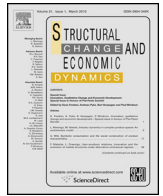




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Toward a unified theory of economic reform[☆]

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ABSTRACT

The dichotomy in the economics of transition literature with regard to the reform speed (Gradualist vs Radical Approach) and reform strategy (incremental reform vs structural reform) fails to capture the essence of the transitional process of a transitional economy that was ever under the control of planned economic system. In this paper, we construct a system dynamics model to provide a unified theoretical framework to illustrate that reform speed and reform strategy are inherently intertwined. We propose 4 optimal reforming combinations between reform speed and reform strategy to track the transitional trajectories of different transitional economies since 1980s. These 4 optimal reforming combinations are: (1) Incremental reform in radical speed. (2) Incremental reform in gradualist speed. (3) Structural reform in radical speed. (4) Structural reform in gradualist speed. In this paper, we demonstrate that a transitional economy would adopt one of the aforementioned 4 optimal reforming combination if and only if it minimizes the reforming cost incurred during the shock period of radical reform as well as the dual track period of gradualist reforms. Several factors in our model affecting these 4 optimal reforming combinations are also discussed. These factors include the spillover effect (both vertical and horizontal) of a newly established reforming promotion sector on other old sectors in a transitional economy, the endogenous reform damping coefficient determined by one transitional economy's initial conditions and the reform damping coefficient determined by the dual track system during the gradualist reform process.

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1. Introduction

In the literature on the economics of transition, two different schools of thought have conjectured how a socialist economy should transform from planned economy to a market economy to secure best economic performance during the transition.¹ One view

is that the transitional process is effective if and only if a transitional economy adopts the big-bang mode or one package of reform in a very radical approach (Sachs and Lipton, 1990; Blanchard, 1996; Williamson, 2000; Lardy, 1998; Woo, 1999). Radical reform was highly valued among economic theorists, as well as Eastern European and Soviet Union policy makers in the early 1980s because it

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¹ In this paper, the "transition" is defined as the transitional process of one country from a planned economy to a market economy. However, some transitional economists adopt different definitions. For instance, the Hungarian economist Kornai (2000) sees "transition" as one country's transformation from socialism to capitalism and contends that this transformation depends on whether the socialist

economic and political systems are replaced by capitalist economic and political systems. In other words, a complete "transition" involves both a planned economy and the Leninist one-party leadership system being transformed into a market economy and multi-party system. Sachs et al., (2000) define "transition" as the convergent process of the systems of post-socialist countries to observing rules of the global economy under WTO regulations. In their paper, the implementation of constitutional reforms is a significant criterion for assessing the completeness of the transition by a single socialist country. Without undergoing a constitutional transition, a socialist country cannot complete a full transitional process. This paper does not give value-judgements to the above definitions. For further details on the definition of "transition", please refer to Kornai, (2000), "What the Change of System from Socialism to Capitalism Does and Does not mean", Journal of Economic Perspectives, volume 14, Number 1, Winter 2000, pp. 27–P42 and Sachs et al. (2000) "Economic Reforms and Constitutional Transition", Annals of Economics and Finance, Vol.1, pp. 260–274

provides the clear policy aims that are compatible with the rationalist approaches of neo-classical economists.

In general, economic policies derived from the radical reform mode mainly include the following four aspects: (1) The swift implementation of price liberalization and the abolition of government subsidies; (2) The achievement of a balanced budget and implementation of tight monetary policy; (3) Accelerated integration of international trade, removing government's control of foreign exchange by lowering tariffs; and (4) Massive privatization of state-owned enterprises. It could well be argued that the effectiveness of the radical reform in a transitional period is determined by whether the reform can reduce the proportions of old upstream sectors in the economy and transform these old upstream sectors into new private sectors.

Another view is that the radical reform mode will dramatically destroy the information structure of the original economy and inevitably damage the social group with vested interests, resulting in the reform process of a long shock (Lin, etc. 1994). Hence, it is more effective for a transitional economy to adopt the gradualist mode with partial economic reforms. The core of the gradualist reform is that it should not damage the old economic sectors. In addition, the gradualist transitional mode is characterized by the pilot reforming method, which establishes the new downstream sectors in the margins of old ones and finally transits smoothly into a market economy.

China adopted the gradualist reforming approach in 1978, when its reform and economic up began and the sharp contrast between its rapid economic growth and the unprecedented recession in Russia and Eastern Europe after their big-bang mode reforms has raised the very important question of the superiority of radical reform. Noting the apparent paradox, several economists began to advocate the view that the gradualist approach would enable a transitional economy to transit into a market economy more effectively (Lau et al., 2000; Naughton, 1994a, 1994b; Rawski, 1996; Jefferson and Rawski, 1994; Murrell, 1992; McMillan and Naughton, 1992).

The advocacy of the gradualist reform approach largely relies on the superior performance of the incremental reform shown in the gradual transitional process in countries such as China, Vietnam, etc. (Fan, 1993; Lin et al., 1994; Sheng, 1996; Naughton, 1994a, 1994b). The major feature of incremental reform is the formation of a dual economy and a two-sector economic structure, namely, the dual-track system. As Zhang and Yi have argued (1994) from the example of China, the strategy of incremental reform in the transitional process typifies that in many reform fields, such as reforms of the price system, the foreign exchange market, the labor market and the ownership system, etc. Naughton, (1994a, 1994b) argues that the formation of a dual system has enabled the Chinese economy to grow beyond what the plan proposed and push further the reform of some old sectors, especially the state-owned one. In contrast, compared with the incremental reform strategy adopted in countries such as China and Vietnam, Eastern Europe and Russia have used a structural reform strategy, in the opinion of many mainstream economists (Wu, 2003; Kornai, 1990).

The growth of non-state owned enterprises out of the planned system and the establishment of new private firms are not generally the main reforming packages in structural reform; rather, the privatization of state-owned enterprises and price liberalization are given priority in this process. Lin et al (1994) consider that there are two major shortcomings in structural reform: first, the changes in resource allocation induced by structural reforms that benefit some groups in the society but not others may harm the latter. That is to say, structural reforms have a capacity to improve the welfare of certain social groups at the expense of certain others. Therefore, this type of reform strategy illustrates “Non-Pareto Improvement” or “Non-Kaldor Improvement”. Second, although structural reform tries to transfer resource from low productivity sectors to high pro-

ductivity sectors, it usually ignores the cost of reform. Since reform will certainly cost something, for instance, the shock period cost resulting from the shock therapy for transferring resources from one use to another. Thus, economic growth during a structural reform process is inevitably shown as either a “J” curve or, worse, an “L” curve trajectory.

Neither the discussion of the respective superiority of distinct reform speeds (radical reform and gradualist reform), nor the analysis of the advantages or disadvantages of specific reform strategies (incremental or stock) has captured the essence of the dynamics of economic performance in the post-socialist countries since the 1980s. For example, even if a gradualist approach is conclusively superior, it cannot explain why the adoption of gradualist reform (1985–1991) by the Soviet Union and Eastern European countries failed. Moreover, supposing incremental reform strategy is more effective than structural reform strategy, it is hard to explain why China has achieved great success in some structural reform fields, such as reform of the ownership system of small and medium sized state-owned enterprises.² Some economists argue that it is not reasonable to describe all the characteristics of Chinese reforms as gradualist in nature. Some reforms such as the “reform of the household contract responsibility system”, “price reform in five years” and “the ownership system reform in small and medium sized state-owned enterprises” are radical (Wu, 1994, 2003). Lin even holds that such gradualist reforms could be regarded as a mini bang (Lin, et al).³

If the arguments presented by these economists are justified, then it is even more difficult using the present transitional economic theories to explain why China has achieved success in its radical reform while the Soviet Union and Eastern Europe have failed in theirs. This paper argues that the current literature has not investigated reform speed and reform strategy in a unified analytical framework and this has led to the inconsistency between the literature and the practice.

1.1. The transitional strategies adopted by Latin America and Africa

The reforms initiated by countries in Latin America and Africa could be regarded as a template for the shock-therapy in the Soviet Union in the early 1990s. For instance, as argued by Morley et al., (1999), structural reforms in the area of international trade, financial liberalization, tax reform, capital account and privatization were widely implemented in Latin American countries from 1970 to 1995. Moreover, according to Lora (1997), all these structural reforms in Latin American aimed to recover economic efficiency and reduce the long-standing persistence of government interference over the market. One could demonstrate that, in Latin American countries at the time, the core of structural reform was twofold. First, the reforms highly emphasized the role of liberalization of the economy. This included the reduction of regulations in terms of trade policies and the liberalization of financial sec-

² According to the research of Professor Wu (2003), around 1995, state-owned enterprises reform began to show strategic progress, with the main indicator being the proposal of policy “to invigorate large enterprises while relaxing over small ones”, which meant that the government did not privatize or partially privatize the ownership system of the large state-owned enterprises that were relevant to national survival, but did privatize the small or medium sized ones through mergers, contracting, selling or bankruptcy, etc. For more information about the reform of Chinese state-owned enterprises, please refer to Wu (2003), “Contemporary Chinese Economic Reform”, pp.177–180, Shanghai Far-East Press.

³ ‘Price reforms in five years’ is a package of reforms which was first initiated by Premier Minister ZiYang Zhao since 1984. Its policy aim was to replace the planned price track with the market track within 5 years. The whole reform lasted for about 5 or 6 years and, until the 1990s, all the price planned tracks had been replaced by the market price system.

tors, allowing more capital inflows and outflows. Second, these reforms made privatization the priority for enterprise restructuring and the enhancement of efficiency at firm level. The reforms in Africa in the 1980s exhibited a similar pattern. As pinpointed by Bienen and Herbst (1996), more than thirty African countries in the 1990s tried to liberalize their political systems and reinvigorate their economies by stabilization and structural adjustments within the economy. Especially with reference to the prudent management of structural adjustments in the Latin American countries, many African countries in the 1980s, implemented simultaneous political and economic structural changes.

1.2. The transitional strategies adopted by the Eastern European countries and the Soviet Union

Needless to say, the African and Latin American countries were the laboratory for wide-ranging structural reforms, which provided something of a template for shock-therapy in the post-Soviet space. However, the effects of this still remain a puzzle in terms of why the post-Soviet and Eastern European economies countries performed differently in the 1990s. The most influential work on explaining such difference is by Kornai (1990) who has created an analytical framework that consists mainly of two basic reform strategies. Strategy A is called the strategy of organic development and Strategy B is called the strategy of accelerated privatization. These two development strategies are compared in the following table.

It can easily be derived from Table 1 that Kornai thinks the Soviet Union adopted Strategy B by accelerating the privatization of state-owned enterprises as the core of reform implementation, whereas the Eastern European countries such as Hungary and Poland adopted Strategy A, the organic development with the movement of non-state-owned sectors from bottom to top. The classification of two different transitional strategies is compatible with the definition of specific reform strategies proposed in this paper. According to the content of Strategy A, what Kornai means by it is incremental reform strategy, while Strategy B could be regarded as the equivalent of structural reform strategy.⁴

Kornai's framework provides a possible explanation why the Eastern European countries performed much better and achieved much more stable growth than the Soviet Union. In countries such as Poland and Hungary, the reforms are more incremental and do not have privatization at their core. Instead, in order to avoid the loss of welfare and of employment for technically redundant workers brought about by very large-scale privatization, the entry of non-state owned enterprises is encouraged, with the guarantee that a complete financial system will grow around them. All these undertakings facilitate much more stable growth such as is found in the Eastern European countries. Nonetheless, the weakness of Kornai's analysis is that speed actually matters in the performance of transitions. According to our paper, speed makes a difference when it comes to the interplay with the reforming strategy. Different interactions between reform speed and reform strategy would largely affect a country's performance in a period of transition.

1.3. The hypothesis of this paper

Our main contribution in this paper is to show the effectiveness of reform during the transition; we also show that the cost minimization in radical reform and the dual-track system in gradualist reform are determined by whether the country has adopted the optimal combination of reform speed with reform strategy. In this paper, four combinations of reform speeds and specific reform strategies are illustrated by the following 2×2 matrix:

		Specific reform strategy	
		Structural	Incremental
reform speed	Radical	Structural reform at radical speed	Incremental reform at radical speed
	Gradual	Structural reform at gradualist speed	Incremental reform at gradualist speed

The rest of this paper is arranged as follows: Part two is the literature review. Part three is the solving of the model. This model explains why the optimal combination between reform speed and specific reform strategy can greatly reduce the shock period cost in radical reform and the dual-track system cost in gradualist reform. Part four holds the policy implications of this model and the concluding discussions. The final remarks are in part five.

2. Literature review

2.1. Literature review of the theoretical work on transitional strategies

Theoretical work on the economics of transition is largely concerned with relative effectiveness of different transitional strategies. For instance, Murphy et al., (1992) demonstrate that some partial reform measures, such as the market-track price in a dual-track price system, will distort the prices planned by government. Hence resource allocation will inevitably be distorted if price control is not relaxed altogether. Furthermore, Ericson (1991) basing his work on the inherent characteristics of the Soviet Union's planned economy, demonstrates why radical reform is necessary. He expounds the characteristics of the Soviet Union's planned economy system from the nine standpoints in which they are interdependent. Ericson concludes that, from this point of view, that a partial or gradualist reform could not wholly replace the original interrelated systematic elements in a planned economy. So radical reform is the only way to establish free market system quickly.⁵

The failure of partial market reform in the Soviet Union and Eastern Europe in the late 1980s was the earliest example for arguments supporting radical reform to draw on. These arguments imply that partial market-oriented reform could not enable the market to play a dominant role in resource allocation. Therefore, only through shock therapy, which abandons the whole system of a traditional planned economy, and through price liberalization and state-owned enterprises privatization, can the economy be transformed into a complete free market economic system

⁴ Rana and Paz (1994) proposed a different classification of reform modes in 1994. They named the reform method in China, Vietnam and Laos, etc. the "Asian approach" while the reform method in the Soviet Union and Eastern Europe, following the Washington consensus, as the "standard approach". In their view, the Asian approach is a reform mode that starts from the bottom and moves up. In this reform mode, micro reform (such as price reform, enterprise reform, etc.) starts first and then macro reform (finance reform, monetary reform) follows. The standard approach is a reform mode that moves downwards from the top, with macro reform as the priority.

⁵ Ericson (1991) has listed nine systematic elements to describe the characteristics of Soviet Union's planned economy system, namely (1) The resolving of decision and conflicts is dominated by an authoritarian hierarchical structure. (2) The production and distribution of goods are finished by a highly centralized planned system. (3) Resources could be mobilized in an all around manner through a centralized planned system. (4) Strict planned rationing existed in the economy. (5) Strict price control. (6) The system lacked response capability and no real currency existed. (7) No adequate substitution of the already existing economic relationships. (8) The economic performance evaluation was totally determined by superior sectors. (9) It lacked an effective incentive structure in micro aspect. Citation from Ericson, R. (1991) "The classical Soviet-Type Economy: Nature of the system and implications for reform", *Journal of Economic Perspective*, vol. 5, no.4. 11–27

Table 1
Major features of two transitional strategies.

Strategy A, meant to	Strategy B, meant to
1. Create conditions to enable private sectors to move from bottom to up	1. Eliminate state-owned ownership as much as possible through the privatization of state-owned enterprises.
2. Transform most state-owned enterprises to private-owned ones by selling them	2. Complete privatization through free distribution of warrants, etc.
3. Prevent the free distribution of state-owned property in any form	3. Prefer the formation of decentralized ownership system
4. Prioritize the selling plan that can generate production owners	4. Not emphasize the move of private enterprise from bottom to up and not to promote the status of private enterprise.
5. Tighten the budget constraints on enterprises and strengthen the development of the financial market to guarantee the effective running of a market economy.	5. Privatize state-owned enterprises to automatically harden budget constraints.

Source: Wu (2003), "Contemporary Chinese Economic Reform", pp.34, Shanghai Far-east Press

(Kornai, 1990; Ericson, 1991; Blanchard, 1991; Nolan, 1993; Sachs and Lipton, 1990, etc.)

Nolan (1993) listed four specific policy measures for radical reform, namely (1) Close down the state-owned firms on a large scale to achieve rapid economic growth through the private ownership of small and medium private enterprises; (2) Make the market demand and supply reflect the optimal resource allocation through complete price liberalization; (3) Implement policy quickly in the short term, to set up the new non-state firms without delay, the sooner the better; and (4) Integration with the world economy by removing the regulations covering foreign exchange and trade.

In addition to Nolan's discussion (1992) on the specific policy proposals for radical reform, Sachs and Lipton, (1990) also comes up with some detailed policy suggestions about shock therapy: (1) Adopt a tight monetary policy by controlling the scale of borrowing by the whole society and reduce financial subsidies and fiscal deficit to constrain the aggregate demand of the economy and also to contain inflation by closing the gap between aggregate demand and aggregate supply; (2) Liberalize prices completely. Price should be determined by market demand and supply; (3) Promote the development of a free trade system by liberalizing currency exchanges and removing the control over trade; (4) Establish a market structure with perfect competition through breaking industry monopolies for state-owned enterprises and eliminating the restrictions on private firms; and (5) Privatize state-owned enterprises on a large scale in order to establish a mixed market economy mode based on private ownership. It can be seen that Sachs' specific policy suggestions have three main aspects: the stabilization of macro reform, economic liberalization and privatization. These three aspects make up a complete policy system and policy purpose for shock therapy.

Our paper partially agrees with the view that radical reform has the advantage of establishing the new institutions in a very short time, which might avoid the resource distortion caused by partial reforms. At the same time, our paper contends that one might need to further divide the radical approach reforms into two different kinds to better assess the effectiveness of radical reforms. One type of radical reformation proposed by our paper is radical reforms with structural characteristics and the other one is radical reform with incremental characteristics. According to our paper, the first type of radical reform largely resembles what is normally assumed of shock therapy reforms in the literature and it is effective only if the cost arising from the shock period is minimized. Whether or not the shock period cost of radical approach reforms is minimized is mainly contingent upon the optimal vertical spillover effect between the old upstream firms and the new downstream ones. The vertical spillover effect is subsequently determined by the initial conditions of a transitional economy such as its economic governance structure. In our paper, the vertical spillover effect directly affects the optimal trade-off between incremental reform at radical speed and structural reform at radical speed.

The theoretical work on gradualist reforms mainly focuses on discussing the feasibility of implementing gradualist reforms from the perspective of a cost-benefit analysis of them (Lin et al, 1994; Fan, 1993; Dewatripont and Roland, 1992a, etc.) Through the cost-benefit analysis of the gradualist reforms which were adopted in China, Lin et al (1994) argue that the gradualist reform, having the four major advantages of increasing total social output, incremental reform, pilot promotion and non-radicalization, is thus endowed with the nature of a Pareto improvement.

First, the reform could continuously expand the total amount of resources, and hence increase the allocated quota of resources to each type of interest group. Thus, the resistance to reform from the interest groups who will be harmed will shrink and in turn the cost of reform may go down. Second, some incremental reform measures, such as the emergence of township enterprises and the implementation of a dual-track system, enable some sectors to hugely develop, even if they had been under pressure from heavy industry in the planned economy era, albeit with the comparative advantages of the Chinese factor endowment structure. This, on the one hand, increases the benefits to new downstream sectors (such as the functions of market-tracking and township enterprises). On the other, once the benefit is large enough to offset the loss of the vested interest groups that have been harmed, this type of reform has the nature of a Pareto improvement.

According to Zhang and Yi (1994), the dual-track system also benefited the original vested interest groups, such as the government bureaucrats, and this would have caused more bureaucratic officials to support the reform. Likewise, Fan (1993) finds that as long as the economic benefits are high enough, for example, the escalating employment level caused by the new downstream sectors, different social groups will become less dependent on the old upstream sectors and finally the reform progress will proceed with minimal resistance. Similarly, Dewatripont and Roland (1992), point out that when the compensation cost for present political restrictions is greater than the allocation gains of radical reform, gradualist reform is more feasible than radical reform.

In general, gradualist reforms with the feature of pilot promotion have three advantages, which can maximize the net benefit of the reform. These three advantageous factors are as follows: (1) reform based on the partial and pilot features could disperse the cost of trial and error so as to avoid the high reform risk from suppressing information during the decision making process; (2) when the pilot reform and incremental reform are bundled together, the information about which type of reform is most beneficial can also be obtained; and (3) a better environment for market growth and development is created. To add a further advantage, non-radical reform can avoid large scale reform shock and wasted resources whereas radical reform is bound to damage some social groups'

vested interests and hence to increase reform resistance and cost.⁶

In regard to the incremental features of gradualist reform, the salience of the dual-track system is well-known. Many economists think the adoption of a dual-track system, especially dual-track price system, enables gradualist reform to maximize the benefits of reform in the transitional period (Naughton, 1994a, 1994b; Chen et al., 1992; McKinnon, 1994; Byrd, 1989, 1988; Hallagan and Zhang, 1999, etc.) Chen et al., (1992) find two major advantages in adopting a dual-track price system: (1) after completing the production assigned by planned targeting, the relevant sectors can trade the rest of their production in the market, which may optimize the allocation of resources; and (2) it can lower the risks of economic reform risk, since the introduction of the market track paves the way for the ensuing price reform and enterprise reform. McKinnon (1994) also claims that because the price dual-track system was introduced in the Chinese state-owned sectors' in the early stages of the reform, it may have enabled China to avoid the risk of an inflation tax.

Our paper argues that the existing literature on the theoretical aspect of gradualist reforms fails to take account of two factors. First, they fail to incorporate the dual track system into the framework of vertical production network in a transitional economy. Since industrial reforms normally start by allowing the downstream sectors to emerge at the beginning of the transition, most of the former socialist economies prioritized the development of such upstream sectors as heavy industry. During this process, it is theoretically worth exploring whether the entry of downstream sectors in the vertical production network will affect the growth of upstream sectors. In our model, its effect is contingent upon whether the upstream sectors receive a high or a low level of subsidy, which in turn decides the degree of sequential substitutability between the new and the old sectors, ultimately affecting the optimal vertical spillover effect in the vertical production network.

The entry effect of the downstream sectors on the upstream sectors will largely determine how the different types of gradualist reforms work in our model. This is the second point in which our paper differs from preceding papers. We classified the gradualist reform into two types. One is incremental reform at gradualist speed and the other is gradualist reform at radical speed. By associating the incremental reforms with the speed of reforms in this paper, we can explain why the incremental reforms in Eastern Europe and Soviet Union failed whereas in China and Vietnam they succeeded. Our paper argues that in Eastern Europe and the Soviet Union, incremental reforms were made mainly in the features of the radical approach, when the state quickly cut the subsidies to the original state sector and encouraged the entry of the downstream private sector. This had two detrimental effects on the economy: (1) the newly emerged downstream private firms quickly crowded out the upstream state firms and became the new private monopolies; and (2) the original beneficiaries of the old upstream sector, including workers and so on, suffered substantial levels of welfare loss. In China and Vietnam, since the state still pays a high level of subsidy to the upstream state sector, it was able to prevent private monopolies and large scale welfare losses to workers, such as unemployment.

2.2. Review of the discussions of historical cases of reform regarding transitional strategies

Although the dual-track system, for instance, the price dual-track system, is one of the important reasons for the success of gradualist reform in China, some economists are skeptical about its absolute merits. If a price dual-track system, as an institutional arrangement, can enhance the benefits of reform, then the question arises why the gradualist reform with the use of a dual-track price system adopted by the Soviet Union and Eastern Europe in the late 1980s failed to secure rapid economic growth.

Some economists responded to this apparent paradox by invoking the different types of price dual-track system that were implemented in China, the Soviet Union and Eastern Europe. Since China adopted the price dual-track system under the constraints of planning quotas, the state-owned sector must continually fulfill its traditional planned contracts. The production in the planned requirement is traded at a lower planned price, while the remaining production can be traded at a higher market price between state-owned producers and state-owned buyers as well as non-state-owned buyers (Byrd, 1989, 1988; Hallagan and Zhang, 1999).

However, the price dual-track system used in the Soviet Union and Eastern Europe had no quota restrictions. The biggest problem of their price dual-track system was that, without this restriction, the planned contracts of the original state-owned sector were barely fulfilled, which gave the state-owned sector too free a hand in production. Some state-owned enterprises, especially the heavy industries, were still under strict price control. Therefore, on the one hand, the state-owned sector was not fulfilling a planned quota contract, while on the other, some important state-owned enterprises, affected by price controls, barely got enough of their important raw materials, which led to a huge dispersion of supply (Zhang, 1997.) The immense cost of this supply dispersion is accounted one of the major fundamental causes of the failure of gradualist reform in the Soviet Union and Eastern Europe from 1985 to 1991 (Murphy et al., 1992)

Our paper reveals why the performance of the dual track system differs in different countries by linking the level of state subsidies for the planned tracking to different combinations of incremental reform strategies with distinct reform speed. We argue that the dual track system in the Soviet Union and Eastern Europe could be described as what this paper calls 'incremental reform at radical speed'. This implies that the subsidies from the state in these regions were drastically cut and therefore the planned quota, as noted above, exerted no restrictions. As a result, the old planned track was very soon crowded out. Contrariwise, the state subsidies to the planned track in China still remained and therefore the planned quotas were still imposed. The incremental reform implemented in China could more precisely count as incremental reform with a gradualist approach, in the sense that the dual track system persisted much longer.

2.3. Review of the discussions on the impact of institutions and culture on transitional strategies

Some economists have studied how institutions shape the performance of different transitional strategies, from the aspect of one country's economic structure when a transition begins (Zhang and Yi, 1994; Qian and Xu, 1994; Sachs and Woo, 1994a, 1994b, etc.) Sachs and Woo, (1994a, 1994b) hold that China's economic structure before reform actually represents a dual mode of a surplus labor force in the normal sense of development economics. With this economic structure, peasants formed the majority in China's population. However, the Soviet Union and Eastern Europe had already finished the process of industrialization with most of their labor force working in the state-owned industrial sector and only

⁶ For instance, Fan (1993) makes the point that reform cost is made up of implementation cost and friction cost. Although gradual reform has a higher implementation cost, friction cost is nevertheless proportional to reform speed, meaning the more radical the reform is, the higher will be the friction cost resulting from reform resistance, and hence the higher will be the degree of the resistance to the reform.

14% working in agriculture. Therefore, in the early period of reform, with their different initial economic structures, China's reform performance appeared different from that of the Soviet Union and of Eastern Europe.

In detail, an economy with agriculture as its leading industry finds reform a problem for economic development by the normal route, which indicates that it is simply a process whereby the labor force transfers from the low productivity of agriculture to the high productivity of industry. In contrast, the Soviet Union and Eastern Europe had completed their industrialization. What they confronted was a problem of structural adjustment which meant reducing the employment in the subsidized inefficient industrial firms, while increasing the employment in the firms conferring the higher economic benefits, such as the service industries. However, in the Soviet Union and Eastern Europe, the labor force in the old industrial sector was often highly subsidized until structural adjustment caused the huge loss of such payments. For this reason, when the Soviet Union developed a large number of new downstream firms or non-state-owned enterprises, most of labor force did not flow into them despite their greater economic efficiency. In the normal sense of economic development, all the workers moving from agriculture to industry sectors would have benefited, which implies that such development illustrates a Pareto improvement. From this point, we see that the benefit does not emerge because gradualist reform is more effective than radical reform but because China's dual mode with surplus labor in the early period of reform favored the success of its reform.⁷

Zhang and Yi (1994) illustrate the view that, with its decentralized economic power structure, China has resorted to a relatively gradualist reform. In China, the power decentralization phenomena exist both in central government and local governments at various levels. When a new economic policy is issued, it not only needs the approval of central government but also the approval of local governments which guard a high degree of autonomy. Hence, government bureaucracies always manipulate reform according to their own interests and consequently many radical policies which do not comply with the interests of local government will not be implemented. According to Wang (1991) and Zhou (2007), the decentralization reform starting in the 1950s endowed China's local governments with many rights in dealing with public resources. Local governments often negotiate with central government as far as these rights permit.

Garnick (1984) considers the Chinese political governance system with its highly decentralized economy as a "Regional Property Rights Arrangement". Local governments have their special economic interests which differ from those of central government. In contrast with China's separate economic system, the economic system in the Soviet Union and Eastern Europe was of a prevailing vertical type. Qian and Xu (1994) describe the economic system

of the Soviet Union as "U" form and that of China as "M" form. The U form system means that the management of the planned economy is vertical and longitudinal. The M form means that the management mechanism of the planned economy is decentralized occupying many areas and man layers. They find that in the vertical system, a superior's order should be unquestioningly obeyed by an inferior, which is convenient for the implementation of the 'one package' reform mode. In the M form planned economic structure, by contrast, economic power is highly decentralized. Local government or inferior government usually has the power to negotiate with a higher-ranking government on the policies released. If a policy is not compatible with the local government's interest, it is likely that the policy will not be followed strictly. This is the so-called "you have your policies and I have my ways of getting around them." This further suggests that the Chinese government could not have adopted radical reforms at the beginning of the transition

The role of different cultures prevailing in different regions also plays an important role in determining the effectiveness of transitional strategies. The famous saying of the Chinese leader Deng that "we wade across the stream by feeling our way" is the best reflection of the cultural logic behind the Chinese reforms. Since human information and reserves of knowledge need time to evolve, radical reform will only damage the information stock in a given organizational structure and hence increase both organization cost and information cost (Zhang, 1997). Consequently, the gradualist or step by step reform mode is the only implementable solution. The popularity of this saying implies that in the early period of reform China had no such clear reform aim as the Soviet Union and Eastern Europe had in theirs. Most Chinese leaders and the masses had not lost confidence in the system of planned economy. They attributed the failings of the planned economy to the continuous political movements in past decades and not to the inherent disadvantages of this economic system. This kind of ruling idea and mainstream social ideology have determined that China can never implement radical reform (Zhang and Yi, 1994).

In contrast, the political leaders of the Soviet Union and Eastern Europe clearly set an optimal reform blueprint showing how to transit their own economies. The neoliberalist ideology, with the ultimate aim of a dramatic and comprehensive transition from a planned economy to a market one provides the cultural foundation of this blueprint, which inevitably induced the policy makers to adopt the radical type of reform.

3. Model

3.1. Basic environment

First, in this paper it is assumed that a transitional economy made up of several sectors could be described as the following set: $S_j \{S = (S_1, S_2, S_3, \dots, S_n)\}$ where S_i could be regarded as an upstream state sector, or a specific industry, such as heavy industry, etc.

When a new downstream sector S_{i+1} is established in an economy S , this new sector becomes a reform promotion sector.⁸ In terms of industrial structure, this promotion sector may be a downstream manufacturer in relation to the remaining state sectors in this economy. Hence, they are vertically-linked and become sequential complements. In other words, this downstream manufacturer provides the key inputs to other state firms in the economy and higher investment in the old upstream sector will increase the marginal value of the investment in the new downstream sectors.⁹

⁷ Some writers oppose this analysis of the way that the initial conditions of a transitional economy can affect its adoption of a certain reform speed and strategy. For example, Lin et al (1994) and Zhang and Gang (1995) have criticized the views of Sachs and Woo. They point out that the success of China's gradual reform is of universal significance. Before their reform, the Soviet Union, Eastern Europe and China had so many more common features in their economic structure that it is wrong to focus only on and exaggerate their differences. Zhang and Gang (1995) argues that all centralized planned economies have the features of forbidding private ownership and the nationalization of production materials. Therefore, all the planned economies have to work out how to proceed with structural adjustment so as to eliminate monopolistic power in the state-owned sector. Lin et al (1994) hold that all the countries with a planned economy adopt the import substitution strategy of catching up and surpassing. They also greatly developed sectors such as heavy industry, which were not in accordance with their countries' own comparative advantage of factor endowment structure. In order to develop these sectors whether viable or not, every planned economy would be prone to act upon macroeconomic policies which severely distorted products and factor markets.

⁸ The concept of the reform promotion sector is also consistent with the idea of the 'chartered city' that Romer proposes (2013).

⁹ In practice, many cases illustrate such a propagation mechanism. For example, some non-state-owned sectors, such as township village enterprises or private

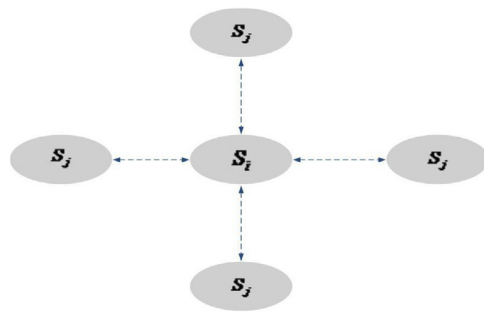


Fig. 1. Sectorial Propagation Mechanism.

Alternatively, the reform promotion sector can also operate in the same industrial chain, but as a sequential substitute for the old upstream sectors. In this case, the investment in the old upstream sectors will reduce the marginal value of the new reform promotion downstream sector. One thing worth mentioning here is that we also allow the crowding out effect to hold in the other direction when the investment made by the downstream sectors reduces the marginal value of the upstream sectors if the new and old sectors are sequential substitutes.¹⁰

Meanwhile, assuming that a reform promotion sector has been established in an economy S , then at time t , the sectorial output of S_{i+1} is marked as $R_{S_{i+1}}(t)$. Thanks to the propagation mechanism, the output of this reform promotion sector will be supplied to other state sectors, which are assumed as $S_{-(i+1)}$. The propagation mechanism between S_{i+1} and $S_{-(i+1)}$ is shown below:

Since the propagation mechanism exists in different sectors as described in Fig. 1, the total output of this transitional economy (the GDP of this economy) at time t could be derived and marked as $Q(t)$.

In this paper, it is assumed that an economy's endogenous reform damping coefficient δ_0 is affected by the initial conditions such as the country's economic structure and the leader's ruling ideas. Here, the damping coefficient δ_0 is equivalent to the country's preference for radical reform. δ_0 here is defined as the current leader's preference for radical reform. The reasons behind this are as follows: In physics, the damping coefficient refers to the concept of its measuring how quickly the frictional force dissipating in a system returns to rest. So it could be regarded as a set of factors impeding change in a particular system. Therefore, if we introduce this concept to study the transitional dynamics of an economy, then the damping coefficient can be treated as the set of factors which will impede the transitions of an economy. Bearing this in mind, the larger a country's endogenous reform damping coefficient is, meaning the presence of more factors that might impede the transition of an economy, the lower will be the current leader's preference for radical reform. Otherwise, if a country has a relatively small δ_0 , it is more likely that this country will implement radical reform. For gradualist reform, in order to describe the links between the new and old sectors, a relative economic reform damping coefficient δ_r in the dual-track system is introduced here. δ_r is positively proportional to the old sectorial output and inversely proportional to

the new sectorial output. The larger the output of the old upstream sectors, the larger the economic reform damping coefficient in the dual-track system; the converse is also true. Hence, in a gradualist reform, the dual-track system economic reform damping coefficient is $\delta = \delta_0 \delta_r$. It can be argued that this coefficient, which is the product of δ_0 and δ_r , captures both economic endogenous reform resistance and the link between the new and old upstream sectors at the same time.

According to Qian (2000), a stage of deadlock may also occur in a radical reform. On the basis of China's reforming experience, he argues that, even when political deadlock grips reactionaries and reformers at the central government level, it does not halt all reform progress at the local government level. A substantial number of reforms have in fact been accelerated at the local state level despite opposition from the central state officials who still benefit from the old system.

In order to describe this reforming process, it is assumed in this paper that there is a deadlock stage in radical reform, during which the output of the old upstream sectors drops rapidly to zero. During the deadlock period, some of the population will support reform while the other part opposes it. When the output from the old sectors falls, the benefit to some people from the old sectors gradually reduces, causing them to support the upcoming reforms for creating new sectors, which may replenish their benefits in the future. However, the old sectorial output will not suddenly drop to zero at a given time. So during the deadlock process, part of the social group who still get benefits from the old upstream sectors will be opposed to the reform.

For gradualist reforms, there is also a deadlock stage, which could be called the bargaining period between the old and new downstream sectors. During this bargaining period, it will be the case that some people will support reform and some will oppose it. The establishment of a new sector will inevitably damage the interests of the vested interest group, making them oppose the reform. Similarly, the establishment of new downstream sectors will entail new reform benefits for some people that they did not have before. As a result, this type of social group will support the reforms.

Establishing a new sector during incremental reform at both radical and gradualist speed is not without cost. The operational or fixed cost of a new sector, such as a township enterprise, is generalized as the establishment cost of new downstream sectors. Gradualist reform also has another cost, "subsidy cost, since in a dual-track system, the introduction of new downstream sectors usually leads to a sharp decrease in the output of the old sectors. In order to keep the operations of the dual-track system such that both old and new downstream sectors can contribute to the total output of the economy, government will grant a subsidy to certain sectors to guarantee that the vested interest groups in the old upstream sectors will not suffer too great a loss, such as unemployment. The most typical example of this lies in the dual-track price system. The introduction of a market-track causes considerable resources to be transferred from the planned track to the market-track. In order to keep the planned track working, the government will give it a certain subsidy, and this is the subsidy cost.

3.2. The model of a reform promotion sector

Definition 1. It is assumed that an economy consists of several sectors, marked $S = \{S_j\}$, and the output of one of these is S_i' at time t is marked C_0 (hereafter, $R(t)$), while the total output of this transitional economy at time t is $Q(t)$.

There is a propagation mechanism between $R(t)$ and $Q(t)$, marked $C_s(t)$, in which C is defined as the vertical spillover coefficient for the input-output linkage in a transitional economy. Such a vertical spillover coefficient captures the positive externalities

enterprises, are normally the key input manufacturers for state owned sectors. For details, please refer to Lin et al (1994) "China's Miracle: Development Strategy and Economic Reform", pp. 265–266, Shanghai People's Press.

¹⁰ The sequential substitutability and complementarity relationship between downstream sectors and upstream sectors were first proposed by Antras and Davin, (2013). They argued that sequential complements between two sectors occur in the sense that higher investment levels by prior suppliers increase the marginal return of the supplier's own investment. Likewise, sequential substitutability occurs when a high value of upstream investments reduces the marginal return from investing in the downstream sectors.

arising from the vertical production structure in this transitional economy. In this paper, we denote the summation of all the positive externalities of all the downstream promotion sectors as the spillover effect in the economy. According to the vertical production network structure, a reform promotion sector in this paper always refers to the newly emergent non-state owned enterprises in the downstream sectors.¹¹

Furthermore, it is assumed that C_{s_i} is contingent upon the establishment of new downstream sectors in an economy S and the effects of the changes of other sectors $R_j (i \neq j)$ on C_{s_i} can be ignored. Unless the new downstream sectors are in decline or in expansion, the C_{s_i} will remain exogenous and constant (hereafter, C). Hence:

$$dQ(t) = CdR(t) \quad (1)$$

Integrating by both sides,

$$\Delta Q = C\Delta R \quad (2)$$

where $\Delta Q = Q(t) - Q(0)$, $Q(0)$ is the initial total output of the economy. It is obvious that the relationship of the larger new downstream sector's vertical spillover coefficient to the other sectors of the economy is as follows: the larger C is, the larger will be the change of total output caused by the new downstream sectors.

Let R_{\max} be the maximum output of this reform promotion sector. Then reform speed V and economic reform damping coefficient δ are introduced. The larger the economic reform damping coefficient δ is, the smaller will be the economic reform speed V , so δ represents the set of factors that impede reform.

Assumption 1. : The speed of reforms is positively proportional to $R_{\max} - R$, implying that V will become smaller through being closer to the maximum output. Therefore, it is assumed that $V = \frac{R_{\max} - R}{\delta_0}$, where $\delta_0 > 1$.

For the radical reforms, once the new downstream sectors are established, the effects of the old upstream sectors will be ignored. It is supposed that δ is determined only by the initial conditions of a transitional economy, including the ruling ideas of leaders, the economic structure of a country, etc. Thus, the economic reform damping coefficient is endogenous with the economy itself and is thus a constant parameter, marked δ_0 . Hence:

$$V = \frac{R_{\max} - R}{\delta_0}, \text{ and } dQ = Vdt = \frac{R_{\max} - R}{\delta_0} \quad (3)$$

Proposition 1. The total output generated by any newly established sectors in a transitional economy will approach saturation in the end.

3.3. Proof of proposition 1

It can be obtained from (1) (3) that:

$$\frac{R_{\max} - R}{\delta_0} dt = CdR \quad (4)$$

Suppose the establishment of a new sector begins at $t=0$, with boundary condition $R(0) = 0$, after integration on both sides,

$$R = R_{\max}(1 - \exp(-\frac{1}{\delta_0 C} t)) \quad (5)$$

It could be obtained from (5) that the eigentime for the establishment of a new downstream sector is $\tau_0 = \delta_0 C$, and during the period

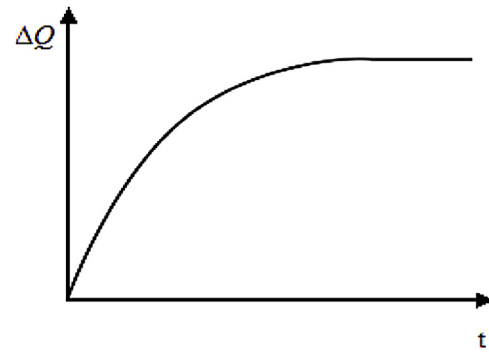


Fig. 2. Note: Fig. 2 illustrates the total output generated by the new downstream sectors has reached saturation.

from $t=0$ to $t=\tau_0$, the new sectorial output has almost approached R_{\max} . Then it can be obtained from (2) that,

$$\Delta Q = CR = CR_{\max}(1 - \exp(-\frac{1}{\delta_0 C} t)) \quad (6)$$

Proof Completes

When $t \rightarrow \infty$, $\Delta Q \rightarrow CR_{\max}$, therefore, after the eigentime τ_0 , the total output Q basically remains constant, as shown in Fig. 2.

Since C_{s_j} is the function of R_{s_i} the total output change ΔQ caused by R_{s_i} will affect the change of the vertical spillover coefficient of sector S_j . Then, the change of C_{s_j} relative to time is proportional to the change of total output caused by the new downstream sectors in a transitional economy S .

In order to calculate the change of total output ΔQ more accurately, the change of C_{s_j} caused by the establishment of new downstream sectors in a transitional economy S will be considered. Hence,

$$C_{s_j}(t + \Delta t) - C_{s_j}(t) = a_{s_{ij}} \frac{dQ_{s_i}}{R_{\max}} = a_{s_{ij}} C_{s_i} \frac{dR}{R_{\max}} \quad (7)$$

In Eq. (7), the change of C_{s_j} relative to time is proportional to the change of total output caused by the new sectorial establishment in the economy S . $a_{s_{ij}}$ is a constant, representing the dependency of other sectors S_j on sector S_i . It is worth mentioning that when sector S_j can be substituted for sector S_i , $a_{s_{ij}}$ is negative. When the

two sectors are complementary, $a_{s_{ij}}$ is positive and $\sum_{j=1, j \neq i}^n a_{s_{ij}} = 1$.

This is obtained from Eq. (3)

$$\frac{\partial C_{s_j}}{\partial t} = \frac{a_{s_{ij}}(R_{\max} - R_{s_i})}{\delta_0 R} \quad (8)$$

after integration on both sides,

$$C_{s_j}(t) = C_{s_j}(0) + a_{s_{ij}} C_{s_i} (1 - \exp(-\frac{t}{\delta_0 C_{s_i}})) \quad (9)$$

From $t=0$ to $t=\delta_0 C_{s_i}$, the change of total output caused by sectors S_j and sectors S_i is,

$$\Delta Q = C_{s_i} R_{\max} (1 - e^{-1}) (1 + \frac{a_{s_{ij}} R_{s_j}}{R_{\max}}) \quad (10)$$

Similarly, the change of total output caused by $S_1, S_2, S_3, \dots, S_n$ is¹²

$$\Delta Q = C_{s_i} R_{\max} (1 - e^{-1}) (1 + \sum_{j=1, j \neq i}^n \frac{a_{s_{ij}} R_{s_j}}{R_{\max}}) \quad (11)$$

¹¹ When we use the terminology for newly established sectors in the rest of the paper, we implicitly mean they are downstream sectors. Meanwhile, the old upstream sectors in this paper are equivalent to the upstream sectors or upstream state-owned enterprises.

¹² It should be noted that Formula (10) describes the sectorial spillover effect on the transitional economy.

Replacing R_{\max} by R_{s_i} , it is then obtained that

$$\Delta Q = C_{s_i} R_{s_i} (1 - e^{-1}) \left(1 + \sum_{j=1, j \neq i}^n \frac{a_{s_{ij}} R_{s_j}}{R_{\max}} \right) \quad (12)$$

It can be seen that, when the effect on other sectors of the output change of sectors S_i is taken into consideration, there will be an added term in the total output of a transitional economy; it is related to the $a_{s_{ij}}$, the dependency of other sectors on sector S_i .

What is more, if $1 + \sum_{j=1, j \neq i}^n \frac{a_{s_{ij}} R_{s_j}}{R_{\max}} < 0$, the change of total output is negative. This implies that the establishment of a new sector is a failure. In addition, the change of total output ΔQ can be seen to be proportional to C_{s_i} .

Nevertheless, similarly, the eigentime τ_0 of the new sectorial establishment is also proportional to C_{s_i} . This indicates that increasing C_{s_i} will lead to an increase of ΔQ with a longer time for new sectorial establishment; moreover, decreasing C_{s_i} will shorten the time for a new sector to be established with a smaller ΔQ . Hence, the following proposition can be obtained:

Proposition 2. There is a trade-off between the eigentime for new sectorial establishment and the total output caused by the establishment of new downstream sectors. It is impossible to have a shorter eigentime and a larger total output at the same time.

3.4. The model for radical reform

Definition 2. Radical reform will reduce the old upstream sectorial output to zero. We define such a state as a relative deadlock period. After this, the reform enters a shock period, during which, due to the expectation for the total output growth caused by new downstream sectors, a certain amount of output will be maintained. After the shock period, according to the model for the new downstream sectorial establishment mentioned above, the output produced by the new downstream sectors will increase gradually to the expected maximum output.

It is assumed here that in the shock period the growth or the decay of sectorial output is unpredictable. Therefore, the sectorial output is averaged in the shock period Δt and this value is considered to be a constant. Thus, Assumption 2 in this paper can be formalized as follows:

Assumption 2. the average value of sectorial output in the shock period is marked as b , which is in the form of an exponential function with the vertical spillover coefficient C_{s_i} (C for abbreviation). Therefore,

$$b = \gamma C^\lambda \quad (13)$$

where λ ($-1 < \lambda < 1$) is a modulation factor, which is to modulate people's expectation that the rise in new sectorial output will lead to an increase of total output, γ is a positive constant and $b = \gamma C^\lambda < R_{\max}$.

Moreover, the model for the radical reform aims to illustrate the relevance of two different types of radical reform: (1) incremental reform at radical speed; and (2) structural reform at radical speed. The respective definitions for these 2 types of radical reform are presented below:

Definition 3. (Incremental reform at radical speed):

The rapid establishment of new downstream economic organizations with non-state owned ownership structure (such as non-state-owned sectors or other de novo firms) out of the traditional planned economy to produce the key inputs provided by

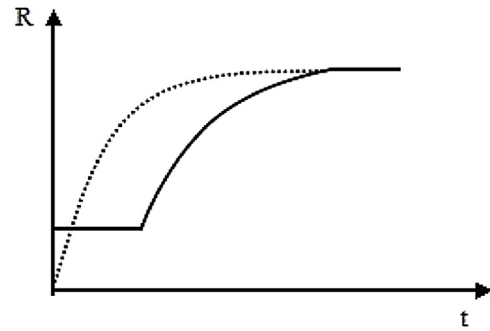


Fig. 3. Note: The dash line represents the ideal new output line of the downstream sectors, while the solid line is the actual new output line of the downstream sectors.

the upstream old upstream sectors such as state-owned enterprises and then sell the final goods in the market. However, the state's subsidy to the state sectors is small and the state sectors will very soon be vertically integrated by these de novo firms.

Definition 4. (Structural reform at radical speed):

The privatization of upstream state-owned enterprises in order to reduce the state sectors' proportion in the economy. Meanwhile, price controls are removed. The state does not take the initiative to grow non-state sectors out of the old planned systems.

Most of the radical reform leaders do not predict exactly how long a shock period will last; some do not even believe in the existence of a shock period. They expect that once the output produced by the old upstream sectors drops to zero, the new downstream sectors will soon be established.

More importantly, according to the Washington consensus, radical reformers always optimistically or ideally think that the establishment of new downstream sectors will proceed in accordance with their own expectation, which is C' . This coefficient will indicate the optimal vertical spillover coefficient without the distortions of a shock period that is expected by those leaders who share the Washington consensus.

However, what happens in practice is different. After a shock period Δt , new downstream sectors are established according to the new sectorial output growth curve in our model. Consequently, the cost caused by the shock period can be calculated and defined as the "shock period cost", marked S , as shown in Fig. 3.

It could be argued that there is a vertical spillover coefficient C_0 which minimizes the shock period cost. Since the total output caused by the increase in new sectorial output cannot be calculated, it is held that C_0 must also be the optimal vertical spillover coefficient for a new sectorial establishment.

Proposition 3. For the radical reform, the optimal vertical spillover coefficient of a new sector C_0 that could minimize the shock period cost must satisfy the following equation: $C_0 \approx \left(\frac{\lambda \gamma \Delta t}{R_{\max} \delta_0} \right)^{\frac{1}{1-\lambda}}$

Proof of Proposition 3:

Shock period cost S is represented as follows:

$$S = \int_0^{\infty} R_{\max} \left(1 - \exp\left(-\frac{t}{\delta_0 C}\right) \right) dt - b \Delta t - \int_{t_b}^{\infty} (R_{\max} - (R_{\max} - b) \exp\left(-\frac{t-t_b}{\delta_0 C}\right)) dt \quad (14)$$

$$S = -b \Delta t + \delta_0 C (R_{\max} - b) - \delta_0 C' R_{\max} + R_{\max} \Delta t \quad (15)$$

Take the derivative of S with respect to C :

$$\frac{\partial S}{\partial C} = -\gamma \lambda C^{\lambda-1} \Delta t - \delta_0 \gamma (\lambda + 1) C^\lambda + \delta_0 R_{\max} \quad (16)$$

In order to get the minimum value of S , $\frac{\partial^2 S}{\partial C^2} > 0$ is required, so

$$\frac{\partial^2 S}{\partial C^2} = -\gamma (\lambda - 1) \lambda \Delta t C^{\lambda-2} - \delta_0 \gamma \lambda (\lambda + 1) C^{\lambda-1} \quad (17)$$

$$0 < \lambda < \frac{\Delta t - C \delta_0}{\Delta t + C \delta_0} \text{ or } \frac{\Delta t - C \delta_0}{\Delta t + C \delta_0} < \lambda < 0 \quad (18)$$

Let time ratio $\rho = \frac{C \delta_0}{\Delta t}$, then Eq. (18) can be written as:

$$0 < \lambda < \frac{1 - \rho}{1 + \rho} \text{ or } \frac{1 - \rho}{1 + \rho} < \lambda < 0 \quad (19)$$

It can be shown from Eq. (19) that, in order to make $\lambda > 0$, $\Delta t > \tau_0$ and $\rho < 1$ are required, meaning that in a shock period, when people expect that the new downstream sectors will be established as soon as possible, the expectation of output growth λ for new downstream sectors will be positive. Contrariwise, when $\Delta t < \tau_0$, namely, $\rho > 1$, then $\lambda < 0$, meaning that in a shock period, when people expect that the establishment of new downstream sectors will take much longer, then the expectation of output growth λ for new downstream sectors will be negative.

(i) When $\lambda > 0$, let $\lambda = 0.5$ and Eq. (16) equal zero; then the stationary value will be obtained.

$$C^{0.5} = \frac{1}{\gamma} (R_{\max} \pm \sqrt{R_{\max}^2 - \frac{3\gamma^2 \Delta t}{\delta_0}})$$

Since $\rho < 1$, τ_0 should be as small as possible, take the smaller value of C_0 and then

$$C_0 = \left[\frac{1}{\gamma} (R_{\max} - \sqrt{R_{\max}^2 - \frac{3\gamma^2 \Delta t}{\delta_0}}) \right]^2 \quad (20)$$

It can be obtained from $R_{\max}^2 - \frac{3\gamma^2 \Delta t}{\delta_0} \geq 0$ that

$$\gamma \leq \sqrt{\frac{\delta_0 R_{\max}^2}{3 \Delta t}} \quad (21)$$

Eq. (21) is the constrained condition of γ .

(ii) When $\lambda < 0$, let Eq. (16) equal zero, then the stationary value will be obtained.

$$C^{\lambda-1} + \frac{\delta_0 (\lambda + 1)}{\lambda \Delta t} C^\lambda - \frac{\delta_0 R_{\max}}{\gamma \lambda \Delta t} = 0 \quad (22)$$

It can be obtained that $\frac{\delta_0 R_{\max}}{\gamma \lambda \Delta t} \gg \frac{\delta_0 (\lambda + 1)}{\lambda \Delta t} C^\lambda$ from the condition of $\frac{R_{\max}}{\gamma} \gg C^\lambda$; then the following can be derived by eliminating the middle term.

$$C^{\lambda-1} - \frac{\delta_0 R_{\max}}{\gamma \lambda \Delta t} = 0 \quad C_0 \approx \left(\frac{\lambda \gamma \Delta t}{\delta_0 R_{\max}} \right)^{\frac{1}{1-\lambda}} < 0 \quad (23)$$

From Eqs. (13) and (23), $b < 0$ can be obtained. This means that in a shock period, the sectorial output is negative and the economic growth is negative. Due to the long-term negative economic growth, reform leaders will change people's expectation such that the new sectorial output growth will increase total output. Then $\lambda > 0$ and a positive C will be obtained. After a certain period of preparation, the transitional economy will encounter a growth period as shown in the establishment model of the new downstream sector.

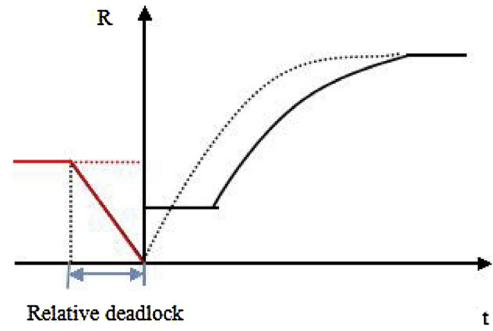


Fig. 4. Note: The red line represents the old sectorial output, while the black line traces the new sectorial output. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Similarly, for $\lambda > 0$, it can be obtained with the use of the approximate expression

$$\frac{R_{\max}}{\gamma} \gg C^\lambda \text{ that } C_0 \approx \left(\frac{\lambda \gamma \Delta t}{R_{\max} \delta_0} \right)^{\frac{1}{1-\lambda}} > 0 \quad (24)$$

Proof Completes

From Eqs. (13) and (24), $b > 0$ can be obtained. This means in a shock period, the sectorial output is positive and the whole economic growth is in a positive trajectory. It shows that, due to people's high expectations of new sectorial output growth, new downstream sectors will be established quickly after a shock period, to make $\Delta t > \tau_0$.

Discussion 1. When $\lambda < 0$, $b < 0$ and the economic growth is negative in a shock period. Therefore, reform leaders will reform the new downstream sectors to convert the expectation to $\lambda > 0$.

Hence, it can be concluded from Eq. (24) that:

- (i) in a radical reform, when the economic endogenous reform damping coefficient δ_0 is very small and other parameters are constant, C_0 will be very high in value. According to Eq. (11), the growth of total output will be large. Correspondingly, the eigentime for new sectorial establishment will be long. In order to offset the loss generated by the long eigentime for the new sectorial establishment through the specific reform strategy, incremental reform should be adopted for the following reasons: assuming that structural reform is implemented to replace the old upstream sectors, then the total time for the reform must include the relevant deadlock time and eigentime for new sectorial establishment. However, with a large C_0 , the original eigentime is long enough; it would be more costly because a new deadlock period would also have to be added as part of the whole time horizon of the reform period. This is shown in Fig. 4.

Otherwise, if incremental reform is used to establish a new downstream sector S_{n+1} out of the old economic system, there will be a cost for any new sectorial establishment that is not within the shock period. But it is known that, in this situation, total output becomes much larger. Compared with waiting for a much longer time to let newly established downstream sectors begin to yield new output, it would be better to offset the cost of the new sectorial establishment by part of the newly added total output.

Therefore, when C_0 is very large, incremental reform is the best way to resolve the trade-off between the total output of a transitional economy and the eigentime for establishing a new downstream sector.

- in a radical reform, when the economic endogenous reform damping coefficient δ_0 is very large and other parameters are

constant, C_0 will be very small. According to Eq. (11), the total output will be quite small; correspondingly, the eigentime for new sectorial establishment will be short. In order to offset the loss generated by insufficient total output growth through a specific reform strategy, structural reform should be adopted, for the following reasons: assuming incremental reform is used to establish a new reform promotion downstream sector, then a new sectorial establishment will entail a greater cost. However, because of a rather small C_0 , the total output growth is small enough. Hence, it is not economically suitable to bear upon another type of larger cost.

Contrariwise, if structural reform is adopted to replace the original old upstream sectors, the additional new sectorial establishment cost will be eliminated. The total time includes a rather short eigentime for new sectorial establishment and a relative longer deadlock time, which is acceptable to the ruling leaders of reform. Hence, when C_0 is very small, structural reform is the best way to resolve the contradiction between total output and the eigentime required for establishing a new sector.

In structural reform, the change of total output in a transitional economy can be obtained by plugging Eq. (24) into Eq. (11).

$$\Delta Q = \left(\frac{\lambda \gamma \Delta t}{\delta_0} \right)^{\frac{1}{1-\lambda}} R_{\max}^{-\frac{\lambda}{1-\lambda}} (1 - e^{-1}) \left(1 + \prod_{j=1, j \neq i}^n \frac{a_{s_{ij}} R_{s_j}}{R_{\max}} \right) \quad (25)$$

Here, from $b = \gamma C^\lambda < R_{\max}$, it is assumed that the output yielded by new downstream sectors increases from $R = 0$ to R_{\max} approximately.

In incremental reform, the change of total output can be expressed as follows

$$\Delta Q = \left(\frac{\lambda \gamma \Delta t}{\delta_0} \right)^{\frac{1}{1-\lambda}} R_{\max}^{-\frac{\lambda}{1-\lambda}} (1 - e^{-1}) \left(1 + \prod_{j=1}^n \frac{a_{s_{ij}} R_{s_j}}{R_{\max}} \right)$$

It can be seen that R_{\max} is actually the maximum level of output after the establishment of a new downstream sector, which, however, is determined by the plans devised by the reform leaders at the beginning of the reform. So it can be regarded here as the expected maximum benefit. Eq. (25) shows that the larger the expected maximum output is, the smaller will be the total output growth. R_{\max} is a misleading parameter, because, if δ_0 is small, incremental reform should be implemented. But the high expected maximum benefit will lead to a relatively small C_0 , which will lead to the adoption of structural reform. Finally, because R_{\max} is too large, the ΔQ will be too small and the reform will be a failure (the failure of radical reform with the strategic characteristics of a structural reform in Russia has demonstrated this point, since the Russian leaders set a very large value of R_{\max} based on the Washington consensus). Thus, it can be concluded that the reform leaders' setting or expectation for R_{\max} should be within a reasonable range, neither too high nor too low.

3.5. Gradualist reform model

The cores of radical reform speed have been discussed above, with the following conclusion: when δ_0 is very small, other parameters being constant, C_0 is very big and incremental reform strategy needs to be adopted at radical speed. When δ_0 is very big with other parameters being constant, structural reform strategy in radical speed needs to be adopted.

The next step is to analyze the gradualist reform speed. First, gradualist reform needs to be defined:

Definition 5. When the old upstream state sectors and new downstream non-state sectors in a transitional economy co-exist (a

dual-track system) and when new sectorial output is larger than that of the old sectors, the dual-track period comes to an end. After this, the new sectorial output will continue to grow until it reaches saturation. This kind of reform is called gradualist reform.

There is a period of bargaining between the reformers and the vested interest group in the old upstream sectors when the new downstream sectors are introduced; it is also called the relative deadlock period and its duration is designated as t_s . It is argued that the dual system is already in existence when the bargaining period begins and the duration of the bargaining period is related to the vertical spillover coefficient of the new downstream sectors, which we denote by C . When C is larger and the expected total output is higher, the bargaining period will be shorter. Otherwise, the bargaining period will be longer. Therefore, the following relationship obtains:

$$t_s = \frac{\eta}{C} \quad (26)$$

in which, η is a positive constant.

The introduction of a new reform promotion sector can be regarded as the process during which people abolish the old contract and sign a new one. Signing a new contract entails some cost, which is the "implementation cost" during the bargaining period. For example, if ownership reform of some sectors is carried out in a vertical industry chain, the capital value should be reassessed, and people's obligations and rights should be redefined. We denote the learning cost required to adapt to the new institutional arrangements, such as the introduction of new downstream sectors in the economy as the implementation cost of signing the new contract.¹³

It is argued in this paper that the "implementation cost" in the bargaining period is positively proportional to the bargaining time, meaning the longer the bargaining time is, the longer are the contract signing times, and the larger the implementation cost will be. So,

$$S_1 = p t_s = \frac{p \eta}{C} \quad (27)$$

It is a well-known that the introduction of new downstream sectors results in a sharp decrease in the old sectorial output. For example, when the market track is introduced into the input markets for state-owned enterprises, free market competition with relatively high productivity will make resources flow into the market track. In order to keep the normal operations of the planned track, government will subsidize the planned track to retrain its output. Hence, while a dual track system remains, the old sectorial output remains the same, marked r_0 .

After the end of the dual track system, the old sectors, being inferior to the new downstream sectors, will be abolished when they have zero output, as shown in Fig. 5. In intuitive terms, that is to say, once the old upstream sectors are abolished, the new downstream sectors as downstream sectors will be vertically integrated with the old upstream sectors. In the late 1990s, many small-to-medium state-owned enterprises in China were transferred to private investors who now normally own the downstream input firms of these SOEs. These downstream firms have various forms of non-state ownership structure, such as township village enterprises or cooperative enterprises.

Definition 6. During the period of dual track system, the reform damping coefficient δ is the product of the economic endogenous reform damping coefficient δ_0 and relative damping coefficient δ_r .

¹³ For the specific definition of implementation cost, please refer to Fan (1993), "Two Kinds of Reform Costs and Two Kinds of Reform Modes", *Economic Research Journal*, vol. 1, 1993

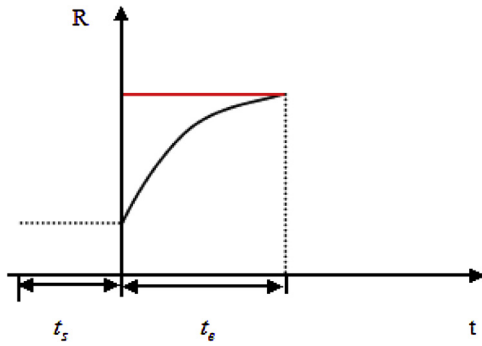


Fig. 5. Note: The red line represents the old sectorial output at time t , while the black line is the new sectorial output at time t . The dash line represents the relative deadlock period, which is the bargaining period. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

δ_r is related to the old sectorial output and new sectorial output at time t with a relationship such that the larger the old sectorial output is, the larger will be the δ_r and the larger the new sectorial output is, the smaller will be the δ_r .

Hence, according to Definition 6, it can be obtained that,

$$\delta_r = \delta_r(t) = a \frac{r_0}{R(t)} \quad (28)$$

$$\delta = \delta_0 \delta_r = \frac{a \delta_0 r_0}{R(t)} \quad (29)$$

Moreover, in our gradualist reform model, two types of gradualist reforms are illustrated with formal definitions, as follows:

Definition 7. (The incremental reform at gradualist speed):

The incremental reform in gradualist speed concerns the establishment of new downstream economic organizations (such as non-state-owned enterprises) out of the traditional planned economy. These downstream firms obtain inputs provided by the old upstream sectors such as state-owned enterprises.¹⁴ The state gives a high level of subsidy to the original state sectors so that the dual track system will persist over a long time horizon.

Definition 8. (Structural reform at gradualist speed)

Incremental reform in gradualist speed will once more reinforce the structural reform in the state sector. The growth of a new reform promotion sector that is not vertically linked but in the same industry as an old upstream sector will finally crowd out this old sector.

Proposition 4. At the gradualist reform speed, the optimal vertical spillover coefficient C_0 which could minimize the dual track system cost, namely, the sum of the implementation cost and subsidy cost must satisfy the following

$$C_0 = \sqrt{\frac{p\eta}{(1-k)r_0\delta_{\min}\ln\frac{r_0(R_{\max}-r_0)}{R_i(R_{\max}-R_i)}}}$$

Proof of Proposition 4:

According to the new sectorial establishment model,

$$\frac{R_{\max}-R}{\delta} dt = CdR \quad (30)$$

¹⁴ For example, these new privately owned enterprises can use the resources transferred from the upstream state sectors to produce and trade according to market prices after completing the production task assigned to them by the government. The most typical example is the introduction of a dual-track price system.

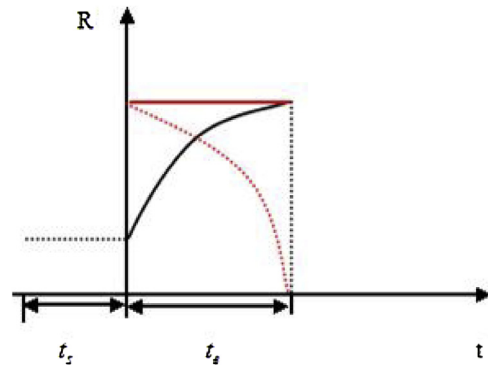


Fig. 6. Note: The dash line represents the original output curve of the old sectors.

Plugging Eq. (27) into Eq. (30), the following equation will be obtained.

$$\frac{R(R_{\max}-R)}{a\delta_0 r_0} dt = CdR \quad (31)$$

Assume that the initial output of new downstream sectors at time 0 is R_i ($R_i < r_0$). After integration on both sides,

$$R = \frac{1}{2} [R_{\max} - \sqrt{R_{\max}^2 - 4R_i(R_{\max} - R_i) \exp(\frac{R_{\max}t}{a\delta_0 Cr_0})}]$$

Let $\sigma = \frac{a\delta_0 Cr_0}{R_{\max}}$, and there is

$$R(t) = \frac{1}{2} [R_{\max} - \sqrt{R_{\max}^2 - 4R_i(R_{\max} - R_i) \exp(\frac{t}{\sigma})}] \quad (32)$$

Let $R(t) = r_0$. The following expression can be obtained at time t_e when the dual track system period ends.

$$t_e = \sigma \ln \frac{r_0(R_{\max} - r_0)}{R_i(R_{\max} - R_i)} \quad (33)$$

In order to ensure the normal operations of the old upstream sectors with the new downstream sectors as downstream firms buying the input, government needs to grant a certain subsidy to the old sectors, forming the “subsidy cost”, shown in Fig. 6. The curve equation that represents the decreasing trajectory of the old sectorial output under the pressure from the growth of the new sectorial output is required to calculate this cost.

At the end of the dual track system, the old sectorial output is zero and the slope of the tangent line of the old sectorial output curve is infinite. Thus, the decaying rate of the old sectorial output should be inversely proportional to $r_0 - R(t)$, meaning the smaller the difference between the new sectorial output and r_0 is; the larger will be the decaying rate. Therefore, the differential equation showing the decay of the old sectorial output can be obtained.

$$-\frac{\beta}{r_0 - R(t)} dt = dr \quad (34)$$

in which β is a positive constant. Plugging Eq. (31) into Eq. (37) and then integrating by both sides obtains the equation of the decaying of the old sectorial output. Because of the impossibility of obtaining the closed-form solution, it is approximately assumed in this paper that the area enclosed by this curve, the x axis and the y axis, is positively proportional to r_0 and t_e , with the proportional coefficient as k . Then,

$$\int_0^{t_e} R(t) dt \approx kt_e r_0 \quad (35)$$

Thus the subsidy cost S_2 is,

$$S_2 = (1 - k)t_e r_0 \quad (36)$$

$$S_2 = (1 - k)r_0 \sigma \ln \frac{r_0(R_{\max} - r_0)}{R_i(R_{\max} - R_i)} \quad (37)$$

It can be concluded that since t_e is positively proportional to r_0 , the subsidy cost for the dual track system is positively proportional to r_0^2 . When the old sectorial output is relatively high, the subsidy cost will increase sharply; otherwise, the subsidy cost will decrease sharply. This means that the smaller the minimum damping coefficient of dual track system is, the larger is the vertical spillover coefficient C_0 (it also means the larger is the total output growth and the smaller is the subsidy cost); hence, the larger will be the net rate of increase of the total output.

The total cost of dual track system can be obtained from Eq. (37),

$$S = S_1 + S_2 = \frac{p\eta}{C} + (1 - k) \frac{a\delta_0 C r_0^2}{R_{\max}} \ln \frac{r_0(R_{\max} - r_0)}{R_i(R_{\max} - R_i)} \quad (38)$$

It can be obtained from Eq. (37) and the fundamental inequality that

$$S \geq 2 \sqrt{(1 - k) \frac{p\eta a \delta_0 C r_0^2}{R_{\max}} \ln \frac{r_0(R_{\max} - r_0)}{R_i(R_{\max} - R_i)}} \quad (39)$$

when $C_0 = \sqrt{\frac{p\eta R_{\max}}{(1 - k)a\delta_0 r_0^2 \ln \frac{r_0(R_{\max} - r_0)}{R_i(R_{\max} - R_i)}}}$, the minimum value of t_a will be obtained.

Let the minimum economic reform damping coefficient of the dual track system $\delta_{\min} = \frac{a\delta_0 r_0}{R_{\max}}$ and plug it into the expression of C_0 ; then the following can be obtained:

$$C_0 = \sqrt{\frac{p\eta}{(1 - k)r_0 \delta_{\min} \ln \frac{r_0(R_{\max} - r_0)}{R_i(R_{\max} - R_i)}}} \quad (40)$$

Proof Completes

It is thus clear that the smaller δ_{\min} is, namely, the smaller the minimum economic reform damping coefficient of the dual track system is, the larger will be the vertical spillover coefficient C_0 . The converse is also true.

The old upstream sectors will be vertically integrated after the end of the dual track period. So the economic reform damping coefficient for the new established sectors will become δ_0 again. The total time t needed for a gradualist reform lasting from the bargaining period to the final establishment of the new downstream sectors can be expressed as follows:

$$t = t_a + t_n \quad (41)$$

in which, t_n is the time required from r_0 to $\frac{R_{\max}}{e}$.

It can be concluded that because t_e is proportional to r_0 , the subsidy cost for the dual track system is proportional to r_0^2 . When the old sectorial output is relatively high, the subsidy cost will increase sharply; otherwise, the subsidy cost will decrease sharply. This means that the smaller the minimum damping coefficient of dual track system is, the larger is the vertical spillover coefficient C_0 (it also means that the total output growth will be large and the subsidy cost will be small). Once the vertical spillover coefficient is large, the net growth of total output of this transitional economy will also be large.

During the period from $t = 0$ to $t = t_e$, the total output change caused by sectors S_i is:

$$\Delta Q_{S_i} = C_{S_i}(r_0 - R_i) - r_0 \quad (42)$$

From Eq. (8), the following can be obtained:

$$\frac{\partial C_{S_i}}{\partial t} = \frac{a_{S_{ij}}(R_{\max} - R_i)}{\delta R_{\max}} \quad (43)$$

So the total output change caused by sectors S_j from $t = 0$ to $t = t_e$ will be expressed as follows:

$$\Delta Q_{S_j} = a_{S_{ij}} C_{S_i}(r_0 - R_i) \frac{R_{S_j}}{R_{\max}} \quad (44)$$

The total output change caused by sectors $S_1, S_2, S_3, \dots, S_n$ from $t = 0$ to $t = t_e$ will thus be expressed as follows:

$$\Delta Q = C_{S_i}(r_0 - R_i) \left(1 + \sum_{j=1, j \neq i}^n \frac{a_{S_{ij}} R_{S_j}}{R_{\max}}\right) - r_0 \quad (45)$$

Before any specific discussion about the incremental reform strategy and structural reform strategy at gradualist reform speed, according to the above definition of such strategy, the second way for gradualist reform to take place will first be discussed; this involves the establishment of a new sector in a transitional economy which is not vertically linked but is in the same industry as the old upstream sectors.

Assumption 3. It is assumed that the dependency of the reform promotion sectors S_i on other old state sectors S_j is much stronger than on other sectors, which means that

$$|a_{S_{ij}}| > |a_{S_{ik}}| \quad (k \neq j) \quad (46)$$

Thus, only the effect of S_i on S_j is considered. From Eq. (9), the following can be obtained,

$$Q_{S_j}(t) = R_{S_j} \left[C_{S_j}(0) + a_{S_{ij}} C_{S_i} \left(1 - \exp\left(-\frac{t}{\delta_0 C_{S_i}}\right)\right) \right] \quad (47)$$

Eliminating the sectorial establishment cost M , it can be obtained from Eq. (6) that

$$Q_{S_i}(t) = C_{S_i} R_{S_i} (1 - \exp(-\frac{1}{\delta_0 C} t)) \quad (48)$$

Proposition 5. when there is sequential substitutability between reform promotion sectors S_i and sectors S_j and the spillover coefficient of sectors S_i satisfies the requirement of $C_{S_i} \geq \frac{C_{S_j}(0)}{(1 - e^{-1})(\frac{R_{S_j}}{R_{S_i}} - a_{S_{ij}})}$, then the mechanism whereby the newly downstream established sectors will crowd out the old upstream sectors becomes possible.

Proof of Proposition 5

When there is sequential substitutability between sectors S_i and sectors S_j , meaning $a_{S_{ij}} < 0$, it is argued in this paper that there was a time before which the total output contributed by the new sectorial output in sectors S_i was increasing continuously, while the total output contributed by the old sectorial output in sectors S_j was decreasing continuously; at this point, the total output contributed by the sectorial output in sectors S_i is equal to that of sectors S_j .

Since the two sectors are in a sequential substitutive relationship, sectors S_i will completely crowd out sectors S_j . After this time point, the old upstream sectors will be crowded out of the market. So in order to avoid being crowded out, sectors S_j will be forced to increase their output. This kind of reform, in which the newly established sectors force the old upstream sectors to decrease their output, is called structural reform at gradualist reform speed. Hence, it can be obtained from Eq. (47) and Eq. (48) that,

$$Q_{S_i} = Q_{S_j} \quad (49)$$

$$t_c = \tau_0 \ln \frac{1}{1 - \rho}$$

in which, $\tau_0 = \delta_0 C_{S_i}$ and $\rho = \frac{1}{-a_{S_{ij}} + \frac{R_{S_j}}{R_{S_i}}} \frac{C_{S_j}(0)}{C_{S_i}}$

It is argued here that when $t = \tau_0$, if Q_{s_i} is still smaller than Q_{s_j} , structural reform at gradualist reform speed cannot occur. So the following is required,

From $t_c \leq \tau_0$, then
 $\rho \leq 1 - \frac{1}{e}$, then

$$a_{s_{ij}} \leq \frac{R_{s_i}}{R_{s_j}} - \frac{e}{e-1} \frac{C_{s_j}(0)}{C_{s_i}} \quad (50)$$

If Eq. (48) is analyzed from another perspective, namely, if $C_{s_j}(0)$, R_{s_j} , R_{s_i} , $a_{s_{ij}}$ are already known and in order that sectors S_i will force sectors S_j to increase output, C_{s_i} needs thus to meet the following requirement:

$$C_{s_i} \geq \frac{C_{s_j}(0)}{(1 - e^{-1})(R_{s_i}/R_{s_j} - a_{s_{ij}})} \quad (51)$$

Proof Completes

Discussion 2. (i) In gradualist reform, a dual track system is equivalent to an incremental reform strategy. No new sectorial establishment cost is incurred. When δ_{\min} is very small and C_0 is very large, there is no need for reformers to worry about extracting part of the total output to offset the cost of establishing a new sector. When δ_{\min} is very large and C_0 is very small, there is also no need for reformers to worry about the total reform time, which will include the time for new sectorial establishment and the relevant deadlock time. Therefore, a dual track system can better resolve the contradiction between the total output of a transitional economy and the eigentime for new sectorial establishment.

(ii) in gradualist reform, establishing a new reform promotion sector that is non vertically-linked to but in the same industry as old upstream sectors is also a type of incremental reform strategy. But when the newly established sectors have a close substitutive relationship with one of the old upstream sectors in addition to $a_{s_{ij}}$ meeting the requirements in Eqs. (46) and (50), the increase of total output contributed by the new downstream sectors will lead to a decrease in the total output generated by the old upstream sectors and further force the old upstream sectors to decrease output after time t_c . Hence, the incremental reform strategy in newly established sectors will indirectly lead to old upstream sectors' decreasing their output.

(iii) At a radical reform speed, it is impossible to implement incremental reform such that establishing a new sector can force the old upstream sectors to decrease output. The reasons are listed as follows. First, there is a shock period during the structural reform in which output in the new downstream sectors keeps constant. This implies that it has no effect on the vertical spillover coefficient of other sectors. The shock period will be very long and during it other sectors will probably have already decreased their output according to the reformers' expectations for the potential output growth in the new downstream sectors (the self-adjustment according to expectation is not structural reform; please refer to the definition of structural reform in the introduction to this paper) so at R_{s_j} , $C_{s_j}(0)$ will become larger, which leads to the fact that it is difficult for the optimal spillover coefficient C_0 to meet the requirement in Eq. (51) after output increase in new downstream sectors. Thus, it will fail to allow other sectors to decrease their output. Second, after the shock period, the new sectorial output will be growing very fast in the radical reform so that even at the beginning of structural reform the old upstream sectors will be crowded out by the new downstream sectors due to their lower output level.

4. Discussions of the model

In the model constructed above, two parameters are required to describe the function of a downstream reform promotion sec-

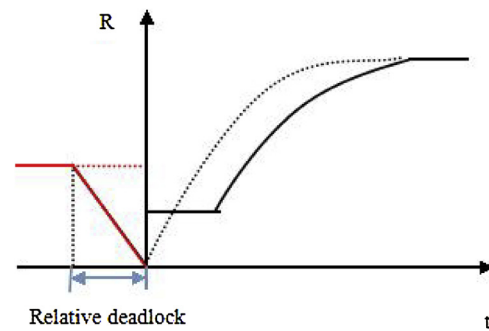


Fig. 7. Note: The red line represents the old sectorial output line, while the black line stands for the new sectorial output curve. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

tor: (1) the sectorial vertical spillover coefficient C ; and (2) the reformers' expected maximum output R_{\max} . The expected maximum output R_{\max} is the blueprint set by the reformers at an early stage of reform and is based on many factors, including the ruling ideas of the reformers, the initial economic condition of one country and so on. It can be seen from the discussion on Eq. (29) that the R_{\max} should be set neither too large nor too small. The sectorial vertical spillover coefficient C is a critical parameter for the economic function of a reform promotion sector, because it describes a reform promotion sector's capability; it generates the total output (GDP) of a transitional economy, contributed by its output at sectorial level. Thus it must be the case that the maximum total output generated by the individual reform promotion sector is a function of the vertical spillover coefficient C .

Furthermore, it is held in this paper that eigentime measures the time horizon of how long it takes for a new reform promotion sector to be established, whereas total output implies the output contribution made by these newly established sectors. Since both the eigentime for new sectorial establishment and total output produced by the new downstream sectors are proportional to the vertical spillover coefficient of the new downstream sectors C , greater total output (GDP) of an economy and longer eigentime will occur together. This contradiction is one of the most important factors that determine the optimal combination of reform speed and specific reform strategy in this paper. It can be seen that, because of the large C in radical reform, in order to avoid the increase of eigentime for new sectorial establishment, an incremental reform strategy must be adopted. Similarly, due to the small optimal vertical spillover coefficient C for the gradualist reform, in order to avoid the decrease of total output (GDP) caused by the decline of old sectors, a structural reform strategy ought to be adopted.

With radical reform, a huge reform cost will be incurred in the short term, as shown in Fig. 7. The minimization of cost is used to calculate the optimal vertical spillover coefficient C_0 in this model.

With a structural reform strategy, the reform cost is generally divided into friction cost and shock period cost. It is held in this paper that the main area enclosed by black dash line and the black solid line is the shock period cost, while the area (a triangle is used here to make a qualitative illustration) enclosed by the red dash line, red solid line and R axis is the friction cost, which can be expressed as one half of the product of the relative deadlock time and old sectorial output.

However, with incremental reform, there is no relative deadlock period and hence no friction cost. In the traditional view, however, the newly established sectors will compete with the old upstream sectors which generate friction cost. But this part of the cost will be wrongly classified. In our model, this part of the cost will be classified into the total output contributed by the new sectorial output, as shown in Eq. (25), in which parameter $a_{s_{ij}}$ which repre-

sents the dependency of two sectors plays an important role. When there is sequential substitutability between sectors S_j and sectors S_i , $a_{s_{ij}}$ is negative; whereas when the two sectors are sequential complementary, $a_{s_{ij}}$ is positive.

The cost generated by the relevant deadlock period before the complete establishment of new downstream sectors is in this paper called friction cost. The concept of friction cost which is proportional to the relative deadlock time and the old sectorial output has been specified in this paper. The approximate expression for relevant deadlock time t_s in a gradualist reform can be obtained from Eq. (26). This equation shows that t_s is inversely proportional to the vertical spillover coefficient C .

In a radical reform, it is held that the relative deadlock time t_s is inversely proportional to the expected maximum output R_{\max} of the new downstream sectors and this is of no relevance to the vertical spillover coefficient C . The reasons are as follows. In a gradualist reform, due to the existence of old sectors, even if the establishment of a new reform promotion sector is a failure, reformers and vested interest groups will not have output expectations that are too low. So they will pay attention to the effect of the new sectorial establishment on the total output of the economy;

However, in a radical reform, due to the fact that the old upstream sectors are abolished, without the potential output contribution made by old upstream sectors, reformers and vested interest groups will place much more attention on the expected output caused by the new downstream sectors at the sectorial level rather than the total output generated by the new sectorial establishment at the country level. But after the relative deadlock time, the reformers or the original vested interest groups will again pay attention to the optimal vertical spillover effect at the sectorial level, as shown in Eq. (13). This is because the expected maximum output is merely a benchmark which exists only in people's expectation, whereas the vertical spillover coefficient is a real policy-oriented parameter. On this basis we could, in this model, therefore use the following approximation method. Since the relevant deadlock time is insensitive to the new sectorial vertical spillover coefficient C and since friction cost is insensitive to C , the calculation process for obtaining the optimal vertical spillover coefficient may exclude the effect of friction cost.

In a gradualist reform, the dual-track cost could be divided into two: implementation cost and subsidy cost. As a result, the optimal spillover coefficient C_0 will be calculated through cost minimization in the model.

Dual-track duration t_a is the sum of bargaining time t_s and the time t_e incurred from the new sectorial output R_i approaching r_0 . Nonetheless, t_s is not always inversely proportional to the vertical spillover coefficient C , as Eq. (26) shows. Instead it assumes in this paper the following form regarding the relationship between t_s and vertical spillover coefficient C .

$$t = \frac{\eta}{C^\mu}$$

The description of subsidy cost (rent-seeking cost is a disguised form of subsidy cost) in the model is also qualitative as the closed-form solution of Eq. (34) could not be obtained. Expressions such as Eq. (36) may be the best approximation that can be reached. Therefore, the total cost, combining two approximate cost expressions, is certainly qualitatively unreliable. Nevertheless, the optimal vertical spillover determined by minimizing the total cost can help us obtain all the possible range of C values by which to attain our aim for the model.

Proposition 5 describes another important factor determining the optimal combination between reform speed and specific reform strategy. The incremental reform is always the reform strategy that will be adopted when reform takes the gradualist approach, which is irrespective of either building a new reform promotion

sector which is not vertically-linked to the old upstream sectors or establishing a downstream reform promotion sector that provides the key inputs for the old upstream sectors in a transitional economy. That is to say, gradualist reform must begin with incremental reform but structural reform need not. According to Proposition 5, new downstream sectors will force the old upstream sectors to decrease output by crowding them out through decreasing the marginal value of investment in the old upstream sectors.

Proposition 5 indicates that for the gradualist reform, the optimal spillover coefficient of new established sectors will be at least C_0 , which satisfies the following formula:

$$C_{s_i} \geq \frac{C_{s_j}(0)}{(1 - e^{-1})(R_{s_i}/R_{s_j} - a_{s_{ij}})}$$

The formula indicates that the higher the degree of sequential substitutability between S_j and S_i is, the less will be the expected maximum output of the new downstream sectors, the bigger will be the C_0 value required to reach it, and the longer eigentime that it will take for new downstream sectors to crowd out old upstream sectors (it is more unlikely for structural reform at gradualist speed to occur); the converse is also true.

For the Soviet Union and countries in Eastern Europe, a completed industrial system had already been established during the period of planned economy, so the level of specialization among the sectors was rather high. At the same time, the old upstream sectors in these countries still received high governmental subsidies so that their labor forces still gained many benefits from the old upstream sectors. Hence, for these countries, the expected maximum output of the new downstream sectors was relatively low.

Meanwhile, the high level of subsidy to a large extent undermined the degree of sequential substitutability between the newly established downstream sectors and the old upstream sectors, namely the relatively low value of $|a_{s_{ij}}|$. This is because the higher subsidies received by the upstream sectors were able to enhance the investment level of the upstream sector which in the meanwhile further increased the investment made by the downstream sectors, thus forming a relationship of sequential complementarity between the upstream and downstream sectors. The above two factors required C_0 to reach a very high value, so the eigentime time required for new downstream sectors to crowd out old upstream sectors should have been longer. But the Soviet Union and Eastern Europe has launched a 6-year structural reform (from 1985 to 1991) at only gradualist speed. As a result, the new downstream sectors during this 6-year period could not completely crowd out the old upstream sectors. According to the model of this paper, the eigentime required for new downstream sectors to crowd out old upstream sectors in these countries should have been at least several times longer than the one required in China.

Countries such as China and Vietnam, during the planned economy era, were not industrialized: The size of the agricultural sector far surpassed that of other sectors and it dominated these two economies.¹⁵ This explains why in this paper it could be derived that the sequential substitutability among sectors is strong in these countries – the investment made by the dominant sector will undermine investment in other, non-dominant, sectors.

¹⁵ The deficiency of the degree of industrialization was certainly the major reason for lower sequential substitutability among sectors in countries like China and Vietnam. But for China, other factors also resulted in lower sequential substitutability among sectors. For example, the longstanding urban and rural household registration control system implemented after 1949 made rural labor forces not able to flow to industrial sectors at their will and forbade the agricultural sectors to provide the industrial sectors with raw materials, etc. This to a large degree limited the level of domestic vertical production complexity.

In terms of the economic structure, since the productivity of the industrial sectors far exceeds that of the agricultural sector, the expected output of the new downstream sectors for most labor forces in these countries thus remained high. What is more, there were few government subsidies for the old upstream sectors and this led to a larger expected output from the new downstream sectors of these countries during the initial stages of the reform.

Meanwhile the low level of government subsidies increased the intensity of the competition between the new downstream sectors and old upstream sectors, namely, the low value of $|a_{sij}|$. Therefore, the C_0 value required was low and the eigentime required for the new downstream sectors to crowd out the old upstream sectors was short. A short eigentime indicates that structural reform at gradualist speed can be implemented shortly after the vertically-linked new reform promotion sectors are established. Hence, the old upstream sectors are much more likely to be crowded out with a gradualist reform approach in countries such as China.

5. Conclusions

This paper constructs a system dynamics model to elucidate that for a planned-economy country the minimization of the cost incurred during a transition to reform is dependent upon the optimal combination of reform speed and specific reform strategy. It demonstrates that the initial conditions, including economic governance structure and the ruling ideas of the reformers will first determine what type of reform speed ought to be adopted for a transitional economy. Then, based on the degree of optimal spillover effect of the newly established sectors derived from the damping coefficients of a transitional economy, it was possible to determine whether incremental or structural reform is the best reform strategy for minimizing the cost of transition. With a radical reform, if the sectorial optimal spillover effect is higher, then the transitional economy ought to adopt incremental reform and vice versa with a structural reform. Likewise, with a gradualist reform, regardless of the optimal sectorial spillover effect, a transitional economy ought always to adopt incremental reform first. Once the optimal sectorial spillover effect is large enough, it becomes possible for new downstream sectors to crowd out old upstream sectors in the economy. This means that structural reform is more likely to occur at a gradualist speed.

References

- Antras, Pol, Davin, Chor, 2013. 'Organizing the value chains'. *Econometrica* 81, 2127–2204.
- Blanchard, O., Unpublished Manuscript 1991. *Notes on the Speed of Transition, Unemployment, and Growth in Poland*. MIT.
- Blanchard, O., 1996. 'Theoretical Aspects of Transition', *The American Economic Review*, Vol. 86, No.2, Papers and Proceedings of the Hundred and Eighth Annual Meeting of the American Economic Association, San Francisco, CA, January 5–7, (May, 1996), pp.117–122.
- Byrd, W., 1989. *Plan and market in the Chinese economy: a simple general equilibrium model*. *J. Comp. Econ.* 13 (2), 177–204.
- Chen, K., Jefferson, G., Sing, I., 1992. 'Lessons from China's economic reform'. *J. Comp. Econ.* 16 (2), 201–225.
- Dewatripont, M., Roland, G., 1992a. 'The virtues of gradualism and legitimacy in the transition to a Market economy'. *Econ. J.* 102 (411), 291–300.
- Dewatripont, M., Roland, G., 1992b. *Economic reforms and dynamic political constraints*. *Rev. Econ. Stud.* 59 (4), 703–730.
- Fan, G., 1993. *Two types of reform costs and Two types of reform modes*. *Econ. Res. J.* 1, 3–15.
- Garnick, D., 1984. *Shifting balances in U.S. Metropolitan and nonmetropolitan Area growth*. *Int. Reg. Sci. Rev.* 9 (3), 257–273.
- Hallagan, W., Zhang, J., 1999. *Starting positions, reform speed and economic growth in transitioning economies*. *Econ. Res. J.* 10, 1–6.
- Jefferson, G., Rawski, T., 1994. *Enterprise reform in Chinese industry*. *J. Econ. Perspect.* 8 (2), 47–70.
- Kornai, J., 1990. 'The affinity between ownership forms and coordination mechanism: the Common experience of reform in socialist countries'. *J. Econ. Perspect.* 4 (3), 131–147.
- Kornai, J., 2000. *What the change of system from socialism to capitalism does and does not mean*. *J. Econ. Perspect.* 14 (1), 27–42, Winter.
- Lardy, N., 1998. *China's Unfinished Economic Revolution*. Brookings Institution Press Washington, D.C.
- Lau, L., Qian, Y., Roland, G., 2000. 'Reform without the losers: an interpretation of China's dual-track approach to transition'. *J. Polit. Econ.* 108 (1), 120–143.
- Lora, E., 1997. 'A Decade of Structural Reforms in Latin America: What Has Been Reformed and How to Measure It', *Inter-American Development Bank, Working Paper Green Series*.348.
- McKinnon, R., 1994. *Financial growth and macroeconomic stability in China, 1978–1992: implications for Russia and other transitional economies*. *J. Comp. Econ.* 18 (3), 438–469.
- McMillan, J., Naughton, B., 1992. 'How to Reform a Planned Economy: Lessons From China', *Oxford Review of Economic Policy*, Vol.8, No.1, *Macroeconomics of Transition in Eastern Europe*, pp. 130–143.
- Morley, S., Machado, R., Pettinato, S., 1999. 'Indexes of Structural Reform in Latin America', *Serie Reformas Económicas*, 12. Jan.
- Murphy, K., Shleifer, A., Vishny, R., 1992. *The transition to a Market economy: pitfalls of partial reform*. *Q. J. Econ.* 107 (3), 889–906.
- Murrell, P., 1992. 'Conservative Political Philosophy and the Strategy of Economic Transition', *Center for Institutional Reform and the Informal Sector, University of Maryland at College Park, IRIS Reprint No.* 13.
- Naughton, B., 1994a. 'Chinese institutional innovation and privatization from below'. In: *The American Economic Review*, Vol.84, No.2, *Papers and Proceedings of the Hundred and Sixth Annual Meeting of the American Economic Association*, pp. 266–270.
- Naughton, B., 1994b. 'What is distinctive about China's economic transition? State Enterprise reform and overall system transformation'. *J. Comp. Econ.* 18, 470–490.
- Nolan, P., 1993. 'China's Post-Mao political economy; A puzzle'. *Contrib. Polit. Econ.* 12 (1), 71–87.
- Qian, Y., 2000. 'The Process of China's Market Transition (1978–1998): The Evolutionary, Historical and Comparative Perspectives', *Journal of Institutional and Theoretical Economics* vol. 156, No.1. 17th International Seminar on the New Institutional Economics: Big-Bang Transformations of Economic Systems as a Challenge to New Institutional Economics: March. pp. 151–171.
- Rana, B., Paz, W., 1994. *Economies in transition: the Asian experience*. In: Lee, Chung H., Reisen, Helmut (Eds.), *From Reform to Growth: China and Other Countries in Transition in Asia and Central and Eastern Europe*. OECD, Paris.
- Sachs, J., Lipton, D., 1990. 'Poland's economic reform'. *Foreign Affairs* 69 (3), 47–66.
- Sachs, J., Woo, W., 1994a. *Structural factors in the economic reforms of China, Eastern Europe, and the Former Soviet Union*. *Econ. Policy* 1 (April), 101–145.
- Sachs, J., Woo, W., 1994b. 'Experiences in the transition to a market economy'. *J. Comp. Econ.* 18 (3), 271–275.
- Sachs, J., Woo, W., Yan, X., 2000. 'Economic Reforms and Constitutional Transition', vol. 1. *Annals of Economics and Finance*, pp. 260–274.
- Sheng, H., 1996. *A survey of the research on the transitional process of market-oriented reform in China*. *Chin. Econ. Stud.* 29 (2), 5–38.
- Wang, S., Unpublished manuscript 1991. *From Revolution to Involution: State Capacity, Local Power, and (un) Governability in China*. Yale University.
- Williamson, J., 2000. *What should the world Bank think about the Washington consensus?*. *World Bank Res. Observer* 15 (2), 251–264.
- Woo, W., 1999. 'The Economics and Politics of Transition to an Open Market Economy: China' *OECD Development Centre. Working Paper No.*153.
- Wu, J., 1994. 'Modern Corporation and Enterprise Reform'. *Tianjin People Publishing Press*.
- Wu, J., 2003. 'Contemporary Chinese Economic Reform'. *Shanghai Far East Press*.
- Zhang, J., 1997. *Economics of transition: a theoretical review and argument*. *Shanghai Econ. Res. J.* (April), 24–32.
- Zhang, W., Gang, Y., 1995. 'China's Gradualist Reform' *A Historical Perspective*, *China Centre for Economic Research Working Papers*.
- Zhou, L., 2007. *Governing China's local officials: an analysis of promotion tournament model*. *Econ. Res. J.* 07, 36–50.