

Development in North East People's Republic of China: an analysis of enterprise performance 1995-2002

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Abstract

Regional disparities within China are now an important policy question. Recently the three provinces of the north-east region has been identified as priority areas for regional development, along with the Western part of the country. The north-east is the old industrial heartland of the country and its economy is based around heavy industry, mineral extraction and state owned enterprises. This paper uses a unique database on medium and large-scale enterprises establish how far enterprise performance in the north-east differs from the national average and the reasons for any such differences. It finds that even allowing for industrial structure and ownership, performance in the north-east is significantly below that in the rest of the country. This is attributed to aspects of the investment climate in the region.

Keywords : Asia, China, enterprises, productivity, profitability, regional development.

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Introduction.

One of the key difficulties that has emerged in the People's Republic of China (hence forth PRC) in recent years has been regional disparities in economic performance. Regional policy has followed different stages from the early *Reform and Opening Up* policy that focussed on the coastal provinces and Beijing, to the *Develop the West* policy that addressed the problems of the poorer western provinces. More recently in 2002 the government announced the *Revitalise the North East policy* that focuses on the three provinces of North East China, Heilongjiang, Jilin and Liaoning, also known collectively as Inner Manchuria or Dongbei.

Historically the region has not been poor by national standards. In terms of GDP per capita by provincial rankings Heilongjiang and Liaoning were fourth and fifth, respectively, in 1978. This position has been eroded over time with the fast growth in the coastal provinces, but in 2004 GDP per capita was about a third above the national average and twice the figure in the poorer Western provinces. The 'One China: Four World's' classification' groups the country into four distinct income categories.¹ These are first, the cities of Beijing, Shanghai and Shenzhen with little more than 2% of the population but an income per capita of a middle-income country; second, a group of large and middle sized cities and higher income coastal areas that cover a little over 20% of the country's population; third, a group of lower-middle income provinces with over a quarter of the population; and fourth, the poor provinces of west and central PRC that take up around half the total population. The disparity within the north-east can be seen from the fact that the province of Liaoning is in the second of these groups, with a per capita income more than one-third above Jilin and Heilongjiang, which are in the third group.

Current problems facing the north-east are well known. They include an infrastructure, especially the transport infrastructure that is focussed on the colonial past; a legacy of a large network of state owned enterprises that are widely recognized as needing major restructuring, particularly in the light of the impact of WTO accession; a culture of corruption fostered by a long period of close collaboration between industry and the state; problems of depletion and pollution due to long periods of exploitation of minerals and other natural resources; and land borders with Russia and the DPRK that are not fully open. However the region also has a number of potential advantages that can be built on, most particularly a relatively well educated and technically skilled labour force with average wages that are below the national average.

The remainder of this paper is organized as follows; the next section surveys the academic literature on regional development in China to establish any general lessons. A third section then considers enterprise level data to establish how far enterprises in the north-east are lagging behind other regions. This latter analysis is based on a unique database for large enterprises and offers one of the first in-depth analyses of enterprise level performance across regions in PRC. It aims to establish how far performance in the north-east can be explained by commonly cited factors such

¹ This classification comes from Hu (2004).

industrial structure, ownership and the social obligations of enterprises and how far it is due to location specific factors relating to the general ‘investment climate’ in the region. A final section links our results with those of other recent studies that do not have access to enterprise-level data.

What explains regional growth in PRC?

There is a lengthy (English language) technical literature examining the factors that have caused the growth experience of the different provinces in PRC. Here to summarize we put forward some broadly agreed stylized facts, with some of the evidence to support them.²

Much of the empirical work has been conducted within the framework of a neoclassical growth model that tests whether there has been income convergence across provinces; in other words whether there is evidence of catch-up with poorer provinces growing faster than richer provinces. The precise results vary between time periods and the form of specification adopted with at least some studies finding evidence of convergence of income from the early reform in the late 1970’s until the early 1990’s saw a convergence of incomes, in particular as the relatively poorer eastern coastal provinces grew rapidly. In the more recent period since the early 1990’s with the ‘Opening Up’ of trade and foreign investment there has been clear divergence.³

Of more direct policy relevance are the control variables that are added in such analyses to explain growth. The key cause of the striking trend towards divergence in the 1990’s noted above has been the rapid growth of the coastal provinces in the eastern region. Two possible factors to account for this are the policy environment, based around the Special Economic Zones and other related incentives for FDI and the favoured geography of the coastal provinces with easy access to the coast and thus international trading networks. One can also add easy access to the growth centres for overseas Chinese in Hong Kong, China and Taipei, China as a further benefit. The main attempt to disentangle these two effects finds both to have been important in explaining the growth of the coastal region with geographical factors, having a slower acting but slightly more important impact up to 1998. (Demurger et al, 2002). In this analysis policy is captured by a crude scoring index determined by the type of zone in a province and the main geographical variable is the proportion of the population of a province living within 100 kms of the coast or a navigable river. The north-east provinces score relatively highly by the policy index from the early 1990’s due to the zones introduced at that time and Liaoning scores relatively highly over the whole period (1978-98) as it started to develop a form of zones in the 1980’s. Overall the north-east has the highest score in the policy index after the coastal region. In terms of the geography measure by its location the north-east has an intermediate position with

² For a recent survey on regional development that also draws on a new database for empirical analysis on convergence, see Song (2005).

³ These results refer to ‘absolute’ convergence, with no qualification for other controlling factors; see Song (2005). For other measures that reflect the same trend like the Gini coefficient and the Theil index, see Cai et al (2002). Tests for ‘conditional convergence’ range from support over a long period in Cai et al (2002) to only ‘hints at’ in Demurger et al (2002:457) and weak support in Jones et al (2003) for shorter periods.

a much lower proportion of its population close to the coast than in the coastal or central regions, but a much higher proportion than the population of the west. It is thus not surprising that the impact of the policy measure is considerably higher for the north-east provinces than is the geography variable.⁴

Ownership of enterprises in a province also appears to have had an important impact on growth. The share of 'foreign invested enterprises' in economic activity in a province appears to have had a positive growth effect either directly through its impact on efficiency or indirectly through externalities. Conversely the share of SOEs in provincial activity appears to exert a negative effect, which may be in part due to their own inefficiencies, but in part also to the requirement over much of the period covered for banks to channel funds to SOEs at the expense of new forms of non-state enterprise. FDI inflows are partly driven by the incentive system on offer to foreign investors and hence are correlated with the policy index referred to above.⁵ As noted above the north-east region is well below the coastal areas in FDI per capita, although it is above the poorer western region by this indicator. It also has a higher than average share of SOEs (for further data see table 2).

An important aspect of the investment climate that impacts on provincial growth has been shown to be the quality of provincial infrastructure, particularly roads and telecommunications. Infrastructure activities link provinces with the external sector and are a means of overcoming geographic barriers like distance to a port. In addition they link provinces with each other and thus stimulate inter-province trade. Good infrastructure can also be added as an incentive to higher FDI inflows. Low levels of inter-provincial trade can also be due to internal trade barriers and there is evidence that these still remain significant.⁶ The north-east provinces are not particularly poorly endowed with infrastructure by national standards. A decomposition of the sources of growth suggests that for Liaoning over 1985-98 infrastructure variables (covering both roads and telecommunications) contribute to a growth rate above the national mean and that it is other variables that cause a lower than average growth rate for the province. For Jilin and Heilongjiang a telecommunications variable contributes to above mean growth in both cases and it is only in the case of Heilongjiang that there is a substantial negative effect from the transport variable.⁷

Remaining barriers to inter-provincial trade are often mentioned in policy discussions on provincial growth. The most detailed examination of this question finds that whilst provinces in PRC have opened substantially to international trade the reverse has taken place for inter-provincial trade for 1987-97. When a distinction is drawn between coastal provinces (in this case including Liaoning) and the rest of the country

⁴ See Demurger et al (2002) tables 2, 4, 5 and 9.

⁵ Positive effects of FDI on growth are reported in Chen and Fleisher (1996) and Demurger (2001) at the provincial level, in Jones et al (2003) at the city level and in Mody and Wang (1997) for coastal provinces. Demurger et al (2002) report a negative impact of SOE share on growth. Their FDI variable is correlated with their policy index and is generally insignificant for this reason.

⁶ Demurger (2001) finds a composite transport density variable and a variable reflecting telephone access to be significant in explaining provincial growth. The impact of the transport variable is non-linear and diminishes with increases in the variable. Earlier work by Mody and Wang (1997) for industry data across the coastal provinces finds a similar result with a road variable significant but with diminishing impact. In their analysis the telecommunications variable has positive increasing returns.

⁷ See Demurger (2001) table 3.

the measure of implicit barriers is lower for the coastal region. A further decomposition by province is not given, but direct evidence on inter-provincial trade flows are provided by regional input-output tables. These show that for Jilin the share of goods from the rest of PRC (that is other provinces) in provincial expenditure remained roughly stable 1987-97, whilst it halved for Liaoning, indicating the possibility of rising internal barriers. Liaoning had a very low share by national standards. Data are not available to allow this comparison for Heilongjiang.⁸

Hence, in general, the consensus is that what matters for relative rates of provincial growth are openness to foreign investment and trade, ownership and by implication competition, infrastructure quality and the constraints imposed by provincial geography. In the following sections we examine how some of these factors work at the enterprise level in what to our knowledge is the most detailed examination of the regional dimension of enterprise performance to date.

Enterprise data

As explained in the appendix in this paper we draw on annual survey data from the National Bureau of Statistics, Beijing on large and medium scale industrial enterprises. This database in principle should be comprehensive although changes in definition and misrecording means that some observations have to be omitted and the coverage of the medium and large-scale sector is not fully comprehensive. However this is a large sample and in 2002 the last year for which we have information the sample of enterprises accounted for over 40% of the national industrial value-added. To our knowledge this is the first effort to use this enterprise data to cast light on questions of regional policy.⁹

For the sample enterprises tables 1 and 2 give an indication of the profitability, employment and ownership trends both nationally and in the north-east provinces. To classify enterprises by profitability for simplicity we use profits reported by enterprises themselves relative to assets and group enterprises into three categories;

- category 1 profitable (profits/assets > 5%)
- category 2 marginally profitable (profits/assets 0 to 5%)
- category 3 unprofitable (profits after tax < 0)

⁸ See Poncet (2003), who suggests that overall the tariff equivalent of internal barriers to trade was as high as 51% in 1997 and that this had risen from 37% in 1987 and 41% in 1992.

⁹ A very detailed analysis of this data is in Xiao (2005) and this paper draws on the results there. Full results of the analysis are presented there.

Table 1 Percentage share of total enterprise assets by profit category: nationally and in north-east 1995- 2002

Region	Profit category	1995	1996	1997	1998	1999	2000	2001	2002
National	1	33.0	30.0	28.8	30.0	31.3	34.5	37.8	43.8
	2	28.9	29.9	30.6	30.7	31.5	31.2	31.7	29.3
	3	48.1	40.1	40.6	39.3	37.2	34.3	30.5	26.9
Liaoning	1	16.1	15.4	15.2	17.9	15.6	26.5	28.1	31.8
	2	21.3	31.9	25.7	36.5	35.7	22.6	32.0	27.2
	3	62.6	52.7	59.1	45.6	48.7	50.9	39.9	41.0
Jilin	1	31.7	38.8	10.0	16.8	18.5	21.6	48.9	48.9
	2	28.2	28.6	38.0	36.4	38.9	39.4	22.6	28.7
	3	40.1	32.6	52.0	46.8	42.6	39.0	28.5	32.4
Heilongjiang	1	35.8	38.7	38.3	35.7	32.9	40.2	43.9	44.2
	2	16.1	13.8	19.8	24.4	19.4	23.4	26.9	29.9
	3	48.1	47.5	41.9	39.9	47.7	36.4	29.2	25.9

In general the picture is mixed with an overall improvement in recorded profitability over the period both nationally and in the region, but with two of the three north-east provinces (Jilin and Liaoning) still having a higher proportion of total assets in loss-making enterprises in 2002 than the national average. On the other hand Jilin and Heilongjiang in particular have a higher proportion of enterprises in the profitable category than the national average. The picture for Heilongjiang is influenced strongly by the location there of the petroleum sector.

Table 2 illustrates the ownership distribution by employment in the sample distinguishing simply between SOEs, foreign firms (including those firms registered in Hong Kong, China and Taipei, China) and private (including here collective and mixed ownership).

Table 2 Percentage share of total enterprise employment by ownership: nationally and in north-east 1995- 2002

Region	Ownership	1995	1996	1997	1998	1999	2000	2001	2002
National	SOE	82.0	80.1	77.5	73.8	69.3	63.0	54.2	49.5
	Foreign	3.7	4.5	5.0	6.3	7.4	8.6	11.7	13.5
	Private	14.3	15.4	17.5	19.9	23.3	29.4	34.1	37.0
Liaoning	SOE	84.5	84.3	81.6	77.9	74.9	69.9	58.8	53.2
	Foreign	2.6	3.0	3.2	4.2	5.1	7.2	8.7	10.6
	Private	12.9	12.7	15.2	17.9	20.0	12.9	34.5	36.2
Jilin	SOE	90.5	90.2	88.1	87.0	82.5	76.0	72.6	69.4
	Foreign	1.3	1.7	1.8	2.1	3.7	4.0	4.6	5.0
	Private	7.2	8.1	10.1	10.9	13.8	20.0	22.8	25.6
Heilongjiang	SOE	92.9	92.2	90.6	85.5	87.0	77.3	71.2	67.8
	Foreign	1.3	1.4	2.1	2.3	2.3	2.9	2.2	3.0
	Private	5.8	6.4	7.3	12.2	10.7	19.8	26.6	29.2

The north-east started the mid-1990s with a higher employment share in the SOE sector. There have been significant employment shifts due to SOE restructuring and privatizations both nationally and in the region, but at the end of the period SOEs still retained roughly two-thirds of employment in medium and large-scale enterprises in Jilin and Heilongjiang. The proportion in Liaoning, at a little over half, is closer to the national average. Conversely the employment share of foreign firms in 2002 is very low in Jilin and Heilongjiang at 3% and 5%, respectively.

In terms of trends over the period 1995-2002 we can measure progress in privatization by the percentage point change in the share of SOEs in both employment and fixed assets. From table 2 we see that in terms of changes in employment nationally the fall for SOEs was 32.5 percentage points; Liaoning with a fall of 31.3 percentage points almost matched the national trend. Jilin and Heilongjiang were behind the national trend with reductions in the employment share for the SOE sector of 21.1 and 25.1 percentage points. However by the criteria of the fall of SOEs in total assets of the medium and large-scale sector, privatization in the region has exceeded or matched the national trend; nationally the fall was 29.8 percentage points, whilst the reduction in the north east provinces was 35.1 percentage points in Liaoning, 29.3 percentage points in Jilin and 41.2 percentage points in Heilongjiang.¹⁰

Enterprise performance

Despite the evidence on improving profitability and the trends towards privatization from tables 1 and 2 there is a widespread perception examined in the early section of this paper that the north-east is a problem region. To resolve this apparent discrepancy and to cast light on the investment prospects for the region we turn to a detailed examination of enterprise performance. We use two simple performance indicators value-added per employee (VA/L), as a measure of productivity, and ‘imputed profits’ to total assets (IP/TA), as a measure of returns on investment.¹¹ Imputed profits are calculated as value added minus the sum of wages, financial charges and depreciation. We prefer this to enterprises’ own accounting profits from their published accounts (which are the basis for table 1) as the frequent changes in accounting practices can distort the underlying picture.

Indicators such as these must be related to particular industrial sectors and a direct comparison of these two measures for the north-east and the rest of the country is given in tables 3 and 4. These tables give the average value for the two indicators in 37 two-digit sectors for the region and the rest of the country. In only three sectors (Food production, Petroleum processing and Non-Metal mining) does the north-east have a higher average productivity. Similarly it has a higher average profitability again in only 3 sectors (now Petroleum extraction, Petroleum processing and Furniture). In all other cases performance of firms in the northeast is below that in the rest of the country, indicating a clear ‘performance gap’. Hence despite the improvements in profitability implied in table 1, relative to the rest of the country the region is not doing well when the relevant comparison is made across sectors.

¹⁰ See Xiao (2005) tables 2.21-2.25.

¹¹ Although our productivity indicator is a measure of single factor productivity, since we include change in the capital-labor ratio in our model implicitly our sector dummies pick up total factor productivity effects.

Table 3 Average Performance of NE Enterprises during 1995-2002 Relative to Others by Industry (Ranked by Productivity)

Ind2	VA/L (1000 yuan/person)			IP/TA (%)		
	NE	Others	NE/Others	NE	Others	NE - Others
[14]Food Production	33	26	129%	7.40%	9.10%	-1.70%
[25]Petroleum Processing	24	19	124%	12.80%	11.40%	1.40%
[10]Nonmetal Mining	11	10	103%	4.00%	4.90%	-0.90%
[21]Furniture	21	22	96%	9.40%	9.10%	0.30%
[29]Rubber	19	21	94%	3.10%	8.60%	-5.50%
[27]Medical	37	46	82%	10.60%	12.30%	-1.70%
[30]Plastic	29	35	81%	4.10%	7.80%	-3.70%
[37]Transport Equipment	26	34	78%	3.10%	5.60%	-2.50%
[13]Food Processing	20	27	73%	5.90%	11.00%	-5.10%
[12]Timber Logging	5	7	71%	1.90%	3.60%	-1.70%
[31]NonmetalProducts	12	17	71%	3.20%	6.30%	-3.10%
[34]Metal Products	22	32	69%	2.60%	7.60%	-5.00%
[09]Nonferrous Mining	8	12	63%	-0.90%	3.30%	-4.20%
[15]Beverage	21	35	61%	13.80%	13.90%	-0.10%
[35]Ordinary Machinery	13	21	60%	1.30%	4.80%	-3.50%
[44]Electric Power	27	46	59%	5.30%	8.50%	-3.20%
[41]Electronic and Telecom	27	46	58%	3.40%	7.20%	-3.80%
[20]Timber	18	34	54%	2.20%	6.30%	-4.10%
[33]Pressing of Nonferrous	14	26	53%	2.50%	7.90%	-5.40%
[18]Garments	9	17	53%	4.90%	13.60%	-8.70%
[26]Raw Chemical	18	35	52%	2.60%	8.10%	-5.50%
[46]Tap Water	7	14	50%	1.60%	2.40%	-0.80%
[40]Electric Equipment	14	28	49%	3.70%	8.80%	-5.10%
[24]Cultural	13	27	47%	0.20%	9.70%	-9.50%
[22]Papermaking	11	23	47%	4.80%	9.80%	-5.00%
[23]Printing	17	36	46%	3.40%	5.70%	-2.30%
[36]Special Equipment	9	19	46%	-0.60%	4.10%	-4.70%
[17]Textile	7	15	44%	0.50%	6.70%	-6.20%
[32]Pressing Ferrous	11	26	43%	2.10%	6.10%	-4.00%

[42]Instruments	8	19	41%	1.10%	3.00%	-1.90%
[16]Tobacco	65	162	40%	28.20%	34.40%	-6.20%
[06]Coal Mining	3	7	40%	-4.00%	3.10%	-7.10%
[45]Gas Production	3	8	38%	-4.30%	-2.80%	-1.50%
[08]Ferrous Mining	5	13	37%	-0.90%	4.10%	-5.00%
[19]Leather	5	16	32%	0.70%	10.80%	-10.10%
[28]Chemical Fiber	11	36	30%	0.70%	6.50%	-5.80%
[07]Petroleum Extraction	35	235	15%	21.70%	16.20%	5.50%

Table 4 Average Performance of NE Enterprises during 1995-2002 Relative to Others by Industry (Ranked by Profitability)

Ind2	VA/L (1000 yuan/person)			IP/TA (%)		
	NE	Others	NE/Others	NE	Others	NE - Others
[07]Petroleum Extraction	35	235	15%	21.70%	16.20%	5.50%
[25]Petroleum Processing	24	19	124%	12.80%	11.40%	1.40%
[21]Furniture	21	22	96%	9.40%	9.10%	0.30%
[15]Beverage	21	35	61%	13.80%	13.90%	-0.10%
[46]Tap Water	7	14	50%	1.60%	2.40%	-0.80%
[10]Nonmetal Mining	11	10	103%	4.00%	4.90%	-0.90%
[45]Gas Production	3	8	38%	-4.30%	-2.80%	-1.50%
[12]Timber Logging	5	7	71%	1.90%	3.60%	-1.70%
[14]Food Production	33	26	129%	7.40%	9.10%	-1.70%
[27]Medical	37	46	82%	10.60%	12.30%	-1.70%
[42]Instruments	8	19	41%	1.10%	3.00%	-1.90%
[23]Printing	17	36	46%	3.40%	5.70%	-2.30%
[37]Transport Equipment	26	34	78%	3.10%	5.60%	-2.50%
[31]Nonmetal Products	12	17	71%	3.20%	6.30%	-3.10%
[44]Electric Power	27	46	59%	5.30%	8.50%	-3.20%
[35]Ordinary Machinery	13	21	60%	1.30%	4.80%	-3.50%
[30]Plastic	29	35	81%	4.10%	7.80%	-3.70%
[41]Electronic and Telecom	27	46	58%	3.40%	7.20%	-3.80%
[32]Pressing Ferrous	11	26	43%	2.10%	6.10%	-4.00%
[20]Timber	18	34	54%	2.20%	6.30%	-4.10%
[09]Nonferrous Mining	8	12	63%	-0.90%	3.30%	-4.20%
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[18]Garments	9	17	53%	4.90%	13.60%	-8.70%
[24]Cultural	13	27	47%	0.20%	9.70%	-9.50%
[19]Leather	5	16	32%	0.70%	10.80%	-10.10%

The key issue we wish to address is what accounts for this gap. How far is it due to factors like differences in scale, technology, ownership, and competition across regions, and how far is it due to the operating environment or ‘investment climate’, which create a ‘location disadvantage’ in the north-east? To address this we employ a fixed effects panel data regression model to the enterprise data over 1995-2002.

This can be thought of as a simple ‘structure-conduct- performance’ approach that attempts to isolate the different effects on performance, based on the characteristics of the enterprise itself, the characteristics of the sector in which it operates, time factors and a series of dummy variables including province specific and regional dummies. As our regression results are based on a very large and representative data set with over 44,000 firms, and on a rigorous econometric approach, the conclusion here should be much more robust and systematic than that drawn from casual observation or limited case studies.

Generically the model can be written as

$$P_{it} = \alpha_0 + \alpha_1 X_{it} + \alpha_2 Y_{jt} + \alpha_3 Z + v_{it} \quad (1)$$

where P is a performance indicator (productivity or profitability)

X is a vector of firm-specific factors for firm i (relating to scale of production and factor intensity)

Y is a vector of sector-specific factors for sector j (relating to concentration and ownership)

Z is a vector of dummy variables (relating to provinces, sectors, years and interaction terms)

α_0 is a constant, v is an error term and t indicates annual observation.

Four different versions of (1) are applied (models 1 to 4). The relevant variables used are set out below:

Dependent variables

- (VA/L): value-added per worker:
- (IP/TA): imputed profit to total assets:

Independent variables

- $\ln(L)$: size of the firm (as measured by number of workers);
- $\ln(Kp/L)$: intensity of production fixed capital (total capital assets per worker)
- $\ln(Kf/L)$: intensity of non-production fixed capital (welfare capital per worker)
- Ind3Concentration: Herfindal index for industry concentration at 3-digit industry level calculated for the sample
- FIE_ind2MKT_Share: market share of foreign invested enterprises at 2 digit industry level in the sample
- D^{ind2} : Sector dummies at 2 digit industry level
- $(D^{ind2}) * \ln(Kp/L)$: Interaction terms between sector dummies and capital intensity
- D^{type} : Ownership dummies for SOEs, private, collective, mixed, foreign and Hong Kong, China-Taipei, ownership.
- D^{year} : Annual dummies 1995 to 2002

- D^{nep} : North-east region dummy
- $D^{nep} * \ln(Kf/L)$ interaction term between north-east dummy and intensity of non-production capital
- $D^{nep} * D^{ind2}$ interaction term between north-east dummy and sector dummy
- $D^{nep} * D^{type}$ interaction term between north-east dummy and ownership type dummy
- $D^{nep} * D^{year}$ interaction term between north-east dummy and annual dummy
- $D^{Lioaning}$, D^{Jilin} and $D^{Heilonjiang}$: province specific dummies for the north east
- D^{place2} : province specific dummies

The regression equation for model 1 is

$$\begin{aligned}
P = & \alpha_0 + \alpha_1 \ln(L_{it}) + \alpha_2 \ln(Kp_{it}/L_{it}) + \alpha_3 \ln(Kf_{it}/L_{it}) + \\
& \alpha_4 \text{Ind3Concentration} + \alpha_5 \text{FIE_ind2MKT_Share}_{it} + \\
& \sum_{j=\text{ind2}} \beta_j [\ln(Kp_{it}/L_{it}) \cdot D^{\text{ind2}}_{it}] + \sum_{j=\text{ind2}} \phi_j \cdot D^{\text{ind2}}_{it} + \sum_{j=\text{type}} \lambda_j \cdot D^{\text{type}}_{it} + \sum_{j=\text{year}} \kappa_j \cdot D^{\text{year}}_{it} + \\
& \alpha_6 \cdot D^{nep}_{it} + v_{it} \tag{1}
\end{aligned}$$

The main purpose of this regression model is to identify the performance gap between the enterprises in the north-east and in the rest of PRC after controlling for other factors that are not specific to location effects. In other words, the regression coefficient for the north-east region dummy (D^{nep}) indicates the performance gap for enterprises in the north-east that is specifically due to the location effects after controlling for enterprise scale and factor intensity, sector competition, ownership and other unmeasurable sector characteristics and time. General macro economic effects are captured through the time dummies.

Scale can have an ambiguous impact on performance depending on the effect of economies of scale. Regarding factor intensity insofar as capital intensity reflects a higher level of technology higher production capital per worker can be expected to have a positive impact. Social obligations of enterprises or ‘welfare capital’ per worker may raise productivity but may also lower profitability and there is the possibility of a negative impact on the profit measure. Sector concentration is taken as a proxy for the degree of competition so that high concentration implies low competition; it is hypothesized that competition has a positive impact on productivity but it may have a negative impact on profitability. Similarly the foreign ownership share in a sector is expected to have a positive impact on productivity both through competition and potential technological spillovers. Its impact on profitability is more ambiguous. Model 1 also includes controls for type of ownership of a firm, annual effects, and sector characteristics. The reference points with which the dummies are compared are SOEs for ownership, 1996 for years, textiles (sector 17) for sectors and the rest of PRC for the north-east dummy.

Table 5 Regression with NE region dummy: Model 1

Dependent Variable	Model 1 ln(VA/L)	Model 1 (IP/TA)
Constant	1.36524 [30.28]***	0.04905 [7.99]***

ln(L)	-0.08062 [19.16]***	0.00108 [1.89]*
ln(Kp/L)	0.29281 [32.93]***	-0.00539 [4.44]***
ln(Kf/L)	0.04724 [28.26]***	-0.00417 [17.81]***
Ind3Concentration	-1.28929 [6.26]***	-0.22037 [7.75]***
FIE_ind2MKT_Share	0.45869 [8.13]***	0.08845 [11.39]***
type=Private	0.5733 [28.89]***	0.08202 [29.03]***
type=Collective	0.38259 [35.69]***	0.05685 [38.18]***
type=Mixed	0.37199 [42.67]***	0.04335 [35.53]***
type=Foreign	0.80864 [36.25]***	0.04563 [14.91]***
type=HK-Taiwan	0.63969 [28.59]***	0.03812 [12.40]***
year=1995	-0.00225 [0.33]	-0.00332 [3.49]***
year=1997	-0.03482 [5.17]***	-0.00629 [6.74]***
year=1998	-0.05057 [7.20]***	-0.01326 [13.59]***
year=1999	0.04065 [5.61]***	-0.00379 [3.73]***
year=2000	0.12642 [16.96]***	0.00405 [3.86]***
year=2001	0.18025 [23.20]***	0.01083 [9.90]***
year=2002	0.26932 [33.57]***	0.01701 [15.06]***
nep=NorthEast	-0.44324 [29.15]***	-0.04023 [20.11]***
Observations	161622	169687
Number of Firm	43541	44552

1. Absolute value of z statistics in brackets.

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

3. Coefficients for ind2 and the interaction terms between ind2 and ln(Kp/L) are not reported here.

4. The base for comparing the coefficients of various dummies is type=SOE, year=96, ind2=17, nep=the rest of China other than the three Northeast provinces.

Table 6 Differences in Performance Implied by Model 1

Dependent Variable	ln(VA/L)	(IP/TA)
nep=Rest	0.00%	0.00%
nep=NorthEast	-44.32%	-4.02%
type=SOE	0.00%	0.00%
type=Private	57.33%	8.20%
type=Collective	38.26%	5.69%
type=Mixed	37.20%	4.34%
type=Foreign	80.86%	4.56%
type=HK-Taiwan	63.97%	3.81%
year=1995	-0.23%	-0.33%
year=1996	0.00%	0.00%
year=1997	-3.48%	-0.63%
year=1998	-5.06%	-1.33%
year=1999	4.07%	-0.38%
year=2000	12.64%	0.41%
year=2001	18.03%	1.08%
year=2002	26.93%	1.70%

The results of model 1 are shown in tables 5 and the implied differences in performance relative to the various reference points are given in table 6. In terms of productivity the scale variable is negatively related to productivity, indicating there are no scale economies. Both capital intensity variables, both production and non-production capital, are positively related to productivity. The concentration ratio is negative related to productivity implying there is a productivity-enhancing competition impact from lower concentration and higher competition. The share of foreign firms in sector output is positively related to productivity, which is consistent with a positive technological spillover. All of the ownership dummies are positively related to productivity indicating that it is higher in enterprises that are not SOEs. The largest coefficient and thus the highest productivity gap over SOEs is for foreign firms, who have 80% higher value-added per worker relative to SOEs, controlling for other factors. In terms of time, productivity shows a significant improvement from 1999 onwards. The regional dummy for the north-east, which is our key variable of interest, is significantly negative, indicating that if all the other control variables have the same value, enterprises located in the north-east are likely to have lower value-added per worker than those in the rest of the country by as much as 44 percentage points.

A different pattern is observed for the profitability measure. Here there is a very weak scale effect as the coefficient on the size of firm is positive, but very small, and only significant at the 10% level. The implication is that as enterprise size grows there may be economies in the use of intermediates and capital rather than labour. However both measures of capital intensity are now negatively related to profitability. As in the case of productivity, concentration is negatively related to performance, so profitability falls with concentration, allowing for all other factors. This is an unexpected result and is likely to be due at least in part to the lower productivity associated with higher concentration noted above. Foreign firm share in a sector is positively related to profitability. The coefficients on all ownership dummies are positive indicating that all ownership types are more profitable than SOEs, when controlling for all other measurable features. Now it is private domestic firms rather than foreign firms that show the largest gap relative to SOEs. Private firms are over 8 percentage points more profitable than SOEs controlling for all other measurable factors. In terms of time profitability shows a significant improvement one year later than productivity in 2000. The regional dummy for the north-east is again strongly significant and negative. It shows that controlling for all other factors the profit to assets ratio in the north-east is 4 percentage points below that of comparable enterprises in other locations in PRC. This and the productivity performance gap are specific to the north-east region and cannot be explained by the other controlling variables in the regression.

These results imply that standard reforms such as privatization, the introduction of market competition and foreign direct investment can help the north-east region to improve enterprise performance, but even allowing for its level of these factors, the region still has a performance gap that is specific to its own location.

Thus far we have treated the north-east as a single region. Model 2 addresses this by replacing the single north-east dummy with three separate provincial dummies (D^{Liaoning} , D^{Jilin} , and $D^{\text{Heilongjiang}}$.)

This regression is designed to check if the three provinces in the north-east region have performed differently relative to the rest of the country. The results, which are not reported here, show an almost identical pattern to those in table 5. The provinces performed similarly and have almost the same performance gap with the rest of PRC. Liaoning has the largest gap. Its profitability is 4.7 percentage points lower, compared with 3.3 percentage points for Jilin and Heilongjiang. In general however there are no significant ‘within north-east’ effects with all three provinces sharing broadly similar locational disadvantages.

Model 3 controls for the same scale, technology, competition and ownership variables used in model 1, whilst in addition removing the negative location-specific impact of the north-east region. This is done by introducing a set of four interaction terms in addition to the original north-east dummy. These are

- between the regional dummy and welfare capital intensity (D^{nep} and $\ln(Kf/L)$)
- between the regional dummy and each sector dummy (D^{nep} and $D^{\text{ind}2}$)
- between the regional dummy and each ownership type (D^{nep} and D^{type})
- and between the regional dummy and each annual dummy (D^{nep} and D^{year}).

The first set of interaction terms ($D^{\text{nep}} * \ln(Kf/L)$) is designed to check for the effect of non-productive or welfare capital on performance, that is specific to the north-east region. We often hear the claim that the enterprises in the north-east have larger social burdens, such as the provision of employee housing and fringe benefits like schools and hospitals. If this effect is important, it will show up as a statistically significant negative coefficient for this interaction term.

The second set of interaction terms is designed to compare the performance gap between the north-east region and the rest of China by sector, after already controlling for systematic factors, like scale and ownership, as well the standard (that is the non-interactive) north-east (D^{nep}) and sector dummies ($D^{\text{ind}2}$). Thus the coefficients on the interactive terms ($D^{\text{nep}} * D^{\text{ind}2}$) will indicate the performance gap after controlling for both industry sector and location effects. In another words, they will indicate the gap in productivity or profitability between enterprises in the north-east and those in the rest of the country, after the negative impact of the north-east region’s location effect is removed. Regression analysis allows us to do this counter-factual exercise by decomposing the impact on performance arising from different sources. We can then compare enterprise performance in the north-east after locational disadvantages are removed with performance in the rest of the country to get a version of ‘potential comparative advantage’ by sector for the region.

The third set of interaction terms ($D^{\text{nep}} * D^{\text{type}}$) is designed to check if the non-state enterprises in the north-east region are doing exceptionally better or worse relative to SOEs than the non-state enterprises in the rest of the country after controlling for all other factors, including the location effect of the region. There is a view that the north-east region does not offer a supportive environment for the development of non-state enterprises, even if its current locational disadvantages could be removed, and a negative coefficient on this term will provide support for this.

The fourth set of the interaction terms ($D^{nep} * D^{year}$) is designed to examine the timing of the performance change of enterprises in the north-east region to see it differs from that nationally, after controlling for locational disadvantages.

The pattern of results, which are not reported here for reasons of space, is identical to that reported in table 5 for model 1. The interest here is in the impact of the new interaction terms.

For the interaction of the north-east dummy and the intensity of welfare capital there is a positive but weak impact (significant at 10% level) on productivity but no significant impact on profitability. Hence over and above the direct negative impact of this form of welfare expenditure on profitability, which is captured by the coefficient on (Kf/L) there is no specific north-east region dimension to this impact on profits.

The coefficients on the interactive terms ($D^{nep} * D^{ind2}$) indicate the performance gap for the region after controlling for sector, location and all other measurable effects. Out of 37 sectors there are positive coefficients for 31 for the productivity and 26 for the profitability measures; of these 24 and 12, respectively, are significant. A positive coefficient on ($D^{nep} * D^{ind2}$) indicates a superior performance relative to the rest of the country, if locational and other disadvantages captured by the explanatory variables are controlled for. These figures must be seen in the light of the direct comparison in tables 3 and 4 on the performance by sector in the region as compared with the rest of the country. By the profitability measure in the direct comparison in only 3 out of 37 sectors (Petroleum Extraction and Processing and Furniture) were enterprises in the north-east performing better than those in the rest of China. The results in tables 8 and 9 show that if we control for the negative location effect of the north-east and the level of other variables, in 26 sectors the north-east has the potential to be competitive in terms of an above average level of profits. The 12 sectors where there the positive coefficient is significant include the three noted above (Petroleum Extraction and Processing and Furniture) plus Food production, Nonmetal mining, Beverages, Medical supplies, Instruments, Nonmetal products, Transport Equipment and Electronics and Telecoms. These are a mixture of resource-based and high technology activities. The implication is that the poor performance of the north-east region in the direct sector comparison is largely due to a range of systematic factors, for example relating to ownership and competition, as well as to location-specific effects. If the north-east region can catch up in these location and non-location specific areas, these results suggest that the region has the potential to have nationally competitive industries in at least 12 sectors. However for this potential to be realized all of these disadvantageous features of the region will have to be corrected.

The third set of interaction terms ($D^{nep} * D^{type}$) is designed to check if non-state enterprises in the north-east are doing exceptionally better or worse than non-state enterprises in the rest of China after controlling for location and non-location factors. The coefficients on the productivity variable are always insignificant indicating no effect. However for profitability the coefficients on the interaction terms for the regional dummy with private, collective and mixed ownership dummies are negative and strongly significant, with the largest effect found for private ownership. For example, the negative coefficient of 0.0492 implies that relative to SOEs the profitability of private firms in the north-east is 4.92 percentage points lower than in the rest of the country. In terms of profitability these enterprises in the north-east seem to perform substantially worse than those in other regions, even after controlling for the negative impact of the region's general location effect. Hence private investors appear to suffer more difficulties than foreign firms, which seem better able to deal with the local business environment than the purely domestic private enterprises.

The fourth set of the interaction terms ($D^{nep} * D^{year}$) is designed to examine the timing of any change in performance of enterprises in the north-east relative to the rest of the country. The positive significant coefficients after 1997 for productivity and after 1998 for profitability indicate that there may have been some time impact, perhaps related to policy shifts on the speed of privatization in the later 1990's.

In regression model 4, the basic model 1 is expanded to include dummies for all 28 provinces ($D^{\text{place}2}$). The aim here is to derive a ranking of the performance gap across all provinces that is specific to location effects in each province, in another words taking away the systematic impact from factors like scale, technology, ownership, competition and sector characteristics that are captured by the control variables. The coefficients on the province dummies give the criteria for ranking. In this analysis the reference province is Shandong, so that all provinces are ranked relative to Shandong.

The results are shown in table 7. The negative coefficients for the three north-east provinces show that their productivity and profitability is always below Shandong. For example by profitability Liaoning is 8.1 percentage points below, whilst Jilin and Heilongjiang are roughly 6.9 percentage points below. In terms of national ranking out of all provinces the three north-east provinces have three out of the bottom four places in value added per worker. By profitability the ranking out of 28 provinces is 21 for Heilongjiang, 22 for Jilin, and 27 for Liaoning. These rankings are lower than might be thought from a direct reading of data such as that in tables 1 and 2 and take account of both characteristics of enterprises and the structure of production in the different provinces.

We discuss the interpretation of these results further below but they show that there is a long way to go for the three provinces in improving their business environment. In other words even if they brought their situation up to the national level in terms of ownership and competition, they would still have substantially lower enterprise profitability due to their locational disadvantages.

Table 7 Regression with Provincial Dummies: Model 4

	Dependent Variable	ln(VA/L)	IP/TA
Constant		1.30122 [28.06]***	0.0792 [12.52]***
ln(L)		-0.06414 [15.31]***	0.00106 [1.85]*
ln(Kp/L)		0.28366 [32.05]***	-0.00522 [4.31]***
ln(Kf/L)		0.04745 [28.46]***	-0.00391 [16.73]***
Ind3Concentration		-1.29496 [6.33]***	-0.21125 [7.47]***
FIE_ind2MKT_Share		0.37894 [6.76]***	0.08807 [11.40]***
type=Private		0.51903 [26.19]***	0.07867 [27.85]***
type=Collective		0.31659 [29.14]***	0.04914 [32.49]***
type=Mixed		0.34478 [39.52]***	0.04058 [33.21]***
type=Foreign		0.72508 [32.52]***	0.0458 [14.95]***
type=HK-Taiwan		0.54359 [24.25]***	0.03645 [11.82]***
year=1995		-0.00226 [0.33]	-0.00319 [3.36]***
year=1997		-0.03276	-0.00619

year=1998	[4.87]*** -0.04339	[6.64]*** -0.01303
year=1999	[6.19]*** 0.05104	[13.36]*** -0.00378
year=2000	[7.06]*** 0.13891	[3.72]*** 0.00407
year=2001	[18.66]*** 0.19513	[3.88]*** 0.01089
year=2002	[25.14]*** 0.28492	[9.96]*** 0.01723
place2=[11]Beijing	[35.55]*** -0.0271	[15.26]*** -0.06695
place2=[12]Tianjin	[0.80] -0.23176	[14.68]*** -0.07855
place2=[13]Hebei	[7.67]*** -0.20426	[19.46]*** -0.02735
place2=[14]Shanxi	[8.08]*** -0.46416	[8.01]*** -0.05086
place2=[15]InnerMongolia	[11.52]*** -0.27733	[9.34]*** -0.04053
place2=[21]Liaoning	[6.59]*** -0.49673	[7.18]*** -0.08176
place2=[22]Jilin	[20.79]*** -0.5118	[25.81]*** -0.06894
place2=[23]Heilongjiang	[15.65]*** -0.47932	[15.89]*** -0.068
place2=[31]Shanghai	[15.86]*** 0.2587	[16.92]*** -0.05346
place2=[32]Jiangshu	[11.21]*** 0.19219	[17.18]*** -0.00182
place2=[33]Zhejiang	[10.05]*** 0.18485	[0.70] -0.02981
place2=[34]Anhui	[7.96]*** -0.16732	[9.47]*** -0.02996
place2=[35]Fujian	[5.90]*** 0.18056	[7.82]*** -0.01617
place2=[36]Jiangxi	[5.56]*** -0.40699	[3.67]*** -0.05666
place2=[41]Henan	[10.80]*** -0.28665	[11.11]*** -0.02571
place2=[42]Hubei	[10.64]*** -0.11085	[7.05]*** -0.02191
place2=[43]Hunan	[4.38]*** -0.3693	[6.38]*** -0.06432
place2=[44]Guangdong	[12.75]*** 0.1918	[16.51]*** -0.04078
place2=[45]Guangxi	[9.39]*** -0.12351	[14.73]*** -0.04492
place2=[46]Hainan	[3.94]*** -0.20228	[10.62]*** -0.0663

	[2.98]***	[7.26]***
place2=[50]Sichuan+Chongqing	-0.19127	-0.05423
	[8.10]***	[17.13]***
place2=[52]Guizhou	-0.31665	-0.06961
	[5.89]***	[9.73]***
place2=[53]Yunnan	-0.14561	-0.06559
	[4.09]***	[13.64]***
place2=[54]Tibet+Qinghai+Ningxia	-0.23178	-0.06755
	[4.44]***	[9.79]***
place2=[61]Shaanxi	-0.45675	-0.07193
	[12.70]***	[15.02]***
place2=[62]Ganshu	-0.48836	-0.07733
	[8.92]***	[10.48]***
place2=[65]Xinjiang	-0.2995	-0.08955
	[5.84]***	[13.10]***
Observations	161622	169687
Number of Firm	43541	44552

1. Absolute value of z statistics in brackets.

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

3. Coefficients for ind2 and the interaction terms between ind2 and $\ln(Kp/L)$ are not reported here.

4. The base for comparing the coefficients of various dummies is type=SOE, year=96, ind2=17, place2=[37]Shandong.

What explains location disadvantage?

The provincial dummies from table 7 give a summary measure of provincial location effects after controlling for measurable variables at the enterprise level and for measurable and unmeasurable effects at the sector level. However it is clearly desirable to try to go behind these dummies to understand what is driving the process of locational disadvantage. We do not have adequate data to replace provincial dummies by accurate continuous variables in these regressions, but we can compare the values of the dummies with proxies for locational effects in the wider literature cited in the earlier section.

Demurger et al (2002) provide the most ambitious attempt to disaggregate provincial effects by replacing provincial dummies with two continuous variables, one based on geography (the proportion of the population within 100 kms from the coast) and the other on policy (using a scoring system based on the type of Special Zones in a province). Demurger et al (2002) only provide an average value for the geography variable averaged across regions of the country. Table 8 shows the regional averages for their geographical variable and our provincial dummies. For ease of exposition our dummies are given for the profitability indicator only. They are shown as negative numbers, so a higher negative value of the dummy indicates increasing provincial disadvantage. As coastal location is treated as an advantage a rise in the geography measure is an indication of geographical advantage.

Table 8: Provincial dummies and measure of geographical advantage from Demurger et al (2002).

Region	Average dummy values for provincial disadvantage	Geographical advantage
metropolises	-6.64	71
coast	-2.6	82
central	-4.51	57
north west	-6.83	0
south west	-6.31	4
north east	-7.29	18

Source: table 7 and Demurger et al (2002) table 2.

Table 8 reveals a consistent pattern with lower negative values for the dummies in the coast and central regions, which have high values of the geographic variable. The north east has the highest score of any region by our dummy measure, indicating the greatest negative location effect. This does not seem to be related systematically to the geographic variable however, since the two western regions score well below the north-east in terms of distance from the coast. Furthermore it will be recalled that in their analysis of provincial GDP growth Demurger et al (2002: table 9) report only a modest impact on north-east growth from geographic effects.

It is possible to test for the impact of the Demurger et al (2002) policy variable on our dummies. Their variable is based on a score averaged over the long period 1978-98 (Demurger et al 2002: table 4). Most provinces had introduced some form of special zones by the mid-1990's with little change over the period 1990-1998. As our data refer to 1995-2002 we take the single year score for the policy variable for the year 1995, although for most provinces the score is constant during the 1990's. When the province dummies are regressed on this policy variable no significant relationship emerges and the adjusted R² is close to zero (see table 9).

Of the other factors affecting provincial growth that have been examined in the literature we also test for a relation between our provincial dummies and simple measures of barriers to inter-provincial trade and infrastructure. Data from Poncet (2003 Appendix B table 2) on inter-provincial trade flows in total province absorption are used as a proxy for internal barriers to trade, on the crude assumption that the higher is the ratio of intra-province expenditure to expenditure on goods from elsewhere in the country the higher are internal trade barriers. There is no relation however between this measure and our provincial dummies, again with an adjusted R² of close to zero (see table 9).

We try two alternative measures of infrastructure - telephones per capita and road density (road length/area). There is no relationship between the provincial dummies and the latter variable by province. Where we do find some relation is in a regression of the provincial dummies on telephones per capita. The dummies are positively and significantly related to the former (so regional disadvantage falls with more telephone communications) (see table 9). Good communications are normally seen as an important part of the business environment so the first positive relation is not unexpected. It should be borne in mind that in her analysis of the impact of infrastructure on provincial GDP growth, Demurger (2001) finds that her telecommunications variable had a positive effect on provincial growth relative to the national

average in all three of the north-east provinces. On the other hand, her transport variable had a negative effect in two out of the three. In both cases infrastructure variables are not the dominant explanation of relative provincial growth in the north-east.

Table 9 Correlation coefficients for regression of provincial dummies on explanatory variables.

explanatory variable	adjusted R2	coefficient
policy variable Demurger et al (2003)	0.05	0.99
intra provincial trade/inter provincial trade Poncet (2003)	-0.03	0.02
telephone (lines) per capita	0.20	0.003**
road density	0.02	0.02

** Significant at 5% level

This analysis has offered little help in opening the ‘black box’ of the provincial dummies. The better known measures on geography and policy do not seem important explanations. Also the basic data on intra and inter-provincial trade flows shed little light. As might be expected infrastructure appears to matter, but different measures give conflicting results. This leaves the key explanation likely to lie with the ‘investment climate’ in the region. Infrastructure provision may play a role, but given the fact that the region is not particularly poorly endowed with infrastructure by national standards this is unlikely to be the key. Lack of ‘marketization’, defined as the limited spread of market relations in the north-east, is a widely cited explanation for its relatively poor performance and prospects.¹¹ Marketization is often measured crudely by the share of non-state or foreign-owned firms in economic activity. However our analysis, which controls for these structural features, shows that there are other factors at work. Even allowing for a lower than average role for non-state or foreign –owned firms in different sectors performance is still poor.

This leaves as the key explanation more fundamental features of the investment climate relating to institutional quality via the enforcement of property rights, the application of regulations and the development of financial norms and institutions. At present although work on the investment climate in the region is ongoing, published data refer only to a limited number of cities. The results are also somewhat ambiguous, showing a very mixed picture for the north-east. Out of a ranking of 23 cities nationally Changchun and Dalian are in the top half of the list of 23 (7th and 10th respectively), whilst Benxi and Harbin are in the very bottom group with the worst investment climate (23rd and 21st, respectively).¹² There is clearly scope for further research in this area to link findings such as our’s on firm- level estimates of performance with surveys on the quality of the investment climate.

¹¹ See for example Qunhui (2004).

¹² Dollar et al (2003) table 6. This analysis measures investment climate in various ways and north east cities do not invariably appear to do poorly by the indicators used. However, Harbin has the longest wait time to hear a court case of any city surveyed and Benxi has the second highest local tax rate of any city.

In general, however, our results leave little doubt that changes in ownership and industrial structure that are often put forward as solutions for the region's problems are unlikely to be sufficient to raise its performance to national levels for comparable activities.

Appendix: Data Sources

This paper uses the firm-level annual survey data for China's large and medium-sized industrial enterprises during 1995-2002, which are collected and maintained at the National Bureau of Statistics (NBS) in Beijing. The firm data set allows us to compare enterprise performance across region, ownership, industry, and time. Fuller details on the dataset are in the Appendix of Xiao (2005).

The NBS survey covers more than 20,000 industrial enterprises classed as medium and large. There are some unusable observations due to incomplete data reporting or small enterprises, which were classified as large and medium-sized historically based on their design production capacity. The classification standard for the size of industrial enterprises was first issued in April 1988 by a number of government agencies including the State Planning Commission and the National Bureau of Statistics. It includes detailed specifications based on the measurement of the output quantity or capacity in technical terms, instead of in value. The original standard is a legacy of the centrally planned economy and is being phased out. It now only applies to state-owned enterprises. For private enterprises, the National Bureau of Statistics is using sales value as the only variable to determine the size classification of enterprises.

In this study, we work with the full NBS sample of medium and large enterprises. However observations meeting one of the following screening conditions are regarded as unusable and deleted from the sample:

1. Net value of fixed assets < RMB100,000;
2. Intermediate inputs < RMB100,000;
3. Number of employees < 30;
4. Gross value of industrial inputs at current price < RMB100,000;
5. Sales < RMB100,000;
6. Total assets < RMB100,000;
7. Total assets – liquid assets < 0;
8. Total assets – gross fixed assets < 0;
9. Total assets - net value of fixed assets < 0;
10. Accumulated depreciation – current depreciation < 0;
11. Significant missing data.

The unusable observations are evenly distributed across ownership, industry, and region. Hence, excluding them from the usable sample should not create much bias in our analysis. However the sample does not have the same population over time. As in principle it should cover the entire large and medium-sized industrial enterprises sector, as defined above, so enterprises that become smaller and no longer qualify for the group exit from the sample every year. This means that this is an unbalanced panel and there may be a risk of 'survivor bias' as we do not have data on enterprises that exit the sample.

The sample represents an important part of the economy. The value added of the sample enterprises is as high as 43.3% of total industrial value added in 2002 and 19.2% of GDP. Employment of the sample enterprises is 16.7% of total industrial employment. The total liabilities of the sample enterprises are 43.6% of total bank loans.

Enterprise data at current prices are deflated by price indices for output, fixed capital, and intermediate inputs. In the data analysis, we use an aggregate price index for fixed capital, but apply industry level price indices to deflate output and intermediate inputs.

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