The Contribution of Foreign Direct Investment to China's Export Performance: Evidence from Disaggregated Sectors

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ABSTRACT

There has been a long debate in the theoretical and empirical economic circles on how host country's exports respond to inward foreign direct investment (FDI). This paper examines whether FDI stimulates export performance of the recipient countries using the case of China. It contributes to the literature by investigating the relationship of FDI and export performance using disaggregated manufacturing sectors from 1995 to 2005. The empirical results suggest that FDI flows into China have statistically significant and positive effects on its exports and it exhibits differences across sectors.

Key Words: export performance, foreign direct investment, China, panel data.
JEL Classification Numbers: F21, F14, C33.

In recent decades, China's economy has experienced a phenomenal level of economic growth characterized by significant increases in inward foreign direct investment (FDI) and growth in commodity exports. However, little empirical research exists that conducted sectoral analysis of the linkage between FDI and China's export performance. There has been a long debate in the theoretical and empirical economic circles on how host country's exports respond to inward FDI. A crucial issue in this debate is whether FDI is a means of stimulating export performance of the FDI receiving countries. This controversy among economists has been fueled by the ambiguous and conflicting nature of existing economic theory and empirical evidence. While some authors argue for an insignificant or even negative effect of FDI on exports, others advocate a strong positive relationship.

Early theoretical analyses in international trade have traditionally claimed, based on the Heckscher-Ohlin framework, that product trade and international capital movements are substitutes (Mundell, 1957). However, later studies by Schmitz and Helmberger (1972) and Kojima (1975) provide a theoretical basis for a complementary relationship between product trade and FDI. Furthermore, FDI theory suggests the existence of two types of production arrangements: vertical integration (Helpman, 1984) and horizontal integration (Horstmann and Markusen, 1992). While the former is likely to facilitate trade because the primary purpose for this kind of FDI is to seek lower cost of production in the host country and then to export goods produced/processed by foreign-funded enterprises (FFEs), the latter is a substitute for trade considering that FFEs move their products for exports to host country to obtain market shares (Liu and Shu, 2003). Apart from the direct effects of FDI discussed above, it is believed that there are also indirect effects of FDI on host exports, which means that exports by indigenous

companies could also be influenced by FFEs (Helleiner, 1989; Caves, 1996; Zhang and Song, 2000), i.e., spillover effects.

Similar to the conflicting theoretical views on the role of FDI, the available empirical evidence is mixed. Several cross-country studies found support for the hypothesis of a negative relationship between FDI and export (Horst, 1972; Jeon 1992; Sharma, 2000). Moreover, Lall and Mohammad (1983) and Sharma (2000) do not see any statistically significant impact of FDI on Indian exports. In contrast, other studies indicated that FDI actually have a positive effect on export performance of host countries, as found in Ireland (O'Sullivan, 1993), Portugal (Cabral, 1995), U.K. (Blake and Pain, 1994) etc. (Ajami and Barniv, 1984; Goldberg and Klein, 1997; Grosse and Trevino, 1996). Pain and Wakelin (1997) yield that the FDI-export relationship can vary in different countries. Besides, disaggregated analyses of FDI's role in specific sectors on exports exist, as shown by Furtan and Holzman (2004). They conclude that U.S. FDI has a positive effect on total agricultural and food product trade, exports and imports between Canada and the U.S.

Research on China's inward FDI and exports relationship has been a more recent addition to the literature. Although some authors have examined the impact of FDI on China's exports, most of them depend on the use of aggregated national or provincial data (Sun, 2001; Wang et al, 2002; Yao, 2006; Zhang and Song, 2000). However, this may lead to biased results because it unnecessarily, and perhaps erroneously, assumes that FDI's effects are equal across sectors. If this assumption is incorrect, then the examination of aggregated national or provincial data is likely to dilute the true nature of the relationship and lessen the probability of obtaining accurate empirical results. It is more plausible to assume that the impact of FDI will differ across sectors.

Moreover, as export-oriented FDI is highly encouraged in China, FDI is likely to promote overall exports. Thus a positive linkage between FDI and exports may be expected (Liu and Shu, 2003).

Nevertheless, the key issue that remains unclear is the mechanism through which FDI creates or promotes China's exports. One possible channel to study this is to examine the industrial distribution of FDI and the industrial structure of exports, and to analyze sectoral difference in the trade impact of FDI, as suggested by Sun (2001). Little research has been done on the impact of FDI on China's export by sector except Liu and Shu (2003). Using data from China's Third National Industrial Census in 1995, the authors investigate the determinants of export performance in China at industrial and sectoral level. They divide the data into two subsamples, namely, low-technology and high-technology with respect to the research and development intensity. Their results suggest that the export performance of different industries is significantly influenced by FDI in addition to firm size and labor costs. They also showed difference between high- and low-technology sectors. However, they fail to include time spectrum with cross-sectional data. Our study extends the empirical research at the sectoral level by focusing on the relationship between China's inward FDI and exports performance in various manufacturing sectors.

This paper focuses on manufacturing sectors because of their dominance in the total value of China's exports. Meanwhile, these industries account for over 90 percent of total FDI to China. Thus, this paper contributes to the literature by analyzing the impact of FDI on China's exports in sub-sectors in manufacturing over the period from 1995 to 2005. This approach would allow for capturing possible variations in the effects of FDI on export performance between different sectors in China, which may not be detected at the aggregated level, and would shed some light on how inward FDI could affect China's exports. In addition, this paper specifies

more sectoral characteristics besides its received FDI, i.e., labor cost, economies of scale, research and development (R&D), domestic investment, gross production, exchange rate and world demand. It will increase the likelihood of grasping the true relationship between exports and FDI for certain sectors in China. Furthermore, our empirical evidence may have important policy implications for designing development strategies and guiding FDI inflow to different sectors during China's economic transition.

The rest of the paper is organized as follows. The next section briefly discusses some facts on China's exports and FDI. Section three describes economic theories and hypotheses that will be tested. Section four gives a brief description of data and presents the empirical model. Estimation results are discussed in section five. Concluding remarks with policy implications and limitation of this study are offered in the last section.

China's Exports and FDI

China's exports have increased over ten times from about 53 billion US dollars in 1995 to 762 billion US dollars in 2005, as shown in Table 1. Primary goods[1] export possesses a decreasing trend in terms of percentages, while export share of manufactured goods[2] has steadily increased from 71 percent in 1989 to 94 percent in 2005. It shows that gradual change in China's export structure, that is, it shifts towards manufactured goods.

Foreign investment in China started in 1979 when there were few relevant laws to protect FDI's legal rights, which has kept foreign funds inflow slow and in small amounts. It steadily increased through 1991 with the gradual improvement of foreign investment laws and domestic economic environment in China, which amounts to $23 billion in total. From 1992 to 1995, many favorable policies and economic development zones were set up for FFEs, and as a result,

the number of FFEs and investment amount rocketed. The average increase rate for FDI was around 84 percent for this time period. It is not surprising that the foreign direct investment accounted for $37.5 billion in 1995 (China Statistical Yearbook, National Bureau of Statistics of China).

It has been shown that the exports by FFEs increased dramatically to 32 percent in 1995 from its mere 3 percent in 1987 (Zhang and Song, 2000). Table 2 presents FDI flows to China, China's total exports, and share of exports by FFEs in total exports of China from 1995 to 2005. It shows a rapid growth in FFEs' exports percentage shares from 32 percent in 1995 to over 58 percent in 2005. Export by FFEs has become an increasingly important part of China's total export. It suggests that China's exports are closely associated with inward FDI, yet the structure of FDI promoting exports could be changing through decades due to China's rapid economic development, and thus sectoral analysis on the linkages between FDI and China's exports by sector is considered as a plausible approach.

Theoretical Framework and Hypotheses

Since the model is established to explain exports, with FDI to be one of the explanatory variables, it is appropriate to start with the underlying theories studying the determinants of exports performance. The theoretical foundations for the empirical studies are among the conventional trade theories based on the Heckscher-Ohlin (H-O) framework, new trade theories, and endogenous growth theories (Liu and Shu, 2003).

According to the H-O theory, a country should export those products using more factors with which the country is better endowed, in that it has comparative advantages in both production and exports. As for new trade theories, they additionally consider imperfect

competition, economies of scale, and trade costs, which then become important factors affecting export performance. Markusen and Venables (1998) incorporated FDI into their general equilibrium trade models due to the rapid globalization. Furthermore, endogenous growth theories have emphasized the role of innovation, and as a result, technological characteristics of an industry are considered as a key factor to export performance (Liu and Shu, 2003). Given that no single theory could by itself account for export performance for developing countries (Liu and Shu, 2003), we construct an empirical model taking into account a number of factors with special attention to FDI.

Foreign Direct Investment (FDI)

There are conflicting theories regarding the linkage between FDI and trade. Generally, FDI may affect the host country's exports through two channels. One is direct effects that depend on whether foreign-funded enterprises (FFEs) resort to resources in host country and search for exports to other countries or just for the market of host country. The former one is referred to as vertical FDI. It is based on relative endowments, attracted by factor cost differentials and repelled by trade costs (Demekas et al, 2007). The latter one is known as horizontal FDI. It is mainly market-seeking investment and aimed at penetrating the domestic market (Demekas et al, 2007). The other effect is indirectly presented through host country's local companies, whose exports may be influenced by FFEs.

Positive direct effects of FDI on exports occur when it is vertical FDI is the main purpose of FFEs. They search for lower cost production location globally and come to a host country for the resources where the country's comparative advantage lies. In this case, the FFEs target at lowering their costs, and they are willing to export those products abroad from the host country. However, if FFEs come to a host country for its huge potential market there, it is less likely that

they will export the products. They may want to sell them instead in the promising market of the host country. Under this circumstance, FDI may have little direct effect on the host country's exports. For China, both cases could be true, due to its lower labor cost and relatively rich natural resources (raw materials), as well as huge potential markets for foreign companies.

Indirect effects of FDI on exports involve the influence of FDI on indigenous companies' exports. Generally, FFEs present higher advantages in production technologies, management, marketing competence, etc. Local firms may increase their exports by observing the export behaviors of FFEs (Haddad and Harrison, 1993). It may also improve local companies' competitiveness through the transfer and diffusion of technologies, management know-how, entrepreneurial skills, and labor training from FFEs (Sun, 2001; Zhang and Song, 2000). However, FDI may also decrease local firms' exports by increasing FFEs' purchase of inputs locally. Some products originally to be exported by local firms may instead flow to FFEs, in which these products are used as inputs and processed to export, or to penetrate the market in the host country. Moreover, FFEs' exports could also squeeze the exports from indigenous firms producing homogenous products since FDI further lowers cost by moving production to the host country, which could make the total effect of this indirect linkage ambiguous as well. Therefore, the effect of FDI by the form of FFEs on export is ambiguous. Thus, our hypothesis for FDI's effect on the China's exports is uncertain.

Other Factors (Domestic Investment, Firm Size, Labor Cost, R&D, Exchange Rate, Gross Sectoral Product and World Demand)

In addition to FDI, domestic fixed assets investment could also be an important factor affecting exports because it is one of the main determinants of productivity which could influence supply for exports. An increase in productive capacity from domestic investment is likely for the

company to promote exports. As shown in previous literature (Coughlin and Fable, 1988; Erickson and Hayward, 1992; Leichenko and Erickson, 1997; Zhang and Song, 2000), domestic investment is a significant factor for export performance of countries. Therefore, it is expected that domestic investment increase exports.

Firm size probably is one of the most researched variables in exporting studies at firm level in empirical studies; however, its impact on export performance remains unclear. Export usually involves uncertainties in international markets in addition to costs from extra transportation and communication, collecting market information, establishing sales channels abroad and localizing products. Moreover, It is believed that large firms possess economies of scale and more overseas resources so that they could reduce their costs and risks for expanding their market shares globally (Liu and Shu, 2003). Therefore, firms that are more resistible to these costs and risks may tend to export more. Cavusgil and Naor (1987), Christensen et al (1987), Perkett (1963), and Tookey (1964) supported that the larger the company the more likely it is to export. However, Glejser et al (1980) pointed out that if large firms are already in a leading or monopolistic position in domestic market, they may be less willing to explore oversea markets, while small firms are inclined to have a strong incentive for seeking bigger market shares elsewhere outside their own country. Da Rocha et al. (1994) showed that motives to export are often associated with smaller firms. Cooper and Kleinschmidt (1985) and Gripsrud (1990) also concluded a negative relationship between firm size and exports whereas Katsikeas et al (1995) suggested no direct relationship. In terms of China, large firms have a history of possessing more channels obtaining export quota from the government and may have had more access and advantages to foreign markets than small firms. In some sectors where exports are dominated by assembled and processed goods, small firms may count more exports. Given the

interaction between these two effects and the mixed empirical findings (Bilkey, 1978), we hypothesize that the effect of firm size on export is uncertain.

Another factor to be included is labor cost. According to factor endowment theory, an industry should export goods which are produced using the relatively abundant resources of the home country. Provided that China is better endowed with labor and the wage rate is much lower than those in developed countries, it may have comparative advantages in its labor-intensive industries, whose products could be more competitive in the world market and thus contribute to exports volume. Our hypothesis then is that the lower the labor costs, the more the country will export especially in labor-intensive sectors.

The role of innovation in developing new products and improving the quality of existing products has been widely acknowledged. In accord, products will be more competitive in markets due to higher quality; thus it may improve the export performance of the firm or the industry. Yet empirical evidence on the impact of research and development (R&D) on exports is not clear. Some studies found a significant positive effect of R&D on the U.K. and the OECD trade performance (Greenhalgh et al., 1994; Leon-ledesma, 2000) while others concluded that R&D does little with promoting exports in Canada (Lefebvre et al., 1998). As for China, we hypothesize that R&D could be positively or negatively related with exports.

Besides, exchange rate is another factor that might have influence on exports. In general, depreciation of a country's currency tends to encourage its exports. The depreciation of the currency makes its goods cheaper in international markets and thus is more competitive. Sun (2001) and Yao (2006) found support for this hypothesis in China when they investigated the impact of FDI on exports at provincial level using data from 1984 to 1997 and 1978 to 2000 respectively. Wang et al. (2002) also showed that exchange rate is one of the most important

factors influencing China's exports with aggregated data for 1983-1999. Our hypothesis remains consistent with the conventional theory that a devaluation of Chinese currency increases demand for its products and promotes exports.

Gross Sectoral Product (GSP) could be another factor that may affect exports. It is similar to Gross Domestic Product except that it indicates productivity of a specific industry. It sheds some light on economic performance and productivity of each sector under study. GSP is expected to be positively related with exports (Banga, 2006).

World demand could also play a significant role in affecting China's export performance. They are concluded as significant explanatory variables for exports in previous literatures (Pain and Wakelin, 1997). It is believed that the higher world demand, the more China's exports could be.

Model Specification and Data

This study examines the impact of FDI on export performance across different sectors in China at a disaggregated level using sectoral data. As discussed in the previous section, many factors may affect total exports and exports by sector. Therefore, the sectoral exports in year *t* are estimated as below:

$$\ln(EXP_{i,t}) = \beta_0 + \beta_1 \ln(FDI_{i,t}) + \beta_2 \ln(EXR_{i,t}) + \beta_3 \ln(DI_{i,t}) + \beta_4 \ln(GSP_{i,t}) + \beta_5 \ln(FS_{i,t}) + \beta_6 \ln(RD_{i,t}) + \beta_7 \ln(WAGE_{i,t}) + \beta_8 \ln(WD_{i,t}) + \varepsilon_{i,t} \quad (1)$$

where subscripts *i* and *t* denote cross-sectional unit and time respectively. ε is disturbance term. β_0 through β_8 are parameters to be empirically estimated. *EXP* represents China mainland's real export volume. *FDI* is real foreign direct investment to China. *FDI* variable is gauged by real total sales of foreign manufacturing companies in China each year by industry[3], due to lack of disaggregated actual FDI inflow data. *DI* stands for domestic investment and it is estimated from

annual aggregated national domestic investment by applying ratios of each sector's capital expenditure (investments) to its total investments[4]. *EXR* is defined as real effective (trade-weighted) exchange rate[5] in Chinese Yuan per basket of China's trade partners' currencies. Due to the lack of bilateral trade data at sectoral level, we use the same *EXR* for each sector. *GSP* stands for China's real gross sectoral product. *FS* represents firm size for economies of scale and is measured by average real output per company. *RD* denotes research and development for innovation; we use number of patents granted a year in each sector as a proxy. *WAGE* represents labor cost; it is average real wage per employee in a year by sector. *WD* stands for world demand, which is the sum of world imports (except China) for each commodity/industry[6].

The dataset contains fourteen main exporting manufacturing sectors[7] from 1995 to 2005 using classification from United Nations (UN) International Standard Industrial Classification of All Economic Activities (ISIC) (See Appendix A for detailed description). Disaggregated sectoral data for *FDI*, *FS*, *WAGE*, *RD*, are obtained from *China Statistical Yearbook* as well as China's consumer price index (CPI) to convert nominal to real terms. All other data come from Global Insight, Inc. All data are processed by the authors and their value units converted to Chinese currency Yuan in real term.

Table 3 presents descriptive statistics for the stacked data before natural log applied. Table 4 details into each sector, in which Electrical Machinery and Textile Industries have the highest exports as well as FDI. Table 5 shows the change over time of each variable averaged across all sectors. Most variables consistently increase as time goes by from 1995-2005, except for *DI* and *EXR*, which have some fluctuation during the period.

Empirical Results

Hausman test is performed and it indicates that fixed effects model is strongly preferable ($\chi^2 = 169.04, p < 0.0001$) to random effects model. Baltagi (2005) argues that fixed effects model is an appropriate specification for panel data analysis if focusing on a specific set of individuals, which fits in our case of 14 manufacturing sectors within Mainland China. Moreover, it is believed that fixed effects are a reasonable way to do with panel data, as they always give consistent results yet may not be the efficient model.

The issue of endogneity is examined and tested with Hausman test. With endogneity being detected and not corrected at its presence, the parameters estimated from ordinary fixed effects model are biased and inconsistent. It turns out that domestic investments are endogenous; therefore Instrumental Variable (IV) method is used to estimate the empirical models.

One common problem encountered in panel data studies is groupwise heteroskedasticity, whose presence renders OLS estimators inefficient. Likelihood ratio test for groupwise heteroskedasticity is applied, and the null hypothesis of homoskedastic disturbances was rejected at 1 percent significant level ($\chi^2 = 100.75, p < 0.0001$). In addition, Wooldridge test for autocorrelation in panel data (Wooldridge, 2002; Drukker, 2003) is performed and it suggests the presence of 1st order autocorrelation ($F = 6.708, p = 0.022$). The XTIVREG2 module (Schaffer, 2007) in Stata is applied to estimate the empirical model with heteroskedasticity and serial correlation corrected.

In addition, we relax the restriction that the effects of variables on exports are equal across all sectors. It would be preferable that the effect of each variable in each sector on export is not restricted to be equal; however, we may encounter degree of freedom problem with our dataset. We then separate the fourteen sectors into two sub-samples, low/medium low-

technology (low-tech) and high/medium high-technology (high-tech) categories based on OECD's Technology classification of manufacturing industries; please see Appendix B for details. Furthermore, in order to examine FDI's specific effect on each sector's export, they are not restricted to be equal across all sectors; so that we have an FDI variable for each of fourteen sectors. The unrestricted model incorporates low-tech and high-tech categories, which enables us to empirically test the equality of parameters in these two sub-samples. It also allows us to test the effects of FDI on export in all the sectors included in our study. The results show that there is no statistically difference between the parameters across the two sub-samples and that the effect of FDI on exports varies from sector to sector. The estimation results are presented in table 6.

For all sectors, firm size, labor costs and exchange rate are not statistically different from zero at even 10% significance level. Firm size is not a determinant of promoting China's export. This finding is consistent with what Katsikeas et al. (1995) found. Exchange rate is not an important factor in stimulating China's exports. It may be attributed to a couple of factors. First, given the characteristics of our yearly data, short-run exchange rate fluctuations may not be observed. Second, even though China has adopted more flexible exchange rate policy more recently but it is still relatively fixed from long-run perspective. Labor cost does not help in enhancing export performance. This may be due to China's already extremely low labor costs. It may shed some light to the effects of wage rate if more exporting countries besides China are incorporated and compared.

It is noted that world demand is significant at 1 percent level. If world demand increases by 10 percent, China's exports will increase by 8.8 percent in the manufacturing industries. It indicates these sectors are very dependent on world demand and might be tremendously impacted by world demand fluctuations. With Chinese Yuan appreciates rapidly lately, the

relative price of Chinese products increases, which may decrease the world demand for Chinese products. It in turn gives a hard time on China's exporting companies and an adverse effect on export volume and value.

Domestic investment could enlarge China's exports as well, and it is consistent with previous research (Coughlin and Fabel, 1988; Erickson and Hayward, 1992; Zhang and Song, 2000). Domestic investment may help improve infrastructure and enhance productivity, thus it gives a better chance for exporting companies to promote exports.

Research and development do not stimulate China's exports at 5 percent significance level, which is consistent with what Liu and Shu (2003) found. This may reflect that China's export products contain more labor-intensive products but limited capital or technology intensive components. It is not surprising to find that China's industries have not established technological competitiveness (Liu and Shu, 2003).

In terms of foreign domestic investment, four out of fourteen are significantly positive at 1 percent level and four additional are significant at 10 percent level. Export of electrical machinery and transport equipment industries benefit most from the FDI received with positive coefficients of 0.55. It is then followed by paper and paper products and manufacturing of transport equipment at 0.50 and 0.47 respectively. The results show that FDI plays different strategic roles in the industries under study. Despite insignificance of some FDI variables, most exhibit a positive sign (thirteen out of fourteen). It may indicate that foreign investments are targeted produce their products using China's relatively rich resources and low wage rates and export them abroad.

Concluding Remarks

The potential impact of China's recent market liberalization policies on trade and global investment flows has been intensively discussed among policy-makers and economists. However, the vast majority of previous studies on this aspect of China's economy have focused on either national aggregated or provincial level data (Liu and Shu, 2003; Sun 2001; Wei and Liu 2006; Zhang and Flemingham 2001; Zhang and Song 2000). In contrast, very little empirical research have emphasized the industrial sectors.

This paper is among the first to re-examine the relationship between FDI and China's exports using panel data including fourteen main FDI receiving and exporting manufacturing sectors from 1995 to 2005. The empirical analysis is characterized by applying differentiated cross-section effect of FDI to explain export in each sector. This is in contrast to most past studies that used more aggregated data, in which they assume that the effects of FDI on exports is the same in direction and magnitude across sectors. It is more plausible to assume that FDI effect on trade varies in different sectors.

The empirical results suggest that FDI has a statistically significant and positive impact on China's exports. More specifically, this effect remains positive in thirteen out of fourteen sectors. The findings for FDI as well as other variables accounting for exports and industrial characteristics offer a number of important implications for policymakers. First, domestic investments should be taken into more consideration for stimulating China's exports. It will be implausible not to gradually upgrade China's export structure and enhance competitiveness of domestic companies through this approach. Second, as FDI does not function equally in all industries, China may realize the differences and specify its policy to FDI by sector. To simply increase export quantity, China could try to attract more FDI to its low tech sectors as they

possesses comparative advantages; however, to upgrade its exporting structure and to obtain more export from high tech sectors, it is would be better for China also to resort to other approaches besides FDI. To sustain growth in long run, research and innovation support should also be better reinforced to make it an important factor for production and export in the future. The dependence of China's exports on world demands should be lessened in the future, though China could still take advantage of them at present. It is crucial for China to adopt a combined strategy of using low labor costs attracting more FDI and enhancing its own technological capacity with domestic investments at the same time.

One limitation of this study is that the dataset only covers eleven years. With more data available, we may be able to relax and test empirically restrictions of equality of other variables across sectors. In future research, dynamic model may be considered.

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Endnotes

[1] Primary goods refer to food and live animals used chiefly for food, beverages and tobacco, non-edible raw materials, mineral fuels, lubricants and related materials, and animal and vegetable oils, fats, and wax.

[2] Manufactured goods refer to chemicals and related products, light and textile industrial products, rubber products, minerals metallurgical products, machinery and transport equipment, miscellaneous products, and products not otherwise classified.

[3] It is due to the lack of detailed data on the industrial composition of FDI. Besides, total sales of foreign manufacturing companies by sector are also not available for 1998, which is replaced by moving average of the sales in 1997 and 1999.

[4] As sectoral DI data is not available to the authors, it is estimated using $DI_{it}=DI_t\times(CapEx_{it}/CapEx_t)$.

[5] Real Effective (Trade-Weighted) Exchange Rate is exchange rate weighted by trade with China's trade partner, i.e. $\Sigma EXR_i\times TRWT_i$, where EXR_i is the exchange rate of Chinese currency per each of the currencies of China's trade partners i in one year, and $TRWT_i$ is the weight of trade measured by the share of each trade partners i in total trade with China in the same year.

[6] We do not use the sum of imports from China's major importing partners, as at sectoral level, the data for each country could be unavailable. As China's exports are so spread around the world, to more than 200 countries, we believe that it is acceptable to use the sum of world imports as proxy.

[7] Exports data in China are divided by UN ISIC Rev.2 referring to http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=8&Lg=1, while FDI (here using proxy, total sales of foreign manufacturing companies) are detailed to only 39 sectors in China's statistics yearbook. The authors matched those relevant ones of the export sectors and 39 FDI sectors, and selected industries to study according to their received FDI and exportation scale, the larger the better. More disaggregated classification of industries could be adopted to this research, but out of simplicity, we presents results with only these 14 sectors.

Appendix

A. Here is the detailed description of the manufacturing sectors included in our analysis with United Nations, International Standard Industrial Classification of All Economic Activities (ISIC) Rev.2. [31excl.314] Manufacture of Food and Beverage excluding Tobacco; [32] Textile, Wearing Apparel and Leather Industries; [33] Manufacture of Wood and Wood Products, Including Furniture; [34] Manufacture of Paper and Paper Products, Printing and Publishing; [351] Manufacture of industrial chemicals; [3522] Manufacture of drugs and medicines; [353+354] Petroleum refineries and Manufacture of miscellaneous products of petroleum and coal; [355+356] Manufacture of rubber and plastic products; [36] Manufacture of Non-Metallic Mineral Products, except Petroleum and Coal; [37] Basic Metal Industries; [381] Manufacture of fabricated metal products, except machinery and equipment; [382excl.3825] Manufacture of machinery except electrical excluding office, computing and accounting machinery; [383+3825] Manufacture of electrical machinery apparatus, appliances and supplies, including office, computing and accounting machinery and [384] Manufacture of transport equipment.

B. Based on OECD's Technology classification of manufacturing industries, please refer to http://fiordiliji.sourceoecd.org/pdf/ann-a.pdf. Low/medium low tech industries include Manufacture of Food and Beverage excluding Tobacco, Textile, Wearing Apparel and Leather Industries, Manufacture of Wood and Wood Products, Including Furniture, Manufacture of Paper and Paper Products, Printing and Publishing, Manufacture of rubber and plastic products, Manufacture of Non-Metallic Mineral Products, except Petroleum and Coal, Basic Metal Industries, and Manufacture of fabricated metal products, except machinery and equipment.

High/medium high tech sector include Manufacture of industrial chemicals; Manufacture of drugs and medicines; Petroleum refineries and Manufacture of miscellaneous products of petroleum and coal; Manufacture of machinery except electrical excluding office, computing and accounting machinery; Manufacture of electrical machinery apparatus, appliances and supplies, including office, computing and accounting machinery and Manufacture of transport equipment.

Table 1. China's Export Facts Sheet (Nominal), 1989-2005

Year	Total (in Billion dollars)	Primary Goods (in Billion dollars)	Share of Primary Goods Exports (%)	Manufactured Goods (USD 100 million)	Share of Manufactured Goods Exports (%)
1989	52.54	15.08	28.70	37.46	71.30
1990	62.09	15.89	25.59	46.21	74.41
1991	71.91	16.15	22.45	55.70	77.46
1992	84.94	17.00	20.02	67.94	79.98
1993	91.74	16.67	18.17	75.08	81.83
1994	121.01	19.71	16.29	101.30	83.71
1995	148.78	21.49	14.44	127.30	85.56
1996	151.05	21.93	14.52	129.12	85.48
1997	182.79	23.95	13.10	158.84	86.90
1998	183.71	20.49	11.15	163.22	88.85
1999	194.93	19.94	10.23	174.99	89.77
2000	249.20	25.46	10.22	223.74	89.78
2001	266.10	26.34	10.22	239.76	90.10
2002	325.60	28.54	8.77	297.06	91.23
2003	438.23	34.81	7.94	403.42	92.06
2004	593.33	40.55	6.83	552.78	93.17
2005	761.95	49.04	6.44	712.92	93.56

Source: China Statistical Yearbook (2006), National Bureau of Statistics of China.

Notes: 1. Primary goods refer to food and live animals used chiefly for food, beverages and tobacco, non-edible raw materials, mineral fuels, lubricants and related materials, and animal and vegetable oils, fats and wax.

2. Manufactured goods refer to chemicals and related products, light and textile industrial products, rubber products, minerals metallurgical products, machinery and transport equipment, miscellaneous products, and products not otherwise classified.

Table 2. China's Inward FDI and Exports by Foreign Funded Enterprises (Nominal), 1995-2005

Year	FDI (in Billion dollars)	Total Exports (in Billion dollars)	Exports by FFEs (in Billion dollars)	Share of Exports by FFEs in Total Exports (%)
1995	37.52	148.78	46.88	31.51
1996	41.73	151.05	61.51	40.72
1997	45.26	182.79	74.90	40.98
1998	45.46	183.71	80.96	44.07
1999	40.32	194.93	88.63	45.47
2000	40.72	249.20	119.44	47.93
2001	46.88	266.10	133.24	50.07
2002	52.74	325.60	169.99	52.21
2003	53.51	438.23	240.31	54.84
2004	60.63	593.33	338.59	57.07
2005	60.33	761.95	444.18	58.30

Source: China Statistical Yearbook (1996-2006), National Bureau of Statistics of China.

Table 3. Descriptive Statistics for Stacked Data (1995-2005, in real value, before natural log applied)

Statistics	EXP (Billion Yuan)	WD (Billion Yuan)	FDI (Billion Yuan)	DI (Billion Yuan)	GSP (Billion Yuan)	FS (Million Yuan)	WAGE (Yuan)	RD (1,000 Item)	EXR (Yuan/100 foreign currency)
Mean	24.55	349.83	1.89	0.50	22.36	0.70	96.12	3.13	98.51
Median	8.10	232.94	0.92	0.38	14.47	0.41	90.29	2.10	100.00
Maximum	477.82	2,282.27	25.72	2.94	273.32	5.36	241.12	22.35	106.63
Minimum	1.23	64.24	0.03	0.04	2.25	0.03	40.03	0.15	80.41
Std. Dev.	58.46	367.23	3.14	0.45	32.35	0.92	40.03	3.63	8.23

Table 4. Descriptive Statistics by Sector from 1995 to 2005 in real terms[8] (before natural log applied)

Sector	EXP (Billion Yuan)	WD (Billion Yuan)	FDI (Billion Yuan)	DI (Billion Yuan)	GSP (Billion Yuan)	FS (Million Yuan)	WAGE (Yuan)	RD (1,000 Item)
Food and Beverage	12.35	342.90	2.36	0.61	34.63	0.39	75.88	1.43
Textile, Wearing Apparel and Leather Industries	67.85	471.53	3.26	0.37	32.81	0.34	103.78	2.21
Wood and Wood Products	9.93	104.40	0.43	0.12	3.49	0.21	65.63	3.91
Paper and Paper Products, Printing and Publishing	3.22	148.19	0.75	0.25	9.42	0.23	80.14	0.91
Industrial chemicals	11.06	342.46	1.72	0.91	24.75	0.80	90.96	2.95
Drugs and medicines	2.65	134.85	0.41	0.33	9.49	0.48	100.68	5.08
Petroleum refineries	3.21	109.60	0.39	0.33	8.14	3.19	151.60	0.41
Rubber and plastic products	9.01	114.16	1.21	0.19	10.02	0.34	79.89	0.52
Non-Metallic Mineral Products	6.87	74.00	0.70	0.43	21.53	0.24	68.03	0.63
Basic Metal Industries	11.52	267.59	1.01	1.19	27.27	1.18	122.77	0.45
Fabricated metal products	13.51	129.04	1.00	0.25	11.65	0.26	87.07	2.58
Machinery	18.27	589.15	1.41	0.60	6.33	0.31	95.71	6.96
Electrical machinery	163.69	1,360.62	9.36	0.76	91.26	1.06	107.00	9.16
Transport equipment	10.62	714.05	2.47	0.62	22.18	0.78	116.47	6.55

[8] Exchange rate is not shown because it does not change across sectors.

Table 5. Mean Statistics (in real term, before natural log applied), 1995-2005

Year	*EXP* (Billion Yuan)	*WD* (Billion Yuan)	*FDI* (Billion Yuan)	*DI* (Billion Yuan)	*GSP* (Billion Yuan)	*FS* (Million Yuan)	*WAGE* (Yuan)	*RD* (1,000 Item)	*EXR* (Billion Yuan)
1995	8.39	252.04	0.72	0.38	9.18	58.63	0.21	1.48	80.41
1996	9.30	276.75	0.70	0.37	12.12	59.08	0.21	1.30	87.06
1997	10.92	297.52	0.82	0.34	12.85	60.44	0.25	1.35	92.45
1998	11.86	303.27	0.99	0.29	12.73	72.54	0.56	1.67	99.97
1999	13.67	313.70	1.16	0.27	14.17	81.18	0.65	2.78	97.49
2000	17.62	342.03	1.46	0.30	16.67	90.76	0.84	2.98	100.00
2001	20.17	339.41	1.68	0.36	18.87	100.69	0.86	3.18	106.63
2002	26.34	349.41	2.03	0.53	22.91	114.24	0.91	3.50	106.18
2003	38.47	397.64	2.82	0.65	30.41	128.23	1.05	4.66	102.12
2004	50.85	468.64	3.62	0.76	43.40	138.60	1.17	5.43	105.31
2005	62.49	507.79	4.82	1.22	52.63	152.88	1.01	6.05	106.00

Table 6. Cross-sectional time-series Instrumental Variable Estimation Regression Results

Explanary Variables	Coefficients	Standard Errors
WD	0.8786	0.1715
DI	0.3206**	0.1288
FS	-0.0043	0.0745
RD	0.1414*	0.0810
GSP	-0.1521*	0.0834
EXR	0.2259	0.2964
WAGE	0.1658	0.2772
FDI1	0.0394	0.1778
FDI2	0.2903*	0.1538
FDI3	0.3237*	0.1727
FDI4	0.4955**	0.1127
FDI5	0.1344	0.1140
FDI6	-0.4843	0.3040
FDI7	0.1809**	0.0620
FDI8	0.2537*	0.1350
FDI9	0.2383	0.1707
FDI10	0.1748	0.1076
FDI11	0.2897	0.2065
FDI12	0.3013*	0.1740
FDI13	0.5498**	0.1328
FDI14	0.4703**	0.1178

Note: 1. ** and * stand for significant at 5% and 10% level respectively.
2. WD stands for world demand; DI for domestic investment; FS represents firm size; RD denotes research and development for innovation; GSP stands for real gross sectoral product; EXR denotes real effective exchange rate; Wage represents labor cost and FDI stands for foreign direct investment.
3. FDI1 stands for Food and Beverage, 2 for Textile, Wearing Apparel and Leather Industries, 3 for Wood and Wood Products, 4 for Paper and Paper Products, Printing and Publishing, 5 for Industrial chemicals, 6 for Drugs and medicines, 7 for Petroleum refineries, 8 for Rubber and plastic products, 9 for Non-Metallic Mineral Products, 10 for Basic Metal Industries, 11 for Fabricated metal products, 12 for Machinery, 13 for Electrical machinery and 14 for Transport equipment.