The co-development of economies and institutions

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Abstract

In this paper, we cast the Schumpeterian growth theory in a simple discrete-time framework where both economy and institutions need to be developed. In order to develop an economy, individuals need to borrow from an imperfect financial market. Hence, a government adopts two potential strategies for improving the borrowing capacity of individuals and, in turn, enhancing economic performance: "general protectionism" and "partial protectionism." Thus, we interpret market-oriented reform in transition economies as shift from "partial protectionism" to "general protectionism." The model reveals that both strategies could be the best choice at different development stages.

Keywords: Institutional reform, political transition, economic growth, innovation, political economy, technology progress.

JEL Classification Numbers: O11, O16, O31, O43, P16, P26, L16

1. Introduction

Today, most economists are in near-consensus that institutions are fundamental for long-term economic growth (North 1990, Acemoglu et al. 2005). Two main strands of literature focus on this important field. One of them belongs to development economics and political economy. This strand of literature emphasizes that the underlying reasons for economic divergence worldwide are institutional barriers in developing economies. Some political economy models explain why better foreign technologies are blocked by domestic vested interest cliques (e.g., Parente et al. 2000, Acemoglu et al. 2000, and Acemoglu 2005). Others shed light on the persistence of a lawless state, which in turn, impedes innovation and investment, thereby inducing economic stagnation (e.g., Aghion et al. 2005, Hoff et al. 2008). While we do not dispute that inefficient institutions need to be abandoned today, the question is why did they emerge in history.

The other strand of literature sheds light on the transition process from an inefficient institution (i.e., a centrally planned economy) to an efficient one (i.e., a market economy) (see Murphy et al. 1992, Roland 2000, Lau et al. 2000). Most studies compare the Big Bang strategy (e.g., the former Soviet Union and other East European countries) and gradualism (e.g., China). Again, too few studies have addressed the question of why an inefficient institution (centrally planned economy) was established in an early stage of development, only to be abandoned after a few decades. In other words, we need to develop a unified theory to explain the process of the co-development of economy and institutions.

The main task of this paper is to present a rationale for the endogenous institutional transition along with the economic growth path. We want to argue that certain institutions that might initially increase growth could subsequently lead to slower growth. We model "institutions" as a two-dimensional vector for developing economies. The first dimension measures the rule of law, which protects property rights equally for all individuals. Thus, it is referred to as "general protectionism." Economists generally agree that the rule of law is the fundamental reason for innovation and investment, which, in turn, is the reason for long-term economic growth (Barro 2001). Since the rule of law is necessary for a well-functioning market economy, we interpret the market-oriented reform as an improvement of the rule of law in our simple model. This is a little different from the traditional transition economics that mainly concentrates on privatization. However, new literature has already shed some light on the rule of law (e.g., Hoff et al. 2004).

The second dimension represents a partial protectionism in which the government supports (or protects) some enterprises for investment through government guarantees. This type of non-competitive policy and institution has been well documented for a long time in the literature (e.g., Gerschenkron [1962, p. 7] and Acemoglu et al. [2006]). However, previous studies emphasize the feature of "investment-based growth." We find that such "long relationships between firms and banks, as well as large firms and state intervention" often are biased *de facto* toward certain enterprises. Thus, we characterize this as partial protectionism.[2] A centrally planned system is the extreme case of this strategy. In such economies, some

[2] The feature that only a few enterprises can obtain support from the government is the key aspect of a centrally planned economy. We owe this term to Shen (2007), in which the group-specific subsidy is the key tool of the ruler for enhancing economic growth.

industries (e.g., the military and steel industries that are the first priority in the former Soviet Union and China) are state-owned and, thus, obtain a large amount of resources; however, others are not (e.g., agriculture in China and consumption goods sectors in the former Soviet Union).[3] Although currently China has made great progress toward a market economy, there are still many subsidies, trade barriers, and entry barriers, most of which are biased toward state-owned enterprises (SOEs).[4] In general, this partial protectionism can be found in many non-centrally planned economies (e.g., Japan and South Korea) in their initial stages of development. We measure it by the number of protected enterprises, denoted by SOEs.

Since partial protectionism induces numerous distortions, which have already been mentioned in the literature (Hsieh et al. 2009, Song et al. 2011), it is of interest to ask why those countries choose partial protectionism instead of the rule of law in the initial stages of development and then switched to the latter in a more advanced stage.

Our main results are based on the following assumptions: (i) We assume that for a developing economy, it is costly to establish a proper institution, either the rule of law or partial protectionism.[5] For simplicity, we assume that the endowment of a government for the development of institutions is constant, denoted as "effort." Hence, the evolution of institutions is determined by the optimal allocation of the government's effort at different stages of development. (ii) Economic development depends on investment in R&D, which need to be financed in an imperfect financial market. The borrowing capacity of individuals depends on their own endowment (the wage income, related to technology level) and the imperfectness of financial market, which, in turn, depends on the rule of law. (iii) Once the government guarantees an enterprise's credit, the enterprise can borrow any amount[6] that it needs. However, the

[3] Such partial protectionism is well recorded by economists (e.g., Roland 2000) and recognized as a failure of development strategy (e.g., Yifu Lin 2003).
[4] This is the potential reason why WTO does not recognize the Chinese market economy position. Many economists concentrate on induced distortion (e.g., Hsieh et al. 2009).
[5] Hoff et al. (2004, 2008) reveal how difficult it can be for a society to establish the rule of law.
[6] It is not necessary to assume that SOEs can borrow "any amount" through government guarantee. However, a government guarantee does ensure that SOEs can borrow more than their own borrowing capacities would otherwise allow.

cost of such guarantees increases disproportionately to the number of guaranteed enterprises (SOEs). Hence, partial protectionism is relatively easy to begin, and its benefit is relatively large in the early stages of development. In contrast, the rule of law brings little benefit in the initial stages because individuals are poor and have little to mortgage. A Ramsey government is willing to choose partial protectionism to promote economic growth in the initial stages of development. As the economy evolves, the cost of partial protectionism becomes increasingly large; consequently, it is cost-effective for the government to establish the rule of law.

Although there are few studies in the literature that have investigated institutional switching along with economic growth, to our limited knowledge, the study of Acemoglu et al. (2006) is an exception. It focuses on switching policies from an investment-based strategy to an innovation-based one. Their first strategy is consistent with our partial protectionism, and the second is similar to our general protectionism (the rule of law). However, the engine of switching in their model is the distance to the world technology frontier. The switch occurs only if the distance is sufficiently small so that innovation, instead of imitation, becomes the main source of economic growth. The cost of establishing institutions plays no role in their framework. Our main results rely on the cost-benefit analysis of government at different stages of development. Although our switch of institutions is also linked with economic performance, it is not necessary that the economy choosing general protectionism be innovation-based. It is more consistent with market-oriented reforms in former centrally planned systems, either in China or former Soviet Union. These economies achieved high economic growth rates in the early stages of development and began reform in the 80s and 90s of the last century. At that time, the distance between these countries and the world technology frontier was huge one. Furthermore, the main engine of growth in China has seemed to be “imitation” but not “innovation.” Hence, our model provides another reasonable interpretation for the institutional switch.

Thus far, our basic model has not been satisfied as we observed that, on one hand, the Chinese government had begun market-oriented reform and, on the other, was implementing policies and institutions favorable to SOEs. (e.g., Song et al. 2011 argues that the Chinese banking system is almost closed for private enterprises (PEs) and only open to SOEs) If the Chinese government would recognize that PEs are more efficient than SOEs, such policies favoring SOEs would vanish in the short term. However, according to Song et al. (2011), we cannot come to this conclusion. If the Chinese government believed that it was necessary to support SOEs by such non-competitive arrangements in order to enhance economic growth, why did it initiate reform at the beginning of the 1980s? This puzzling phenomenon can be understood if we slightly extend the basic model by introducing a fixed cost in the above R&D investment. Then the transition path is no longer smooth in the short run. Due to fixed costs, private enterprises are not willing to invest when their incomes are low. The government begins to improve the rule of law in order to induce private investments in innovation. Since individuals are still poor and do not have sufficient income for mortgage payments, the government has no incentive to improve the rule of law so much that PEs' investment is much higher than their fixed costs. During this period, PEs do make investments; however, their investments are kept at a minimal level (just a little more than fixed costs). Thus, their profits are small. The benefit from economic growth induced by private investments is used to support an increasing number of SOEs. Only if the economy grows further and reaches certain threshold values is the government willing to invest in the rule of law again. Furthermore, we show that the government prefers to support more SOEs in an industry whose fixed costs are higher. This result is consistent with empirical evidence using a Chinese industrial dataset compiled by China's Bureau of Statistics (NBS).

The other extension is in keeping with political-economy models by assuming a non-Ramsey government, which is more concerned with SOEs than with PEs. Thus, there is a slightly more pessimistic process of transition than that described above. A *de jure* biased-to-SOEs government begins reform by reducing the number of SOEs when certain conditions are satisfied. However, with economic growth, the government reverts to partial protectionism. This implies that the positive gradualism reform in China could be a transitory phenomenon. The “Big Bang” strategy is dominant in this sense because it eliminates the possibility of bias toward SOEs in the short term.

The other similar study investigating endogenous institutions and policies is that of Wang (2010). However, his work concentrates on the stepwise process from an inefficient institution to an efficient one with economic growth. He did not show the other side of inefficient institutions or explain why such institutions should be established. Furthermore, his model is fully established on the basis of a Ramsey government; hence, our result of a zigzag and/or transitory reform process is not included in his work.

The remainder of the paper is organized in the following manner. Section 2 outlines the basic model. Section 3 extends a fixed cost in investments. Section 4 presents some simple empirical evidence. Section 5 discusses a *de jure* biased-to-SOEs government. Section 6 presents the conclusion.

2. The basic model

Here, we follow Aghion et al. (2005) in casting Schumpeterian growth theory in a simple discrete-time framework. We consider an economy with two types of players: one is a continuum L of citizens each with one unit of labor force; the other is a government who has one unit of effort, which can be used to improve institutions and is denoted by E. Citizens are assumed to live in two periods. In the first period, they supply labor to produce general goods; their income is in the form of a wage w_{1t}, which can be used to consume and/or invest. In the second period, citizens do not work and their income is the return on investment from the first period, denoted by w_{2t+1}. The utility function is linear: $u_t = c_{1t} + \beta c_{2t+1} \quad \beta \in (0,1)$; thus, individuals are indifferent between saving and consumption.

There are two types of products in the economy, the multipurpose “general” good (which we use as the numéraire) and intermediate goods. The general good is produced by labor and a continuum of intermediate goods according to the production function:

$$Y_t = L^{1-\alpha}\int_0^1 (A_t(i))^{1-\alpha}(x_t(i))^{\alpha}\, di\,, \tag{1}$$

where $x_t(i)$ is the quantity of intermediate good i, and $A_t(i)$ is its productivity. For the sake of simplicity, we follow Aghion et al. (2005) and assume $L=1$. The average productivity is $A_t = \int_0^1 A_t(i)di$. Citizens invest $N_t(i)$ to improve productivity $A_t(i)$ with a probability of success u_t. Hence, we obtain,

$$A_{t+1}(i) = \begin{cases} \overline{A}_{t+1} & u_t \\ A_t & 1-u_t \end{cases}, \tag{2}$$

where $\overline{A}_{t+1}$ is the world technology frontier, which grows at the constant rate $g>0$. If the innovator does not succeed, the technology level of sector i in $t+1$ is equal to the average level of the previous period A_t. We define $a_t = A_t / \overline{A}_t$, which measures the distance to the technology frontier. The evolution of a_t is according to the following equation:

$$a_{t+1} = u_t + \frac{1-u_t}{1+g}a_t\,. \tag{3}$$

After successful innovation[7], sector i has an incumbent, who can transfer one unit general good to one unit intermediate good. Hence, the marginal cost is 1. In addition, there are an unlimited number of people who can copy the latest version of that intermediate good at a cost $\chi > 1$. Hence, regardless of whether innovation succeeds, the price of intermediate goods is χ. A successful innovator can earn a positive profit $\chi - 1$ in one period, whereas in non-innovating sectors production is undertaken under perfect competition. It follows that an unsuccessful innovator will earn zero profit in the next period, and the profit of a successful innovator is

[7] Here, we follow Aghion et al. (2005) to call it "innovation." However, we realized that such innovation is a kind of "imitation" in Acemoglu et al. (2006). A backward economy can catch up with the world frontier only with a probability smaller than 1, which means that, on average, the technology level of backward economies cannot catch up with the world frontier by such "imitation." If a developing economy does not invest in such "imitation," its technology gap will become larger because the world frontier grows constantly.

$$\pi_t = (\chi - 1)\left(\frac{\alpha}{\chi}\right)^{\frac{1}{1-\alpha}} \bar{A}_t = \pi \bar{A}_t . \tag{4}$$

In the first period, the wage rate is given by the marginal products. Hence, we obtain:

$$w_{1t} = (1-\alpha)Y_t = (1-\alpha)\left(\frac{\alpha}{\chi}\right)^{\frac{\alpha}{1-\alpha}} A_t \equiv (1-\alpha)\zeta A_t , \tag{5}$$

where $\zeta = (\alpha/\chi)^{\frac{\alpha}{1-\alpha}}$. Hence, per capita GDP is $Y_t = w_{1t} + u_t \pi_t$, which is equal to

$$Y_t = \bar{A}_t \left((1-\alpha)\zeta a_t + u_t \pi\right). \tag{6}$$

GDP is proportional to the technology frontier $\bar{A}_t$, which represents the spillover effect. On the other hand, it is subject to the technology gap a_t, which, in turn, depends on R&D investments. Therefore, a developing country that aims to catch up with the world technology frontier has great incentive to maximize u_t.

Innovation

Apart from working as a laborer, citizen i invests R&D ($N_t(i)$) in sector i in the first period. The probability of a successful innovation u_t depends on the investment ratio, $n_t = \frac{N_t}{\bar{A}_{t+1}}$, which implies that catching-up is more difficult the higher the new technology frontier. We assume that $u(n_t)$ satisfies $u(\infty) \to 1$, $u(0) = 0$, $u' > 0 \quad u'' < 0$. In a perfect credit market, an individual simply maximizes his/her expected profit:

$$u_t \pi_{t+1} - RN_t . \tag{7}$$

where R is the interest rate. Substituting (4) we have the following optimization problem:

$$\max_{n_t} \left(\pi u(n_t) - Rn_t\right) \bar{A}_{t+1} . \tag{8}$$

In order to ensure an interior solution, we make the following assumption:

Participation assumption: $\pi u'(0) \geq R \quad \forall R > 0$.

Under the participation assumption, individuals are willing to invest in R&D. The

FOC is $\pi u'\left(n^*\right)=R$. Hence, the optimal investment ratio is independent on the technology gap. Individual i borrows from financial markets if her income w_{1t} is smaller than $n^*\overline{A}_{t+1}$, which implies that $a_t < \frac{n^*\left(1+g\right)}{\left(1-\alpha\right)\zeta}$. For a developing economy, the technology gap a_t is always small enough. Hence, catching-up often needs a well-functioning financial market.

Status quo assumption: $a_0 < \frac{n^*\left(1+g\right)}{\left(1-\alpha\right)\zeta}$

Intuitively, the larger the technology gap, the higher the growth rate if there is a perfect financial market. This is consistent with the "advantage of backwardness" (Gerschenkron 1962).

Imperfect financial market

Although financial markets are necessary for economic growth in developing economies, these markets are not well developed in such economies. If financial markets are not perfect, a borrower can defraud if she pays a cost cN_t, where $0 < c < R$. Hence, the condition of non-defrauding is

$$cN_t \geq R(N_t - w_{1t}). \quad (9)$$

Therefore, an individual cannot invest more than

$$N_t^{\max} = \frac{R}{R-c} w_{1t}. \quad (10)$$

Further, he/she cannot borrow more than $\frac{c}{R-c} w_{1t}$ from imperfect financial markets. Since $\frac{c}{R-c}$ increases in c, the lesser the financial markets develop, the fewer are the R&D investments, and in turn, the lower the innovation rate. For $c \to 0$, the individual definitely defrauds. Hence, nobody is willing to lend money to this individual. Therefore, $N_t^{\max} \to w_{1t}$ (i.e., the individual cannot finance with help from financial markets). For $c \to R$, he/she cannot defraud. Hence, financial markets approach perfectness. If there is no binding constraint, then she invests $n^*\bar{A}_{t+1}$. This credit constraint is binding if the unconstrained optimal investment is strictly greater than the innovator's borrowing capacity:

$$n_t^*\bar{A}_{t+1} > \frac{R}{R-c}w_{1t} \Leftrightarrow n_t^* > \frac{R(1-\alpha)\zeta}{(R-c)(1+g)}a_t \equiv \omega(c)a_t \text{, where } \frac{\partial\omega}{\partial c} > 0. \qquad (11)$$

Institutions

We assume that there is a benevolent government that wants to maximize the technology level or minimize the technology gap. This assumption is consistent with Lin's (2003) concept. It could be argued that most developing countries have a dictatorial government (e.g., Shen 2007). Hence, it is not natural to assume them to be benevolent. However, even for a dictator, social welfare (here, it is equivalent to the technology level) is not something that can be entirely neglected—in particular, when it has "encompassing interest" (McGuire et al. 1996). We introduce a benevolent government as a benchmark and then extend the model in section 4 to include a government that is slightly biased toward SOEs.

The government makes an effort E, which can be employed in the following two ways:

1) **The rule of law (general protectionism).** In order to improve financial markets, the government invests b_t in the rule of law (c rises). When c rises, for all investors, the constraint $\omega(c)a_t < n^*$ releases in equal measure. In the early stages of development, the government is probably not able to improve the rule of law to such an extent that c becomes sufficiently large to release the constraint for all. Rearranging $\omega(c)a_t < n^*$, we have a threshold value for c, only if the institutional investment is so large that c is greater than $\tilde{c} \equiv R\left[1-\frac{(1-\alpha)\zeta}{n^*(1+g)}a_t\right]$, and then individuals invest n^*.

Let us assume that $c_t = c(b_t)$, where $c(0)=0$ $c(\infty)=R$, $c'(b)>0$ $c''(b)<0$. Hence, the institutional investment in the rule of law has a normal production function (i.e., diminishing marginal products). For simplicity, we assume $c(b) = \frac{b}{b+1} R$; substituting this in (10), we obtain $N_t^{\max} = (b_t + 1) w_t$ (i.e., the maximal R&D investment increases in the investment of government under the rule of law). Hence,

$$n_t^{\max} \equiv N_t^{\max} \big/ \bar{A}_{t+1} = \frac{(1+b_t)(1-\alpha)\zeta A_t}{\bar{A}_{t+1}} = \frac{(1+b_t)(1-\alpha)\zeta a_t}{1+g} . \tag{12}$$

Let $\omega \equiv \frac{(1-\alpha)\zeta}{1+g}$, we have $n_t^{\max} = (1+b_t)\omega a_t$.

2) **Partial protectionism.** In order to encourage private R&D investments, it is not necessary for the government to establish the rule of law. It can help a portion of the population to borrow sufficient money and invest in R&D. Let us assume that the population share of individuals who can obtain support from the government is λ_t. We call them SOEs because state-owned enterprises are the extreme example of such government support. Once they are supported by the government, they can finance their investments at the optimal level; consequently, their innovation rate is u^*. The other unprotected citizens are called "PEs," representing "private enterprises," whose innovation rate is denoted by $\tilde{u}$. The cost of government support is $d_t = d(\lambda_t)$, where $d(0) = 0$, $d'(0) = 0$, $d'(\lambda_t) > 0 \quad \forall \lambda_t > 0$, $d''(\lambda_t) > 0 \quad \forall \lambda_t \geq 0$. It must be noted that the costs of establishing the two institutions are similar: $b'(0) = 1/R \; vs. \; d'(0) = 0$ and $b'' > 0 \; vs. \; d'' > 0$. This implies that the development of any type of institution is expensive. However, the benefits to both institutions are different in the initial periods: the benefit of the rule of law depends on the initial income of individuals; hence, it is relatively small when the economy is poor. However, the benefit of partial protectionism is independent of the initial income. Hence, it is not beneficial for the government to make the choice of establishing the rule of law in the early stages of development.

The optimization problem of government is given in the following manner:

$$\underset{b_t \geq 0, \lambda_t \geq 0}{Max} \{A_{t+1}\} \quad s.t. \quad b_t + d(\lambda_t) = E . \tag{13}$$

We define $\overline{\lambda} \equiv d^{-1}(E)$, which is the maximal number of SOEs when the government invests everything in partial protectionism and nothing in the rule of law. Then (13) is equal to

$$\max_{\lambda_t}\left\{\lambda_t\left[u^*\overline{A}_{t+1}+\left(1-u^*\right)A_t\right]+\left(1-\lambda_t\right)\left[\tilde{u}\overline{A}_{t+1}+\left(1-\tilde{u}\right)A_t\right]\right\}, \quad (14)$$

$$\text{s.t. } \tilde{u}=u\left[\left(E-d\left(\lambda_t\right)+1\right)\omega a_t\right] \textit{ and } 0\le\lambda_t\le\overline{\lambda}.$$

Again, (14) is equivalent to the maximization of the technology gap in the next period:

$$a_{t+1}=\left\{\lambda_t\left(u^*+(1-u^*)\frac{a_t}{1+g}\right)+(1-\lambda_t)\left(\tilde{u}+(1-\tilde{u})\frac{a_t}{1+g}\right)\right\}; \quad (15)$$

$$\text{FOC: } \frac{da_{t+1}}{d\lambda_t}=\left[u^*-\tilde{u}+(1-\lambda_t)\frac{d\tilde{u}}{d\lambda_t}\right]\left(1-\frac{a_t}{1+g}\right)=0. \quad (16)$$

Because $a_t<1+g$, (16) is equal to $u^*=\tilde{u}-(1-\lambda_t)\frac{d\tilde{u}}{d\lambda_t}$. The left-hand side of the above equation is the benefit received by increasing one unit of λ[8], whereas the right-hand side is the cost. Further, $\tilde{u}$ is the innovation rate of PE—i.e., increasing one unit of SOEs implies reducing one unit of PEs; $-\left(1-\lambda_t\right)\frac{d\tilde{u}}{d\lambda_t}$ is the reduction in the innovation rate for all PEs due to fewer investments in the rule of law. For the sake of convenience, we define the cost function as $G(\lambda_t,a_t)=\tilde{u}-(1-\lambda_t)\frac{d\tilde{u}}{d\lambda_t}$. The interior solution $\lambda^*\left(a_t\right)$ satisfies $G\left(\lambda^*(a_t),a_t\right)=u^*$.

Lemma 1: *Given assumption ∴ 1)* $-\frac{u''(\bullet)}{u'(\bullet)}<\frac{1}{\left(1+E\right)\omega}$ *and 2)* $\frac{d''(\bullet)}{d'(\bullet)}>\frac{2}{1-\overline{\lambda}}$, *we obtain:* $G_\lambda>0, G_a>0$.

Proof: see Appendix 1.

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[8] Here, the benefit of increasing one unit of λ is just u^* because we assume SOEs can borrow at the optimal level n^*. If we release our assumption to let SOEs be slightly inefficient, as most of the existing literature argues, we can assume their innovation rate is $\psi u^*\ \forall\ \psi<1$. Our results do not change qualitatively.

Intuitively, $-\frac{u''(\bullet)}{u'(\bullet)}$ represents the curvature of innovation function $u(\bullet)$, and $\frac{d''(\bullet)}{d'(\bullet)}$ is the curvature of the cost function of partial protectionism. Both assumptions ensure that the curves are bending enough so that the cost of partial protectionism increases in the number of SOEs and the technology level. It implies that partial protectionism will not be optimal in the advanced stages.

Proposition 1: *We define a certain value of technology gap* $a^2 \equiv \frac{n^*}{(1+E)\omega}$. *There exists a threshold value* $\tilde{a} < a^2$, *so that* $\lambda^*(\tilde{a}) = \overline{\lambda}$.

1) For $a_t \leq \tilde{a}$, *the optimal No. of SOEs is* $\overline{\lambda}$;

2) For $\tilde{a} < a_t \leq a^2$, *the government chooses* $\lambda_t^* = \lambda^*(a_t)$, *which satisfies* $\lambda^{*\prime}(a_t) < 0$ *and* $\lambda^*(a^2) = 0$.

3) For $a_t > a^2$, *the government chooses* $\lambda_t^* = 0$.

Proof: See Appendix 2 and figure 1.

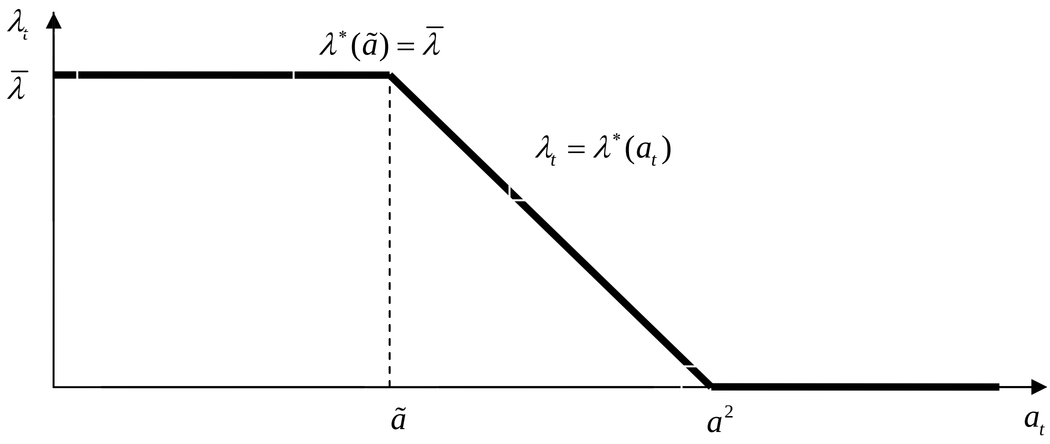

Figure 1

Figure 1 presents the implication of the above proposition. A backward economy needs partial protectionism to trigger the initial growth at very early stages of development. When $a_t \leq a^2$, a_t is so small that even government invests all efforts in the rule of law, the maximal R&D investment of individuals financed by credit markets cannot exceed the unconstrained optimal level n^*. Furthermore, the effect of the rule of law is subject to technology. The lower the level of technology, the lesser is the increase in borrowing capacity when the rule of law is improved. This implies that the government is not willing to invest all efforts in general protectionism in the early stages of development. However, if the government implements partial protectionism strategies, it can induce some individuals to invest at the optimal level. Hence, partial protectionism can generate a higher innovation rate in aggregate than general protectionism in the early stages of development. In particular, if $a_t \le \tilde{a}$, the government invests all efforts to protect SOEs, which could be interpreted as a centrally planned economy. In this case, the evolution equation of a_t is given by[9]

$$a_{t+1} = \bar{\lambda}\left[u^* + (1-u^*)\frac{a_t}{1+g}\right] + (1-\bar{\lambda})\left[\tilde{u}(\omega a_t) + (1-\tilde{u}(\omega a_t))\frac{a_t}{1+g}\right]. \qquad (17)$$

In the second case, $\tilde{a} < a_t \le a^2$, government implements market-oriented reform by reducing the number of SOEs and investing in the rule of law. As a result, the growth rate of the economy increases.[10]

$$a_{t+1} = \lambda^*(a_t)\left(u^* + (1-u^*)\frac{a_t}{1+g}\right) + (1-\lambda^*(a_t))\left(\tilde{u}(a_t) + (1-\tilde{u}(a_t))\frac{a_t}{1+g}\right). \qquad (18)$$

With the increase in a_t, failed enterprises in terms of innovation have a higher technology level ($a_t/(1+g)$), which increases the level of aggregate technology. At the same time, the increase in a_t improves the income of individuals, which implies that they can borrow more from financial markets, which, in turn, increases their

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[9] It is easy to see that $a_{t+1}'(a_t) > 0$ and $a_{t+1}''(a_t) < 0$. Hence, there is, at most, one steady state—a^{1*}. However, it is not very clear whether $a^{1*} < \tilde{a}$.

[10] It is easy to see $\frac{da_{t+1}}{da_t} > 0$. Due to the envelope theorem, we obtain

$$\frac{da_{t+1}}{da_t} = \frac{d\lambda^*}{da_t}\left(\frac{\partial a_{t+1}}{\partial \lambda^*} + \frac{\partial a_{t+1}}{\partial \tilde{u}}\frac{\partial \tilde{u}}{\partial \lambda^*}\right) + \frac{\partial a_{t+1}}{\partial \tilde{u}}\frac{\partial \tilde{u}}{\partial a_t} + \frac{\partial a_{t+1}}{\partial a_t} = \frac{\partial a_{t+1}}{\partial \tilde{u}}\frac{\partial \tilde{u}}{\partial a_t} + \frac{\partial a_{t+1}}{\partial a_t} > 0.$$

innovation rates ($\tilde{u}(a_t)$). This further accelerates the progress in technology. If the economy eventually enters into the third case, where the government establishes the entire system of the rule of law, there are no SOEs. This could be interpreted as a market economy. Then the evolution equation of the technology gap is given as

$$a_{t+1} = u^* + \frac{1-u^*}{1+g} a_t . \tag{19}$$

The steady state is

$$a^{2*} = \frac{u^*(1+g)}{u^* + g} . \tag{20}$$

We find that even in the third case, where the rule of law system is established, the steady state is still smaller than 1 ($a^{2*} < 1$). This is because our assumed innovation is in fact an "imitation." The success of innovation brings enterprises closer to the world frontier, while the failed stay behind the frontier. Hence, on average, a backward economy cannot catch up with the world frontier (i.e., $a^{2*} = 1$) through "imitation." Our model can be extended to include true "innovation"; however, it does not qualitatively change our results regarding the switching of institutions.[11]

3. Innovation with a fixed cost

We now extend our basic model by introducing a fixed cost in the innovation investment; that is,

$$u(n_t) = \begin{cases} 0 & if \quad n_t \le \bar{n} \\ > 0 & if \quad n_t > \bar{n} \end{cases} . \tag{21}$$

Furthermore, if $\forall n_t > \bar{n}$, we have $u' > 0 \quad u'' < 0$. We can define $f(m_t)$ as $\forall n_t > \bar{n} \quad f(m_t) = f(n_t - \bar{n}) = u(n_t)$. Hence, $f'(\bullet) > 0$, $f''(\bullet) < 0$, $f(\infty) = 1$, $f(0) = 0$, and $f'(0) > 0$. Substituting (21) in (8), we obtain, again, $\pi u'(n_t^*) = R$. Now, we need to check whether the local optimal value is globally optimal. For the

[11] The trade-off between imitation and innovation is well discussed in Acemoglu et al. (2006).

case of $\pi u(n_t^*) - Rn_t^* > 0$, we have a positive solution n_t^* satisfied FOC (figure 2); for $\pi\mu(n_t^*) - Rn_t^* = 0$, we have two solutions: one is 0 and the other is positive; for $\pi\mu(n_t^*) - Rn_t^* < 0$, we have a corner solution, which is 0. Hence, the globally optimal solution n_t^E is given by

$$n_t^E = \begin{cases} 0 & if\ \pi\mu(n_t^*) - Rn_t^* \le 0 \\ n_t^* > 0 & if\ \pi\mu(n_t^*) - Rn_t^* \ge 0 \end{cases}, \tag{22}$$

Participation assumption: When there exists a $\overline{R}(\overline{n}, \chi, \alpha)$, $\forall R \in \left(0, \overline{R}\right)$ individuals are willing to invest in R&D. Hereafter, we assume that this assumption holds.

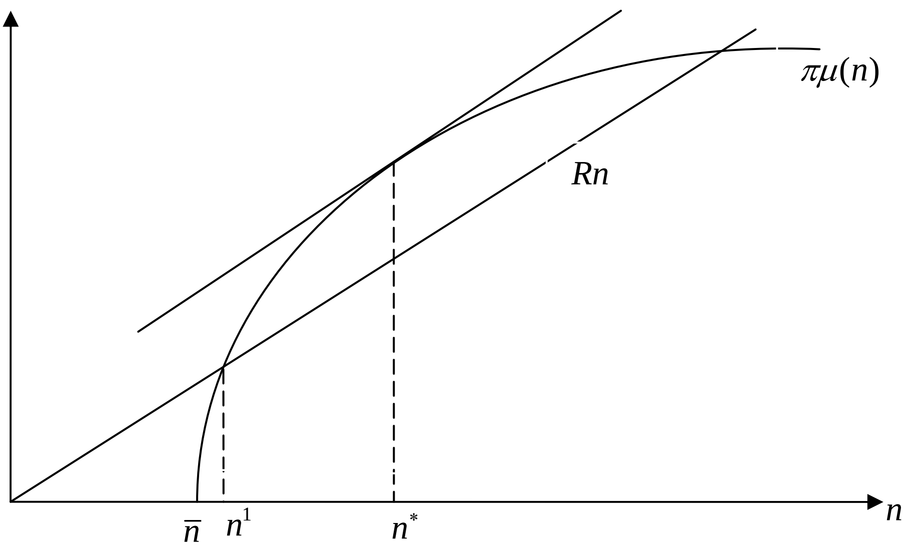


Figure 2

Now, we can distinguish three cases. Case 1: For very low a_t, $\omega\left(c\right)a_t < n^1$, and the optimal R&D investment is zero. Case 2: For $n^1 \le \omega\left(c\right)a_t < n^*$, the optimal R&D investment has a constraint $\omega\left(c\right)a_t$ **,** where n^1 : $Rn^1 = u(n^1)\pi \Leftrightarrow u^1 \equiv u(n^1) = Rn^1 / \pi$ and $n*$: $Rn* = u'(n*)\pi \Leftrightarrow u* \equiv u(n*)$. Case 3: For $\omega\left(c\right)a_t > n^*$, the R&D investment is the unconstraint optimal level $n*$.

Case 1: $a_t < a^1 = \dfrac{n^1}{\omega\left(E+1\right)}$ **.**

In this case, the government has no incentive to invest in the rule of law because individuals are not willing to invest in R&D. Hence, the government uses all efforts for partial protectionism. If the population share of SOEs is $\bar{\lambda}$, the evolution equation of the technology gap is

$$a_{t+1} = \bar{\lambda} u^* + \frac{1 - \bar{\lambda} u^*}{1+g} a_t \,. \tag{23}$$

Further, the steady state is

$$a^{1*} = \frac{\bar{\lambda} u^* (1+g)}{\bar{\lambda} u^* + g} \,. \tag{24}$$

The technology gap decreases (a_t increases) according to the evolution equation (23). Potentially, it will reach the steady state before it is sufficiently large to avoid the case in which $a_t \le a^1$, and then the economy remains as a centrally planned one. There is no market-oriented reform. Moreover, the condition $\frac{\bar{\lambda} u^* (1+g)}{\bar{\lambda} u^* + g} \le a^1$ provides some interesting implications:

Corollary 1: *The likelihood of remaining in the central planning system forever is larger if 1) the world technology frontier grows faster, 2)* n^1 *is larger, and 3)* $\bar{\lambda}$ *is smaller.*

Proof: See Appendix 3.

The world technology frontier can affect domestic institutions. If $g \to 0$, the steady state is $a^{1*} \to 1$. The intuition is rather evident. The lower the growth rate of the world technology frontier, the smaller the technology gap of enterprises that have failed in innovation. Hence, the economy will eventually catch up with the world technology frontier, even under a centrally planned system. Nevertheless, the cost of a centrally planned system becomes increasingly larger with economic growth. The government will eventually find that the rule of law is more cost-beneficial before backward economies catch up with the frontier. Then, it will definitely enter into the second phase, where a market-oriented reform begins. If $g \to \infty$, for backward economies, the failure of innovation implies a larger technology gap in the subsequent period ($a_t/(1+g) \to 0$). Hence, a growth maximization government has a larger incentive to choose centrally planned systems in order to ensure that certain enterprises achieve a higher innovation rate (u^*). In this case, the steady state approaches $\bar{\lambda}u^*$. On the other hand, a^1 approaches infinity due to a very small endowment of $\omega \to 0$. Consequently, the economy remains governed by a centrally planned system forever.

Further, n^1 increases fixed costs; hence, it is more likely for the government to intervene in an industry with higher fixed costs by implementing partial protectionism. We have often found that even in a market economy, there were still many SOEs and government interventions in certain capital intensive industries, such as Airbus in Europe and Die Bahn in German. The airplane industry in Europe was a backward one compared to the United States at that time. The high fixed costs prevented private enterprises from investing in this industry. A government intervention encouraged the establishment of the Airbus Co.

$\bar{\lambda}$ measures the capacity of the government to manage SOEs. A stronger government that can manage many SOEs is capable of inducing a higher growth rate in a centrally planned system, which, in turn, triggers a market-oriented reform in more advanced stages of development. It must be noticed that $\bar{\lambda}$ should be interpreted as the maximum number of efficient SOEs; thus, the inefficiency of SOEs is not included in our simple model (see footnote 8). Hence, our results do not directly contradict the tragic experience in China in the 1960s, when the Chinese government attempted to increase the number of SOEs, even to include the entire agriculture sector. After all farmers became “workers” in state-owned farms, the output declined dramatically and this led to a serious famine. This case precisely reflects that the cost of partial protectionism becomes extremely large if the share of SOEs approaches one.

Hence, the Chinese government was not able to manage so many SOEs, as its $\bar{\lambda}$ was exceeded. A successful story through partial protectionism within $\bar{\lambda}$ (here, the innovation rate of SOEs is optimal, u^*) cannot be duplicated by simply increasing the share of SOEs over $\bar{\lambda}$.

Case 2: $a^1 \le a_t \le \dfrac{n^*}{\omega\left(E+1\right)} = a^2$**.**

The first inequality implies that the maximum R&D investment is able to exceed n^1 if the government invests all efforts in establishing the rule of law. However, the second inequality implies that such R&D investment is still lower than the optimal level, n^*. Consider the decision of the government, b_t, which measures institutional reform: we know that the government is not willing to invest $b_t > 0$ that is so small that $\left(b_t+1\right)\omega a_t < n^1$ because such investment brings nothing to the government. Hence, the government must compare the maximum innovation rate with $b_t > 0$ for $\left(b_t+1\right)\omega a_t \ge n^1$ and the corner solution $b_t = 0$. The optimization problem for $\left(b_t+1\right)\omega a_t \ge n^1$ is expressed in the following manner:

$$\begin{aligned}&\max_{\lambda_t}\left\{\lambda_t\left(u^*\bar{A}_{t+1}+(1-u^*)A_t\right)+(1-\lambda_t)\left(\tilde{u}\bar{A}_{t+1}+(1-\tilde{u})A_t\right)\right\}\\ &s.t.\ \tilde{u}=f\left(\left(E-d(\lambda_t)+1\right)\omega a_t-\bar{n}\right),\qquad and\ \ 0\le\lambda_t\le\tilde{\lambda}_t\end{aligned}, \tag{25}$$

where $\tilde{\lambda}_t = d^{-1}(E - \dfrac{n^1}{\omega a_t} + 1)$. It is the largest number of SOEs when the government invests $\dfrac{n^1}{\omega a_t} - 1$ in establishing the rule of law so that PEs can invest just n^1 in R&D. It is easy to show that $\dfrac{\partial\tilde{\lambda}_t}{\partial a_t} > 0$, which implies more SOEs associated with economic growth if the government keeps the innovation investment of PEs at the minimal level, n^1. Solving the above optimization problem, we have following proposition:

Proposition 2: *Define* $\tilde{\lambda}_t = d^{-1}(E - \frac{n^1}{\omega a_t} + 1)$ *and* $\lambda^*(a_t)$ *as the unconstrained optimal choice for* $a_t \in [a^1,\ a^2]$. *We obtain the following results:*

1. If $u^1 < \frac{\bar{\lambda} - \tilde{\lambda}}{1 - \tilde{\lambda}} u^*$, *government chooses* $\bar{\lambda}$ *until* a_t *exceeds the threshold value* $\tilde{a}$; *thereafter it determines* $\lambda^*(a_t)$. *See figure 1.*

2. If $u^1 \geq \frac{\bar{\lambda} - \tilde{\lambda}}{1 - \tilde{\lambda}} u^*$, *the number of SOEs first decreases from* $\bar{\lambda}$ *to* $\tilde{\lambda}(a^1)$, *which increases in the technology gap,* a_t. *When* a_t *exceeds the threshold value,* $\tilde{a}$, *the government chooses* $\lambda^*(a_t)$, *which decreases in* a_t. *The reduction of SOEs continues until* $\lambda^*(a^2) = 0$. *See figure 3.*

3. The higher the fixed cost, $\bar{n}$, *the greater is the likelihood of the second case (figure 3). If* $\bar{n} \to 0$, *we revert to the basic model (Proposition 1).*

Proof: See Appendix 4.

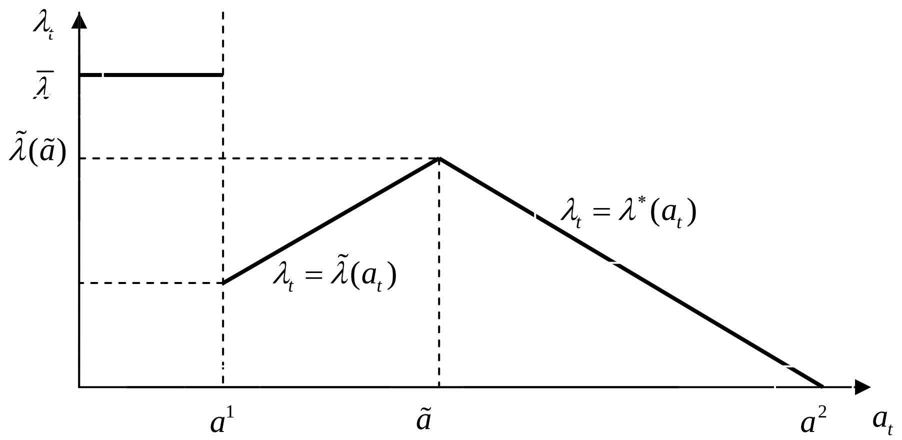


Figure 3

Case 3: $a_t > a^2$.

In this case, the economy enters into a period of general protectionism. The government invests all efforts in the rule of law, and there is no SOE. All PEs invest at the unconstrained optimal level n^*. The economy grows according to (19).

In this section, with fixed costs, we reveal an interesting case where market-oriented reform could be zigzag in transition economies. If fixed costs are sufficiently large, figure 3 shows that the initial reduction of SOEs (from $\bar{\lambda}$ to $\tilde{\lambda}\left(a^1\right)$) is followed by an increase in the number of SOEs. The government induces private investment in R&D from zero to a minimal level n^1, which requires a reduction in the number of SOEs from $\bar{\lambda}$ to $\tilde{\lambda}\left(a^1\right)$. After this initial reform, the technology level is still low and individuals are still poor, thus, the government prefers to partial protectionism. Hence, the effort for investing in the rule of law is maintained at the minimal level, which just induces PEs' investments to be at n^1. With an increase in a_t, the government does not need to invest in the rule of law so much in order to maintain the level of private investment at n^1. Consequently, the number of SOEs increase (i.e., $\tilde{\lambda}(a_t)$ increases in a_t). Only if technology progresses further and exceeds $\tilde{a}$ will individuals become sufficiently rich that the government is willing to reduce the number of SOEs, as well as to improve the rule of law.

This theory could be used to explain the Chinese market-oriented reform, which shows a general market-oriented reform (decreasing SOEs) as well as a tendency called "SOEs forwards and privatization retreats" (*Guojin Mintui* in Chinese) in many industries. As predicted in Proposition 2, this phenomenon is more likely if fixed costs are greater. We can test this prediction using Chinese industrial data.

4. The evidence

The theoretical predictions of this study can be summarized in the following manner: First, in the long run, a growth maximization government prefers partial protectionism in the early stages of development and then switches to the rule of law in the more advanced stages of development. We emphasized the "long run" because there is no "fixed cost" in the long run. Second, in the short run, where fixed costs are important for production, the higher the fixed cost, the larger is the share of SOEs in the industry. The first prediction is consistent with the experiences of many developing countries, which are already well documented by Acemoglu et al. (2006). We interpret the process of a shift from partial protectionism to general protectionism as a market-oriented reform in the economies of China and former Soviet Union. Here, we hope to supply more evidence that in the short run, the path of reform is more zigzag rather than straight.

At the end of 2009, in Shanxi province, where most of China's coal mines are located, the government announced that the reorganization of the coal industry had succeeded in its first step: 98% of small- and middle-sized private mines agreed (by signing contracts) to sell themselves to big state-owned (or province-owned) coal firms—of course, at the price determined by the government. The official reason for such nationalization was to reduce the mortality rate within coal production, as small mines have a higher mortality rate in general. At the same time, in Zhejiang province, which is thousands of kilometers away from Shanxi, the association of private investors placed Shanxi as well as Dubai (due to the real estate bubble) in the black list of the FDI[12] because they lost hundred billions of RMB in this type of nationalization. There have been a few such incidents during the Chinese market-oriented reform in the last few decades. For example, there have been numerous "reorganizations" or "reforms" in the steel and airline industries in recent years.[13] Most of them end up with *Guojin Mintui.* All these stories occurred in such industries where fixed cost investment is important in production.

Apart from for such anecdotes, there is little empirical evidence in the literature to show such a tendency for nationalization because China is implementing a general privatization process. Hence, the share of SOEs reduces in aggregate and general terms. Figure 4a presents the share of output produced by SOEs and collective firms in China in the past two decades.[14] These data are from various years of the China

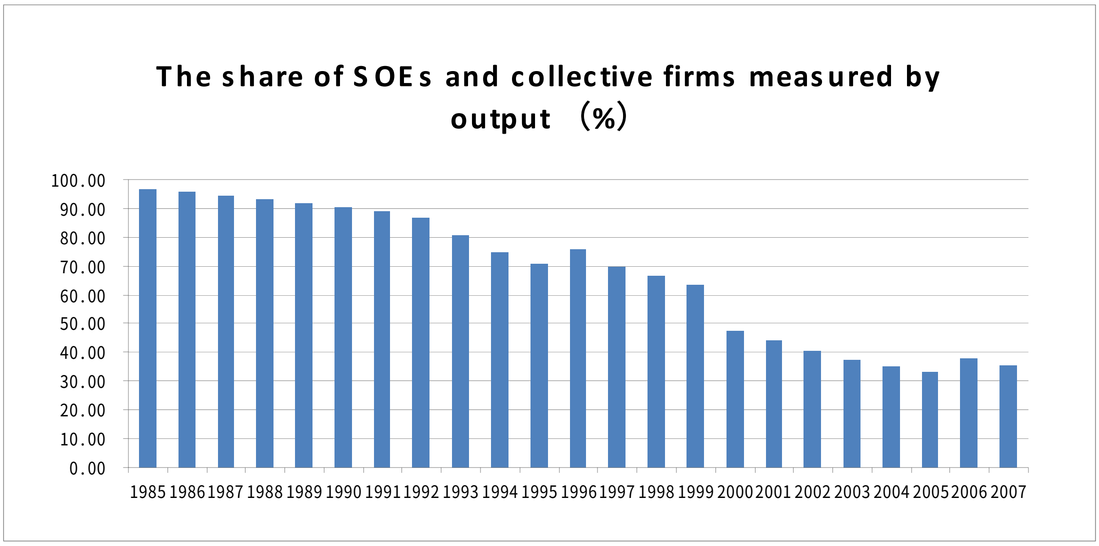
[12] Zhejiang is famous for its private enterprises. Most private coal mines in Shanxi belong to investors from Zhejiang. For details, see related reports in Sina.com, finance.ifeng.com, etc.

[13] There are many reports regarding such incidents; for example, Tieben Steel Co. in Jiangsu province was closed by the central government in 2004, and East Star Airline Co. in Hubei province was closed in 2009.

[14] Loosely speaking, SOEs are owned by the state government and collective firms belong to local governments.

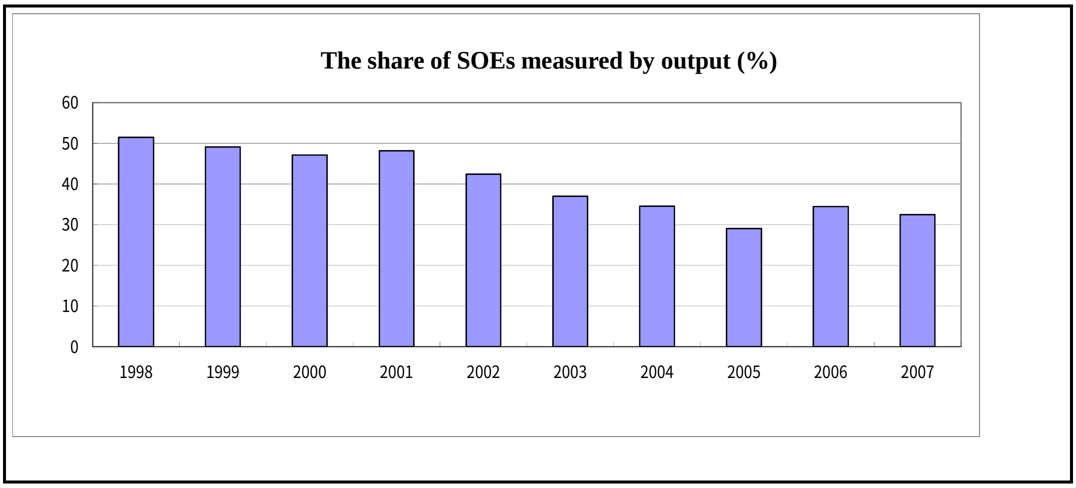
Statistical Yearbook. Since 2000, NBS has changed the measurements of output and SOEs; hence, these data are not fully consistent for before and after 2000. However, there certainly exists a general tendency for privatization.

Figure 4a



Sources of data: various years of the China Statistical Yearbook.

Figure 4b



Sources of data: the industrial dataset of China (1998-2007) published by China's National Bureau of Statistics (NBS). Output is measured by the added value of goods produced by firms.

Our model predicts that the government is willing to increase the share of SOEs in an industry that requires larger fixed costs. This implies that there is a positive relationship between the share of SOEs and fixed costs on the industrial level.

Our data are collected from various years of the China Statistical Yearbook, which can be freely downloaded from http://www.stats.gov.cn/.

Furthermore, large fixed costs induce partial protectionism, which, in turn, leads to more profits for SOEs due to their monopolistic position. Thus, we expect a positive relationship between the share of SOEs and the ratio of SOEs' profits to that of PEs. However, there should be no such relationship between the share of SOEs and the fixed costs ratio of these two types of enterprises because fixed cost is an industrial feature that is independent of the share of SOEs.

Since Chinese Statistical Yearbooks do not supply information on the industrial level, in the following simple regressions, we use the industrial dataset of China during 1998 to 2007 published by NBS.[15] This annual firm-level survey includes the universe of Chinese industrial firms (manufacturing, mining, and construction) in 40 two-digit industries. It reports numerous aspects of firms (e.g., ownerships, capital structures, employees, sales and profits, etc.). Before calculating the industrial aggregate information, we first omitted firms whose revenue is zero. As shown in Figure 4b, there is also a general tendency toward privatization revealed in these industrial data, which are consistent with the aggregate information from Chinese Statistical Yearbooks. In order to investigate the relationship between the share of SOEs and fixed costs, we construct the core variable—*the share of SOEs in industry i in year t*—measured by the added value of outputs produced by firms.

$$shareofSOEs_{it} = \frac{the\ added\ value\ of\ SOEs\ in\ industry\ i\ in\ year\ t}{the\ aggregate\ added\ value\ of\ industry\ i\ in\ year\ t}$$

There is no such information for the years 2001 and 2004; however, the dataset reports tax revenue on the basis of added value. Hence, we use this as the instrumental variable for both years. The other important variable is fixed cost. The dataset reports *fixed assets investment* for each firm, which we use as the index of fixed costs in our model. Others variables are *profit before tax per worker and wage before tax per worker.*

First, we investigate the following cross-sectional regression.

$$GrowthrateofSOE_{i98-07} = \beta_1 shareofSOEs_{i98} + \beta_2 fixed\cos t_{i98} + \beta_3 wage_{i98} + \varepsilon_i . \quad (26)$$

[15] This dataset is not free and we can supply the data resources upon request. Many recent studies on the Chinese economy use this dataset (for example, Song et al. 2011).

The dependent variable $GrowthrateofSOE_{i98-07}$ is *the annual growth rate of the share of SOEs* from 1998 to 2007. The independent variables are the initial *share of SOEs in 1998* and the initial level of *fixed costs* and *wages per worker*. As shown in the first column of table 1, the initial fixed cost has a positive relationship with the following growth rate of the share of SOEs, which is significant at a 10% confidence level. The revealed positive relationship is consistent with our theoretical prediction. However, when we add *the wage per worker in 1998* in the regression, both are insignificant. It seems that the government pursues partial protectionism in certain industries not only because of higher fixed cost but also higher wage level, although both are highly correlated. This could be interpreted as a biased-to-SOEs government, which aims to maximize the wage income of the employees of SOEs.

Table 1

	Growth of SOEs for the period 1998–2007	
SOEs in 1998	-0.215	-0.206
	(-0.99)	(-0.96)
Fixed cost in 1998	0.381	0.152
	(1.76)	(0.563)
Wage in 1998		0.314
		(1.4)

Note: t-values are given in parentheses.

We ran a panel regression in order to investigate the relationship between fixed costs and the share of SOEs at the industrial level. Thus, the basic estimating equation is given as

$$shareofSOE_{it} = \beta_1 fixed\cos t_{it} + \beta_2 profit_{it} + \beta_3 wage_{it} + \varepsilon_i . \qquad (27)$$

The main results are summarized in table 2. Initially, all independent variables were run separately. All variables showed a negative correlation with the share of SOEs. However, when we put all three variables together, both fixed effect and random effect show a significant positive relationship between the fixed cost in industry and its share of SOEs. This confirms our theoretical prediction. In order to show the causality, we ran the regression using a 1 period-lagged variable. There is no qualitative change in the results. Thus, we can conclude from this simple regression that larger fixed costs induce partial protectionism.

Table 2

Share of SOEs	Fixed effect				Random effect
Fixed cost	-0.032381			0.0293796	0.0462919
	(-3.95)			(2.94)	(4.77)
Profit		-0.015		0.0304703	0.03445
		(-2.01)		(3.75)	(4.13)
Wage			-0.86883	-1.345136	-1.45076
			(-9.44)	(-9.88)	(-10.43)
Lagged 1 period	Fixed effect				Random effect
Fixcost1	-0.040612			0.0146429	0.0411701
	(-4.13)			(1.19)	(3.48)
Profit1		-0.011		0.0368787	0.0434197
		(-1.18)		(3.64)	(4.14)
Wage1			-0.8453	-1.228916	-1.395232
			(-7.59)	(-7.36)	(-8.14)

Note: t-values are given in parentheses.

Finally, we test the prediction that partial protectionism leads to a higher ratio of SOEs' profits to that of PEs, whereas no such relationship exists between the share of SOEs and fixed costs. Since the literature often argues that SOEs have a soft budget constraint so that the wage of workers is often linked with the profit of SOEs, we expect that there exists a positive relationship between the share of SOEs and the wage per worker in SOEs. Table 3 roughly confirms our predictions (see the last column). The effect of the share of SOEs on the fixed cost of SOEs is not significant, whereas the effect on profits and wages of SOEs are significantly positive at the 10%

and 5% confidence levels, respectively. The effect on wages of SOEs implies that it is of interest to see the behavior of a biased-to-SOEs government. We extend our basic model in this direction in the following section.

Table 3

The ratio of fixed costs of SOEs to PEs						
Share of SOEs	0.003 (1.21)			0.002 (0.82)	0.0028 (0.14)	**0.002** **(0.77)**
Profits per worker		-0.0014 (-3.93)		-0.001 (-3.82)		-0.0014 (-3.17)
Wage per worker			-0.012 (-2.43)		-0.0115 (-2.11)	0.0006 (0.10)
The ratio of profits per worker of SOEs to PEs						
Share of SOEs	-0.001 (-0.14)			0.007 (1.24)	0.007 (3.29)	**0.011** **(1.65)**
Profits per worker		0.01 (13.21)		0.001 (13.28)		0.011 (10.14)
Wage per worker			0.088 (6.8)		0.109 (7.63)	0.018 (1.18)
The ratio of wages per worker of SOEs to PEs						
Share of SOEs	0.0018 (1.33)			0.002 (1.74)	0.0065 (4.55)	**0.006** **(4.52)**
Profits per worker		0.0007 (3.57)		0.0007 (3.74)		0.000 (-0.36)
Wage per worker			0.0146 (5.73)		0.02 (7.3)	0.021 (6.15)

Note: t-values are given in parentheses. The fixed effect is shown in this table. The random effect regression produces the same results.

5. An SOE-biased government

The above discussion assumed a growth maximization government that aims to maximize the technology level for the entire society. It is possible that it establishes an institution *de facto* that is biased to SOEs (i.e., partial protectionism); however, it is not biased *de jure*. Although we can interpret such a government as a dictatorial one whose interests have encompassed in the social welfare, someone could still challenge that the government in a gradualism reform is somewhat *de jure* biased toward SOEs. This is the important feature for gradualism. In a transition economy with a “Big

Bang" strategy, all SOEs transformed to PEs in a short period. Hence, the government has less incentive to be biased toward SOEs. However, for the government in a gradualism economy like China, the situation is different. In such an economy, both SOEs and PEs coexist for a long time. Hence, it is natural for the government to give more consideration to the technology of SOEs (as well as their profits) more than that of PEs. Here, we model it by assuming a higher weight for SOEs in the objective function of the government.[16]

$$\begin{aligned} &\max_{\lambda_t} V_{t+1} = (1+\theta)\lambda_t\left(u^*\overline{A}_{t+1} + (1-u^*)A_t\right) + (1-\lambda_t)\left(\tilde{u}\overline{A}_{t+1} + (1-\tilde{u})A_t\right) \\ &s.t. \quad \tilde{u} = f\left((E - d(\lambda_t)+1)\omega a_t\right), \quad and \quad 0 \le \lambda_t \le \overline{\lambda} \end{aligned} . \qquad (27)$$

Solving (27), we obtain

$$\text{FOC: } \frac{dV_{t+1}}{d\lambda_t} = u^*\left(\overline{A}_{t+1} - A_t\right) + \theta u^*\left(\overline{A}_{t+1} - A_t\right) + \theta A_t - \left(\tilde{u}_t - (1-\lambda_t)\frac{d\tilde{u}_t}{d\lambda_t}\right)\left(\overline{A}_{t+1} - A_t\right) = 0 \qquad (28)$$

Compared to the basic model, the above FOC equation has two additional items. $\theta u^*\left(\overline{A}_{t+1} - A_t\right)$ represents the extra utility from the successfully innovated SOEs and θA_t is that from the failed SOEs. These additional items change the behavior of the biased government. Rearranging (28), we obtain

$$\frac{dv_{t+1}}{d\lambda_t} = \frac{1+g-a_t}{1+g}\left\{\theta\left(1+u^*\right) + \theta\frac{a_t}{1+g-a_t} - G(\lambda_t, a_t)\right\}, \qquad (29)$$

where $v_t = V_t / \overline{A}_t$. Defining $H(\lambda, a, \theta) \equiv \theta\left(1+u^*\right) + \theta\frac{a_t}{1+g-a_t} - G(\lambda_t, a_t)$, if $\theta \to 0$ then we revert to the basic model; if $\theta \to \infty$, then $H(\lambda, a, \theta) >> 0$; hence, we obtain the corner solution $\lambda^* = \overline{\lambda}$. The intuition is clear from this. If the government is too biased toward SOEs, it is not willing to implement market-oriented reforms. If the government is totally neutral, both SOEs and PEs are equally important in its utility function. Then, the government chooses the optimal strategy at different stages of development entirely on the basis of the growth maximization consideration. Now, we turn to the interesting case where the government is a little biased toward SOEs—that

[16] In this section, we assume $\overline{n} = 0$ for the sake of simplicity.

is, θ takes a medium value.

Proposition 3：*Let* $\theta_1 \equiv G_a(\bar{\lambda},0)$, $\theta_2 \equiv \frac{G_a(\bar{\lambda},1)g^2}{1+g}$, *where* $\theta_1 > \theta_2$.

1) If $\frac{G\left(\bar{\lambda},1\right)}{G_a\left(\bar{\lambda},1\right)} < \frac{u*}{G_a\left(\bar{\lambda},1\right)} + \frac{g\left(1+gu*\right)}{1+g}$ *, then the government with a higher* θ *(*$\exists\hat{\theta}\in\left(0,\ \theta_2\right)$ $\forall\theta>\hat{\theta}$*) is willing to insist on "partial protectionism" forever, i.e.,* $\lambda^*=\bar{\lambda}$ $\forall a_t$*; and the government with a lower* θ *(*$\theta\le\hat{\theta}$*) prefers to establish "general protectionism" when* a_t *exceeds a certain threshold value.*

2) If $\frac{G\left(\bar{\lambda},1\right)}{G_a\left(\bar{\lambda},1\right)} \ge \frac{u*}{G_a\left(\bar{\lambda},1\right)} + \frac{g\left(1+gu*\right)}{1+g}$*, there exists a transitory market-oriented reform between the above two extreme ones.* $\exists\tilde{\theta}\in\left[\theta_2,\theta_1\right]$ *for* $\theta>\tilde{\theta}$*, the government insists that* $\lambda^*=\bar{\lambda}$ *for any* a_t*; and for* $\theta<\theta_2$ *the government initiates a stable reform where the number of SOEs reduces steadily to zero with economic growth.* $\forall\theta\in\left[\theta_2,\ \tilde{\theta}\right]$*, the government implements "partial protectionism" in the early stages of development,* $\lambda^*=\bar{\lambda}$ *(*a_t *is small); thereafter, the government reduces the number of SOEs and begins to establish the rule of law (*λ_t *reduces) when* a_t *exceeds certain threshold values. However, when* a_t *grows further, the government is willing to increase the number of SOEs again and eventually reverts to the original case where* $\lambda^*=\bar{\lambda}$*.*

Proof: See Appendix 5 and figure 5.

Proposition 3 distinguishes three possible cases of institutional reforms: 1) when the government insists on partial protectionism and there is no reform; that is, $\lambda^*=\bar{\lambda}$ $\forall a_t$, which we call "the stable central-planning economy"; 2) the stable and irrevocable market-oriented reform, where the government initially chooses $\lambda^*=\bar{\lambda}$ for a small a_t and then switches to reducing λ for a big a_t (see figure 1); and 3) the transitory market-oriented reform, where the government begins to reduce λ and then reverts to $\lambda^* = \bar{\lambda}$ with economic growth.

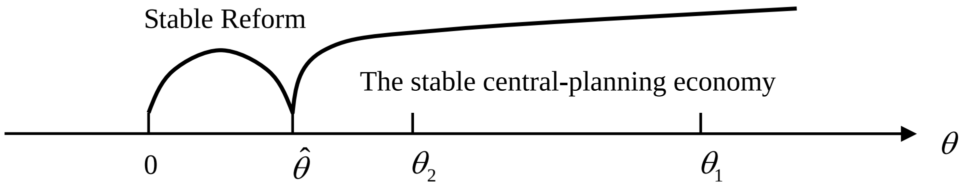


Figure 5a The case of Proposition 3 (1)

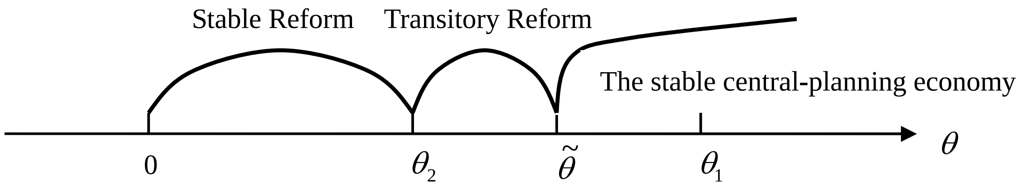


Figure 5b The case of Proposition 3 (2)

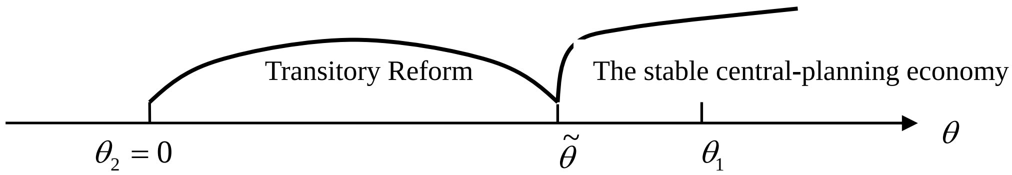


Figure 5c The extreme case of Proposition 3 (2) $g = 0$

Figure 5a presents the first result, which is very intuitive. It is of interest to see the second one (figure 5b) because it implies that the positive gradualism in China could be a transitory phenomenon. When an economy grows further, a *de jure* biased-to-SOEs government has great incentive to revert to partial protectionism. In this sense, the “Big Bang” strategy is dominant because it eliminates the possibility of *de jure* biased-to-SOEs government. Further, our result implies that the possibility of this transitory gradualism stems from the cost of partial protectionism. $G\left(\bar{\lambda},1\right)$ is the cost when there is no technology gap ($a=1$), and $G_a\left(\bar{\lambda},1\right)$ is its marginal cost; the condition that $\frac{G\left(\bar{\lambda},1\right)}{G_a\left(\bar{\lambda},1\right)}$ is sufficiently large implies that only a large cost of partial protectionism is not enough to induce such transitory gradualism reform. Only if the cost of partial protectionism is large relative to its marginal cost will such reform occur.[17]

The second interesting implication of this condition is the effect of the growth rate of the world technology frontier (g) on the possibility of this transitory reform. If $g \to 0$, the condition degenerates to $G\left(\bar{\lambda},1\right) \geq u^*$ which holds for all θ. Hence, we have only two possibilities: One is the stable central-planning economy, and the other is the transitory reform (see figure 5c). In other words, if g increases, θ_2 also rises. Hence, the domain of the transitory reform decreases whereas the stable reform increases.

The faster the world frontier progresses, the larger the cost of partial protectionism becomes. Hence, a backward economy with a *de jure* biased-to-SOEs government is more likely to initiate a stable market-oriented reform. This theoretic prediction could be consistent with the experience of Chinese reform. China established a centrally planned economy from the beginning of the 1950s. It achieved a high growth rate at that time, in particular in the 1950s and the beginning of the 60s. However, from the 60s to the 70s, the growth rate of other East Asian economies accelerated, and the Chinese growth rate declined.

These East Asian Tigers could be interpreted as frontiers for China because in our model, the frontier is the level that a backward economy can attain through innovation investment in one period. For China, the economic performance of the East Asian Tigers is more important than that of the United States or Japan in this sense. Facing the economic success of the East Asian Tigers, China initiated market-oriented reform in the 1980s. However, for the former Soviet Union, the United States was likely the frontier. Hence, the accelerated progress of the East Asian Tigers had less effect on the reform of the former Soviet Union, whereas good economic performance in the United States and technological progress in the weapon

[17] It is a stricter condition than that $G\left(\bar{\lambda},1\right)$ is sufficiently large.

competition of the "cold war" pushed the former Soviet Union onto the track of reform in the 1990s.

Of course, this interpretation does not confirm that Chinese gradualism reform is stable and irrevocable. As we indicated earlier, gradualism reform could strengthen a *de jure* biased-to-SOEs government, which will possibly induce a transitory reform. However, we treat the measurement of bias exogenously, which simplifies the analysis. This could be unsatisfactory because the number of SOEs changes along with gradualism reform. We leave this aspect as a possible subject for future research.

6 Concluding remarks

This paper addressed an important question: "Why were some inefficient institutions, such as those in a centrally planned economy, established in the early stages of development and then abandoned in more advanced stages?" Our model treats this as the process of switching from partial protectionism to general protectionism. The government of a backward economy wants to maximize the growth rate with two institutional tools: either to protect certain individuals in order to promote their investments or to improve the rule of law in order to induce R&D investments for all. In the early stages of development, the rule of law benefits less because individuals are poor. However, under partial protectionism, resources can be collected for a few persons. Hence, its effect on the growth rate is relatively large. This strategy can be interpreted as a centrally planned economy because SOEs represent the extreme case of partial protectionism.

With economic growth, the cost of partial protectionism becomes larger and the benefit of general protectionism increases as well. Hence, it is reasonable for a backward economy to implement a market-oriented reform at more advanced stages of development. We modeled this as a reducing number of SOEs and increasing default cost under imperfect financial markets. This reform could be zigzag when we introduce a fixed cost in the R&D investment. The theoretical prediction that higher fixed costs lead to an increase in the number of SOEs is consistent with empirical evidence. There are also many cases in Chinese reform that confirm this prediction.

The other important extension is to allow a *de jure* biased-to-SOEs government, which is the important feature of gradualism reform. We distinguished two possible reform tracks: one is stable and irrevocable and the other is transitory. If the cost of partial protectionism (which can be interpreted as the distortion of a centrally planned economy) is sufficiently large, then a transitory reform is possible even for a very biased government. The world technology frontier can affect the reform process in a backward economy. The acceleration in the growth of the world technology frontier increases the possibility of an irrevocable reform and reduces that of transitory reform. This conclusion supplies a reasonable interpretation for the reform processes in China and the former Soviet Union.

There are many aspects that can be delineated for further research. For example, we assumed a fixed effort for the government. In fact, it is endogenous if we interpret it as the tax revenue. Then, the total amount of available resources of the government depends on the strategy that it adopts. Further, we can also endogenize the bias measurement θ within a market-oriented reform. It would be interesting to ascertain whether market-oriented reform can be self-reinforced.

Appendix

Appendix 1

Using Assumption 1 we can prove $G_a\left(\lambda_t, a_t\right) > 0$

$$G_a = \omega\left\{ f'(\cdot)\left(E - d(\lambda_t) + 1\right) + (1-\lambda_t)\left(E - d(\lambda_t) + 1\right) f''(\cdot)\omega a_t d'(\lambda_t) + (1-\lambda_t) f'(\cdot) d'(\lambda_t) \right\}$$

$$\frac{G_a}{\omega f'(\cdot)} = \left(E - d(\lambda_t) + 1\right) + (1-\lambda_t) d'(\lambda_t) + (1-\lambda_t)\left(E - d(\lambda_t) + 1\right)\omega a_t d'(\lambda_t)\frac{f''(\cdot)}{f'(\cdot)}$$

$$> \left(E - d(\lambda_t) + 1\right) + (1-\lambda_t) d'(\lambda_t) - (1-\lambda_t)\left(E - d(\lambda_t) + 1\right) a_t d'(\lambda_t)\frac{1}{\left(E+1\right)}$$

$$= \left(E - d(\lambda_t) + 1\right) + (1-\lambda_t) d'(\lambda_t)\left[1 - \frac{E - d(\lambda_t) + 1}{E+1} a_t\right] > 0$$

Using Assumption 2 we can prove $G_\lambda\left(\lambda_t, a_t\right) > 0$

$$G_\lambda = \omega a\left[(1-\lambda) d''(\lambda) f'(\cdot) - 2 d'(\lambda) f'(\cdot) - (1-\lambda)\left[d'(\lambda)\right]^2 f''(\cdot)\omega a\right]$$

$$-\frac{G_\lambda}{\omega a_t} = 2d'(\lambda_t) f'(\cdot) + (1-\lambda_t)\left[d'(\lambda_t)\right]^2 f''(\cdot)\omega a_t - (1-\lambda_t)d''(\lambda_t) f'(\cdot)$$
$$< 2d'(\lambda_t) f'(\cdot) - (1-\lambda_t)d''(\lambda_t) f'(\cdot)$$
$$< 2d'(\lambda_t) f'(\cdot) - (1-\lambda_t)\frac{2}{1-\bar{\lambda}} d'(\lambda) f'(\cdot)$$
$$= 2d'(\lambda_t) f'(\cdot)\left\{1-\frac{1-\lambda_t}{1-\bar{\lambda}}\right\} < 0$$

Appendix 2

Solving FOC (16), we obtain $G\left(\lambda^*(a_t), a_t\right) = u^*$. Hence, the optimal choice $\lambda^*\left(a_t\right)$ is the function of a_t. Consider the case $\lambda_t = 0$ at first. Because $d'(0) = 0$ we have:

$$G(0, a_t) = f\left((E+1)\omega a_t\right) + \omega d'(0) f'\left((E+1)\omega a_t\right) a_t = f\left((E+1)\omega a_t\right)$$

Hence, $G(0, a^2) = f\left((E+1)\omega a^2\right) = u^*$. From lemma 1 we know $G_a > 0$, hence, for $a_t < a^2$, $G(0, a_t) < u^*$. $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\lambda=0} = \left[u^* - G\left(0, a_t\right)\right] \geq 0$. Only when $a_t = a^2$, the ruler chooses $\lambda_t = 0$.

Now turn to the case $\lambda_t = \bar{\lambda}$. $G\left(\bar{\lambda}, a_t\right) = (1-\bar{\lambda})d'(\bar{\lambda}) f'\left((E+1)\omega a_t\right)\omega a_t$. Hence, $G\left(\bar{\lambda}, 0\right) = 0 < u^*$. From $G_\lambda > 0$ and $G(0, a^2) = u^*$ we know $G\left(\bar{\lambda}, a^2\right) > u^*$. Therefore there exists a threshold value $\tilde{a} \in \left[0, a^2\right]$ so that $G(\bar{\lambda}, \tilde{a}) = u^*$.

For $a_t \in \left(0, \tilde{a}\right]$, $G(\bar{\lambda}, a_t) \leq u^*$, $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\lambda=\bar{\lambda}} = \left[u^* - G\left(\bar{\lambda}, a_t\right)\right] \geq 0$. Hence, the ruler chooses $\lambda_t = \bar{\lambda}$;

For $a_t \in \left(\tilde{a}, a_2\right]$, $G\left(\bar{\lambda}, a_t\right) > u^*$, $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\lambda=\bar{\lambda}} = \left[u^* - G\left(\bar{\lambda}, a_t\right)\right] < 0$. Together with $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\lambda=0} = \left[u^* - G\left(0, a_t\right)\right] \geq 0$ there is an interior solution $\lambda^*\left(a_t\right)$ so that:

$$G\left(\lambda^*(a_t), a_t\right) = u^*$$

It is easy to see that $\frac{d\lambda^*(a_t)}{da_t} = -\frac{G_a}{G_\lambda} < 0$ and $\lambda^*\left(\tilde{a}\right) = \bar{\lambda}$. See figure 1.

Appendix 3

We rearrange the condition $a^{1*} \le a^1$ to get: $\frac{\bar{\lambda} u^*}{\bar{\lambda} u^* + g} \le \frac{a^1}{1+g}$. According to the definition of a^1, we know that $\frac{a^1}{1+g} = \frac{n^1}{\omega(1+E)(1+g)} = \frac{n^1}{(1-\alpha)\zeta(1+E)}$, which is independent on g. Therefore, if $g \to 0$, then $\frac{\bar{\lambda} u^*}{\bar{\lambda} u^* + g} \to 1$. We know $1 > \frac{a^1}{1+g}$, hence, the economy will definitely enter into the next stage. If $g \to \infty$, then $\frac{\bar{\lambda} u^*}{\bar{\lambda} u^* + g} \to 0$. The economy will definitely stay in the first case. The condition holds more easily for a larger value of n^1.

Appendix 4

In order to solve (23) we obtain

FOC: $$\frac{da_{t+1}}{d\lambda_t} = \left\{ u^* - \tilde{u} - (1-\lambda_t) f'(\cdot) d'(\lambda_t) \omega a_t \right\} \left(1 - \frac{a_t}{1+\text{g}} \right) = 0$$

and SOC:

$$\frac{d^2}{d\lambda_t^{\ 2}} = \left(1 - \frac{a_t}{1+\text{g}} \right) \omega a_t \left\{ 2d'(\lambda_t) f'(\cdot) + (1-\lambda_t) \left[d'(\lambda_t) \right]^2 f''(\cdot) \omega a_t - (1-\lambda_t) d''(\lambda_t) f'(\cdot) \right\} < 0$$

where $f(\cdot) = f\left(\left(E - d(\lambda_t) + 1 \right) \omega a_t - \bar{n} \right)$.

Given assumption 2 $\frac{d''(\lambda)}{d'(\lambda)} > \frac{2}{1-\bar{\lambda}}$, SOC is satisfied.

We consider $\left. \frac{da_{t+1}}{d\lambda_t} \right|_{\lambda = \tilde{\lambda}}$ at first:

$G\left(\tilde{\lambda}(a_t), a_t \right) = f\left(n^1 - \bar{n} \right) + \omega a_t \left[1 - \tilde{\lambda}(a_t) \right] d'\left(\tilde{\lambda}(a_t) \right) f'\left(n^1 - \bar{n} \right)$ which increases in a_t. (because of $G_{\lambda_t}(\lambda_t, a_t) > 0$ and $\frac{\partial \tilde{\lambda}_t}{\partial a_t} > 0$) For $a_t = a^1$, $\tilde{\lambda}\left(a^1\right) = 0$ and then $G\left(0, a^1\right) = f\left(n^1 - \bar{n} \right) < u*$ hence $\left. \frac{da_{t+1}}{d\lambda_t} \right|_{\substack{\lambda = \tilde{\lambda} \\ a = a^1}} > 0$; for $a_t = a^2$,

$G\left(\tilde{\lambda}\left(a^2\right),a^2\right)>G\left(0,a^2\right)=u*$ hence $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\substack{\lambda=\tilde{\lambda}\\ a=a^2}}<0$. Therefore, there exists a threshold value $\tilde{a}$ so that $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\substack{\lambda=\tilde{\lambda}\\ a=\tilde{a}}}=0$.

Then we consider $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\lambda=0}$: Since $G_a(\lambda_t,a_t)>0$, we have $G\left(0,a_t\right)=f\left(\left(1+E\right)\omega a_t-\bar{n}\right)<G\left(0,a^2\right)=u*$, hence $\left.\frac{da_{t+1}}{d\lambda_t}\right|_{\lambda=0}>0$. For $a_t\in\left[a^1,\tilde{a}\right]$, the solution of (22) is the corner solution $\tilde{\lambda}\left(a_t\right)$, we show it in figure 6a; for $a_t\in\left[\tilde{a},a^2\right]$ we have an interior solution $\lambda^*\left(a_t\right)$, which is shown in figure 6b. Furthermore, it is easy to see that $\frac{d\lambda^*\left(a_t\right)}{da_t}=-\frac{G_a}{G_\lambda}<0$ and $\tilde{\lambda}\left(\tilde{a}\right)=\lambda^*\left(\tilde{a}\right)$.

For the case of figure 6a， $a_t\in\left[a^1,\tilde{a}\right]$. We can distinguish two sub-cases:

Case 6a-1: $a_{t+1}\left(\tilde{\lambda}\left(\tilde{a}\right),\tilde{a}\right)\geq\bar{\lambda}u^*+\frac{1-\bar{\lambda}u^*}{1+g}\tilde{a}$. In this case, government reduces the number of SOEs from $\bar{\lambda}$ to $\tilde{\lambda}\left(a_t\right)$ at time t before $\tilde{a}$ reaches. Because $\tilde{\lambda}\left(a_t\right)$ increases in a_t, this reduction of SOEs is temporary, the number of SOEs $\tilde{\lambda}\left(a_t\right)$ arises with the growing technology.

Case 6a-2: $a_{t+1}\left(\tilde{\lambda}\left(\tilde{a}\right),\tilde{a}\right)<\bar{\lambda}u^*+\frac{1-\bar{\lambda}u^*}{1+g}\tilde{a}$. In this case, government doesn’t reduce the number of SOEs.

Now we turn to simplify the condition $a_{t+1}\left(\tilde{\lambda}\left(\tilde{a}\right),\tilde{a}\right)\geq\bar{\lambda}u^*+\frac{1-\bar{\lambda}u^*}{1+g}\tilde{a}$

where $a_{t+1}\left(\tilde{\lambda}\left(\tilde{a}\right),\tilde{a}\right)=\tilde{\lambda}\left(\tilde{a}\right)\left[u*+\left(1-u*\right)\frac{\tilde{a}}{1+g}\right]+\left(1-\tilde{\lambda}\left(\tilde{a}\right)\right)\left[u^1+\left(1-u^1\right)\frac{\tilde{a}}{1+g}\right]$

$$=\frac{\tilde{a}}{1+g}+\left[\tilde{\lambda}\left(\tilde{a}\right)u*+\left(1-\tilde{\lambda}\left(\tilde{a}\right)\right)u^1\right]\left(1-\frac{\tilde{a}}{1+g}\right)$$

Hence, the condition equivalents to $\tilde{\lambda}\left(\tilde{a}\right)u*+\left(1-\tilde{\lambda}\left(\tilde{a}\right)\right)u^1\geq\bar{\lambda}u*$ which is, in turn,

$u^1 \geq \frac{\bar{\lambda} - \tilde{\lambda}(\tilde{a})}{1 - \tilde{\lambda}(\tilde{a})} u*$. When $\bar{n}$ arises, u^1 increases and $\frac{\bar{\lambda} - \tilde{\lambda}(\tilde{a})}{1 - \tilde{\lambda}(\tilde{a})}$ decreases. Thus, the condition is more likely to satisfy. When $\bar{n} \to 0$, $a_{t+1}\left(\tilde{\lambda}(\tilde{a}), \tilde{a}\right) \to \bar{\lambda} u^* + \frac{1 - \bar{\lambda} u^*}{1+g} \tilde{a}$. It is consistent with the basic model.

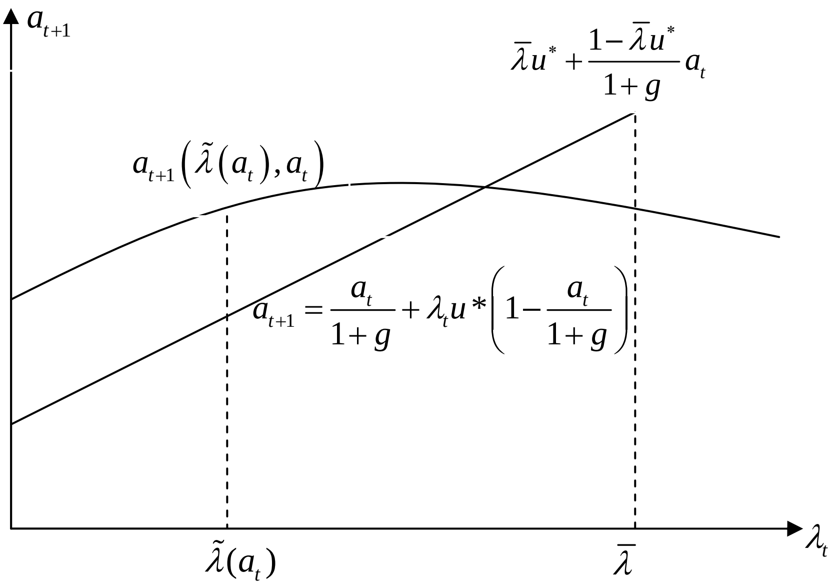


Figure 6a

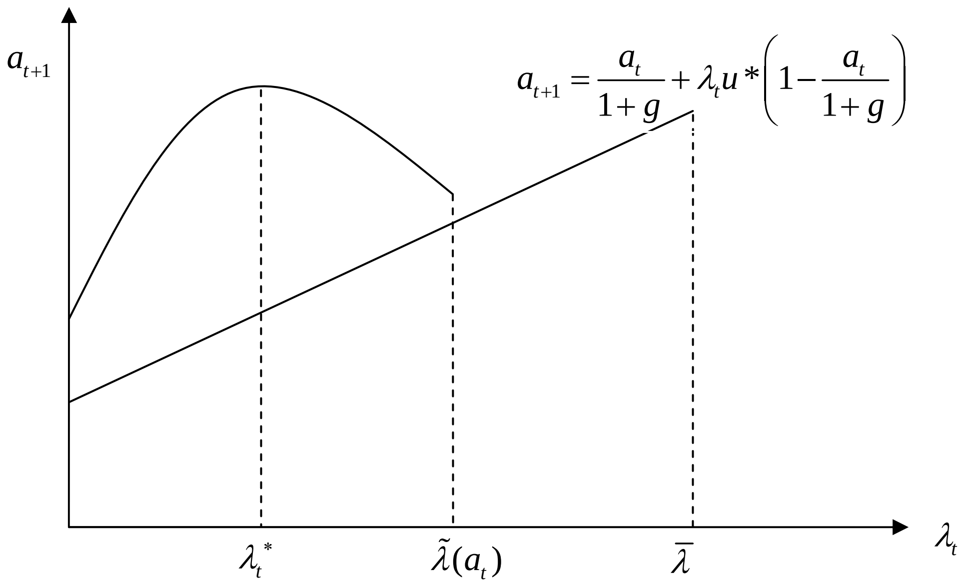


Figure 6b

For the case of figure 6b， $a_t \in \left[\tilde{a}, a^2\right]$.

Because $a_{t+1}\left(\lambda^*\left(a^2\right),a^2\right)=a_{t+1}\left(0,a^2\right)=u^*+\frac{1-u^*}{1+g}a^2>\bar{\lambda}u^*+\frac{1-\bar{\lambda}u^*}{1+g}a^2$, there must exist a point of time $a_t\in\left[\tilde{a},a^2\right]$, after that government reduces the number of SOEs from $\bar{\lambda}$ to $\lambda^*\left(a_t\right)$. Because $\lambda^*\left(a_t\right)$ decreases in a_t, the reduction of SOEs continues until $\lambda^*\left(a_t\right)=0 \quad a_t=a^2$.

Appendix 5

$$H(\lambda,a,\theta)=(1+\theta)u^*+\theta\frac{a}{1+g-a}-G(\lambda,a)\ ,$$

we have $H_\theta>0$ and $H_\lambda<0$ because of $G_\lambda>0$.

Case 1: $\forall\theta>G_a(\bar{\lambda},0)\equiv\theta_1$ **we have** $\lambda^*=\bar{\lambda}$ **.**

Proof: At first $H_a(\bar{\lambda},0,\theta)=\theta-G_a(\bar{\lambda},0)>0$ in this case, then we have $H_{aa}(\bar{\lambda},a,\theta)=\frac{2\theta(1+g)}{(1+g-a)^3}-G_{aa}(\bar{\lambda},a)>0$ because of $G_{aa}<0$, hence, $\forall\theta>G_a(\bar{\lambda},0)$ we have $H_a(\bar{\lambda},a,\theta)>0$. Because we know already $H(\bar{\lambda},0,\theta)=\theta(1+u^*)>0$, together with $H_a(\bar{\lambda},a,\theta)>0$ we conclude $H(\bar{\lambda},a,\theta)>0$. Because of $H_\lambda<0$, $H(\lambda,a,\theta)>0 \quad \forall\lambda$ Hence, we have the corner solution $\lambda^*=\bar{\lambda}$. Intuitively, if the government is too biased to SOEs ($\forall\theta>\theta_1$), it is not willing to set up the rule of law.

Case 2: $\forall\theta\in\left[\theta_2,\theta_1\right]$ *where* $\theta_2\equiv\frac{G_a(\bar{\lambda},1)g^2}{1+g}$ **, the government could choose a** $\lambda^*<\bar{\lambda}$ **if the minimal value of** $H\left(\lambda,a,\theta\right)$ **is negative, i.e.,** $G\left(\bar{\lambda},1\right)>\left(1+\theta_2\right)u*+\frac{\theta_2}{g}$ **; otherwise** $\lambda^*=\bar{\lambda}$.

Proof: in this case we have $H_a(\bar{\lambda},0,\theta)<0$ and $H_a(\bar{\lambda},1,\theta)>0$. Hence, there exists a $\hat{a}(\theta)\in(0,1)$ so that $H_a(\bar{\lambda},\hat{a}\left(\theta\right),\theta)=0$ because of $H_{aa}>0$. The $H(\bar{\lambda},\hat{a}\left(\theta\right),\theta)$

is the minimal value and $dH\left(\bar{\lambda},\hat{a}(\theta),\theta\right)/d\theta = H_\theta > 0$ because of the envelop theorem. The maximal value of $H(\bar{\lambda},\hat{a}(\theta),\theta)$ is $H\left(\bar{\lambda},\hat{a}(\theta_1),\theta_1\right)$, which is positive; and the minimal value of $H(\bar{\lambda},\hat{a}(\theta),\theta)$ is $H\left(\bar{\lambda},\hat{a}(\theta_2),\theta_2\right)$.

Case 2a: if $H\left(\bar{\lambda},\hat{a}(\theta_2),\theta_2\right)$ **is positive**, then $H(\bar{\lambda},a,\theta)>0$ and in turn we have the same conclusion as the case 1: $\lambda^* = \bar{\lambda}$.

Case 2b: if $H\left(\bar{\lambda},\hat{a}(\theta_2),\theta_2\right)$ **is negative**, there must exist a $\tilde{\theta}\in[\theta_2,\theta_1]$ so that $H\left(\bar{\lambda},\hat{a}(\tilde{\theta}),\tilde{\theta}\right)=0$ and $H(\bar{\lambda},\hat{a}(\theta),\theta)<0 \quad \forall\theta<\tilde{\theta}$. Hence, there exists a stage of development $a_t\in[a**,a*]$ when $H(\bar{\lambda},a,\theta)<0 \quad \forall\theta<\tilde{\theta}$. (see following figure) Furthermore, $H(0,a,\theta)>0 \quad \forall\theta$. The government choose an interior solution $\lambda*<\bar{\lambda}$ in $a_t\in[a**,a*]$. It is easy to know that $\frac{d\lambda^*}{d\theta}=-\frac{H_\theta}{H_\lambda}>0 \quad \frac{d\lambda^*}{da}=-\frac{H_a}{H_\lambda}$.

Hence, $\frac{d\lambda^*}{da}<0 \quad \forall a_t\in[a**,\hat{a}]$ and $\frac{d\lambda^*}{da}>0 \quad \forall a_t\in[\hat{a},a*]$. Intuitively, if the government is a little biased to SOEs ($\forall\theta<\tilde{\theta}$), then it is willing to begin a market oriented reform when the technology level grows above the certain threshold value ($a_t\in[a**,a*]$). However, the reform is transitory. After further growing and $a>a^*$, the government turns back to the "partial protectionism" $\lambda^*=\bar{\lambda}$.

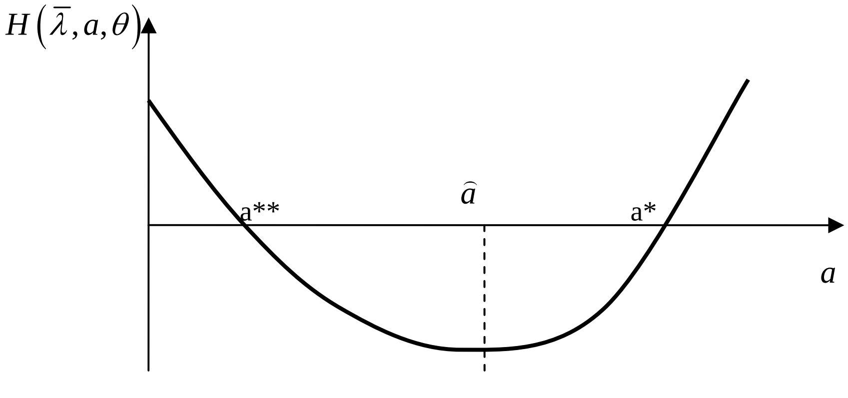


Figure 7

The condition $H\left(\bar{\lambda},\hat{a}\left(\theta_2\right),\theta_2\right)<0$ implies that $\left(1+\theta_2\right)u*+\frac{\theta_2}{g}-G\left(\bar{\lambda},1\right)<0$ because $\hat{a}\left(\theta_2\right)=1$. Substitute $\theta_2\equiv\frac{G_a(\bar{\lambda},1)g^2}{1+g}$ into it we have $u*-G\left(\bar{\lambda},1\right)+\frac{G_a(\bar{\lambda},1)g}{1+g}\left(1+gu*\right)<0$. We divide $G_a\left(\bar{\lambda},1\right)$ on both sides to get $\frac{u*}{G_a\left(\bar{\lambda},1\right)}+\frac{g\left(1+gu*\right)}{1+g}<\frac{G\left(\bar{\lambda},1\right)}{G_a\left(\bar{\lambda},1\right)}$.

Case 3: $\forall\theta\in\left[0,\theta_2\right]$ *where* $\theta_2\equiv\frac{G_a(\bar{\lambda},1)g^2}{1+g}$ **there must exist a** $\hat{\theta}$ **so that** $\forall\theta<\hat{\theta}$ **we have the same conclusion as Proposition 1.**

Proof: in this case, $H_a(\bar{\lambda},1,\theta)<0$ and the minimal value of $H(\bar{\lambda},a,\theta)$ is $H(\bar{\lambda},1,\theta)$ instead of $H(\bar{\lambda},\hat{a}\left(\theta\right),\theta)$. Because $H(\bar{\lambda},1,\theta)=\left(1+\theta\right)u*+\frac{\theta}{g}-G\left(\bar{\lambda},1\right)$ increases in θ, and $H(\bar{\lambda},1,0)=u*-G\left(\bar{\lambda},1\right)=G\left(0,a^2\right)-G\left(\bar{\lambda},1\right)<0$, there must exist $\hat{\theta}$ so that $\forall\theta<\hat{\theta}$ $H(\bar{\lambda},1,\theta)<0$. In this case, the government chooses the "partial protectionism" $\lambda^*=\bar{\lambda}$ if $a_t\in\left(0,\tilde{a}\right)$ and then begins market oriented reform $\lambda*<\bar{\lambda}$ if $a_t\in\left(\tilde{a},1\right)$. It is same as Proposition 1.

Together with above two sub cases, we know that:

Case 3a: if $H\left(\bar{\lambda},\hat{a}\left(\theta_2\right),\theta_2\right)$ **is positive**, then $\hat{\theta}<\theta_2$

Case 3b: if $H\left(\bar{\lambda},\hat{a}\left(\theta_2\right),\theta_2\right)$ **is negative**, then $\hat{\theta}=\theta_2$.

Combining three cases together, we have proofed the proposition 3.

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