

# A Comparison of Management Incentives, Abilities, and Efficiency between SOEs and TVEs: The Case of the Iron and Steel Industry in China\*

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## I. Introduction

Despite the implementation of a series of state-owned enterprise (SOE) reforms in China since the inception of open door policies in 1978, the production share of the SOE sector has continued to decline in many industrial sectors because of the faster growth of township-village enterprises (TVEs) as well as joint ventures (Zhang 2002). Even in the iron and steel industry, which is generally characterized by large-scale economies and high capital intensity, the production share of TVEs increased from 4% in 1985 to 9% in 1990, and further to 21% in 2000.<sup>1</sup> Furthermore, there has been no clear indication of improvement in management efficiency, which is reflected in increased total factor productivity.

These observations have led to skepticism as to the effectiveness of piecemeal SOE reforms within an institutional framework of the state ownership of enterprises. Indeed, some Chinese economists argue that it will not be possible to enhance the management efficiency of SOEs significantly without reforming the enterprise ownership system itself (Zhang 1995; Zhu 1998). Yet others disagree with the fear that hasty property-right reforms may result in chaos rather than efficiency improvement in view of the failure of the sweeping state enterprise reforms in the Russia and East European economies (Rawski 1996; Li 1997; Jefferson 1998). Further, Lin, Cai, and Li and also Steinfeld argue that hardening the soft budget constraints facing SOEs and enhancing the competitive market structure are more important than the property-right reforms of SOEs (Lin, Cai, and Li 1998; Steinfeld 1998).<sup>2</sup>

Empirical evidence on the relative management efficiency of state and

nonstate sectors and the impact of the SOE reforms, however, is scanty, even though SOE reform is one of the central issues of economic reform in China.<sup>3</sup> Without identifying the extent and the causes of the management inefficiency of SOEs, it will not be possible to design socially desirable reform policies.

This study attempts to identify factors affecting the relative performance of SOEs and TVEs, using the panel data of 108 enterprises (59 SOEs and 49 TVEs) from 1995 to 1999 collected by our own survey. By estimating the production function separately for SOEs and TVEs, we first examine the efficiency-enhancing effects of SOE reforms that have transformed selected SOEs into stock companies and joint ventures.<sup>4</sup> To the extent that the reforms introduce efficient management incentives, we expect that they have positive effects on production efficiency. Second, we examine if TVE reforms, which range from the introduction of the management responsibility system to the establishment of stock companies and private enterprises, are conducive to the efficient management of TVEs. Although TVE reforms may strengthen management incentives, they might have negative consequences on management efficiency if township and village governments significantly contribute to the transaction of materials and final products in the absence of efficient markets (Li 1996; Hsiao et al. 1998; Chen and Rozelle 1999; Li, Rozelle, and Brandt 1999; Tian 2001). Third, we attempt to identify the productivity effects of management interventions by the government in the form of the selection and appointment of chief executives of enterprises and the mode of payment of rewards to them. More specifically, by estimating both the production function and the reward function to enterprise managers simultaneously, we examine whether the government interventions have consistent impacts on production efficiency and the amount of rewards to managers. We argue that the interventions are distortional, if, for example, the government appointment of enterprise managers increases a manager's rewards without increasing production efficiency. Finally, we examine the differences in the rates of productivity growth between the TVE and SOE sectors from the coefficients of year dummies. The results of statistical analyses indicate that in order for SOEs to compete with TVEs, a major ownership reform of SOEs is indispensable.

The organization of this article is as follows: after comparing the characteristics of sample SOEs with TVEs in Section II, we specify the testable hypotheses in Section III. In Section IV, we test the hypotheses by estimating the production function as well as the function explaining the reward to chief executives. Policy implications of this study are discussed in Section V.

## **II. Characteristics of Sample Enterprises**

We conducted enterprise surveys in the four most important provinces in the production of iron and steel products in China, that is, Liaoning, Hebei, Jiangsu, and Sichuan provinces. Based on the 1995 census of manufacturing enterprises, we selected 20 state and 30 nonstate enterprises in each of these four provinces randomly and distributed questionnaires to ask questions about

TABLE 1  
NUMBER OF SAMPLE ENTERPRISES BY TYPE IN 1995 AND 1999

	1995	1999
State enterprises (SEs):		
State-owned (SOEs)	42	35
Stock companies	10	18
Joint ventures	7	6
Total	59	59
Township-village enterprises (TVEs):		
Local government owned	42	27
Stock companies	3	12
Joint ventures	4	3
Private enterprises	0	7
Total	49	49

enterprise systems, the value and cost of production, the amount of capital stock and employment, the personal characteristics of chief executives, and the appointment and reward systems for them for each year from 1995 to 1999. We received replies from 150 enterprises. Although the overall response rate was fairly high, we admit that there was some tendency for the response rates from larger enterprises to be higher. In order to remove the possible impacts of sampling bias, we will apply the enterprise-level fixed-effect model for the estimation of the production and reward functions.

After deleting 18 enterprises with incomplete information and 24 urban collectives, we focus on 59 state enterprises and 49 TVEs in this study.<sup>5</sup> Note that we use the term “state enterprises” (SEs) to refer not only to state-owned enterprises (SOEs) but also to stock companies and joint ventures that have been transformed from SOEs. Similarly, TVEs refer not only to township- and village-run enterprises (TVREs) but also to stock companies, joint ventures, and private enterprises that have been transformed from TVREs.<sup>6</sup>

In order to check the accuracy of our survey data, we compared basic enterprise statistics obtained from our survey with the official statistics shown in the *Iron and Steel Yearbook* published by the State Administration of Metallurgical Industry. Almost all sample SEs are included in the official data. As far as these enterprises are concerned, the correlation coefficients of value added, the number of workers, and the value of fixed capital between sample data and official data are all .999 for 1995 and no less than .99 for 1999. Although these high correlation coefficients do not prove the accuracy of our data, they indicate that the reported statistics are not particularly distorted.<sup>7</sup>

#### *Changes in Enterprise System*

Table 1 exhibits the number of our sample enterprises by enterprise type in 1995 and 1999. Seventeen out of 59 SEs had already been reformed to stock companies or international joint ventures in 1995, and from 1995 to 1999 the number of stock companies continued to increase at the sacrifice of SOEs.<sup>8</sup> Thus, although gradual, it appears that state enterprises have been reformed

considerably in the late 1990s. Yet, stock companies are still controlled by the central or provincial governments in charge of SEs because they can exercise the stockholders' rights to choose their chief executives. Therefore, whether the reform of SOEs to stock companies has had a pervasive impact on enterprise performance is an important and unresolved empirical question.

The number of traditional TVREs has declined from 42 in 1995 to 27 in 1999. Unlike SEs, not only the number of stock companies but also that of wholly privatized companies significantly increased from 1995 to 1999. It is interesting to explore if the privatization of TVREs, as well as the conversion to stock companies, has significant effects on the management efficiency of TVEs. To our knowledge, the positive effects of TVE privatization have seldom been confirmed statistically.<sup>9</sup>

#### *Enterprise Performance*

It will be highly misleading to assess the effects of enterprise reforms on management efficiency of enterprises by simply comparing the performance of different types of enterprises, because the selection of enterprises for reform may not be random. For example, it is possible that both the central and township governments choose deficit-ridden enterprises to be reformed in order to improve profitability.<sup>10</sup> In that case, SOEs or TVREs may appear more profitable than stock companies, even though the conversion to stock companies improved management efficiency. Therefore, in order to assess the effects of enterprise reform properly, we have to control for the effects of innate management ability and other enterprise-specific factors.

Table 2 shows the average gross output value per enterprise and the rate of profit defined as the ratio of gross profit before tax (i.e., the sum of tax payments and profits) to gross value of fixed assets, corresponding with the classification of enterprises in table 1. In order to see how representative the sample enterprises are, we also show the data of national averages in parentheses for comparison (see table 2 notes for the problem of the data comparability between 1995 and 1999). It must be pointed out, however, that the rate of profit, which normalizes profit by the size of capital, is only a rough measure of management efficiency. In particular, we must note that profits tend to be underrated in the SE sector, as SEs often deduct the costs of social services (e.g., health, pensions, housing, and education) and research and development for public dissemination from "true" profit, unlike TVEs.<sup>11</sup> Thus, the comparison between the SE and TVE sectors is particularly hazardous.

According to table 2, while the average value of production, which is expressed in real terms, remained almost unchanged among the 59 state enterprises from 1995 to 1999, the average value decreased appreciably among SOEs and increased rapidly among stock companies. This is because it was large SOEs that were reformed to stock companies in the late 1990s. The average rate of profit declined from 5.3% in 1995 to 1.7% in 1999 among SOEs, whereas it declined much less among stock companies. These observations suggest that more profitable SOEs in 1995 had become stock com-

TABLE 2  
AVERAGE PERFORMANCE OF SAMPLE ENTERPRISES BY TYPE IN 1995 AND 1999

	GROSS OUTPUT VALUE (Million Yuan)		PROFIT RATE <sup>a</sup> (%)	
	1995	1999	1995	1999
State enterprises (SEs):				
State-owned (SOEs)	1,165	369	5.3	1.7
Stock companies	1,426	2,980	2.9	1.7
Joint ventures	353	597	5.2	3.4
Average	1,113	1,189	5.2	1.8
(National average) <sup>b</sup>	(234)	(383)	(9.1)	(3.5)
Township-village enterprises (TVEs):				
Local government owned	70	79	16.1	14.1
Stock companies	113	64	8.7	7.5
Joint ventures	214	799	.2	8.5
Private enterprises	... <sup>c</sup>	84	... <sup>c</sup>	17.4
Average	85	120	14.3	12.6
(National average) <sup>d</sup>	(13)	(11)	(14.0)	N.A. <sup>e</sup>

SOURCE.— Authors' own survey except for the data of national averages, for which we used Zhonghua Renmin Gongheguo Disanci Gongye Pucha Bangongshi (1997), State Statistical Bureau of China (various years, 1999 in this case) for the SEs in 1999, and Ministry of Agriculture (various years, 2000 in this case).

<sup>a</sup> The ratio of gross profit before tax (i.e., the sum of tax payments and profits) to gross value of fixed assets.

<sup>b</sup> Data for 1995 pertain to SOEs, whereas data for 1999 pertain to SEs as a whole, so that, strictly speaking, direct comparison between the 2 years cannot be made.

<sup>c</sup> Not applicable.

<sup>d</sup> Data for 1995 pertain to TVEs run by township governments excluding those run by village governments, whereas data for 1999 pertain to TVEs as a whole, so that strict direct comparison between the 2 years cannot be made.

<sup>e</sup> Not available.

panies in 1999, even though there is a possibility that the conversion to stock companies enhanced management efficiency, thereby preventing a large decrease in profits.

There are substantial differences in the size and profitability of enterprise operation between SEs and TVEs. The average value of the production of SEs is roughly 10 times as large as that of TVEs, resulting in the dual structure of the iron and steel industry in China. On average, the value of production per enterprise increased by 41% in the case of TVEs and only by 6% in the case of SEs from 1995 to 1999, which is consistent with the increasing production share of the TVE sector in the iron and steel industry in China. As expected, there are also marked differences in the rate of profit between the two enterprise sectors; it was higher among TVEs than SEs by 3 times in 1995 and 7 times in 1999. It is clear that despite SOE reforms, including a reduction in the provision of social services, the gap in profitability between the state and TVE sector has widened rather than narrowed, which indicates that the continuation of current SOE reforms may not enhance the profitability of SEs significantly. It is also unlikely that given the vast difference in size, the dual structure of this industry can be resolved by piecemeal reforms.

The manner of selecting local-government-owned TVREs for enterprise reform seems different from the case of SOEs, judging from the small differences in the average value of production among the different enterprise categories within the TVE sector in both 1995 and 1999, except for joint ventures that tend to be larger. There are, however, significant differences in the rate of profit among different enterprise groups.

First, traditional TVREs attained a relatively high rate of profit both in 1995 and 1999, which indicates that TVREs may not be significantly more inefficient than stock companies and joint ventures. As has been pointed out by the literature on TVE reform, intervention by the local government into TVE management could be helpful, if competitive markets are underdeveloped.<sup>12</sup> This may be particularly true in the iron and steel industry, where TVEs must purchase such materials as iron ore and coal primarily from SEs and sell part of their products to other SEs. More important, the local government assists the acquisition of land for factories and offices, and credit from banks (Park and Shen 2003). Thus, there is room for the local government to contribute to the management of TVEs. The fact that stock companies and joint ventures had relatively low rates of profit may reflect the effects of the absence of such supports from township and village governments. Furthermore, if we confine our attention only to the 12 stock companies as of 1999, nine of which were TVREs in 1995, it is found that the average rate of profit declined abruptly from 13% in 1995 to 7.5% in 1999, suggesting the absence of positive efficiency-enhancing effects from the conversion to stock companies.

By contrast, the average rate of profit is very high among the seven private enterprises in 1999. Although data are not shown in table 2, it is important to point out that these seven private enterprises in 1999 had an extremely high profit rate of 22.4% in 1995 before they were privatized. This indicates that particularly profitable TVEs have been fully privatized, as TVEs have to make the payment of a large sum to the local governments for full privatization.

There are large differences in average size between our sample enterprises and all the enterprises in China. There are at least three possible reasons. First, iron and steel enterprises in the four provinces selected in this study tend to be large, as they are the core and the most advanced provinces in China. Second, enterprises in the four provinces generally perform all production activities from the production of pig iron to the production of steel plates and pipes, whereas there are a large number of small enterprises in China, which specialize in the production of certain products, such as pig iron and steel products. Third, as was pointed out earlier, the response rates to our questionnaire were higher for larger enterprises. Thus, we cannot claim that our sample enterprises are representative in China; it is probably fair to say that this study focuses on large enterprises, which are generally found in advanced regions in the iron and steel industry in China. The profit rate tends

TABLE 3  
OTHER MANAGEMENT INDICATORS OF SAMPLE ENTERPRISES BY MAJOR ENTERPRISE TYPE  
IN 1995 AND 1999

	SEs		TVEs	
	1995	1999	1995	1999
Average of sample enterprises:				
Capital-labor ratio (1,000 yuan/person)	81	139	53	72
No. of workers (1,000 persons)	12.0	10.7	.39	.41
Annual wage per employee (1,000 yuan)	6.9	7.2	5.0	6.7
Proportion of university and college graduates (%)	9.1	11.0	2.2	3.1
Ratio of net to gross fixed capital (%)	72	71	82	67
National average:				
Capital-labor ratio (1,000 yuan/person)	123	253	41	...
No. of workers (1,000 persons)	2.6	2.8	.11	.06
Annual wage per employee (1,000 yuan)	8.0	...	4.1	...
Proportion of university and college graduates (%)	10.5	...	1.7	...
Ratio of net to gross fixed capital (%)	63	64	81	...

NOTE.— See table 2 for data sources and notes. In particular, see notes b and d for the definition of national average.

to be lower for our sample state enterprises, partly because larger SEs tend to incur a larger amount of nonproductive costs.

Other major differences in production structure between SEs and TVEs include a higher capital-labor ratio and the larger employment size of workers of the former rather than the latter (see table 3). The capital-labor ratio of SEs increased from 1995 to 1999 due partly to the reduction in the size of employment, even though the average size of employment of state enterprises is still 25 times as high as TVEs in 1999. By contrast, the difference in annual wage payment to workers between SEs and TVEs was small and narrowing, despite the fact that the education level of workers measured by the proportion with university or college diplomas is much higher in SEs. The difference in the vintage of fixed capital does not seem significantly different, according to the small difference in the “net-gross fixed capital ratio”; since the gross capital is the accumulated value of nominal investment adjusted for scrapping and the net capital stock is also adjusted for depreciation, the larger the ratio of net capital to gross capital, the younger the capital stock.<sup>13</sup>

Compared with the national average, our sample SEs are larger in terms of the number of workers and are less capital intensive (see table 3). Other differences are not so pronounced.

#### *Personal Characteristics of Chief Executives*

A large number of Chinese economists attribute inefficient management of SOEs to the inability of chief executives and to the lack of management incentives for them (Zhu 1998; Zhang 1999; Li 2002). While descriptive analyses have been conducted on this issue, rigorous statistical analyses have seldom been attempted. Moreover, a comparison of the role of the abilities and work incentives of chief executives between SEs and TVEs has never

TABLE 4  
PERSONAL CHARACTERISTICS OF CHIEF EXECUTIVES BY MAJOR ENTERPRISE TYPE  
IN 1995 AND 1999

	SEs		TVEs	
	1995	1999	1995	1999
Average age (years)	51.5	49.3	45.0	44.6
Years as chief executive	5.2	4.5	3.7	5.4
Schooling completed (%):				
Four-year university and above	58	64	6	8
Three-year college	24	29	25	29
High schools and specialized secondary schools	17	7	43	43
Regular secondary schools and below	2	0	27	20
Specialized areas of study (%):				
Science and engineering	59	53	8	6
Social sciences	27	39	47	57
None and others	14	10	45	41

been made. In order to undertake a comparative study, we have collected data on the characteristics of chief executives, the manner of their appointment, and the reward systems to them, which are not available from secondary data sources.

In China, the age of chief executives can be an important factor affecting the incentives of enterprise management, because under the tradition of seniority rules with mandatory retirement at 60 years of age, younger managers would have stronger incentives to work than older managers approaching the retirement age. This will be particularly the case for SEs, where the mandatory retirement age is strictly followed. As may be expected, the average age of chief executives is somewhat higher in SEs than in TVEs (table 4). Such differences in the age of chief executives may partly explain the difference in the productivity between SEs and TVEs.

The average length of tenure as chief executive tends to decline among SEs and to increase among TVEs, even though the overall averages are not much different. These observations imply that the turnover of managers is quite fast among SEs, whereas TVEs, which are relatively new, tend to keep the same chief executives for extended periods. Much clearer differences exist in their schooling levels: more than 80% of chief executives of SEs graduated from 3-year colleges or above, and this proportion increased over the 5-year period, whereas as many as 60%–70% of the chief executives of TVEs did not go to colleges and universities. Therefore, it is clear that the chief executives of SEs are far more educated than those of TVEs. Furthermore, more than half of the chief executives of SEs majored in sciences and engineering, which are supposed to be related to the production technologies employed in the iron and steel industry. There are only a few such managers in TVEs.

The question is to what extent the appointment of such highly educated managers with scientific knowledge of iron and steel production technologies leads to SEs' higher production efficiency. A counterargument is that schooling



TABLE 5  
 APPOINTING ORGANS, PREVIOUS POSITIONS, AND JOINT APPOINTMENT OF CHIEF EXECUTIVES  
 BY MAJOR ENTERPRISE TYPE IN 1995 AND 1999

	SEs		TVEs	
	1995	1999	1995	1999
Appointing organs (%):				
Government bodies	78	66	39	29
Board of directors	10	14	25	27
Jointly by government bodies and board of directors	5	14	13	16
Others <sup>a</sup>	5	7	25	31
Previous positions (%):				
Government leaders	10	9	6	6
Leaders of current enterprises	66	61	31	35
Leaders of other enterprises	19	22	31	27
Others <sup>b</sup>	5	9	33	33
Joint appointment with (%):				
Communist Party secretary <sup>c</sup>	69	56	16	16
Chairman of board of directors <sup>d</sup>	27	32	12	18
None and others	29	26	74	69

<sup>a</sup> The most important in this category is the appointment by employee representative committees.

<sup>b</sup> The most important in this category for rural enterprises is farming.

<sup>c</sup> Includes Communist Party deputy secretary.

<sup>d</sup> Includes vice chairman of board of directors.

is used as a screening device for chief executives, even though it is not an appropriate indicator of useful human capital acquired by schooling. In this connection, it may be of interest to realize that about half of chief executives of private enterprises in the TVE sector completed only middle school or below. The high proportion of such low-educated chief executives in the TVE sector is reflected in the high proportion of the “none and others” category in the “specialized areas of study” section in table 4.

#### *Appointment of Chief Executives*

How chief executives are selected can have an important bearing on the objectives of enterprise management. If appointed by upper government organs, chief executives are likely to serve government interests in order to secure their positions and receive favorable treatment in future. By contrast, if they are selected and appointed by the board of directors, they are more likely to be motivated toward profit-oriented management. As is shown in table 5, chief executives of most SEs are appointed by upper government bodies in charge of supervising them, even though the decisions of the board of directors seem to have been increasingly recognized. However, many local governments no longer appoint chief executives of TVEs, particularly for joint ventures and private enterprises, and instead the enterprises themselves have selected their own chief executives in many cases. In both SEs and TVEs, the fact that the proportion of chief executives appointed by the government declined indicates that this appointment system is detrimental to the efficient

management of enterprises in the face of increasing competition among enterprises in the iron and steel industry.

It is often argued that government leaders and bureaucrats who had been in positions to supervise SEs and TVEs were appointed to be their chief executives in the 1980s. Yet, such practice has seldom been observed in the iron and steel industry, according to table 5. In the case of SEs, more than 60% of current chief executives used to be employees of the same enterprises. Previous government leaders, however, often became the chief executives of joint ventures, because of their contribution to the establishment of such enterprises. In the case of TVEs, while only one-third of current chief executives used to be employees of the same enterprises, reflecting their recent establishment, one-third used to be employees of different enterprises, including SOEs, and the remaining one-third used to be engaged in other occupations such as farming.

The decision-making authority of the chief executives depends partly on their relationships with the Communist Party and the board of directors, particularly among SOEs where the presence of the Communist Party secretary cannot be ignored and joint ventures where the decision of the board of directors must be respected. According to the last part of table 5, a major characteristic of chief executives of SEs is that they are jointly appointed as the Communist Party secretary or deputy secretary based in the enterprises. It is true that although the decision-making power of the Communist Party secretary has declined considerably, the secretary nonetheless retains certain authority over employment and other decisions. Thus, the joint appointment of top executives and Communist Party secretary may reduce conflicts between the policies of the Communist Party and management decisions. About 30% of the chief executives of SEs are also jointly appointed as the chairman or vice chairman of the board of directors. This may increase their decision-making authority, even though this is achieved at the cost of the reduced autonomy of the board of directors. Among TVEs, joint appointment is uncommon, because the influences of the Communist Party and the board of directors tend to be more modest.

#### *Reward Systems for Chief Executives*

Needless to say, the amount of reward and the manner by which it is made to chief executives are fundamental determinants of incentives to work for them, as has been discussed extensively in the economic literature on contracts and organization (Shapiro and Stiglitz 1984; Milgrom and Roberts 1992). Although traditionally fixed payments were made to chief executives in China, gradually more incentive-enhancing reward systems were introduced over time. The most common system among SEs in the late 1990s was the system of specified wage payments supplemented by bonus payments. According to table 6, such a system accounted for 89% in 1995 and 82% in 1999.<sup>14</sup>

Although the bonus payment is supposed to vary depending on the performance of enterprises, it is not sufficiently flexible in practice and, hence,

TABLE 6  
REWARD SYSTEMS AND AMOUNT OF ANNUAL REWARD TO CHIEF EXECUTIVES BY MAJOR  
ENTERPRISE TYPE IN 1995 AND 1999

	SEs		TVEs	
	1995	1999	1995	1999
Percentage of firms that employ the various reward systems (%):				
Wage plus bonus <sup>a</sup>	89	82	71	51
Profit-linked <sup>b</sup>	2	2	20	37
Yearly salary	9	17	8	12
Average annual reward of chief executives in each reward system (1000 yuan):				
Wage plus bonus <sup>a</sup>	14.7	16.1	22.8	23.8
Profit-linked <sup>b</sup>	10.0	10.0	49.5	30.9
Yearly salary	31.5	28.5	16.8	20.1

<sup>a</sup> Basic wage or postspecific wage-plus-bonus payment, except for one case in SEs, which adopted the fixed wage system.

<sup>b</sup> The system in which the manager's income depends on realized profit in the case of SEs and the system in which the manager receives residual profit after paying a fixed sum of profit to the local government in the case of TVEs.

does not seem to provide sufficiently strong management incentives. Thus, it has been gradually replaced by the yearly salary system among SEs, in which decent payments are made to provide management incentives, along the line of arguments advanced by the efficiency wage theory (Chinese Academy of Social Sciences 2000). Note that there is only one SE that adopted the profit-linked reward system, so that its impact is hard to identify empirically. The wage-plus-bonus system is less common, and its use has decreased more sharply among TVEs, where the choice of reward system is less restricted. Among TVEs, it has been replaced not only by the yearly salary system but also by the profit-linked system, in which either a portion of the profit or the residual profit after the payment of a fixed sum to the government is received by chief executives.<sup>15</sup>

Judging from the amount of annual earnings or reward shown in table 6, which corresponds to officially reported income, remuneration to chief executives in the SE sector is less than that in the TVE sector. This is, however, erroneous; chief executives of SOEs also receive income from various sources, both legally and illegally, including income in kind, such as free meals and the private use of official cars, and under-the-table monetary rewards in exchange for providing special favors. In all likelihood, however, those hidden income components are unrelated to the performance or may even be counterproductive. This is why the yearly salary system has been introduced in the SEs to increase both incentive effects and accountability of the reward to chief executives. Higher annual reward under the yearly salary system among SEs is partly nominal, as some portions of the income in kind have been converted to monetary value. By contrast, the annual reward under the yearly salary is relatively low among TVEs.

### **III. Hypotheses**

According to the theory of the firm, the firm embodies the bundle of contracts between the owners and managers of the firm (Coase 1937; Grossman and Hart 1986). Because of asymmetric information, owners cannot fully control managers, thereby leaving some room for managers to make decisions for their own benefit. This potential inefficiency cannot be prevented, unless the rights to residual profits and to control are possessed by the same person (Milgrom and Roberts 1992). As Andrei Shleifer and Robert Vishny illustrate, there are cases in which the government has the right to receive residual profits but does not have the right to control enterprise management, as in the case of China (Shleifer and Vishny 1994).

It is likely that the divergence between the right to receive residual profits and the right to control enterprise management results in significant inefficiency in the socialist system of enterprise management, because the right to receive residual profits is traditionally owned by the government, which has no strong incentive to raise profit—nor does it have accurate information to do so. Thus, the government failed to motivate enterprise managers to exercise their right to control toward profit maximization. Note that the terms “efficiency” or “inefficiency” used in this article refer to the static production efficiency captured by the variables representing the enterprise and other reforms in the estimation of the production function. The dynamic effects, which are more difficult to assess, will be partly captured by the coefficient of year dummies.

Recognizing the inefficiency of SOE management, the central government of China has introduced various reforms, most important, the reform of the enterprise system itself. Obviously, how strong the influence of the central government will be on the management decisions of stock companies and joint ventures, which have been converted from SOEs, is an important empirical question. In the case of stock companies that were formally SOEs, the government still retains partial rights to appoint chief executives. Even in the case of joint ventures, the government seems to exercise some influence on management decisions by appointing former government officials as chief executives.

If the current enterprise reform is ineffective in improving SE management efficiency, it is likely that a more thorough reform of the enterprise ownership system is inevitable for the improvement of SE management. Although we cannot a priori determine the significance of the effects of property rights or enterprise reform, we postulate the following purely as a null hypothesis:

**HYPOTHESIS 1.** State enterprise reform has no significant impacts on the production efficiency of enterprises.

Similarly, the effects of TVE reform require careful empirical scrutiny, as there is a possibility that the privatization of TVEs reduces their management efficiency because of the absence of competitive input and output markets for the iron and steel industry. Indeed, partial reforms, such as the management

responsibility system in which township and village governments support the enterprise management by facilitating material and product transactions with state enterprises under profit-sharing arrangements, may be conducive to management efficiency. Thus, we postulate the following hypothesis:

**HYPOTHESIS 2.** Township-village enterprise reform, which converts local government-owned enterprise to stock companies, joint ventures, and private enterprises, may fail to improve management efficiency of enterprises significantly.

The thrust of the reform of the reward system for chief executives has been to delegate the right to receive residual profits from the government to the enterprise managers. We have already confirmed that annual rewards to chief executives were substantially raised by the introduction of the yearly salary and profit-linked systems, which replaced the wage-plus-bonus system. Therefore, a central question is whether the new reward systems increased not only the annual rewards to chief executives but also the efficiency of enterprise management. We cast some doubts on the effectiveness of the yearly salary system in enhancing work incentives for chief executives, in view of the fact that it is difficult for the upper government body to assess the performance of the enterprises properly.<sup>16</sup>

In order to test the impacts of the reward system reform, we postulate the following hypothesis:

**HYPOTHESIS 3.** The new reward system (i.e., yearly salary and profit-linked systems) increased the rewards to chief executives but not necessarily the production efficiency of enterprises.

In the case of SOEs, the government retains the full right to appoint chief executives. Thus, to the extent that the appointment of chief executives is made on the basis of considerations unrelated to profit maximization, the inefficiency of state enterprises is likely to remain serious. In practice, the appointment of chief executives by the government seems to be determined by bureaucratic considerations, according to our informal interviews with the chief executives of selected SEs. First, since the position of chief executive is supposed to be filled by government leaders, their selection is based on the same considerations that are applied to other governmental positions, such as an understanding of socialist philosophy, which are unrelated to enterprise management. Second, school background often receives excessive weight for the selection of enterprise managers, even though there have been warnings from upper governmental bodies that schooling and ability should not be treated as synonymous (Chen 1983). There are many indications that the government has continued to use advanced schooling background as an important qualification to be a chief executive (Quanguo Qiye Guanli Ganbu Peixun Gongzuo Lingdao Xiaozhu 1993; State Economic and Trade Committee 1996, 1999). As a result, many chief executives and potential candidates reenter universities and graduate schools solely for the sake of obtaining higher degrees. Third, more often than not, the government has no ability to choose and assess appropriate chief executives, nor is there motivation to do so,

resulting in serious agency problems, as pointed out by many Chinese researchers (Fan 1995; Zhang 1997). Thus, it seems reasonable to postulate the following hypothesis:

**HYPOTHESIS 4.** The appointment of the chief executives of SEs by the central government leads to inappropriate choices. By contrast, adverse effects of government intervention, if any, would be much less pronounced in the case of TVEs, as local governments are under competitive pressure to improve TVE management.

The distortional effects on enterprise management will be reflected in the negative effect of the government appointment dummy and the absence of significantly positive effects of schooling in the estimation of the production function of SEs. It is also possible that the government appointment simply increases the reward to chief executives without improving production efficiency.

#### **IV. Estimation**

In order to test the hypotheses postulated in Section III, we propose to estimate the following Cobb-Douglas type production function, in which the dependent variable is the logarithm of labor productivity measured by real value added per worker ( $\ln VA/L$ ), and manager's reward (R) function:

$$\begin{aligned} \ln VA/L = & \alpha_0 + \Sigma\alpha_{1i}(\text{enterprise dummy})_i + \alpha_2(\text{appointment dummy}) \\ & + \Sigma\alpha_{3j}(\text{characteristics of chief executives})_j + \Sigma\alpha_{4k}(\text{reward system dummy})_k \\ & + \Sigma\alpha_{5l}(\text{characteristics of inputs})_l + \Sigma\alpha_{6m}(\text{year dummy})_m + \varepsilon, \end{aligned}$$

$$\begin{aligned} \ln R = & a_0 + \sigma a_{1i}(\text{enterprise dummy})_i + a_2(\text{appointment dummy}) \\ & + \Sigma a_{3j}(\text{characteristics of chief executives})_j + \Sigma a_{4k}(\text{reward system dummy})_k \\ & + \Sigma a_{5l}(\text{characteristics of inputs})_l + \Sigma a_{6m}(\text{year dummy})_m + e, \end{aligned}$$

where  $\varepsilon$  and  $e$  are error terms,  $\alpha_s$  and  $a_s$  are parameters, and the subscripts  $i$ ,  $j$ ,  $k$ ,  $l$ , and  $m$  indicate multiple dummy variables. Since there are only two appointment systems (i.e., government appointment and internal promotion), we have only one appointment dummy.

Although we attempted to formulate the simultaneous equation system, we found it difficult to find exogenous variables that are expected to affect only one of the dependent variables. Thus, we have chosen to estimate the "semireduced" form equations, in which all the explanatory variables are identical in the two equations. A salient feature of this estimation is that the consistency and effectiveness of reform policies can be examined by comparing the estimated coefficients of the same variable across the two equations. For example, if the new reward system reform is effective, we expect that it will have positive effects on both production efficiency and top manager's

reward, that is,  $\alpha_{ak} > 0$  and  $a_{ak} > 0$ . In order to control for enterprise-specific effects, including product types and qualities, we applied the fixed-effects estimation. Strictly speaking, the reform dummies are endogenous variables, and using fixed effects does not remove the endogeneity problem insofar as the factors that affect reforms are enterprise and time specific.<sup>17</sup> Although we admit such a shortcoming, we would also like to point out that the decision to reform has been made through highly complex negotiation processes based on both political and economic considerations, so that it is easy to imagine the political factors that would have affected the timing and type of reform undertaken but not the valued-added per worker directly.

For the reward function, separate dummies for profit-linked salary and yearly salary are used for TVEs, but a dummy for the combined category is used for SEs because there is only one SE adopting the profit-linked system.<sup>18</sup> The system of specified wage-plus-bonus payment is an omitted category. In addition to stock company, joint venture, and privatized enterprise dummies, the enterprise dummies include a dummy for the management responsibility system, in which management is responsible for achieving certain profit and output targets under profit-sharing arrangements between the government and enterprise, and a dummy for the lease system, in which the enterprise commits to pay a fixed amount of profit to the government.<sup>19</sup> Thus, we used a traditional SOE and collective TVE system, in which the government is a residual claimant, as a default. The appointment system is represented by a dummy for government appointment.

Characteristics of the chief executives include an internal promotion dummy, age, schooling dummies, years of service as chief executive, and a dummy for joint appointment as Communist Party secretary. In order to control for the effects of unobservable enterprise-specific factors, we applied the fixed-effects estimation method at the enterprise level.<sup>20</sup> We included year dummies to capture the speed of productivity growth of SEs and TVEs over time.

The estimation results are shown in table 7. First of all, it is important to point out that all the enterprise dummies are insignificant in the estimation of production function for SEs, which renders clear support for hypothesis 1. Thus, mere changes in the enterprise system from SOEs to stock companies or joint ventures did not have significant impacts on production efficiency. Yet, the stock company dummy has a negative and significant effect in the reward function, which suggests that the top manager's reward tends to be reduced under this system, whereas the lease system is found to have positive effects on the reward.

The privatization of TVEs in the iron and steel industry does not seem to have significant effects on management efficiency.<sup>21</sup> It is interesting to find that the stock company dummy has a negative and significant coefficient in the estimation of the production function, whereas the management responsibility dummy has a positive and significant coefficient. In other words, the intervention of township and village governments in the management of TVEs under the responsibility system, rather than the independence of TVEs from

TABLE 7

ESTIMATION RESULTS OF PRODUCTION FUNCTION AND MANAGER'S REWARD FUNCTION FOR  
1995-99: FIXED-EFFECTS ESTIMATION BY MAJOR ENTERPRISE TYPE

	TVEs		SEs	
	Production	Reward	Production	Reward
Stock company dummy	-.392** (2.799)	-.119 (1.260)	-.131 (.645)	-.235** (2.846)
Joint venture dummy			.194 (.350)	.296 (1.305)
Private enterprise dummy	-.158 (.896)	-.580** (4.891)		
Responsibility system dummy	.294** (2.434)	-.199** (2.447)	.372 (.674)	-.071 (.316)
Dummy for lease	-.070 (.323)	.192 (1.307)	-.374 (.730)	.400* (1.916)
Government appointment dummy	.347* (1.842)	-.327** (2.576)	.104 (.284)	.494** (3.304)
Dummy for internal promotion	-.210 (1.131)	.081 (.645)	-.218 (1.450)	-.034 (.563)
Age of managers	.008 (1.037)	.002 (.400)	-.029** (2.509)	-.001 (.171)
Dummy for university and above			-.510** (2.368)	.084 (.956)
Dummy for college graduates	.511** (2.440)	.520** (3.688)	-.399* (1.936)	.023 (.269)
Dummy for high school graduates	.033 (.175)	.232* (1.805)		
Years as managers	-.024 (1.449)	-.007 (.700)	.032* (2.201)	.015** (2.472)
Joint secretary dummy			.170 (1.097)	-.062 (.987)
Dummy for profit-linked wage	.025 (.120)	.245* (1.761)		
Dummy for yearly salary	.125 (.571)	.121 (.818)	.180 (.649)	.626** (5.528)
No. of workers	-.100 (.621)	-.011 (.099)	.381 (1.225)	.332** (2.616)
<i>K/L</i>	.364* (2.196)	-.156 (1.392)	.568** (2.804)	.214** (2.589)
Net fixed capital ratio	-.381 (.747)	.527 (1.531)	-.785 (1.232)	-.468* (1.800)
Proportion of educated workers	-2.243 (1.500)	-.042** (4.119)	.849 (.351)	-.826 (.836)
1996	.131 (1.642)	.061 (1.146)	-.097 (.873)	.004 (.096)
1997	.196* (1.820)	.185** (2.552)	-.123 (1.050)	-.004 (.088)
1998	.271* (2.092)	.256** (2.934)	-.029 (.227)	.051 (.973)
1999	.337* (2.303)	.215* (2.177)	-.007 (.048)	.0002 (.003)
Adjusted $R^2$	.814	.920	.786	.835
No. of observations	235	235	295	295

NOTE.—Numbers in parentheses are *t*-statistics.\* Significant at the 5% level in accordance with one-tailed *t*-test.

\*\* Significant at the 1% level.



local governments under the stock company system, seems conducive to the management efficiency of TVEs. These results support hypothesis 2.

There is clear evidence that the appointment of chief executives by the state government has detrimental effects on the management of SEs: while the chief executives appointed by the government receive higher rewards, such appointment does not contribute to production efficiency. It is likely that the government selects chief executives on the basis of criteria unrelated to the maximization of enterprise profit. By contrast, there is a tendency that appointment by township or village governments has a positive effect on production efficiency and a negative effect on the reward of chief executives, suggesting the efficiency orientation of local governments. These results support hypothesis 4. We may conclude that while the appointment of chief executives by the central or provincial government is one important source of the management inefficiency of SEs, appointment by township and village governments does not lead to such adverse consequences.

The estimation results of the impacts of the chief executives' personal characteristics are informative. As far as SEs are concerned, not only the age of managers but also college and university education compared with high school education have a negative effect on production efficiency. While the former result may be expected, considering the disincentive effect of the compulsory retirement system, the latter result would be surprising, even though it is consistent with hypothesis 4. Literally, this result implies that an advanced school background is not only useless but rather detrimental to management efficiency in SEs. At the very least, it indicates that educated chief executives are employed not because of their superior management knowledge but because of other considerations. Unlike SEs, the coefficient of college graduation dummy is positive and significant in the estimated production function of TVEs. Thus, the schooling of chief executives positively affects the production efficiency of TVEs. It is also interesting to observe that years as chief executive is a significant factor in the production function of SEs but not in that of TVEs. It appears that the management of large state enterprises requires management experience.

The introduction of the yearly salary system seems to have strong positive effects on the reported reward of chief executives of SEs, even though it has no significant effect on production efficiency. Among TVEs, there is no discernible effect of the reward system on the amount of reward to chief executives. These results provide support for hypothesis 3.

It is found that the number of workers is insignificant in the production function of both TVEs and SEs, which indicates that there are no significant scale economies within the TVE or SE sector. It is also noteworthy that although the capital-labor ratio has significant coefficients in the estimated production of both TVEs and SEs, the coefficient of the former is substantially smaller than that of the latter. These findings imply that SEs and TVEs adopt structurally different technologies in that SEs employ large, capital-intensive technologies, whereas TVEs use labor-intensive, small-scale production sys-

tems. By contrast, both the number of workers and capital-labor ratio have positive effects on the manager's reward of SEs, which may suggest that the prestige associated with the large size of enterprise and the use of capital-intensive technology are positively associated with the salary of managers.

In short, large structural differences exist between SEs and TVEs not only in the design of the reward system to chief executives and their appointment and selection systems but also in the choice of production technologies. Furthermore, judging from the coefficients of year dummies, TVEs improved production efficiency rapidly over time due to technological change, while SEs experienced no such improvement in the late 1990s.

### **V. Concluding Remarks**

There has been increasing recognition among researchers, practitioners, and policy makers in China that in order to improve the management efficiency of state enterprises, the role of chief executives as entrepreneurs needs to be duly taken into account. Indeed, without proper profit incentives, chief executives will not assume the role of entrepreneurs in the sense of Schumpeter (1912), which is vital for the sustainable and dynamic growth of enterprises. This study represented an attempt to identify quantitatively the role of such profit incentives, or more generally the role of government interventions, in the management of both state and township-village enterprises, based on our own original survey data of selected enterprises in the iron and steel industry in China.

The major implication of this study is that the problem of the inefficient management of state enterprises is deep-rooted and multifaceted. As a matter of fact, we obtained evidence that the reform measures had conflicting impacts on production efficiency and manager's reward. First, those chief executives who have been appointed by the government receive higher rewards, even though their contribution to production efficiency is nil. Second, educated chief executives do not contribute to production efficiency, which may be taken to imply that they are often unqualified as top managers. Third, the introduction of new reward systems, notably the yearly salary systems for chief executives, merely raised their reward without an accompanying improvement in productivity. Finally, and most important, there is no indication that the reform of the enterprise system had discernible impacts on production efficiency.

By contrast, the distortions associated with the interventions by township and village governments are generally absent in the case of TVE management. Although it is often asserted that the management of TVEs suffers from ambiguous property rights, our analysis strongly indicates that township and village governments are motivated to provide proper work incentives to chief executives and to support the management of TVEs. Such behavioral differences between the central or provincial governments in charge of SE management and township-village governments explain why the TVE sector has

increased its production share at the sacrifice of SEs in the iron and steel industry, even though SEs enjoy significant scale economies in production.

How can these drawbacks of SE management be improved? An important observation is that there is no indication that the distorted management systems of SOEs have been improved by changes in the system of reward to chief executives and by the reform of the enterprise system from the state-owned system to stock companies and joint ventures. These findings strongly indicate that in order for SEs to be truly reformed, piecemeal reforms within the context of the state ownership or state control of enterprises are far from adequate. A thorough reform of SEs ought to take place, if SEs have to compete with TVEs in such a strategically important industry as the iron and steel industry in China.

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## Notes

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1. Various data sources are used for this estimation, including State Statistical Bureau of China (various years), Zhonghua Renmin Gongheguo Disanci Gongye Pucha Bangongshi (1997), and Ministry of Agriculture of China (various years).

2. Although we do not deny the importance of such views, we believe that the enterprise ownership system per se has significant effects on the management efficiency of enterprises, as will be demonstrated in this study.

3. See, however, earlier contributions by Murakami, Liu, and Otsuka (1994) and Jefferson and Singh (1998), both of which compare the production efficiency of TVEs and SOEs through the estimation of production function. According to the estimation results, TVEs are more efficient than SOEs in selected industries.

4. We made separate estimations because of the vast differences in the parameters of the production functions and reward functions.

5. We omitted urban collectives to focus solely on a comparison between the state and TVE sectors.

6. The SOEs and TVREs are transformed to stock companies when stocks are issued to those who invested in the fixed assets, including the governments, in accordance with the amount of investments. Stock companies are privatized when stocks owned by the governments are sold to the enterprises and private investors, so that the government no longer holds the majority of stocks.

7. In order to examine the reliability of our data, it is desirable to compare our survey data with those collected by other studies in recent years. To our knowledge, however, a comprehensive survey of SOEs in the iron and steel industry was conducted only in 1992 by Otsuka, Liu, and Murakami (1998). Although the Chinese Academy of Social Sciences conducted a large survey of 403 and 769 SOEs in the manufacturing sector in 1988 and 1990, respectively, the coverage of SOEs in the iron and steel industry was limited (e.g., only 27 in 1990).

8. The number of joint ventures decreased from 1995 to 1999 in both the state and TVE sectors, because of the termination of the joint venture agreements.

9. An exception is Sonobe, Hu, and Otsuka (2002).

10. According to Sonobe et al. (2002), TVREs suffering from deficits at present but expected to bear positive profits after reform tend to be privatized.

11. We expect that since stock companies and joint ventures undergo audits of financial reports, the reported profits among these types of enterprises are likely to be more reliable. We owe this point to one of the reviewers of this article.

12. See Li (1996), Hsiao et al. (1998), Chen and Rozelle (1999), Li et al. (1999), and Tian (2001).

13. Since an important contribution by Jefferson (1990), the net-gross fixed capital ratio is often used as a proxy for the vintage of fixed capital in the statistical analyses of production performance in China.

14. Strictly speaking, the wage-plus-bonus system consists of the two systems, depending on how the specified wage component is determined. In one case basic wage is determined based on age and work experience, and in another case it is based on the characteristics of the post. We consider that the two systems are essentially similar. Also note that there was one state enterprise that adopted the fixed wage system in 1995. This case was included in the "wage plus bonus" category.

15. Although it is preferable to distinguish the two systems, we put them together because of the low incidence of the profit-linked systems, which accounted for only 4% of the cases in both 1995 and 1999.

16. Note that although we do not assess the dynamic effects, there may be a career ladder in which pay in the next job may reflect performance in the previous positions.

17. According to Li et al. (1999) and Sonobe and Otsuka (2003), enterprise reforms have clear impacts on productivity with a time lag of 1 year or so. Thus, we used the interaction terms between the enterprise reform dummies and dummies for the first year of reform implementation. None of those interaction terms, however, are significant.

18. Qualitatively, the regression results remain unchanged, even if we use separate profit-linked and yearly salary system dummies.

19. The number of SEs, which adopted the management responsibility system, slightly decreased from eight in 1995 to seven in 1999, whereas that of TVEs remained unchanged at 15 during the same period, even though six enterprises abandoned this system and another six newly adopted it after 1995. By contrast, the number of enterprises that adopted the lease system was relatively few (e.g., three among SEs and five among TVEs in 1999).

20. For details of this estimation method, see Baltagi (1995, pp. 106–23).

21. This result contradicts somewhat the results of a recent study of TVE reform in the garment and metal casting industries (Sonobe et al. 2002), which finds improvements in total factor productivity or changes in resource allocations including investment.