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Adjustment of State Owned and Foreign-Funded Enterprises in China to economic reforms,1980s-2007: a logistic smooth transition regression (LSTR) approach

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Abstract

This paper applies a logistic smooth transition regression approach to the estimation of a homogenous aggregate value added production function of the State Owned (SOE) and Foreign-Funded Enterprises (FFE) in China, 1980s-2007. The transition associated with the economic reforms in China is estimated applying a curvilinear logistic function, where the speed and the timing of the transition are endogenously determined by the data. We find high but gradually declining markups in both SOEs and FFEs during the early stages of the adjustment, with SOEs having a much larger scale and market size than the FFEs. However, over the transition process, returns to scale in industrial SOEs dropped sharply. For both FFEs and SOEs the transition is slow, with a midpoint about 7 and 14 years, respectively. We find significant increase of TFP growth rate for both FFEs and SOEs, by 0.1436 and 0.1971, respectively.

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1 Introduction

The Government of China has employed foreign direct investment (FDI) as a key element in its development strategy since the adoption of the Open Door Policy in December 1978. Against a background of radical change, China is now estimated to be the second largest economy in the world in terms of purchasing power parity (World Bank, 2001), and since 1993, second only to the United States as a destination for global FDI. However, disentangling the effects of any one of the myriad of fundamental changes since the structural reforms is highly problematic. As a result, although foreign direct investment have played important roles in China's economic growth, few studies have systematically examined the performance of FDI, or more specifically model the development of Foreign-Funded Enterprises (FFE) in China over the past 30 years after the Open Door Policy.

This paper takes a new approach to the question. It starts from the presumption that any changes in economic performance following reforms and liberalization may be more appropriately modeled as a steady transition rather than a discrete change. A standard explicit or implicit assumption underlying linear models is that there is a single structural break in the sample. In this paper that assumption is replaced by a more general one stating that the parameters of the model may change continuously over time. In the context of China, we model the changes in development and improvements of economic performance of the FFEs following the 'Open Door' policy as a steady transition rather than a discrete change. This assumption is more reasonable than that of a structural break especially if we take into account that

it is a slow process for foreign technology and capital to adjust to and interact with domestic environment and innovative activity in creating productivity improvements. Learning of the new rules and the game, and inferring the credibility and durability of new policies is a gradual process. Thus, we adopt an estimation process where the transition starting date and the speed of adjustment to the new long run equilibrium is determined endogenously. Such a specification allows the data to determine the timing, duration and direction of the regime change.

Since China didn't open up its service sector to FDI until 2001, we only consider the industrial sector (representing about half of output), where most all of the foreign direct investment in the post-reform period goes. Our analysis is in three stages. First, together with the adoption of the value added production function, we take a novel approach, a logistic smooth transition regression (LSTR) model to modeling growth of FFEs in China, which allows us to model deterministic changes without, as other analysis have done, imposing discrete changes. The value added production incorporating the market structure parameters allow us to give an estimates of the price-marginal cost markups, returns to scales (RTS) and productivity growth of industrial FFEs. Then we compare the growth performances of FFEs with that of State Owned Enterprises (SOEs), which are estimated using the same approach. Having identified the transitions in growth of the two different ownership groups we are investigating, we then explore the coincidence of these transitions with well-documented episodes of liberalization in China. We do not formally test whether liberalization and foreign direct investment results in

growth. Our results are, however, informative in two respects. Firstly, they post a clear picture of the adjustment and development process of FFEs and SOEs in China after liberalization and FDI. Secondly, they also point the way to improved econometric modeling of these processes.

The remainder of this paper is organized as follows. Section 2 briefly discusses the economic reforms context in China against which our analysis is set. Section 3 outlines the Time Varying Logistic Smooth Transition Regression Model (TV-LSTR) and estimation methodology, and discusses some econometric issues and describes the data. Section 4 presents and discusses the estimation results. Section 5 concludes.

2 Open Door Policy and Economic Reforms in China

The Open Door Policy has been carried out for more than 20 years since the late 1970's by Deng Xiaoping. Before Deng's era, China was ruled under the radical politics-oriented and self-sustained policy by Mao Zedong, which had China's door closed in front of the foreign countries. The central government in Beijing exerted strict controls over the economy, all enterprises were publicly owned and managed, and all staff deployed according to the political and economic interests of the state. Enterprises were required to submit profits to the central government, and workers salaries were deter-

mined by the state. The term "Open Door Policy", announced by Deng in 1978, refers to the equal trading rights among countries. In 1980, four coastal cities (Shenzhen, Zhuhai, Shantou in Guangdong and Xiamen in Fujian) were designated as Special Economic Zones in order to attract foreign investment, and in 1984, this so-called open-door policy was extended to 14 coastal cities (such as Shanghai, Tianjin, GuangZhou and Nanjing) and Hainan Island. In these preferential areas, foreign investment was encouraged and new factories were established offering tax privileges, that were, reduced import tariffs on raw materials, tax exemption for importation of certain capital goods, etc. The foreign funded enterprises in these areas took the forms of Joint Owned Economic Units, Cooperative Economic Units and Foreign (or Oversea Chinese) Owned units. Later in 1986, China eventually accepted wholly foreign-owned enterprises. The Open Door Policy, which encouraged foreign investments and market liberalization, had achieved the desired effect of stimulating China's economic growth during the past three decades. China's actual and contract utilization of foreign capital are illustrated in Figure 1. Due to the lack of precedent, coupled with an uncertain political climate and other unfavorable factors, at first severely hindered Chinese attempts to attract FDI. In 1980, the flow of FDI into China totalled less than $200 million (US dollars). However, the actual utilization of FDI picked up dramatically since 1992 after Deng's famous southern tour of China reasserting his economic policy after his retirement from office, and in 2007, China received around US$75 billion [1] foreign direct investments.

[1]Data from National Statistics Yearbook of China

At the same time, efforts were made to reform poorly managed, inefficient and wasteful state-owned enterprises (SOEs). The process of SOE reform has taken over two decades, and although it is now largely complete, the effects of reform are still being felt all over China. The reform process can be divided into three stages, progressing from mild changes to fundamental overhaul. The first stage (1978-1984) is management reform during which increase economic incentives for SOEs by giving management greater autonomy. The second stage (1984-1992) of reform is the Dual Track System marked by the promulgation of the *Provisional Regulations on Expanding the Autonomy of Enterprises in May 1984*. Under the new provisions, if they exceeded their production quotas, enterprises were allowed to sell their products outside the state plan at as much as 20 percent above the state price. This was referred to the Dual Track (Plan and Market) System. In terms of personnel management, enterprises were allowed to appoint technical and mid-level staff and to hire or fire middle-level administrative staff, to offer rewards and bonuses, and to establish direct links with suppliers. At the same time, profit tax was introduced to replace profit remittance. However, enterprises still didn't have the freedom to recruit or terminate staff simply based on business considerations. The third stage (post-1992) is ownership reform. Between 1988 and 1992, SOE reform slowed due to concerns about the social and economic impact of reform, such as high unemployment, increases in the cost of living, and political unrest. However, the economic performance of the majority of SOEs remained at a very low level. It was not until Deng Xiaoping's now famous Southern Tour in early 1992 that the reform process got back on track. Deng called for an intensification of reform

and urged officials to think less about ideological correctness and more about economic development. In Deng's own words, "It doesnt matter if a cat is black or white, as long as it catches mice, it is a good cat." In July 1992, the government issued *Regulations on Transforming the Operational Mechanism of State-owned Industrial Enterprises*. These regulations allowed inefficient, under-performing enterprises to completely overhaul their structure. The government also allowed some SOEs to be leased or sold to the public or the employees.[2] The number of SOEs fell from 74,066 in 1992 to 41,125 in 2002, and then 20,680 in 2007. At the same time, industrial output increased from 1709 billion yuan ($309.9 billion) in 1992 to 11969 billion yuan ($1574 billion) in 2007.[3]

3 The Time Varying Logistic Smooth Transition Regression (TV-LSTR) Model and Estimation Issues

3.1 The TV-LSTR Model

Smooth Transition Regression Model (STR), initiated by Bacon and Watts (1971), can be seen as a generalized switching regression models in such a way that the transition from one extreme regime to the other is not discrete but

[2]See Lardy (1998) for further details on the gradual economic transition in China.
[3]Data from National Statistics Yearbook of China

smooth as a function of the continuous transition variable. The TV-LSTR model, as a member of the STR family, is a more recently developed type of STR model by Granger and Terasvirta (1993) and Lin and Terasvirta (1994), which models deterministic structural change in a time-series regression and use time t as the transition variable.

Consider the nonlinear regression model

$$y_t = x_t^{'}\varphi + (x_t^{'}\theta)S(\gamma, c; z_t) + u_t,\ t = 1, \ldots, T \tag{1}$$

where $x_t = (1, x_{1t}, \ldots, x_{qt})^{'}$ with $m = 1 + q$ is the vector of explanatory variables. $\varphi = (\varphi_0, \varphi_1, \ldots, \varphi_m)^{'}$, and $\theta = (\theta_0, \theta_1, \ldots, \theta_m)^{'}$ are parameter vectors, and $\{u_t\}$ is a sequence of i.i.d. errors. S is the well-known curvilinear logistic transition function, bounded continuously between zero and unity. Granger and Terasverta(1993, Chap. 7) define S of the form

$$S(r, c; z_t) = (1 + \exp\{-\gamma(z_t - c)\})^{-1},\ \gamma > 0 \tag{2}$$

Assuming $\gamma > 0$ [4], the transition function (2) is monotonically increasing function of z_t.[5] The slope parameter γ indicates how rapid the transition is,

[4] If $\gamma < 0$, the initial and final model states are reversed but the interpretation of the parameters remains the same.

[5] The logistic function S_t as specified here does impose certain restrictions, in that the transition path is monotonic. More flexible specifications could also be considered, which allow for non-monotonic transition paths, by including a higher order polynomial in t in the exponential term of S_t. However, this more complex specifications will lose economic sense and the advantage of straightforward interpretation of our specification. Moreover, since the number of observations available in this study is relatively small, degrees of freedom problems would also quickly arise. Therefore, we will use equation (2) as the definition of S_t for the estimation, and solve this problem by testing the flexibility of

and the location parameter c determines in which year the transition midpoint occurs. If γ takes a large value then the transition is completed in a short period of time and as $\gamma \to \infty$, the model collapses to one with an instantaneous structural break at time $t = \tau$; the smaller the γ, the smoother (slower) the transition process. Thus our model is a more general framework, which embeds the standard structural break model (the most popular alternative to parameter constancy in econometric work) as a special case, and may often be a more realistic assumption than that of a single structural break. With the transition variable z_t=t, the TV-LSTR model is testing the constancy of regression parameters against continuous structural change.

By writing (1) as $y_t = x_t'(\varphi + \theta S) + u_t$, it is seen that the model is locally linear in x_t and that the combined parameter vector $\varphi + \theta S$. If S is bounded between 0 and 1, the combined parameters fluctuate between φ and $\varphi + \theta$, and the model transition occurs smoothly between the initial and final state.

A standard explicit or implicit assumption underlying linear models is that there is a single structural break in the sample. In this paper that assumption is replaced by a more general one stating that the parameters of the model may change continuously over time. Moreover, in sharp contrast to conventional approaches to modeling structural changes, no a priori information is used to fix the date of a transition since the midpoint of the transition is determined endogenously by the location parameter c, together

model specification later based on a short sequence of nested tests as in Terasvirta (1994) and Granger and Terasvirta (1993, ch.7). Our specification survives the tests, and results are available upon requests.

with the transition speed parameter γ effectively determining the start and end points. In terms of modeling liberalization reforms, this means that we can take into account all the reforms happening after the Open Door Policy and allow the data to determine all the pertinent features of any transition in the growth performances of enterprises with different ownership – its timing, duration and direction. If any such transition is found, and it need not be, one can then refer back to the dating of a liberalization or economic reform episode, as established from policy accounts, to see whether or not there is any apparent coincidence of timing.[6]

In developing the analytical framework we follow the methodology initially advocated by Hall (1988) and extended by Harrison (1994) and Krishna & Mitra (1998). Consider a homogenous aggregate value added production function of degree θ , for the industrial sector with a certain type of ownership:

$$Y = A \cdot G(L, K) \tag{3}$$

where value added of production Y is produced with inputs, labor L and

[6]Among the few papers applying of the LSTR in International Economics and macro, see Fouquau, Hurlin, and Rabaud (2008), studying the Feldstein Horioka puzzle, and Geng (2008), studying the dynamics of output and market adjustments to trade liberalization in India using the panel smooth transition regression approach, finding that the effects of liberalization are better modelled as a smooth transition process instead of previously assumed instantaneous 'big-bang' shift just after reforms. Further Geng (2008) shows that it actually took years for the Indian firms start to react to the reforms, and the transitional impact of reforms takes approximately 4-8 years to complete, with different timing across industries. Also see Greenaway et al. (1997) for a study of the long-run growth rates in a number of developing countries which have undertaken liberalization.

capital K. A is the technology shock, $G()$ is a general functional form. Taking the logs and differentiating both sides of (3) w.r.t time gives:

$$\begin{aligned}\frac{1}{Y}\cdot\frac{dY}{dt} &= \frac{\partial G}{\partial L}\cdot\frac{L}{G}\left(\frac{1}{L}\cdot\frac{dL}{dt}\right)+\frac{\partial G}{\partial K}\cdot\frac{K}{G}\left(\frac{1}{K}\cdot\frac{dK}{dt}\right)\\ &\quad+\frac{1}{A}\cdot\frac{dA}{dt}\end{aligned} \tag{4}$$

Assuming that there is market power in the goods market but are competitive in the factor market, the resulting first-order optimality conditions imply:

$$\frac{\partial G}{\partial L}\cdot\frac{L}{G}=\left(\frac{P}{MC}\right)\frac{wL}{PY}=\mu\alpha \tag{5}$$

$$\frac{\partial G}{\partial K}\cdot\frac{K}{G}=\left(\frac{P}{MC}\right)\frac{rK}{PY}=\mu\beta \tag{6}$$

where P, w, r are the prices of output, labor, and capital respectively; MC is marginal cost; $\mu = P/MC$ is the price-marginal cost markup; α and β are labor and capital revenue shares. Combining equations (4) and (5)–(6) and expressing the result in discrete time, we get:

$$\triangle y=\mu(\alpha\triangle l+\beta\triangle k)+\triangle a \tag{7}$$

where lower case letters are log terms. To incorporate the returns-to-scale parameter (θ) into the framework we apply Euler's theorem to equation (3) and get:

$$\theta=\frac{\partial G}{\partial L}\cdot\frac{L}{G}+\frac{\partial G}{\partial K}\cdot\frac{K}{G}=\mu(\alpha+\beta) \tag{8}$$

Combining (7) and (8) we can write:

$$\triangle y^* = \mu \triangle l^* + (\theta - 1)\triangle k + \triangle a \tag{9}$$

where $y^* = \ln(Y/K)$, and $\triangle l^* = \ln(L/K)$. Equation (9) is the basic estimating equation which permits both non-competitive pricing behavior through a mark-up μ and non-constant returns to scale through a scale parameter θ.

The TV-LSTR model for equation (9) can be written as:

$$\triangle y_t^* = \mu \triangle l_t^* + \mu_l S_t \triangle l_t^* + (\theta - 1)\triangle k_t + \theta_k S_t \triangle k_t + \eta S_t + u_t \tag{10}$$

where u_t is disturbance term, and $S_t = 1/\{1 + \exp[-\gamma(t - c)]\}$ is the smooth transition function (monotonically increasing in t and lies between 0 and 1). The subscripts t is for time (year); η measures the change in productivity growth over the transition process; γ is the velocity or speed of transition; and c is the location of transition, which measures the number of years before the transition midpoint, and will be a number between 0 and total number of years T in the sample. μ_l and θ_k are the total change of markup and RTS over the transition.

3.2 Estimation Methodology and Data

Equation (10) is our final estimation equation. Since the model is highly nonlinear in parameters, to get the consistent estimates of the TV-LSTR model for equation (10), we will apply Iterated Nonlinear Least Square (ITNLS)

using a suitable iterative optimization algorithm to determine the values of the parameters that minimize the concentrated sum of squared errors, conditional on γ and c[7]. The variance matrix for NLS estimation is reestimated at each iteration with the parameters determined by the NLS estimation. The iteration terminates when the variance matrix for the equation errors change less than the preset convergence value. A practical issue that deserves special attention in the estimation of the LSTR model is the selection of starting values of the parameters in the transition function. In this paper, we apply simulated annealing[8] instead of the often used means of grid search to get the starting value of (γ, c). The (γ, c) space is then sampled more densely than in the case of a grid search, which improves the quality of the starting values. As pointed out in Granger and Terasvirta (1993, Chap. 7), while the other parameter estimates can converge quickly, that for γ may converge very slowly, particularly if the true parameter value is large (such that the transition occurs quickly). This is because a large set of estimated values of γ result in very similar values of S_t, which deviate noticeably from each other only in a local neighborhood of the location parameter τ. The practical consequence of this is that standard errors of the NLS estimate of γ may appear artificially large and should not, therefore, be taken necessarily to indicate insignificance of the estimate.

[7]Parameters are obtained by ordinary least squares at each iteration in the non-linear optimization. In case the errors are normally distributed, this estimation procedure is equivalent to maximum likelihood, (where the likelihood function is first concentrated with respect to the fixed effects μ). An appendix Gonzalez et al (2005) paper considers the properties of the ML estimator in full detail, including a formal proof of its consistency and asymptotic normality.

[8]For practical implementation, see Goffe, Ferrier, and Rogers (1994) and Brooks and Morgan (1995)

Based on the LSTR model outlined in equation (10), we are going to examine the economic performances and growth process of both the industrial enterprises funded by foreign capital or overseas Chinese from Hong Kong, Macao and Taiwan in China (FFEs)[9], and those industrial enterprises owned by state government of China (SOEs) separately. The data used in the estimation are sector level longitudinal data of different ownership from Statistical Year Book of China.

Real value added of production, labor, capital stock, and labor share of the value added of production are used in the estimation. Real value added of production are obtained by deflating the aggregate industrial sectoral value added of production of FFEs or SOEs by Industrial Sectoral Level Price Index. Labor is total number of staff and workers in manufacturing FFEs or SOEs. Real capital stock is computed by deflating annual average balance of Net Value of Fixed Assets deflated by Fix Asset Investment Price Index. The sample period covered in this study is 1980-2007 for SOEs, and 1984-2007 for FFEs. The real value added of production and real net fixed assets of both FFEs and SOEs are depicted in Figure 2. There are generally smoothly increasing trends in all series, with larger speed of increasing in later years. As illustrated in Figure 3, while the number of employees in FFEs grows faster and faster, SOEs has a significant reduction in labor force since 1999 following the dramatic SOE reforms to gain efficiency.

[9]Here FFEs include three different types of ownership funded by foreign capital: the Joint Owned Economic Units, Cooperative Economic Units and Foreign (or Oversea Chinese) Owned units.

4 Estimation Results from the TV-LSTR Model

4.1 Goodness of Fit of the TV-LSTR Model

The convergence criteria we set to the ITNLS estimation is 0.001 and has been met, which means all the estimates converge. The estimation results on the TV-LSTR Model from equation (10) are presented in Table 1. Asymptotic heteroscedasticity-consistent standard error are given in parenthesis. R^2 of model estimations for FFEs and SOEs are 0.377 and 0.482, respectively, which show overall good fit of the model.

To test the null hypothesis of constancy of parameters (linearity) against the smooth transition alternative, we cannot rely on the standard likelihood ratio test for the restriction $\gamma = 0$. This is because under this null the parameters μ_l, θ_k, η and c are no longer identified. However, a valid Lagrange Multiplier (Fisher) test[10] of this hypothesis, which is based on a two-step approach proposed by Davies (1977), has been suggested by Lin and Terasvirta (1994). This test procedure first assume that the logistic function S_t can be adequately approximated by a polynomial function of t up to some order k, say, via a Taylor series expansion. Next, the residuals from the model under

[10]They are not Lagrange multiplier statistics but are related in the sense that testing does not require the estimation of equation under the alternative. Furthermore, the tests can be carried out by means of a simple auxiliary regression. Hence, following Lin and Terasvirta (1994) we also call them 'LM type' tests, and they recommend the use of the F statistic in practice.

the null hypothesis (which assumes constant parameters) are constructed, together with the residual sum of squares which we denote as SSR_0. These residuals are then regressed on the same regressors in the model in the first step together with additional regressors which are polynomial terms in t up to order k. If we denote the SSR from the second regression as SSR_1, the Lagrange multiplier (Fisher) test statistic can be written as:

$$LM_F = (SSR_0 - SSR_1)/(SSR_0/T) \tag{11}$$

Given standard regularity conditions LM_F has an asymptotic $\chi^2(k)$ distribution under the null hypothesis of constancy of parameters. For our purposes, following Greenaway et al. (1997), we assume a first-order Taylor-series approximation of S_t is adequate, requiring that polynomial terms in t up to the third order are included in the second regression[11] Therefore the LM_F statistic here follows a $\chi^2(3)$ distribution under the null hypothesis of parameter constancy over time, and the critical value for $\chi^2(3)$ distribution is 7.81 under the 5 percent significance level. The reported LM_F test values in (1) for both ownership types are significant at the 5 per cent level, suggesting that for both FFEs and SOEs evidence of nonlinear transition of parameters is present. Moreover, all estimates survive the diagnostic checks and model specification tests, which means no remaining heterogeneity in the error term and enough flexibility of our specification of transition function and the results of which are available upon request.

[11]For $k = 3$ the transition function (change) need no longer be monotonic in t, and rather different types of structural change if existing can be captured by the third-order Taylor-series expansion.

4.2 Estimation Results

Based on the mark-up, scale, and transition parameter estimates from Table 1 the time-series smooth transition behavior of the mark-up and scale parameters is plotted in Figures 4 and 5. As shown in Figure 4, the initial mark-ups vary substantially between industrial FFEs (6.3) and SOEs (15.9) during the earlier years after the Open Door Policy, and generally linked to the level of protection and the level of labor cost. Moreover, they are all values significant and much higher than unity, which reflects the market reality of lack of competition and the privileges enjoyed by both FFEs (e.g.: tax and tariff break) and SOEs in China at the beginning of the reforms. the change of markup μ_x for both ownerships are negative, but only significant for FFEs, which provide strong evidences of increase in competition, which pushes down the markup and make it possible for China to get welfare gains from reduction of dead weight losses by increasing competition and lower markups. After the 30-years transition, although the price marginal cost ratios converge a bit, it seems that the SOEs are still enjoying more privileges in terms of competitiveness of market than FFEs.

As illustrated in both Table 1 and Figure 5, the initial scale parameter $\theta - 1$ are all positive and significant, with SOEs having a much larger scale and market size. However over the transition process, returns to scale in industrial SOEs dropped significantly by -2.7829 with their market size shrinking significantly.

As shown in Table 1, the transition speed parameter γ for both FFEs

and SOEs are relatively small numbers, 86.5 and 0.4017 respectively, with the transition process of SOEs appearing to be much more gradual than that of FFEs. Importantly, however, none of transitions appear to occur in an instantaneous fashion (which would be associated with a very large estimated value of γ). This, therefore, raises rather serious doubts about the ability of models which only permit discrete structural breaks, as typically employed in other studies, to capture the features of transition of industries or sectors. Especially, as outlined in Figure 4, it took 6 years for the industrial FFEs to start to transit, and this reflects the FFEs' initial difficulties of adapting themselves to the environment in China. However, Figures 4 and 5 also show that the transition of FFEs happened in a faster pace from a pre-reform to a post-reform era, and reached its transition midpoint around the year 1991-92. In comparison, though the transition of SOEs started earlier, the transition midpoint for it happened in the later year around 1994.

The good news for both FFEs and SOEs are the significant increase of TFP growth rate by 0.1436 for FFEs and 0.1971 for SOEs, respectively. This means that after the painful SOEs reforms, SOEs did have some efficiency gains, and are significantly more productive. For FFEs, it is indeed a slow process for foreign technology and capital to adjust to and interact with domestic environment and innovative activity in creating productivity improvements. To look at the transition of TFP growth rate closer and in more details, we impute the TFP growth rate[12] for both FFEs and SOEs based on

[12]Here TFP growth is calculated using the relevant Tornquist index number formula with markup μ and θ incorporated in the definition:

$$TFP = [\ln Y_t - \ln Y_{t-1}] - \mu[\alpha(\ln(L/K)_t - \ln(L/K)_{t-1})) + (\theta/\mu - \alpha)(\ln K_t - \ln K_{t-1})].$$

our estimates, and graph them in Figure 6. The fact that the change of TFP growth rate during the transition seems to be higher with the SOEs is partly due to the fact that they were much less efficient to start with. Although overtime both FFEs and SOEs improved their efficiency, not only the starting point of TFP growth rate of FFEs was higher than that of SOEs, but also did TFP of FFEs increase with a higher speed than that of SOEs all the times throughout our sample period.

4.3 Comparison of the Estimated Timing of Transition and the Timing of Major Policy

Together with γ, estimated parameter c shown in Table 1 give us a good idea of the timing of the transition. After taking log difference, there are 23 sample points (years) in the sample for FFEs, and 27 for SOEs. Hence the total number of years T for the FFEs sample equals to 23, and 27 for SOEs. Therefore the transition mid-point for FFEs happened around 1992, and 1994 for SOEs. These coincide with Deng's famous southern tour of China in the spring of 1992, which brings the Open Door Policy in a much deeper level and was the starting point of ownership reform of the SOEs . To reassert his economic agenda, he visiting Guangzhou, Shenzhen, Zhuhai and spending the New Year in Shanghai, in reality using his travels as a method of reasserting his economic policy after his retirement from office. On his tour, Deng made various important speeches and generated large local support for his reformist platform. He stressed the importance of economic construc-

where $\alpha = (1/2)(\alpha_t + \alpha_{t-1})$.

tion in China, and criticized those who were against further economic and openness reforms. Deng called for an intensification of reform and urged officials to think less about ideological correctness and more about economic development. While this does not constitute a formal test of the relationship between policy reforms and growth, rather it is an attempt to see whether there are any obvious associations, and examine the goodness of fit of the model.

5 Conclusions

This paper illustrated the usefulness of the Smooth Transition Regression approach in tracing the adjustment to reforms in China. The flexible smooth transition methodology helps in identifying the speed of the adjustment in the various sectors of the economy, and should be useful in estimating the adjustment process to policy changes in other countries. The transition associated with the economic reforms in China is estimated applying a curvilinear logistic function, where the speed and the timing of the transition are endogenously determined by the data. We find high but gradually declining markups in both SOEs and FFEs during the early stages of the adjustment, with SOEs having a much larger scale and market size than the FFEs. However, over the transition process, returns to scale in industrial SOEs dropped sharply. For both FFEs and SOEs the transition is slow, with a midpoint about 7 and 14 years, respectively. We find significant increase of TFP growth rate

for both FFEs and SOEs, by 0.1436 and 0.1971, respectively. In interpreting the results, one should keep in mind that aggregation issues and imprecise data affect adversely the quality of the results. Thus, while the trends of the markups and productivity identified in our study are reasonable, one should take the point estimates of the various parameters with a grain of salt. Another challenge facing our study is that the reform process in China is gradual, and policies in China have been modified sequentially. Hence, the gradual transition may reflect both gradual adjustments to a given reform, and the sequential nature of the reform process in China, when every several years new initiatives are adopted. Dealing with these challenges requires better disaggregated data, and is left for future research.

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Table 1: Estimation Results from the TV-LSTR Model

Industrial Sector by Ownership Type	Foreign-Funded Enterprises 1984-2007	State Owned Enterprises 1980-2007
μ	6.2923***	15.9385**
	(1.6999)	(7.5227)
μ_l	-5.3998*	-13.63
	(2.8150)	(1.6743)
$\theta - 1$	0.5687***	2.6965 **
	(0.0891)	(1.0624)
θ_k	-0.0805	-2.7829*
	(0.2858)	(1.3617)
η	0.1436**	0.1971**
	(0.0584)	(0.0696)
γ	86.5000	0.4017
	(73.15)	(0.4906)
c	6.9544***	13.7985 ***
	(0.0000)	(1.6743)
R^2	0.3770	0.4822
LM_F	14.2	15.9
N	23	27

[a] Asymptotic heteroscedasticity-consistent standard error in parenthesis.
[b] Two-sided statistical significance at the 1 percent, 5 percent and 10 percent levels are marked by ***, ** and *, respectively.
[c] As pointed out in Granger and Terasvirta(1993, Chap. 7), while the other parameter estimates can converge quickly, that for γ may converge very slowly. This is because a large set of estimated values of γ result in very similar values of S_t, which deviate noticeably from each other only in a local neighborhood of the location parameter τ. The practical consequence of this is that standard errors of the NLS estimate of γ may appear artificially large and should not, therefore, be taken necessarily to indicate insignificance of the estimate.

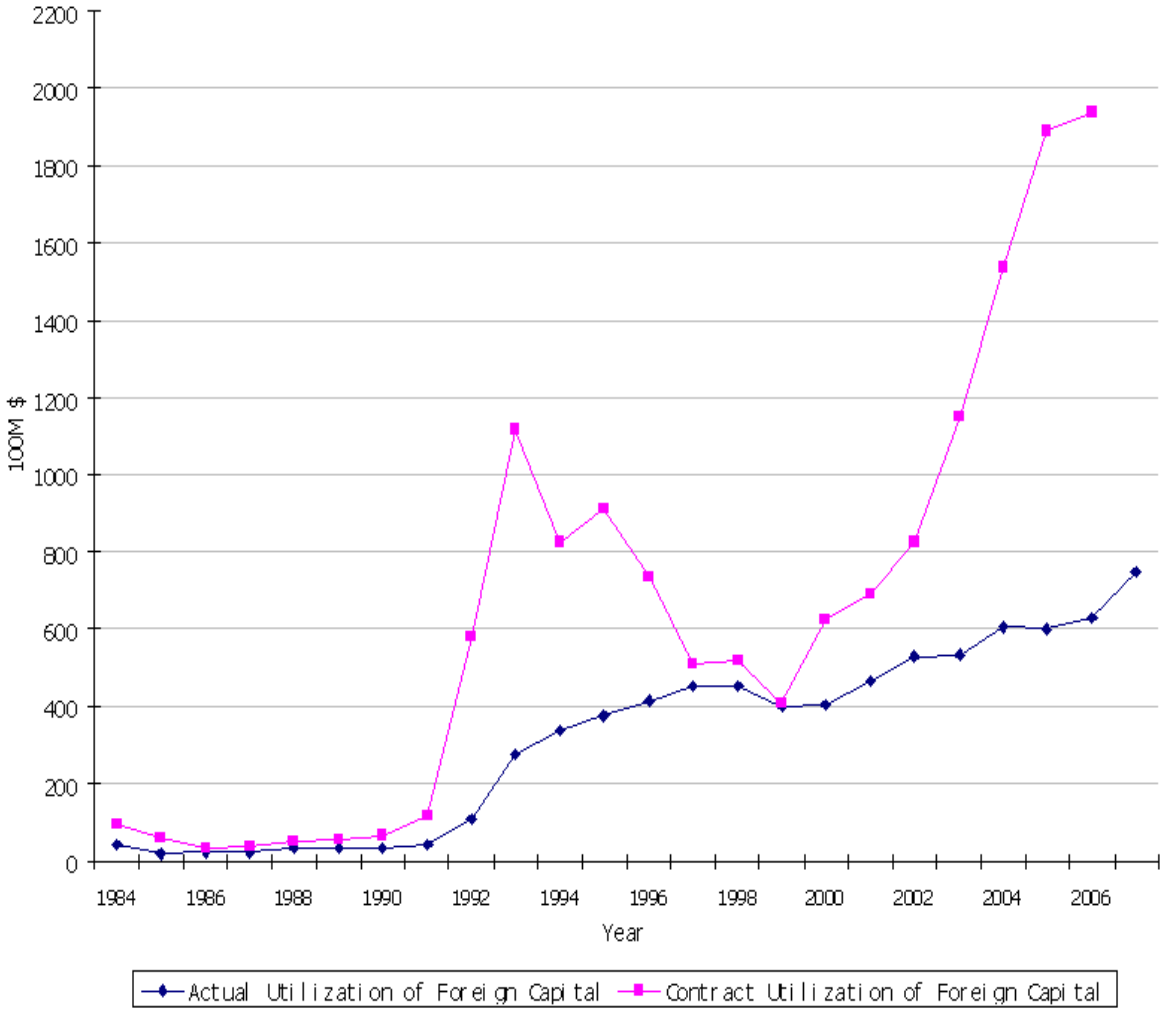

Figure 1: Utilization of Foreign Capital

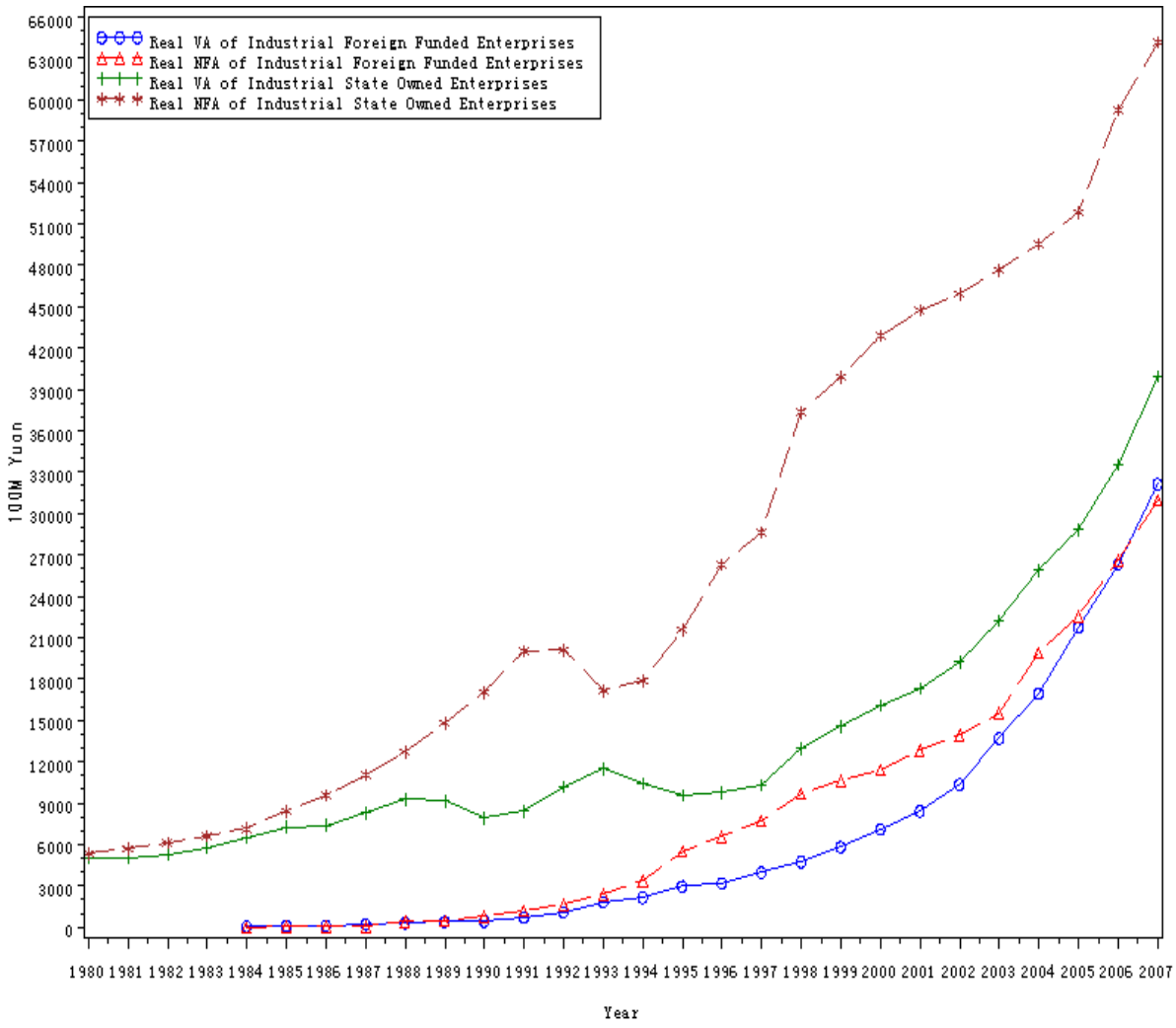

Figure 2: Real Value Added of Production and Real Net Fixed Assets in Industrial FFEs and SOEs

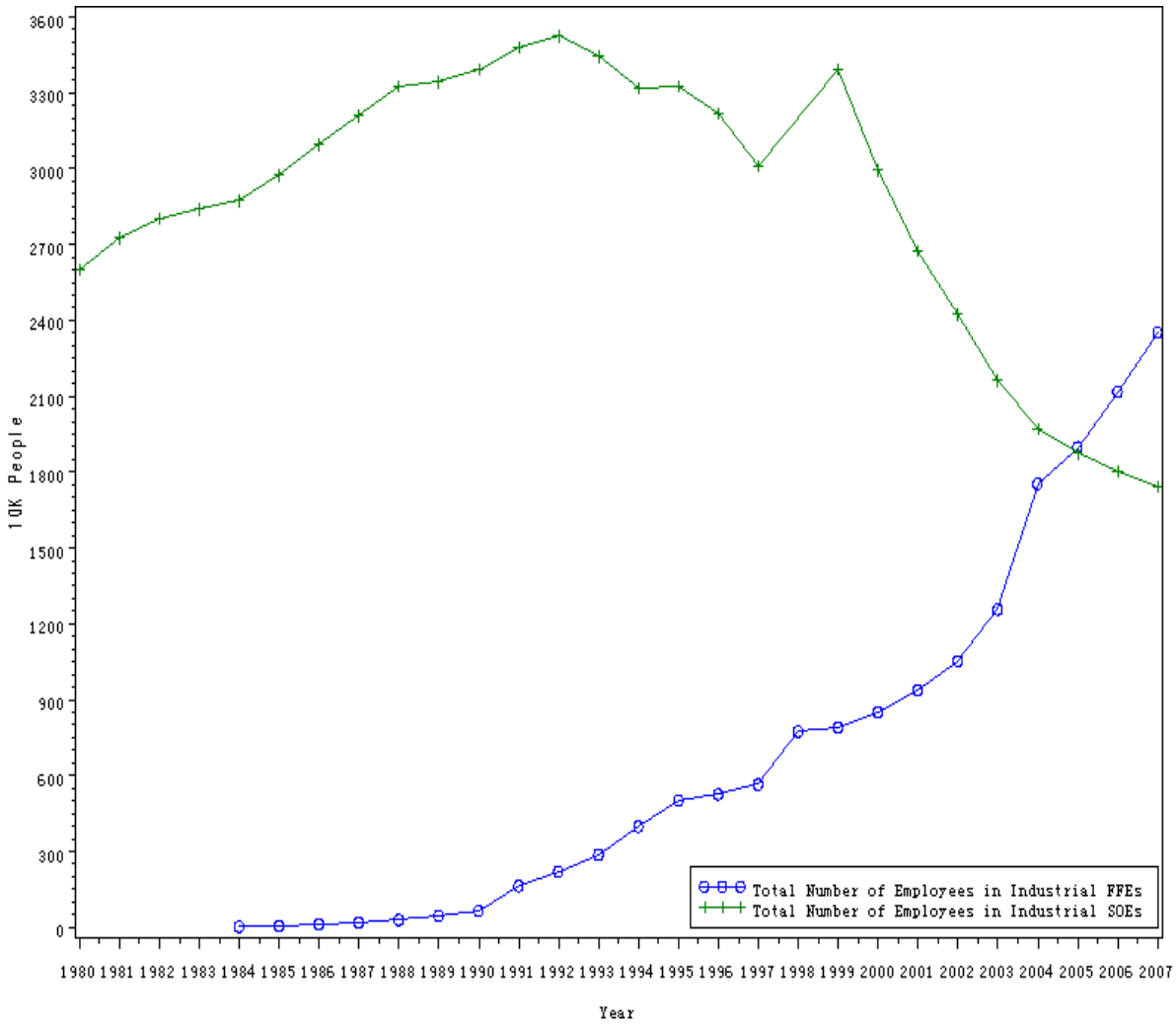

Figure 3: Total Number of Employees in Industrial FFEs and SOEs

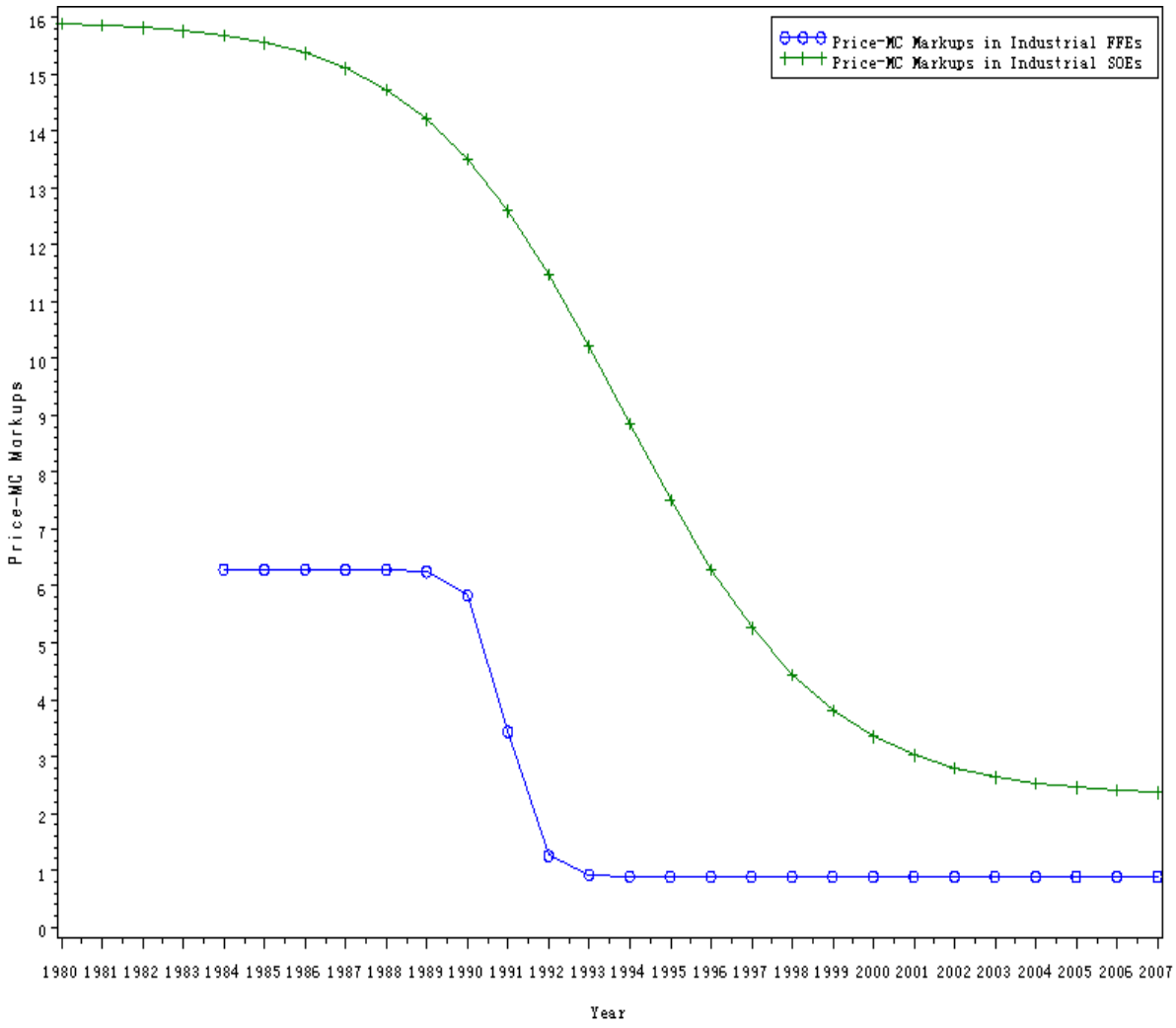

Figure 4: Estimated Price-Marginal Cost Markups of Industrial FFEs and SOEs

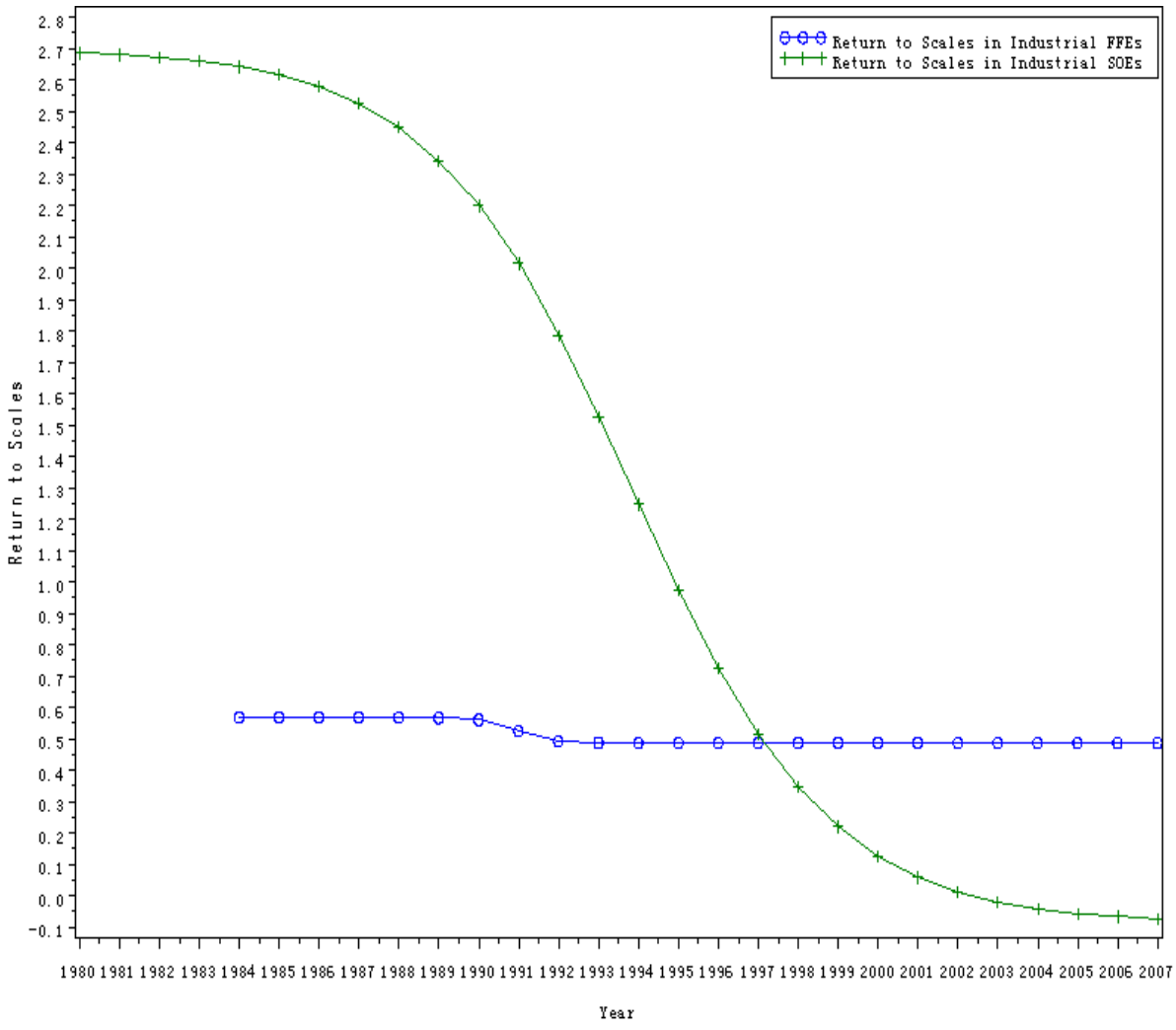

Figure 5: Estimated Scale Parameters of Industrial FFEs and SOEs

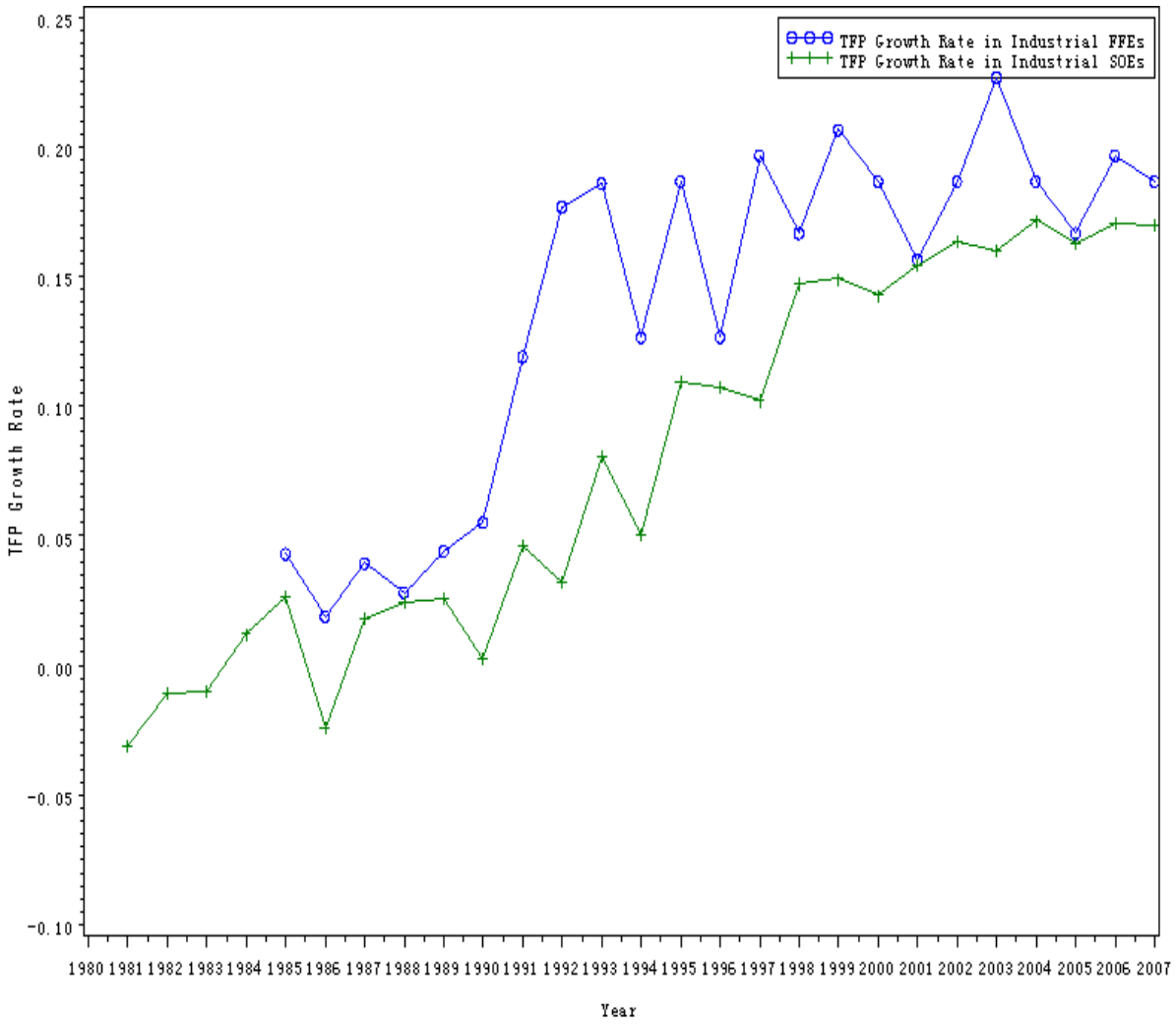

Figure 6: Total Factor Productivity Growth Estimates of Industrial FFEs and SOEs