Productivity Growth and Structural Change in Chinese Manufacturing

Lili Wang and Adam Szirmai

Maastricht, 6 March 2008

Literature

Wang, L. and A.Szirmai, 'Productivity Growth and Structural Change in Chinese Manufacturing, 1980-2002', *Industrial and Corporate Change*, accepted, forthcoming

Szirmai, A. and R. Ren, *Measuring Labour Productivity in Chinese Manufacturing: Statistical Problems and Solutions*, B. Pant, eds, *National Accounts of the People's Republic of China. Measurement Issues, Recent Developments and the Way Forward*, Asian Development Bank, 2007, pp. 58-113.

Szirmai, A, R. Ren and M. Bai, Chinese Manufacturing Performance in Comparative Perspective, 1980-2002, Yale Economic Growth Center, Discussion Paper No. 920, July, 2005.

Lili Wang and Adam Szirmai, *Regional Productivity Trends in Chinese Industry*, Paper for the IARIW-NBS International ConferenceExperiences and Challenges in Measuring National Income and Wealth in Transition Economies,September 18–21, 2007, Beijing, China

Focus of presentation

- The reform process in Chinese manufacturing
- Problems involved in measuring growth and productivity in China
- Applications of shift and share techniques
- Contributions of Structural Change in China
- Regional disparities

Changes in Chinese Manufacturing

- Rapid productivity acceleration in the 1990s. Between 1992 to 2002, productivity growth accelerated to 14.8 per cent per year. Between 1996 and 2003 it was no less than 19.6 per cent per year.
- From growth without catch up to catch up
- In 1992, productivity relative to the USA stood at 5.5 percent of the US level. By 2002, it had reached 13.7 per cent of the US level.
- Rapid productivity growth in manufacturing has been achieved in the context of shrinking employment.
  - In 1980, the manufacturing sector at township level and above employed 41.9 million persons. This increased to 71.3 million persons in 1995, but subsequently dropped to 48.7 million persons in 2004.
  - Lay-offs were particularly pronounced in the state-owned sector.
  - In spite of the drop in employment since 1995, manufacturing value added continued to expand at 15.1 per cent per year between 1995 and 2003.
  - Part of the shedded labour was reabsorbed in smaller enterprises. After 1995, the social labour force in total manufacturing did shrink somewhat, but only by some three million workers. Excess labour was also absorbed in the service sector

Explanations

- high domestic rates of investment
- the opening up of the economy to foreign direct investment,
- a massive shakeout of non-productive labour in the state-owned enterprises,
- a succession of efficiency enhancing economic market reforms
- the emergence of new dynamic types of ownership such as joint stock companies, village and township enterprises and foreign owned enterprises, and structural changes within manufacturing

The Reform Process

- **1978-1985: pre-reform period for manufacturing**

  Basic institutions unchanged till 1984. Reform in agriculture

  Opening up to foreign investment
- **1985-1992: take –off**

  managerial independence of state enterprises

  government controls relinquished or decentralised

  private enterprises formally recognised in 1987

  contract responsibility system

  Township and village enterprises
- **1992-1997: acceleration of reform**

  new company law, new forms of ownership, further opening to FDI, reform of trade regime
- **1997-2002: maturing of reform process**

  Legal sanctioning of private enterprise, restructuring of state enterprises, privatising small and medium enterprises, central government cut by one third

Measurement Issues

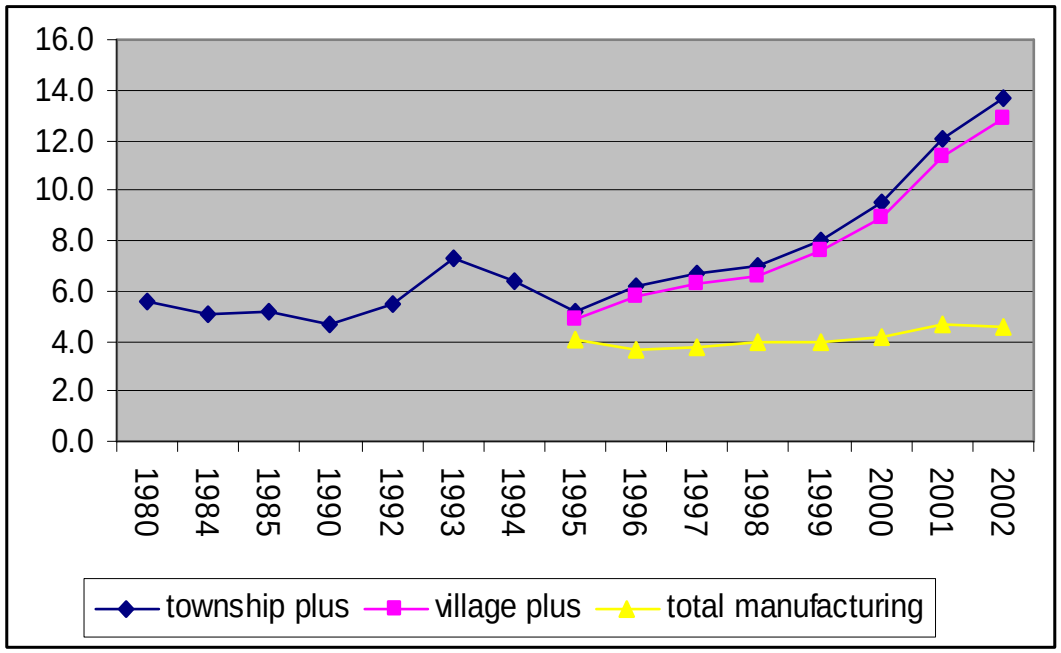
- Transition from Material product system to System of National Accounts;
- Statistical system lagging behind rapid changes in the real world.
- Lack of long consistency; lack of interest; letgacy of cultural revolution
- challenge of vast numbers

- No clear delineation of the manufacturing sector within industry.
- Inconsistencies in coverage of output in sectoral time series; declining coverage
- Changes in output concepts
- Changes in Coverage of employment
- Changes in employment concepts

Adjustments based on using Census of Industries 1985 and 1995 as benchmarks

Figure 1: aggregate productivity growth

Figure 2: Comparative Productivity Growth (USA=100)



Decomposition methods

$$\frac{P^t - P^0}{P^0} = \frac{\sum_{i=1}^{n}(P_i^t - P_i^0)S_i^0}{P^0} + \frac{\sum_{i=1}^{n}(S_i^t - S_i^0)P_i^0}{P^0} + \frac{\sum_{i=1}^{n}(S_i^t - S_i^0)(P_i^t - P_i^0)}{P^0} \qquad (1)$$

P^t is the aggregate labour productivity at year t;

P^0 is the aggregate labour productivity at year 0;

P_i^t is the labour productivity of branch i (sector, ownership or region) at year t;

P_i^0 is the labour productivity of branch i at year 0;

S_i^t is the employment share of i branch at year t;

S_i^0 is the employment share of i branch at year 0.

Decomposition methods

Suppose

K is the set of sectors which expand their labour shares;

J is the set of sectors with declining labour shares.

The increase in the labour share of the expanding sectors equals the decline of the labour share of the shrinking sectors. Therefore, for expanding sectors we can use to express the combined shift effect from shrinking and expanding sectors. This effect will be positive if average productivity in an expanding sector is higher than average productivity in the shrinking sectors

Decomposition methods

Thus the contribution of sector *i* to the aggregate labour productivity becomes

$$C_i = C_i^{intra} + C_i^{shift} = (P_i^T - P_i^0)\cdot \bar{S}_i + (S_i^T - S_i^0)(\bar{P}_i - \bar{P}_J) \quad i \in K \text{ (expanding sectors)}$$

$$C_i = C_i^{intra} = (P_i^T - P_i^0)\cdot \bar{S}_i \qquad i \in J \qquad (2)$$

where S^0, S^T are the labour share at year 0 and year T respectively

$\bar{S}$ is average labour share for the whole period;

P^0 and P^T are the labour productivity at year 0 and year T,

$\bar{P}$ is the average productivity level.

Table 2: Decomposition of Manufacturing Productivity: Contribution of Sectoral Shifts, 1980-1990

	1980-1990				
	LP level (Po) **1980**	**Annual LP growth rate**	Intra	shift	Total
Food manufacturing	3094	4.21%	8.72%	0.14%	8.86%
Beverages	4356	3.50%	2.22%	1.37%	3.59%
Tobacco processing industry	38988	3.55%	12.59%	9.04%	21.63%
Textile industry	4176	-2.65%	-19.09%	3.75%	-15.34%
Clothing industry	1845	3.89%	4.63%	-0.75%	3.88%
Leather and fur products	1950	1.76%	0.71%	-0.33%	0.38%
Wood products	1799	-4.14%	-1.88%	-0.57%	-2.45%
Paper, paper products and printing industry	2639	0.62%	0.42%	0.00%	0.42%
Oil refining, coal, coking and coal products	23345	-4.99%	-14.45%	6.39%	-8.06%
Chemical industry, excluding oil refining	4181	3.64%	20.60%	4.42%	25.02%
Rubber and plastic products	3780	0.60%	0.50%	0.60%	1.10%
Building materials and other non-metallic minerals	1817	1.77%	1.83%	-2.05%	-0.22%
Basic metals	4313	0.26%	-0.06%	1.87%	1.81%
Fabricated metals	1962	1.02%	2.28%	0.00%	2.28%
Machinery	2086	4.33%	23.95%	0.00%	23.95%
transport equipment	2122	7.49%	11.95%	0.11%	12.05%
Electrical machinery and equipment	2760	4.09%	8.56%	0.25%	8.80%
Electronic and telecom machinery	2219	8.87%	10.20%	0.50%	10.70%
instruments	2531	2.08%	0.78%	0.00%	0.78%
Furniture	1339	0.45%	-0.15%	0.00%	-0.15%
Other manufacturing	2362	2.21%	1.56%	-0.59%	0.98%
Total manufacturing	3090	2.32%	75.86%	24.14%	100%

Table 1b
Decomposition of Manufacturing Productivity: Contribution of Sectoral Shifts, 1980-2002

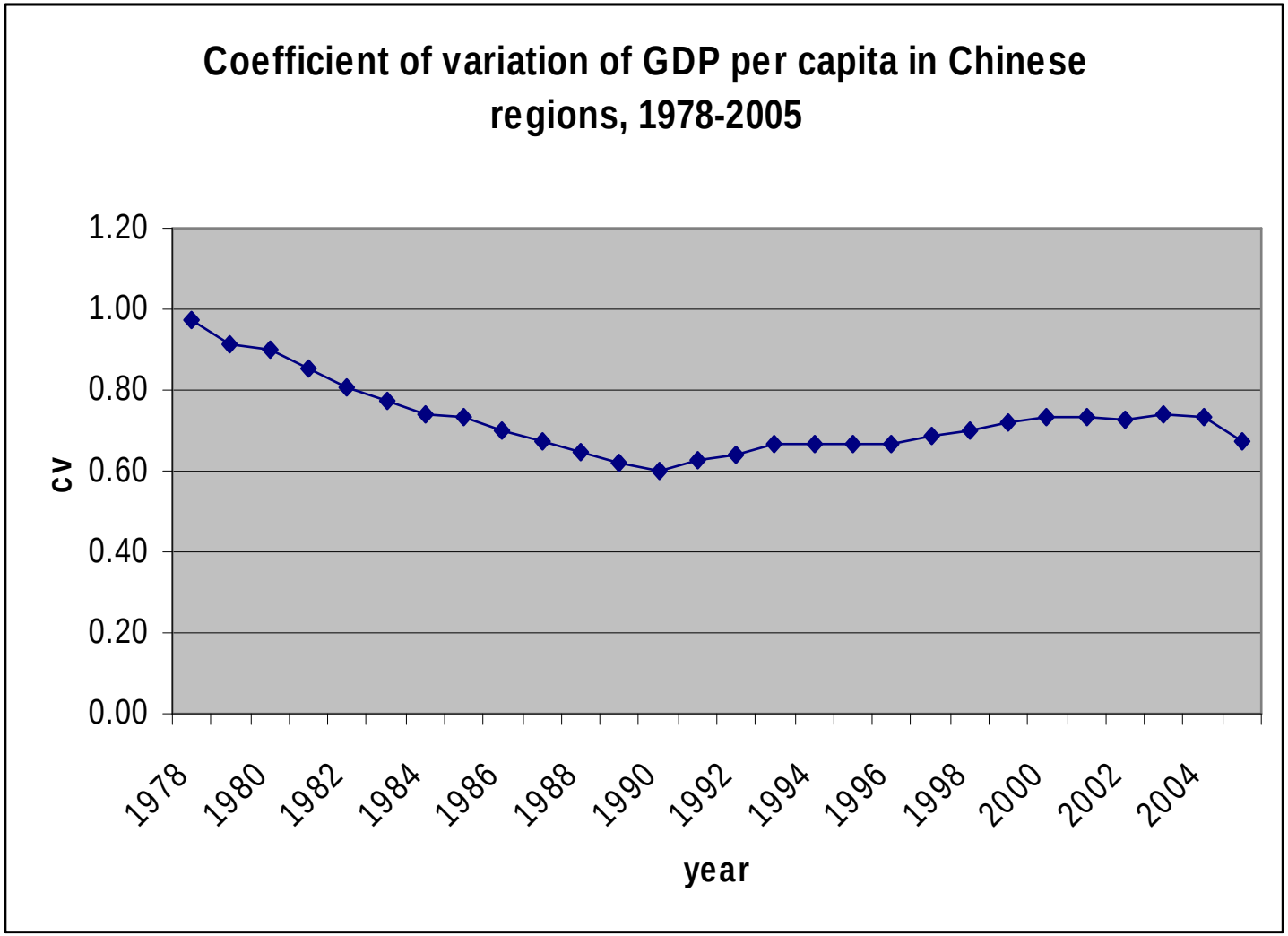
	LP level (Po) **1980**	**Annual LP growth rate**	Intra	shift	Total	LP level (Po) **1990**	LP level Pt 2002
Total manufacturing							
1980-1990	3090	2.32%	75.86%	24.14%	100%	3727	
1990-2002	3727	15.92%	96.69%	3.31%	100%		18334
1980-2002	3090	9.12%	95.82%	4.18%	100%		18334

Table 2: Decomposition of Industrial Productivity: Contribution of Shifts in Ownership[a]

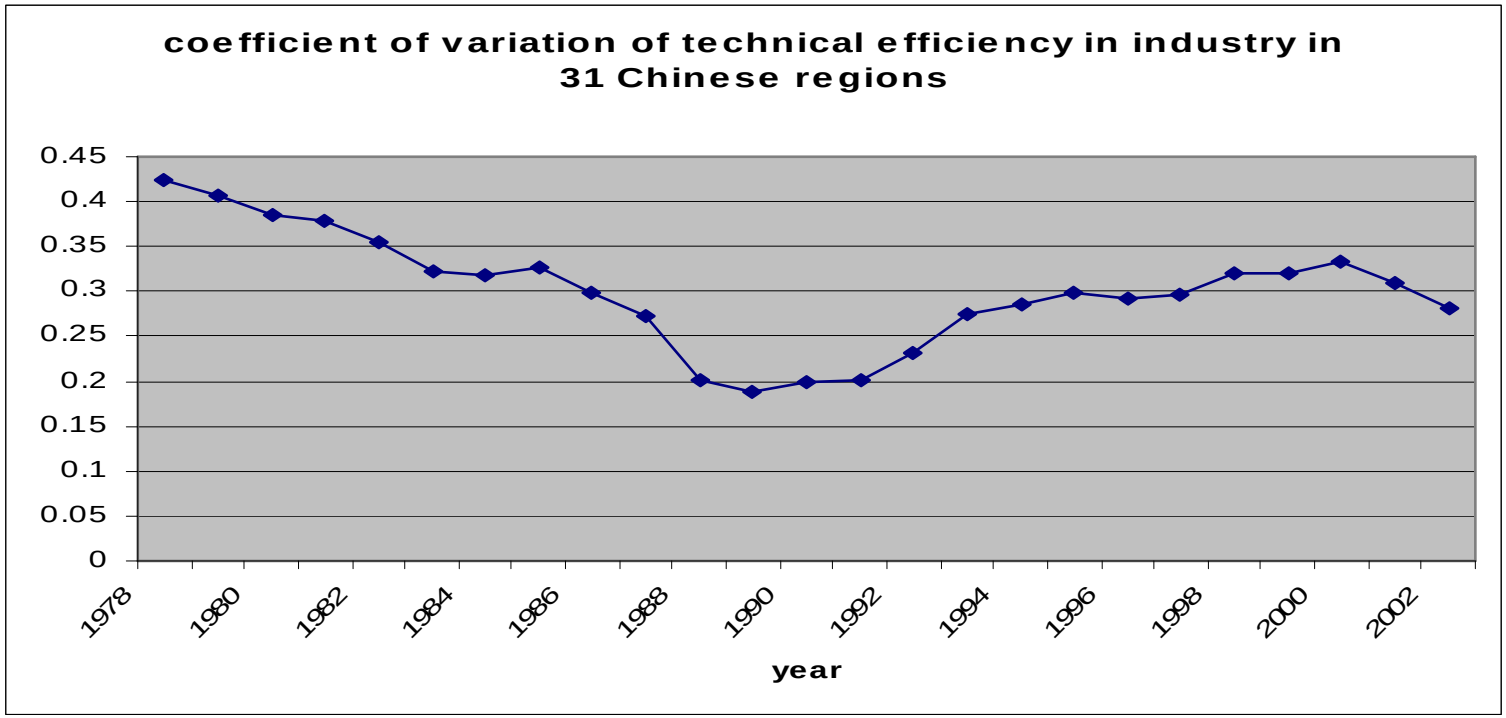
	1980-1985					1985-1992[b]				
	LP level (Po)	Annual LP growth rate	Intra	Shift	Total	LP level (Po)	Annual LP growth rate	Intra	Shift	Total
State-owned	4118	3.66%	83.00%	0.00%	83.00%	4928	0.30%	6.32%	0.00%	6.32
Collective	1674	6.65%	40.01%	-25.00%	15.01%	2310	6.90%	58.00%	0.00%	58.00
Foreign +HK,MC,TW	4090	16.05%	0.49%	0.32%	0.81%	8610	2.58%	3.61%	20.43%	24.03
Private	1268	8.88%	0.01%	-0.07%	-0.05%	1940	16.16%	0.16%	-0.03%	0.12
Joint-ownership	3453	6.13%	1.32%	-0.10%	1.23%	4650	2.96%	1.02%	0.31%	1.33
Others	NA	NA	0.00%	0.00%	0.00%	NA	NA	9.37%	0.82%	10.19
Total industry	**3263**	**3.43%**	**124.85%**	**-24.85%**	100.00%	**3864**	**3.17%**	**78.48%**	**21.52%**	100.00
	1992-1997[b]					**1997-2002**				
	LP level (Po)	Annual LP growth rate	Intra	Shift	Total	LP level (Po)	Annual LP growth rate	Intra	Shift	Total
State-owned	5034	5.90%	37.94%	0.32%	38.25%	6703	23.13%	56.75%	0.00%	56.75
Collective	3685	8.67%	29.37%	0.00%	29.37%	5583	17.62%	15.42%	0.00%	15.42
Foreign +HK,MC,TW	10291	6.47%	9.88%	15.88%	25.75%	14076	10.76%	13.10%	8.90%	22.00
Private	5537	10.16%	0.22%	0.83%	1.05%	8982	7.37%	2.69%	1.34%	4.03
Joint-ownership	5705	3.91%	0.49%	0.00%	0.49%	6913	21.78%	0.93%	0.00%	0.93
Others	9638	-1.10%	-1.02%	6.10%	5.09%	9118	2.25%	0.96%	-0.10%	0.86
Total Industry	**4808**	**8.27%**	**76.87%**	**23.13%**	100.00%	**7153**	**19.24%**	**89.85%**	**10.15%**	100.00

Table 3a: Decomposition of Industrial Productivity
The Contribution of Regional Shifts, 1985-2002

	LP level (Po)	Annual LP growth rate	Intra	Shift	Total
1985-1992	**3864**	**3.17%**	**103.79%**	**-3.79%**	**100.00%**
1992-1997	**4807**	**8.27%**	**94.93%**	**5.07%**	**100.00%**
1997-2002	**7154**	**19.24%**	**93.82%**	**6.18%**	**100.00%**


Coefficient of variation of GDP per capita in Chinese regions, 1978-2005
1.20
1.00
0.80
0.60
0.40
0.20
0.00
cv
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
year


Coefficient variation of industrial labor productivity in Chinese regions, 1978-2002
cv
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
year


coefficient of variation of technical efficiency in industry in 31 Chinese regions
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
year

Conclusions

1. Overall productivity growth was slow in the 1980s, but accelerated dramatically from 1990 onwards.
2. Clear evidence of a structural change bonus at sectoral level in the 1980s. Sectoral shifts contribute 24 per cent to overall productivity growth in manufacturing.
3. When productivity growth accelerated in the 1990s, the contribution of the shift effect dropped to a mere 3.3%. Interpretation: The structural changes in the early reform period of the 1980s resulted in a more efficient economic structure, which provided a foundation for rapid intra-sectoral productivity growth after the 1990.
4. In marked contrast to sectoral changes, changes in the ownership structure contributed negatively to overall productivity growth in the early 1980s. There was a negative shift effect of around 25 per cent.
5. The shift effect for institutional change turned positive after 1985, reaching a peak of 23 per cent in the period 1992-1997, just when the shift effects of sectoral change were negligible. Institutional change has been especially important in the coastal regions. The reform of the ownership structure contributed very substantially to the acceleration of productivity growth after 1992.

Conclusions

6. The effects of regional change are much more modest than those of sectoral and institutional change. Regional shifts contributed negatively to aggregate productivity growth before 1992, and positively after 1992. During the period 1997-2002, there was a positive shift effect of 6.18 per cent. Like institutional change, regional change contributed positively to the acceleration of productivity growth in the nineties.
7. In terms of contributions to productivity growth, the importance of the coastal regions is confirmed by our analysis for all periods. Between 1997 and 2002, seven regions - Guangdong, Shandong, Shanghai, Jiangsu, Zhejiang, Heilongjiang and Liaoning - together account for 54 per cent of total productivity growth.
8. At the aggregate level there was convergence rather than divergence. There is no long-run divergence trend between Chinese regions since 1978. Whatever indicator was used, the degree of regional inequality was substantially lower in 2002 than at the beginning of the reform period.
9. There has been substantial regional convergence from 1978 to around 1990. This was followed by a period of modest divergence up till around 2001. The convergence trend resumed after 2001.
10. Coastal regions had higher productivity than inland regions, but there was no clear tendency for coastal regions to forge ahead relative to regions in the west and in the middle.