Manufacturing Productivity in China and India: The Role of Institutional Changes

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Abstract

In this paper we undertake a comparative study of productivity in the manufacturing sector for China and India using data from survey of manufacturing industries for the two countries. We find that productivity of manufacturing industries in China relative to that in India improved substantially over the 1998-2003 period. Specifically, the average total factor productivity (TFP) growth for the manufacturing sector over this period was about 12 percent higher in China than in India. We document two substantial changes in government policies in China that were not witnessed in India. First, the late 1990s saw an enormous wave of ownership restructuring due to the formal endorsement of private property rights by the Chinese central government. Second, in 1997 a large scale labor retrenchment program was launched to address the long standing problem of labor redundancy in the public sector. Using data from the Chinese survey of manufacturing industries, we quantify the impact of these large scale institutional changes on TFP of Chinese manufacturing industries. We find that these policy changes can explain about 30 percent of the growth in TFP of manufacturing industries. Hence we conclude that these institutional changes in China can account for a significant part of the gains in productivity of manufacturing industries in China relative to that in India over the 1998-2003 period.

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1. Introduction

China and India in the last decade or so have emerged as economic powerhouses. The performance of the world's most populous countries has long been a fascinating subject largely because they have embraced very different models of development. Having embarked on the path of deregulations and trade liberalization a decade earlier than India, China has more aggressively integrated its economy with the world economy through international trade and foreign investment but has taken a more cautious approach to divesting its ailing state sector. Commentators contend that while China's early steps to reform its economy and success in attracting foreign investment gave it a substantial edge over India in terms of per capita income growth over the past two decades, however, India has a long-term advance over China with its superior institutional infrastructure and corporate governance (Huang and Khanna, 2003).

In this paper we undertake a comparative analysis of the performance in the manufacturing sector for the two economies. While a number of studies have analyzed the performance of the manufacturing sector for each of these economies, none of these studies have undertaken a comparative analysis of productivity of the manufacturing sector in the two economies.[1] Specifically, none have asked the question: how does productivity in China compare with that in India.[2]

For the comparative analysis we use data for manufacturing industries at the 2-digit level of aggregation from the Annual Survey of Industries for India and the Annual Survey of Industrial

[1] Some recent contributions analyzing China's manufacturing sector include Izumi et al. (2000), Zhang (2003), Jefferson et. al. (2005), Dong et. al. (2006) and Yao and Song (2004) among others. The performance of the Indian manufacturing sector has been analyzed by Sharma (2006), Mitra and Ural (2006) among others.

[2] Two recent studies have analyzed the comparative performance of the two countries. Bloom et al. (2006) address the issue of why the China took off before India while Hsieh and Klenow (2006) study the misallocation of capital and its effect on manufacturing total factor productivity for the two countries.

Production for China for the 1998-2003 period.[3] We compute productivity as value added per worker as well as total factor productivity (TFP). These measures of productivity are then used to identify areas where China had a productivity advantage over India and document how this advantage has evolved over the 1998-2003 period. In 1998 China's productivity advantage was in consumer non-durable industries while India had an advantage in consumer durable industries. Over the short time span of 6 years, we find that China has not only improved its performance in consumer non-durable industries but also caught up, and in some cases exceeded, the productivity of consumer durable industries in India. For the 1998-2003 period we find that the average TFP growth for manufacturing industries was about 12 percent higher in China than in India.

Next we explore the reasons for this phenomenal performance of the Chinese manufacturing sector relative to that of India. In the mid and late 1990s the Chinese government undertook two large-scale policy reforms, ownership reforms and labor market reforms, which were not witnessed in India. The ownership reforms resulted in a reduction of the Chinese government share of equity in the manufacturing sector from 48 percent to 26 percent over the 1998-2003 period. Since manufacturing industries in India were largely owned by the private sector, there were no ownership reforms on the scale witnessed in China. In the late 1990s the Chinese government introduced changes to labor laws that made it easier for firms to dismiss workers and as a consequence firm size, measured as workers per firm, reduced by about 14 percent. In India the policy reforms in the early and mid 1990s did not include changes to its outdated labor laws and this has remained a cause of concern.[4]

We hypothesize that the large scale policy reforms witnessed in China, but absent in India, should have helped Chinese manufacturing firms to re-organize their production. By moving a firm's

[3] Given that India and China follow different classification system for their surveys, we had to reclassify the data for the two surveys according to a common classification (ISIC Rev. 3.1) to obtain a comparable dataset. We converted all monetary variables to U.S. dollars and accounted for price level changes over the period. This provided us with data for 18 2-digit manufacturing industries common to both countries.

[4] For a discussion of the problems with Indian labor laws see Basu (2005) and references therein.

allocation towards the production possibility frontier, ownership restructuring and labor reforms would increase TFP for the manufacturing sector in China and hence could account for some of the substantial growth in average TFP of the manufacturing sector in China relative to that in India.

To quantify the effect of ownership and labor market reforms on manufacturing TFP growth in China we use a production function based regression. Using data for 3-digit manufacturing industries we find that the two policy changes together can account for about 30 percent of the growth in average manufacturing TFP over the 1998-2003 period. We further find that the effect of ownership restructuring on average growth in manufacturing TFP was larger than the effect of firm downsizing. Similar results are obtained for the Chinese consumer durable and consumer non-durable industries for the effect of the two policy reforms on TFP growth. These results lead us to conclude that the sweeping policy changes in China starting in the 1990s have had a significant positive impact on the TFP growth of manufacturing industries in China.

The rest of the paper is organized as follows. In Section 2, we review policy changes in China and India with regards to ownership of firms and labor regimes in the 1990s. Section 3 describes the data we use for our analysis. In Section 4 we present a comparative analysis of changes in productivity of the manufacturing sector in China and India over the 1998-2003 period. Section 5 investigates the impact of policy changes in China on TFP growth in the manufacturing sector. Section 6 concludes.

2. Policy Review:

In this section we present a brief review of policy changes in China and India over the 1990s. Specifically, we focus on changes to ownership structure and labor regimes for the two countries.

China:

Under central planning, China's industrial sector consisted almost exclusively of state- and collective-owned enterprises. In late 1970s China began its transition to a market-oriented economy with a gradualist approach. Early efforts to reform state-owned enterprises (SOEs) were largely

focused on restructuring incentive structures within the established system of public ownership, enhancing the role of markets, encouraging the entry of new non-state enterprises. While state enterprises were under pressure to become more competitive, the dismissal of state employees remained an exception up until the early 1990s. The rigid labor system and inefficient governance under state ownership resulted in mounting losses and growing labor surplus in state owned enterprises (SOEs). Studies reveal that nearly a third of SOEs were losing money and 20 to 40 percent of all SOE workers were redundant in the early 1990s (Li and Xu, 2001; Dong and Putterman, 2001).[5]

The pace of market reforms greatly accelerated in the 1990s. In late 1992, the central government formally endorsed private property rights and initiated ownership reforms. The ownership rights reform policies were reaffirmed during the 15th Congress of the Chinese Communist Party in September 1997. Thus, the late 1990s saw an enormous wave of ownership restructuring in the state owned industries; a large number of SOEs were transformed into joint-stock companies, went bankrupt, merged with other enterprises, or were sold to private individuals. Evidence has begun to emerge indicating that ownership rights reforms have brought about a significant improvement in the performance of Chinese industrial enterprises.[6]

Accompanying these radical changes in property rights was the acceleration of labor market reforms. In 1994, a new Labor Law was passed sanctioning the right of employers to dismiss workers. In 1997, newly elected Premier Zhu Rongji announced a large-scale labor retrenchment program in an attempt to revitalize SOEs. As a result, more than 28 million state workers were laid off between 1998 and 2002 (Zhang, 2004). Studies show that the removal of employment guarantees for state workers has led to substantial labor reallocation both within and between sectors and the pace and pattern of job

[5] In these studies labor redundancy rates are defined as the difference between the observed level of employment and the profit maximizing level of employment (both in log form) in a firm.
[6] For example, refer to Ho et al. (2003); Li and Rozelle (2004); Jefferson et al. (2005); Yao and Song (2006); Dong et al. (2006).

flows in China's industrial sector after the public sector restructuring are markedly similar to those found in mature market economies with a less regulated labor regime (e.g. Dong and Xu, 2007).

India:

Post independence, in 1947, large state owned enterprises were created to produce manufactured goods deemed critical by the government of India (for example, steel and cement). The private sector was allowed to produce in non-critical sectors, although subject to licensing and quota restrictions. In the 1980s such restrictions were gradually relaxed and by the early 1990s (sweeping reforms in 1991) most of these restrictions were removed (see Delong, 2000, Sachs et al., 1999, Joshi, 1998 for details). Thus India has had a long history of private sector production in the manufacturing sector. By the late 1990s privately owned firms produced most of the goods in the manufacturing sector. The Indian government, however, still holds some equity in few sectors (about 4% of plants that accounted for about 16% of manufacturing value added were owned by the government in 1994, Hsieh and Klenow (2006)).

Even when most of the Indian manufacturing firms are privately owned, they face a number of restrictions in the labor market. For example, the Indian *Industrial Disputes Act* of 1947 along with the amendments to it in 1976 and 1982 places a number of restrictions on large firms for dismissal and layoff of workers. Specifically, the Act requires that firms employing 50 or more workers firms have to pay a predetermined compensation for laying-off workers. For firms employing more than 100 workers the restriction is even more stringent since the Act requires that firms seek the government's permission for layoffs and retrenchment of workers as well as for closing down the firm. These restrictions are imposed on both public and private sector firms.

Labor market reforms have been a cause of concern for India. The major reforms undertaken in 1991 were not accompanied by reforms in the outdated Indian labor laws. In fact the 2005-2006 Economic Survey, an annual review of the Indian economy presented by the Indian Ministry of

Finance, urges India to take a leaf out of China's experience with labor reforms and presents the following argument "…studies indicate that Indian labour laws are highly protective of labour, and labour markets are relatively inflexible… Perhaps there are lessons to be learnt from China in the area of labour reforms. China, with a history of extreme employment security, has drastically reformed its labour relations and created a new labour market, in which workers are highly mobile."[7]

Recent studies on the Indian economy find that the lack of labor market reforms may be detrimental to growth of the Indian economy in the long run. In a comprehensive overview of policy changes in India, Kochar et al. (2006) argue that lack of labor market reforms may have hurt the Indian manufacturing sector.[8] Basu (2005), analyzing the impact of prevailing Indian labor laws on workers, argues that labor market rigidities in India are in sharp contrast to Asian countries and have resulted in poverty, underemployment and unemployment of workers in India.

The large scale ownership restructuring and labor market reforms in China in the 1990s were not witnessed in India. Hence, a comparative study of productivity of manufacturing industries for India and China over the 1998-2003 period provides a way of evaluating the role of such policy changes in promoting productivity growth.

3. Data

For India we use data available from the Annual Survey of Industries (ASI) website for the period from 1998 to 2003 at the 2-digit level of organized manufacturing industries classified according to ISIC Rev 3.1.[9] The survey covers all factories employing 200 or more workers and includes about 120,000 factories each year over the 1998-2003 period. The dataset provides

[7] Economic Survey 2005-2006 available at http://indiabudget.nic.in/es2005-06/esmain.htm.
[8] Besley and Burgess (2004) analyze labor regulations in India and reach a similar conclusion.
[9] We only have access to data aggregated at the 2-digit level for India. ASI website: (http://mospi.nic.in/stat_act_t3.htm)

information about the employment, capital stock, total wages and value added for each 2-digit manufacturing industry with all monetary values in Indian rupees.

The data for China are from the Annual Survey of Industrial Production from 1998 through 2003 undertaken by China's National Bureau of Statistics (NBS). The Annual Survey of Industrial Production is a census of all state-owned enterprises plus all non-state enterprises with more than 5 million *yuan* in sales revenue-a total of 119,000 to 169,000 enterprises in 1998 and 2003. However, we only have access to the data aggregated at the 2- and 3-digit industry levels.

Given that China and India follow a different classification system for their surveys, we merged the data according to ISIC Rev 3.1, the classification system used for the Indian survey, to construct a comparable dataset for the two countries at the 2-digit level of aggregation.[10] To accomplish this we had to aggregate some manufacturing industries in China according to the definition of industries for the ISIC Rev 3.1 system of classification. Reclassifying the data according to the common classification for the two countries, converting all monetary values to US dollars and taking account of price changes over the 6 year period provides us with a comparable dataset for India and China for 18 2-digit manufacturing industries for the 1998-2003 period.[11, 12]

4. China – India Manufacturing Productivity Comparison

Using the comparable dataset at the 2-digit level of aggregation, in this section we evaluate productivity of manufacturing industries in India relative to those in China. We consider two measures of productivity, labor productivity, which is defined as value added per worker, and total factor

[10] For details on the ISIC Rev 3.1 classification see http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17&Lg=1.

[11] For the comparative analysis that follows, we do not include the tobacco industry as this industry is dominated by government production in China and was not effected by the large scale institutional changes undertaken by the Chinese government.

[12] We use the national ex-factory price index for China and the national Wholesale Price Index (WPI) for India to convert all monetary values to real terms. The price index for China is obtained from China Statistical Yearbook 2005, Table 9-1 while the WPI for India is obtained from the website of Reserve Bank of India (http://rbidocs.rbi.org.in/rdocs/Publications/PDFs/69105.pdf).

productivity (TFP). [13] Labor productivities and TFP of India relative to China for 1998 and 2003 for each industry are presented in Table 1.[14]

In 1998 China had a significantly higher labour productivity than India in food processing and wood products, while India had a significant productivity advantage in coke, chemical products, basic metals, office computing and electrical machinery. Grouping industries as consumer non-durables sector (code 15-20) and consumer durable and producer goods sector (code 21-34) it is evident that China had a productivity advantage over India in the former group of industries while India had an advantage in the latter. By 2003, however, China gains in terms of labor productivity relative to India in all 2-digit level industries.

Differences in labour productivity could be due to differences across industries in utilization of capital for production. Capital per worker in India relative to China across industries reported in Table 1 shows that there are substantial differences in the use of capital across industries between the two countries. Hence, to get a measure of technology differences across industries for the two countries, we compute TFP of India relative to China for each industry.

In 1998 TFP in India was higher than that for China for a number of 2-digit industries. Over the 1998-2003 period China gained in terms of TFP relative to India in all industries (last column of Table 1). Over the 6 year period, not only did China increase its productivity advantage over India in the consumer non-durable sector but also caught up with, and in some cases exceeded, the productivity of industries in the Indian consumer durable and producer goods sector.

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[13] For China, capital assets are measured by net value of fixed assets and labor is annual average number of employed person. As measure of capital assets for India we use the invested capital variable from the Indian survey. This variable provides the value of net total assets for each 2-digit industry. Labor for India is measured using the total persons engaged variable in the ASI. For details on the definition of these variables refer to the ASI codebook.

[14] TFP is calculated assuming a capital share of 0.4 for all industries as: $TFP = y/k^{0.4}$, where y is value added per worker and k is capital per worker.

Productivity in China relative to India increased substantially over the 1998-2003 period for almost all manufacturing industries at the 2-digit level. We next use a production function based regression to estimate the difference in average TFP growth for manufacturing industries between the two countries. To do so, we assume the following production function for an industry *i* for country *j* at time *t*:

$$Y_{it} = A_{it} K_{it}^{\alpha_j} L_{it}^{\beta_j},$$
$$A_{it} = A_o e^{\lambda_j t + \varepsilon_{it} + \eta_i}, \quad (1)$$

where *Y* is value added, *K* is capital stock, *L* is quantity of labor, *A* represents TFP, while the parameters α and β represent capital and labor shares, respectively. Note that we allow capital and labor shares to differ between India and China. TFP growth has three components: a time trend coefficient λ that is country specific and represents the average annual growth in TFP, an exogenous iid shock ε and an industry specific fixed effect η.

Dividing the production function for a 2-digit industry in India by that in China and taking logarithms we get the following regression equation:

$$\ln(relY)_{it} = c + a_1 \ln(Kind_{it}) + a_2 \ln(Lind_{it}) + a_3 \ln(Kchn_{it}) + a_4 \ln(Lchn_{it}) + \theta_j t + \omega_i + \pi_{it} \quad (2)$$

where for industry *i* at time *t*, *relY* represents value added for the industry in India relative to that in China, *Kind* and *Lind* are capital and labor in India, *Kchn* and *Lchn* are capital and labor in China, θ represents the average growth of TFP in India relative to that in China, ω is the difference in industry fixed effects and π is the difference in the exogenous shocks between the two countries. Regression (2) is estimated using panel data for the 1998-2003 period allowing for industry specific fixed effects.

Table 2 presents the estimation results. Based on the estimates for regression (2) we find that over this period average TFP growth of manufacturing industries was about 12 percent faster in China

than in India.[15] To regression (2) we add time dummies (d99-d03 with 1998 as base year) to estimate the temporal variations in relative TFP growth rates (column 2 of Table 2). All dummies are negative and significant, with the exception of the dummy for 1999, suggesting that TFP in China relative to India increased for most of the period under investigation.

Productivity of manufacturing industries in China relative to that in India improved substantially over the 1998-2003 period. As mentioned earlier, in 1998 manufacturing industries were largely owned by the private sector in India while the Chinese government still held a substantial equity in manufacturing industries. Perhaps, an explanation for this phenomenal productivity performance of China relative to India could be the enormous ownership restructuring with the Chinese government selling off its equity to private individuals. This may have led to an increase in efficiency of enterprises in the Chinese manufacturing industries as private property rights provide managers with better incentives to allocate resources according to commercial criteria.

In addition, as a result of the labor market reforms, China also witnessed large-scale firm size downsizing over this period. Having more autonomy to hire and fire workers would lead to increased efficiency for firms in the manufacturing sector. This may be another reason for productivity increase in China relative to India, since, as elaborated in Section 2, there were no changes to the outdated labor laws in India. By moving a firm's allocation towards the production possibility frontier, ownership restructuring and labor reforms would increase TFP for the manufacturing sector in China and hence could account for some of the substantial growth in average TFP of the manufacturing sector in China relative to that in India. We explore these explanations and quantify the impact of the two policy changes on TFP growth of Chinese manufacturing industries in the next section.

[15] Average TFP growth rates for manufacturing industries for the two countries differ substantially even when local currency values of value added and capital stocks are used to estimate the TFP growth. Using the log-linearized production function to estimate the average TFP growth for the two countries based on data in local currency units results in an average annual growth rate of 2.04% for India and 9.10% for China.

5. Ownership Restructuring, Firm Downsizing and Chinese Manufacturing Productivity

We use data at the more disaggregated 3-digit level from the Chinese survey to analyze and quantify the impact of ownership structuring and downsizing of firms on manufacturing productivity growth in China. Table 3 provides a summary of the data for 3-digit industries available from the Annual Survey of Industrial Production for China.[16] Over the 1998-2003 period the ownership share of SOEs and collectives (share of equity publicly owned) decreased from 48.3 percent to 25.7 percent. Majority of this decrease was captured by increase in ownership share of legal persons (increased by 9%) and domestic private investors (increased by 10%).[17] In addition, as a result of workforce retrenchment, firm size (measured as workers per firm) declined by about 20 percent between 1998 and 2003.[18,19] Thus the policy reforms in the mid and late 1990s had a significant impact on the organizational structure of firms in the manufacturing sector in China over the 1998-2003 period.

Accompanying these organizational changes, there was a 10 percent decline in the number of money losing firms in the manufacturing sector as well as a substantial reduction (about 7%) in losses as percentage of manufacturing value added over this period. In other words, performance of firms in the manufacturing sector improved substantially over the 1998-2003 period. Table 3 also provides ownership shares, firm size and performance indicators for consumer non-durable and consumer

[16] We consider only manufacturing industries at the 3-digit level from the Chinese survey. According to the Chinese industrial classification we include industries with codes between 1500 and 4390, both inclusive. This data is at a more disaggregated level for the 2-digit industries used for the comparison between China and India.

[17] Ownership reforms are measured by the share of equity owned by domestic private investors and foreign investors. Legal-person share is a mixture of ownership by state legal persons and private legal persons, and based on our conversation with Chinese accounting experts, state legal persons often account for the majority of legal person-owned firms. Hence, we count equity owned by legal person as publicly owned to avoid overstating the size of the private sector.

[18] Firm size, measured as workers per firm for a 3-digit industry, is used as our measure for labor market reforms since downsizing the workforce was the objective of the public sector labor retrenchment program introduced in the fall of 1997.

[19] The 20 percent decline in firm size is computed taking into account the weight of each industry in the manufacturing sector. The mean decline in firm size between 1998 and 2003 across 3-digit industries is 14 percent and we would use this number for the growth decomposition exercise that follows.

durable and producer goods industries. The patterns for share of equity publicly owned, firm size and improvements in performance of firms for the two groups are very similar to that for the overall manufacturing sector.

To quantitatively evaluate the impact of these large-scale changes on the average manufacturing TFP growth in China, we use a production function based regression similar to that used in the previous section. We assume the following production function for an industry *i* at time *t*:

$$\begin{aligned} Y_{it} &= A_{it} K_{it}^{\xi} L_{it}^{\psi}, \\ A_{it} &= A_o e^{\lambda t + \sigma' X_{it} + \varepsilon_{it} + \eta_i}, \end{aligned} \tag{3}$$

where Y is value added, K is capital stock, L is quantity of labour, A represents TFP, while the parameters ξ and ψ represent output coefficients on capital and labour, respectively. Now growth in TFP has four components: a time trend coefficient λ that represents average annual growth of TFP; X includes policy change variables (changes in ownership structure and firm size) that effect TFP growth; an exogenous iid shock ε and an industry specific fixed effect η. Taking logs yields the following empirical specification:

$$\ln(Y)_{it} = c + a_1 \ln(K_{it}) + a_2 \ln(L_{it}) + \lambda t + \sigma' X_{it} + \varepsilon_{it} + \eta_i . \tag{4}$$

Using panel data for 3-digit industries for China over the 1998-2003 period, we first estimate regression (4) allowing for industry specific fixed effects without our policy change variables (X). The estimates are presented in Column 1 of Table 4. Between 1998 and 2003 average annual TFP growth for 3-digit manufacturing industries in China was about 10% (estimated annual time trend).

Next we sequentially add reform variables that may effect TFP growth and evaluate the average TFP growth conditional on these variables. In Column 2 of Table 4 we add to the regression private equity share, which captures the ownership restructuring in China due to the sweeping ownership reforms undertaken by the Chinese government in the 1990s. As expected, the share of private equity has a significant positive effect on productivity; a one percentage point increase in private share raises

productivity by about 0.86 percent. After controlling for the privatization effect, the estimated annual time trend (7.5%) is substantially lower than before suggesting that if private equity share had not changed between 1998 and 2003, TFP growth in China would have been about 28 percent lower. Hence ownership restructuring played a substantial role in accelerating TFP growth for the Chinese manufacturing sector between 1998 and 2003.

In Column 3 of Table 4 we add our firm downsizing variable, logarithm of workers per firm (Log(LPF)), to the regression. This variable captures the labor market reforms which allowed Chinese employers to dismiss workers as well as the effect of the large-scale labor retrenchment program for state owned enterprises. Consistent with economic intuition, the estimates show that firm size has a significant negative effect on average TFP for manufacturing industries. Based on the estimated coefficient for Log(LPF) we find that if the average workforce of a firm in a given 3-digit industry falls by one percent, average TFP for the manufacturing sector would increase by 0.13 percent. The estimated annual TFP growth without the downsizing over this period would have been 9.8 percent. Thus the contribution of the downsizing effect to TFP growth was about 5 percent .[20]

In Column 4 of Table 4 we add both the reform variables to quantify their combined effect on average TFP growth. The estimated annual time trend decreases from 0.103 in column (1) to 0.073, suggesting that ownership restructuring and firm downsizing can account for about 30 percent of the growth in average TFP for 3-digit Chinese manufacturing industries over this period.

When comparing productivity of manufacturing industries in India and China in Section 4, we found that there were differences between the consumer durable and consumer non-durable manufacturing industries.[21] To assess whether the impact of the two policy reforms differed between

[20] We follow the work of Podrecca and Carmeci (2001) and use the Arellano and Bond (1991) test for panel data and find that there are no issues with endogeneity for our policy variables, private equity share and workers per firm. Results of the endogeneity tests are presented in the Appendix.

[21] For the Chinese 3-digit level data industries with codes between 1500 and 2490 are classified as consumer durable goods industries while those with codes between 2500 and 4390 are classified as consumer non-durable and producer goods industries.

the two groups of industries, we repeat the production function regression based analysis for the sub-samples of consumer non-durables and consumer durables and producer goods sectors and present the respective results in Tables 5 and 6.

These estimates reveal a pattern similar to the overall manufacturing sector in which ownership restructuring and firm downsizing contribute significantly to average TFP growth for each sub-sample. Without controlling for policy changes the average annual TFP growth for consumer non-durable industries was about 7.1 percent (Regression 1 Table 5). After controlling for the effect of the two policy reforms the estimated average growth in TFP reduces to 5.2 percent. Hence the combined contribution of the two reforms to average TFP growth was about 27 percent for this sub-sample of industries (Regression 4 Table 6). In addition, both policy reforms contributed significantly to average TFP growth for this group of industries.

The growth of average TFP for t he consumer durable and producer goods industries (11.7%) was higher than that for consumer non-durable industries (Regression 1 Table 6). Controlling for the two policy reforms by introducing the policy change variables in the regression reduces the estimated annual time trend to 8.6 percent, suggesting that the two policy reforms can account for about 26 percent of the average growth in TFP for this group of industries. Furthermore, similar to the results for the overall manufacturing sector, the estimates indicate that the contribution of labor downsizing to TFP growth was small for this group of industries.

Using the estimates from the production function based regressions reported in Column 4 of Tables 4 to 6 we undertake a growth decomposition analysis to access the contribution of each of these policy changes to output growth. For the growth decomposition we log-linearize the production function and take the difference over time for each variable to get the following relationship:

$$\Delta \ln Y_t = \hat{a}_1 \Delta \ln K_t + \hat{a}_2 \Delta \ln L_t + \hat{\sigma}_1 \Delta \mathrm{Pr}\, ivate\_sh + \hat{\sigma}_2 \Delta Log(LPF) + \hat{\lambda} \Delta time,$$

where *hat* represents estimated coefficients while Δ represents change in the variable over time.

Results of the growth decomposition for the 1998-2003 period are presented in Table 7. Over the 6 year period output of the Chinese manufacturing sector increased by 91 percent. Increase in capital and labor inputs accounted for about 44 percent of this increase in output. The contribution of the two policy changes was about 13 percent; while the remaining 40 percent of the output growth was due to TFP growth resulting from technological changes and other reform measures. [22]

Table 7 also presents the results of the growth decomposition exercise for the two sub-samples, consumer non-durable goods sector and consumer durable and producer goods sector. The increase in output for the consumer non-durable goods sector (72%) was lower than that for the consumer durables and producer goods sector (97%). The results of the growth decomposition exercise confirm our earlier finding that the effect of the two policy reforms on TFP growth the same for both the sub-samples latter. The two policy reforms account for about 14 percent and 11 percent of the output increase for the consumer durables and producer goods sector and the consumer non-durable goods sector, respectively.

The changes to the ownership structure and the labor market reforms in China in the late 1990s can account for about 30 percent of the growth in TFP of the manufacturing sector in China for the 1998-2003 period. Over this time period China substantially increased its productivity in all manufacturing industries relative to India. Since the large-scale reforms undertaken in China were not observed in India, we conclude that a significant part of the growth in productivity of China relative to that in India can be explained by the two policy reforms.

[22] The contribution of ownership restructuring to TFP growth appears to be noticeably greater than that of labor retrenchment. This may reflect that while the elimination of labor surplus and the improvement of labor flexibility should improve economic efficiency, massive lay-offs have negative psychological effects that offset the positive effect of labor reforms in the short run (De Meuse, et al. 2004). Despite the potential ambiguous consequences, our estimates reveal a positive net effect of labor market reforms. With the passage of time, we anticipate a larger positive impact of the sweeping labor market reforms.

6. Conclusions

Given the growing importance of India and China in the world economy, there have been a number of discussions about the economic performance of these two countries. Commentators have argued that while China's success in attracting foreign investment gave it a substantial edge over India in terms of per capita income growth, India has a long-term advance over China with its superior institutional infrastructure and corporate governance. Since the late 1990s, however, China has undertaken a series of measures to reform ownership structure and downsize the workforce of public enterprises while no such reforms were witnessed in India. In this paper we examine to what extent the recent public sector restructuring in China has succeeded in closing the institutional advantage of India over China with a comparative analysis of the performance of industrial enterprises in the two countries.

Using a dataset for manufacturing industries at the 2-digit level of aggregation we compare average TFP growth for the two countries for the 1998-2003 period. We find that over this period most manufacturing industries in China improved their performance in terms of productivity relative to those in India and average manufacturing TFP growth in China was substantially greater than that in India. Using a production function based regression we further explore how much of the TFP growth in the manufacturing sector can be accounted for by the two policy changes. We find that as much as 30 percent of the average TFP growth of Chinese manufacturing industries can be explained by the two policy reforms. The substantial improvement in performance of manufacturing industries in China relative to those in India following the two sweeping policy reforms in China highlights the crucial role played by policy changes in promoting TFP growth.

The findings suggest that China has been successful in closing the institutional gap relative to India in terms of private property rights of manufacturing firms and has improved efficiency significantly in the process. Further, China has outdone India in removing labor market rigidities and this again has had a positive impact on TFP growth for manufacturing industries. Thus our findings

support recent literature which argues that India stands to gain significantly in terms of TFP through labor market reforms.

Our research is subject to some caveats. Due to the data limitations and problems with constructing a comparable dataset for the two countries, our comparative analysis concentrated on the 2-digit level of aggregation for manufacturing industries. A parallel investigation at the level of 3-digit industry for India would shed more light on the changes in the Indian industrial sector during the period of investigation. A comparative study using firm-level data would generate more insights into the institutional strengths and weaknesses of the two emerging economic powers.

1. **Appendix**

Endogeneity

For our analysis of the impact of policy changes on TFP growth for the Chinese manufacturing industries we assumed that private equity share (*Private_sh*) was an exogenous variable. However, an argument can be made that private equity may increase in sectors that are more productive and hence productive may be the cause of the increase in private equity share. To ensure the robustness of our results we undertake a causality test to assess whether private share of equity may be an endogenous variable. We perform the panel data causality test suggested by Podrecca and Carmeci (2001) based on Arellano and Bond (1991). Specifically, we estimate the first differenced version of regression (4) by regressing the first difference of log(*Y*) on lagged first difference of log(*Y*), first difference of log(*K*), first difference of log(*L*), first difference of *Private_sh* and one period lag of the first difference of *Private_sh*. Then we test whether the coefficient on lagged *Private_sh* is zero. If it is then *Private_sh* does not granger cause *Y*. Similarly we estimate a regression with the first difference of *Private_sh* as the dependent variable and then test whether *Y* granger causes *Private_sh*.

Table 8 presents the results of our causality tests. The Wald tests reported in the Table suggest that we must accept the null of non-causality for both the specifications. This leads us to conclude that private share of equity is not an endogenous variable.

A similar test of endogeneity is presented for our second policy change variable, labor per firm (*Log(LPF)*). The results of the test are reported in Table 9. As for *Private_sh*, the Wald test of non-causality is accepted for both specifications, leading us to conclude that lagged values of *Log(LPF)* conditional on other variables do not effect output growth and that lagged values of output growth conditional on other variables does not effect changes in *Log(LPF)*. Hence we find that labor per firm is not an endogenous variable.

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Table 1: Labor, capital and total factor productivity: India relative to China

Code	Two-digit industry	Value-added per worker			Capital per worker		
		1998	2003	% change	1998	2003	% change
15	FOOD PRODUCTS AND BEVERAGES	0.67	0.23	-65.05	1.18	1.03	-12.88
17	TEXTILES PRODUCTS	0.96	0.41	-57.21	0.40	0.21	-46.91
18	WEARING APPAREL, DRESSING & DYEING OF FUR	0.93	0.41	-55.44	4.35	2.83	-34.91
19	LEATHER & RELATED PRODUCTS	0.77	0.40	-48.63	1.23	1.44	17.43
20	WOOD AND WOOD PRODUCTS	0.49	0.30	-39.31	0.65	0.70	7.14
21	PAPER AND PAPER PRODUCTS	0.94	0.48	-49.28	1.71	1.02	-40.39
22	PUBLISHING, PRINTING AND RELATED ACTIVITIES	1.14	0.71	-37.86	3.91	2.14	-45.20
23	COKE, PETROLEUM PRODUCTS AND NUCLEAR FUEL	2.47	2.29	-7.54	2.25	2.44	8.70
24	CHEMICALS AND CHEMICAL PRODUCTS	2.75	0.89	-67.83	6.65	1.58	-76.23
25	RUBBER AND PLASTIC PRODUCTS	1.00	0.62	-38.25	1.48	1.40	-5.35
26	NON-METALLIC MINERAL PRODUCTS	1.08	0.60	-43.91	1.66	1.08	-34.88
27	BASIC METALS	1.72	0.76	-55.64	3.84	2.15	-44.06
28	FABRICATED METAL PRODUCTS	0.98	0.47	-51.78	3.90	1.90	-51.13
29	MACHINERY AND EQUIPMENT N.E.C.	1.26	0.77	-38.75	1.72	1.70	-1.15
30	OFFICE, ACCOUNTING AND COMPUTING MACHINERY	2.14	1.84	-13.92	3.62	5.23	44.76
31	ELECTRICAL MACHINERY AND APPARATUS, N.E.C	1.41	0.59	-58.16	1.77	1.66	-6.09
32	RADIO, TELEVISION AND COMMUNICATION EQUIPMENTS	0.91	0.43	-52.96	1.53	1.24	-19.20
34	MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	1.00	0.64	-35.29	1.48	2.64	78.44

Table 1: Labor, capital and total factor productivity: India relative to China (continued…)

Code	Industry	Relative TFP		
		1998	2003	% change
15	FOOD PRODUCTS AND BEVERAGES	0.63	0.23	-63.07
17	TEXTILES PRODUCTS	1.38	0.76	-44.88
18	WEARING APPAREL, DRESSING & DYEING OF FUR	0.52	0.27	-47.08
19	LEATHER & RELATED PRODUCTS	0.71	0.34	-51.83
20	WOOD AND WOOD PRODUCTS	0.58	0.34	-40.96
21	PAPER AND PAPER PRODUCTS	0.76	0.47	-37.61
22	PUBLISHING, PRINTING AND RELATED ACTIVITIES	0.66	0.52	-20.95
23	COKE, PETROLEUM PRODUCTS AND NUCLEAR FUEL	1.79	1.60	-10.58
24	CHEMICALS AND CHEMICAL PRODUCTS	1.29	0.74	-42.85
25	RUBBER AND PLASTIC PRODUCTS	0.85	0.54	-36.87
26	NON-METALLIC MINERAL PRODUCTS	0.88	0.58	-33.42
27	BASIC METALS	1.00	0.56	-44.03
28	FABRICATED METAL PRODUCTS	0.57	0.37	-35.79
29	MACHINERY AND EQUIPMENT N.E.C.	1.01	0.62	-38.46
30	OFFICE, ACCOUNTING AND COMPUTING MACHINERY	1.28	0.95	-25.75
31	ELECTRICAL MACHINERY AND APPARATUS, N.E.C	1.12	0.48	-57.10
32	RADIO, TELEVISION AND COMMUNICATION EQUIPMENTS	0.77	0.39	-48.78
34	MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	0.85	0.44	-48.67

Data Source: Annual Survey of Industrial Products for China and Annual Survey of Industries for India.
Notes: TFP: calculated using capital share of 0.40 for all industries.

Table 2: China-India Total Factor Productivity Comparison

Dependent variable: Log(relYindchn)		
	(1)	(2)
Log(Kind)	0.440	0.432
	(0.064)*	(0.064)*
Log(Lind)	0.522	0.553
	(0.073)*	(0.076)*
Log(Kchn)	-0.443	-0.462
	(0.406)	(0.413)
Log(Lchn)	-0.534	-0.659
	(0.323)***	(0.368)***
Time	-0.123	
	(0.033)*	
d99		-0.066
		(0.102)
d00		-0.271
		(0.112)**
d01		-0.449
		(0.134)*
d02		-0.471
		(0.162)*
d03		-0.535
		(0.178)*
constant	242.356	-1.987
	(64.671)*	(3.946)
R-sq	0.932	0.935
N	108	108

Note: Standard errors in parenthesis. *, **, *** signify 1%, 5% and 10% level of significance, respectively.

Table 3: Ownership Rights Reforms and Enterprise Downsizing

	Ownership distribution (%)				Firm size	Labor cost as % of value-added	% of money-losing firms	Losses as % of value-added
year	SOEs & collectives	Legal person	Domestic Private investors	Foreign investors	Worker/firm			
Overall:								
1998	48.3	15.5	6.8	29.4	3461	0.284	0.283	0.097
1999	46.4	17.5	7.4	28.8	3478	0.279	0.270	0.067
2000	39.8	20.5	9.6	30.1	3156	0.251	0.229	0.048
2001	34.9	22.4	11.9	30.8	2941		0.232	
2002	31.4	22.9	14.2	31.5	2818	0.236	0.207	0.038
2003	25.7	24.4	16.8	33.0	2750	0.214	0.183	0.029
Consumer non-durables								
1998	46.9	12.0	7.1	33.9	3481	0.270	0.286	0.094
1999	47.0	13.5	7.3	32.2	3601	0.292	0.275	0.062
2000	39.1	16.2	10.1	34.6	3195	0.249	0.230	0.044
2001	34.1	17.5	13.0	35.4	3009		0.233	
2002	30.2	18.5	15.5	35.8	2901	0.235	0.205	0.035
2003	25.0	19.8	18.0	37.2	2826	0.227	0.187	0.028
Consumer durables and producer goods								
1998	49.3	18.0	6.5	26.1	3445	0.293	0.281	0.100
1999	45.9	20.3	7.4	26.4	3468	0.270	0.266	0.071
2000	40.3	23.6	9.3	26.9	3139	0.253	0.228	0.051
2001	35.4	25.9	11.2	27.5	2930		0.231	
2002	32.2	26.1	13.2	28.5	2812	0.237	0.207	0.040
2003	26.2	27.5	16.1	30.2	2745	0.205	0.180	0.029

Data Source: China's Statistical Bureau.
Notes: Data on labor compensation for 2001 are not available.

Table 4: Production Function Regressions for China's 3-Digit Industries

Dependent variable: Log(Y)				
	(1)	(2)	(3)	(4)
Log(K)	0.592	0.653	0.597	0.654
	(0.033)*	(0.031)*	(0.033)*	(0.031)*
Log(L)	0.356	0.302	0.380	0.314
	(0.037)*	(0.035)*	(0.037)*	(0.036)*
Time	0.103	0.075	0.098	0.073
	(0.004)*	(0.005)*	(0.005)*	(0.005)*
Private_sh		0.861		0.842
		(0.080)*		(0.081)*
Log(LPF)			-0.127	-0.058
			(0.043)*	(0.041)
constant	-205.07	-148.34	-194.33	-144.69
	(8.607)*	(9.592)*	(9.295)*	(9.918)*
R-sq	0.896	0.910	0.897	0.910
N	924	924	924	924

Note: Standard errors in parenthesis. *, **, *** signify 1%, 5% and 10% level of significance, respectively.

Table 5: Production Function Regressions for China's Non-Durable Industries

Dependent variable: Log(Y)				
	(1)	(2)	(3)	(4)
Log(K)	0.683	0.663	0.654	0.643
	(0.062)*	(0.059)*	(0.060)*	(0.058)*
Log(L)	0.271	0.282	0.357	0.348
	(0.058)*	(0.056)*	(0.060)*	(0.058)*
Time	0.071	0.052	0.067	0.052
	(0.007)*	(0.008)*	(0.006)*	(0.007)*
Private_sh		0.641		0.526
		(0.141)*		(0.142)*
Log(LPF)			-0.293	-0.231
			(0.069)*	(0.069)*
constant	-140.32	-102.41	-130.67	-101.61
	(12.999)*	(14.956)*	(12.683)*	(14.586)*
R-sq	0.899	0.908	0.907	0.913
N	250	250	250	250

Note: Standard errors in parenthesis. *, **, *** signify 1%, 5% and 10% level of significance, respectively.

Table 6: Production Function Regressions for China's Durable Industries

Dependent variable: Log(Y)				
	(1)	(2)	(3)	(4)
Log(K)	0.549	0.633	0.552	0.632
	(0.039)*	(0.037)*	(0.039)*	(0.037)*
Log(L)	0.411	0.334	0.417	0.331
	(0.046)*	(0.043)*	(0.046)*	(0.043)*
Time	0.117	0.085	0.115	0.086
	(0.005)*	(0.006)*	(0.006)*	(0.006)*
Private_sh		0.927		0.933
		(0.095)*		(0.096)*
Log(LPF)			-0.042	0.022
			(0.052)	(0.049)
constant	-232.33	-169.88	-227.97	-171.80
	(10.823)*	(11.838)*	(12.110)*	(12.561)*
R-sq	0.899	0.914	0.899	0.915
N	674	674	674	674

Note: Standard errors in parenthesis. *, **, *** signify 1%, 5% and 10% level of significance, respectively.

Table 7: Output Growth Accounting: 1998-2003

		Inputs		TFP		
	Output	Capital assets	Labor	Private ownership	Firm size	Trend
Overall Manufacturing Sector						
Change	0.91	0.52	0.20	0.14	-0.14	5
Contribution by each component						
Growth		0.34	0.06	0.12	0.00[a]	0.37
Share (%)	100	37.33	7.00	12.92	0.00	40.30
Consumer Non-durables						
Change	0.72	0.48	0.24	0.13	-0.04	5
Contribution by each component						
Growth		0.31	0.08	0.07	0.01	0.26
Share (%)	100	43.02	11.51	9.66	1.16	36.12
Consumer Durables and Producer Goods						
Change	0.97	0.53	0.19	0.14	-0.17	5
Contribution by each component						
Growth		0.33	0.06	0.13	0.00[a]	0.43
Share (%)	100	34.28	6.33	13.65	0.00	44.50

Notes: The estimates presented in Tables 4 to 6 are used respectively in the calculation for the full sample and sub-samples of consumer non-durables and consumer durables and producer goods industries is sub-samples industries.

[a] The coefficient for Log(LPF) is insignificant and hence the contribution of this variable to output growth is set to zero.

Table 8: Endogeneity Test for Private Equity Share

Dependent variable: D.Log(Y_{it})		Dependent variable: D.$(\Pr ivate\_sh)_{it}$	
D.Log(Y_{it-1})	-0.237	D.$(\Pr ivate\_sh)_{it-1}$	0.246
	(0.230)		(0.443)
D.Log(K_{it})	0.645	D.Log(K_{it})	-0.059
	(0.115)*		(0.046)
D.Log(L_{it})	0.322	D.Log(L_{it})	0.054
	(0.126)*		(0.040)
D.$(Ln(LPF))_{it}$	0.027	D.$(Ln(LPF))_{it}$	-0.114
	(0.116)		(0.058)**
D.$(\Pr ivate\_sh)_{it}$	1.234	D.Log(Y_{it})	0.030
	(0.579)**		(0.069)
D.$(\Pr ivate\_sh)_{it-1}$	1.203	D.Log(Y_{it-1})	-0.155
	(0.796)		(0.278)
constant	0.070	*constant*	0.041
	(0.032)**		(0.029)
Wald p-value (noncausality test)	0.131	*Wald p-value (noncausality test)*	0.310
N	586	N	586

Note: Robust standard errors in parenthesis. *, **, *** signify 1%, 5% and 10% level of significance, respectively.

Table 9: Endogeneity Test for Labor per Firm

Dependent variable: D.Log(Y_{it})		Dependent variable: D.$(Ln(LPF))_{it}$	
D.Log(Y_{it-1})	-0.018	D.$(Ln(LPF))_{it-1}$	0.795
	(0.237)		(0.406)
D.Log(K_{it})	0.578	D.Log(K_{it})	-0.115
	(0.098)*		(0.156)
D.Log(L_{it})	0.346	D.Log(L_{it})	0.090
	(0.108)*		(0.111)
D.$(\Pr ivate\_sh)_{it}$	0.908	D.$(\Pr ivate\_sh)_{it}$	-0.642
	(0.315)*		(0.243)*
D.$(Ln(LPF))_{it}$	0.162	D.Log(Y_{it})	0.272
	(0.226)		(0.213)
D.$(Ln(LPF))_{it-1}$	-0.362	D.Log(Y_{it-1})	-0.082
	(0.221)		(0.203)
constant	0.074	*constant*	-0.006
	(0.036)**		(0.039)
Wald p-value (noncausality test)	0.120	*Wald p-value (noncausality test)*	0.170
N	586	N	586

Note: Robust standard errors in parenthesis. *, **, *** signify 1%, 5% and 10% level of significance, respectively.