MANAGERIAL AUTONOMY, FRINGE BENEFITS, AND OWNERSHIP STRUCTURE: A COMPARATIVE STUDY OF CHINESE STATE AND COLLECTIVE ENTERPRISES

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ABSTRACT: This paper presents a property rights analysis about the provision of fringe benefits and the dilemma of managerial autonomy in Chinese industrial enterprises. According to this analysis, because of the ownership differences, the state-owned enterprises may be less efficient in industrial production than the collective enterprises if controlling for economies of scale and the use of fringe benefits. These predictions have been confirmed by the evidence from an econometric production function analysis of the cross-city data of Chinese industrial enterprises in 1985 and 1987. Controlling for economies of scale and current investment in fringe benefits, the state-owned enterprises have not only lower output elasticities of capital and labor but also lower total factor productivity than the collective enterprises. The estimated gaps of the Total Factor Productivity adjusted for economies of scale are 34.8% in 1987 and 23.7% in 1985. During the period from 1985 to 1987, the state sector also maintained a stagnant TFP growth and low allocative efficiency while the collective sector achieved a rapid growth of TFP and high allocative efficiency. The paper suggests that for the state-owned enterprises, the limited partial reforms toward a market-oriented economy have given root to other problems such as the inefficient expansion of fringe benefits and have accomplished little in the late years of the decade-long reforms. However, the reforms have facilitated the development of collectively owned enterprises which demonstrated much greater efficiency than the state-owned enterprises in this period.

1. INTRODUCTION

Chinese economic reforms since 1978 have been very successful in the agricultural sector. Lin (1987) and McMillan et al. (1989) have shown that in rural China the Household Responsibility System, which replaced the Commune System after 1982, has given better work incentives to peasants and raised their productivity significantly. In the industrial sector, reforms have concentrated on giving more autonomy

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to state-owned enterprises (Byrd & Tidrick, 1987; Zhang & Zhang, 1987). The central government has devolved significant economic control to the local governments (Wong, 1987) and also reduced restrictions on collectively owned enterprises and private family business (Lockett, 1988).

The recent reforms intended to remedy the rigidity and inefficiency of the planning system. However, the limited partial reforms quickly gave root to other problems such as the expansion of fringe benefits. The excessive use of fringe benefits and the dilemma of managerial autonomy have more to do with the separation of ownership and control than with planning. Hence, I use a property rights approach to study these new problems arising from the partial reforms toward a market-oriented system. Although the state-owned enterprises have larger factory scale, better technology, more government-funded investment, higher wages, and better employee fringe benefits such as subsidized employee housing, they may be less efficient in the use of capital and labor than the collective enterprises due to the ownership difference. Since the state and collective sectors produced 59.7% and 34.6% respectively of Chinese industrial output in 1987, the empirical findings in this paper about their relative efficiency have important policy implication for future economic reforms in China. The development of the collective sector should be encouraged if this sector has significantly higher productivity than the state sector. In addition, the findings will suggest future reforms in the state sector because they identify the role of ownership structure in influencing enterprise performance.

2. INSTITUTIONAL FEATURES OF CHINESE INDUSTRIAL ENTERPRISES

Officially, all the Chinese people own the production factors and products in the state-owned enterprises, which means the property belongs to none. In practice, the property rights of these enterprises are defined by policies of the Chinese government. The larger and more important state-owned enterprises are under the direct control of central government ministries. The small and medium-sized state-owned enterprises (as well as collective enterprises) are controlled primarily by the local governments.

Before the recent reforms, the government supervisory agencies decided the directive plans regarding materials, production and sales (although managers could make suggestions to their supervisory agencies). Following these directive plans, input materials and output products were handed over to a material exchange bureau and then redistributed to each enterprise according to the planned quota.

Reforms have given managers much more authority to decide production, supply, and sales. For instance, the state-owned enterprises that meet their assigned quotas can sell any extra production at the market price. Alternatively, they can produce other products after realizing their quotas. This creates a dual-allocation system, one through government planning and the other through market price. At the margin, this enables enterprises to sell products and buy inputs freely.[1] The dual-allocation system facilitates not only normal transactions between enterprises but also corruptions since some managers can acquire cheap materials from the planning bureaus and sell them illegally to other enterprises for bribery.[2] In addition to transactions of materials and products between enterprises, reforms allow enterprises of various ownerships to share their capital, funds, technology, and skilled labor by joint venture or horizontal

integration. Although the central government still makes policies on wages, employment, and pensions, reforms have also given managers greater authority to set bonuses and non-wage benefits.

The increase in managerial autonomy has been accelerated by the practice of the *profit contract system*. With this system, the enterprises negotiate a contract with their local supervisory agencies or the central government ministries regarding retained profits, funding, and quota of input materials and output. After paying 15% of the retained profits as energy and transportation taxes, the enterprises may put about half of the net retained profits into welfare and bonus funds, and the other half into reserve, production development, and new product development funds. However, it has been common for enterprises to use more than half of their retained profits to finance welfare projects such as enterprise-owned residential housing, hotels, and movie theaters. On several occasions, the central government has ordered enterprises to stop these projects to no avail. While the profit contract system lessened the power of the central government ministries and local supervisory agencies, it also simplified their task to collecting contracted profits, reallocating profits for investments and subsidies, and assigning chief managers. This simplification has improved the ability of these agencies to monitor important dimensions of the state enterprises's activity. The system has been easily implemented and has effectively enlivened many state-owned enterprises.

Reforms have benefitted workers in the Chinese state-owned enterprises. Both their wages and non-wage benefits have increased significantly. However, the structure of worker compensation has not changed much. The compensation can be divided into four categories: wages, subsidized housing, medical care, and retirement benefits.

Before reform, wages were low, varied little among workers, and were largely spent on food. Reform has greatly improved this situations, but the basic patterns of low wage and high fringe benefits remain. The workers receive free housing, education, and other benefits from their enterprises directly.

Among the fringe benefits, housing is a major item and is provided to most workers for less than five percent of their income. The quality of the housing differs based on the worker's job tenure, importance to the enterprise, and number of dependents. Medical care is free for workers and free or half price for dependents. Although the standard of medical care is low, basic needs are covered. Large enterprises provide health care at their own hospitals. Smaller enterprises have clinics within the enterprise and pay for the hospitalization of seriously ill workers.

The governments guarantee permanent employment to formal employees of the state-owned enterprises. At retirement, a worker's most recent employer pays him a pension equal to 70% or more of his regular wage. In addition, retirees can continue living in their subsidized housing. Previously, upon retirement, a worker could bring one dependent into his enterprise. However, the government now discourages this practice.

In addition to these benefits, state-owned enterprises also offer workers recreational facilities, schooling for dependents, transportation, and even consumer goods. Therefore, unlike Western firms which compensate workers primarily though wage payments, the Chinese state-owned enterprises compensate workers in large part by offering an array of non-cash benefits.

Managers and government supervisors receive slightly more wage and benefit compensation than workers. Moreover, their control over economic decisions can be considered a form of compensation. In contrast to the West, where many decisions are made through transactions in the marketplace, in China, most decisions are made within organizations. This gives managers and government supervisors considerable power and discretion.

Having discussed the structure of state-owned enterprises, I compare state-owned enterprises with collective enterprises. Although, officially, workers in the collective enterprises own the factors of production and the products produced, they have little to say about their enterprises. It is the local governments that is really responsible for collective enterprises. However, the state encouraged the development of collective enterprises by local governments as a cheap way to increase urban employment. The local governments favored collective enterprises but could give only limited help. However, less help often means less control. Loose control helped the collective enterprises maintain a degree of autonomy even before reform. Nevertheless, the collective enterprises are still publicly owned enterprises. Their institutional arrangements are similar to those of the state-owned enterprises. Below, I briefly sort out differences of the two systems.

The collective enterprises have more difficulty obtaining government funding than the state-owned enterprises. The central government controls most investment funds and requires all projects exceeding a certain investment scale to be controlled by the central government ministries instead of the local governments. New technologies transferred from foreign countries are mostly reserved for the state-owned enterprises instead of collective enterprises.

The collective enterprises have less non-industrial fixed capital than the state-owned enterprises. Fixed capital in the Chinese state-owned and collective enterprises consists of industrial and non-industrial capital. The non-industrial fixed capital includes residential housing, hotel, hospital construction, school housing, movie theater and others. The ratios of non-industrial to industrial capital are .216 for the state-owned enterprises and .156 for the collective enterprises according to the 1985 industrial survey. One reason for this difference in the ratios is that the state-owned enterprises are allowed to spend the equivalent of 11% of their wage bills on welfare projects and count them as production costs. With the same capital-labor ratio, the above estimated ratios would mean that workers in the state-owned enterprises have 38.5% more non-industrial fixed capital. However, I estimated, based on 1987 data, that the capital-labor ratio of the state-owned enterprise was about 4 times that of the collective enterprise. As a result, the workers in the state-owned enterprises actually enjoyed 153.8% more non-industrial capital per worker than those in the collective enterprise.

Like wages in state-owned enterprises, wages in collective enterprises are set according to comprehensive rules made by the central government. Nevertheless, the collective enterprises compensate their workers more with wages and bonuses and less with non-wage benefits than the state-owned enterprises. In 1980, the average wage was 629 yuan for workers in the collectives enterprises and 859 yuan for workers in the state-owned enterprises—a 36.6% difference. These numbers changed to 900, 1195, and 32.7% respectively in 1985 (see SSB 1988, 1989). To certain

extent, the wage gap reflects differences in labor skill of the two sectors since most college graduates enter the state enterprises.

The collective enterprises receive less government control than the state-owned enterprises. Collectives are better able to take advantage of China's pool of cheap labor because they need not obey restrictive employment rules. Also collectives can acquire non-labor inputs and sell output more efficiently by offering commission to salesmen. Although this is illegal in China, collectives face less stringent enforcement.

The collective enterprises are smaller than the state-owned enterprises in scale measured either by employees, capital, or output. However, the industrial composition between the two sectors is quite different. The heavy industry consists of mainly state-owned enterprises while the light industry has a lot of collective enterprises. This contributes to difference in firm size.

The collective enterprises have grown more rapidly than the state-owned enterprises as local governments get more and more authority from the central government. While the contribution to the gross industrial output by the state-owned enterprises decreased from 80.8% in 1978 to 68.7% in 1986, the contribution of the collectives increased from 19.2% to 29.2% (see SSB 1988).

Although, the state and collective enterprises are quite similar in their basic institutional features (e.g. public ownership, managerial autonomy, and fringe benefits), they have significant differences in some important aspects (e.g. capital-labor ratio, factory scale, the level of fringe benefits, and management etc.).

3. LITERATURE AND THEORIES

Chinese economists (Chen et al. 1987; Reynolds 1987) have been skeptical about the small-scale collective enterprises. They argue that one problem of the industrial reform was miniaturization of investment scale. They were concerned that raw materials and energy were used less efficiently in small-scale collective enterprises than in large-scale state-owned enterprises. Another theory warning against the development of small collective enterprises was given indirectly by Wong (1987). Wong was concerned about the expansion of local government's control over industrial enterprises which include mainly small-scale collective enterprises. In her view, the increase of local control hindered the market-oriented reforms by transferring part of decision-making authority to the local bureaucrats instead of economic agents and lowered efficiency accordingly. On the other hand, Perkins (1989) and others argue that small collective enterprises would contribute more to the growth than the large and medium-sized state-owned enterprises.

Using county level cross-sectional data, Jefferson (1989a) estimated that the small-scale industrial sector had lower Total Factor Productivity (TFP) and lower marginal productivity of labor than the large-scale industrial sector had, although the marginal productivity of capital was significantly higher in the small-scale industrial sector. There were also empirical work concentrated solely on the state-owned enterprises. The World Bank (1985) suggested little TFP growth in the large and medium-sized state-owned enterprises in the early years of the reforms. However, Chen et al (1988) and Dollar (forthcoming) have found significant Total Factor Productivity growth in

the Chinese state-owned enterprises after the reforms. These evidences do not give a clear indication whether ownership can make a decisive difference in the performance of Chinese enterprises.

The comparison of the relative efficiency between the state and collective sectors is complicated by their differences not only in factory size and capital to labor ratio but also in investment in non-industrial capital such as enterprise-owned residential housing among others. Chinese economists, such as those in the Chinese Economic System Reform Research Institute, have emphasized the problems of these fringe benefits (Chen et al. 1987; Reynolds 1987). Using extensive survey information and data collected directly from Chinese enterprises, they suggested that investment in residential housing and other non-industrial projects hindered future reforms. However, Western economists have criticized this research on theoretical and statistical grounds. Jefferson (1989b) argues that the increase in the residential housing investment may be a temporary adjustment to compensate for the historically lower levels of housing investment, and the increase in investment in other non-industrial projects may reflect a demand for skill-training facilities. Although Jefferson's explanation of the housing investment boom as a one time adjustment to correct for a historical bias is largely consistent with the overall housing investment pattern, the comparison of housing investment in different sectors reveals a more complicated picture. The collective sector had a lower level of non-industrial fixed capital both before and after the recent reform. Investment in residential housing seems a luxury item which only the rich state-owned enterprises can afford.

In the next section, I compare productivity of the state and collective sectors controlling for economies of scale and the use of fringe benefits. Because the use of fringe benefits reflects unique feature of the Chinese system after the reform and may influence productivity difference between the two sectors, I discuss the theoretical aspects of the use of fringe benefits in the Chinese system in the rest of this section using a property rights approach.

There are at least three major problems in applying the modern theories of the firm such as the property rights approach to the Chinese publicly owned enterprises.[3] First, it is not clear who really owns the Chinese enterprises. Second, governments are heavily involved in the management of the enterprises through planning. Third, there are no conventional labor and capital markets such as those in the developed or newly developed countries. The market-oriented reforms have reduced planning and government control, but have not liberalized factor markets.

On the ownership issue, although there is no indication of dramatic change such as privatization, there is significant evidence that both the central and local governments are now interested in claiming the taxes and profits of the publicly owned enterprises instead of their in-kind products, much like an investor seeking investment returns (Gao 1987). Also, although managers and workers in the Chinese publicly owned enterprises are by no means investors, their claim of fringe benefits (in addition to wages) may qualify them as implicit owners (or stakeholder) of their enterprises, if not explicit owners.

As discussed in the last section, an important feature of the Chinese publicly owned enterprises is the provision of comprehensive non-wage benefits and community services to their employees. Unlike fringe benefits in Western countries, which are

part of a competitively determined package of employee compensation, the Chinese fringe benefits are obtained from each enterprise as welfare benefits. The amount and even the kind of the fringe benefits are unspecified and may vary among enterprises. These fringe benefits cannot be written into a contract and cannot be un-bundled and traded with other benefits because of public ownership of the fringe benefits capital. Moreover, some of the fringe benefits, such as residential housing, involve large amounts of fixed capital investment, and become an important channel for employees to accumulate quasi-private property, since it is practically impossible for enterprises to take back those apartments that have been distributed to their employees, although the apartment are officially state property. Hence, these fringe benefits may be characterized as "implicit claims" much like some ownership benefits (Klein 1983; Cornell and Shapiro 1987).

In the current structure of ownership, the government and the employees of public enterprises act much like co-owners. The legitimacy of claims on the fringe benefits by workers and on profits (and taxes) by the government is rooted in the ideology and practice of socialism in China. After all, the Chinese enterprise law declares that workers are part owners of their state-owned or collectively owned enterprises.

On the other hand, this joint ownership of Chinese public enterprises is very primitive and implicit in nature, and is very far from the advanced institution of the modern corporation, in which most ownership claim is explicitly specified by monetary value (even if the claims may not be traded in the capital market).[4] Because of the nature of this joint ownership, the central government faces the difficulty of choosing the degree of managerial autonomy. The higher the degree of the autonomy, the more difficult the monitoring of the expansion of the fringe benefits.

Before reform, the governments gave little autonomy to these enterprises and tried to control their operation directly through planning. The planned economy largely failed in China because the government bureaucrats could not get enough information to make proper judgments to raise productivity, nor can they apply effective incentives. Ineffective government control has been one of the major reasons the government initiated reforms of the state-owned industry.

After reform, the governments began to rely on managers to manage the publicly owned enterprises. The increase of managerial autonomy allowed managers to run their enterprises more efficiently. However, it increased the government's burden of monitoring the management. The effectiveness of monitoring is limited not only by the weak incentive of government bureaucrats but also by a lack of external monitoring institutions such as capital and labor markets. The monitoring costs are increased further by the underdeveloped ownership structure. Under the ill-defined ownership structure, government claims part of the increased profits and the enterprise employees claim wages, bonuses and fringe benefits. This arrangement allows profits and fringe benefits to grow at different rates. With higher management autonomy, the growth of the fringe benefits is likely to be faster and become a serious drain to profits.

The inefficient use of fringe benefits in the state enterprises has roots in the partially reformed socialist economic system. The use of fringe benefits as one kind of compensation can be as efficient as wage compensation. In an advanced market economy, fringe benefits are commonly used as part of employee compensation packages. They

are part of voluntary contracts between employees and firm owners. Sometimes, they are also implicit claims depending on the growth of the firm. However, these fringe benefits are limited by the competitive labor and capital markets, in addition to close monitoring by private owners. They would not be closely associated with the efficiency of firms. If some managers prefer luxury offices, beautiful secretaries and other on-the-job consumption, they would receive lower salaries to match the competitively determined level of compensation. It would also cost the firm less to provide this consumption on the job than at home since, in the later case, the firm would have to give additional pay to compensate the managers' substituting take-home consumption for on-the-job consumption. This additional pay would exceed the cost of on-the-job consumption if employees prefer to consume on the job rather than at home (Demsetz 1983). The conclusion that fringe benefits do not affect the efficiency of firms depends partly on the existence of a competitive labor market and a well functioning market for corporate control. In China, there is no well functioning labor and capital markets. Hence, the growth of the fringe benefits may increase the pay of some employees even though they have not increased their productivity. Inefficiency results.

The inefficiency of the excessive fringe benefits will depend on the amounts of capital invested by the governments since it results from the inability of government to monitor this investment effectively. If the amounts of capital invested by the government are small, as in the case of collective enterprises, the ownership is more concentrated in the employees. Accordingly, in the collective enterprises, the employees themselves will bear more of the costs of the growing fringe benefits. They would then consider more carefully the tradeoffs among present wages, fringe benefits, and productive investment which will affect their future wages and fringe benefits. The resulting inefficiency in the provision of fringe benefits will be more severe in the state-owned enterprises than in the collectively owned enterprises because of the different levels of government investment they receive.

The inefficient use of the fringe benefits arises only if the wages and the fringe benefits for some workers exceed their labor's productivity. It was probably efficient for the Chinese enterprises to provide housing and other basic needs for their workers in the period of early industrialization since the basic and low level of living and working conditions could be efficiently set up within the enterprises at that stage (Harberger 1984).

When compensation exceeds labor productivity, fringe benefits may be regarded as a return received by workers from their ownership of enterprise non-industrial capital or their firm-specific human capital. The use of fringe benefits instead of profits as returns from ownership of resources would still be inefficient because the expansion of fringe benefits may lead to a biased investment toward housing and other consumption projects instead of productive venture. With diminishing price controls after the industrial reforms, this biased investment would easily generate inflation, in addition to inefficient allocation of investment resources.

The inefficiency with provision of fringe benefits system is also related to the uncertainty about the ownership of fringe benefits capital. If workers are always free to extract fringe benefits, they will probably maximize their consumption of fringe benefits over time by investing appropriately in long-term profitable projects. Indeed,

many workers stay in an enterprise for their whole life. They do care about the future of the enterprise. However, the fringe benefits capital is mixed with industrial capital which is clearly a state property. The Chinese government has the ultimate authority to reallocate both the industrial and fringe benefits capital, a residual right associated with the ownership of the capital. Because no one can predict or control the behavior of this government, particularly in the long-run, workers in the enterprise are anxious to acquire any fringe benefits available as soon as possible.

The theoretical analysis in this section is formalized in Xiao (1990a) through a dynamic utility-maximizing model. Using cross-firm industrial data from 1985 Chinese industrial census, Xiao (1990a) also tests the resource allocation hypothesis derived from the model and finds significantly higher productivity in the collective enterprises than in the state firms. However, the sample used in Xiao (1990a) includes only large and medium-sized Chinese industrial enterprises. The next section examines the productivity gaps between the state and collective sector using cross-city data of all Chinese industrial enterprises. Hence, the work here complements Xiao (1990a).

4. EVIDENCE FROM CITY-LEVEL DATA OF CHINESE INDUSTRIAL ENTERPRISES

According to the theoretical analysis in the last section, the collective enterprises should be more efficient in production if controlling for economies of scale and the use of fringe benefits than the state-owned enterprises because of their difference in ownership structure. The control for scale is necessary since large factories can realize economies of scale. Potentially, the collective enterprises can have large scale factories if the capital needed for such a scale is available to them. The productivity difference associated with economies of scale should then be separated with the productivity gap relating to the management of the enterprises. Hence, by holding firm scale the same for the two sectors, I identify the productivity gap that has more to do with the management efficiency. Control for the use of fringe benefits is also important. Fringe benefits can contribute to labor productivity but only at an additional cost. If this additional cost exceeds the extra productivity which the fringe benefits may bring about, the investment in the fringe benefits will be inefficient. By including fringe benefits as an input and considering the total factor productivity, I measure the net contribution to productivity by the fringe benefits as well as by the capital and labor.

4.1. Production Function Models[5]

I first specify a modified translog production function. Then, I select statistically more robust models among the translog and some simplified functional forms such as the Cobb-Douglas and Kmenta (1967), which are all nested in the following modified translog production function:

$$\log (V/L) = \log \Gamma + \alpha \log (K/L) + \theta \log (H/L) + \mu \log (L) + \nu \log (L/\mathrm{NFIRM}) + \beta [\log (K/L)]^2 + \gamma [\log(L)]^2 + \delta \log (K/L) \log (L) + \epsilon \quad (1)$$

In equation (1), V is net output value. K, L and H are inputs of capital, labor, and investment in non-industrial capital such as firm-owned residential housing. NFIRM is number of firms in the city. Γ, α, θ, μ, ν, β, γ, and δ are constant coefficients to be estimated. ϵ is assumed as normal stochastic disturbances uncorrelated with inputs. The output and inputs can be regarded as aggregate variables for Chinese cities and the parameters as constant technical parameters to be estimated from the city data.

Assuming $\theta = 0$ and $\nu = 0$, equation (1) is the standard translog production function with two inputs (capital and labor). By adding the term $\theta \log (H/L)$, I modified the two inputs translog function to allow the influence of third input H on output. The term $\nu \log (L/\text{NFIRM})$ is added to examine the influence of the average firm size of each city on its output. If γ and δ are assumed zero in addition to $\theta = 0$ and $\nu = 0$, equation (1) is simplified to the Kmenta production function with two inputs. The Kmenta function is an approximation of the CES function (CES stands for Constant Elasticity of Substitution) when the elasticity of substitution is close to unit (Kmenta 1967). The Kmenta function becomes the Cobb-Douglas if the square term $\beta[\log (K/L)]^2$ is dropped. The two terms used to examine effects of housing investment and firm size on output ($\mu \log (H/L)$ and $\nu \log (L/\text{NFIRM})$) may be added to the Kmenta or Cobb-Douglas function as well as to the translog function in the following estimations.

The elasticities of capital, labor, housing investment, substitution between capital and labor, and scale are derived as the following:

$$\text{Elasticity of capital} = d \log (V)/d \log (K) = e_K = \alpha + 2\beta \log (K/L) + \delta \log (L) \tag{2}$$

$$\text{Elasticity of labor} = d \log (V)/d \log (L) = e_L = 1 - \alpha - \theta + \mu + \nu + (\delta - 2\beta)\log(K/L) + (2\gamma - \delta) \log (L) \tag{3}$$

$$\text{Elasticity of housing investment} = e_H = d \log (V)/d \log (H) = \theta \tag{4}$$

$$\text{Elasticity of scale}^6 = e_K + e_L + e_H = 1 + \mu + \nu \tag{5}$$

where μ and ν are related respectively to economies of city and firm scales.

$$\text{Elasticity of substitution between capital and labor}^7 = 1/(1 + g) \tag{6}$$

where

$$g = -2\beta(e_L + e_K)/(e_L{}^* e_K)$$

Equation (1) can be estimated by linear regression. In the following estimations, I include dummy variables for provinces, enterprise ownership, and time, in addition to the variables specified in equation (1). These dummy variables allow distinct values of the estimated Γ parameters for subsamples of the regression. As can be seen in the production function equation (1), the value of technical parameter Γ represents the "height" or "level" of the production function. I regard these distinct Γ parameters of

each subsample as their adjusted total factor productivity indexes (adjusted for economies of scale).

The standard TFP index with two inputs is defined as the ratio of value added divided by a weighted average of all inputs. With two inputs, the formula can be written as the following:

$$\text{TFP} = V/(K^{z}L^{x}) \tag{7}$$

where z is the weight for capital and x the weight for labor. Usually, factor shares are used as the weights and they add to one. Sometimes when factor shares seem unreasonable as the weights, output elasticities are used as weights. However, the output elasticities will not added to unit when there are economies of scale. In the standard case, it is required that these elasticities be normalized so that the weights will add to one. If the sum of weights are allowed to be greater than one, these output elasticities can be used as weights directly without normalization. In this case, I call the resulting index as the adjusted TFP index since it is adjusted for economies of scale. If the Cobb-Douglas function is used, the adjusted TFP index is equal to the estimate of the parameter Γ in the production function equation (1).

The production function approach requires a reasonably consistent price structure and exogenous input variables. The capital and labor in the Chinese enterprises were more exogenous than those in a market economy since the immobility of labor and capital did not change much during the reform period. The price structure was distorted compared to market-determined prices. However, the price problem was more serious for some industries such as energy, transportation and communications. For other manufacturing industries, the price structure tended to be more and more consistent within the Chinese economy as reforms allowed free trading of materials at the margin between all kinds of enterprises (see discussion in Section 2). Except for a few industries, I cannot find evidence showing significant price differences for similar products between the state and collective enterprises. However, the estimated productivity index may have biases because of the difference in industrial composition of the two sectors. The collective sector may have more enterprises of light industry and produce more consumer goods while the state sector may have concentrated in energy, transportation, communications and heavy industry and produced more products which may sell at lower state-controlled prices. The city data do not allow me to explore the impact of industrial composition on the estimated productivity index.[8] To the extent that the price of capital-intensive goods was biased below their market-determined prices, the estimation using the city data will underestimate the productivity of the state sector. However, the state-owned enterprises were likely to obtain quotas for key materials sold at below market prices if their products were under price controls. The lower material costs may offset the disadvantage of price controls. Hence, on average, I would believe the price structure of the Chinese economy from 1985 to 1987 was reasonably consistent for a comparative study of productivity between the state-owned and collective sectors.

The differences in the capital-labor ratio, firm scale and housing investment are more important problems in comparing productivity of the two sectors. The labor productivity (V/L) of the state sector was much higher than that of the collective

sector, but it could not be a meaningful measure of efficiency since the state-owned enterprises had a much higher capital-labor ratio, a larger factory scale, and more housing and non-industrial facilities contributing to labor productivity. The production function specified here tries to control for these differences.

4.2. Estimation Results

Equation (1) is first estimated using pooled cross-city sample of 1402 observations from the state and collective sectors in 1985 and 1987, and then estimated again using subsamples for each sector in the two years. The pooled regression estimates average values of the production function parameters for the two sectors except the intercepts which will be estimated separately for each subsample. The productivity index will be computed from these different intercepts estimated from the pooled regression. The separate regressions for each sector try to identify differences between the two sectoral production functions. When comparing relative productivity of the two sectors based on the average production function, it is important to bear in mind the differences among the three separate production functions. In the following regressions, the sector-year dummies, province dummies, and investment in non-industrial capital will always enter into my regressions since they are not only statistically significant in most of my regressions but also have important theoretical meanings. I use the Ordinary Least Square estimator to obtain estimates of coefficients. But, I use the White (1980) heteroscedastic-consistent covariance matrix to compute *t*-ratios and test statistics to correct for heteroscedasticity across cities in all regressions. Based on the specification analysis, I choose the Cobb-Douglas as the primary production function form for the pooled sample and the collective subsample, and the Kmenta for the state subsample.[9]

Table 1 reports estimates of the three production functions and elasticities of each function. The elasticities of capital and labor are higher in the collective sector than in the state sector. However, the elasticity of non-industrial investment is much higher in the state sector than in the collective sector.[10] These output elasticities give us a normalized measure of the importance of capital, labor and non-industrial investment for each sector. They can be regarded as factors' contributions to output. The differences in elasticities of capital, labor and non-industrial investment imply that the capital and labor are more important in the collective sector while the fringe benefits are much more important in the state sector. The significantly higher elasticity of non-industrial investment in the state sector suggests that the state enterprises can raise productivity by offering fringe benefits to their workers. The evidence on scale elasticities shows significant economies of city and firm scales in both state and collective sectors. The scale effect is larger for the collective sector than for the state sector which might suggest diminishing economies of scale. The lower elasticities of substitution in the state sector may reflect its more rigid allocation mechanism for capital and labor.

Hence, the state sector can benefit from economies of firm scale and use non-industrial investment more effectively while the collective sector can use capital and labor more effectively. It seems the collective sector has been winning the competition of productivity in the real world. According to the estimated coefficients of *C87* and

TABLE 1

Estimates of Production Function for Chinese Cities Each Sector and the Average

Coefficients of:	*Pooled*	*State*	*Collective*
log (K/L)	.606	1.685	.695
$\{\alpha\}$	(13.45)	(6.64)	(14.99)
log (L) + log $(L \cdot NFIRM)$	.049	.061	.074
$\{\mu = \nu\}$	(5.73	(5.35)	(7.86)
$[\log (K/L)]^2$	—	−.063	—
$\{\beta\}$		(−4.02)	
log (H/L)	.054	.152	.0023
$\{\theta\}$	(4.14)	(5.32)	(.16)
H0	.278	—	.0118
	(4.01)		(.17)
S87	−.258	.0032	—
	(−3.18)	(.092)	
S85	−.237	—	—
	(−3.16)		
C87	.091	—	.089
	(2.52)		(2.50)
Constant	2.74	−2.94	2.63
	(7.88)	(−2.95)	(7.66)
R^2 (adjusted)	.634	.407	.638
Observation	1402	700	702
Elasticities of:			
Capital	.606	.556	.659
Labor	.438	.414	.487
Non-Prod. Investment	.054	.152	.0023
Scale	1.098	1.122	1.148
Substitution	1	.653	1
Productivity Gap in 1987	34.9%	—	—
Productivity Gap in 1985	23.7%	—	—

Source: *Statistical Yearbook of Chinese Cities*, 1986, 1985.
Note: Coefficients for province dummies not reported.

S87 in the two sectoral production functions, the collective sector's total factor productivity was growing at 4.5% a year during 1985 to 1987 while the state sector had a stagnant total factor productivity during the same period. Unlike the cross-sectional comparisons I will discuss soon in the rest of this section, the TFP growth rates and the elasticities for each sector discussed above do not suffer from problems associated with cross-sectional comparisons and identify useful information about each sector.

However, the information from the separate sectoral production functions cannot be used to compare the relative efficiency between the two sectors. In particular, the higher output elasticity of non-industrial investment in the state sector does not imply more efficient use of fringe benefits. It only tell us that the fringe benefits used in the state-sector are comparatively more important in raising productivity than those in the collective enterprises. The fringe benefits can be costly as well as important. Efficient

use of fringe benefits requires that the fringe benefits are not only important or effective in improving productivity but also cost less than cash compensation. Since the increase of output from the use of various incentive compensations such as wages and fringe benefits cannot be distinguished because of the joint use of them, only a comparison of total factor productivity between the two sectors can tell us how efficiently the state and collective enterprises have used capital, labor and fringe benefits.

The Total Factor Productivity index is usually obtained from dividing value added by a weighted average of factors or inputs. If the weights add to one, constant return to scale is implicitly assumed. I will allow economies of scale by using weights which add greater than one. The TFP indexes will be sensitive not only to the weights given to factors but also to assumptions about economies of scale. Output elasticities can be used as the weights since they suggest factors' contributions or importance in the production. However, the output elasticities are different between the two sectors. For cross-sector comparisons, I will derive a measure of the average output elasticities for the two sectors which suggest "average contribution or importance of factors". This is accomplished by the pooled regression in which the average elasticities of capital, labor and non-industrial investment are estimated and used as weights to compute TFP indexes. As can be seen from Table 1, the elasticities of capital, labor and non-industrial investment estimated in the pooled regression lie between their corresponding values estimated in the sectoral production functions.

The scale elasticity, which is the sum of all output elasticities, in the pooled regression, however, is below the two estimates in the sectoral production functions. On the one hand, this may reflect the fact that large factory size changes, such as change from the size normally found in the collective enterprises to the one normally found in the state enterprises, may enjoy less economies of scale than the small changes within the size ranges of each sector. On the other hand, the lower scale elasticities may be a result of multicollinearity since the size variable is correlated with the sectoral dummy and the large state enterprises turn out to be less efficient than the small collective enterprises. Given the city data, I cannot decide which of the two explanations for lower scale elasticities in the pooled regression are close to the truth although I believe the multicollinearity is part of the explanation. Moreover, interpretations about economies of firm scale in the pooled regression are complicated because of the difference in industrial composition between the two sectors.

Computed from the estimates in the pooled regression, the TFP index controlling for economies of scale is 77.3 and 109.5 respectively for the state and collective sectors in 1987, and 78.9 and 100 for the two sectors in 1985. The gaps between the two sectors in the TFP level are 34.8% in 1987 and 23.7% in 1985 with the 95% confidence intervals respectively of (23.0%, 46.6%) in 1987 and (9.0%, 38.4%) in 1985. These gaps may reflect inefficient use of all factors in the state-owned enterprises including capital, labor, fringe benefits, management etc. They may also reflect differences in industrial composition and labor skill in the two sectors, among others. Many cross-sectional differences may account some of the TFP gaps but it would be difficult for them to explain the entire gaps. Because of the sizable differences in the use of fringe benefits between the state and collective enterprises, these gaps may have a lot to do with the provision of fringe benefits in the Chinese

system. Hence, these gaps confirmed the analysis in previous sections about the inefficient provision of fringe benefits.[11] These productivity indexes also suggest that there would be large efficiency gains during 1985 to 1987 if some resources could be transferred from the low productivity state enterprises to high productivity collective enterprises and the collective enterprises would be allowed to produce at an appropriate factory scale.

When estimating the above TFP indexes for the two sectors, I have controlled economies of scale and non-industrial investment. The TFP gaps may increase or decrease by changing those assumptions about economies of scale and the use of fringe benefits. I will do a few experiments of changing those assumptions to place bounds on the productivity gaps. The productivity gaps will increase if the original fixed capital data, which include non-industrial fixed capital, are used in the pooled regression (see Data Appendix). The accumulated non-industrial capital such as enterprise-owned housing certainly incurred an resource cost and was used more in the state-owned enterprises. In the pooled regression, I only considered a proxy for the current investment of non-industrial capital. By ignoring the accumulated non-industrial fixed capital, I overestimated the productivity of state-owned enterprises. In column (1) of Table 2, I list a regression including the non-industrial capital into the capital variable. As a result, the productivity gaps between the state and collective sectors become 38.5% in 1987 and 27.4% in 1985, an increase of about 3.7% in both years from the primary estimation in Table 1. These gaps can be seen as the upper bounds of the productivity difference.

The lower bounds for the productivity gaps can be obtained by assuming constant return to scale and excluding fringe benefits capital and investment from the input set. I will first estimate the productivity gaps assuming no economies of scale and then estimate the lower bounds by excluding the nonindustrial investment in the pooled regression in addition to assuming constant return to scale. Column (2) of Table 2 shows results from the regression which is otherwise the same as the pooled regression as in Table 1 but assuming constant return to scale for both city and firm size. In this regression, the productivity gaps are 19.9% in 1987 and 9.5% in 1985. Both of the gaps are about 14% lower than those measured from the regression including scale terms in Table 1. Hence, the gaps are very sensitive to scale assumptions. In the regression reported in column (3) of Table 2, I assume no influence of non-industrial investment on output ($\theta = 0$), in addition to the assumption of constant return to scale. In this experiment, the state sector's advantages in factory scale and in the use of non-industrial investment would count as if they were obtained from efficient use of capital and labor with the same scale and equal use of non-industrial investment in the two sectors. It turns out that the two sectors have still a productivity gap of 13.6% in 1987 although the gap is only 2.3% in 1985 under these assumptions. These gaps can be regarded as the lower bounds. Results in column (2) and (3) also show that by ignoring non-industrial investment alone, the gaps in both years decrease about 6.5%. Combining this 6.5% with the 3.7% difference accounted by the non-industrial fixed capital, the fringe benefits factor makes about 10% difference on the estimated TFP gaps between the state and collective sectors. According to these lower bounds of the TFP gaps, in 1985, the productivity in the two sectors differed litter if economies of scale and non-industrial capital and investment were ignored. The state-owned enter-

TABLE 2
Experimental Estimates of Production Function for Chinese Cities
Pooling: State 85 & 87 and Collective 85 & 87

Coefficients of:	*(1) If Including Non-Industrial Capital*	*(2) If Assuming Constant Return to Scale*	*(3) If Assuming CRS and Ignoring Non-Indus. Investment*	*(4) If Assuming Kmenta Function Form*	
log (K/L)	.606	.603	.630	1.197	
{α}	(13.45)	(14.12)	(14.72)	(3.80)	
log (L) + log (L/NFIRM)	.049	—	—	.054	
{$\mu = \nu$}	(5.72)			(7.07)	
[log (K/L)]^2	—	—	—	−.037	
{β}				(−1.95)	
log (H/L)	.054	.039	—	.053	
{θ}	(4.14)	(2.80)		(4.11)	
$H0$	.278	.121	—	.290	
	(4.01)	(1.61)		(4.38)	
$S87$	−.294	−.126	−.065	−.246	
	(−3.54)	(−1.51)	(−.83)	(−3.35)	
$S85$	−.274	−.095	−.023	−.238	
	(−3.55)	(−1.20)	(−.321	(−3.37)	
$C87$	.091	.073	.071	.073	
	(2.52)	(2.09)	(2.07)	(1.93)	
Constant	2.65	2.62	2.58	.434	
	(7.45)	(8.17)	(8.05)	(.33)	
R^2 (adjusted)	.634	.627	.617	.637	
Elasticities of:				S	C
Capital	.606	.603	.630	.538	.639
Labor	.438	.358	.370	.516	.416
Non-Prod. Investment	.054	.039	—	.053	.053
Scale	1.098	1	1	1.108	1.108
Substitution	1	1	1	.782	.774
Productivity Gap in 1987	38.5%	19.9%	13.6%	31.9%	
Productivity Gap in 1985	27.4%	9.5%	2.3%	23.8%	

Source: *Statistical Yearbook of Chinese Cities*, 1986, 1988.
Note: Coefficients for province dummies not reported. 1402 observations for each regression.

prises had lower output elasticities of capital and labor but used larger factory scale and more non-industrial facilities such as enterprise-owned residential housing than the collective enterprises. Hence, in 1985 the state sector could still dominate the economy under the discriminating policy of the Chinese government. However, in 1987, even if ignoring economies of scale and non-industrial capital and investment in the measurement of productivity, there was still a 13.6% productivity gap between the two sectors. Hence, in 1987, the state sector had to face competition from the collective sector as the collective sector was growing rapidly in employment, output, and productivity during 1985 to 1987.

Column (4) of Table 2 shows results from my last experimental regression. In this experiment, I try to examine robustness of the pooled production function estimates to

specification of the functional form. In the testing of functional forms, I have rejected the Kmenta function and selected the Cobb-Douglas for the pooled regression based on testing results. However, since the state sector production function uses the Kmenta form, it is interesting to see the measure of relative productivity from using the Kmenta function form for the pooled regression.

The Kmenta function adds a square term $\beta[\log (K/L)]^2$ to the Cobb-Douglas function and allows for a non-unit elasticity of substitution. The added square term will allow elasticities to change with the capital-labor ratios as can be seen from formula (2) to (6). In the Cobb-Douglas function, elasticities are assumed to be the same for the state and collective sectors. As discussed before, the output elasticity of each input can be regarded as the normalized factors' contributions or importance and are used as weights in computing the TFP index. Hence, in the Cobb-Douglas regression, the state sector is assumed to use the same weights in measuring TFP as the collective sector. The sector-year dummies (*S87*, *S85* and *C87*) in the Cobb-Douglas function then measure differences in total factor productivity with the assumption that normalized factors' contributions and scale are the same in the two sectors. However, when using the Kmenta function, the productivity differences measured by the sector-year dummies does not assume the same factors' contributions for the two sectors because of their different capital-labor ratios although it still assumes equal scale and equal elasticity of non-industrial investment. Hence, the interpretations of the productivity indexes from the two regressions are a little different.

In the regression reported in column (4) of Table 2, the *F*-Test of $\beta = 0$ for the pooled regression including the square term $\beta[\log (K/L)]^2$ can not be rejected at the 95% level. The square term causes only small changes in average elasticities and relative productivity levels. As shown in the table, the productivity gaps measured from the Kmenta functions are 31.9% in 1987 and 23.8% in 1985. Compared with the 34.8% and 23.7% measured from the Cobb-Douglas function, the gap in 1987 only changed about 3% and the gap in 1985 hardly changed at all. I would conclude from these comparisons that the Cobb-Douglas function estimates of the productivity differences are robust to specifications of functional forms.

However, the Kmenta specification gives smaller estimates of TFP gaps. The smaller productivity gap estimates from the Kmenta regression can be explained partly by the different elasticities or weights used for the two sectors in computing TFP indexes. In column (4) of Table 2, I have computed each sector's elasticities from its geometric mean value of the capital-labor ratio. The state sector's elasticity of capital is lower but its elasticity of labor is higher than those of the collective sector. This implies that the weights or the normalized factors' contributions of capital and labor are different for the two sectors. When measuring TFP differences from the sector-year dummies in the Kmenta regression, the state sector is assumed to have a smaller weight for capital and a larger weight for labor than the collective sector has. These implicit assumptions about the weights for capital and capital will increase the state sector's TFP estimate and decrease collective sector TFP estimate because the state sector has comparatively more capital than labor. Hence, the estimated TFP gaps will narrow in the regressions allowing different elasticities for the two sectors.

Having compared the differences of productivity levels in the state and collective

sectors, I will now discuss allocative efficiency of the two sectors. The TFP indexes measure how efficient enterprises use their inputs on average, assuming that all inputs are being measured. Even if the productivity of each enterprise differs significantly within the sector, it can still have high average productivity as long as a few enterprises in the sector perform good enough. In that case, the sector will have very poor allocative efficiency since it could produce more if resources are reallocated from the lower productivity enterprises to the high productivity enterprises. In the previous sections, I have found that collective enterprises have much higher productivity than the state enterprises. Hence, the allocative efficiency can be improved by transferring resources from the state sector to the collective sector. Here, I will examine allocative efficiency within each sector. With more market competition and easier flow of materials between enterprises, the collective sector may have higher allocative efficiency as well as high productivity than the state sector. In the study of allocative efficiency, I will use the following indexes to measure productivity of the state and collective sectors in each city:

State Sector's Productivity of City i in Year t

$$\mathrm{TFP}_i^{st} = exp(R_i^{st}) \tag{7}$$

Collective sector's Productivity of City i in year t

$$\mathrm{TFP}_i^{ct} = exp(R_i^{ct}) \tag{8}$$

R_i^{st} and R_i^{ct} in equation (7) and equation (8) are residuals for each city i in year t respectively of the state and collective sectors in the pooled Cobb-Douglas regression in Table 1. The coefficients of variation for TFP_i^{st} and TFP_i^{ct} are measures of allocative efficiency since they measure the degree of dispersion of productivity from the average productivity of each sector in each year. These coefficients of variation are .687 and .691 for the state sector in 1987 and 1985. and .366 and .339 for the collective sector in 1987 and 1985. Although cross-sectional differences such as industrial composition, scale, investment etc., may explain some of the differences in these coefficients of variations. They show at least qualitatively that the collective sector had much better allocative efficiency than the state sector. During 1985 to 1987, the state sector did not significantly improve its allocative efficiency or productivity while the collective sector largely maintained its higher allocative efficiency despite a rapid growth of its total factor productivity at about 4.5% a year.

In the above discussions, I compared the efficiency of the state sector with that of the collective sector. The city data also allows me to examine productivity differences across regions. In the regressions, I used 22 dummy variables to distinguish productivity levels in 23 regions listed in Table 3. These dummies are useful in reducing biases of production function estimates from regional differences in addition to give estimates of regional productivity indexes. The productivity indexes in Table 3 for Chinese provinces or regions are computed from the pooled regression in Table 1. I have normalized the indexes so that the average is 100. It is clear from the table that the south-eastern provinces such as Jiangsu (TFP = 123), Zhejiang (TFP = 139) and Guangdong (TFP = 126) have performed much better than other inland provinces. These indexes capture recent developments as well as historical and geographical

TABLE 3
Regional Productivity Index

Province or Region	*Index*
National Average	100
Hebei, Beijing and Tianjing	108
Shanxi	79
Nei Monggol	75
Liaoning	99
Jilin	100
Heilongjiang	84
Jiangsu and Shanghai	123
Zhejiang	139
Anhui	110
Fujian	119
Jangxi	104
Shandong	107
Henan	102
Hubei	91
Hunan	103
Guangdon	126
Guangxi	99
Sichuan	91
Guizhou	83
Yunnan	97
Xizang, Gansu, Qinghai and Ninxia	85
Shaanxi	84
Xinjiang	92

Source: *Statistical Yearbook of Chinese Cities*, 1986, 1988.
Note: Coefficients for province dummies not reported; 1402 observations for each regression.

differences among the regions. In the history, the coastal cities such as Shanghai in the eastern China have started industrialization earlier than the inland cities and the south eastern China has better soil and clime for the agricultural development. Recent economic reforms with open-door policies also benefit the coastal cities the most, particularly those cities close to Hongkong and Taiwan.

5. CONCLUSION

In this paper, I present a property rights analysis about the provision of fringe benefits and the dilemma of managerial autonomy in the reforming Chinese industrial enterprises. The provision of fringe benefits such as employee subsidized housing has been an important feature of Chinese enterprise system. Before recent reforms, because of limited managerial autonomy and extensive planning, the fringe benefits in Chinese enterprises were quite limited. The reform have reduced planning and delegated more economic control to managers. This have lessened planning inefficiency but led to other problems such as the excessive expansion of fringe benefits in the state-owned enterprises because of their high concentration of government ownership. The gov-

ernment is ineffective in monitoring the state-owned enterprises under the partial reforms because of the bureaucrats' weak incentive and limited information as well as a lack of functioning external monitoring institutions such as capital and labor markets. Hence, the state-owned enterprises will be less efficient in production than the collective enterprises if adjusting for economies of scale and the use of fringe benefits. These predictions have been confirmed by the evidence from a econometric production function analysis of the cross-sectional city-level data on the Chinese industrial enterprises in 1985 and 1987. Controlling for economies of scale and current investment in fringe benefits, the state-owned enterprises have not only lower output elasticities of capital and labor but also lower total factor productivity than the collective enterprises. The estimated gaps of the Total Factor Productivity adjusted for economies of scale are 34.8% in 1987 and 23.7% in 1985. These gaps may reflect inefficient use of all factors in the state-owned enterprises including capital, labor, fringe benefits, management etc. They may also reflect differences in industrial composition and labor skill in the two sectors, among others. Other cross-sectional differences may also account some of the TFP gaps. However, the ownership structure, which determined, among others, the forms of compensation in Chinese enterprises, seems a major cause for the efficiency gaps. During the period from 1985 to 1987, the state sector also maintained a stagnant TFP growth and low allocative efficiency while the collective sector achieved a rapid growth of TFP and high allocative efficiency. The analysis and evidence in this paper show that for the state-owned enterprises, the limited partial reforms toward a market-oriented economy have given root to other problems such as the inefficient provision of fringe benefits and have accomplished little in the late years of the decade-long reforms. However, the reforms have facilitated the development of collectively owned enterprises which demonstrated much greater efficiency than the state-owned enterprises in this period. The paper also suggests that there were large efficiency gains during the period from 1985 to 1987 if state-owned enterprises could be reformed into collective-like enterprises. If future reforms would allow private and collective enterprises to develop without severe discriminations, the Chinese industrial sector could likely achieve rapid growth in productivity.

DATA APPENDIX

The data used in this section are taken from the *Statistical Yearbook of Chinese Cities (1986 and 1988)*. The yearbook contains aggregate city level industrial data for all Chinese cities. Data of 324 cities in 1985 and 382 in 1987 are used in this paper. For each city, the yearbook reports statistical data separately for both the state-owned and collectively owned industrial enterprises. Apart from some limitations of the city-level data, such as a lack of information about industrial composition, the city-level data do provide me with a comparable data set for studying differences between the Chinese state and collective sectors.

In China, in addition to urban districts, each city government also administers several rural counties around the city. My sample covers urban districts and excludes rural counties. Hence, the recent rapid growth of rural enterprises, which consist mainly of collectively owned small enterprises, is not considered in this paper.

The data used in this paper cover industrial variables in the years 1985 and 1987. 1985 is the earliest year in which data are available for me and is the year the Chinese industrial reform took effects all over the Chinese cities. The market-oriented economic reforms started from the Chinese Communist Party's Third Plenum of the Eleventh Congress held in late 1978. These reforms took roots in the agricultural sector by early 1982 when the CCP formally recognized the Household Responsibility System for the agricultural production in its celebrated No. 1 Central Committee Document issued on January 1, 1982. In the industrial sector, reforms were slow and in the nature of adjustment and experiment before 1984. 1984 could be seen as one turning point for urban reforms. Encouraged by the success in the rural reform, Chinese leaders Deng Xiao-ping and Zhao Zhi-yang decided to push forward the urban reform. Several important reform policies were publicized in 1984, including the decision to open 14 coastal cities to foreign investment (May 4, 1984), the move to expand further managerial autonomy for the state-owned enterprises (May 10, 1984), and most importantly the publication of the "CCP Central Committee's Resolution on Economic System Reform" (October 20, 1984). It would be very useful if I could obtain the same cross-sectional city-level data in the early 1980s for the state and collective sectors separately. Then I could also assess the impact of the policy change during 1980 to 1984 on the performance of each sector. Since I have only data from 1985 to 1987, what I will examine here is the performance of each sector under the partially reformed economic system. Before 1984, the state sector was severely limited by the planning system compared with the collective sector. After 1988, the Chinese economy suffered serious inflation and political instability. The Chinese government has intervened heavily in favor of the state sector since 1989. During the period from 1984 to early 1988, the Chinese state-owned and collective enterprises experienced a relatively stable economic environment characterized by extensive managerial autonomy. Hence, the period from 1984 to 1987 in which data are available to me is suitable for a comparative study of the state and collective sectors.

Table A.1 gives a brief description of variables used in the following estimations. In the statistical yearbook, the production variables, such as value added (V) and net fixed capital (K), are contained in a separate aggregate accounting report for those industrial enterprises with independent accounting. The variables in this separate accounting report are more accurate and consistent with each other since the coverage of the enterprises in this report is clearly defined, and the enterprises covered by the report are subject to regular auditing every year.

However, this accounting report does not report number of enterprises. I will use the number of all industrial enterprises (*NFIRM*), which is recorded in the yearbook, as a proxy for the more narrowly defined number of the industrial enterprises with independent accounting, since I need such a variable to compute a measure of the average firm size (*L/NFIRM*). This does not incur large errors under the Chinese classification system.

The accounting report does not have variables relating to fringe benefits. I found one variable in the yearbook which can be used as a proxy for fringe benefits. That is the current investment in non-industrial fixed capital (H) in all enterprises (including industrial and non-industrial enterprises). I will use this variable as a proxy for the corresponding variable in the industrial sector. This variable (H) also has been re-

TABLE A.1
Description of Variables in City Data

V	Value added of each city in the industrial sector covering enterprises with independent accounting; Transformed into 1985 constant price and measured in Chinese currency of 10,000 yuan.
L	Number of employees of each city int he industrial sector covering enterprises with independent accounting; L is computed from the labor productivity variable (V/L) and value added variable (V) of the same classificatin; Measured in 10,000 of persons.
K	Net fixed capital including both productive and non-productive capital of each city in the industrial sector covering enterprises with independent accounting; Adjusted for non-production capital (see explanation on data section); Transformed into 1985 constant price and measured in Chinese currency of 10,000 yuan.
H	Current investment of each city on non-production fixed capital such as enterprise-owned housing in all sectors; Transformed into 1985 constant price and measured in Chinese currency of 10,000 yuan.
$H0$	Dummy variable set to 1 if $H = 0$; There are total 70 observations with $H = 0$, all of them in collective sector with 28 in 1985 and 42 in 1987.
NFIRM	Number of industrial enterprises in each city; Slightly different from the number of industrial enterprises with independent accounting.
$S87$	Dummy variable set to 1 if the observation is from state sector in 1987; There are 378 observations with $S87 = 1$.
$S85$	Dummy variable set to 1 if the observation is from state sector in 1985; There are 322 observations with $S85 = 1$.
$C87$	Dummy variable set to 1 if the observation is from collective sector in 1987; There are 378 observations with $S85 = 1$.
22 dummy variables for Chinese provinces. Each province is given a dummy variable except a few underdeveloped provinces in western China; Beijing, Tianjing and Shanghai are included in their neighbor provinces; See table 4.10 for detail.	

Source: *Statistical Yearbook of Chinese Cities*, 1986, 1988.
Note: Each variable has data for state and collective sectors in 1985 and 1987.

corded separately for the state and collective enterprises. Measured by the number of employees, the industrial sector has almost 50% share of the total in all sectors. Hence, investment in non-industrial capital in all sectors (H) is highly correlated with the corresponding variables covering the industrial sector alone. Although the variable H as a proxy suffers from errors-in-variables problems, I decided to use it since, as I have discussed in Section 2 and 3, fringe benefits capital is an important element in the operation of the Chinese industrial enterprises and H is the only variable in the city data I can use to study the effects of fringe benefits expenditures on productivity. Since the proxy includes the current investment in non-industrial fixed capital by non-industrial as well as industrial enterprises, I should discount it to measure more accurately the non-industrial investment in the industrial enterprises. However, I used the original variable, which was inflated, because what I really needed was a measure of the fringe benefits capital, which was not available, instead of the non-industrial investment. I believe the inflated original variable (H) is closer in size to the level of fringe benefits capital, although it is still inaccurate in terms of variation.

The original capital variable in the city data covers non-industrial fixed capital as well as production capital. It would be useful if the capital data could be separated into industrial and non-industrial components. Then, the contributions by each component of capital can be assessed separately. However, with the non-industrial and

industrial fixed capital mixed together, I cannot estimate separately output elasticities of industrial capital and non-industrial capital. What I can estimate using the city data is output elasticity of entire capital including both industrial and non-industrial capital. As discussed in Section 2, the state-owned enterprises have more non-industrial capital than the collective enterprises. In the following estimation, I will assume that the ratio of non-industrial to industrial capital is stable and approximately the same across cities for each sector. More specifically, I will assume the industrial capital of the state sector is 80% of its entire capital and that of the collective sector is 85%. The 80% and 85% standards for the two sectors are based on analysis in Section 2 on the capital composition using 1985 industrial survey data. Hence, I will regard the estimated output elasticity of the adjusted capital as elasticity of industrial capital. My assumptions about the composition of capital in the city data are certainly subject to errors-in-variables problems. Reducing the level of capital to its 80% or 85% is not intended to correct the errors-in-variables problems. However, the adjustment is necessary for productivity index estimation. Without the adjustment, the levels of capital stock for both sectors are inflated by the component of non-industrial capital. Since the inflation of capital is larger in the state sector than in the collective sector, using unadjusted capital data will underestimate the production efficiency of the state sector relative to that of the collective sector.

All the variables in this sample were recorded in current prices. To transform V, K, and H into 1985 constant prices, I divide 1987 variables by two separate deflators for the state and collective sectors respectively. The two deflators, 1.1075 for the state and 1.0861 for the collective, are computed from the implicit price index for Gross Industrial Output in the Statistical Yearbook of China (1987 and 1988). The two deflators derived indicate that the price of industrial output in the state sector has increased about 11% from 1985 to 1987, which is about 2% more than in the collective sector (about 9%) during the same period. I have used the two deflators for output to deflate capital and housing investment as well since more precise price indexes for capital and housing are not available.

The variables in 1985 and 1987 with constant price of 1985 are pooled into a sample with 1402 observations after dropping 10 observations with incomplete data or negative value added. Means of each variable are listed in Table A.2 for each sector-year subsample and the whole sample. The average levels of value added, capital, and labor of the collective sector in Chinese cities were about 22%, 12%, and 64% respectively of those of the state sector in 1985. These number changed to 26%, 14% and 51% in 1987 indicating increases of collective sector's share in output and capital and decrease of its share in labor. The investment in non-industrial capital by the collective sector was about 5% of that by the state sector. Divided by number of employees in each sector, the number decreases to less than 2%. The pattern of non-industrial investment did not change much between 1985 and 1987 and was consistent with the finding in Section 2 about the pattern of capital composition of the two sectors. The average size of state-owned enterprises was about 70 employees and that of collective enterprises about 15. The capital-labor ratio of the state sector was about 4 times of the ratio of the collective sector. With a higher capital-labor ratio, larger factory scale and more non-industrial investment, the state sector's labor productivity was about 3 times of that in the collective sector in 1985 and about 2 times in 1987.

TABLE A.2
Means of Variables in City Data

Variable	*Pooled Sample*	*State 85 Subsample*	*State 87 Subsample*	*Collective 85 Subsample*	*Collective 87 Subsample*
	1402 obs	322 obs	378 obs	324 obs	378 obs
V	30,109	49,543	47,587	10,905	12,539
K	39,898	67,892	73,118	7,823	10,325
L	6.35	8.01	8.19	5.11	4.15
H	6,193	12,336	11,333	610	606
NFIRM	231	115	115	337	356
V/L	3,775	5,131	5,489	1,790	2,608
K/L	5,557	8,210	9,410	1,695	2,752
H/L	926	1,949	1,466	146	181
log (L)	.96	1.32	1.24	.73	.55
log (V/L)	7.99	8.35	8.39	7.38	7.79
log (K/L)	8.28	8.90	9.01	7.31	7.84
log (H/L)	5.48	7.06	6.86	3.88	4.12

Source: *Statistical Yearbook of Chinese Cities*, 1986, 1988.

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NOTES

1. See Byrd (1987) for discussions about the contribution of the dual-allocation system on the market-oriented reforms.
2. See Wu and Zhao (1987) for discussions about the problems associated with the dual-allocation system.
3. The literature of the modern theory of the firm started with Coase (1937) and was further developed by Alchian and Demsetz (1972), Jensen and Meckling (1976), Klein, Craw-

ford, and Alchian (1978), Fama and Jensen (1983), Klein (1983), Demsetz and Lehn (1985), Williamson (1985), and Alchian and Woodward (1988) among others. Kornai (1980, 1985, 1986ab, and 1990ab) discussed institutions and reforms of Socialist economy.

4. However, if stakeholders are included as owners of the corporation, their ownership claims cannot be classified as explicit monetary claims. The stakeholder's implicit claims will not necessarily grow at the same rate as shareholders' claims. See Cornell and Shapiro (1987).
5. For early literature on econometric estimation of the production function using cross-sectional data, see Griliches and Ringstad (1971).
6. This formula does not apply to translog function. Since translog function is not homothetic function, the standard measure of scale elasticity of homothetic function does not apply.
7. This formula does not apply to translog function.
8. Using Shanghai's industrial data by industry and ownership, I find that the collective sector has indeed concentrated in the labor-intensive industries.
9. Results of standard specification tests for functional forms can be found in Xiao (1990b). For space limitation, they are omitted in this paper. However, I report estimates from alternative functional specification in Table 2.
10. The elasticities of the state sector are computed from the geometric means of its capital-labor ratio since, unlike the elasticities in the collective sector which do not change with the capital-labor ratios, they will change with the capital-labor ratios because of the Kmenta production function form.
11. Since the variable of investment in non-production fixed capital in this paper is not a very good proxy for fringe benefits provision, I also report the regression without this variable in Table 2. The very limited city-level data prevent me from exploring other specifications concerning the fringe benefits issue. However, Xiao (1990a) formalized the institution of fringe benefits provision in Chinese enterprises and explored further the evidence using much detailed firm-level data from 1985 PRC industrial survey.

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