Local Economic Growth and the Legacy of SOEs in China

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Abstract

We study the effect of a large SOE (State-Owned Enterprises) sector on economic growth. In particular, we document that localities (prefectures) in China that have a large SOE sector in 1995 experience a smaller economic growth than those with a small SOE sector in 1995. Then we analyze the mechanisms through which the size of the SOE sector affects subsequent economic growth. The data reveals two patterns that are suggestive of the mechanisms through which the size of the SOE sector affects economic growth: (i) the effect on firm entry, and (ii) the relative share of high and low capital-intensive industries in the SOE sector.

JEL Classification: .

Keywords: .

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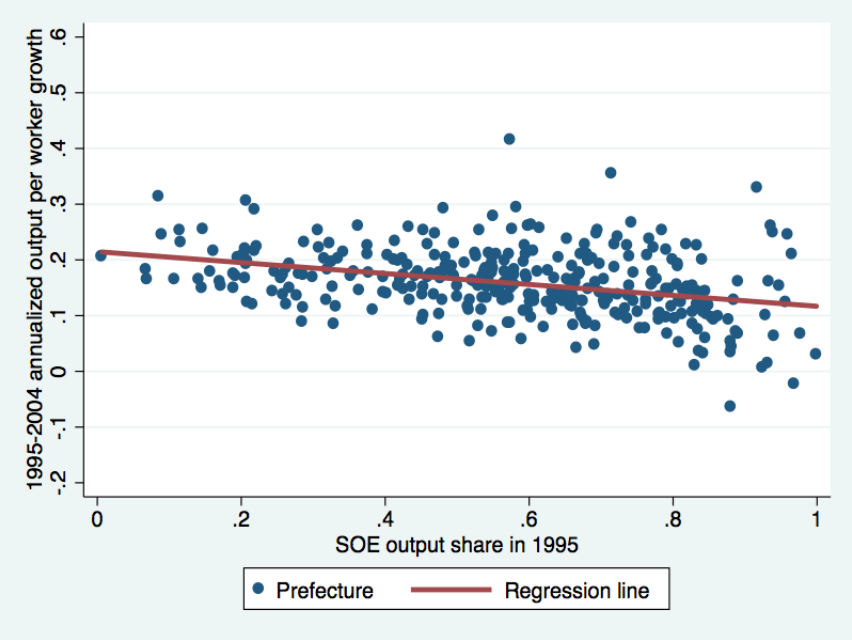
1 Understanding changes in output per worker: 1995-2008

We study the effect of a large SOE (State-Owned Enterprises) sector on economic growth.[1] In particular, we document that localities (prefectures) in China that have a large SOE sector in 1995 experience a smaller economic growth than those with a small SOE sector in 1995. The aim of the paper is to analyze the mechanisms through which the size of the SOE sector affects subsequent economic growth.

1.1 A preliminary look at the data

Figure 1: The SOE Output Share in 1995 and Annualized Output per Worker Growth, 1995-2004, Chinese Manufacturing Census, 1995, 2004, and 2008: by Prefecture.



Notes: Each point represents a Chinese prefecture. The scatter plot describes the relationship between the share of SOEs in prefecture output in 1995 and the annualized growth rate in prefecture output per worker in 1995-2004. The regression line is not weighted.

We start with a preliminary look at the data and argue that the evidence overwhelmingly supports the hypothesis that a high SOE share is detrimental to growth in output per worker (labor productivity) and output between 1995 and 2004 while in the period 2004-2008 this is less obvious.

Chinese Manufacturing Census (1995, 2004, and 2008). We begin our analysis by using data from the Chinese Manufacturing Census (1995, 2004, and 2008) for approximately 350 prefectures.

[1] Brandt et al. (2013), Brandt et al. (2012), Song et al. (2011).

Table 1: The effect of prefecture SOE share: Manufacturing Census Data.

A. ANNUAL GROWTH RATE IN OUTPUT PER WORKER

	Manufacturing Census							
	1995-2004		1995-2008		2004-2008		2004-2008	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SOE_{1995}	-0.098	-0.075	-0.039	-0.023	0.108	0.089		
	(-6.76)	(-5.85)	(-3.49)	(-2.23)	(4.74)	(3.92)		
SOE_{2004}							0.061	0.041
							(2.13)	(1.46)
$\ln\left(\frac{Y_p}{N_p}\right)_{1995}$		-0.066		-0.048				
		(-10.2)		(-9.38)				
$\ln\left(\frac{Y_p}{N_p}\right)_{2004}$						-0.041		-0.046
						(3.74)		(-4.15)
N of obs.	334	334	334	334	334	334	337	337
Adj R^2	0.118	0.325	0.032	0.233	0.061	0.096	0.010	0.056

B. ANNUAL GROWTH RATE IN OUTPUT

	Manufacturing Census							
	1995-2004		1995-2008		2004-2008		2004-2008	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SOE_{1995}	-0.090	-0.180	-0.020	-0.093	0.163	0.107		
	(-3.20)	(-6.63)	(-0.92)	(-4.42)	(5.63)	(3.33)		
SOE_{2004}							0.090	0.035
							(2.45)	(0.93)
$\ln Y_{p,1995}$		-0.032		-0.026				
		(-9.00)		(-9.39)				
$\ln Y_{p,2004}$						-0.016		-0.021
						(-3.66)		(-5.14)
N of obs.	334	334	334	334	334	334	337	337
Adj R^2	0.027	0.216	0.025	0.208	0.084	0.117	0.015	0.084

Notes: t-statistics are in parentheses. SOE_j is the SOE share in prefecture output in year j. $\left(\frac{Y_p}{N_p}\right)_j$ is prefecture output per worker in year j while $Y_{p,j}$ is prefecture output in year j.

We study the effects of the SOE output share in a prefecture on the subsequent economic growth in that prefecture. Figure 1 plots the relationship between the share of SOEs in output in a prefecture in 1995 and the subsequent (annualized) growth in output per worker in that prefecture between 1995 and 2004. The data reveals a negative relationship implying that those prefectures which had a high share of their output produced by SOEs in 1995 experienced a small output per worker growth between 1995 and 2004. Furthermore, the effect is significant: a large SOE sector can decrease output growth by as much as 10 percentage points each year. Therefore, the large presence of SOEs in a prefecture seems to be having a negative stifling effect on the growth rate of prefecture output. Nevertheless, the data also show that, conditional on the SOE share in 1995, there is significant variation in prefecture 1995-2004 output growth rates, implying that other factors have also contributed to the large dispersion in growth rates over the period.

Table 1 summarizes the relationship between the SOE output share in a prefecture and the subsequent economic growth in that prefecture. The top panel in the table, Panel A, refers to the annual growth rate in output per worker while the bottom panel, Panel B, refers to the annual growth rate in a prefecture. Column (1) in Panel A corresponds to the results in Figure 1. Column (2) shows that the result is robust to controlling for the initial level of output per worker in the prefecture. On the other hand, columns (5)-(8) which summarize the 2004-2008 time period show that after 2004, the SOE sector no longer has a detrimental effect on the output per worker growth in a prefecture. The results on annual output growth in Panel B follow a similar pattern.

Table 2: The effect of prefecture SOE share: GDP data and Lights-at-Night data.

A. DEPENDENT VARIABLE: ANNUAL GROWTH RATE IN GDP PER CAPITA

	GDP Data								Lights-at-Night Data							
	1990-2000		1990-2005		1990-2010		2000-2010		1990-2000		1990-2005		1990-2010		2000-2010	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
SOE_{1992}	-0.052	-0.059	-0.034	-0.042	-0.023	-0.031				-0.054		-0.028		-0.021		
	(-4.7)	(-5.1)	(-3.7)	(-4.4)	(-3.4)	(-4.6)				(-3.9)		(-2.9)		(-2.6)		
SOE_{1995}							0.042	0.025								0.000
							(3.9)	(2.2)								(0.0)
$\ln\left(\frac{Y_p}{N_p}\right)_{1990}$		-0.014		-0.017		-0.017				-0.033		-0.024		-0.020		
		(-1.9)		(-2.8)		(-3.9)				(-11)		(-11)		(-12)		
$\ln\left(\frac{Y_p}{N_p}\right)_{2000}$								-0.017								-0.015
								(-3.2)								(-5.6)
N of obs.	260	260	261	261	273	273	257	257		277		277		277		276
Adj R^2	0.323	0.302	0.245	0.265	0.200	0.187	0.103	0.134		0.590		0.583		0.625		0.211

B. DEPENDENT VARIABLE: ANNUAL GROWTH RATE IN GDP

	GDP Data								Lights-at-Night Data							
	1990-2000		1990-2005		1990-2010		2000-2010		1990-2000		1990-2005		1990-2010		2000-2010	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
SOE_{1992}	-0.062	-0.058	-0.044	-0.045	-0.032	-0.037				-0.059		-0.036		-0.027		
	(-5.3)	(-4.5)	(-4.7)	(-4.4)	(-4.6)	(-4.7)				(-4.2)		(-3.8)		(-3.5)		
SOE_{1995}							0.027	0.019								-0.006
							(2.5)	(1.5)								(-0.6)
$\ln Y_{p,1990}$		0.002		-0.001		-0.002				-0.031		-0.026		-0.018		
		(0.6)		(-0.3)		(-1.3)				(-10)		(-13)		(-11)		
$\ln Y_{p,2000}$								-0.005								-0.012
								(-1.6)								(-4.3)
N of obs.	260	260	261	261	273	273	257	257		277		277		277		276
Adj R^2	0.369	0.368	0.337	0.334	0.317	0.320	0.071	0.076		0.519		0.581		0.501		0.100

Notes: t-statistics are in parentheses. SOE_j is the SOE share in prefecture GDP in year j. $\left(\frac{Y_p}{N_p}\right)_j$ is prefecture GDP per capita in year j while $Y_{p,j}$ is prefecture GDP in year j.

Additional Dataset. We also find that the state sector has a robust negative effect on GDP growth using the 1990-2010 Prefecture Data (PD) and the Lights-at-Night Data from Baum-Snow et al. (2012). The results, presented in Table 2, consistently show the negative effect of SOEs on the prefecture growth in output per worker and output during the 1990-2000 period. The effect is statistically significant and the magnitude is economically significant as well. Similar to the pattern observed on the Manufacturing Census data, the negative effect of SOEs is observed only in the 1990s and the pattern reverses in the 2000-2010 period.

1.2 Understanding changes in output per worker

In order to get a better understanding of the effect of SOEs on the economic development of prefectures and be able to differentiate among alternative theories, we use the Manufacturing Census data in 1995, 2004, and 2008 to study the changes in output per worker at prefecture levels in greater detail.

The average labor productivity (output per worker) in prefecture p can be decomposed into (1) a cross-sectional (unweighted) mean labor productivity of firms in that prefecture and (2) the covariance between firms' output per worker and their relative employment size:

$$\frac{Y_{pt}}{N_{pt}} = \frac{E\left(y_{fpt}\right)}{E\left(n_{fpt}\right)} = E\left(\frac{y_{fpt}}{n_{fpt}}\right) + cov\left(\frac{y_{fpt}}{n_{fpt}}, \frac{n_{fpt}}{E\left(n_{fpt}\right)}\right). \tag{1}$$

Then, the *change* in a prefecture's average labor productivity can be written as

$$\Delta\frac{Y_{pt}}{N_{pt}} = \Delta\left[E\left(\frac{y_{fpt}}{n_{fpt}}\right)\right] + \Delta cov\left(\frac{y_{fpt}}{n_{fpt}}, \frac{n_{fpt}}{E\left(n_{fpt}\right)}\right). \tag{2}$$

The aggregate labor productivity change can be decomposed as follows:

$$\Delta\frac{Y_t}{N_t} = \underbrace{\sum_p \frac{Y_{p,t+1}}{N_{p,t+1}} \cdot \Delta\frac{N_{pt}}{N_t}}_{\text{(1) Across-prefecture reallocation}} + \underbrace{\sum_p \frac{N_{pt}}{N_t}\Delta\left[E\left(\frac{y_{fpt}}{n_{fpt}}\right)\right]}_{\text{(2) Mean firm labor productivity}} + \underbrace{\sum_p \frac{N_{pt}}{N_t} \cdot \Delta cov\left(\frac{y_{fpt}}{n_{fpt}}, \frac{n_{fpt}}{E\left(n_{fpt}\right)}\right)}_{\text{(3) Across-firm sorting}}. \tag{3}$$

These three terms have straightforward interpretations.

- **Across-prefecture reallocation.** The first term captures the aggregate productivity growth due to migration across prefectures from period t to $t+1$.
- **Mean firm labor productivity.** The second term captures the shift in the within-prefecture firm distribution (i.e., the increase in the unweighted average productivity of firms in the prefecture), weighed by the period t relative employment share of the prefecture.
- **Across-firm sorting.** The last term captures the productivity growth due to reallocation of workers across firms within prefectures, weighed by the period t relative employment share of the prefecture.

1.2.1 Multiplicative measurement error

The decomposition is sensitive to measurement error in employment. To illustrate this, and to correct the bias introduced by measurement error, we consider a special model of measurement error, where measurement error in employment is a combination of a classical measurement error and a permanent bias, both proportional to employment (and thus additive in logs).

Suppose firm-specific employment is measured with proportional classical measurement error, i.e., that we observe

$$\hat{n}_{ft} = n_{ft} \exp(\varepsilon_{ft}) \tag{4}$$

where $\hat{n}_{ft}$ is observed employment in firm f in period t, n_{ft} is true employment, and ε_{ft} is an i.i.d. measurement error. For simplicity, assume that ε is normally distributed with mean μ and variance ν, i.e., $\varepsilon \sim N\left(\mu - \frac{\nu}{2}, \nu\right)$. Thus, $E(\exp(\varepsilon)) = \exp(\mu)$ and $E(\hat{n}_{tf}) = \exp(\mu) E(n_{tf})$.

The cross-sectional mean productivity, $E\left(\frac{y_{ft}}{\hat{n}_{ft}}\right)$, will be biased upward, i.e., $E\left(\frac{y_{ft}}{\hat{n}_{ft}}\right) > E\left(\frac{y_{ft}}{n_{ft}}\right)$. Moreover, the covariance term, $cov\left(\frac{y_{ft}}{\hat{n}_{ft}}, \frac{\hat{n}_{ft}}{E(\hat{n}_{ft})}\right)$, would be biased downward.

To see this, note that since ε is independent of y_{ft}/n_{ft}, it follows that

$$\begin{aligned} E\left(\frac{y_{ft}}{\hat{n}_{ft}}\right) &= E\left(\frac{1}{\exp(\varepsilon_{ft})}\frac{y_{ft}}{n_{ft}}\right) = E\exp(-\varepsilon_{ft}) \cdot E\left(\frac{y_{ft}}{n_{ft}}\right) \\ &= \exp(\nu - \mu) \cdot E\left(\frac{y_{ft}}{n_{ft}}\right), \end{aligned} \tag{5}$$

and

$$\begin{aligned} cov\left(\frac{y_{ft}}{\hat{n}_{ft}}, \frac{\hat{n}_{ft}}{E(\hat{n}_{ft})}\right) &= \frac{E(y_{ft})}{E(\hat{n}_{ft})} - \exp(\nu - \mu) \cdot E\left(\frac{y_{ft}}{n_{ft}}\right) \\ &= \frac{1}{\exp(\mu)}\frac{E(y_{ft})}{E(n_{ft})} - \frac{1}{\exp(\mu)}E\left(\frac{y_{ft}}{n_{ft}}\right) + \left(\frac{1}{\exp(\mu)} - \exp(\nu - \mu)\right) \cdot E\left(\frac{y_{ft}}{n_{ft}}\right) \\ &= \frac{1}{\exp(\mu)} cov\left(\frac{y_{ft}}{n_{ft}}, \frac{n_{ft}}{E(n_{ft})}\right) - \frac{1}{\exp(\mu)}(\exp(\nu) - 1) \cdot E\left(\frac{y_{ft}}{n_{ft}}\right) \\ &= \frac{1}{\exp(\mu)}\left[cov\left(\frac{y_{ft}}{n_{ft}}, \frac{n_{ft}}{E(n_{ft})}\right) - (1 - \exp(-\nu)) \cdot E\left(\frac{y_{ft}}{\hat{n}_{ft}}\right)\right]. \end{aligned} \tag{6}$$

1.2.2 Correcting the bias

Suppose we have two different measures of employment (this is the case for 1995). Moreover, assume that these measures are subject to classical measurement error of the type in equation (4) and that the errors of the two measures are independent with variance ν_A and ν_B, respectively (the assumption of independence might be questioned − perhaps the errors are positively correlated). In this case the measurement error of the two measures (A and B) can be estimated as

$$\begin{aligned} \nu_A &= var\left(\log(\hat{n}^A_{ft})\right) - cov\left(\log(\hat{n}^A_{ft}), \log(\hat{n}^B_{ft})\right) \\ &= var(\log n_{ft}) + var\left(\varepsilon^A_{ft}\right) - var(\log n_{ft}) \\ &= var\left(\varepsilon^A_{ft}\right), \end{aligned} \tag{7}$$

and vice versa for ν_B. Note that this measurement error can be estimated conditional on prefecture, ownership structure (SOE versus non-SOE), and industry (e.g., capital- versus labor intensive).

We can then estimate the difference in mean measurement error, $\mu_A - \mu_B$, as[2]

$$E\left[\log(\hat{n}_{ft}^A) - \log(\hat{n}_{ft}^B)\right] = E\left(\varepsilon_{iA} - \varepsilon_{iB}\right) = \mu_A - \mu_B - \frac{\nu_A}{2} + \frac{\nu_B}{2}. \tag{8}$$

Given the estimate of ν, we can immediately correct the bias introduced by measurement error using equations (5) and (6)

$$E\left(\frac{y_{ft}}{n_{ft}}\right) = \exp\left(-v + \mu\right) E\left(\frac{y_{ft}}{\hat{n}_{ft}}\right) \tag{9}$$

$$cov\left(\frac{y_{ft}}{n_{ft}}, \frac{n_{ft}}{E\left(n_{ft}\right)}\right) = \exp\left(\mu\right) cov\left(\frac{y_{ft}}{\hat{n}_{ft}}, \frac{\hat{n}_{ft}}{E\left(\hat{n}_{ft}\right)}\right) + \left(1 - \exp\left(-\nu\right)\right) \cdot E\left(\frac{y_{ft}}{\hat{n}_{ft}}\right) \tag{10}$$

1.2.3 Findings

In 1995, we have access to two different employment series at the firm level which allows us to estimate the measurement error in employment in 1995. The first one, $\hat{n}_{ft}^A$, covers most of the firms in the data set while the second one, $\hat{n}_{ft}^B$, covers only a subset of the firms. As mentioned above, the procedure allows us to estimate the measurement error for numerous cells in the data. At this point, our cell is a prefecture and we assume that measurement error does not differ within prefectures.[3] We use the following estimation strategy:

- Use equation (7) to estimate the variance in the measurement error for the two employment series, ν_A and ν_B.
- Use equation (8) to estimate the difference in mean measurement error, $\mu_A - \mu_B$. Since the employment series $\hat{n}_{ft}^A$ covers a much larger part of the existing firms, we impose the normalization that $\mu_A = 0$, and thus estimate μ_B.
- Use equations (9) and (10) to compute the corrected (i) cross-sectional (unweighted) mean labor productivity of firms in a prefecture and (ii) the covariance between firms' output per worker and their relative employment size.
- Use equation (3) to decompose the change in aggregate labor productivity.

For the years 2004 and 2008, we use the available employment series.

[2] Alternatively, the difference in the mean measurement error can be estimated using:

$$E\left[(\hat{n}_{ft}^A)/(\hat{n}_{ft}^B)\right] = E\exp\left(\varepsilon_{iA} - \varepsilon_{iB}\right) = \exp\left(\mu_A - \mu_B + \nu_B\right).$$

[3] We have also estimated the measurement error for prefecture/sector (SOE and non-SOE) cells and the subsequent results do not change in any significant way.

Table 3: Decomposition of the change in aggregate output per worker: $\Delta \frac{Y_t}{N_t}$.

Interpretation	Decomposition Term	1995-2004	2004-2008
1. Across-prefecture reallocation	$\sum_p \frac{Y_{p,t+1}}{N_{p,t+1}} \cdot \Delta \frac{N_{pt}}{N_t}$	-0.07	-0.06
2. Mean firm labor productivity	$\sum_p \frac{N_{pt}}{N_t} \Delta \left[E\left(\frac{y_{fpt}}{n_{fpt}} \right) \right]$	0.61	0.53
3. Across-firm sorting	$\sum_p \frac{N_{pt}}{N_t} \cdot \Delta cov \left(\frac{y_{fpt}}{n_{fpt}}, \frac{n_{fpt}}{E\left(n_{fpt}\right)} \right)$	0.45	0.53

Figure 2: Change in prefecture employment share: $\Delta \frac{N_{pt}}{N_t}$.

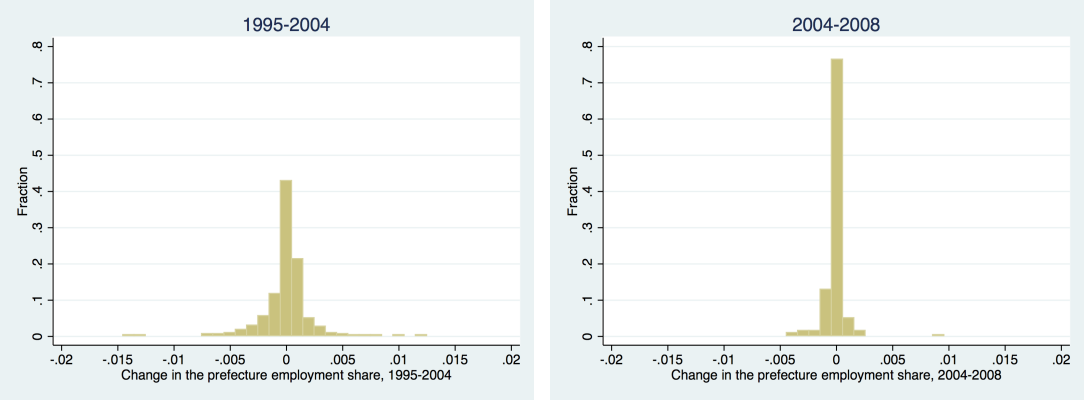


Table 3 shows the factors contributing to the increase in aggregate labor productivity (output per worker) during the 1995-2004 and 2004-2008 periods. In terms of the 1995-2004 period, the reallocation of workers across prefectures did not contribute to the increase in aggregate labor productivity. In facts, the contribution is negative, implying that the relative size of prefectures with low output per worker slightly increased over the period. The most important factor contributing to the increase in aggregate labor productivity is the increase in mean firm productivity in prefectures; i.e., on average (not weighed by the firms' employment), firms in prefectures exhibited higher output per worker levels. 61% of the improved aggregate labor productivity is due to this channel. However, we also observe a much improved sorting of workers across firms in a prefecture – 41% of the increase in aggregate labor productivity is due to the fact that more and more workers are allocated towards the firms in a prefecture with a higher output per worker levels.

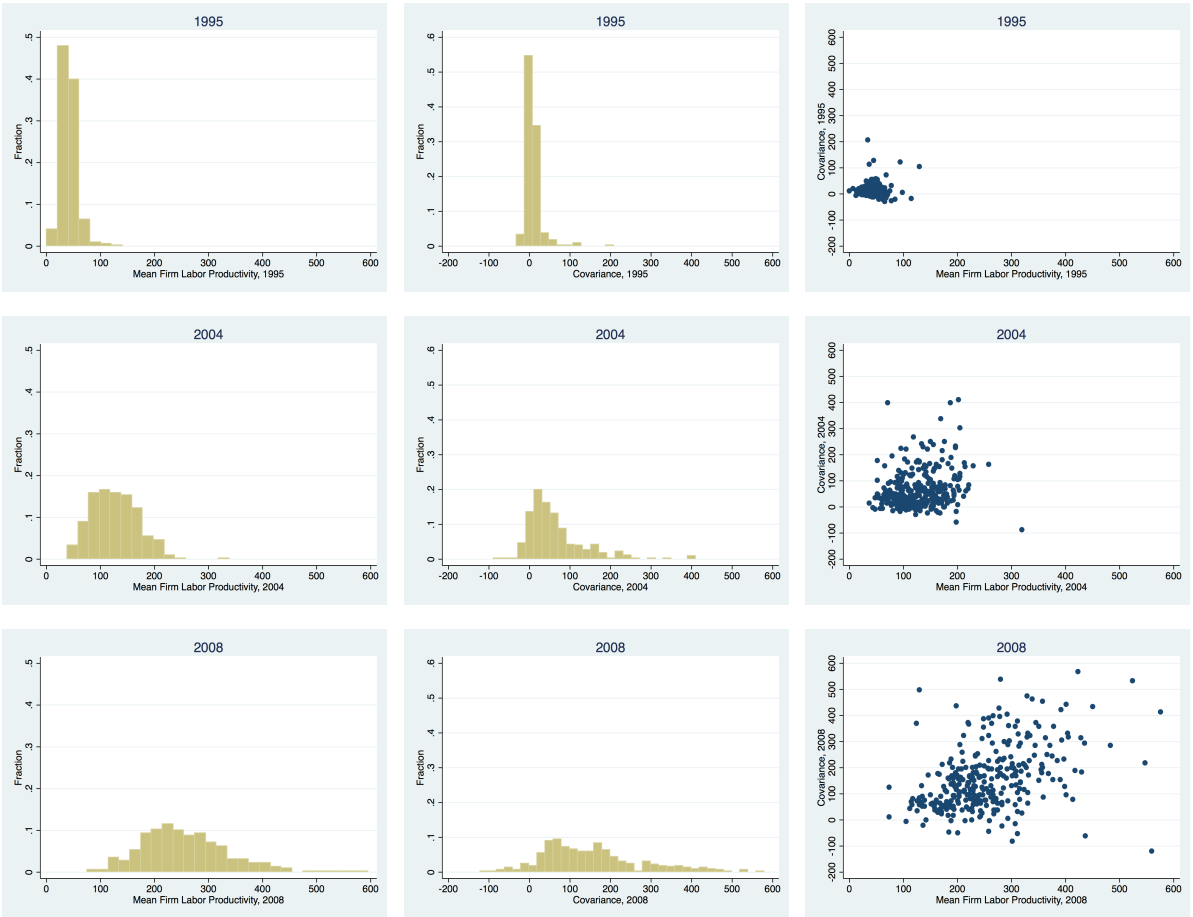
The relative importance of the three contributing factors in the change of aggregate labor productivity during the 2004-2008 period is similar. The average firm output per worker in a

prefecture and the sorting of workers across firms in a prefecture are equally important for the increase in aggregate labor productivity while the reallocation of workers across prefectures is not a contributing factor.

Figures 2-4 provide more detail regarding these results by plotting the histograms across prefectures of the distributions of mean firm labor productivity and the covariance for the years 1995, 2004, and 2008, as well as the changes in these distributions.

Figure 2 shows that the relative employment shares of prefectures did not change much during the 1995-2004 and 2004-2008 periods. As a result, it is not surprising that the reallocation of workers across prefectures did not contribute much to the increase in aggregate labor productivity in the economy.

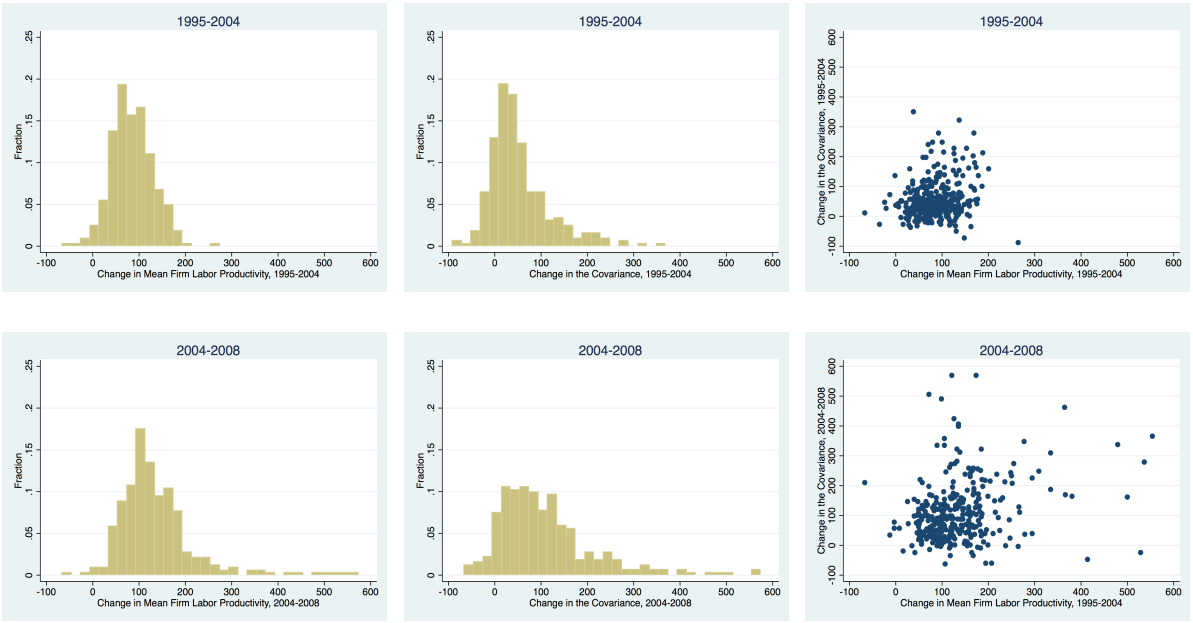
Figure 3: Mean firm labor productivity and covariance in 1995, 2004, and 2008: by prefecture.



Notes: .

Table 3 provides a snapshot of the mean firm labor productivity and the covariance in 1995, 2004, and 2008. The first column of figures shows the distribution of mean firm labor productive across all prefectures in the economy. As we have already discussed above, it is clear that the mean

Figure 4: Change in mean firm labor productivity and covariance, 1995-2004 and 2004-2008: by prefecture.



Notes: .

firm labor productivity has increased dramatically over this period. The second column of figures shows the distribution of the covariance across all prefectures. In 1995, workers were badly sorted across − a substantial fraction of all prefectures show a covariance close to zero implying that the allocation of workers across firms in those prefectures was unrelated to the output per worker levels in the firms. The sorting has visibly improved ager that, and in 2004 and 2008 in many prefectures more workers tend to work in the more productive firms. Table 4 summarizes these changes in the mean firm labor productivity and the covariance.

1.3 Understanding changes in output per worker: the effect of SOEs

In the previous section we establish that the improvement in the aggregate labor productivity in the economy was due to two channels: (i) firms in prefectures were becoming more productive (in terms of labor productivity) and (ii) the relative employment share of the more productive firms was increasing. In this section, we investigate whether these two patterns are related to the output share of SOEs in a prefecture.

To begin with, we provide a new decomposition of the change in aggregate labor productivity in the 1995-2004 and 2004-2008 time periods, which incorporates the SOE and non-SOE sectors in the various prefectures. Equation (11) presents this decomposition.

$$\Delta\frac{Y_t}{N_t} = \underbrace{\sum_p \frac{Y_{p,t+1}}{N_{p,t+1}}\cdot\Delta\frac{N_{pt}}{N_t}}_{\text{(1) Across-prefecture reallocation}} + \underbrace{\sum_p\sum_i \frac{N_{pt}}{N_t}\frac{Y_{i,p,t+1}}{N_{i,p,t+1}}\Delta\frac{N_{i,pt}}{N_{pt}}}_{\text{(2) Across-ownership reallocation (within pref.)}}$$

$$+\underbrace{\left(\sum_p \frac{N_{ipt}}{N_t}\Delta\left[E\left(\frac{y_{fipt}}{n_{fipt}}\right)\right]\right)_{i=\text{Non-SOE}}}_{\text{(3) Mean firm labor productivity, Non-SOE}} + \underbrace{\left(\sum_p \frac{N_{ipt}}{N_t}\Delta\left[E\left(\frac{y_{fipt}}{n_{fipt}}\right)\right]\right)_{i=\text{SOE}}}_{\text{(4) Mean firm labor productivity, SOE}}$$

$$+\underbrace{\left(\sum_p \frac{N_{ipt}}{N_t}\Delta cov\left(\frac{y_{fipt}}{n_{fipt}}, \frac{n_{fipt}}{E\left(n_{fpt}\right)}\right)\right)_{i=\text{Non-SOE}}}_{\text{(5) Across-firm sorting, Non-SOE}} + \underbrace{\left(\sum_p \frac{N_{ipt}}{N_t}\Delta cov\left(\frac{y_{fipt}}{n_{fipt}}, \frac{n_{fipt}}{E\left(n_{fpt}\right)}\right)\right)_{i=\text{SOE}}}_{\text{(6) Across-firm sorting, SOE}} \quad (11)$$

The decomposition consists of six terms which have straightforward interpretations.

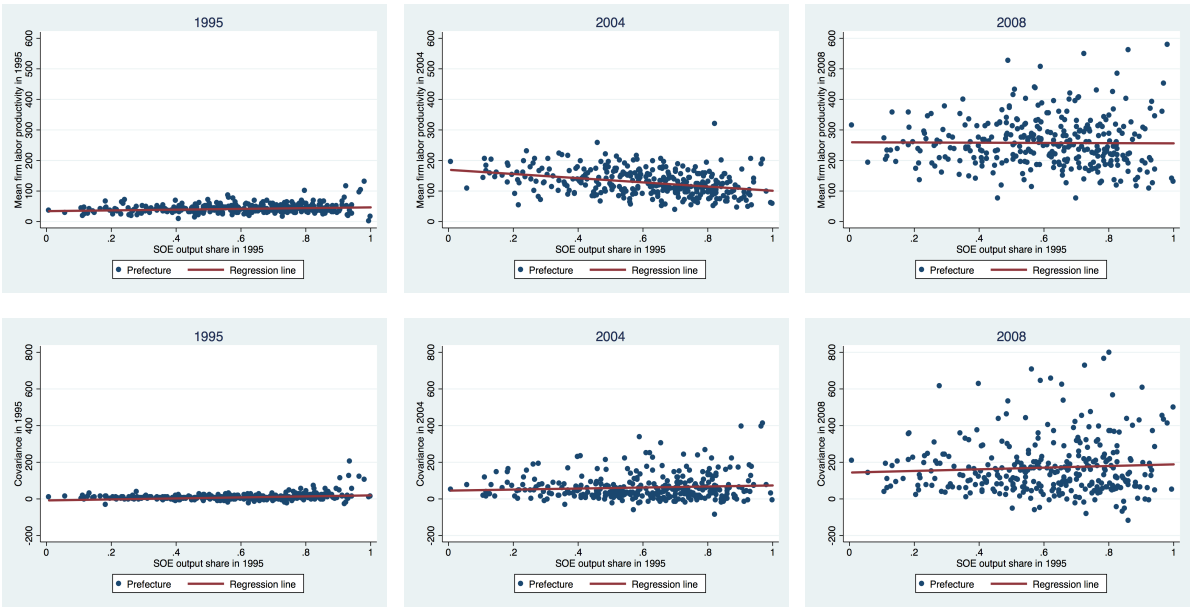
- **Across-prefecture reallocation.** The first term captures the aggregate productivity growth due to migration across prefectures from period t to $t+1$.
- **Across-ownership reallocation (within pref.)**
- **Mean firm labor productivity, Non-SOE.** The third term captures the shift in the within-prefecture firm distribution in the Non-SOE sector (i.e., the increase in the unweighted average productivity of firms in the Non-SOE sector in the prefecture), weighed by the period t relative employment share of the prefecture Non-SOE sector out of the total employment in the economy.
- **Mean firm labor productivity, SOE.** The fourth term captures the shift in the within-prefecture firm distribution in the SOE sector (i.e., the increase in the unweighted average productivity of firms in the SOE sector in the prefecture), weighed by the period t relative employment share of the prefecture SOE sector out of the total employment in the economy.
- **Across-firm sorting, Non-SOE.** The fifth term captures the productivity growth due to reallocation of workers across firms within the Non-SOE prefecture sector, weighed by the period t relative employment share of the prefecture Non-SOE sector out of the total employment in the economy.
- **Across-firm sorting, SOE.** The last term captures the productivity growth due to reallocation of workers across firms within the SOE prefecture sector, weighed by the period t relative employment share of the prefecture SOE sector out of the total employment in the economy.

Table 4: Decomposition of the change in aggregate output per worker: $\Delta \frac{Y_t}{N_t}$.

Interpretation	Decomposition Term	1995-2004	2004-2008
1. Across-prefecture reallocation	$\sum_p \frac{Y_{p,t+1}}{N_{p,t+1}} \cdot \Delta \frac{N_{pt}}{N_t}$	-0.07	-0.06
2. Across-ownership reall. (within pref.)	$\sum_p \sum_i \frac{N_{pt}}{N_t} \frac{Y_{i,p,t+1}}{N_{i,p,t+1}} \Delta \frac{N_{i,pt}}{N_{pt}}$	-0.09	-0.01
3. Mean firm labor prod., Non-SOE	$\left(\sum_p \frac{N_{ipt}}{N_t} \Delta \left[E\left(\frac{y_{fipt}}{n_{fipt}}\right)\right]\right)_{i=\text{Non-SOE}}$	0.42	0.43
4. Mean firm labor prod., SOE	$\left(\sum_p \frac{N_{ipt}}{N_t} \Delta \left[E\left(\frac{y_{fipt}}{n_{fipt}}\right)\right]\right)_{i=\text{SOE}}$	0.29	0.16
5. Across-firm sorting, Non-SOE	$\left(\sum_p \frac{N_{ipt}}{N_t} \Delta cov\left(\frac{y_{fipt}}{n_{fipt}}, \frac{n_{fipt}}{E(n_{fpt})}\right)\right)_{i=\text{Non-SOE}}$	0.29	0.41
6. Across-firm sorting, SOE	$\left(\sum_p \frac{N_{ipt}}{N_t} \Delta cov\left(\frac{y_{fipt}}{n_{fipt}}, \frac{n_{fipt}}{E(n_{fpt})}\right)\right)_{i=\text{SOE}}$	0.16	0.07

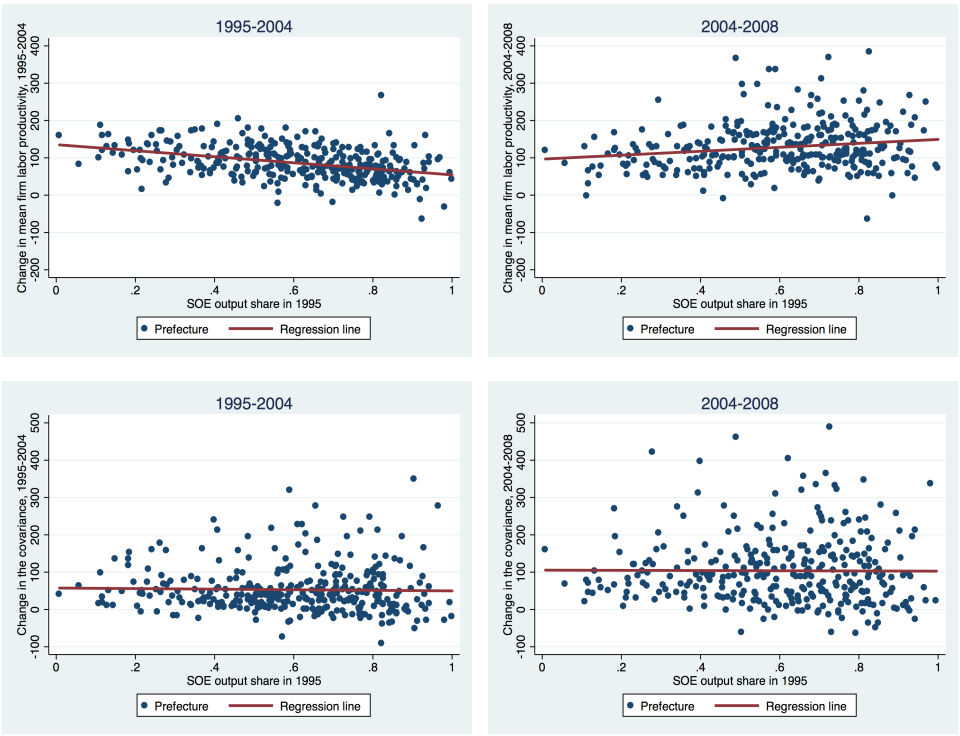
Table 4 shows the relative contribution of each of the six terms in the change in aggregate labor productivity in the 1995-2004 and 2004-2008 periods. One caveat in interpreting the results is the fact that SOE sectors are smaller than the Non-SOE sectors and thus decreasing the importance of the terms related to the SOE sectors in prefectures.

Figure 5: Mean firm labor productivity and covariance in a prefecture in 1995, 2004, and 2008, and SOE share in 1995.



Notes: .

Figure 6: Changes in mean firm labor productivity and covariance in a prefecture in 1995-2004 and 2004-2008, and SOE share in 1995.



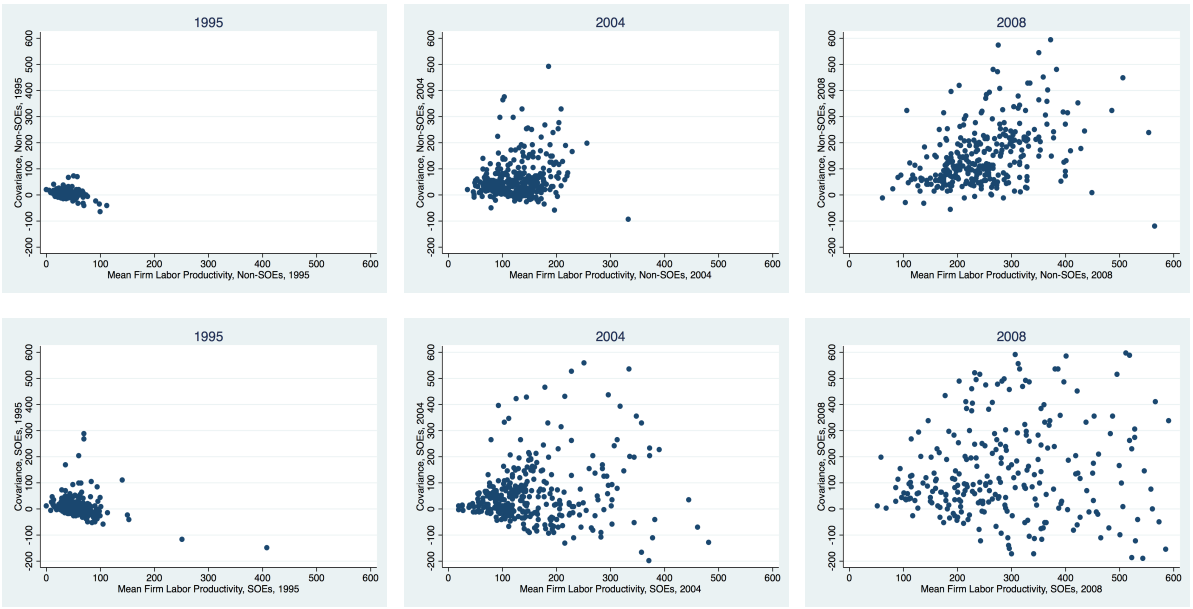
Notes: .

Figures 5-8 show more detail about the performance of the SOE and Non-SOE sectors in a prefecture, as well as the overall performance of the prefecture conditional on the size of the SOE sector.

The top panel in Figure 5 shows the firm mean labor productivity in a prefecture as a function of the SOE output share in that prefecture in 1995. The bottom panel of figures shows the covariance as a function of the SOE output share in that prefecture in 1995. First, the firm mean labor productivity in 1995 is low in all prefectures. However, in 2004, there is a substantial improvement in that dimension, with the largest increase in the mean firm labor productivity being observed in the prefectures with a low SOE output share. That change is plotted again in the top panel on Figure 6, and the negative effect of the size of the SOE sector is obvious on the graph. Second, the covariance in 1995 is low and close to zero in all prefectures. In 2004, the covariance improves in some prefectures, but deteriorates in others. The bottom panel in Figure 6 plots the change in the covariance against the SOE output share in 1995. The pattern that seems to be emerging is that the dispersion in the change in the covariance increases with the 1995 SOE output share in the prefecture.

The experience in the 2004-2008 period is reversed.

Figure 7: Mean firm labor productivity and covariance in a prefecture in 1995, 2004, and 2008: non-SOE and SOE sector.



Notes: .

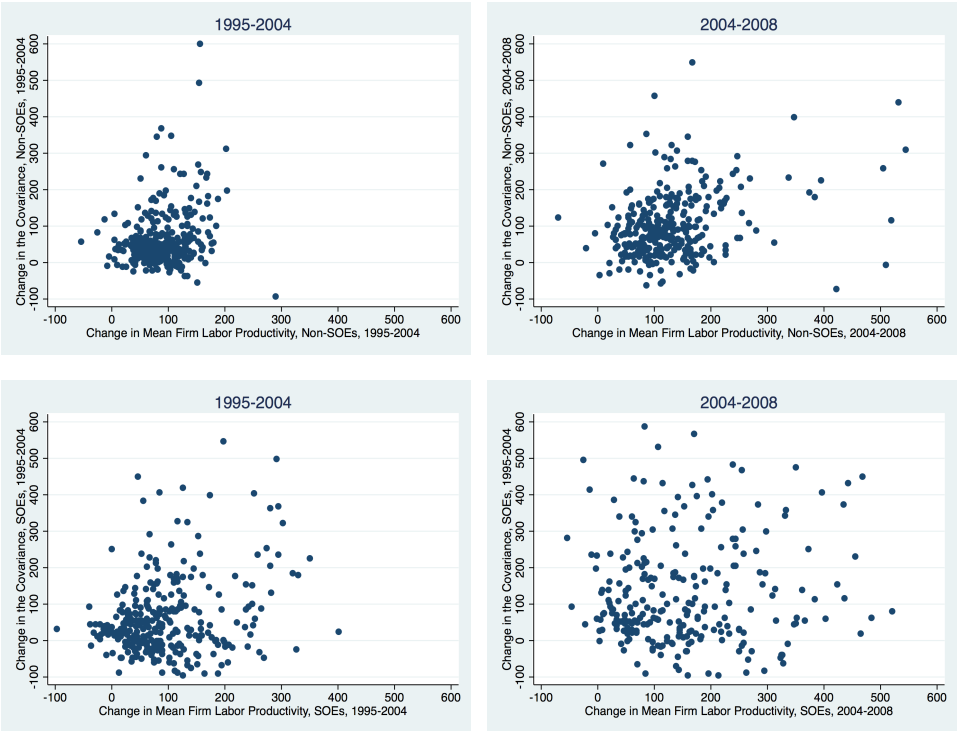
2 Additional empirical facts

The Chinese Manufacturing Census data for 1995, 2004, and 2008 reveals two patterns that are suggestive of the mechanisms through which the size of the SOE sector affects economic growth: (i) the effect on firm entry, and (ii) the relative share of high and low capital intensity industries in the SOE sector.

2.1 New entrants

Figure 9 provides evidence on firms which appeared between 1995 and 2004. We classify as new entrants all firms that are present in 2004 and were established after 1995. The first panel plots the distribution across prefectures of all firms in 2004 which are classified as new entrants; i.e., we consider in 2004 the set of new entrants and plot the percentage of those firms going to a particular prefecture. It is clear that most of these new entrants were concentrated in prefectures with a low SOE output share in 1995, with some of those prefectures receiving as much as 2-3% of the new entrants. As a result, as the lower two panels show, there was an increase in the mass of firms in the low SOE-share prefectures between 1995 and 2004.

Figure 8: Changes in mean firm labor productivity and covariance in a prefecture: non-SOE and SOE sector.



Notes: .

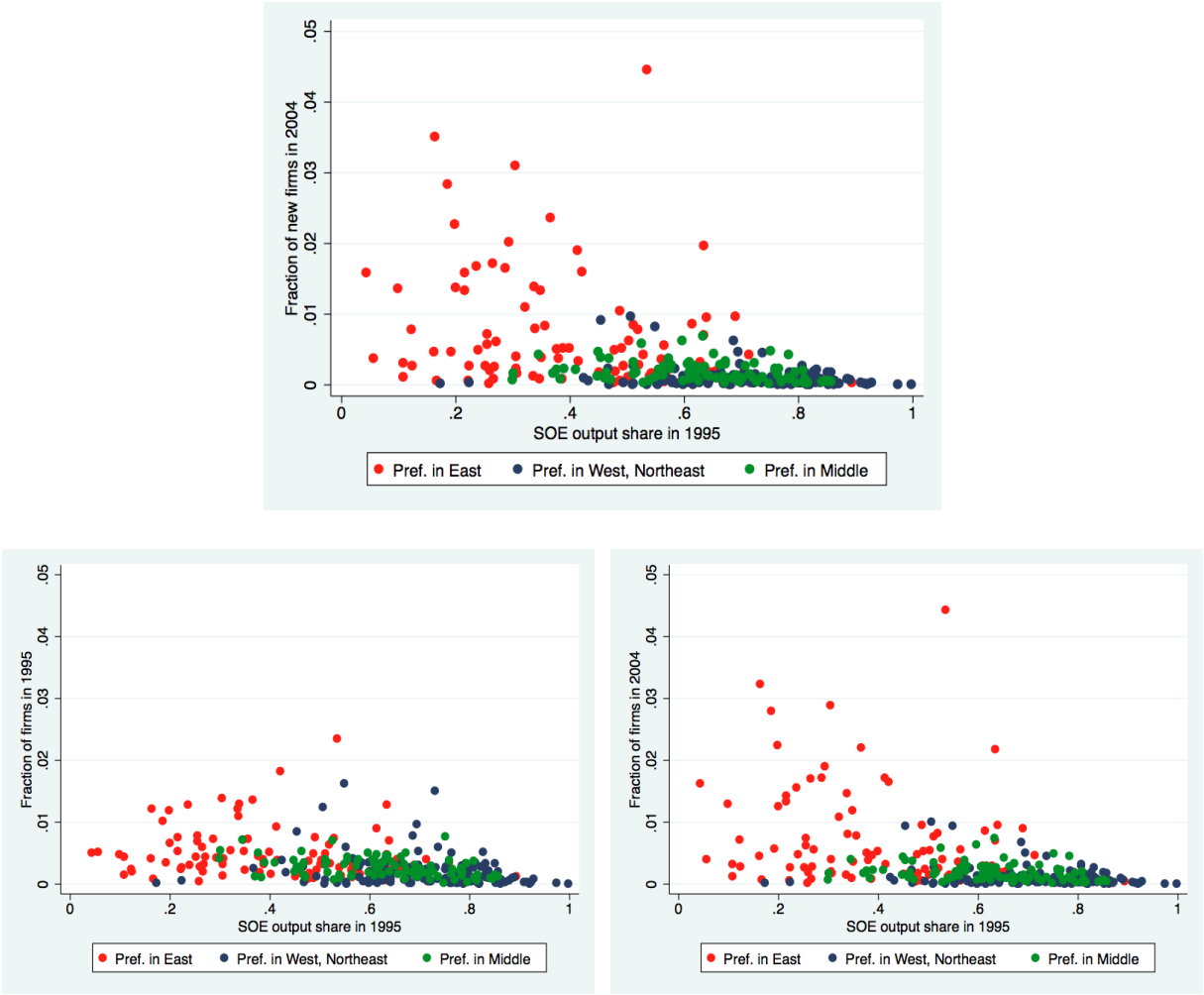
2.2 The share of SOEs in low capital intensive industries

Using the Chinese Manufacturing Census, we find that, controlling for the output share of the SOE sector, a higher share of SOEs in low capital intensive industries leads to a lower output growth over the 1995-2004 (or 1995-2008) period. This finding points towards the following intuitive hypothesis. New entrants after 1995 are mostly observed in the low capital intensive industries − entering a high capital-intensive industry requires a massive investment which private firms would find it difficult to undertake. Therefore, in a prefecture in which the state sector is mostly concentrated in the high capital-intensive industries, entry into low capital-intensive industries would be feasible since they would not be directly completing with the existing local state sector. However, if SOEs are mostly concentrated in low capital-intensive industries, then private firms would find it difficult to enter and compete directly with the already existing local state sector, thus reducing the prospects for long-run growth in the prefecture.

2.3 Policy effects

Finally, we will use the analysis to understand the extent to which various government policies after 1990 may (or may not) have affected the legacy of the SOEs in China.

Figure 9: The SOE Output Share in 1995 and New Firm Entrants Between 1995 and 2004, Chinese Manufacturing Census, 1995 and 2004: by Prefecture.



Notes: Each point represents a Chinese prefecture. The top scatter plot describes the relationship between the share of SOEs in prefecture output in 1995 and the distribution of new firm entrants between 1995 and 2004. The two bottom panels describe the distribution of firms across prefecture in 1995 and 2004, respectively. The prefectures are grouped into three broad regions: East (red), West and Northeast (blue), and Middle (green).

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