The impact of foreign direct investment on the productivity of China's automotive industry.

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Abstract

- This study contributes to the existing literature by empirically investigating the effect of FDI inflows on the aggregate labour productivity of China's automotive industry.

- A production function model is developed using a panel data set at sub-sector level. Two statistical models: pooled ordinary least squares model (POLS) and fixed effects model (FES) were used to estimate the influence of foreign direct investment on aggregate labour productivity in the industry.

Key Results

- Inward FDI plays a positive role in increasing industrial productivity, implying that the government should continue to encourage inward investment. However the results also suggest that efforts to increase capital intensity and average firm size in the industry will also improve labour productivity.

1. Introduction

There is increasing interest in the impact of foreign direct investment (FDI) on host country productivity. However, contradictory empirical results have been obtained from a number of previous studies. Kokko et al. (1994, 1996), Egger & Pfaffermayr (2001), Blomstrom & Persson (1983), and Bertschek (1995), for example, found evidence of a significant positive effect of FDI on spillovers. Haddad & Harrison (1993), Girma, et al, (2001), Kholdy (1995), Globerman (1979), and Veugelers & Houte (1990), however, found insignificant, or negative impacts in their empirical results. Interestingly, Aitken & Harrison (1999), Zukowska-Gagelmann (2000), and Djankov & Hoekman (2000) obtained a complicated pattern of mixed results in their respective studies. This paper adds to this important field of research by examining the impact of FDI on China's automotive industrial productivity using a panel data set.

The automotive industry is chosen for several reasons. First, the automotive industry is one of the six key industries[1] in China. It has expanded rapidly over the reform years and typically accounts for a large and increasing share of industrial production, output, exports, and employment. In 1999, total sales of China's auto-industry were about US$ 38 billion, accounting for nearly 4 percent of the country's GDP. In 1998, seven million employees worked in the auto-industry, accounting for 3.3 percent of the total Chinese urban workforce (Harwit, 2001). The automotive industry, particularly in industrialised countries, is a focus of attention due to its major contribution to GDP and employment (Irandoust, 1999). Historically, in the USA, Japan, and South Korea, automotive exports have been an important element of foreign trade. Further, the development of China's automotive industry has been driven by both domestic policy and foreign economic participation. Through studying this sector it is possible to investigate issues both of industrialisation in general, and the impact of technology transfer in particular (Harwit, 1995). It is also important to note that there has been a significant amount of FDI in the Chinese automotive industry. By the end of 2000, the cumulative "actually used" FDI[2] in the automotive industry reached US$ 45.4 billion; accounting for 13 percent of total realised FDI in China. Moreover, China is also one of the largest automobile markets in the world and has become the most important destination for FDI by automobile multinational enterprises (MNEs), especially since China's entry into the World Trade Organisation (WTO).

WTO entry, however, has forced China's automotive industry to face fierce international competition. As Sit and Liu (2000) point out, China's entry into the WTO has two effects on China's automotive industry: one is the gradual reduction of tariffs on imported automobiles and components and the other is the further opening of the industry to FDI. With increasing inflows of FDI into the industry, it is essential to improve our understanding of the effects of FDI on the productivity of the industry.

The rest of the paper is organised as follows. Section 2 provides a background on FDI in the Chinese automotive industry. Section 3 discusses the theoretical framework and reviews the relevant literature. Section 4 focuses on the empirical analysis, discussing the model, data, and methodology. Section 5 presents the empirical results and the last section summarises the key conclusions and policy implications.

2. FDI in China's Automotive Industry

According to the *Chinese Automotive Industry Yearbook* (1999), the development of China's automotive industry after 1949, when the People's Republic of China was established, can be split into three different phases. The period 1949-65 can be termed the early 'starting stage'. The 'growing up stage' can be thought of as the time period 1966-80. From 1981 onwards China's automotive industry has been in a 'rapidly developing stage'.

Since the 1950s, the Chinese government has made several attempts to introduce Soviet-style structures and methods in order to achieve the goal of industrialisation. China's automotive industry originated with the founding of the First Automotive Works (FAW) in Changchun, Jilin province, which is now the largest state-owned auto-maker in China. In July 1953, China and the Soviet Union reached an agreement to introduce Soviet automotive technology and assembly lines to produce medium trucks with a projected capacity of 30,000 units. China's first truck was produced by FAW in 1956, marking the birth of China's automotive industry. The Nanjing Automotive Works were set up in March 1958, Beijing Automotive Works in June of the same year, Jinan Automotive Works in April 1960, and Shanghai Automotive works in October 1960. The Chinese automotive industry then had five production bases and 104 plants, including one vehicle assembler, one motor engine maker, sixteen repair plants, and eighteen motor and motorcycle parts producers. In 1965, 40,542 units of automotive vehicles were produced, of which only 133 were cars (see Table 1), accounting for 0.3 percent of total output.

<<Include Table 1 here>>

China’s automotive industry advanced in the second ‘growing up’ stage. In March 1966, Sichuan Automotive Works was set up in Chongqing, Sichuan province. In April 1967, Second Automotive Works (SAW) was set up in Shiyan, Hubei province, which was later renamed Dongfeng Automotive Corporation in 1992. In March 1978, Shannxi Automotive Works was set up in Xi’an. Moreover, three new firms emerged as important automotive vehicle production sites in Tianjin, Shenyang, and Wuhan. During this period, most of the provinces and autonomous regions, and even the cities of China set up local automotive production. By 1980, the number of automotive enterprises had risen to 2,379 - consisting of 56 vehicle manufacturers, 129 repair plants, 24 motorcycle makers, 33 motor engine makers and 2,076 parts producers. In 1980 222,288 units of automotive vehicles were produced, of which 135,500 were trucks and 5,418 were cars (see Table 1), accounting for 61 percent and 2.4 percent of the total output respectively.

However, owing to the absence of competition, all production units ran at low levels of productivity and efficiency. Central planning also created a further problem of restricted product scope in terms of limited product lines. The result was a fragmented production system with severe overcapacity in auto production nation-wide, characterised by production at levels below minimum efficient scale in each province.

The opening up of China’s economy brought unprecedented opportunities and challenges for its automotive industry. Domestic demand for cars (initially dominated by demand from the government sector for official use) rose rapidly in the 1980s. However, China’s vehicle producers were truck makers rather than car makers. The car industry was a minor part of vehicle production during the first three decades of China's socialist economy and was unable to meet the increasing demand for cars. Since the early 1980s, Chinese car imports have increased dramatically (see Table 1)

The Chinese government began to encourage FDI in auto production by setting up joint ventures with auto producing MNEs. Several major projects were established between 1984 and 2002. The first was between the Beijing Automotive Works and Chrysler of the United States (in 1984). The second was between the Shanghai Automotive Industry Corporation and Volkswagen of Germany (in 1985). The third was between the Guangzhou Automotive Company and Peugeot of France (in 1985), which was taken over by Honda of Japan, who established Guangzhou Honda with Guangzhou Automotive Company in 1998. The fourth was between the FAW and Volkswagen-Audi (in 1991). The fifth was between the Beijing Automotive Works and Hyundai of Korea (in 2002). The sixth and last was between the Tianjin Automotive Industry Corporation and Toyota of Japan (in 2002).

These joint ventures started production by assembling cars with parts and individual components imported from foreign makers. Import substitution helped to reduce the foreign exchange burden of imported finished cars. Moreover, the introduction of market competition placed increasing pressure on manufacturing operations and development, as indigenous Chinese owned firms sought to improve their technological capability and industrial competitiveness, first at home, and then in the international market. The automotive industry is both capital and technology intensive, and so joint ventures became a channel for attracting foreign investment and for obtaining modern manufacturing technology and modern management techniques. MNEs are part of an integrated international production system, and through FDI attempt to acquire greater access to markets and resources in host countries.

Rapid economic growth and a large population assured a ready market for automotive products in China.

China's automotive industry continued to develop strongly during the third 'rapidly developing stage', since the introduction of Sino-foreign joint ventures. China produced 1.83 million automotive vehicles in 1999 (see Table 1), which placed China in the top ten automotive vehicle producers in the world according to the OICA[3] (*China Automotive Industry Yearbook*, 2000).

The industry now consists of foreign firms, centrally planned state-owned firms, locally planned state-owned firms, township and private firms. By the end of 2000, more than 600 foreign firms had set up in China's automotive industry from more than 20 countries. Cumulative contracted FDI amounted to US$ 52.9 billion, while actually used FDI reached US$45.4 billion (*Chinese Automotive Industry Yearbook*, 2000), which is 13 percent of the total actually used FDI in China. The major sources of foreign investment are from the US, Germany, Japan, France, Italy, South Korea, and the UK.

Despite heavy foreign investment and the market discipline of WTO entry, many industry experts argue that major structural and technological weaknesses continue to exist in the Chinese automotive industry. Sinclair (2005), for example, reports on the fragmented nature of both the auto manufacturing and components sub-sectors of the industry, with small scale producers scattered throughout the country operating below capacity. He also points to the continuing culture of protectionism, with local component suppliers favoured by local assembly firms, despite their inferior quality and higher price. Harwit (2001) agrees with this assessment, emphasizing that the drive for quick utilisation of domestically produced parts has impeded the production of quality domestic vehicles. He (Harwit, 2001, p. 655) summarises the situation, noting that while China has built a ‘significant vehicle production system’ its ‘price and quality’ problems leave it vulnerable in a post-WTO environment.

3. Theoretical Framework and Literature Review

The aggregate impact of FDI on a host country’s productivity is often de-composed into two types of effects: direct and indirect effects. The direct effect of inward FDI refers to its impact on the productivity of FDI-recipient firms, while the indirect effect refers to the impact of foreign firms’ presence on the productivity of indigenous firms i.e. productivity spillovers from foreign to indigenous firms. This paper is somewhat unusual in that it focuses on one industrial sector and the combined direct and indirect effects of FDI inflows on that sector. The policy interest of the paper is in whether the Chinese government’s encouragement of foreign investment into the automotive sector has raised the overall productivity and international competitiveness of the industry. The limitations of a data set based on sub-sectors of the industry also prevents us from separating direct and indirect effects empirically, which in practice, as noted below, can become blurred. Nevertheless it is useful to briefly explore the various types of impacts on host country productivity that can be attributed to FDI.

Direct productivity benefits occur when the proportion of industrial output produced by foreign firms or FDI-receiving firms increases, assuming that foreign firms are more productive on average than indigenous firms. MNEs must have monopolistic or ownership advantages that allow them to overcome the higher costs associated with production abroad (Hymer, 1976). They may have higher productivity than indigenous firms because of their superior technological knowledge, access to international networks and superior management structures (Girma, et al., 2001). MNEs may also exhibit higher levels of productivity than their domestic counterparts, due to a number of other factors: employees with greater skills and training; more machinery and equipment per worker; and greater technical efficiency. Most studies, which have focused on the productivity differences between foreign and indigenous firms in developing countries, have concluded that foreign firm are superior in this respect. Willmore (1994) reported that foreign firms in Brazil typically have higher levels of labour productivity compared to indigenous firms of a similar size operating in the same industry. Using detailed Indonesian data, Blomstrom and Sjoholm (1999) found labour productivity to be higher in establishments with foreign equity compared to purely domestically owned firms, with the latter benefitting from spillovers from FDI. With respect to China, Zhou et al. (2002) concluded that the productivity of foreign firms is significantly higher than that of indigenous firms.

While the direct productivity benefits of FDI can be predicted to be positive, particularly when hosts are developing countries, there is much more controversy surrounding the direction of indirect benefits. Indirect benefits occur when the superior technology and manufacturing methods of foreign firms 'spillover' to indigenous firms increasing their productivity and competitiveness. Kinoshita (1998) decomposes spillover effects from FDI into four categories: the demonstration-imitation effect, the competition effect, the foreign linkage effect, and the training effect.

The demonstration-imitation effect arises from differences in the levels of technology between foreign and indigenous firms. Foreign firms with more advanced technologies enter a local market and introduce newer technologies to the industry. Through direct contact with foreign affiliates, indigenous firms can watch and imitate the way foreigners operate and can therefore become more productive. The competition effect arises from the additional competition created by MNEs. Because competition in the domestic market is increased, indigenous firms have to perform more efficiently and increase their innovative activity to maintain their market position (Bertschek, 1995). This type of spillover generally occurs at the intra-industry level. While not a concern of this particular study, inter-industry spillovers may also occur through backward and forward linkages when foreign affiliates enter into transactions with local suppliers and customers. Finally a training effect may be present. MNEs might be only able to transfer superior technology to their foreign affiliates after having trained local workers. The training may be provided by foreign joint venture partners, foreign buyers or suppliers. Indigenous firms may also train their own workers to increase product quality in order to cope with foreign competition. In addition spillovers might also occur through labour turnover from foreign to indigenous firms. However, this type of spillover may not materialise if there is very little labour mobility between foreign and indigenous firms (Fosfuri, et al., 2001).

A number of empirical studies, using both case study and econometric techniques, have confirmed the existence of positive indirect productivity benefits from FDI. For example, in an early study Caves (1974) tested several hypotheses concerning the effects of FDI on domestically-owned firms in Canada and Australia competing with foreign subsidiaries. He found foreign subsidiaries to be an effective force in reducing the excess profits of domestic competitors and improving allocative efficiency. His evidence also was consistent with a speedier transfer of technology in industries more populated by foreign subsidiaries. Positive indirect benefits have also been identified in cases where the host country is a developing economy. Blomstrom and Persson (1983) and Kokko (1994) found positive spillover effects in manufacturing sectors in Mexico. Fan's (1999) results for China reveal that the behaviour of indigenous firms is critical in determining the impact of FDI on their total factor productivity. The TFP growth of collective firms[4] was positively related to FDI, while that of state-owned firms[5] was negatively related to FDI inflows to China.

As previously noted, the indirect benefits of FDI have not always been found to be positive. Kholdy (1995) found no evidence of spillover benefits in several host developing countries with a significant FDI presence in manufacturing. For developing countries especially, it is argued that positive spillovers may not materialise if the technology gap between foreign and indigenous firms is too large. Haddad and Harrison (1993) studied the effects of foreign presence on indigenous firms' productivity in Moroccan manufacturing and suggested that large technology gaps were inhibiting spillovers. In contrast, the model of Wang and Blomstrom (1992) predict a positive relationship between the degree of spillovers from FDI and the size of the technology gap between foreign and indigenous firms; the larger the gap the stronger the possibilities for catch-up. In his study of intra-industry spillovers from FDI in Uruguayan manufacturing plants, Kokko et al. (1996) found a positive and statistically significant spillover effect only in indigenous plants with moderate technology gaps relative to foreign firms, pointing to the existence of firm-specific differences in the ability to absorb spillovers from foreign firms. Cohen & Levinthal (1989) and Kinoshita (2000) suggested that the contradictory empirical findings might imply that the incidence of productivity spillovers requires the indigenous firms to possess the ability to absorb advanced technology from foreign firms.

A high presence of foreign firms may also have a negative impact if foreign firms take the best workers from indigenous firms, leaving them with low wage and less productive employees. There is also a possibility that the competition effect may be harmful to a host economy when indigenous firms are not efficient enough to compete with foreign firms. Indigenous firms may in fact become less competitive and eventually may be displaced by foreign firms (Cantwell, 1995). Globerman (1979) uncovered evidence of negative productivity spillovers in his study of Canadian manufacturing plants. He found there was a negative relationship between FDI and indigenous firm labour productivity, and pointed out that any positive spillovers might be offset by the negative impact of more fierce competition arising from the presence of foreign firm. The finding supports the argument that negative effects from foreign firms might overshadow positive spillovers (Buckley and Casson, 1991).

A number of studies have focused on the combined direct and indirect impacts of FDI on host country industrial productivity. Girma, et al. (2001) drew mixed conclusions for UK manufacturing, finding a positive impact overall, but with little or no productivity spillovers to indigenous firms. Conclusions were also mixed for those studies focusing on developing countries as hosts; Zukowska-Gagelmann (2000) for Poland; Djankov & Hoekman (2000) for the Czech enterprises; and Aitken & Harrison (1999) for Venzuela. All of these studies suggest that a higher presence of foreign firms raises aggregate industrial productivity, even if the affect on indigenous firms is negative. In the case of Venzuela the overall impact balancing direct and indirect effects was quite small. Table 2 provides a summary of previous studies on the impact of FDI on the productivity of host countries.

<<Include Table 2 here>>

In this study of the Chinese automotive industry, the focus will be on the total impact of FDI on labour productivity. While a knowledge of direct and indirect impacts may be useful in interpreting the empirical results, the key issue for government policy towards inward investment is its effect on the productivity and competitiveness of the industry as a whole. Also while the bulk of the literature treats direct and indirect impacts as if they could be separated empirically, in the automotive industry in particular, they are increasingly blurred. Many of the so-called indirect effects are transmitted through contractual means or even equity arrangements with foreign affiliates.

4. Model, Data and Methodology

The available data allow us to estimate the aggregate impact of FDI on the productivity of China's automotive industry. Following a number of previous studies (Caves, 1974; Globerman, 1979; Blomstrom and Persson, 1983; Kokko, 1994; Gorg and Strobl, 2002), we estimate a model of the production function with labour productivity as the dependent variable. Our objective is to determine the impact of foreign presence on output per worker when other important influences on labour productivity are accounted for. An alternative measure of productivity, total factor productivity, is often used (see for example, Egger and Pfaffermayr, 2001), with some arguing that the combined impact of labour and capital productivity is a superior measure. However, we employ the labour productivity measure for two reasons: (1) we want our results to be comparable to similar studies; and (2) we also want to isolate the effects of increased capital intensity on labour productivity. Traditional models of economic growth predict that capital accumulation will raise the level of output per worker, up to a point of diminishing returns. We want to see if this point of diminishing returns has been reached given the current development stage of the Chinese automotive industry. The model of the production function to be estimated is given in equation (1) below:

$$LP = f\,(CI, FS, LQ, RFI, RIN, TO) \qquad (1)$$

Where LP (Labour Productivity) is the ratio of industry value-added to the annual average number of staff and workers in the sub-sectors of China's automotive industry.

CI (Capital Intensity) is the ratio of the net value of fixed assets to the annual average number of staff and workers. The more machinery and equipment used by each employee, the higher level of firm automation and the higher the expected productivity. Capital intensity represents an important control variable in studies of FDI impacts. As Egger and Pfaffermayr (2001) note, investment by foreign firms leads to increases in the domestic stock of capital and enhanced production capacity. In order to isolate the productivity effects associated with firm-specific assets in FDI-receiving firms and their spillovers to other firms, it is important to control for the more traditional productivity enhancing effects of investment generally.

FS (Firm Size) is the ratio of the value of gross industrial output to the number of firms. Firm size represents the economies of scale variable, which has been particular important in some sectors of the automotive industry. According to production theory, as average firm size increases, unit costs will decrease leading to higher productivity.

LQ (Labour Quality) is the ratio of the number of technical staff to the annual average number of staff and workers in each industry sub-sector. Labour quality indicates the level of skill or education of labour force. The use of the number of technical staff offers a more direct measure of the average skill/education level of the labour force than the often-used proxy of primary and secondary school enrolment, since there is a time lag between school enrolment and entry into labour force. Improvements in labour force quality can be expected to lead to increases in productivity.

RFI (Foreign Investment) is the ratio of foreign investment to total capital. As mentioned above, FDI not only transfers capital but also transfer new technologies, managerial skills, and advanced production functions. Therefore, the greater are the foreign investment inflows, the higher productivity will be. This variable is lagged by one-year to avoid any bi-directional effects where efficient and therefore competitive sub-sectors of the automotive industry might attract inward FDI.

RIN (Innovation) is the ratio of innovation investment to total investment. Innovation represents the new methods, ideas, or products introduced into either the market or production process. A higher amount of innovation investment is expected to lead to higher productivity. It should be noted that labour quality (LQ) and innovation investment variables may be positively related in that a high level of labour quality is necessary if a strong R&D capacity is to develop. The two variables in so far that they represent the technological capabilities of the domestic economy, may also indicate something about the ability of domestic firms to absorb the technical knowledge of foreign firms.

TO (Turnover of Working Capital) is the number of the times working capital is turned over in a year. Faster rates of turnover should lead to higher productivity as current assets of the firm, such as inventories of raw materials or finished goods are converted into cash inflows.

All of the monetary variables are measured at 1995 constant prices. It is predicted that all of the explanatory variables will positively influence labour productivity in China's automotive industry. To test the model for China's automotive industry, a panel data set is employed at sub-sector level. The time period considered is the five years from 1995 to 1999. Data are from *China Automotive Industry Yearbook* 1996-2000, in which China's automotive industry is divided into five sub-sectors: Auto-manufacturing, Auto-assembling, Motor-manufacturing, Vehicle-engines, and Vehicle-parts (see Table 3).

<<Include Table 3 here>>

In order to measure directly the impact of the explanatory variables on the dependent variable in terms of elasticity, the variables in the equation (1) can be rewritten in logarithmic form:

$$LLP_{it} = \beta_1 LCI_{it} + \beta_2 LFS_{it} + \beta_3 LLQ_{it} + \beta_4 LRFI_{it-1} + \beta_5 LRIN_{it} + \beta_6 LTO_{it} + v_{it} \quad (2)$$

where L indicates logged values; i and t denote the sub-sectors of the industry and time, respectively; v_{it} is a composite term including both the intercept and the stochastic error term. The coefficients β_1, β_2, β_3, β_4, β_5, β_6 indicate the percent change in LP associated with a given percent change in CI, FS, LQ, RFI, RIN, and TO, respectively.

There are three statistical models used to estimate panel data sets: a pooled ordinary least squares model (POLS), a fixed effects model (FES), and a random effects model (RES). The models differ mainly in their assumptions concerning the intercepts and error terms. In estimating equation (2), both the POLS model and the FES model are employed. The RES model cannot be used in this study because the number of parameters exceeds the number of cross-sections, represented by the five sub sectors of the Chinese automotive industry. The Likelihood ratio (LR) test is applied to identify the better statistical model between POLS and FES. A value of LR that is significantly different from zero means that the FES estimation is preferable to the POLS estimation.

5. Empirical Results

The empirical results obtained from the POLS and FES models are summarised in Table 4. As the table shows, the large and statistically significant LR value favours the FES model over the POLS model. The remaining discussion therefore focuses on the results of the FES estimation.

<<Include Table 4 here>>

The results from the FES model show that LCI, LFS, $LRFI_{(-1)}$, and LTO are positive as expected and statistically significant at different levels, while LLQ and LRIN are negative but insignificant. The coefficient for LCI is positive and statistically significant at the 5 percent level, indicating that capital intensity positively affects labour productivity in China’s automotive industry. The results suggest that capital accumulation continues to be important at the current stage of development of China’s industry. The magnitude of LCI reveals that a one percent increase in capital intensity will raise labour productivity by 0.62 percent. The LFS variable is positive and statistically significant at the 10 percent level. This result implies that firm size does affect productivity positively, supporting the presence of scale economies. The magnitude of LFS indicates that a one percent firm size increase would result in a 0.88

percent increase in labour productivity. The coefficient for the foreign investment variable, $LRFI_{(-1)}$ again is positive and statistically significant at the 10 percent level, which suggests that FDI lagged by one year positively affects labour productivity in China's automotive industry. The magnitude of $LRFI_{(-1)}$ is not high, however, with a 1 percent increase in $LRFI_{(-1)}$ raising labour productivity by 0.11 percent. The result suggests only a weak transfer of know-how from foreign firms to their indigenous counterparts in sub sectors of China's auto industry, although this suggestion should be viewed with caution given the limitations of our dataset. The result however, is consistent with statements from industry experts (see section 2) who argue that a culture of protectionism existing in the industry prevents needed changes in practices and technology. The LTO variable is also positive and statistical significant at the 1 percent level as expected, with a one percent increase in the annual turnover of working capital leading to a 0.96 percent increase in productivity. This result is consistent with that expected.

Surprisingly however, LLQ and LRIN are found to be negative, though insignificant with respect to labour productivity. The results imply that labour quality and innovation are not important determinants of labour productivity in China's automotive industry. In interpreting these results, it is important to consider the stage of economic development currently attained in the Chinese industry. While China is industrialising rapidly, with a rapid rate of capital accumulation, in many industries competitiveness is still driven by the advantages of an abundant labour supply. In contrast, the importance of variables such as labour quality and innovative investment may be more important at a latter stage of development, which is driven by the accumulation and utilization of knowledge assets. Our study covers only a five year period, so the factors influencing the productivity and competitiveness of the industry and even the type of foreign investment attracted to the industry may change over time.

The results are in accord with previous papers that suggest FDI has a positive impact on the productivity of host economies and suggests that the government should continue to promote FDI in the Chinese automotive industry. However while the FDI variable is significant, it is not the most influential factor (significant at 10 percent level) and efforts to increase the capital intensity of the industry, average firm size and working capital turnover should also be encouraged. The results also show that at the current stage of its development, innovative investment (as opposed to basic manufacturing investment) and improvements in labour quality are not important determinants of productivity growth in China's automotive industry. This is not however to suggest that they will not become more important as the industry matures. Such innovation investment as there has been in China may be incremental, merely tailoring existing products and methods to a new market and production environment. At least in the component sub-sector, Sinclair (2005, p. 48) notes that Chinese auto component manufacturers have been slow to invest in real product development, although they are 'adept at making prototypes based on blueprints or physical samples'.

6. Conclusions

This paper has focused on the impact of FDI inflows on aggregate automotive industrial productivity in China's automotive industry using a panel data set consisting of five sub-sectors over the five years from 1995 to 1999. It has thus contributed to the empirical evidence concerning the impact of foreign presence on host economies that are developing countries through a unique approach focusing on a particular sector. An important finding is that inward FDI plays a positive role in raising labour productivity in one of China's key sectors, supporting the theory of FDI, which predicts that MNEs transfer not only capital but also advanced technologies and managerial skills. The results imply that government policies to attract foreign investment have resulted in productivity benefits.

However the results also indicate that the Chinese government cannot rely solely on FDI to improve the productivity and competitiveness of the automotive industry. In fact capital intensity, firm size and the quick turnover of working capital are equally if not more important at this stage of the industry's development. These findings are consistent with reports from industry experts on the continuing fragmentation and over-capacity in certain sectors of the industry: auto-manufacturers and component suppliers. Certainly our results indicate that sub-sectors of the industry could benefit in terms of productivity growth through an increase in average firm size to achieve scale economies.

While China's automotive industry has undergone rapid development since the opening up of China's economy, further structural and technological changes need to take place for it to be internationally competitive. Our estimates of the effect of inward FDI on the labour productivity of China's automotive industry suggest that the Chinese government should continue to attract FDI inflows into the industry. However in order to ensure that the industry, and particularly indigenous firms in the industry, realise the full benefits of FDI, the culture of protectionism needs to be addressed. The auto parts and components sub-sector seems to be particularly vulnerable to import competition in the post-WTO environment, as auto assemblers can no longer be pressured into buying Chinese parts for their vehicles. In this sub-sector particularly consolidation should be an important priority. If domestic firms are to survive, they need to take advantage of the demonstration and competitive effects which foreign firms in the sub-sector can offer.

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Table 1 China's automotive industry 1955-1999
Volume in Units

Year	Output		Import		Export	
	Total	Car	Total	Car	Total	Car
1955	61	0				
1956	1654	0	56466	4067	0	
1957	7904	0	(1953-57)	(1953-57)	(1953-57)	
1958	16000	57				
1959	19601	101	68157	3048	1317	
1960	22574	98	(1958-62)	(1958-62)	(1958-62)	
1961	3589	5				
1962	9740	11				
1963	20579	11	18549	4266	2695	
1964	28062	100	(1963-65)	(1963-65)	(1963-65)	
1965	40542	133				
1966	55861	302				
1967	20381	144	41200	949	5952	
1968	25100	279	(1966-70)	(1966-70)	(1966-70)	
1969	53100	163				
1970	87166	196				
1971	111022	562				
1972	108227	661				
1973	116193	1130	97863	2317	21267	
1974	104771	1508	(1971-75)	(1971-75)	(1971-75)	
1975	139800	1819				
1976	135200	2611				
1977	125400	2330	141926	20292	4449	
1978	149062	2640	(1976-80)	(1976-80)	(1976-80)	
1979	185700	4152				
1980	222288	5418				
1981	175645	3428	41575	1401	726	
1982	196304	4030	16077	1101	238	
1983	239886	6046	25156	5806	1892	
1984	316367	6010	88743	21651	2919	
1985	443377	5207	353992	105775	1659	
1986	372753	12297	150052	48276	4179	
1987	472538	29865	67182	30536	6129	
1988	646951	36798	99233	57433	9159	
1989	586936	28820	85554	45000	2676	6
1990	509242	42409	65430	34063	4431	73
1991	708820	81055	98454	54009	4108	789
1992	1061721	162725	210087	115641	6375	914
1993	1296778	229697	310099	180717	11116	2866
1994	1353368	250333	283060	169995	18648	784
1995	1452697	325461	158115	129176	17747	1413
1996	1474905	391099	75863	57942	15112	635
1997	1582628	487695	49039	32019	14868	1073
1998	1629026	507861	40216	18016	13627	653
1999	1829396	566265	35192	19953	10095	326

Source: *Chinese Automotive Industry Yearbook* (1999, 2000)

Table 2 Summary of previous studies on FDI-productivity

Studies	Countries/Industry	Data/Econometric technique	Results – the effects of FDI inflows on host country's productivity
Caves (1974)	Canada and Australia Manufacturing sectors	Industry-level (1965-67 Canada; 1962, 1966 Australia)	Lagged FDI positively affected value-added per worker in indigenous firms while changes in FDI had a negative impact
Kokko, et al. (1996)	Uruguayan Manufacturing sector	Plant-level (1988) OLS	Positive and significant in the sub-sample of plants with moderate technology gaps vis-à-vis foreign firms
Egger and Pfaffermayr (2001)	Austria Manufacturing sectors	Panel data (1981-94) FES	General and labour-augmenting productivity improving
Girma, et al. (2001)	UK Manufacturing sector	Firm-level Panel data (1991-1996)	Higher productivity of foreign firms raise aggregate productivity but on average no productivity spillovers to indigenous firms
Zukowska-Gagelmann (2000)	Poland Manufacturing sector	Firm-level (1993-97) OLS	A higher foreign presence in an industry affects indigenous firms negatively while positive impact on performance of the whole domestic industry including foreign firms
Djankov and Hoekman (2000)	Czech Republic	Firm-level (1992-96) OLS, RES	Positive on TFP growth of FDI recipient firms but negative on firms that do not have foreign partnerships
Kokko (1994)	Mexico Manufacturing sectors	Industry-level (1970) OLS, 3SLS	Positive spillovers from competition between indigenous firms and foreign affiliates but excludes suspected 'enclaves'
Blomstrom and Persson (1983)	Mexico Manufacturing sectors	Industry-level (1970) OLS	Positive spillovers of technical efficiency between indigenous plants and the foreign participation of various industries
Kholdy (1995)	Mexico, Brazil, Chile, Singapore, and Zambia Manufacturing sector	Industry-level (1970-90) Causality test	No evidence of spillover efficiency as defined by higher labour productivity and capital formation in the host developing countries merely as a result of the presence of FDI
Haddad and Harrison (1993)	Morocco Manufacturing sector	Firm-level (1985-89)	The dispersion of productivity is smaller in the sectors with more foreign firms. No evidence of FDI accelerated productivity growth or technology spillovers in indigenous firms
Aitken and Harrison (1999)	Venezuela industry	Plant-level Panel data (1979-89, excluding 1980), OLS	Positive on small FDI recipient plants but negative on indigenous plants, the net impact of FDI is quite small
Globerman (1979)	Canada Manufacturing sectors	Plant-level (1972)	Negative relationship between FDI and indigenous firm labour productivity because of any positive spillovers may be offset by the negative impact of greater competition
Zhou, et al. (2002)	China Manufacturing sectors	firm-level (1992-95) SAS, REG	Indigenous firms in regions that attract more FDI or have a longer history of FDI tend to have higher productivity while indigenous firms in industries that have more FDI or have a longer history of FDI tend to have lower productivity

Table 3 China's automotive industry by sub-sector 1995-1999

Variable	Sub-sector	1995	1996	1997	1998	1999
CI	Auto-manufacturing	4.5742558	6.2688892	9.0959735	9.8805414	14.893051
	Auto-assembling	2.2602812	3.2361879	3.7553854	4.3146843	5.7644928
	Motor-manufacturing	3.8767455	5.0499728	6.1212909	8.303593	9.3519668
	Vehicle engine	3.1400503	4.6611794	5.1773525	5.8902539	9.6964367
	Vehicle parts	2.5262449	3.2333535	3.8417525	4.8889233	6.1122707
FS	Auto-manufacturing	83746.984	96589.787	121157.57	131322.49	145319.65
	Auto-assembling	3026.7597	3615.4192	3907.7794	4717.6914	4645.0495
	Motor-manufacturing	35180.33	36673.331	37632.993	54353.931	62051.336
	Vehicle engine	13907.115	13158.032	15532.519	18129.143	23138.373
	Vehicle parts	2240.3232	2570.2637	3112.1928	3524.4005	4288.4156
LQ	Auto-manufacturing	0.0927242	0.0898452	0.0923135	0.0863653	0.0940836
	Auto-assembling	0.0842533	0.0839291	0.0844614	0.0836696	0.0952829
	Motor-manufacturing	0.0824712	0.0804882	0.0818508	0.0899097	0.0906366
	Vehicle engine	0.1089765	0.1043297	0.1075615	0.0990893	0.0953243
	Vehicle parts	0.07589	0.0817157	0.0811973	0.0848694	0.0933093
RFI	Auto-manufacturing	0.0383161	0.0068772	0.0194796	0.0161251	0.0176689
	Auto-assembling	0.005667	0.0026935	0.0019939	0.0043458	0.0027547
	Motor-manufacturing	0.0211781	0.0071269	0.0074143	0.0012396	0.0012174
	Vehicle engine	0.0338106	0.0103632	0.0077037	0.0043399	0.0025812
	Vehicle parts	0.0291625	0.0293917	0.0177283	0.0109579	0.0081942
RIN	Auto-manufacturing	0.3606092	0.4207747	0.4417124	0.5803921	0.582734
	Auto-assembling	0.5765195	0.4207262	0.4367979	0.4211837	0.3146838
	Motor-manufacturing	0.6294588	0.5110032	0.3691246	0.5434328	0.5318273
	Vehicle engine	0.8203023	0.6749895	0.6897452	0.6387712	0.9461698
	Vehicle parts	0.7167057	0.70505	0.6000557	0.6247178	0.6391674
TO	Auto-manufacturing	1.34	1.42	1.18	1.11	1.33
	Auto-assembling	1.15	1.15	1.11	1.21	1.27
	Motor-manufacturing	2.3	1.77	1.64	1.18	1.39
	Vehicle engine	1.13	0.98	0.88	0.73	0.84
	Vehicle parts	1.17	1.01	1.08	1.02	1.06

Source: *China Automotive Industry Yearbook* (1996-2000), computed by the authors

Table 4 Results of panel data estimations, 1995-1999

	POLS	FES
LCI	0.8722 (0.2055) ***	0.6180 (0.2685) **
LFS	0.0287 (0.0593)	0.8768 (0.4700) *
LLQ	-0.5505 (0.6611)	-0.9274 (0.5581)
$LRFI_{(-1)}$	0.0185 (0.0494)	0.1127 (0.0545) *
LRIN	0.3604 (0.2417)	-0.3476 (0.2086)
LTO	1.3763 (0.3453) ***	0.9595 (0.2866) ***
C	7.2500 (1.7918) ***	-1.4040 (4.4784)
Adjust R^2	0.8933	0.9667
NT	20	20
Test	LR = 17.20***	

Notes: 1. Standard errors are in parentheses.
2. ***, ** and * indicate that the coefficient is significant at the 1%, 5% and 10% levels, respectively.

[1] Six key industries in China are automotive, electronics and telecommunications, electric appliances, power station equipment, chemicals, and steel.

[2] The term of "actually used FDI" means that FDI has been realised or 'utilised' in China, which is the term used in Chinese official statistics by the Chinese government as opposed to merely contracted or pledged FDI.

[3] International Organisation of Automobile Manufacturers

[4] Collective firms are formally owned by local governments at the urban and rural levels and include township and village enterprises.

[5] State-owned firms are formally owned by all of the people but are controlled by central, provincial or local governments.