Chapter 4

External Openness and Firm Productivity in China and India: Evidence from Business Enterprises Surveys

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Introduction

China and India have experienced high economic growth over the last two decades after a long period of stagnation. During the period 1980-2007 India's annual growth rate of per capita income was 6.4 percent compared with that of China at 10.9 percent.[2] While India's growth performance has been considerable, China's has been nothing short of a miracle. The main propose of this paper is to provide a comparative analysis of China's and India's economic growth pattern.

The growth process in China and India is different in the sense that the Indian growth has been driven by the service sector, whereas in China it has been led by the industrial sector. For example, for the period 2005-2007, while the manufacturing sector contributed 49 percent of China's GDP, the figure for India is only 29 percent (Table 1). According to Bosworth and Collins (2008, p. 54), the annual growth rate of the total factor productivity (TFP) in the Indian industrial sector during the periods 1978-1993 and 1993-2004 was 0.3 and 1.1 percent compared with 3.0 and 6.1 for China's TFP during the same periods. The gap between China's and India's productivity performance is also significant.

Table 1 Macroeconomic Performance, 1980-2007

		1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2007
GNI per capita, PPP (current international $)	China	332	593	1044	1800	2898	4737
	India	504	698	940	1288	1712	2477
Industry, value added (% of GDP)	China	45	44	44	47	46	49
	India	26	26	26	27	26	29
Trade ratio (% of GDP)	China	22	29	42	39	51	72
	India	14	13	19	24	30	45

Source: World Bank, World Development Indicators.
Note: Figure means the average value in each period.

China's performance of the manufacturing sector has been far superior to that of India's. In other words, India has not succeeded in enhancing the manufacturing industries that have contrib-

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[2] We estimate the growth rate by using the purchasing power parity measure of gross national income per capita in terms of the current international dollar drawn from the World Bank's World Development Indicators.

uted to China's sustainable economic growth. Therefore, growth in the manufacturing sector explains the divergent growth experiences in China and India.

Looking at the external openness of China and India, there is remarkable expansion in the trade ratio of GDP since 1980 (Table 1). But India has lagged behind China in external openness. For example in 2005-2007, while the trade ratio contributed 72 percent of China's GDP, the figure for India was 45 percent (Table 1). Therefore, it is assumed that external openness also influences the growth pattern of China and India.

A large body of empirical evidence indicates that exporting firms are more efficient than non-exporting firms in developing countries (Aw, Chung and Roberts, 2000; Delgado, Farinas and Ruano, 2002; Pavcnik, 2002; Van Biesebroeck, 2007; Clerides, Lach and Tybout, 1998; Tapalova, 2004; Isgut, 2001; Aw and Hwang, 1995; Loecker, 2007; Bigsten et al., 2004; Hiep and Ohta, 2009; Amitt and Konings, 2007; Blalock and Veloso, 2007; Krisha and Mitra, 1998; Fernandes, 2007; Tybout and Westbrook, 1995). Therefore, to understand the cause and nature of the differences in comparative economic performance between China and India, it is interesting to examine the positive nexus between the external openness and the productivity in manufacturing industries.

One limitation of the existing literature on comparative studies on the economic performance in China and India is that it is based on aggregate data or micro data which are not necessarily consistent across the two countries (Bosworth and Collins, 2008; Felipe, Lavina and Fan, 2008; Srinivasan, 2004; Bardhan, 2006; Bardhan, 2007; Bardhan, 2008; Bardhan, 2009; Hsieh and Klenow, 2007; Das, 2006; Chai and Roy, 2006; Lall, 1995; Winters and Yusuf, 2007).[3] Therefore, findings in existing works might be limited due to the data problem. The World Bank's Business Enterprises Survey provides detailed information on sample firms in the many developing countries surveyed based on a questionnaire with a common framework. In this paper, we use the firm-level data set of both China and India drawn from the World Bank's Business Enterprises Surveys.

This paper contributes to the literature on comparative studies on China and India in two ways. First, most of the existing literature is based on aggregate data. We focus on the determinant of firm-level productivity, which has been omitted by most of the existing studies.[4] Second, the positive nexus between external openness and firm productivity is tested by using the comparable data set in China and India. We expect these two ways to allow us to examine the firm-level heterogeneity, which affects the divergent growth pattern in China and India

The rest of this paper is organised as follows. In Section 2 we discuss the model and estimation strategy for analysing the relationship between external openness and productivity. In Section 3 we describe our data and main variables. In Section 4 we report our empirical evidence and in Section 5 we provide a summary of the main findings with some remarks.

[3] The study by Gregory, Nollen and Tenev (2009) is exceptional. This is based on the International Finance Corporation (IFC) survey, which collected firm-level data of software services and hardware manufacturing companies in China and India. But the number of sample manufacturing firms is only 91 for China and 49 for India.

[4] Hsieh and Klenow (2007) use firm-level data in order to investigate the comparative performance of the productivity in manufacturing firms in China and India. This is an exceptional study but there is the problem of the data comparability.

Model and Estimation Strategy

We examine the relationship between external openness and productivity at the firm-level in two steps. In the first step, we calculate firm-level TFP, and in the second step we specify how external openness affects TFP.

Following Aw, Chung and Roberts (2000), Caves, Christensen and Diewert (1982) and Good, Nadiri and Sickles (1997), the multilateral TFP index for firm *i* in year *t* is defined as:

$$\begin{aligned}\ln TFP_{it} = & (\ln Y_{it} - \overline{\ln Y_t}) \\ & - \left[\frac{(SK_{it} + \overline{SK_t})}{2}(\ln K_{it} - \overline{\ln K_t}) + \frac{(SL_{it} + \overline{SL_t})}{2}(\ln L_{it} - \overline{\ln L_t})\right] \\ & + \sum_{s=1}^{t}(\overline{\ln Y_s} - \overline{\ln Y_{s-1}}) \\ & - \sum_{s=1}^{t}\left[\frac{(\overline{SK_s} + \overline{SK_{s-1}})}{2}(\overline{\ln K_s} - \overline{\ln K_{s-1}}) + \frac{(\overline{SL_s} + \overline{SL_{s-1}})}{2}(\overline{\ln L_s} - \overline{\ln L_{s-1}})\right] \quad (1)\end{aligned}$$

By using this TFP index, each firm in year *t* is compared to a hypothetical firm in year 0, with an average log of value added ($\overline{\ln Y}$), capital ($\overline{\ln K}$), labour ($\overline{\ln L}$), capital income share ($\overline{SK}$) and labour income share ($\overline{SL}$). According to the experiments conducted by Van Biesebroeck (2007), this type of TFP index is superior to the other four widely used techniques for estimating the productivity, i.e. data envelopment analysis, stochastic frontier, GMM and semi-parametric estimation.

Employing the firm-level measures of TFP from Equation (1), we estimate the equation:

$$\begin{aligned}\ln TFP_{it} = & \gamma_0 + \alpha_r + \alpha_c + \alpha_t + \gamma_1(export)_{it} + \gamma_2(import)_{it} \\ & + \sum \gamma_k(otherfactors_k)_{it} + e_{it} \quad (2)\end{aligned}$$

I use OLS with region fixed effects, α_r, industry fixed effects, α_c and year fixed effects, α_t, for controlling unobserved regional and industrial heterogeneity and shocks over time that affect productivity across all firms. Explanatory variables are time-invariant so we cannot use fixed effect models for the estimation.

We hypothesize that export activity will increase productivity ($\gamma_1 > 0$), as exposure to the export market is likely to force firms to become more efficient via the learning-by-exporting channel. A large body of literature examines the relationship between export and productivity (Aw, Chung and Roberts, 2000; Delgado, Farinas and Ruano, 2002; Pavcnik, 2002; Van Biesebroeck, 2007; Clerides, Lach and Tybout, 1998; Tapalova, 2004; Isgut, 2001; Aw and Hwang, 1995; Loecker, 2007; Bigsten et al., 2004; Hiep and Ohta, 2009).

The importing firms will be expected to obtain the productivity gain due to the foreign technology embodied in importing goods ($\gamma_2 > 0$). Many studies show the empirical evidence on the relationship between importing intermediate goods and productivity (Amitt and Konings, 2007;

Blalock and Veloso, 2007; Krisha and Mitra, 1998; Fernandes, 2007; Tybout and Westbrook, 1995). Increasing import competition raises productivity via new technology embodied in import goods. It also forces the domestic competing firms to become more competitive and more efficient, resulting in increasing productivity.

To see whether the other factor has an effect on TFP, we use several business environment variables such as infrastructure deficiency, credit availability and so forth.

Data

The World Bank has conducted an intensive survey on the business environments in many developing countries, including China and India. We use the *World Bank Investment Climate Survey* of China, which was undertaken in 2003 in collaboration with the National Bureau of Statistics of China and the *Firm Analysis and Competitiveness Survey of India 2002,* which was conducted in 2002 in collaboration with the Confederation of Indian Industry. These two surveys are available on the website of the Enterprises Surveys of the World Bank Group at [https://www.enterprisesurveys.org/Portal/].[5]

Chinese firms were randomly sampled from the following eighteen cities: Benxi, Changchun, Changsha, Chongqing, Dalian, Guiyang, Haerbin, Hangzhou, Jiangmen, Kunming, Lanzhou, Nanchang, Nanning, Shenzhen, Wenzhou, Wuhan, Xian, and Zhengzhou. The Indian sample firms were randomly drawn from the following forty cities: Ahmedabad, Bangalore, Calcutta, Chandigarh, Chennai, Cochin, Delhi, Hyderabad, Kanpur, Mumbai, Pune, Mysore, Vijayawada, Lucknow, Guntur, Surat, Vadodara, Gurgaon, Faridabad, Panipat, Hubli-Dharwad, Calicut, Palakkad, Bhopal, Gwalior, Indore, Nagpur, Nashik, Thane, Jalandhar, Ludhiana, Coimbatore, Hosur, Madurai, Ghaziabad, NOIDA, Shahjahanpur-Lakimpur, Howrah, and Mangalore. The industries sampled in both China and India include not only manufacturing, but also services. In this paper, we ignore the observations on the service industry.

The Enterprises Surveys offer micro data in two formats: One is standardised data and the other is complete data. The standardised data is constructed by matching to a standard set of survey questions. This format enables us to compare the economic performances of China's and India's firms. But those country-specific questions that cannot be matched are unavailable in this format. The complete data offers the full information for a country survey. However, in this format, the question coding is different in each country.

By using commonly available survey questions in China's and India's standardised data sets, we could conduct solid comparative analysis on the economic performance of manufacturing firms in these two countries. But the standardisation was incomplete in the standardised data format.

[5] Goswami et al. (2002) and the World Bank (2004) provide a comprehensive business profile of sample firms and investment climate information in India by using the Firm *Analysis and Competitiveness Survey of India 2002*. Using firm-level data of this survey, Lall and Mengistae (2005) examine the impact of the business environment on firm-level productivity in India. We cannot find any similar comprehensive report on the *World Bank Investment Climate Survey* of China in 2003. But Ayyagari, Demirguc-Kunt and Maksimovic (2008) show the sampling method and the characteristics of sample firms in this survey.

Therefore, several crucially important variables for this paper such as the productivity measures are drawn from the complete data. Thus, we use the standardised data adjusted by complementing with complete data.

Most of the qualitative questions are available in the year 2002 for the Chinese survey and in the year 2001 for the Indian survey. In the case of quantitative information on the productivity measures, while short panel data from 1999 to 2001 are available for India, it is available from 1999 to 2002 for China. We limit attention to the sample firms of manufacturing industries with the productivity measures for the period 1999 to 2001 and commonly available survey questions. The data is cleaned by dropping some observations with missing values or unreliable values. The final dataset of China is a balanced panel for the period 1999 to 2001 of 1073 firms per year with a total of 3219 observations. India's is a balanced panel for the period 1999 to 2001 of 633 firms per year with a total of 1899 observations.[6] Table 2 shows the sample firms' distribution in terms of industry.

Table 2 Number of Sample Firms by Industry Group

	Garments, Textiles & Leather	Food	Metals	Electronics	Chemicals	Auto	Total
China	234	43	91	356	61	288	1073
	(22)	(4)	(8)	(33)	(6)	(27)	(100)
India	231	51	34	94	82	141	633
	(36)	(8)	(5)	(15)	(13)	(22)	(100)

The main variables are calculated as follows:

Real value added (Y): Nominal values added can be obtained by subtracting materials cost including fuel and power from the sales value. In calculating real value added, the double deflation method, which has practically become a standard in this research field in recent years, is used.[7] Through this method, the calculation of real value added is performed by using the corresponding output prices to deflate the sales values, and total input prices to deflate total material cost. Wholesale price indices in the Reserve Bank of India, *Handbook of Monetary Statistics of India* for India and producer price indices, retail price indices and consumer price indices in the National Bureau of Statistics of China, *China Statistical Yearbook* for China were used as output price indices. Total input prices for China were the "purchasing price index for raw material, fuel and power" in the *China Statistical Yearbook*. Total input prices for India were calculated as the weighted average of the prices of intermediate goods, using input share from the Government of India, *Input-Output Transaction Table 1998* as weights.[8]

[6] As Equation (1) indicates, we cannot calculate $\ln TFP_i$ in base year 1999. Therefore, we use the panel data of 2000 and 2001 for regression analysis. The number of observations is 2,146 for China and 1,266 for India.

[7] The double deflation method is better than the single deflation method for calculating the estimates of real value added. Balakrishnan and Pushpangadan (1994) provide a detailed discussion of the relationship between the double deflation method and TFP in India's manufacturing sector.

[8] We use wholesale price indices drawn from the *Handbook of Monetary Statistics of India* and the implicit deflator of services obtained from the Government of India, *National Account Statistics*.

Capital (K): We use the net book value of fixed assets in order to construct capital stocks. The perpetual inventory accumulation method is employed for estimating capital stocks. Real fixed capital formation (I) is defined using the equation:

$$I_t = \frac{(B_t - B_{t-1})}{P^I}.$$

Consequently, the sum of increases in fixed assets (i.e. $B_t - B_{t-1}$) equals the nominal fixed capital formation, which, when deflated by the investment goods price, becomes real fixed capital formation. As for the investment goods price (P^I), we use the "price index for investment in fixed assets" in the *China Statistical Yearbook* for China and the implicit deflator for fixed capital formation in the *National Account Statistics* for India. Next, we calculate time series data for real capital stock using the following formula:

$$K_t = K_{t-1} + I_t = K_0 + \sum_{i=1}^{t} I_i$$

For base year capital (K_0) , we use the net book value of fixed capital (B_0) given in the original data.

Labor (L): This paper uses the number of workers as an indicator of labour inputs.

Capital income share (SK) and labour income share (SL): The SL is obtained as the ratio of the nominal total labour cost paid to workers over nominal value added. The remaining share of the nominal value added is defined as the SK.

Export (*export*): Export variable is the percentage of sales sold by exporting.

Import (*import*): Import variable is the percentage of material inputs and supplies purchased by importing.

Table 3 shows the profile of the sample firms in terms of value added (ln Y), capital (K), labour (L), capital income share (SK), labour income share (SL), productivity (ln TFP) and the other variables.

Table 3 Summary Statistics

	China					India				
Variable	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
ln Y	3219	9.55	2.12	1.59	16.05	1899	8.24	1.44	3.47	15.52
ln K	3219	8.81	2.27	0.00	16.06	1899	8.13	1.51	2.49	17.56
ln L	3219	5.17	1.44	0.00	10.26	1899	3.09	1.01	0.69	8.05
SK	3219	0.73	0.20	0.00	1.00	1899	0.74	0.16	0.01	1.00
SL	3219	0.27	0.20	0.00	1.00	1899	0.26	0.16	0.00	0.99
ln TFP	2146	0.21	1.32	−5.39	6.19	1266	0.0084	0.86	−7.11	5.88
export ratio	2146	12.27	29.26	0.00	100.00	1218	12.23	28.49	0.00	100.00
import ratio	2130	6.30	19.09	0.00	100.00	1258	3.15	14.20	0.00	100.00
credit availability	2108	0.32	0.47	0.00	1.00	1256	0.52	0.50	0.00	1.00
association	2128	0.60	0.49	0.00	1.00	1264	0.81	0.39	0.00	1.00
power cost	2140	0.70	0.41	0.15	9.00	1044	13.36	96.17	2.50	2000.00
power loss	2072	2.04	4.38	0.00	40.00	1214	9.69	9.67	0.00	100.00
inventory	2116	16.42	22.88	0.00	360.00	1260	26.01	32.18	0.00	365.00
market share	790	19.66	23.55	1.00	100.00	1128	9.01	20.24	0.00	100.00

Results

The results from estimating Equation (2) are presented in Table 4 for China and Table 5 for India. First, we regress TFP only on the export ratio as the benchmark. Column 1 of Table 4 shows that an increase in the export ratio raises TFP. This significant positive coefficient is consistent with the existing studies. In Columns 2 to 10, we include the import ratio in addition to the export ratio. The inclusion of the import ratio reduces the t-value on the export ratio while the estimated coefficients of the export ratio are still positive. In Column 3, the coefficient of the import ratio is positive and statistically significant. However, in the other columns, it is still positive but insignificant. Before we conclude that external openness does not raise the productivity in China, we should check the joint null hypothesis as to whether the coefficients of export and import are simultaneously zero or not. The last row of Table 4 shows the F-test on this joint null hypothesis. These results show that in four cases out of nine, the null hypothesis is rejected at the 10 percent significance level. Accordingly, we can argue that external openness is likely to raise the productivity in China as a whole.

Table 4 Results: China

Dependent variable: ln TFP									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
export ratio	0.002	0.001	−0.002	0.001	0.001	0.002	0.001	0.002	0.001
	(1.96)#	(1.39)	(0.67)	(1.23)	(1.35)	(1.52)	(1.39)	(1.59)	(0.96)
import ratio		0.002	0.005	0.003	0.001	0.002	0.002	0.002	0.003
		(1.26)	(2.41)*	(1.58)	(0.87)	(0.96)	(1.19)	(1.09)	(1.72)#
market share			−0.002						
			(1.36)						
government regulation dummy									−0.001
									(0.66)
credit availability dummy								0.205	
								(3.57)**	
association dummy							−0.13		
							(2.10)*		
power cost						0.000			
						0.00			
power loss					−0.01				
					(1.74)#				
inventory				0.000					
				(0.23)					
area fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2146	2130	788	2100	2058	2124	2112	2092	1994
R−squared	0.09	0.09	0.11	0.09	0.09	0.09	0.09	0.1	0.09
F−statistics (H_0: $gamma_1$ = $gamma_2$ =0)		2.22	3.08*	2.49#	1.61	2.01	2.10	2.33#	2.37#

Robust statistics parentheses
significant at 10%; * significant at 5%; ** significant at 1%

If a firm has monopoly power, the estimated TFP of the firm can be overestimated to the degree of monopoly power. To check this, we add the market share of main products sold by a firm. Column 3 of Table 4 shows the coefficient of market share is negative and insignificant. Based on these findings, market share does not affect TFP in China.

In Columns 4 to 5, we include variables relating to infrastructure, i.e. “days of inventory of main input” (inventory) which indicate the deficiency of transportation, and “average cost of a kilowatt-hour of electricity from the public grid” (power cost) and “lost value per total sales due to power outages or surges from the public grid" (power loss) which mean the problem of public supply of power. In Columns 3 and 4, inventory and power cost are insignificant, but in Column 5, we see that power loss is negative and significant. Therefore, we can confirm poor infrastructure will depress TFP.

Regarding the business information advantage, whether a firm is a "member of a business association or chamber of commerce" (association) is seen as an important factor that influences the productivity. We check this by including the association dummy variable. In Column 7, the association dummy is unexpected sign and significant. There are two possibilities accounting for this. In the first, inefficient firms tend to be members of business associations for their survival, resulting in a negative relationship between the association dummy and TFP. In the second, business associations provide the incentive to member firms not for improving their efficiency but for demanding the government's support and protection.

For other business environments, we include the credit dummy (credit), which indicates whether a firm has an ``overdraft facility or line of credit" in Column 8 and the "percentage of senior management's time that was spent in dealing with requirements imposed by government regulations" (regulation) in Column 9. The former represents the credit availability, whereas the latter means the burden of government regulations. In Column 8, we see that the coefficient of credit dummy is positive and significant while Column 9 shows the regulation variable is not significant. Based on these findings, credit availability improves TFP.

So far, we have seen the results for China. In Table 5, we address the case of India. First of all, we see that in all specifications, the import ratio is positive and highly significant. But in any column, the export ratio is not significant with a considerably low t-value. We conclude that it is not the export but import channel of external openness that enhances the productivity in India.

Table 5 Results: India

Dependent variable: ln TFP									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
export ratio	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.73)	(0.29)	(0.06)	(0.29)	(0.07)	(0.32)	(0.24)	(0.17)	(0.38)
import ratio		0.007	0.006	0.007	0.007	0.008	0.007	0.008	0.008
		(3.69)**	(3.48)**	(3.62)**	(3.63)**	(3.42)**	(3.71)**	(4.21)**	(4.11)**
market share			−0.001						
			(0.51)						
government regulation dummy									0.001
									(0.57)
credit availability dummy								0.037	
								(0.71)	
association dummy							−0.069		
							(1.23)		
power cost						−0.001			
						(2.16)*			
power loss					−0.005				
					(1.53)				
inventory				0.000					
				(0.09)					
area fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1218	1214	1080	1210	1168	996	1212	1204	1138
R-squared	0.19	0.2	0.24	0.2	0.21	0.22	0.2	0.21	0.21

Robust statistics parentheses
significant at 10%; * significant at 5%; ** significant at 1%

The other variables are statistically insignificant in all columns except for Column 6. In Column 6 of Table 5, the coefficient of power cost is negative and significant. This suggests infrastructure deficiency constrains the firms' productivity in India. This is consistent with China's results.

Concluding Remarks

Existing comparative studies on China's and India's growth experiences are confined to the macro- or industry-level and use less comparable data. In this paper we use firm-level comparable data of China and India. As many studies have shown a positive relationship between external openness and firm productivity in developing countries, we find similar evidence for manufacturing firms in both China and India. But the channel which raises the firm-level productivity is slightly different between China and India. For India's manufacturing firms, it is not the export channel but the import channel of the external openness that is significant, while for China's firms both channels are likely to be important. Taken together with the finding that infrastructure constrains depress the productivity of manufacturing firms, export activity does not necessarily stimulate the productivity of manufacturing firms under poor business environments. Therefore, if India tries to catch up with China, we conclude that the tentative statement “Ultimately, India will need to redress its inadequate infrastructure and to broaden its trade beyond the current emphasis on service” (Boswarth and Collins, 2008, p. 64) may be corrected by emphasising India's need to improve its manufacturing-cum-export-oriented infrastructure.

We cannot address the issues of the potential endogeneity of the export and import ratio. As Goldar and Kato (2008) and Hiep and Nishijima (2009) have investigated the determinant on a firm's export activity, we can insert the model on export or import decision making into our Equation (2) by using 2SLS. This is one of the future subjects of our paper.

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