

Incentives, Policy Burdens and Supervision Intensity: Some Lessons from the Chinese SOE Reforms*

Bo Hu[†] Justin Yifu Lin[‡] and Jianye Yan[§]

This version: May, 2021

Abstract

The past forty years have witnessed the high-speed growth of Chinese economy. Together with the growth is the continuous reform of the Chinese state-owned enterprises (SOEs). We first review the main three waves of SOEs reform, which all took a gradual format, first experimented in selected enterprises, once successful, then promoted to the vast majority. Despite the success in the selected pilots, the effect of each wave became less satisfactory after popularization. We reinvestigate these reforms under the perspective of incentive mechanism with policy burdens, which led to SOE's soft budget constraint. With the separation of ownership and control, moral hazard arose and possible opportunistic behaviors from the managers and workers of the SOEs could appear. In the experiment stage, since each firm faced extraordinary external supervision, opportunistic behaviors were suppressed, and the government sees an increased profit. Once more firms got involved in the reform and the external supervision intensity was diluted, opportunistic behaviors dominated, and the government saw a failure of the reform.

*Comments and suggestions from the participants of the workshop for RIEB (Research Institute for Economics & Business Administration) 100th Anniversary at Kobe University are appreciated.

[†]Institute of New Structural Economics, Peking University. Email: bohu@nsd.pku.edu.cn.

[‡]Institute of New Structural Economics, Peking University. Email: justinlin@nsd.pku.edu.cn.

[§]Institute of New Structural Economics, Peking University. Email: jianyeyan@nsd.pku.edu.cn.

1 Introduction

The past forty years have witnessed the high-speed growth of Chinese economy and its transition from centrally planned economy to market economy. State-owned enterprise (SOE) reform has been an important ingredient of this transition. Chinese SOE reform, initiated in 1978, has experienced multiple different phases and is yet finished. The first phase of this reform, lasting from 1978 to the mid-1990s, was characterized by a series of incentive enhancing measures from the state such as giving firms more autonomy and designing reward-punishment mechanisms for the managers of the firms.

It was generally believed that such incentive enhancing measures would increase productivity and consequentially the state's revenues and taxes. However, it is an interesting and puzzling phenomenon that although this conjecture was proved by small-scale experiments in selected pilot firms, the incentive enhancing measures failed to deliver the desired results after being promoted to a country-wide scale. The state did see elevated productivity, but not taxes and revenues submitted by the SOEs. In this paper, we argue that the poor performance of the SOEs is due to the soft-budget constraint caused by policy burdens, and explain the puzzle by the interplay between soft-budget constraint and supervision dilution in the process of promoting reform from selected firms to a country-wide level.

One obvious reason for the low efficiency of the Chinese SOEs before the reform was a lack of incentives. This was induced by the state setting the wages of managers and workers a priori without taking into account the enterprise's performance. However, there is a less obvious reason that is often ignored. Chinese SOEs usually undertake strategic and social policy burdens. The distorted industrial structure, as a consequence of the nation's developing strategy during its centrally planned economy era, consists of many non-viable SOEs in capital-intensive sectors that are important for national security but go against the country's comparative advantages, and also many SOEs that employ redundant workers for the sake of maintaining social stability. The state is accountable for the loss arising from policy burdens. Due to information asymmetry, the state cannot distinguish between policy burdens, workers' shirking and other moral hazard behaviors for the loss of the firms, causing the problem of the soft budget constraint. Although the reform in China introduced incentives, the government had to provide subsidies for these SOEs to continue to exist, so the issue of soft budget constraint remained.

On the other hand, the managers were given more autonomy after the reform, which gave them incentives to mis-report the true profit in the presence of soft-budget constraint. From the government's perspective, whether it saw more reported profits and therefore more tax revenues depended on how much the misreport incentives were suppressed by supervision. In the experimental stage when the number of firms selected to conduct the reform was small, the supervision intensity is high enough so that managers dare not to misreport too much. After the reform was promoted to a country-wide scale, supervision intensity was diluted, and opportunistic behaviors from the managers increased significantly, leading to decreased revenue and tax and increased subsidy demanded.

In this paper we reviewed the early stage Chinese SOE reforms and present an analytical model in which incentives, policy burdens and supervision intensity interact with each other in the process of reform. The model features asymmetric information between the government and the managers of the SOEs, soft budget constraint, mis-report as opportunistic behaviors of the managers of SOEs, and optimal supervision from the government. We show analytically that whether the reform would succeed depends on the level of policy burdens and supervision intensity. If policy burden is sufficiently large and supervision intensity is low, managers do not work harder than their pre-reform level, and they will steal heavily.

The lessons from the Chinese SOE reforms are not only useful to the further reform of the Chinese economy, but also helpful to economic reforms in other countries. Many other transition economies still have a large state-owned sector inherited from their old economic systems, which are subject to the same low-efficiency and policy burden issues as the Chinese SOEs. And even for developed countries, in some particular sectors the shares of SOEs are still significant. Our study here could help us understand the issues of these SOEs and the potential solution to these issues.

The paper is organized as follows. Section 2 introduces basic facts about the Chinese SOE reforms from 1978 to the mid-90s and reviews the related literature. Section 3 presents a model for the SOE reforms during this period. Section 4 concludes and provides some policy implications.

2 SOE Reforms in Early Stages

2.1 The Start of the Reform

Before China started to reform its SOEs in the late 1970s, the country had implemented many years' planned economy, and the firms were regarded basically as affiliates of the administrative machinery. SOEs did not have the autonomy in choosing what to produce, how much to produce, where and at what prices to buy the inputs, to whom and at what prices to sell their products; they just implemented plans for the government. On the other hand, managers and workers of the firms could not claim any of the profits from the production, neither were they responsible for any loss of operating the firms. SOEs received their budgets, including wages and other expenditures, from the state and remitted all their revenues to the state. Wages were set *ex ante* by a system of eight scales, and a worker's scale was set *ex ante* according to the complexity of the production process and the workers' experience in production, and not linked to the firm's performance. As a consequence of a lack of autonomy and incentives, this system was working in a very inflexible, inefficient and luckluster way.

Since the July of 1978, the central government had been discussing reforming the Chinese economic system. In the October of 1978, the government of Sichuan province started to experiment in six SOEs a reform that granted the firms more autonomy. The reform gave the SOEs some freedom to produce and sell products outside the plan (but by very limited amount), and some freedom to retend and use part of the profits. To be more specific, the main features of the reform was to allow the firms to 1) keep part of the profits 2) establish fund for enlarging the production 3) have greater flexibility in dealing with depreciation 4) have the freedom to produce and sell productions not in the plan 5) have flexibility in using foreign exchanges 6) have flexibility in using rewards 7) have rights to (economically) punish works or managers. More than one hundred SOEs in Sichuan were included in the experiment in the following January.

These experiments lauched by the local government of Sichuan soon earned the support from the central government. The central government started to experiment these reforms in eight SOEs in the May of 1979. After seeing the improvements of performance in the pilot SOEs, the government decided to promote this reform country-wide in July. As the reform continued, more forms were introduced into the reform process, which included lump-sum contracts and self-financing. In 1981, the government started to implement the "system of economic responsibility". SOEs in the system took one and only one of the following three forms of reform.

- (i) Profit retention. Instead of sending all the profits to the government and waiting for the government to allocate money for future production plans, SOEs in this reform were allowed to keep a proportion, usually small, of their profits, if any, to improve production and welfare of workers, and also to provide incentives to reward hard-working workers. The retention ratio

is relatively low, at about 5-10% of the total profits. And more than 60% of the retention were required to be used to improve production rather than to reward.

- (ii) Contract responsibility system¹. The SOEs in this reform signed contracts with the government in terms of a lump-sum amount of target profits. If the SOEs accomplished the goal, they could keep a proportion of the extra profits. The government required that the retention ratio should be less than 40%. The actual contracted amount was determined by individual negotiations between the government and the firms.
- (iii) Full responsibility system. The relatively small-sized SOEs may choose to be responsible for any profit and loss by their own, at the expense of paying taxes to the government at a pre-set tax rate. This particular form of reform was promoted to a larger scale reform that substituted profits deliveries to tax payments, which started in 1982.

The third reform was similar to privatization in that the managers and workers of the firms were responsible for any profits or losses of operating the firm. However, as opposed to privatization, the legal owner of the firm in this reform was still the government. The managers could not, for example, trade the firm or its assets in a private fashion. Besides these incentive-based reforms, SOEs were asked to finance their production cost by bank loans instead of the government's budget.

The full responsibility reform was later leveled up to the privatization reform. Starting from the mid-90s, the government started to implement the reform philosophy of "reinvigorate the big, let go of the small", or "zhua da fang xiao" in Chinese. During this period, the small-sized SOEs were allowed to go bankrupt and be purchased by private parties. On the other hand, the government focused on the big-sized SOEs, which usually were in the industries that are relevant to finance and national security, and were in the relatively upstream, monopolistic industries. By doing so, the government alleviated itself from a large fraction of the social policy burden. Since the economic conditions and the reform philosophy after mid-90s were quite different from its past, in this paper we focus on the period from 1978 to the mid-90s in which the reform was mainly incentive-based. But as we would see, our framework incorporates the case of privatization and the implications of our framework also apply to privatization.

2.2 The Performance of the Reforms

These reforms turned out to be very successful at the beginning in the piloting firms. For example, during the first half of 1979, the industrial profits of Sichuan province increased by 17% comparing to the same period the previous year, while the number for 84 piloting SOEs was 26%.² It was exactly these significantly improved performances that made the central government (in particular the Department of Treasury) to decide to promote the profit retention reform to a country-wide scale.

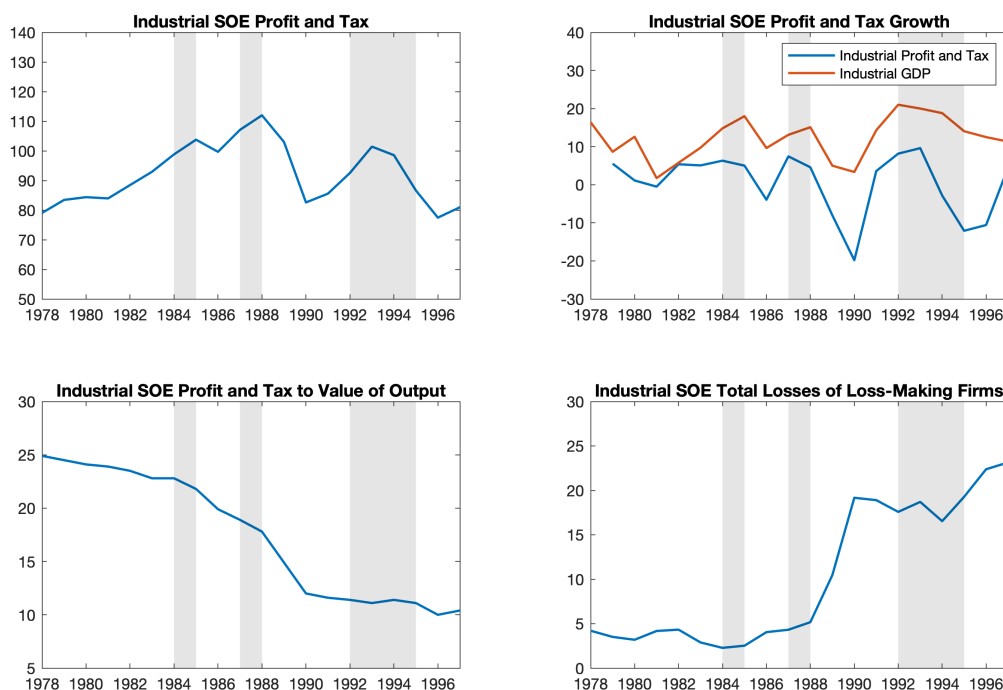
However, once the reforms were promoted to a large scale country-wide, the central government found that the results became unsatisfactory. The government found the following issues that made the government to pause and re-evaluate the effects of the reform.

- (i) The most serious issue is the deterioration of the national fiscal income. Contrary to what was targeted by the government when it initiated the reform, the national fiscal income had been declining since the reform, and the government found it providing more subsidies to the SOEs that were running losses.
- (ii) One big reason for the government seeing less fiscal income was that it became a quite common phenomenon that managers under-reported the profit of the firms to the government so that

¹This name is borrowed and inspired from the successful "Household Contract Responsibility System" reform in the agricultural sector in China.

²Data source: West Times. September 2nd, 2009. <http://www.reformdata.org/2009/0902/10040.shtml>.

Figure 1: SOE Performance (1978-1997)



Notes: Data for profit and tax, total losses of loss-making SOE firms, and the ratio of profit and tax to value of output for industrial SOE firms are from the China Industry Statistical Yearbook. All the numbers are deflated using the GDP deflator published by the World Bank using 1978 as the base year. The shaded areas indicate the years of high inflation, using the criteria of a GDP deflator higher than 10%.

they could keep the unreported profits in their own on-job consumptions and even graft.

- (iii) Managers tended to undertake short-sighted behaviors. They tended to use their free money to increase the reward and welfare of the workers instead of maintaining the equipments or conducting investment and researches that would improve qualities of their products. For the managers who did invest, they tended to conduct investments that increased the sizes but not efficiency of the firms. (During that period a full-functioning market had not been established. Prices did not serve as good signals as usually assumed in the neoclassical theory.)

Figure 1 plots various measures of the performance of Chinese industrial SOEs during 1978-1997. The top left panel shows that during the years of reform, the profit-and-tax of these firms did not grow in any essential way. The top-right panel shows that the growth rate of profit-and-tax was well below the growth rate of the industrial GDP, and for many years, the growth rate was negative. The bottom left panel shows that the ratio of profit-and-tax to output for these firms, which is a measure of profitability of operation, had been steadily declining. The bottom right panel shows that the total losses of the loss-making firms, instead of decreasing as one would expect, remained roughly constant during the first part of the 1980's, and start to rocket after that. Given that the number of SOEs have actually decreased during this period, the performance of individual SOEs on average had actually deteriorated significantly. During the late 1980's and early 1990's, there were periods of high-inflation in China due to the price reforms and deterioration of the fiscal conditions resulted from the SOE reform. High inflation may had some effects on the behavior of the firms so we have labeled these periods in the plot.

On the firm level, [Groves et al. \(1994\)](#) conducted a survey on annual data in 1980-89 for 769 SOEs from 4 provinces with details of the firm's internal incentives, the firm's cost and revenue accounts. Their empirical study found that there was some increase in the productivity of the SOEs after the first two waves of reform; "for the firms in...sample, between 1980 and 1989 total factor productivity rose at an average annual rate of 4.5 percent". However, the government, as the owner of the SOEs, found itself getting less tax revenues from the SOEs in general and in some industries for some SOEs, having to provide more subsidies to them; "...strengthening of workers' incentives correlated with higher productivity; the improved productivity raises the workers' incomes (but not the managers' incomes), and resulted in more investment by the enterprises, but did not lower subsidies or increase profits".³

It is clear that the SOE reforms in China before the new century was not very successful, contrary to the prediction of the usual economic theory and also contrary to the appealing results from the early experiments.

2.3 Ownership, Policy Burdens, and Supervision

Traditionally the low efficiency of SOEs are attributed to lack of autonomy, delineation of property rights and bad incentive system. The SOE reforms in China gave SOEs, in particular the managers, more autonomy and incentives. However, the reforms also brought about the principal-agent problem. Due to the separation of ownership and control, there was information asymmetry, and the managers could utilize his informational advantage to benefit themselves at the expense of the owner, i.e., the government in the SOE case. This led to opportunistic behaviors of the managers.

There was one thing associated with the Chinese SOEs that worsened the information asymmetry even more. The SOEs in China, like the ones in many other transition economics, usually undertake policy burdens. These burdens are either strategic or social ([Lin and Tan, 1999](#)). The firms that undertake strategic policy burdens operate in industries that are against their comparative advantages but considered essential for the national securities or strategically important sectors. They are therefore not viable if left in a competitive market. However, due to strategical reasons, the government still need these firms to exist. The firms that undertake social policy burdens are firms that the government relies on to maintain an appropriate level of employment and social stability as the development of those capital-intensive strategically-important industries does not generate sufficient job opportunities to maintain full employment and the existing firms are obliged to absorb redundant workers. In the existence of policy burden and information asymmetry, the government cannot distinguish whether the bad performance of a firm in terms of profitability is due to the manager and/or the workers' low effort levels, or due to the policy burdens it undertakes. Although both burdens were alleviated gradually as the reform continued, at least up to the end of the period we consider, they were still important burdens to the SOEs.

The existence of policy burdens and asymmetric information between the manager and the government brings about the issue of "soft budget constraint (SBC)". The government, as the "guarantee" of the last resort to the SOEs, are not able to set hard budget constraint to these firms. Once a loss appears, the government has to provide subsidies to cover the loss. Since this

³As we will see, the two previous distinct aspects after the reform found by [Groves et al. \(1994\)](#) just support our modeled reasoning and recovery of the non-ignorable (but often ignored) initial condition tied together with the reform, that is, the endogenous "policy burden" as a result of the predetermined and distorted development strategy of the planned economy. On the one hand, the standard well-functioned incentive design increases ex-post measured productivity; on the other hand, the room for opportunistic and under-reporting behavior of the manager is enlarged, i.e., the ultimate purpose of incentive design on behalf of the owner (the state) of SOEs is not attained when incentive and policy burden coexist: the incentive-based reform "tended not to raise remittances to the state", as found by [Groves et al. \(1994\)](#).

issue is caused by policy burdens, and the incentive-based reforms did not get rid of the policy burdens, the issue continued to exist after the reform in China.

If the government wants to correct the principal-agent problem, then it must supervise the SOEs to figure out which firms' running low or negative profits is due to managers or workers low effort levels, and which firms' running low or negative profit is due to policy burdens. It is well expected that if the supervision level is high, then the manager and workers will work hard, while if the supervision level is low, the manager and workers tend to take advantage of the information asymmetry. This behaviorist difference between different levels of supervision explains why the reform was successful in piloting firms but became unsuccessful after promotion. When a policy is experimented in selected firms, the supervision level is high since everyone is watching. When the policy is promoted to a large scale, the supervision is diluted, and therefore it is more likely for opportunistic behaviors to appear.

An alternative explanation for the performance differences between the experiment stage and promotion stage could be selection bias. One may argue that the firms in the experiment were selected firms, and the selection could be conducted in a way that favors its potential outcome. To address this issue, ideally we should check the detailed criteria of the policy makers used for selection at that time. Unfortunately, this criteria may or may not existed at that time, and even if it existed, it seems that it is hard to know them now. As an imperfect answer, we argue that the policy maker had an incentive to select the firms that historically had a relatively better performance, not the firms that were historically bad performing. Also, the distribution of the industries of the experimented firms were quite diverse, not concentrating in particular ones.

2.3.1 Soft Budget Constraint

The term "soft budget constraint (SBC)" was originally formulated by Kornai (1979). Kornai (1980) pointed out that SBC could appear in environments that are based on private ownership. And the World Bank (1996, p. 45) does find that SBC continues to exist in transitional economics even after they have privatized their SOEs. Kornai et al. (2003) summarized the causes of SBC:

- (i) Paternalism. The supporting organization may feel protective and responsible for the budget-constrained firms. This is the main motive Kornai (1980) emphasized under socialism. However, this seems to be not very economically rooted and less plausible.
- (ii) Externalities, or spillover effect. Some of the SOEs will have large spillover effects to other aspects of the economy if they are allowed to fall. For example, a series of papers by Lin et al. (1998), Lin and Tan (1999), and Lin and Li (2008) argue that policy burden, both strategic and social, is the more fundamental reason behind soft budget constraint.
- (iii) Time-inconsistency problem. It could be beneficial for the supporting organization to continue investing into a budget-constrained organization that hit the constraint because of fear of loss of prior investments. See, for example, Dewatripont and Maskin (1995).
- (iv) Individual political motives. Stabilized employment may increase the politician's popularity; Corruptive incentives in supporting organization. See Shleifer and Vishny (1994). Reputational incentives to prevent financial failure in the existence of hierarchical control.

Soft budget constraint could take many different forms. Kornai et al. (2003) listed a few means of softening the constraint, including fiscal means, means in the form of credit (for example through bank) and indirect methods such as price protection and so on. These forms all appeared in the practice of the Chinese SOEs.

2.3.2 Policy Burden

Lin et al. (1998) argue that the fundamental problem of SOE is the separation of ownership and control, and soft-budget constraint arises as a consequence of various state-imposed policy burdens. Lin and Tan (1999) further explain that the traditional Stalinist system was designed to support the non-viable SOEs; after the market reform, the state has to continue to support these firms for strategic purposes, and the state's accountability problem leads to the soft budget constraint. Lin and Li (2008) propose a model in which the government and the SOEs play a game to explain how policy burdens can lead to soft-budget constraint.

2.3.3 Privatization

There has been a quite large literature on privatization. By analyzing privatization in various countries, Vickers and Yarrow (1991) argue that the relationship between privatization and its various socio-economic outcomes is complex and depends on the conditions of the countries that implement the privatization. They also argue that private ownership has efficiency advantages only in competitive conditions but not necessarily in the situation where there is market power. Competition and regulation jointly matter for the performance of privatization. By careful investigation on listed firms on NYSE, Berle and Menas (1991) conclude that in modern enterprise system, the owners most emphatically will not be served by a profit seeking controlling group. Hart (1995) argues that there is no perfect corporate governance, among which leak always presents, and therefore possibly moral hazard. Boycko et al. (1996) argue that privatization can lead to efficient restructuring of the firm, and such effect is stronger when new owners are investors rather than workers and managers of the firm. Dewenter and Malatesta (2001) show that much of the increase in the privatized firms performance actually happens over the three years before privatization. Estrin and Pelletier (2018) argue that pre-conditions such as regulatory infrastructure and the process of privatization are important for private ownership to generate positive results for developing countries.

2.3.4 Incentive Theory

The standard wisdom from theory of incentives (though without the consideration of predetermined structural condition, “policy burden”, in our context) regarding the optimal incentive design within an organization can be largely borrowed from the work of Holmstrom and Milgrom, among others, within which, mainly, can be concentrated to Holmstrom and Milgrom (1987),⁴ which first proved the optimality of linear incentive contract among all the infinite functional forms in an infinitely repeated contracting time horizon; as a comparison, the first wave of the reform from 1978, concluded as “profit retention”, can be exactly regarded as linear incentive scheme. The second wave of reform, on the other hand, can be regarded essentially as a “step-wise incentive” scheme. In the same paper, Holmstrom and Milgrom (1987) also showed that sometimes “step-wise” incentive

⁴Holmstrom and Milgrom (1987, 1994) were series working out the optimal incentive scheme to stimulate worker(s) inside a firm from the perspective of firm owner/manager/entrepreneur in all kinds of circumstances; we borrow the wisdom to apply in the situation to stimulate manager/entrepreneur by firm owner (the state) of SOEs. To answer the long-existing question, *employment* (to hire a worker) or *independent contracting* (with a contractor), Holmstrom and Milgrom (1994) justifies the trend toward greater worker responsibility (“empowerment”) as well as the effectiveness of low-powered incentives within the firm as a coherent incentive system. So when we try to deal with the third wave in the reform, “full responsibility system (full residue-claim)”, Holmstrom and Milgrom (1994) can also be a theoretical benchmark and counterpart to compare: if ignoring policy burdens, the optimal incentive from Holmstrom and Milgrom (1994) may fail also in “full responsibility system” (full residue-claim and similar to privatization), i.e., the policy burdens generate incentive incompatibility.

can still do better than linear incentive contract in some circumstances as long as the contracting environment is no longer an infinite time horizon, e.g., static or multi but finite periods.

After the dialogue with the well-established theory of incentives, a question naturally arises: why the well-performed wisdom of incentive theory does not work in SOE Reform of China? We believe that our research could shed light on some new thinking and conversations with the progress of incentive theory.

3 Modeling Incentive-Based SOE Reforms

In this section we present an analytical model that characterizes the interplay between incentives, policy burdens and supervision.

3.1 Model Setting

We consider a model in which the government interacts with SOEs. In our model there is a measure one of SOEs. Each SOE is owned by the government, but is managed by a manager. We model the existence of policy burden in our simple model in a reduced form by the assumption that each firm hires a fixed amount of workers L , and is paid by a fixed wage rate w by the SOE. Therefore we have modeled, for example, the welfare benefit associated with an SOE worker and the fact that some of the SOEs are operating in comparative advantage defying industries, into a high wage rate w .

It requires both the workers and the manager's efforts to produce. The workers in an SOE have average efficiency level denoted by ϵ , and the manager has efficiency level denoted by A . For simplicity, we assume that the average level of efficiency in a firm is exogenously given. As a consequence, the distribution of the worker's average efficiency level across firms could be taken as given. A manager could choose his or her own effort level in response to incentives they receive, at the expense of some disutility. In any firm, the effort levels of both the workers and the manager are observable to the manager, but not to the government. This is one aspect of the information asymmetry issue in our model.

We assume in our simple model a linear production function. The true profit of the SOE, denoted by π , is given by

$$\pi = A\epsilon L - wL,$$

which, as a consequence of our setting, is the knowledge of the manager, but not of the government. The manager may choose to report a fake revenue level \tilde{R} , or equivalently, a fake profit level $\tilde{\pi} = \tilde{R} - wL$, to the government. We shall call this behavior stealing or mis-reporting. The government takes efforts and resources to discover this mis-reporting behavior. And once discovered, the dishonest managers will be punished.

Before the Reform:

Before the reform, the flows of inputs and outputs of production activities are controlled by the government, and there is almost no private markets for most of the products the SOEs produce. Therefore, the managers have very little incentive to mis-report their revenues because it is hard to mis-report without being discovered and they have no where to sell the products they steal. So before the reform, managers will choose to not mis-report, and because of the lack of incentives, they will provide the least effort. We assume that their least effort level is \underline{A} .

After the Reform:

After the reform, the manager and the government agrees on a targeted amount of profits, or a reduced level of loss. As an incentive, the manager is rewarded by the government a fraction s of the reported extra profit $\tilde{\pi} - D$ if the contracted amount is achieved, where D is the contracted amount of target profits (negative if the contract is on a loss reduction). If the contracted amount is not achieved, the government has no means to punish the manager, or the punishment is relatively small so that we in this paper ignore it. On the other hand, since now managers have some autonomy in controlling the production plan, they have chances to steal the products. If the stealing behavior is not discovered by the government, they will receive a fraction γ of the under-reported amount $\pi - \tilde{\pi}$. To make under-reporting behavior beneficial, it is necessary to assume that γ is at least greater than s . If this under-reporting behavior is observed, the manager cannot get the reward, has to return the stolen profit, and has to bear a punishment that is increasing with the mis-reported amount. The probability p of being discovered is exogenous to an individual mis-reporting SOE, but is at the choice of the government, subject to some supervision cost.

If the reported profit is negative, because of information asymmetry and the soft-budget constraint problem induced by the existence of policy burden, the government cannot punish the manager but has to subsidize the firm.

Let $\theta = (\underline{A}, L, \epsilon, w, s, \gamma, p, c, \phi)$ where c and ϕ are two parameters to be introduced soon, we may write the managers value function as

$$V^*(\theta) = \max \{V^T(\theta), V^M(\theta)\}$$

where the value of truth-telling is given by

$$V^T(\theta) = s \max_A (A\epsilon L - wL - D, 0) - \phi (A - \underline{A})^2,$$

the value of mis-report is given by

$$V^M(\theta) = \max_{A, \tilde{R}} \left\{ (1-p) \left[s \max(\tilde{R} - wL - D, 0) + \gamma (A\epsilon L - \tilde{R}) \right] - pc (A\epsilon L - \tilde{R})^2 - \phi (A - \underline{A})^2 \right\}.$$

In the above expressions ϕ is the coefficient associated with the disutility of manager's effort, and c is the coefficient associated with the punishment if the cheating behavior is discovered. The existence of D not only characterizes the actual practice of the profit retention reform and the contract responsibility system reform, but also covers the full responsibility system reform by letting $D = 0$.

3.2 Analytics

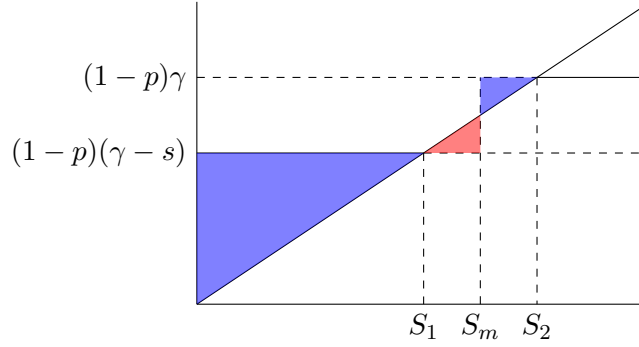
3.2.1 Behaviors under Truth-telling

The truth-telling case corresponds to the case in which $\tilde{R} = A\epsilon L$. Given that the manager will report the true revenue, his decision on his effort level is

$$A^* = \begin{cases} \underline{A} + \frac{s\epsilon L}{2\phi}, & \text{if } \frac{w}{\epsilon} \leq \underline{A} + \frac{s\epsilon L}{2\phi} - \frac{D}{\epsilon L}, \\ \underline{A}, & \text{otherwise.} \end{cases}$$

Given that the manager has to tell the truth, the rewards from the government do provide incentives for the managers to work harder, but only if the policy burden is not too high. If the policy burden w is high enough such that positive profits cannot be generated even if the manager

Figure 2: Determining the Stealing Amount



Notes: This figure presents an illustration of the manager's choice of stealing amount given that stealing is optimal. The manager will either steal at S_1 or S_2 , depending on whether the profit hits zero at the stealing amount of S_m .

choose his best input of A , then it is optimal for the manager to just put the least effort, i.e., $A = \underline{A}$, to minimize its disutility. This serves as one dimension through which incentive-based reforms fail in the presence of policy burden. In practice, the government can avoid the issue by setting a reasonable target D if it knows the true policy burden.

3.2.2 Behaviors under Mis-reporting

The mis-reporting case corresponds to the case in which $\tilde{R} < A\varepsilon L$. Given that the managers will steal, Figure 2 shows how the managers can best steal.

Fix any effort level A . Let the stealing amount be denoted by S . If the manager chooses to steal one more unit of the product, The marginal cost associated with getting caught is $2pcS$, which is a linear function of R . If the stealing amount is such that the reported profit is still positive, i.e., $A\varepsilon L - S - wL - D \geq 0$, then the marginal benefit associated with not getting caught is $(1-p)(\gamma-s)$. If the stealing amount is such that the reported profit is negative, i.e., $A\varepsilon L - S - wL - D < 0$ (in this case the government has to subsidize the firm), the marginal benefit associated with not getting caught is $(1-p)\gamma$, which is higher than $(1-p)(\gamma-s)$. The plot of MB and MC against the steal amount S is shown in the following picture.

The two optimal stealing amount is given by

$$S_1 = \frac{(1-p)(\gamma-s)}{2pc} \quad \text{and} \quad S_2 = \frac{(1-p)\gamma}{2pc}.$$

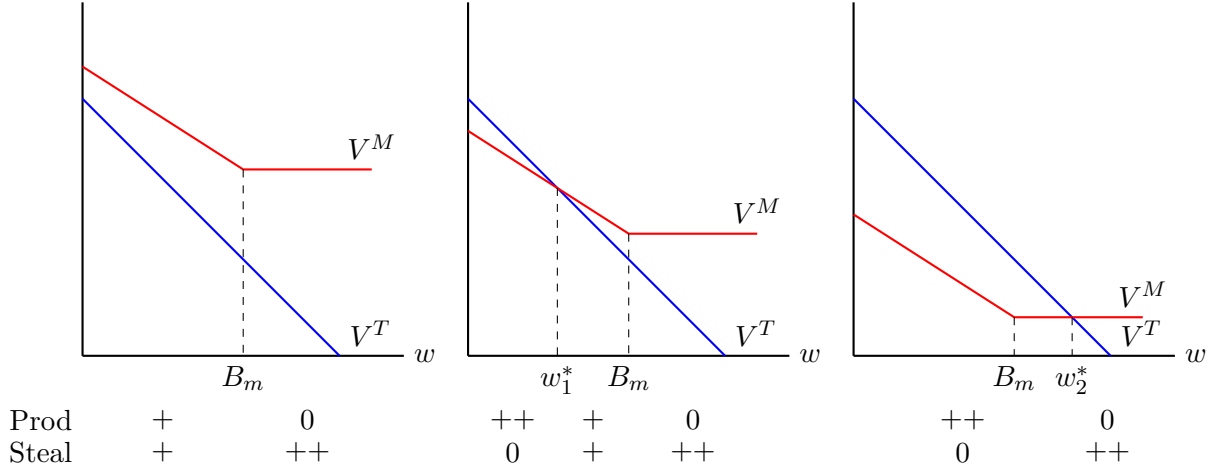
The jump of marginal benefit from $(1-p)(\gamma-s)$ to $(1-p)\gamma$ happens somewhere between $S = S_1$ and $S = S_2$. Between the interval $[S_1, S_2]$, the marginal surplus is negative (denoted by red in the figure) to the left of the jumping point and positive (denoted by blue in the figure) to the right of the jumping point.

Let

$$S_m = \frac{S_1 + S_2}{2} = \frac{(1-p)(2\gamma-s)}{4pc}.$$

If $A\varepsilon L - S_m - wL - D > 0$, then the jump point will be between $S = S_m$ and $S = S_2$. The plots then clearly indicates that the manager will steal S_1 . Similarly, if $A\varepsilon L - S_m - wL - D < 0$, then the manager will steal S_2 . If $A\varepsilon L - S_m - wL - D = 0$, then the manager will be indifferent in

Figure 3: Truth-telling v.s. Misreport



Notes: This figure illustrates the decisions of the managers productivity and stealing amount under three scenarios. The blue and red lines in each sub graph are respectively the value functions of the managers under truth-telling and misreport against the wage rate of the workers, which could be interpreted as an indicator of the policy burden. The bottom two rows presents the levels of the productivity and stealing amount comparing to the pre-reform level. A double + sign indicates an amount greater than a single + sign, which in turn is greater than 0.

stealing S_1 or S_2 . So the optimal scheme is

$$(A^*, S^*) = \begin{cases} \left(\underline{A} + \frac{(1-p)s\varepsilon L}{2\phi}, \frac{(1-p)(\gamma-s)}{2pc} \right), & \text{if } \frac{w}{\varepsilon} \leq B_m, \\ \left(\underline{A}, \frac{(1-p)\gamma}{2pc} \right), & \text{if } \frac{w}{\varepsilon} \geq B_m. \end{cases}$$

where $B_m = \underline{A} + \frac{(1-p)s\varepsilon L}{4\phi} - \frac{(1-p)(2\gamma-s)}{4pc\varepsilon L} - \frac{D}{\varepsilon L}$.

In the case when managers will mis-report, they have the incentive to increase productivity and keep part of the production by themselves. If policy burden passes a certain threshold, in the presence of soft-budget constraint, managers will work hard, and steal hard. The profit of the firm in this case will become negative. And there is of course apparent trade-offs between incentives, disutility of work, and punishment.

3.2.3 Truth-telling v.s. Mis-Reporting

For managers to determine whether to tell the truth or to mis-report, they look at the values V^T and V^M of the two scenarios. The two values as functions of the wage rate w are plotted in Figure 3. The solutions of course depends on whether the two functions intersect, and on where they intersect.

To illustrate the solution qualitatively, we also represent the managers optimal choices at the bottom of the Figure 3 using 0, + or ++. The first row indicates the effort level of the manager, with 0 indicating the no extra effort level \underline{A} , + signifying the effort level $A_1 = \underline{A} + \frac{(1-p)s\varepsilon L}{2\phi}$, ++ signifying the effort level $A_2 = \underline{A} + \frac{s\varepsilon L}{2\phi}$. The number of + increases with the effort level. The second row indicates the stealing amount with 0 indicating truth-telling, + indicating an under-report amount of S_1 , and ++ indicating an under-report amount of S_2 . Similarly, the number of + increases with the stealing amount.

The full analytical solution is given by equation (1) in the footnote.⁵ There are altogether seven cases, and in which category the solution falls depends on the value of the parameter θ .

We have the following propositions concerning the optimal behavior of the managers following from Figure 3 directly.

Proposition 3.1. If policy burden (w) is sufficiently large, the incentive-based reform fails: managers do not work harder than their pre-reform level, and they will steal heavily. When policy burden is small enough, managers will work harder than their pre-reform level.

Proposition 3.2. When policy burden increases, the managers are more inclined to under-report.

We also have the following result from equation (1).

Proposition 3.3. If the gain γ from the under-report is sufficiently small, then there is no incentive to under-report by the manager.

3.3 Government

Suppose that the government cares about its tax revenues collected from these firms. The tax revenues collected from an SOE before the reform is $\underline{A}\epsilon L - wL$, which could be either positive or negative. In the case of negative tax revenue, the government actually provides subsidies to the firm.

Whether the tax revenue collected by the government increases or decreases after the reform depends first of all on the behaviors of the managers, and therefore on the parameter values. It

⁵The full analytical solution to the manager's problem is given by

$$(A^*, S^*) = \begin{cases} \left(\underline{A} + \frac{(1-p)s\epsilon L}{2\phi}, \frac{(1-p)(\gamma-s)}{2pc} \right), & \text{if } ps\underline{A}\epsilon L + [1 - (1-p)^2] \frac{s^2\epsilon^2 L^2}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4pc} < 0 \text{ and} \\ & w < \underline{A}\epsilon + \frac{(1-p)s\epsilon^2 L}{4\phi} - \frac{(1-p)(2\gamma-s)}{4pcL} - \frac{D}{L}, \\ \left(\underline{A}, \frac{(1-p)\gamma}{2pc} \right), & \text{if } ps\underline{A}\epsilon L + [1 - (1-p)^2] \frac{s^2\epsilon^2 L^2}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4pc} < 0 \text{ and} \\ & w > \underline{A}\epsilon + \frac{(1-p)s\epsilon^2 L}{4\phi} - \frac{(1-p)(2\gamma-s)}{4pcL} - \frac{D}{L}, \\ \left(\underline{A} + \frac{s\epsilon L}{2\phi}, 0 \right), & \text{if } ps\underline{A}\epsilon L + [1 - (1-p)^2] \frac{s^2\epsilon^2 L^2}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4pc} > 0 \text{ and} \\ & \frac{ps^2\epsilon^2 L^2}{4\phi} + \frac{(1-p)p\gamma^2}{4pc} - \frac{(1-p)(\gamma-s)^2}{4pc} < 0 \text{ and} \\ & w < \underline{A}\epsilon + \frac{(2-p)s\epsilon^2 L}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4p^2csL} - \frac{D}{L}, \\ \left(\underline{A} + \frac{(1-p)s\epsilon L}{2\phi}, \frac{(1-p)(\gamma-s)}{2pc} \right), & \text{if } ps\underline{A}\epsilon L + [1 - (1-p)^2] \frac{s^2\epsilon^2 L^2}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4pc} > 0 \text{ and} \\ & \frac{ps^2\epsilon^2 L^2}{4\phi} + \frac{(1-p)p\gamma^2}{4pc} - \frac{(1-p)(\gamma-s)^2}{4pc} < 0 \text{ and} \\ & w > \underline{A}\epsilon + \frac{(2-p)s\epsilon^2 L}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4p^2csL} - \frac{D}{L} \text{ and} \\ \left(\underline{A}, \frac{(1-p)\gamma}{2pc} \right), & \text{if } ps\underline{A}\epsilon L + [1 - (1-p)^2] \frac{s^2\epsilon^2 L^2}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4pc} > 0 \text{ and} \\ & \frac{ps^2\epsilon^2 L^2}{4\phi} + \frac{(1-p)p\gamma^2}{4pc} - \frac{(1-p)(\gamma-s)^2}{4pc} < 0 \text{ and} \\ & w > \underline{A}\epsilon + \frac{(1-p)s\epsilon^2 L}{4\phi} - \frac{(1-p)(2\gamma-s)}{4pcL} - \frac{D}{L}, \\ \left(\underline{A} + \frac{s\epsilon L}{2\phi}, 0 \right), & \text{if } ps\underline{A}\epsilon L + [1 - (1-p)^2] \frac{s^2\epsilon^2 L^2}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4pc} > 0 \text{ and} \\ & \frac{ps^2\epsilon^2 L^2}{4\phi} + \frac{(1-p)p\gamma^2}{4pc} - \frac{(1-p)(\gamma-s)^2}{4pc} > 0 \text{ and} \\ & w < \underline{A}\epsilon + \frac{s\epsilon^2 L}{4\phi} - \frac{(1-p)^2\gamma^2}{4pcsL} - \frac{D}{L}, \\ \left(\underline{A}, \frac{(1-p)\gamma}{2pc} \right). & \text{if } ps\underline{A}\epsilon L + [1 - (1-p)^2] \frac{s^2\epsilon^2 L^2}{4\phi} - \frac{(1-p)^2(\gamma-s)^2}{4pc} > 0 \text{ and} \\ & \frac{ps^2\epsilon^2 L^2}{4\phi} + \frac{(1-p)p\gamma^2}{4pc} - \frac{(1-p)(\gamma-s)^2}{4pc} > 0 \text{ and} \\ & w > \underline{A}\epsilon + \frac{s\epsilon^2 L}{4\phi} - \frac{(1-p)^2\gamma^2}{4pcsL} - \frac{D}{L}. \end{cases} \quad (1)$$

also depends on the government's behavior. The government choose the reward ratio s and the supervision level p .

In the case where productivity of the manager does not increase but the manager misreport, the tax revenue of the government definitely decreases after the reform. This corresponds to the situation that the policy burden w is high.

In the case of truth-telling, which corresponds to the case of a low policy burden w and high enough supervision p , the reform increases productivity. However, in these situations any increased profit will be shared by the manager and the government, so whether the government sees an increase of tax revenue depends on the parameters, especially on s . This could be easily seen from the expression of the difference of tax revenue pre- and post-reform

$$\Delta\tau(s) = s \left[(1-s) \frac{\varepsilon L}{2\phi} - (\underline{A}\varepsilon L - wL) \right],$$

which is a quadratic function of s .

In the case of mis-report but not mis-reported so heavily so that the reported profit is still positive, the expected tax revenue change is

$$\begin{aligned} \Delta\mathbb{E}\tau(s, p) &= \frac{(1-s)(1-p)^2 s\varepsilon^2 L^2}{2\phi} - \frac{(1-s)(1-p)^2 (\gamma - s)}{2pc} \\ &\quad - s(1-p)(\underline{A}\varepsilon L - wL) + \frac{p(1-p)s\varepsilon^2 L^2}{2\phi}. \end{aligned}$$

The value of the above expression could be positive or negative, depending on the value of s and p . We can easily see that $\Delta\mathbb{E}\tau(s, p) \rightarrow -\infty$ as $p \rightarrow 0$. That is, when p is sufficiently low, the tax revenue will be significantly smaller than the pre-reform level.

From the above analysis, we see the following holds.

Proposition 3.4. *Ceteris paribus*, for any choice of s from the government and any ε the firm is endowed with, there exists a \underline{p} such that truth-telling cannot be supported if $p < \underline{p}$.

Apparently, the government has a strong incentive to increase its supervision level, however, supervision is not free. It is costly for the government to increase supervision intensity, especially in the case when the number of firms is big.

To characterize the firm's optimal behavior, we assume that firms are indexed by $i \in I = [0, 1]$. Suppose the firms have idiosyncratic efficiency level ϵ for workers, which follows a distribution with distribution function F . Suppose that a fraction μ of firms are chosen to conduct the reform, and the indexes of the selected firms are collected in I^* . Suppose that the government's problem is given by

$$\max_{s \in [0, 1], p \in [0, 1]} \int_{i \in I^*} \tau_i(s, p) di - \frac{\kappa\mu}{1-\mu} p$$

where $\frac{\kappa\mu}{1-\mu}$ is the marginal cost of increasing supervision intensity. By using this functional form, we assume that the marginal cost is increasing in the supervision intensity. It is not possible to obtain the analytical solution of the government's problem, but we may conduct some asymptotic analysis for the case when μ is close to one. This corresponds to the case where the reforms are promoted to the majority, and the marginal cost of supervision is very high.

Proposition 3.5. As $\mu \rightarrow 1$, the optimal supervision level $p^* = O(\sqrt{1-\mu}) \rightarrow 0$, regardless of the orders of the firms that are chosen to conduct the reform. The fiscal income of the government deteriorates significantly after the reform.

Proof. The order of the reform does not matter because when $\mu \rightarrow 1$, nearly all firms are involved in the reform. Since $\mathbb{E}\tau_i = O(p^{-1})$. The optimal p is achieved when $O(p^{-1}) = O(\frac{\mu}{1-\mu}p)$ as $\mu \rightarrow 1$. This implies that $p^* = O(\sqrt{1-\mu})$. \square

The above proposition is in line with the observation that the seemingly successful SOE reform in China in the stage of experiment failed after it was promoted to a large scale.

3.4 Remarks on Privatization

Privatization could be analyzed in the above framework in the presence of policy burden, too. The third wave of reform, full responsibility system (full residue-claim), is similar to privatization in that the managers and workers of the firms are responsible for any profits or losses of operating the firm.⁶ This is equivalent to setting the reward rate s of privatized SOEs to be one minus the tax rates. Besides, we notice that the parameter γ in the definition of the value of mis-report V^M can also be contingent on the ownership type of firm. γ is the fraction of the under-reported amount $\pi - \tilde{\pi}$ that the manager can steal into his own pocket if the stealing behavior is not discovered by the government. For a privatized SOE, γ should definitely become larger or even close to one since it's more legitimate for a private owner to consumer firm's surplus and the government has less controlling power over a privatized SOE than before over a completely state-owned firm. We see that V^M is increasing in γ (from the definition of V^M in Section 3.1.1), so in Figure 3, the V^M line will unambiguously move up for an increased γ , which is to say, the under-reporting behavior and the unsuccessful performance in the measure of post-reform profitability more probably happen after the third wave of privatization reform (full responsibility system with full residue-claim), *ceteris paribus*; and asking for subsidy after privatization is even more frequent under the extreme stealing such that not only $\bar{R} < wL + D$, but also $\bar{R} < wL$ (see the definition of V^M in Section 3.1.1). Further, from equation (1), the full analytical solution to the manager's behavior after the reform, the stealing amount is non-decreasing in γ in all cases. Hence, both the probability and the amount of stealing behavior tend to be larger after privatization compared to the first two waves of reform.

Because of the existence of policy burdens, SBC continues to hold even after privatization, and the formulation of the problem is unchanged. As a result, the implications of our model also remain, or is even stronger for evaluating the third wave of reform on privatization.

4 Concluding Remarks

In this paper we argue that the huge difference in the performance of incentive-based SOE reforms between the experiment stage and the promotion stage is due to the interaction of incentives, policy burdens and supervision intensity. For incentives to work properly in the presence of soft budget constraint induced by policy burdens, the government has to impose enough amount of supervisions to individual firms, or to deprive all of the manager's discretionary authority as the case before the reform. In the case of supervision, once the reform was promoted to many SOEs and supervision is diluted, incentives will fail.

Privatization does not solve the problem. This is because a large part of the principal-agent problem comes from policy burdens, and privatization alone cannot solve this issue. Government still needs to subsidize those firms that are running losses and the soft budget constraint continues to exist. Due to information asymmetry, the more autonomy the managers posses, the severer

⁶Though, as opposed to privatization, the legal owner of the firm in this reform is still the government. The managers can not, for example, trade the firm or its assets in a private fashion. See Section 2.1.

the moral hazard, and the more subsidies the government find itself providing in the end. The experience from the Russia's privatization reform has lend support to this point.

So what is the correct solution? In order for the market to play its role, we need to put the SOEs and non-SOEs on the same playing field. That is, we need to get rid of the policy burden of those SOEs, at least for the SOEs that are operating in the competitive industries. For removing the social burden, the state needs to set up a social security system so that the SOEs can lay off redundant workers without the fear of undermining social stability. For removing the strategical burden, the economy needs to grow and accumulate capital so as to turn the strategically important industries from going against the country's comparative advantages to becoming consistent with the country's advantages. Only if the policy burdens are eliminated will the state not be accountable for the SOEs' losses and the SOEs' budget can be hardened. By doing so, even if the SOEs are not privatized, the government can still infer the profitability of the SOEs by looking at the situation in the competitive market. Also, for the market to work, we need a functioning price system that reveals the correct demand and cost information and to guide resource allocation with its "invisible hand". These "infrastructures" or "pre-conditions" for the market to work can only be established after the policy burdens are eliminated, and then the state does not need to distort the prices and directly involve in the allocation of resources to subsidize the non-viable SOEs. The setting up of social security and the accumulation of capital to change the comparative advantage of economy take times. This also justifies the advantages of gradual reform against the shock therapy.

References

- Berle, A. A. and Menas, G. C. (1991). *The Modern Corporation and Private Property*. Routledge, 2nd edition.
- Boycko, M., Shleifer, A., and Vishny, R. W. (1996). A theory of privatisation. *Economic Journal*, 106(435):309–319.
- Dewatripont, M. and Maskin, E. (1995). Credit and efficiency in centralized and decentralized economies. *Review of Economic Studies*, 62(4):541–555.
- Dewenter, K. L. and Malatesta, P. H. (2001). State-owned and privately owned firms: An empirical analysis of profitability, leverage, and labor intensity. *American Economic Review*, 91(1):320–334.
- Estrin, S. and Pelletier, A. (2018). Privatization in developing countries: What are the lessons of recent experience? *World Bank Research Observer*, 33(1):65–102.
- Groves, T., Hong, Y., McMillan, J., and Naughton, B. (1994). Autonomy and incentives in chinese state enterprises. *Quarterly Journal of Economics*, 109(1):183–209.
- Hart, O. (1995). Corporate governance: Some theory and implications. *Economic Journal*, 105(430):678–689.
- Holmstrom, B. and Milgrom, P. (1987). Aggregation and linearity in the provision of intertemporal incentives. *Econometrica*, 55(2):303–328.
- Holmstrom, B. and Milgrom, P. (1994). The firm as an incentive system. *American Economic Review*, 84(4):972–991.
- Kornai, J. (1979). Resource-constrained versus demand-constrained systems. *Econometrica*, 47(4):801–819.
- Kornai, J. (1980). *Economics of Shortage*. Elsevier Science.
- Kornai, J., Maskin, E., and Roland, G. (2003). Understanding the soft budget constraint. *Journal of Economic Literature*, 41(4):1095–1136.
- Lin, J. Y., Cai, F., and Li, Z. (1998). Competition, policy burdens, and state-owned enterprise reform. *American Economic Review*, 88(2):422–427.
- Lin, J. Y. and Li, Z. (2008). Policy burdens, privatization and soft budget constraint. *Journal of Comparative Economics*, 36:90–102.
- Lin, J. Y. and Tan, G. (1999). Policy burdens, accountability, and the soft budget constraint. *American Economic Review*, 89(2):426–431.
- Shleifer, A. and Vishny, R. W. (1994). Politicians and firms. *Quarterly Journal of Economics*, 109(4):995–1025.
- Vickers, J. and Yarrow, G. (1991). Economic perspectives on privatization. *Journal of Economic Perspectives*, 5(2):111–132.
- World Bank (1996). World bank annual report.