

Impacts of Privatization on Employment: Evidence from China*

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Abstract

This paper evaluates the impact of privatization on firm employment using a panel dataset of 386 firms in China in the period 1995-2001. Controlling firm and year fixed effects, our panel regressions find that employment grows faster in privatized firms than in pure state-owned firms by a margin of 17.7 percentage points over the base year of 1995. We also study the dynamic impact of privatization on employment growth and find that the performance of privatized firms improves over time. These findings are robust even after we control other performance and financial variables as well as the pre-privatization employment history of privatized firms. In addition, we employ the difference-in-difference propensity score matching method to check the robustness of our results. The estimates confirm the regression-based results.

JEL Classification: J23, L33, P31

1 Introduction

Privatization has been the most significant economic phenomenon in recent years in China. Between 1995 and 2004, 50 percent of state-owned enterprises (SOEs) were fully or partially privatized (Garnaut, Song, Tenev, and Yao, 2005). China's privatization program, if fully carried out, may be the largest industrial ownership transformation ever undertaken, affecting more than 200,000 SOEs and 100 million urban workers (Wei, Varela, and Hassan, 2002).

Because of the large-scale employment in the SOEs, one concern about privatization is the potential loss of employment and its negative impacts on social stability. In the period 1995-2003, a total of 43.8 million people lost their jobs in the SOE sector (Garnaut et al., 2005, Table 4.1). Privatization is easily picked up as the cause for this massive reduction of employment. To the extent that there is high worker redundancy in the SOEs, it seems legitimate to suspect that privatization inevitably leads to massive layoffs. However, several reasons render this suspicion dubious. First, China implemented massive structural adjustment in its industrial sector in the mid-1990s, trimming off excessive capacities in industries that over-supplied their products (such as textile) and mining cities that ran out of resources. This led to reduction of employment in the SOE sector. Second, facing growing competition from private firms, SOEs began to implement a policy called *jianyuan zengxiao* (cutting the number of employees, improving efficiency) in the mid-1990s, resulting in massive layoffs. Privatized firms may also reduce the size of employment, but there is no a prior reason to believe that they would lay off more workers than SOEs did. This is related to our last reason concerning the efficiency gains of privatization. Evidence shows that privatization has led to significant improvements in firm efficiency (Sun and Tong, 2003; Xu, Zhu, and Lin, 2005; Garnaut, Song, and Yao, 2006). To the extent that efficiency leads

to firm expansion, it is reasonable to believe that privatized firms would maintain a lower reduction rate of employment.

Existing empirical studies on other transition countries provide mixed results regarding privatization's impact on employment. Using multi-country samples, Galal, Jones, Tandon and Vogelsang (1994), Megginson, Nash, and Randenborgh (1994), and Boubakri and Cosset (1998) all find that employment increases after privatization, but D'Souza and Megginson (1999) come to the opposite conclusion.¹ So far, there are few studies on the impact of privatization on employment in China. D'Souza, Hassan, Varela and Wei (2003) study 208 listed firms for the period 1990-1997 and find no significant change in employment shortly after the listing, but their employment declines significantly in the long run. But this study just uses the Wilcoxon signed rank test (z-statistic) to test the significance of the mean change.

Our paper aims at providing more accurate and more general estimates for the causal effect of privatization on employment in China. We use a unique panel dataset of 386 firms for the period 1995-2001. This panel dataset enables us to handle the selection problem that plagues most studies of privatization (Djankov and Murrell, 2002). To assess the impact of privatization on employment, we need to make inferences about employment that would have been observed for privatized firms had they not been privatized. However, privatized firms might be selected on the basis of employment; for example, it is possible that firms with a stronger potential of growth are more likely to be privatized (Guo and Yao, 2005). This is because politicians are concerned with unemployment and incline to retain firms with the worst prospects in state ownership to prevent possible layoffs. Overlooking such selection problems could lead to biases when we estimate the impact of privatization on employment. The panel structure of our data enables us to use the fixed-effect model to

¹D'Souza and Megginson (1999) have one Chinese firm in their sample.

eliminate selection bias due to time invariant unobservables. In the absence of a genuinely randomized experiment, the fixed-effect panel estimation is a nearly ideal tool to take care the selection problem of privatization.

In addition to the fixed-effect model, we also estimate the impact of privatization on employment by the difference-in-difference propensity score matching (DID PSM) method. Although applying a fixed-effect model could largely reduce selection biases due to time-invariant and firm-invariant unobservables, DID PSM method has two advantages over it. First, we do not need to impose the assumption of linear functional form in the DID PSM method as we do in the fixed-effect model. When functional form restrictions cannot be justified by economic theories or the data generating process, DID PSM can lead to more accurate estimates (Dehejia and Wahba, 1998; Smith and Todd, 2000). Second, DID PSM reweighs the observations according to a pre-determined weighting function over the common support, while fixed-effect estimations rely on functional form to extrapolate outside the common support. When there is poor overlapping in the support between privatized and non-privatized firms, this raises questions on the robustness of the methods relying on functional forms to extrapolate outside the common support (Bryson, Dorsett, and Purdon, 2002).

Our descriptive analysis shows that both SOEs and privatized firms reduced their employment in our sample period. However, our econometric studies show that privatization leads to significantly less reduction of employment. The simple fixed-effect estimate shows that the overall benefit of privatization is to increase employment growth over the base year of 1995 by 17.7 percentage points. This effect decreases to 11.5 percentage points when we control firms' attributes of finance and performance, suggesting that part of the effect of privatization is substantiated through improving the firm's financial and performance parameters.

We also study the dynamics of the impact of privatization over time using both the fixed-effect panel method and the DID PSM method. The fixed-effect panel estimates show that privatization has a significantly positive effect on employment in the first 6 years after privatization. The DID PSM estimates are smaller than the fixed-effect estimates, but they follow the same pattern of dynamics.

We conduct a robustness test to the alternative interpretation that privatized firms lay off workers before privatization so they do not need to do layoffs after privatization. This amounts to adding in the panel regressions pre-privatization year dummies for the privatized firms. The results show that although privatized firms do perform better than pure SOEs even before they are privatized, the gap enlarges significantly after privatization. So our results are robust.

The rest of paper is organized as follows. Section 2 describes the data and present descriptive evidence. Section 3 discusses our methods of estimations. Sections 4 and 5 report the empirical results of the fixed-effect and DID PSM estimation, respectively. Section 6 presents the results of the robustness test on the fixed-effect results. Conclusions are summarized in Section 7.

2 Data and Descriptive Evidence

2.1 Data

The data we use are taken from the “2002 Comprehensive Survey of SOE Reform in China”, which was jointly carried out by the then State Economic and Trade Commission (SETC), PRC and the International Finance Corporation (IFC) in 2002. The original sample contains 683 firms that are located in 11 cities, which are, from north to south, Harbin (120 firms), Fushun (11 firms), Tangshan (59 firms), Xining (26 firms), Lanzhou (39 firms), Weifang (30 firms), Chengdu (44 firms), Guiyang (149 firms), Huangshi (79 firms), Zhenjiang (69 firms),

and Hengyang (57 firms). Some of these cities are large provincial capitals, and others are medium-size cities. Detailed information about these cities and survey implementation can be found in Garnaut et al. (2005). Firms were sampled from the SOEs managed by each city as of the end of 1995. The year 1995 was chosen because large-scale privatization started in 1996. Data were recorded for the period 1995-2001.

A problem of the survey is concerned with the selection biases in the sampling process. There were two potential sources of bias. One was the self-selection of the firms in returning the questionnaire, and the other was the selection of the city branches of the SETC, the local counterparts that implemented the survey. The first source is unavoidable in any survey based on voluntary participation, but hopefully the selection was not systematically related to the decision of privatization. However, the second source may bring real concerns as local officials might press the firms that had closer ties with the government, usually the larger ones and non-privatized SOEs, to fill the questionnaire. This would cause over-sampling of non-privatized SOEs. We have the number of firms that were fully owned by the government or controlled by the government with majority shares in each city in each year, so weighted regressions can be adopted to correct this bias. To accommodate different methods of regression, however, we have adopted a different strategy to resample the SOEs in each city by the following method.

Let S_{it} be the ratio of SOEs to privatized firms in city i and year t , and let \hat{S}_{it} be the corresponding ratio in our sample. Our aim is to preserve all the privatized SOEs in the new sample. So for the sample of city i in year t , we define a weight for SOEs $\omega_{it} = S_{it}/\hat{S}_{it}$, which can bring the ratio of SOEs to privatized firms in the new sample to that of the city in the same year when it is used to resample the SOEs. To keep the panel structure of the data, however, we define a weighted weight for each city, $\sum_{t=1995}^{2001} \omega_{it}(N_{it}/N_i)$, in which N_{it} is

the number of SOEs of city i and year t in the sample, and N_i is the sum of N_{it} from 1995 to 2001. We then use this weighted weight to resample the SOEs of each city in year 2001. We keep the cases of those sampled SOEs of each year in the new sample and drop the cases of the other SOEs. Combining the selected SOEs with the privatized firms, we get a new sample of 386 firms. The distribution of these firms is: Harbin (71 firms), Fushun (6 firms), Tangshan (35 firms), Xining (19 firms), Lanzhou (13 firms), Chengdu (11 firms), Guiyang (52 firms), Weifang (27 firms), Huangshi (52 firms), Zhenjiang (45 firms), and Hengyang (55 firms).

2.2 Descriptive Evidence

We follow Estrin and Rosevers (1999) to define privatization as the introduction of private shares into an SOE. That is, a firm is regarded as privatized as long as it has any amount of private shares. Evidence shows that firm performance improves as the amount of private shares increases (Garnaut et al., 2006), so using this definition of privatization will obtain the lower bound of the effect of privatization on employment. Figure 1 shows the trend of privatization in the new sample. The earliest privatization happened in 1996 in the sample. The year 1998 was the turning point of accelerated privatization. The left vertical axis represents the average private shares of the new sample, and the average private shares increased steadily over the sample period reaching one fourth on average by 2001. The right vertical axis represents SOE ratio of the new sample. By the end of 2001, 154 firms, or 39.9 percent of the new sample, were privatized and the SOE ratio decreased to 60.1 percent. The speed of privatization matched the national average shown in Garnaut et al. (2005).

[Figure 1 about here]

We use the number of on-duty workers to measure a firm's real employment. Over-employment was a major problem for SOEs in the 1990s and was caused by two factors. One, as Boycko, Shleifer and Vishny (1996) theorize in a general setting, local politicians used employment to gather political supports. The other was that the performance of SOEs deteriorated rapidly from the early 1990's onwards (Huang and Meng, 1997; Perkins, 1996), which led to overcapacity in SOEs. This forced SOEs to downsize. *Jian yuan zeng xiao* thus became prevalent in the 1990s. However, the fear of social instability prevented firms from laying off workers in the outright manner. Instead, two measures were created to mitigate the impacts. One was *xiagang*, which means that a worker does not work for a factory but still retains a nominal employment status with it and gets partially paid with a subsistence wage. The other measure was internal retirement by which a worker gets retired but still remains as an employee of the factory. As a result, there was a large discrepancy between real employment and nominal employment, especially for pure SOEs. Therefore, using the number of on-duty employees is a more appropriate measure for employment.

[Figure 2 about here]

Figure 2 compares the employment performance of pure SOEs and privatized firms over time. It is clear in the figure that privatized firms outperformed pure SOEs. The employment size of pure SOEs declined constantly throughout the survey period, trimming down from an average of 700 on-duty workers in 1995 to only 400 in 2001. Privatized firms maintained larger employment than pure SOEs throughout the sample period. This difference might be caused by privatization's selection of larger firms, so it is more interesting study the growth rates of the two kinds of firms. Between 1995 and 1997, the average size of privatized firms increased. After 1997, they joined in the rank of pure SOEs to reduce their employment, but at a slower pace. The average reduction rate of pure SOEs in the period 1995-2001 was

7.2 percent per annum, but it was 3.8 percent per annum for privatized firms in the period 1997-2001.

3 Econometric Strategies

In assessing the impact of privatization on employment, we need to make inferences about the counterfactual outcomes that could have been observed for privatized firms had they not been privatized. Without a random experiment, no direct estimate of such counterfactual outcomes is available. In this paper, we rely on two econometric techniques to obtain nearly ideal estimates. One is the fixed-effect panel model and the other is the DID PSM method. Both methods are effective in controlling the selection biases arising from time-invariant factors. In addition, the second does not rely on the linear functional form and handles the control group in a more precise manner. The results of the two methods can be compared to discover the more robust outcomes.

As we showed in the last section, the level of employment is not a good dependent variable to study as the selection of privatization may be correlated with it. Studying employment growth rates is a more sensible approach. However, annual growth rates are volatile and may contain many noises that cannot be properly captured by observed variables. As an alternative, we study the fixed-base growth rate of employment using 1995 as the base year. Specifically, the employment growth rate of firm i in year t is the percentage increase of its number of on-duty workers between 1995 and year t .²

²the growth rate of 1995 is naturally set to zero.

3.1 Fixed-effect Model

Taking advantage of our panel data, we will estimate the following model with firm and year fixed effects:

$$Y_{it} = X_{it-1}\beta + P_{it}\delta + \alpha_i + I_t + \epsilon_{it}, \quad (1)$$

where Y_{it} is the fixed base growth rate of employment of firm i in year t ($t = 1996, 1997, \dots, 2001$), X_{it-1} is a set of variables representing firm performance and finance (lagged by one year) that might be correlated with both the growth rate of employment and privatization, P_{it} is the privatization dummy variable that is equal to 1 if firm i had nonzero private share in year t and equal to 0 if it had zero private share, α_i is the firm fixed effect for firm i , and I_t is the year fixed effect for year t . The control variables enter with their lagged values to avoid their contemporaneous correlations with the dependent variable. As a result, the time span for the dependent variable is from 1996 to 2001. The firm fixed effects control the kind of time-invariant firm quality that is correlated with both ownership and employment but is unobserved in our data. They extract time-invariant correlations between the explanatory variables and the error term. The year fixed effects control time-specific factors that were correlated with both employment and privatization and common to all firms. These could include changes in macroeconomic conditions as well as government policies that affected both employment and the pace of privatization. The residual ϵ_{it} includes the effects of measurement and specification errors. Our identifying assumption is that these components are uncorrelated with firm ownership. The coefficient of our interest is δ , the mean difference in employment growth between privatized firms and pure SOEs.

With the set of control variables X_{it-1} included, equation (1) is estimating the direct effect of privatization. The effects of privatization can be categorized into two sets. One set includes those that can be captured by improved profitability and financial positions. Priva-

tization could lead to better performance and adjustments to a firm's financial conditions, which in turn could lead to more employment. In particular, two practices in privatization are important for a privatized firm to improve its financial conditions. One is debt evasion, and the other is discounts of privatization prices. It has been found that some privatized firms set up a new identity to move productive assets into it and leave debts in the old firm (Garnaut et al., 2005). To exchange for privatized firms' consent to retain more workers, local governments are found to give them discounts in privatization prices, including removing part or all of their debts to a government-owned dummy company (Garnaut et al., 2005). With these two practices, the financial conditions of privatized firms are automatically improved and employment could go up. We call this kind of improvement the indirect effect of privatization. The other set of effects is related to those that are not captured by the current profitability and financial performance, but rather linked to the expectation for future performance. These include improved firm management skills and incentives, changed product lines, new R&D, and other improvements whose positive effects take time to show up. This set of effects is what we meant by the direct effect. The coefficient of the privatization dummy in equation (1) measures this effect as the equation controls the indirect effect through the control variables. In addition to estimating the direct effect, however, we are also interested in the total effect of privatization, which is the sum of the direct and indirect effects. To estimate it, it suffices to drop the control variables X_{it-1} and to estimate equation (1) again.

We also want to investigate the dynamic effects of privatization. This amounts to splitting the privatization dummy in equation (1) into a set of post-privatization year dummies: $priv_{0it}$ (for the year of privatization), $priv_{1it}$ (for the first year after privatization), \dots , and $priv_{5it}$ (for the fifth year after privatization).³ Naturally, the sum of these six dummies is

³The first year of privatization in our sample is 1996, so the maximum number of post-privatization years

equal to the privatization dummy. We then estimate the following model to get the direct effects of privatization:

$$Y_{it} = X_{it-1}\beta + \Pi_0\text{priv}_{0it} + \Pi_1\text{priv}_{1it} + \Pi_2\text{priv}_{2it} + \Pi_3\text{priv}_{3it} + \Pi_4\text{priv}_{4it} + \Pi_5\text{priv}_{5it} + \alpha_i + I_t + \epsilon_{it}, \quad (2)$$

where Π_0 measures the average effect of privatization for the year of privatization, Π_1 the average effect for the first year after privatization, etc. This model will help us get a sense on the speed with which the estimated effect occurs: Is the effect immediate or gradual? Is it only temporary, or permanent? Like in the case of estimating the average effect, we will also drop the control variables X_{it-1} and estimate (2) again to obtain the total effects of privatization.

3.2 DID PSM Estimation

The treatment group in our PSM estimation is defined as the firm-year observations of privatized firms after they were privatized, and the control group is defined as the firm-year observations of firms that had not been privatized till the end of 2001. Thus defined, there are 154 observations in the treatment group and 1392 observations in the control group. One problem arising from this definition is that one needs to worry about the firm specific effects in the estimation of the propensity scores. For that, we estimate the following random-effect logit model: ⁴

$$P_{it} = Z_{it-1} + v_i + e_{it}, \quad (3)$$

where P_{it} is defined as in equation (1), Z_{it-1} is a set of variables that predict the probability of privatization, v_i is the random effect of firm i , and e_{it} is an i.i.d error term. Because privatization is a nonreversible process, we only include the cases of the privatization year

is 5.

⁴Our panel is relatively short so a fixed-effect logit model cannot be consistently estimated.

for the privatized firms. The propensity score for each observation is then estimated by assuming that $Ev_i = 0$.

[Table 1 about here]

Following Heckman, Ichimura, Smith, and Todd (1997, 1998), we adopt the difference-in-difference (DID) estimator to estimate the effects of privatization and use the kernel-weighted weights in the matching. The estimation is a bit tricky because privatization happened in different years. One way is to estimate the dynamic effects of privatization that equation (2) tries to estimate. Table 1 illustrates the way that observations are matched and the effects are estimated. In the table, T_0 is the calendar year before treatment (i.e., privatization), and T_1 is the calendar year after treatment. For the treatment group, T_0 is always the year before privatization. It varies from firm to firm because privatization happened in different years. T_1 then is the order of year after privatization for which the effect is estimated. For the control group, T_0 is any year between 1995 and 2000, and T_1 is $T_0 + k + 1$ as long as it does not exceed 2001, where k is the order of year for which the effect of privatization is estimated. Then the DID PSM estimator for the effect of the k th year after privatization is given by

$$\hat{\alpha}_k = \frac{1}{P_k} \sum_{i=1}^{P_k} [(Y_{k1i} - Y_{0i}) - \sum_{j=1}^{NP_k} W_{ij} (Y_{k1j} - Y_{k0j})], \quad (4)$$

In the equation, P_k is the number of observations that remain in the treatment group for the k th ($k = 0, 1, 2, \dots, 5$) year after privatization, NP_k is the corresponding number of observations that remain in the control group; Y_{0i} is the employment growth rate of the i th firm of the treatment group in the year before it was privatized, Y_{k1i} is its employment growth rate in the k th year after privatization, Y'_{k0j} and Y'_{k1j} are the employment growth rates of the j th firm of the control group with interval of $k + 1$ years; and lastly, W_{ij} is the

kernel-weighted weight of the j th firm in the control group relative to the i th firm in the treatment group.⁵ Thus defined, the DID PSM estimator $\hat{\alpha}_k$ is in fact the average effect of the k th year after privatization based on the performance of firms privatized in different years.

4 Results of the Fixed-effect Model

In this section, we report the estimated impact of privatization on employment using fixed-effect model. We start with the basic results from the estimation of the average privatization effect δ . Next we report our estimates of the dynamics for five years after the privatization.

4.1 Control Variables

Before presenting the econometric results, we provide a short description of the control variables. These variables can be divided into four groups. The first is concerned with a firm's performance, the second its employment conditions, the third its financial conditions, and the fourth industry and city characteristics. In the first group, we have included firm profitability (before-tax profit divided by the gross value of assets),⁶ labor productivity (sales revenue divided by the number of on-duty workers, in 2001 yuan using the CPI as the deflator), unit cost (material costs divided by sales revenue), investment rate (new investment divided by the gross value of assets), and the amount of outside state shares. Naturally, we expect that firms with higher rate of profitability, higher labor productivity, lower unit cost, and higher investment rate would achieve higher employment growth. The variable of outside state shares is included because it is found that outside state shares improve firm performance either by bringing in capital or by changing the incentive schemes in the firm (Song and Yao, 2006).

⁵The formula for W_{ij} can be found in Heckman et al. (1998).

⁶We use the gross value of assets, not the net value, because many firms had negative net values.

In the second group of control variables, we have included three variables: average wage (total wage payroll divided by the number of on-duty workers, in 2001 yuan using the producer price index as the deflator),⁷ redundancy rate (the total number of textitxiagang workers, internally retired workers, and officially retired workers divided by the number of on-duty workers),⁸ and capital per-worker (the gross value of assets divided by the number of on-duty workers, in 2001 yuan using the producer price index as the deflator).⁹ It is natural to expect that higher average wage (higher labor cost) and redundancy rate reduce employment growth rate. In addition, capital per-worker captures the “weight” of a firm. Many SOEs are “over-weighted” in the sense that they have adopted too capital-intensive technologies, which prevents them from absorbing more workers. So we expect that more capital per-worker retards employment growth.

The third group of control variables also includes three variables: debts/assets ratio (the amount of commercial and bank debts divided by the gross value of assets), bank dues (the amount of new overdue bank loans and interests divided by the gross value of assets), and tax dues (new overdue taxes divided by the gross value of assets). The debts/assets ratio reflects a firm’s general financial conditions, and bank dues and tax dues reflect a firm’s budget constraint with respect to bank borrowing and its relationship with the government. Soft budget constraints with the bank and the government are results of bad performance. It is then natural to expect that worsening financial conditions represented by the three variables would result in slower employment growth.

⁷This definition exaggerates the average wage paid to on-duty workers as firms also pay their textitxiagang and internally retired workers. On the other hand, using the average wage paid to all the workers underestimates the average wage paid to on-duty workers. Since worker redundancy is high (Figure 2), our calculation of the average wage is a sensible way to characterize the labor cost of on-duty workers.

⁸Officially retired workers are counted as redundant workers as in many cases they are not covered by the public retirement scheme and still paid by their factories. This is especially true for firms in the privatization process. See Garnaut et al. (2005) for detailed discussion.

⁹Our survey did not record the value of fixed capital, so here we use the gross value of assets. The correlation between these two values is high as fixed capital is the largest component of assets in most firms.

The last group of control variables is a set of industrial and city dummies that aim at controlling industrial and city specific effects. They do not appear in the fixed-effect panel estimation for obvious reasons but appear in the logit model for PS matching. Although the industrial coverage of the sample firms is large, the number of firms in each industry would be small if we use the two-digit industries to classify the sample firms. Instead, we group the sample firms into 10 industries.

[Table 2 about here]

Summary statistics of the control variables as well as the dependent variable and the privatization dummies are presented in the first panel of Table 2. The table also makes a comparison between privatized firms and pure SOEs. On average, privatized firms outperformed pure SOEs in profitability, labor productivity, and unit cost, and also had more outside state shares. However, privatized firms had lower investment rate than pure SOEs. In terms of employment conditions, privatized firms were much "lighter", had a smaller redundancy rate, but paid a higher wage than pure SOEs. The Chinese labor market is not fully competitive so wage may be correlated with firm performance. We will keep this in mind when we interpret our empirical results. Lastly, privatized firms performed much better than pure SOEs in terms of debts and bank dues. In contrast, they had more overdue taxes than pure SOEs. It seems that privatization has hardened firms' budget constraints with respect to bank borrowing and commercial deals, but has done nothing or even worsened firms' budget constraint with respect to the government.

4.2 Average Effect of Privatization on Employment

The estimation results of equation (1) are presented in the first two columns of Table 3. The t-statistics are calculated using the robust standard errors. Column 1 presents the results

for the total effect of privatization. It is shown that on average, privatization increases the number of on-duty workers by 17.65 percent over the base year of 1995, with a t-statistic 6.53. This is a very large effect because it is equivalent to 41 percent of the rate of employment reduction in pure SOEs in the period 1995-2001. Column 2 presents the results for the direct effect of privatization. The direct effect is 11.49 percent, which is smaller than the total effect, but remains significant. This means that privatization does have an indirect effect on employment through improvements made to a firm's performance and financial conditions.

[Table 3 about here]

Among the performance variables, profitability and outside state shares increase employment growth. However, both effects are not very large: one percentage increase of them increases employment by 0.17 percent and 0.15 percent, respectively, both over the 1995 level. Nevertheless, the positive effect of outside state shares still calls for attention. One possible reason is that outside SOEs are more capable than private owners to bring in capital to the firm because SOEs are favored by banks in making loans. However, more research is needed to find out the exact reason behind this result. The paradoxical result is that labor productivity has a negative coefficient that is marginally significant at the 10 percent significance level. However, it may be a spurious result arising from the definition of labor productivity which is revenue per on-duty worker. Lastly, investment rate and unit cost are not significant.

As for the variables representing employment conditions, average wage and per-worker capital significantly reduce employment although neither effect is economically strong. Worker redundancy is not found to have a significant effect on employment growth.

A higher debts/assets ratio slows down employment growth. But again, the effect is not economically strong as one percentage increase of the ratio only brings down employment growth by 0.03 percentage points. The two variables for soft-budget constraints with the bank and the government are highly insignificant, though.

4.3 Dynamic Impacts of Privatization

We turn next to the dynamic effects of privatization. In columns 3 and 4 of Table 2 we report the estimated results for the total and direct dynamic effects of privatization, respectively. Among the control variables, profitability, per-worker capital, and debts/assets ratio have kept their signs and remained significant while labor productivity, outside state shares, and average wage have turned insignificant. All the other control variables have remained insignificant. The total effects of privatization are strong as all the six privatization dummies in column 3 are highly significant and their coefficients are economically strong. Compared with an SOE of the same size in 1995, an average privatized firm has an employment size 14.2 percent larger in the year when privatization happens. The effect increases as time passes and peaks at 27.3 percent in the 4th year after privatization happens. It declines to 23.5 percent in the 5th year, though. The direct effects shown in Column 4 follow the same pattern as that of the total effects, albeit all with slightly smaller magnitudes. These results indicate that the positive effects of privatization on employment are not only immediate, but also persist for a reasonably long time period.

5 DID PSM Estimations

The crucial step in using PSM is estimating the propensity score. Hence, the underlining principle to choose a suitable specification of the participation equation is that variables that influence simultaneously the participation decision and outcome should be included

(Heckman, Ichimura and Todd, 1997). It should also be clear that only pre-intervention variables that are not influenced by privatization should be included in the regression (Jalan and Ravallion, 2003). The existing literature shows that firm performance, employment conditions, and financial positions all influence the privatization decision (Su and Jefferson, 2003; Brandt et al. 2005; and Guo and Yao, 2005). This leads us to include all the control variables of the fixed-effect model in the logit estimation of privatization. As before, these variables enter the regression with their one-year lagged values. In addition, we have included city, industrial and year dummy variables to control unobserved city and industrial characteristics as well as changes of government policy over time. To satisfy the balance test, we have included squares of some variables following Smith and Todd (2005).

As being discussed before, we only include in the treatment group the firm-year observations of privatized firms in the year when they were privatized. In the meantime, all the firm-year observations of firms that remained as pure SOEs as of 2002 are in the control group. This leaves us with a sample of 1500 firms in which 154 are in the treatment group and the rest in the control group. As being indicated before, random effect model is used in the logit estimation.

[Table 4 about here]

The results of the estimation are reported in Table 4. Although significant estimates are scant, the model provides relatively good prediction rates. Prediction rates are emphasized by Heckman and Smith (1999) and HIST (1998) as a check for the quality of the specification to separate the treated and control groups. A common practice to assess correct predictions is to use the fraction of the treated subjects in the total number of observations as the cutoff value for the predicted probability. This cutoff value for our sample is 0.103. Using this value, we find that the prediction rates for the treatment and control groups are 76.2

percent and 74.7 percent, respectively. So it turns out that our propensity model is a good predictor of participation.

For the PSM to be valid to match the treatment and control groups, we need to make sure that our estimation satisfies the CIA and common support conditions. We use the balancing test proposed by Rosenbaum and Rubin (1983) to examine whether the propensity model has been adequately specified to balance the covariates included in the specification. There are several approaches to carry out such test, and the basic idea of them is to compare the situation before and after matching and check if there remain any differences after conditioning on propensity scores. If there are differences, it then suggests that either the model is mis-specified or there is a failure of the CIA (Smith and Todd, 2005). In our paper, we follow Sianesi(2004) to do the balance test by comparing the pseudo- R^2 's before and after matching. We find that before matching the pseudo- R^2 is 0.234 and after matching it is 0.025.¹⁰ That is, conditional on the propensity score, the variables included in the regression can not provide new information about the treatment decision.

The mean propensity score for the privatized firms is 0.418 (with a standard deviation of 0.360) while the mean score for pure SOEs is 0.086 (with a standard deviation of 0.158). Figure 3 plots the histograms of the estimated propensity scores for privatized firms and pure SOEs to check the common support condition. There are regions where the two histograms do not overlap. We thus exclude the privatized firms in the non-overlapped region in our matching exercise, and there are 17 such privatized firms.

[Figure 3 about here]

Table 5 presents the DID PSM estimates for the dynamic effects of privatization based on equation (5). These estimates are all statistically significant except the one for the year

¹⁰We re-estimate the propensity score on the matched sample, that is only on pure SOEs and matched privatized firms, and get the pseudo- R^2 after matching.

of privatization. However, their magnitudes are considerably smaller than either the total or the direct effects produced by the fixed-effect panel estimation. Nevertheless, they follow the same time pattern as the fixed-effect results, that is, the effect of privatization increases and peaks in the 4th year after privatization, but begins to decrease in the 5th year after privatization. In addition, the PSM effects are still very strong. By the 4th year after privatization, the fixed-based employment growth rate of privatized firms is higher than that of pure SOEs by 19.6 percentage points.

[Table 5 about here]

6 Robustness Test

There is a possibility that privatized firms laid off more workers than pure SOEs before they were privatized so they do not need to lay off workers after privatization. In other words, there is a moral hazard problem. Layoff is costly for firms as they need to make compensations to laid-off workers (Garnaut et al., 2005). If he anticipated that the firm would be soon privatized and he would be the new owner, the firm manager would lay off workers before privatization to save the compensations that he had to pay out of his own pocket after privatization. If such argument is true, this raises the problem that the effects of privatization are exaggerated by both our fixed-effect panel model and the PSM estimation. To handle this problem, we perform a robustness test by adding in equation (2) dummies of pre-privatization years for the privatized firms. If privatized firms laid off workers quicker than pure SOEs before privatization happened, the estimates for the pre-privatization dummies should be significantly negative. Notice that the sum of the pre- and post- privatization dummies equals exactly the firm dummy for privatized firms, so the fixed-effect estimation cannot be carried out. Instead, we estimate equation (2) by the OLS

technique.

[Figure 4 about here]

Both the total and direct effects of privatization are estimated. Instead of presenting the full set of results of the two regressions, though, we graph the estimates for the privatization dummies in Figure 4. The horizontal axis is the number of years relative to the privatization year, and the vertical axis is the estimated effect. Our data allow us to have 5 years each before and after privatization. The graph shows that both the total and the direct effects are always positive and increase along the horizontal axis. The estimates of the total effects are all statistically significant except for the 4th and 5th year before privatization. As for the direct effects, all but the estimates of the 2nd and 3rd years before privatization and the 4th and 5th years after privatization are significant. These results show that the moral hazard problem does not exist in privatized firms' decision of employment before privatization happens.

However, the results shown in Figure 4 may reflect a selection bias in privatization, that is, firms with a better prosperity of employment growth are privatized first. While our earlier fixed-effect and PSM estimations have reasonably controlled this problem, we further notice that there is an immediate jump of performance after privatization in Figure 4, which suggests that something more than selection biases is at work and that privatization has a real impact on employment.

7 Conclusion

In this paper, we have empirically examined the impact of privatization on firms' employment in China by employing a unique set of survey data. The fixed-effect panel model shows that privatization on average raises the fixed-base employment growth rate by 17.7 percentage

points. The contribution of privatization remains at 11.5 percentage points even when firm performance, employment conditions, and financial positions are controlled for. We further find that privatization has long-lasting effects on employment growth after privatization. We also use the DID PSM method to relax the assumption of linear functional form used in the fixed-effect model and reweigh the observations over the common support. Its results reinforce the fixed-effect results. Our robustness test refuses the moral hazard hypothesis that privatized firms lay off more workers than pure SOEs before privatization happens. So the effects that we have found are not outcomes of firms' strategic moves, but are the real impacts of privatization.

These results possess strong implications for the policy debate in China regarding the role of privatization in massive unemployment. Both old and privatized SOEs were losing employment in the late 1990s and early 2000s, but our results show that privatized SOEs maintained a significantly smaller reduction rate than pure SOEs. It is therefore wrong to accuse privatization of causing China's massive unemployment.

Then, what are the reasons for privatized firms' better performance? We believe that two factors are at work here. The first is that privatization improves firm profitability, financial stance, and employment conditions, so firms are able to retain more workers. This factor may be weakened by the fact that privatized firms get favorable treatments from the bank and the government so their financial conditions are improved automatically (Garnaut et al., 2005), but there is also evidence for true efficiency improvements (e.g., Garnaut et al., 2006). The second factor is related to the expectation of the management. The fact that he buys the firm shows that the new owner of the firm, no matter he is the old manager or an outside investor, has a faith in the firm's future. This optimism can lead to a higher employment rate. In addition, the new owner may introduce technological and managerial

changes to the firm, but the effects of these changes take time to show up and cannot be adequately accounted for by current firm attributes. Our estimate of the direct effect of privatization captures this kind of expectation-related effects.

One remaining question is how one explains the massive unemployment in China in the late 1990s and early 2000s. Although the exact causes need careful analysis to find out, here we provide two tentative explanations. First, it was a result of the structural adjustment in the SOE sector. This included closing down unviable firms (especially those in the resource industries) and cutting the overcapacities in certain industries (noticeably the textile industry). A case at point is Fushun, a sample city in this study. It was a mining city that ran out of coal in the mid-1990s. The adjustment was a painful process for the city and its unemployment rate reached 40 percent in 2001. However, the privatization rate in Fushun was among the lowest in the 11 sample cities (about 45 percent in 2001). Second, massive unemployment was also related to the *jianyuan zengxiao* policy adopted by the SOEs. In the 1990s, the rise of the private sector in China became a phenomenal event (Garnaut, Song, Yao, and Wang, 2001). In addition, banks began to strengthen their disciplines over SOEs (Cao, Qian, and Weingast, 1999). As a result, SOEs began to face both fierce competition from the private sector and a hardened budget constraint imposed by the bank, forcing them to improve their efficiency for the cause of survival. Shaking off redundant workers was thus a natural choice for SOEs.

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Table 1. Illustration of DID matching

Year of Effect	Treatment group		Control group	
	T0	T1	T0	T1
Year of priv.	Year before priv. (Y_{0i})	Year of priv. (Y_{01i})	Any year (Y_{00j})	T0 + 1 (Y_{01j})
1 st year after priv.	Year before priv. (Y_{0i})	1 st year after priv. (Y_{11i})	Any year (Y_{10j})	T0 + 2 (Y_{11j})
2 nd year after priv.	Year before priv. (Y_{0i})	2 nd year after priv. (Y_{21i})	Any year (Y_{20j})	T0 + 3 (Y_{21j})
...

Notes: T0 is the calendar year before treatment, and T1 is the calendar year after treatment. Y_{0i} is the employment growth rate of the i th firm of the treatment group in the year before it was privatized, Y_{k1i} is its employment growth rate in the k th year after privatization, and Y_{k0j} and Y_{k1j} are the employment growth rates of the j th firm of the control group before and after the treatment happens.

Table 2: Descriptive Statistics of Key Variables

Sample Variables	Whole Sample			SOE			Privatized Firms		
	Obs.	Mean	Standard Deviation	Obs.	Mean	Standard Deviation	Obs.	Mean	Standard Deviation
Dependent Variable									
Number of on-duty workers	2691	633.96	943.30	1619	551.50	729.86	1072	758.50	1185.07
Firm's Performance									
Profitability (%)	2702	-1.16	11.84	1624	-2.64	12.00	1078	1.06	11.24
Labor Productivity	2702	55.7	82.2	1624	5.00	8.51	1078	6.42	7.68
Unit Cost (%)	2695	62.75	18.43	1624	64.40	18.55	1071	60.24	17.96
Investment Rate (%)	2695	13.86	37.90	1624	14.85	34.61	1071	12.36	42.37
Outside State Share (%)	2596	5.45	20.50	1614	3.51	18.18	982	8.64	23.51
Employment Conditions									
Average Wage	2689	24.2	228.5	1617	2.36	25.43	1072	2.52	18.30
Redundancy Rate (%)	2622	204	809	1583	259	903	1039	119	632
Capital per Worker	2650	235.7	600.6	1597	28.15	68.14	1053	16.63	44.26
Financial Conditions									
Debt/Assets Ratio (%)	2320	69.90	68.44	1393	80.74	73.64	927	53.62	56.01
New Bank Dues/Assets (%)	2607	4.39	81.81	1589	6.02	73.14	1018	1.84	93.73
New Tax Dues/Assets (%)	2702	1.17	76.59	1624	0.63	23.42	1078	1.99	117.83

Note: Monetary units are 1,000 Yuan, in 2001 prices

Table 3: Fixed-effect Panel Estimation

	Average Effect		Dynamic Effect	
	(1)	(2)	(3)	(4)
Privatization dummy	17.654*** (6.53)	11.492*** (4.14)		
Privatization year			14.188*** (4.52)	9.073*** (3.00)
First year after privatization			21.241*** (5.88)	14.853*** (3.67)
Second year after privatization			24.442*** (5.55)	22.682*** (4.79)
Third year after privatization			26.973*** (5.12)	25.480*** (4.50)
Fourth year after privatization			27.288*** (4.22)	26.874*** (3.90)
Fifth year after privatization			23.454*** (2.92)	19.958** (2.40)
Firm's performance				
Profitability (%)		0.169* (1.88)		0.152* (1.69)
Labor Productivity		-0.301* (1.65)		-0.268 (1.47)
Unit Cost (%)		0.063 (0.86)		0.060 (0.81)
Investment Rate (%)		0.112 (1.56)		0.114 (1.59)
Outside State Share (%)		0.145* (1.90)		0.083 (1.06)
Employment Conditions				
Average Wage		-0.130* (1.72)		-0.121 (1.61)
Redundancy Rate (%)		-0.156 (0.87)		-0.159 (0.89)
Capital per Worker		-0.110*** (5.19)		-0.106*** (5.00)

Table 3: Fixed-effect Panel Estimation (Continued)

Financial Conditions				
Debt/Assets Ratio (%)		-0.027*		-0.028*
		(1.75)		(1.80)
New Bank Dues/Assets (%)		-0.659		-0.689
		(0.71)		(0.74)
New Tax Dues/Assets (%)		1.109		1.170
		(1.04)		(1.10)
Constant	-0.912	0.169*	0.090	-0.956
	(0.56)	(1.88)	(0.05)	(0.18)
Observations	2691	2156	2691	2156
Number of Firms	386	377	386	377
R-squared	0.09	0.15	0.10	0.16

Note: The dependent variable is the fixed base growth rate of employment. Column 1 and Column 2 presents the results for the total and direct average effects of privatization, respectively. And in columns 3 and 4, we report the estimated results for the total and direct dynamic effects of privatization, respectively. Absolute values of t-statistics are in parentheses. Results for year dummy variables are not shown.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Logit Estimation of the Propensity Score

Variables	Coefficient	z ratio
Firm's performance		
Profitability (%)	0.013	0.76
Labor Productivity	0.023	0.89
Unit Cost (%)	-0.020*	1.81
Investment Rate (%)	-0.008	1.20
Outside State Share (%)	0.016	1.54
Employment Conditions		
Original Number of On-duty Workers	0.0002	0.79
Average Wage	0.055	1.30
Redundancy Rate (%)	-0.096	1.17
Capital per Worker	-0.012	1.34
(Capital per Worker) ²	0.000	1.54
Financial Conditions		
Debt/Assets Ratio (%)	0.004	0.58
(Debt/Assets Ratio) ²	-0.000013	0.96
New Bank Dues/Assets (%)	-0.182	0.33
(New Bank Dues/Assets) ²	-0.107	0.55
New Tax Dues/Assets (%)	0.762	1.62
Constant	-4.341***	2.87
Observations	1500	
Number of eid	370	
Log likelihood	-271.7	

Note: As for estimation of propensity score, we only include in the treatment group the firm-year observations of privatized firms in the year when they were privatized. And all the firm-year observations of firms that remained as pure SOEs until 2001 are in the control group.

All independent variables are 1 year lagged. Results for industrial, city and year dummy variables are not shown.

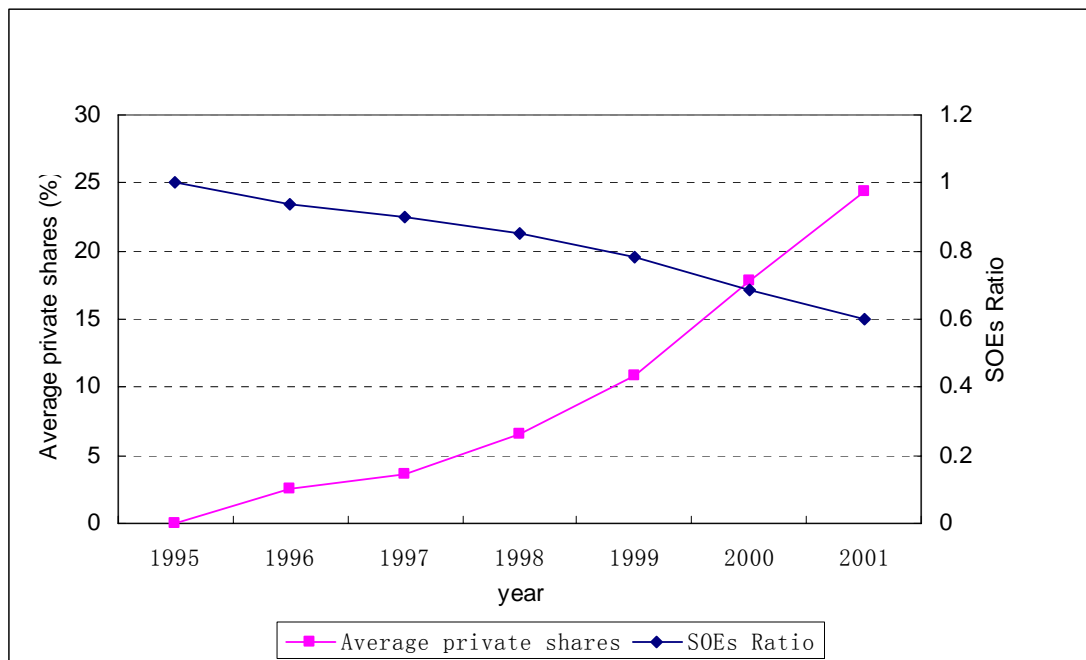
* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: DID PSM estimation

	# of privatized firms	# of pure SOEs	ATT	Std. err	t value
Privatization year	124	1,352	1.431	1.783	0.803
First year after privatization	93	1,128	7.888	3.793	2.080
Second year after privatization	70	902	10.212	6.168	1.656
Third year after privatization	52	675	15.742	8.673	1.815
Fourth year after privatization	35	448	19.628	10.746	1.826
Fifth year after privatization	22	221	18.471	10.211	1.809

Note: Observations of the treatment group (privatized firms) and of the control group (pure SOEs) are matched in the method as stated in Table 1.

Figure 1: Average Private Shares and SOEs Ratio during the Period of 1995-2001.



Note: The left vertical axis represents the average private shares of the new sample and the right vertical axis represents SOEs ratio of the new sample.

Figure 2: Dynamics of On-duty Workers and Total Workers.

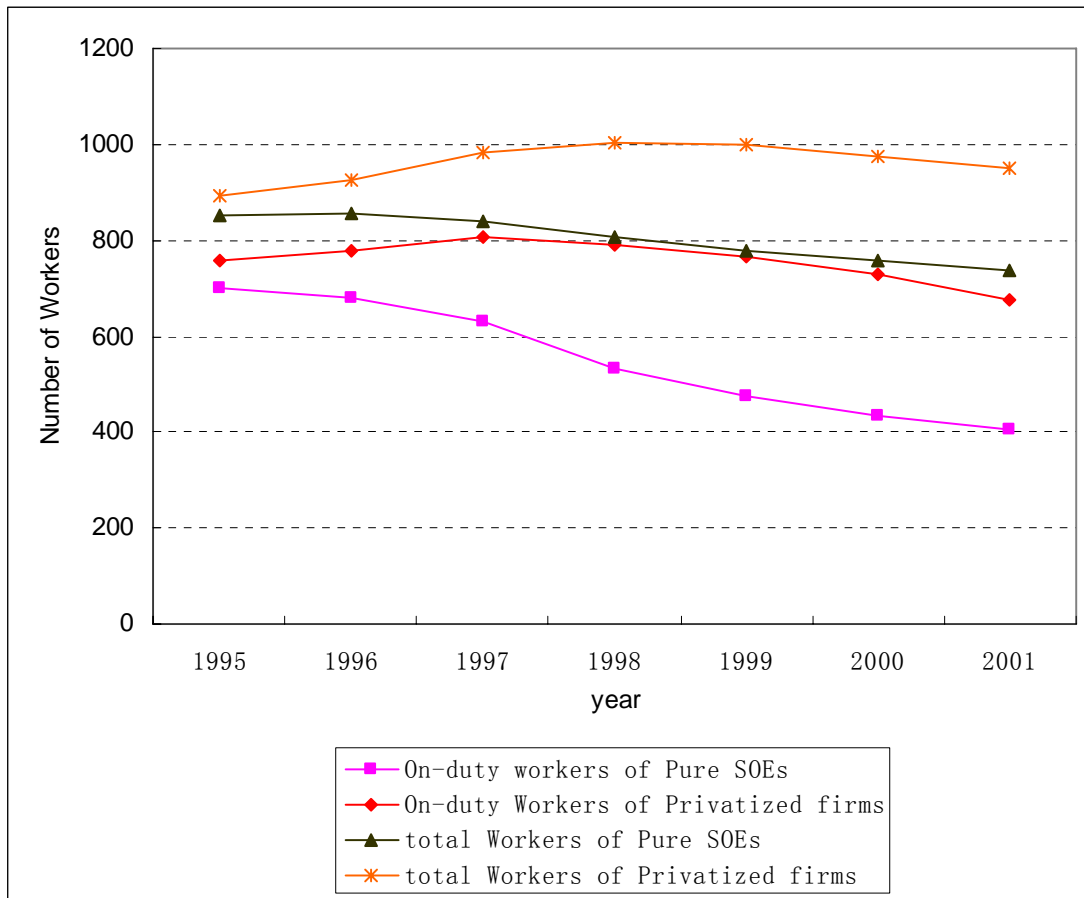


Figure 3: Histograms of Propensity Scores.

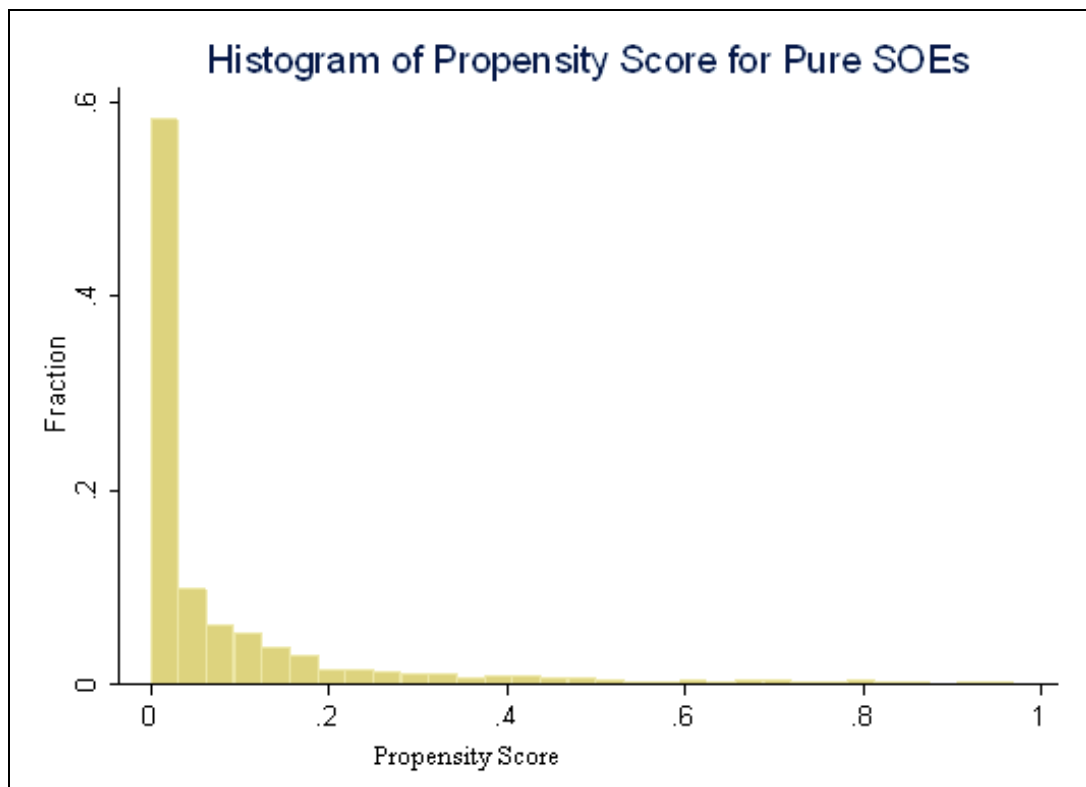
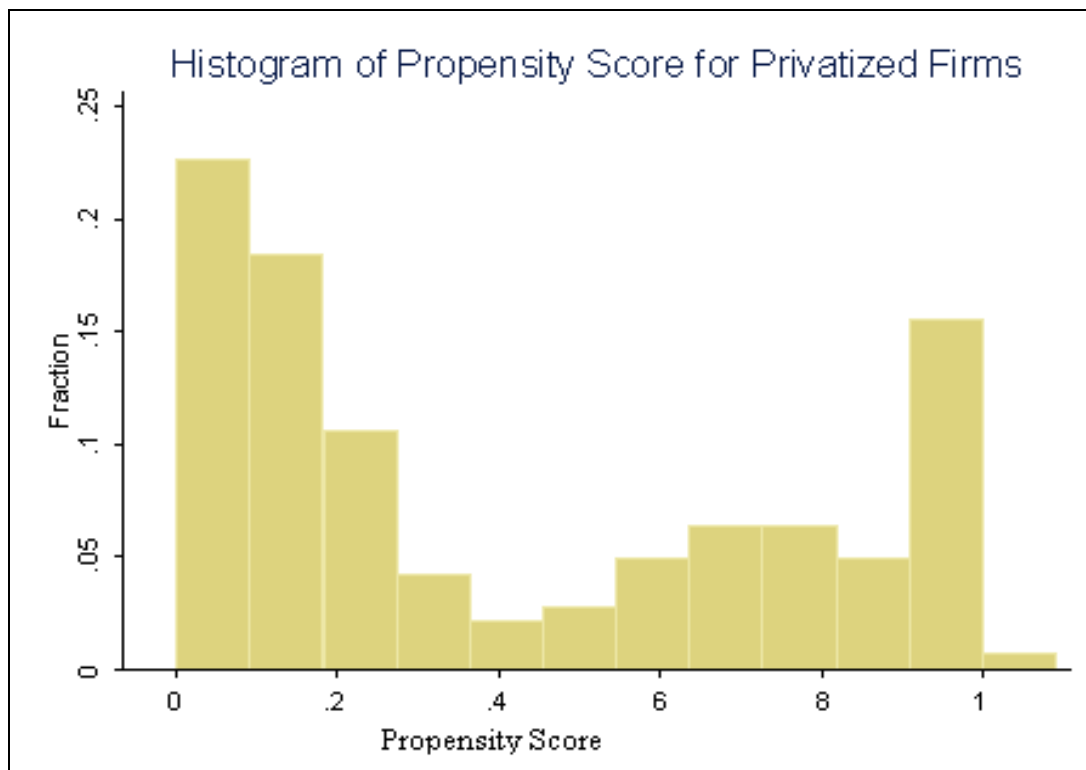


Figure 4: Coefficients of Pre- and Post- privatization Dummies in the Robust Test

