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Effects of Government Policy Changes on the Private Sector Development in a Transitional Economy: A Long-run Analysis

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The purpose of this paper is to investigate the long-run effects of government policy changes on the private sector development in a transitional economy. The policy changes include (i) increases in the nominal interest rate on deposits in the state banking system, (ii) increases in the tax rates on labor income and corporate income, and (iii) implementation of further enterprise reforms in the state sector. The private sector development is measured by the size of the sector, its labor employment share, investment share, and output share in the economy. Interestingly, our results suggest that an increase in the nominal interest rate on bank deposits will hinder the development of the private sector; while an increase in the effective labor income tax may enhance it.

I. Introduction

After 19 years of economic reform, the Chinese economic structure has been drastically changed. In 1978, just before the reform began, the total output produced by the state-owned enterprises accounted for 78 percent of China's industrial output. However, by the end of 1990, it accounted for roughly 50 percent of industrial output. If agricultural and service outputs were included, the state share of China's GDP was less than 25 percent (The Economist (1992)). The gradual but substantial decline of the state sector has been accompanied by a rapid expansion of the non-state sector, which is one of the most important factors contributing to China's impressive economic growth performance of the past 19 years.[1]

As one of the sectors with non-state ownership, the private sector (referred to as "individual economy" in China) has made substantial contributions to the economic growth in China. First, the private sector created new employment opportunities for the rapid-growing labor force and absorbed labor force reallocated from other sectors. Labor employment by the private firms in the industrial sector increased from 16 million in 1990 to almost 30 million in 1994 (China's Industrial Development Report (1996)). Moreover, the sector contributed to improvement of the nation's economic efficiency

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1. While undergoing a fundamental transformation, the real GDP in China grew at an average annual rate close to 10%.

in two ways. Being smaller in size and subject to fewer regulations than their counterparts in the state sector, the private firms enjoyed more flexibility in altering their production structures. As a result, they have been very successful in coping with the fast-changing economic environment and in developing products. The industrial production share of private business increased from zero percent in 1978 to almost 10 percent in 1995 (China Statistics Yearbook (1996)). Furthermore, through market competition, the private sector squeezed profits of the state sector and thus put more pressure on those inefficient state-owned enterprises to improve efficiency. As Singh, Ratha and Xiao (1993) find that large provincial shares of non-state industrial output are associated with higher levels of total factor productivity in the state industrial sector.

Now, as another round of reforms have been initiated in China, it is anticipated that the private sector will continue to make significant contributions to the future development of the economy. Thus, how rapidly the sector is able to grow will exert a great impact on the Chinese economy. As such, it is important to know how government policies will influence the development of the sector. The objective of this study is to investigate how government policy changes affect the development of the private sector in the transforming Chinese economy. The development of the private sector, in comparison to Eastern European and Soviet economies, has been relatively gradual in China. When economic reforms were initiated in 1978, the original objective of encouraging the development of the private sector was limited to solving the serious unemployment problem created by the return of the young intellectuals to the cities from rural areas after the Cultural Revolution. However, the private sector has continued to boom rapidly even after this objective was met. With industrial reforms in the state-owned enterprises, more and more workers have had to leave the state sector. Part of these unemployed labor resources have been gradually taken up by the private sector.

In the early 1980s, the only private businesses that legally allowed were those operated by an individual or a family.[2] This type of private businesses have been governed by a set of regulations promulgated by the State Council in 1981, 1983, 1984, and 1987.[3] Each of them was allowed to hire only one or two helpers and several apprentices, and the total number of employees cannot exceed seven. While the private sector grew at a fast pace, the employment restriction seriously affected the expansion and development of successful private firms in the sector. For that reason, the State Council promulgated regulations governing private enterprises (referred to as *siying qiye* in Chinese) in 1988. A private enterprise is defined as a profit-making economic entity that employs at least eight persons with its assets owned by private individual(s). It may be in the form of a sole proprietorship, partnership, or limited liability company. These private enterprises

2. Such businesses are known as *geti hu* in Chinese which literally means individual households.

3. The four sets of regulations are : 1) "Some Policy Provisions of the State Council on Urban Non-Agricultural Private Economy" (July 7, 1981); 2) "Supplementary Provisions to Some Policy Provisions of the State Council on Urban Non-Agricultural Private Economy" (April 13, 1983); 3) "Some Provisions of the State Council on Rural Industrial and Commercial Businesses" (February 27, 1984); 4) "Interim Regulations on the Administration of Urban and Rural Individual Industrial and Commercial Households" (August 5, 1987).

are also allowed to set up joint ventures with foreign corporations. By removing the restrictions on the scope of private business, these new regulations have provided more growth opportunities of the private sector.

According to China's Industrial Report (1996), private firms in China have the following three characteristics. First, more than 50 percent of them engage in light manufacturing industries. Second, the size is small with an average employment of about 15 workers in each firm. Third, most of them are managed by their owners. Compared with the state-owned enterprises which are constrained by numerous government rules and regulations on allocating inputs and distributing their outputs, private firms enjoy much more flexibility in their operations and decision-making. Owners of private firms find it easier and less costly to monitor productivity and efficiency, which are the two common important problems in the state-owned enterprises (Byrd and Lin (1990), Weitzman and Xu (1993), Yusuf (1993a, b)).

However, there are some difficulties faced by the private business in China. According to a survey on private entrepreneurs in China conducted by the Chinese Academy of Social Sciences in 1995, private businesses are faced with a scarcity of resources and institutional support. Unlike state-owned and collective enterprises, private businesses do not enjoy any institutional privileges or special assistance from the central or local governments. Insufficient capital poses major difficulties for private businesses. In the absence of a liberalized financial market, the allocation of financial resources is mainly carried out by the state banking system. Since state banks generally offer loans more on the basis of political considerations than on economic ones, private businesses have difficulties in obtaining loans from the government-owned banking system (McKinnon (1994)). The 1995 survey indicated that the three major sources of initial business capital for private enterprises are personal savings, loans from friends or relatives, and personal loans from other people. Only 11.8 percent of business owners reported that their primary source of capital came from the banking system. Even for those established private enterprises, the percentage of capital borrowing from banks has remained low.

As the economic structure in China is far from being comparable to those existing in the advanced market economies, theoretical models developed to evaluate government policies of western economies are not immediately applicable to the Chinese case. We must modify the existing analytical framework in such a way to provide a sufficiently close characterization of the transforming Chinese economy. The model developed in this study incorporates the following major institutional features of the economy. By the nature of ownership, there are two sectors: a state sector and a private sector, with the latter being more efficient in production and learning by doing.[4] In the real sector, markets are liberalized. However, the financial sector is monopolized by the government, which sets interest rates for on financial assets and decides to whom bank loans are allocated.[5] The enterprises in the state sector face soft budget constraints - getting subsidies

4. Jefferson *et al.* (1992) show that the growth rate of total factor productivity of state-owned enterprises is lower than that of other types of enterprises in the 1980s.

5. Allsopp (1995) describes how credit plans are determined and implemented in China.

from the government through bank loans with low interest rates. The private sector faces hard budget constraints - depending mainly on its internal sources of finance for capital investment.[6] Given insufficient tax revenue, the government's deficit is financed by endogenously determined money creation.[7]

A dynamic general equilibrium model is constructed in this paper. The model has the following three sets of attributes. First, it is an overlapping generations model featuring endogenous growth. Externalities or learning-by-doing are introduced to the production technologies, which makes sustained growth feasible through a combination of increasing social returns and diminishing private returns to capital.[8] Second, money is introduced into the model by assuming that there are cash-in-advance constraints on the purchases of the consumption and capital goods. As the government finances its budget by collecting tax revenue and printing money, the quantity of money being circulated in the model economy is endogenously determined. Third, by ownership, there are a state sector and a private sector. The enterprises in the state sector face soft budget constraints, being subsidized by the government through bank loans with low interest rates, while the private sector faces hard budget constraints, depending on its internal source of finance for capital investment. Each of the individuals in the private sector is endowed with a production project, which has a productivity parameter distributed over the unit interval. They may choose to be entrepreneurs and start their own production. The decision depends on the rate of returns to their capital investment, which is endogenously determined in the model.

By using the general equilibrium model, we can investigate how the private sector development is affected by different government policies.[9] First, we show that an increase in the interest rate on bank deposits, an important policy instrument of macroeconomic control in China,[10] can exert a negative effect on the private sector development. Second, we study how changes in effective tax rates[11] affect the private sector development. Our results indicate that the a rise in the corporate income tax rate retards the private sector development while an increase in the labor income tax may enhance the development of private sector. Third, we show that the productivity improvement in state-owned enterprise,[12] which may be the result of the enterprise reform in the state sector,[13] can

6. See McKinnon (1994) for discussions.
7. Feltenstein and Farhadian (1987) show that changes in money supply for the period of 1954-1983 can be explained by : 1) the government deficits, 2) procurement payments to farmers, and 3) the wage bills of government and state-owned enterprises.
8. These are "spillover externalities" considered by Romer (1986), and Bencivenga and Smith (1991, 1993).
9. We only perform a positive analysis to see how the development of the private sector will be affected by the government policies. We are not going to derive the first-best solution which must be based on the specification of an objective function.
10. As a policy tool to cut down the inflation rate, the interest rate was increased in 1988, 1989 and 1993.
11. A fiscal reform has been proposed to raise the tax revenue by increasing the effective tax rates (McKinnon (1994)).
12. The continuous improvement of total factor productivity in the state sector is shown by Chen *et al.* (1988) Jefferson *et al.* (1992), and Jefferson and Rawski (1994).
13. See Groves *et al.* (1994).

slow down the private sector development.

The rest of the paper is organized as follows. Section II describes the economic environment and the general equilibrium of the model economy. Section III provides the major results and intuitions. Section IV concludes the paper by discussing the policy implications.

II. The Model

1. Agent and Preferences

Consider the following economy where time is discrete and infinite, indexed by $t = 0,1,2,3,\cdots$. The economy is inhabited by an infinite sequence of overlapping generations of individuals. At the beginning of each period, individuals of measure one are born. The individuals live for three periods. When young, each of them is endowed with a single unit of labor and inelastically supplies it to a perfectly competitive labor market, where W_t is the nominal wage rate prevailing in period t.[14] Using the labor income earned, the young individuals make their portfolio decisions at the end of the first period of their lives. At the end of the second period of their lives, the middle-aged individuals collect returns from their portfolios. When they are old, the individuals do nothing but consume their wealth.

The individuals of the same generation are heterogeneous in their ability to organize production processes (i.e., setting up and managing individual firms for commodity production). That is, each young individual is endowed with a non-transferable production project and has the potential to become a producer. Thus, in each period, there is a continuum of production projects. Individual i of generation t can be characterized by a distinct productivity parameter θ_t^i which is distributed over the unit interval, (0, 1). The distribution of the productivity parameter, θ_t^i, is characterized by a time invariant distribution function $F(\theta_t^i) = \theta_t^i$ with density function $f(\theta_t^i) = 1,\ \theta_t^i \in (0,1),\ \forall t$. It is assumed that value of productivity parameter for every individual is common knowledge in the economy.

The individuals of all generations have identical preferences about consumption. For simplicity, it is assumed that individuals value consumption only when they are old. The preferences of agent i of generation t are characterized by the utility function

$$U_t^i(C_t^i, C_{t+1}^i, C_{t+2}^i) = C_{t+2}^i, \qquad \forall t \geq 1, \tag{1}$$

where C_{t+j}^i, $j = t, t+1, t+2$, are the consumption of this agent in period j. Since

14. Even though in the state sector wage rates are determined administratively, they can be viewed as if they are determined by the market. This is because since 1979 the growth rates of wages in the sector have been maintained at the same level as those in the non-state sector, which are determined in the labor market. See Brandt and Zhu (1995) for detailed discussion as to how and why.

the individuals value consumption only when old, they save their labor income made in the first period of their lives by making financial and/or physical investment in the second period of their lives. Further, because consumption must be paid in cash, old individuals finance their consumption by the cash balance carried over from the second period of their lives.[15]

2. Production and Production Technology

There are two types of commodities being produced in the economy: a non-storable consumption good and a capital good. The markets for trading the two types of commodities are perfectly competitive. The nominal prices of the capital good and consumption good in period t are denoted by P_t^k and P_t, respectively. The capital good is produced by an investment technology, which converts one unit of consumption good into one unit of capital good without using the inputs of labor effort. Thus, the nominal prices of the two goods are always equal, $P_t^k = P_t$. For simplicity, it is assumed that the capital good depreciates completely after the production processes have been completed.

Production of the consumption good requires the inputs of both capital and labor. In order to produce the consumption good in period $t+1$, firms must install the capital good at the end of period t. It is assumed that the capital good must be paid when purchases are made but workers are paid only after the production processes are completed. That is, there exists a cash-in-advance (liquidity) constraint on hiring capital but not on hiring labor.

By the nature of ownership, there are two types of producers in the economy: private firms and state-owned enterprises. The private firms are assumed to have no access to external funds.[16] For these firms, the production function of the project owned by agent i of generation t who produces the consumption good in period $t+1$ is given by

$$\begin{aligned} Q_{it+1}^i &= Q(\theta_j^i, k_{it+1}, l_{it+1}, H_{t+1}) \\ &= A\theta_j^i k_{it+1}^{\sigma} l_{it+1}^{1-\sigma} H_{t+1}^{1-\sigma}, \quad A>0,\ \sigma \in (0,1),\ \theta_j^i \in (0,1). \end{aligned} \tag{2}$$

15. Initial conditions of the economy are specified as follows. In period 1, there is an initial old generation, which is endowed with M_0 units of fiat money, and an initial middle-aged generation, which is endowed with a continuum of production projects of measure one and a capital stock of k_1^i units. The initial old generation lives and consumes only in period 1. Each member of this generation has preferences represented by $U_1^{-1}(C_{i1}^{-1}) = C_{i1}^{-1}$, where C_{i1}^{-1} is the consumption of the initial old agent i in period 1. The initial middle-aged agents live for two periods and consume only in period 2. They have identical preferences characterized by the following utility function $U_2^0(C_{i2}^0) = C_{i2}^0$, where C_{i2}^0 is the consumption of the initial middle-aged agent i in period 2.

16. This is to capture the fact that in the transforming economies, farmers and small-scale, privately-owned firms are subject to very hard budget constraints and have to self-finance their investment. See McKinnon (1992) for a detailed discussion.

That is, the output level of the consumption good of this private firm, Q^i_{it+1}, depends on the firm-specific inputs of capital, k_{it+1}, and labor, l_{it+1}, on the firm-specific productivity parameter, θ^i_t, on the economy-wide productivity parameter, A, and on the economy-wide level of technology, H_{t+1}. The level of technology, H_{t+1}, in the economy has a positive external effect on the production of the consumption good of each individual firm.

Note that the production projects of the individuals differ in productivity and only those whose productivity parameters are sufficiently high will start their own business. Thus, the number of individuals who will set up their own firms is endogenously determined in the model; and the measure of the private firms is always less than one.

In each period, there is a continuum of state-owned enterprises (with measure one and indexed by a superscript s) in the economy. Given that these firms are under total control of the government, they submit their profits to the government at the end of each period. Each of these enterprises has access to the following production technology,

$$\begin{aligned} Q^s_t &= Q^s(\theta^s_t, k^s_t, l^s_t, H_t) \\ &= A\theta^s_t k^{s\sigma}_t l^{s1-\sigma}_t H^{1-\sigma}_t, \qquad A>0,\ \theta^s_t \in (0,1),\ \sigma \in (0,1), \end{aligned} \tag{3}$$

where the output level of a representative state-owned enterprise, Q^s_t is a function of the firm-specific inputs of labor l^s_t, and the capital good, k^s_t, the productivity parameter of the state-owned sector, θ^s_t, the economy-wide productivity parameter, A, and the level of technology of the economy, H_t. Note that the state-owned enterprises share a common productivity parameter, θ^s_t, which is introduced for capturing the differences in efficiency between the state-owned enterprises and the private firms.

3. Evolution of Technology

The economy-wide level of technology, H_t, evolves over time. It is assumed that H_t is determined by the aggregate capital stock of the private sector in period t, and the capital accumulation of the state sector has no effect on the economy-wide level of technology.[17] That is, only the augmentation of the capital good in the private sector can generate a positive external effect on the productivity of the whole economy. Formally,

$$H_t = \frac{\int_0^1 \theta^{i-1}_t k_{it} d\theta^{i-1}_t}{\theta_t}, \tag{4}$$

17. This specification is meant to capture the fact that the private sector is relatively more efficient than the state sector in learning by doing (e.g., adapting to a fast changing environment and adopting modern technologies and advanced management techniques) in China.

where θ_t is the measure of private firms in period t, which is an endogenous variable. Note that $\theta_j^{t-1} k_{jt}$ can be interpreted as measuring the capital input of private firm j in terms of "efficiency units". The evolution of technology is driven by the average of the efficiency units of capital inputs of all private firms in operation. The strength of the positive external effect depends on the firm-specific productivity parameter, θ_j^{t-1}.

4. The Financial Sector and Fiscal Arrangement

In the economy, there are two types of financial assets: money and bank deposits. The government monopolizes the allocation of financial resources by controlling the banking system through a central bank. At the end of period t, the commercial banks accept deposits from individuals and make loans to state-owned enterprises. Once made, bank deposits cannot be withdrawn until the end of the next period. Since there is a cash-in-advance constraint on the purchases of the consumption good and bank deposits will be illiquid for one period, at the end of period t, only the young individuals will deposit their labor income into the commercial banks.

At the end of period t, banks accept bank deposits from savers, D_t, and make bank loans to the state-owned enterprises, B_t^s. Thus, the liquidity constraint faced by the state-banking system is $D_t \geq B_t^s$. The nominal interest rates on bank deposits and loans are denoted by i_t^d and i_t^L, respectively. The state banking system will receive the loan repayment, $B_t^s(1+i_t^L)$, and pay out the deposit accounts, $D_t(1+i_t^d)$, at the end of period $t+1$. The interest rate on loans i_t^L is set so low that there is an excess demand for bank loans. A positive interest rate on deposits, i_t^d, implies that the liquidity constraint always binds; that is, $D_t = B_t^s$.

The government subsidizes the state-owned enterprises by offering bank loans with interest rate which is lower than the deposit interest rate, i.e. $i_t^L < i_t^d$. It follows that the repayments from the state-owned enterprises, $B_t^s(1+i_t^L)$, received by the banks are not sufficient to pay out the savings deposit accounts, $D_t(1+i_t^d)$. A the end of period $t+1$, the government has to finance a loss of the state banking system of $B_t^s(i_t^d - i_t^L)$ units of money.

The government obtains revenues from the two types of taxes levied on residents: the labor income tax and corporate profit tax, the tax rates are denoted by τ^l and τ^c, respectively. It is assumed that only private firms are subject to the corporate profit tax. The state-owned enterprises are not subject to any taxes, but they must submit all of their profits to the government. The tax revenue collected in period $t+1$ is

$$T_{t+1} = \tau^l W_{t+1} + \tau^c \Pi^p_{t+1}, \tag{5}$$

where $\Pi^p_{t+1} \equiv \int_0^1 (P_{t+1} Q^i_{gt+1} - W_{t+1} l_{gt+1}) d\theta^i_g$ is the aggregate profit of the private sector.

Let Q_{t+1} denote the government budget deficit in period $t+1$, which is defined as the difference between the government's total current spending, $B^g_t(r^M_t - r^L_t)$, and its total revenue, $\Pi^g_{t+1} + T_{t+1}$.[18]

$$Q_{t+1} \equiv B^g_t(r^M_t - r^L_t) - \Pi^g_{t+1} - T_{t+1}. \tag{6}$$

The government can finance its budget deficit by printing new money, $M_{t+1} - M_t$, where M_t and M_{t+1} are the end-of-period money stock of the economy in period t and $t+1$, respectively. The growth rate of the money supply in period $t+1$ is μ_{t+1}, which is defined as $1 + \mu_{t+1} \equiv \frac{M_{t+1}}{M_t}$.[19]

In period $t+1$, the government's budget constraint is given by

$$(M_{t+1} - M_t) = Q_{t+1} = B^g_t(r^M_t - r^L_t) - \Pi^g_{t+1} - T_{t+1}. \tag{7}$$

III. Optimization, Equilibrium, and Balanced Growth

1. Optimal Portfolio Decisions of Young Agents

Let us consider the individuals' optimization problem first. Each individual is subject to the technology constraint, the budget constraint, and the nonnegative constraints. At the end of period t, taking as given the nominal price of the capital good, P^k_t, the nominal wage rate, W_{t+1}, the nominal price of the consumption good, P_{t+1}, the interest rates r^M_t, and the tax rates τ^c and τ^l, the individual i of generation t chooses k_{gt+1}, l_{gt+1}, and D_{gt} to solve the following optimization problem.

$$\max_{k_{gt+1}, l_{gt+1}, D_{gt}} (1-\tau^c)[P_{t+1} Q(k_{gt+1}, l_{gt+1}, H_{t+1}) - W_{t+1} l_{gt+1}] + D_{gt}[1 + r^M_t] \tag{8}$$

18. Note that Π^g_{t+1} can be positive even though the production of the state sector is inefficient. The positive profit is created by the government's loan subsidization. McKinnon (1994) refers to this phenomenon as "hidden deficit".
19. When the money growth rate is positive, the government uses money creation to finance its budget deficit. The inflation tax induced by money creation will have real effects on the economy as it imposes a tax on the money-holders (the old generation) effectively.

subject to

$$Q(k_{it+1}, l_{it+1}, H_{t+1}) = A\theta_j^i k_{it+1}^{\sigma} l_{it+1}^{1-\sigma} H_{t+1}^{1-\sigma},$$

and

$$(1-\tau^l)W_t \geq D_{it} + P_t^k k_{it+1}, \tag{9}$$

$$k_{it+1} \geq 0, \tag{10}$$

$$l_{it+1} \geq 0, \tag{11}$$

$$D_{it} \geq 0. \tag{12}$$

Note that as reflected by the liquidity constraint (7), the individual has no access to external funds and must finance the project internally. Hence, the production decision and the portfolio decision of each entrepreneur are jointly determined. Since the nominal rate of return on money is equal to zero, no young individual would like to hold money, and thus the liquidity constraint (9) is always binding. That is, $(1-\tau^l)W_t = D_{it} + P_t^k k_{it+1}$.

At the end of period $t+1$, individual i of generation t receives a cash balance of m_{it+1}^i

$$m_{it+1}^i = (1-\tau^c)(P_{t+1}Q_{it+1}^i - W_{t+1}l_{it+1}) + D_{it}(1+i_t^d). \tag{13}$$

The cash balance will be used to finance the consumption of this agent in period $t+2$. The purchases of the consumption good by the old agents are subject to cash-in-advance constraints.

$$P_{t+2}C_{it+2}^i \leq m_{it+1}^i. \tag{14}$$

The first order conditions for this optimization problem can then be derived

$$k_{it+1}: \ (1-\tau^c)\sigma P_{t+1}A\theta_j^i k_{it+1}^{\sigma-1} l_{it+1}^{1-\sigma} H_{t+1}^{1-\sigma} - P_t^k \rho_{1it} + \rho_{2it} = 0,$$

$$l_{it+1}: \ (1-\tau^c)(1-\sigma)P_{t+1}A\theta_j^i k_{it+1}^{\sigma} l_{it+1}^{-\sigma} H_{t+1}^{1-\sigma} - W_{t+1}(1-\tau^c) + \rho_{3it} = 0,$$

$$D_{it}: \ (1+i_t^d) - \rho_{1it} + \rho_{4it} = 0,$$

where ρ_{jit}, j = 1,2,3,4 are the multipliers associated with constraints (14) and (17)-(19),

respectively. The multiplier ρ_{1it} is always positive because the third-period consumption always yields positive marginal utility and then constraint (14) always binds.

Using the first-order conditions, we have the following equations.

$$(1-\tau^c)\sigma P_{t+1} A\theta_j^i k_{jt+1}^{\sigma-1} l_{jt+1}^{1-\sigma} H_{t+1}^{1-\sigma} - P_t^k(1+r_t^d) + \rho_{2it} - \rho_{4it} = 0, \tag{15}$$

$$(1-\tau^c)[(1-\sigma) P_{t+1} A\theta_j^i k_{jt+1}^{\sigma} l_{jt+1}^{-\sigma} H_{t+1}^{1-\sigma} - W_{t+1}] + \rho_{3it} = 0. \tag{16}$$

Let θ^{*t} be the productivity parameter of the marginal projects which satisfies the following two conditions,

$$(1-\tau^c)\,\sigma\left(\frac{P_{t+1}}{P_t^k}\right) A\theta^{*t}\left(\frac{(1-\tau^l)W_t}{P_t^k}\right)^{\sigma-1} l_{t+1}^{*\,-\sigma} H_{t+1}^{1-\sigma} - (1+r_t^d) = 0, \tag{17}$$

and

$$(1-\sigma)\,P_{t+1} A\theta^{*t}\left(\frac{(1-\tau^l)W_t}{P_t^k}\right)^{\sigma} l_{t+1}^{*\,-\sigma} H_{t+1}^{1-\sigma} - (W_{t+1}) = 0. \tag{18}$$

Therefore, there are two groups of individuals. for the individuals with $\theta_j^i \in [\theta^{*t}, 1)$, $\rho_{2it} = \rho_{3it} = 0$ and $\rho_{4it} \geq 0$.[20] These individuals will invest all their after-tax labor income in their production projects. Thus $D_{it} = 0$ and $k_{jt+1} = W_t(1-\tau^l)/P_t^k$, which is the maximum level of investment they undertake.

The optimal level of labor input of each agent with $\theta_j^i \in [\theta^{*t}, 1)$ can be derived from Equations (22), (23) and (24). Hence we have

$$l_{t+1}^* = \frac{1-\sigma}{\sigma}\frac{W_t(1-\tau^l)(1+r_t^d)}{W_{t+1}(1-\tau^c)}, \quad l_{jt+1} = \left(\frac{\theta_j^i}{\theta^{*t}}\right)^{\frac{1}{\sigma}} l_{t+1}^*, \quad \forall \theta_j^i \in [\theta^{*t}, 1). \tag{19}$$

For individuals with $\theta_j^i \in (0, \theta^{*t})$, they have $\rho_{2it} > 0$, $\rho_{3it} > 0$ and $\rho_{4it} = 0$. Since the productivity of their production projects is too low, they prefer holding bank deposits to investing in their production projects. Thus, these individuals have $D_{it} = W_t(1-\tau^l)$ and $k_{jt+1} = l_{jt+1} = 0$.

It follows that the aggregate capital stock, labor input, and output in the private sector in period $t+1$ are respectively given by

20. For the marginal private producer with $\theta_t^i = \theta^{*t}$, $\rho_{2it} = \rho_{3it} = \rho_{4it}$. This individual is indifferent between making investment in private production and putting savings into bank deposits. For simplicity, we assume that he takes former option.

$$k_{t+1}^{y} = \int_0^1 k_{it+1}\, d\theta_t^i = (1-\theta^{*t})k_{t+1}^{*} = (1-\theta^{*t})\left[\frac{(1-\tau^l)W_t}{P_t^k}\right]. \tag{20}$$

$$l_{t+1}^{y} = \int_0^1 l_{it+1}\, d\theta_t^i = \frac{\sigma}{1+\sigma}(\theta^{*t\frac{-1}{\sigma}} - \theta^{*t})\, l_{t+1}^{*}. \tag{21}$$

$$Q_{t+1}^{y} = \int_0^1 Q_{it+1}^{i}\, d\theta_t^i = \left[\frac{\sigma}{1+\sigma}(\theta^{*t\frac{-1}{\sigma}} - \theta^{*t})\right]\theta^{*t} A\, k_{t+1}^{*\sigma} l_{t+1}^{*1-\sigma} H_{t+1}^{1-\sigma}. \tag{22}$$

The technology level of the economy in period $t+1$ is

$$H_{t+1} = \left(\frac{1+\theta^{*t}}{2}\right)k_{t+1}^{*} = \frac{1+\theta^{*t}}{2}\left[\frac{(1-\tau^l)W_t}{P_t^k}\right]. \tag{23}$$

At the end of period t, the aggregate bank deposits held by the young individuals, D_t, is given by

$$D_t = \theta^{*t}(1-\tau^l)W_t = \int_0^1 (D_{it})\, d\theta_t^i, \tag{24}$$

and the aggregate savings of the young individuals, S_t^y, is given by

$$S_t^y = (1-\tau^l)W_t = \int_0^1 (D_{it} + P_t^k k_{it+1})\, d\theta_t^i. \tag{25}$$

The aggregate savings of the middle-aged individuals, S_t^{y-1}, is given by

$$S_t^{y-1} = \int_0^1 w_{it}^{y-1}\, d\theta_t^{y-1} = (1-\tau^c)(P_t Q_t^y - W_t l_t^y) + D_{t-1}(1+r_{t-1}^d), \tag{26}$$

where

$$D_{t-1} = \int_0^1 D_{it-1}\, d\theta_t^{y-1}.$$

It follows that the aggregate consumption of the old individuals in period $t+1$ is

$$C_{t+1}^{o} = \int_0^1 C_{it+1}^{y-1}\, d\theta_t^{y-1} = \left(\frac{1}{P_{t+1}}\right)\int_0^1 w_{it}^{y-1}\, d\theta_t^{y-1}. \tag{27}$$

2. Production Decisions of State-Owned Enterprises

Since the government desires to subsidize the state-owned firms by way of offering them funds with lower costs, it does not adjust the interest rate so as to eliminate the excess demand.[21] The allocation of funds is determined by the central bank. Let us assume that each state-owned firm, which will produce the consumption good in period $t+1$, obtains a loan of B_t^s units of money at the end of period t.

Taken as given the production technology, the allocation of funds, B_t^s, the nominal interest rate on loans, i_t^L, the price of the capital good, P_t^k, the market wage rate, W_{t+1}, and the price of the consumption good, P_{t+1}, the objective of a representative state-owned enterprises is to maximize its profit.[22] That is, it solves the following optimization problem,

$$\max_{k_{t+1}^s, l_{t+1}^s} \; P_{t+1} Q^s(\theta_{t+1}^s, k_{t+1}^s, l_{t+1}^s, H_{t+1}) - B_t^s(1+i_t^L) - W_{t+1} l_{t+1}^s \tag{28}$$

subject to

$$Q_t^s = Q^s(\theta_t^s, k_t^s, l_t^s, H_t) = A\theta_t^s k_t^{s\sigma} l_t^{s1-\sigma} H_t^{1-\sigma},$$

and

$$B_t^s \geq P_t^k k_{t+1}^s. \tag{29}$$

The existence of credit rationing implies that cash-in-advance constraints (5) always binds. That is, the demand for the capital good is

$$k_{t+1}^s = \frac{B_t^s}{P_t^k} \quad \text{and} \quad \sigma P_{t+1}\theta_{t+1}^s A\left(\frac{B_t^s}{P_t^k}\right)^{\sigma-1} l_{t+1}^{s1-\sigma} H_{t+1}^{1-\sigma} - P_t^k(1+i_t^L) > 0. \tag{30}$$

The demand for the labor effort can be derived from the following first order condition,

$$l_{t+1}^s: \qquad (1-\sigma) P_{t+1}\theta_{t+1}^s A\left(\frac{B_t^s}{P_t^k}\right)^{\sigma} l_{t+1}^{s-\sigma} H_{t+1}^{1-\sigma} - W_{t+1} = 0. \tag{31}$$

21. The state-owned firms are facing soft budget constraints effectively. Given the assumption that there is an excess demand for bank loans and each state-owned firm faces credit rationing, the interest rate i_t^L has no displinary effect on the state-owned firms' behavior.

22. For simplicity, the state-owned enterprises are modelled as profit-maximizing entities. It is not an unrealistic assumption as more incentives are given to the state-owned enterprises to maximize profit under the industrial reforms in state sector. See Grove *et al.* (1994).

The profit of the representative state-owned enterprise is

$$\Pi^g_{t+1} = P_{t+1} Q^g(\theta^g_{t+1}, k^g_{t+1}, l^g_{t+1}, H_{t+1}) - B^g_t(1+i^L_t) - W_{t+1} l^g_{t+1}$$

$$= \sigma P_{t+1} \theta^g_{t+1} A\, k^{g\sigma}_{t+1} l^{g1-\sigma}_{t+1} H^{1-\sigma}_{t+1} - B^g_t(1+i^L_t). \tag{32}$$

At the end of period $t+1$, each state-owned firm submits its profit of Π^g_{t+1} units of money to the government.

3. The Competitive Market Equilibrium

In equilibrium, three conditions must be satisfied in each period. First, taking as given the market prices and government policies, each agent (an individual or a firm) solves his optimization problem. Second, the government's budget constraint is balanced. Third, all markets are cleared. The market-clearing conditions for the economy in period t are

the labor market: $l^g_t + l^p_t = 1$, (33)

the consumption good market : $C^{-2}_t + I_t = Q^p_t + Q^g_t$, (34)

the capital good market: $I_t = (k^p_{t+1} + k^g_{t+1})$, (35)

the loan market: $D_t = B^g_t$, (36)

the money market: $\int_0^1 m^{-1}_{jt} dj \theta^{-1}_t = M_t$, (37)

where I_t is the aggregate investment in the economy in period t.

For a given set of policy parameters (the productivity of the state-owned sector, θ^g, the tax rates, τ^l and τ^c, and the interest rate on bank deposit, i^d) and the specification of preferences and technologies in this model, the economy exhibits an equilibrium balanced growth path. To focus on our analysis, we provide the characterization of the balanced growth path in the appendix.

Along the balanced growth path, the magnitude of θ^* is a constant and it is determined by the following condition:

$$\frac{\sigma^2(1-\tau^c)^2\left[\frac{\sigma}{1+\sigma}\left(\theta^{*\frac{-1}{\sigma}} - \theta^*\right) + \theta^*\right]}{(1+i^d)(1-\sigma)(1-\tau^l)[1-(1-\sigma)(1-\tau^l)]} = \left[\frac{\sigma}{1+\sigma}\left(\theta^{*\frac{-1}{\sigma}} - \theta^*\right) + \theta^*\left(\frac{\theta^g}{\theta^*}\right)^{\frac{1}{\sigma}}\right]^2. \tag{38}$$

Note that $1-\theta^*$ is the measure of private firms on the balanced growth path; and it is an indicator of the size of the private sector on the balanced growth path. A lower value of θ^* implies a larger size of the private sector in equilibrium. Other than the size of the private sector, θ^*, the development of the private sector can be measured by the sector's employment share (η^L), investment share (η^K) and output share (η^Q) in the economy; and all are constant along the balanced growth path.

Given that the total labor endowment is one, the labor employment in the private sector is also the sector's employment share in the economy. According to the definition of θ^*, and Equations (19), (21), (25), (31) and (36), the employment share of the sector in the economy can be obtained as follows:

$$\eta^L = l^p = \frac{\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^*\right)}{\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^*\right) + \theta^*\left(\frac{\theta^g}{\theta^*}\right)^{\frac{1}{\sigma}}}.$$

It can be shown that, other things being the same, an increase in θ^* will decrease the labor employment in private sector:

$$\frac{\theta^*}{l^p}\frac{\partial l^p}{\partial \theta^*} = -\frac{\left(\frac{\theta^g}{\theta^*}\right)^{\frac{1}{\sigma}}\left[\frac{\sigma}{1+\sigma}\theta^{*-\frac{1}{\theta}} + \left(\frac{\sigma}{1+\sigma} + \frac{1-\sigma}{\sigma}\right)\theta^*\right]}{\left[\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^*\right)\right]\left[\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^*\right) + \theta^*\left(\frac{\theta^g}{\theta^*}\right)^{\frac{1}{\sigma}}\right]} < 0.$$

From the definition of θ^*, and Equations (3), (20), (24), (31), (33), (36) and (39), the investment share and output share of the private sector can be obtained as follows:

$$\eta^K = \frac{\triangle^K}{1+\triangle^K}; \qquad \eta^Q = \frac{\triangle^Q}{1+\triangle^Q}$$

where

$$\triangle^K \equiv \frac{k^p_{t+1}}{k^g_{t+1}} = \frac{1-\theta^*}{\theta^*},$$

$$\triangle^Q \equiv \frac{Q^p_{t+1}}{Q^g_{t+1}} = \theta^{g^{-\frac{1}{\sigma}}}\left(\frac{\sigma}{1+\sigma}\right)\left(\theta^{*-1} - \theta^{*\frac{1}{\sigma}}\right).$$

It can be shown that an increase in θ^* will decrease the sector's output share and investment share in the economy:

$$\frac{\partial \Delta^Q}{\partial \theta^*} < 0, \quad \frac{\partial \Delta^k}{\partial \theta^*} < 0.$$

IV. Government Policies and the Development of the Private Sector

1. An Increase in the Nominal Interest Rate on Bank Deposits

Proposition 1: *In the long run, a higher nominal interest rate on bank deposits will reduce the size of the private sector, its labor employment share, investment share, and output share in the economy. That is,*

$$\frac{d\theta^*}{di^D} > 0; \qquad \frac{d\eta^l}{di^D} < 0; \qquad \frac{d\eta^k}{di^D} < 0; \qquad \frac{d\eta^Q}{di^D} < 0.$$

An increase in the rate of return on bank deposits will induce the young individuals to allocate more of their disposable income to bank deposits. Hence, this direct effect will reduce the young individuals' incentive to become entrepreneurs. However, higher interest payment implies more disposable income for the old individuals, which will lead to an increase in the aggregate demand for the consumption good and thus exert an upward pressure on the price level of the good. A higher future price implies a lower real interest rate on deposits. Thus, this direct effect will raise the young individuals' incentive to become entrepreneurs. Since the direct effect dominates the indirect effect, the size of the private sector is smaller in the economy.

Further, given that the private sector is relatively more efficient in learning by doing than the state sector, the decrease in the level of private capital investment will not only reduce the production scale in the private sector but also lower the level of the productivity of the economy. This reduction in the productivity of the economy will reduce the demand for labor and thus the wage rate in the economy despite the fact that the increase in the nominal interest rate raises the amount of bank loans available to the state sector and thus the level of capital investment and production scale in the sector. A lower level of labor income will exert a further negative effect on the level of capital investment in the private sector and the state sector and thus the production scale of the economy. As a result, there is a further negative effect on the size of the private sector. Consequently, the private sector's employment share, output share and investment share in the economy are smaller on the new balanced growth path.

2. An Increase in the Effective Tax Rate on Labor Income

Proposition 2: *In the long run, a higher labor income tax rate will increase the size of the private sector, and its labor employment share, investment share, and output share in the economy if and only if the labor share in the production of the consumption good is sufficiently small. That is,*

$$\frac{d\theta^*}{d\tau^l} < 0; \qquad \frac{d\eta^l}{d\tau^l} > 0; \qquad \frac{d\eta^k}{d\tau^l} > 0; \qquad \frac{d\eta^Q}{d\tau^l} > 0;$$

if and only if $2(1-\delta)(1-\tau^l) < 1$.

An increase in the tax rate on labor income does not influence the rate of return on capital investment and thus exerts no direct effect on the size of the private sector. However, the policy change affect the economy through two indirect channels: the effect on individuals' income and the effect on the price of the consumption good. Keeping the price of the consumption good constant, a higher labor-income tax rate will reduce the young individuals' disposable income. Consequently, they will reduce their bank deposits and the level of capital investment even if there is no effect on θ^*. Since fewer bank loans are available, the level of capital investment in the state sector will be reduced as well. The lower level of capital investment in the economy will lead to a fall in the economy-wide production scale and will exert a positive effect on the price of the consumption good. However, the fall in the production scale will reduce the demand for labor and the wage rate. A lower level of labor income has a negative effect on the demand for the consumption good and thus a negative effect on the price of the good.

Since these effects oppose each other, the net effect on the level of private capital investment is in general ambiguous. However, if the labor share of the output is sufficiently small, then the negative income effect on the demand for the consumption good will be sufficiently small. In this case, an higher tax rate on labor-income will increase the price of the consumption good and therefore the size of the private sector. Consequently, the shares of the private sector on labor employment, capital investment, and output are higher on the new balanced growth path.

3. An Increase in the Effective Tax Rate on Corporate Income

Proposition 3: *In the long run, a higher tax rate on corporate-profit will decrease the size of the private sector, and its labor employment share, investment share, and output share in the economy. That is,*

$$\frac{d\theta^*}{d\tau^c} > 0; \qquad \frac{d\eta^l}{d\tau^c} < 0; \qquad \frac{d\eta^k}{d\tau^c} < 0; \qquad \frac{d\eta^Q}{d\tau^c} < 0.$$

A higher corporate-profit tax rate will reduce the rate of return of capital investment in the private sector. Hence, this policy change will lower the incentive for young individuals to become entrepreneurs. As a result, the size of the private sector is smaller on the new balance growth path. Moreover, the reduction in the level of private investment will lead to a reduction of the production scale in the private sector and the economy-wide

productivity. Lower levels of production scale and productivity will exert a negative effect on the demand for labor and therefore the level of the wage rate. This reduction in labor income has a further negative effect on the size of the private sector in the economy. Due to the reduction in the number of private firms in the economy, the labor employment share, the investment share, and output share of the private sector are smaller.

4. An Increase in the Productivity in State Sector

Proposition 4: *In the long run, a higher productivity in the state sector will reduce the size of the private sector, and its labor employment share, investment share, and output share in the economy. That is,*

$$\frac{d\theta^*}{d\theta^s} > 0; \qquad \frac{d\eta^l}{d\theta^s} < 0; \qquad \frac{d\eta^k}{d\theta^s} < 0; \qquad \frac{d\eta^Q}{d\theta^s} < 0.$$

An increase in θ^s represents an improvement in the productivity of state-owned enterprises, which can be brought about by enterprise reform in the state sector. As the marginal products of both labor and capital increase for a given level of inputs, the state-owned enterprises will try to increase their production scales. Since capital input is constrained by the loanable funds available to them, the state-owned enterprises can only increase their production scales by raising labor input. The higher demand for labor drives up the wage rate and lowers the demand for labor by the private firms. The decrease of labor input in the private sector shifts the marginal product of capital schedule downward in the sector. Hence, as the rate of return on private capital investment decreases, the number of young individuals who choose to become entrepreneurs will drop.

Further, the expansion of the production scale in the state sector lowers the price level for the consumption good and thus exerts a negative effect on the incentive for young individuals to become entrepreneurs. As the intensity of entrepreneural activities decreases, the private sector's labor employment share, investment share, and output share in the economy will also decrease.

V. Concluding Remarks

This study is among the first attempt to study how government policy changes affect the private sector development in the transforming Chinese economy through formal modelling technique. By using the analytical model developed in this paper, we show that some government policy changes, which are designed to solve certain problems of the economy, may exert positive or negative effects on the private sector development. In particular, first, an increase in the nominal interest rate on deposits in the state banking system may help cutting down the inflation rate, but it can also slow down the pace

of the private sector development. Second, even though an increase in tax rates can raise the fiscal revenue and thus reduce government budget deficit, this type of policy change can also retard the private sector development. Last, although further enterprise reform in state sector can increase the productivity of state-owned enterprises, it is likely that the private sector development may be slowed down.

Appendix

Along a balanced growth path, output levels of the consumption good and the capital good, consumption, investment, and savings are all growing at the same rate g. The money supply, government bonds and wage rate of labor are growing at the same rate μ. Given the constant values of the productivity parameter, θ^{*}, and the decisions of the government, $\tau^{I}, \tau^{C}, i^{L}$, and i^{M}, any feasible balanced growth path requires the growth rate of money supply, μ, the growth rate of the economy, g, the inflation rate, π, and the productivity parameter of the marginal projects, θ^{*}, are all constant over time.

On the balanced growth path, the relationship between the endogenous growth rate of the economy, g, and the growth rate of money supply, μ, is

$$(1+\mu) = (1+g)(1+\pi). \tag{39}$$

From Equations (4), (7), (17), (18), (19), (24), (31), (33), (36), and (39), we have

$$(1+\mu) = \frac{1}{2}(1+\theta^{*})\theta^{*\frac{1}{1-\sigma}}(1-\tau^{I})\left[(1+\pi)A(1-\sigma)\left[\frac{\sigma(1-\tau^{C})}{(1-\sigma)(1+i^{M})}\right]^{\sigma}\right]^{\frac{1}{1-\sigma}}, \tag{40}$$

$$\frac{\sigma(1-\tau^{C})(1+\mu)}{(1-\sigma)(1-\tau^{I})} = (1+i^{M})\left[\frac{\sigma}{1+\sigma}(\theta^{*\frac{-1}{\sigma}}-\theta^{*})+\theta^{*}\left(\frac{\theta^{*}}{\theta^{*}}\right)^{\frac{1}{\sigma}}\right], \tag{41}$$

$$(1+\mu)^{2}\left[\frac{1}{(1-\sigma)(1-\tau^{I})}-1\right] = (1+i^{M})\left[\frac{\sigma}{1+\sigma}(\theta^{*\frac{-1}{\sigma}}-\theta^{*})+\theta^{*}\right]. \tag{42}$$

The simultaneous equations system, (39)-(42), can be used to solve for the equilibrium balanced-growth values of μ, θ^{*}, π and g. (38) is derived from Equations (41) and (42). By totally differentiating Equations (38), the results of the comparative statics analysis can be derived.

Results of the Comparative Statics Analysis

From Equations (41) and (42), we can derive the effects of changes in θ^{*}, τ^{C}, τ^{I}, and i^{M} on μ and θ^{*}. Define

$$\alpha_{12} \equiv \frac{\frac{1}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}}-\theta^{*}\right)}{\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}}-\theta^{*}\right)+\theta^{*}}, \quad 0<\alpha_{12}<\frac{1}{\sigma},$$

$$a_{22} \equiv \frac{\frac{1}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^{*}\right) + \theta^{*}\left(1-\left(\frac{\theta^{\#}}{\theta^{*}}\right)^{\frac{1}{\sigma}}\right) + \frac{\theta^{*}}{\sigma}\left(\frac{\theta^{\#}}{\theta^{*}}\right)^{\frac{1}{\sigma}}}{\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^{*}\right) + \theta^{*}\left(\frac{\theta^{\#}}{\theta^{*}}\right)^{\frac{1}{\sigma}}}$$

$$= \frac{1}{\sigma} + \frac{\theta^{*}\left(1-\left(\frac{\theta^{\#}}{\theta^{*}}\right)^{\frac{1}{\sigma}}\right)}{\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^{*}\right) + \theta^{*}\left(\frac{\theta^{\#}}{\theta^{*}}\right)^{\frac{1}{\sigma}}},$$

$$a^{\#} \equiv \frac{\frac{\theta^{*}}{\sigma}\left(\frac{\theta^{\#}}{\theta^{*}}\right)^{\frac{1}{\sigma}-1}}{\frac{\sigma}{1+\sigma}\left(\theta^{*-\frac{1}{\sigma}} - \theta^{*}\right) + \theta^{*}\left(\frac{\theta^{\#}}{\theta^{*}}\right)^{\frac{1}{\sigma}}} > 0.$$

Note that if $\theta^{\#} < \theta^{*}$, then $a_{22} > a_{12} > 0$. Hence, we assume that $\theta^{\#} < \theta^{*}$ holds. It is noted that on the equilibrium balanced growth path in which $\mu \geq 0$, the equilibrium value of θ^{*} will be greater than $\theta^{\#}$. Then we have

$$\frac{\theta^{\#}}{1+\mu}\frac{d\mu}{d\theta^{\#}} = -\frac{a^{\#}a_{12}}{2a_{22}-a_{12}} < 0,$$

$$\frac{\theta^{\#}}{\theta^{*}}\frac{d\theta^{*}}{d\theta^{\#}} = \frac{2a^{\#}}{2a_{22}-a_{12}} > 0,$$

$$\frac{1-z^{c}}{1+\mu}\frac{d\mu}{dz^{c}} = -\frac{a_{12}}{2a_{22}-a_{12}} < 0,$$

$$\frac{1-z^{c}}{\theta^{*}}\frac{d\theta^{*}}{dz^{c}} = \frac{2}{2a_{22}-a_{12}} > 0,$$

$$\frac{1-z^{I}}{1+\mu}\frac{d\mu}{dz^{I}} = -\frac{\left[\frac{1}{1-(1-\sigma)(1-z^{I})}\right]a_{22}-a_{12}}{2a_{22}-a_{12}} < 0,$$

$$\frac{1-z^{I}}{\theta^{*}}\frac{d\theta^{*}}{dz^{I}} = -\frac{2-\left[\frac{1}{1-(1-\sigma)(1-z^{I})}\right]}{2a_{22}-a_{12}},$$

$$\operatorname{sign}\frac{d\theta^*}{d\tau^d} = -\operatorname{sign}\left[2-\frac{1}{1-(1-\sigma)(1-\varepsilon^d)}\right],$$

$$\frac{1+\tau^{id}}{1+\mu}\frac{d\mu}{d\tau^{id}} = \frac{a_{22}-a_{12}}{2a_{22}-a_{12}} > 0,$$

$$\frac{1+\tau^{id}}{\theta^*}\frac{d\theta^*}{d\tau^{id}} = \frac{1}{2a_{22}-a_{12}} > 0.$$

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