	−1.9504	−1.6112

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels, respectively.

Table 6. Estimation results of the error correction equation.

Dependent Variable: ΔI_t	Coefficients	Robust Standard Errors	T-Statistic	p-Value
Independent Variables				
<i>constant</i>	−146.670	136.214	−1.077	0.2894
<i>ecm_{t−1}</i>	−0.207 *	0.103	−2.014	0.0522
ΔY_t^e	0.641 ***	0.065	9.840	0.0000
Δr_t^e	47.230	148.675	0.318	0.7527
R-squared: 0.8323 F-statistic: 54.609 *** Sum squared resid: 19,844,789				
Adjusted R-squared: 0.8171 P (F-statistic): 0.000 Durbin–Watson stat: 1.655				

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels, respectively.

In China, the problem of soft budget constraints is especially serious among local governments and state-owned enterprises. Economic growth is the most important standard in the assessment of Chinese officials, so the leaders of the local government and state-owned enterprises will strive to improve the GDP in order to be promoted. These leaders are said to be engaging in “political tournaments” [41]. On the one hand, the local government leaders have a strong incentive to attract investment, so they give various institutional concessions to potential investor enterprises, especially the state-owned ones. On the other hand, the local government leaders have a serious “investment hunger”. They are keen to launch projects designed to build their own images, such as development zones and science parks. The investment process often neglects the cost factor, as there is no need to worry about debt-induced bankruptcy. Therefore, the adjustment of capital by the government and state-owned enterprises takes the maximization of income (or output) as the primary principle, thereby violating the principle of profit maximization in the market economy. It is an accepted economic principle that surplus capacity is generally the outcome from maximizing income. The existence of a large number of inefficient capital projects owned by the government and state-owned enterprises gives privately-owned enterprises that maximize profits the incentive to expand their production capacity for greater profit. A large excess will inevitably affect our capital adjustment and hinder the sustainable economic growth. Therefore, setting up a sound market-based capital allocation mechanism as soon as possible will be the key to whether China can rebalance its economy away from investment and toward consumption in order to achieve the goal of sustainable economic growth.

6. Conclusions

As economic growth has slowed and overcapacity has become increasingly serious, the issue of China's economic sustainability has become a focus of attention. The government is aware of the limitations of past investment-driven models, so it is trying to transform China's economy towards a

consumption-driven model. According to economic growth theory, aside from technological progress, capital accumulation is still the main guarantee of growth. Therefore, consumption-driven growth does not mean reducing investment, but rather raising the effectiveness and rationality of investment to meet the residents' consumption needs. In theory, we need to analyze what is the most reasonable level of capital stock in China under a demand orientation, and determine how to adjust the capital to achieve it; this was the main purpose and content of this study.

In order to reflect the transformational characteristics of China's economy, this study chose the flexible acceleration model to characterize the capital adjustment. This model is put into an IS-LM framework to reflect the guiding role of demand in capital adjustment. When the output is expected, the resident consumption equation is used as a signal equation, which takes consumption as the initial driving force of the entire IS-LM system. This is the main contribution of this study, in our opinion.

The empirical results of this study show that the flexible acceleration model fits China's investments well, and the demand-oriented market mechanism of capital adjustment has been formed. However, the ability of the market to adjust capital is not sufficient, and the adjustment coefficient is only 0.22. This is far less than in developed countries, whose adjustment coefficient is up to 0.7 [21]. Even worse, the adjustment coefficient shows a decreasing trend year by year. Therefore, China's pursuit of sustainable growth driven by consumption cannot be achieved by relying solely on the adjustment of the market itself. At the same time, the calculated replacement rate of capital is as high as 0.429, indicating that China's capital is less efficient and has serious problems in relation to capital duplication, idleness, and waste. Further, this study uses the error correction model to conduct long-term and short-term comparative analyses of the investment equation, and its results show that the impact of the interest rate on the investment is not significant in the short term. This implies that although China's investment is stimulated by market demand, it also shows significant irrational short-sighted characteristics, and ignores the control of costs driven by output maximization, which in turn causes the path of capital accumulation to deviate from its long-term equilibrium. This is related to the policy tendency of soft budget constraints in China, especially for local governments and state-owned enterprises.

Therefore, in order to achieve sustained economic growth driven by consumption, China needs to make every effort to eliminate soft budget constraints. For example, the government and banks should treat state-owned enterprises the same as privately-owned ones, and the financial support for state-owned enterprises should depend on their profit. The government should also establish a corresponding elimination mechanism to allow state-owned enterprises to go bankrupt. Only in this way can enterprises consider cost factors when making investment decisions, and emphasize the goal of maximizing profits. Furthermore, it can reduce ineffective investments, enhance the rationality of the investments, and finally form a sound market-oriented capital allocation mechanism. Obviously, this is crucial for the sustainable growth of China's economy. Besides, the government can use subsidies and other measures to help residents develop green, environmentally-friendly consumption habits, and in turn motivate producers to use clean and energy-saving technologies that are conducive to sustainable development. In the end, the research in this article actually implies the assumption of constant technological progress. So, we still need to emphasize the role of innovation in sustainable growth, because only innovation can create new needs in the long run, which is true for every country.

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