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Why the Manufacturing Firms in Developing Countries can be Competitive? The Evidence of China

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Abstract

Based on the data of more than 95,000 Chinese manufacturing firms, this study explores the reasons for the recent surge of manufacturing exports from China. Contrary to common belief, neither unit labor cost nor Research and Development (R&D) investment has been a contributing factor to the export success of Chinese firms, even in high-technology sectors. Although exportation of high-technology products has traditionally been dominated by foreign manufacturing firms, domestic firms have invested more heavily in R&D than their foreign counterparts. However, the major contributors to the increase in Chinese exports are product innovation, collaboration with foreign investors, and fierce domestic competition.

JEL Code: F14; F21; O14

Key words: Export Competitiveness; Manufacturing Firms; Processing Trade; China

1. Introduction

A commonly discussed topic in trade literature has been the export performance of countries, industries, and firms (Glejser et al., 1980; Daniels, 1993; Gustavsson et al., 1999; Carlin et al., 2001). A majority of the studies in this area examine cases of exportation in industrialized countries. Only a handful of studies such as those by Aggarwal (2002) on Indian firms, Zhao and Li (1997) and Liu and Shu (2003) on Chinese industry, and Ozcelik and Taymaz (2004) on Turkish firms have focused on the export industry in developing countries. One of the reasons that so little research has been done on developing countries is the dearth of sound data. A more plausible explanation, we argue, is the lack of technological competitiveness, which has made it difficult for firms in the developing world to export a broad range of manufactured products until recently.

The 1970's was the watershed in the trade structure transformation of developing countries. Before then, their major export merchandise was limited to raw materials such as petroleum and coal and labor-intensive products such as textile and footwear products (Krugman and Obstfeld, 2000, p.79). Between 1960 and 2001, the export share in the world trade of manufactured goods in developing countries gradually increased from 12 percent to 65 percent. During the same period, their share of primary commodities, excluding fuels, fell from 63 percent to 13 percent (UNCTAD, 2005). The main contributors of these trends were the Southeast Asian countries. Manufacturing exports from China, for example, grew twice as fast as the world average after the mid-1990's.

These exports included eight products—leather and furs, footwear, cement and ceramics, base metals, machinery and electronic products, transportation equipment, optical and precision instruments, and miscellaneous manufactured products—which grew much more rapidly than those of the other sectors between 1985 and 2003 (see Table 1). China's export volume was 16.8 times as high in 1985 as it was in 2003. However, the export growth of certain product categories was even more outstanding: exports of machinery, electrical equipment, and electronic products were 497 times as high, and the volume of optical products and precision instrument products 215 times. These numbers reflect a major shift in China's export competitiveness from labor- and natural resource-intensive sectors to capital-intensive sectors such as transportation equipment and high-technology (high-tech) sectors such as electronic, optical, and precision instrument manufacturing. [1]

(Here insert Table 1)

Since these technology- or knowledge-intensive sectors were traditionally dominated by firms in developed countries, we would like to identify the factors that contributed to the international competitiveness of manufacturing sectors in developing countries. Generally, the success of the export business in developing countries has been attributed to the low cost of labor. However, we do not know how important labor costs are

[1] In this paper, we adopt OECD's classification of low-, medium-, and high-technology sectors (OECD, 2003, p.156). Manufacturing industries are classified by OECD in four different categories of technological intensity: high technology, medium-high technology, medium-low technology, and low technology. The classification is based on indicators of (direct as well as indirect) technological intensity, which include R&D expenditures divided by value added, R&D expenditures divided by production, and R&D expenditures plus technology embodied in intermediate and capital goods divided by production.

compared with other factors that determine export performance. Undoubtedly, multinational firms have been responsible for a significant portion of manufacturing transfer to developing countries. However, once they acquire transferred export business, it is not clear if the developing countries can develop the technological competence necessary to move up the ladder in the global value chain through learning by doing or technology transfer.

In this paper, we identify the factors that determine export performance by evaluating data from more than 95,000 Chinese manufacturing firms. The data show no evidence that either unit labor cost or R&D investment, even in high-tech sectors, determines the success of Chinese firms in the foreign market. Although foreign enterprises dominate high-tech exports in China, domestic firms are more committed to R&D than their foreign counterparts. However, the primary reason why Chinese firms have increased exports to foreign markets is their product innovation, connection to foreign capital, and fierce competition.

The remainder of this paper is organized as follows: Through a review of the literature, Section 2 analyzes how certain characteristics of a firm determine its export performance; Section 3 describes the econometric strategy utilized to analyze the firm-level data; Section 4 presents the results of estimation; and Section 5 discusses the policy implications and concludes the paper.

2. The Characteristics and Export Performance of Chinese Manufacturing Firms

Before introducing the econometric analysis of the data, we sketch the relationship between the characteristics of Chinese manufacturing firms and their export performance from a theoretical point of view. We assume that the domestic and international markets that a typical Chinese manufacturing firm might enter are, to some degree, segmented. Segmentation could be the result of differences between transportation costs, standards, and consumer taste in domestic markets and those in foreign markets. Segmentation would also be the result of export tariffs and the non-perfect-substitution between the products in domestic and foreign markets.

In our analysis (Figure 1), the typical Chinese firm is a price-taker in both domestic and international markets and intends to export. D_w and D_d denote international and domestic market demand, respectively, while international market demand is more elastic with respect to price than domestic market demand. International market supply S_w and demand D_w determine the price in international market P_w. Similarly, P_d , the price in the domestic market, is lower than P_w. A firm earns profits in the domestic market since the domestic price is higher than its average production cost for domestic market AC_d. However, it does not earn profits in the international market because its average production cost AC_w is higher than the international market price. To enter the international market, a firm has to push AC_w down to AC_w'.

(Here insert Figure 1)

One action that the firm could take to lower production costs is to lower labor costs. Particularly in the context of Chinese exporting industries, low labor costs have been considered the primary advantage of Chinese firms in the international market. Although Lall and Albaladejo (2004) and Shafaeddin (2004) argued that China's admission to the World Trade Organization (WTO) would not endanger the global market share of certain labor-intensive products of other developing nations, a major concern about China's integration into the world trade market was whether its products would dominate in sectors in which the low-cost advantage of "made in China" products was overwhelming. To measure the impact of labor costs on the export performance of Chinese manufacturing firms, we include the variable of unit labor cost in the econometric function.

If the firm in Figure 1 increases its scale through expansion in the domestic market, it could naturally benefit from economies of scale in production to push down the average cost curve AC_w. Large firms are more likely to obtain lower cost financing services, hold more power in negotiation with upper-stream suppliers, and act more resiliently in the fluctuating international market (Wagner, 1995). However, Bonaccorsi (1992) contends that the relationship between the size and export intensity of a firm should not be generalized because the decision to export or not to export depends, to some extent, on the strategies of the firm. For example, some small firms have been found to be active in their international niche markets. Thus, to test the influence of size on export performance, we use the ratio of the number of employees of a firm to the number of the employees of the firm which hires most employees in the particular four-digit sector as a measure of the scale of a Chinese manufacturing firm.

To enhance the quality of its products, improve the production process, and ameliorate the management, a firm could enhance its R&D and innovation capacity, which would in turn reduce production costs (Wakelin, 1998). However, manufacturing firms in different sectors do not rely on R&D to acquire technology or to enhance their productivity in the same way. In his paper on innovation in British manufacturing industries, Pavitt (1984) concluded that in scale-intensive sectors such as metal manufacturing and vehicles, firms generally tend to develop their own process technology. In textile firms, however, most process innovations come from suppliers. Therefore, R&D intensity does not accurately measure technological upgrading efforts in certain manufacturing sectors, particularly in low-technology sectors (von Tunzelmann and Acha, 2005). Other important contributors to innovation efforts include design, engineering development and experimentation, adoption-related learning activities, and exploration of markets for new products (Smith, 2005). Thus, new product intensity, which represents total R&D efforts of a firm, including both product innovation and R&D intensity, enter our regressions, which will provide a more accurate estimation of the impact of R&D and innovation on the export competitiveness of Chinese manufacturing firms.

In Figure 1, the assumption that the average production cost AC_w is higher than international market price is not at all an extreme case. The costs involved for potential exporters to enter the international market is normally high due to the difficulty of obtaining information about foreign markets and setting up distribution channels to reach foreign clients (Keesing, 1983; Abdel-latif, 1993). In their study of Mexican manufacturing sectors, Aitken et al. (1997) found that a domestic plant is more likely to export if it is located near a multinational firm. They suggest that the presence of foreign-owned enterprises facilitates the access of domestic firms to information and technology and helps them establish distribution channels in foreign markets. To some degree, the activity of foreign investors enhances the export prospects of local firms. At the same time, while thousands of foreign investors set up manufacturing plants in China, they also bring knowledge about foreign markets to their local joint venture partners. Foreign investors' production technology, management skills, and business development strategies certainly lower the export costs of local collaborators. Therefore, we expect that the coefficient of the foreign capital intensity variable will be significant in the econometric estimation.

Previous research on the relationship between domestic market structure and export performance has reached ambiguous conclusions about export performance, so predicting whether a firm's export performance is positively affected by competition has been difficult. Caves and Jones (1973) contended that domestic collusion and limits on domestic competition are associated with high international competitiveness. In contrast, Porter (1990) cited the case of the Japanese fax machine industry that supported his "domestic rivalry" hypothesis, which states that the most important source of international competitiveness comes from domestic pressure. After all, domestic competition forces firms to innovate, resulting in rapid cost reduction. Porter's argument built on Shumpeter's theory that the small scale, entrepreneurial type of firm as the driving force of innovation (Schumpeter, 1939). Evidence supporting Porter's hypothesis can be found in Glejser et al. (1980). In their research, the Herfindahl-Hirschman Index of exporting firms in Belgium is negatively correlated with their exporting propensity. Similarly, based on the United States food manufacturing industries, Kim and Marion (1997) argued that net export share is negatively related to industry concentration. In order to test whether the above mentioned hypotheses are valid in the context of a fast-growing export country such as China, we include the Herfindahl-Hirschman Industrial Concentration Index (HHI) in the econometric model.[2] A larger HHI indicates weaker competition in the industry. The definitions of all dependent and explanatory variables of the econometric analysis are listed in Table 2.

(Here insert Table 2)

3. Data, Econometric Specifications, and Model Selection

The primary data used in this study were collected from Chinese manufacturing enterprises whose added values were larger than five million RMB.[3] The database that was constructed by China's National Bureau of Statistics included 135,923 firms in the

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[2] In empirical studies, the K-firm Concentration Ratio (C_k) is also widely applied to evaluate the industrial concentration. We prefer the Herfindahl-Hirschman Index simply because it can more thoroughly capture the information carried by the large number of observations in our database. The difference between the results of the Herfindahl-Hirschman Index and the K-firm Concentration Ratio can be read in Sleuwaegen and Dehandschutter (1986).

[3] According to the Chinese Industry Enterprise Classification Standard (2003 version), enterprises with revenue less than 30 million RMB per year are classified as small firms. Therefore, apart from encompassing large and medium manufacturing firms, our database includes a large number of small manufacturing firms in China.

2000 data, 146,180 in the 2001 data, 155,403 in the 2002 data, and 171,349 in the 2003 data. Each firm was assigned an invariant code in the database. Information for every firm, such as geographical location at the provincial level, the sector where it operates (a four-digit sector level), and the ownership status, was well recorded. More than 50 statistical indicators of the dataset were classified into five categories: output indicators, capital indicators, assets and liabilities, profits, and remuneration indicators. Because of exit and entry, we were able to use the data from only 95,517 firms, whose data existed for the three consecutive years from 2001 to 2003. We do not include the 2000 data in this analysis since the R&D indicator is not available for that year.

The dependent variable Y in this study is export intensity, namely the export value divided by sales value. This type of dependent variable is known as a censored dependent variable; that is, the values of the variables in a certain range are all reported as a single value, e.g., zero. The conventional linear regression method is not able to distinguish the difference between the non-linear "zero" observations and the continuous observations. Therefore, the following tobit model is a good candidate for estimating the data.

(1) $$Y^{*} = a + X^{'}\beta + \varepsilon$$

With ε ~ IIN $(0, \sigma^2)$ and

(2) $$Y = Y^{*} \text{ if } Y^{*} > 0$$

$$= 0 \text{ otherwise,}$$

where Y^* can be understood as the unobserved "export competence" of the firm. For the exporting firm, Y^* is equal to the observed export intensity *Y*; for the firm that does not export, Y^* is not observed, and *Y* is reported as zero. Equation (2) can be estimated by the maximum likelihood estimation.

Cragg (1971) proposed an alternative two-stage model as an unrestricted form against the tobit model that could be understood as a restricted form. The first-stage specification is a probit model that utilizes the entire data set and examines whether the firms export. The second-stage specification is a truncate model that analyzes only the data of exporting firms, for which dependent variables are greater than zero. Applying the rationale of designing a two-stage specification (Lin and Schmidt, 1984) to our case, we argue that the impact of the explanatory variables on whether the firms export and how much they export could differ. However, the difference is not detected in the tobit model, but could be revealed in the two-stage specification.

To choose between the tobit model and the two-stage model, a likelihood ratio statistic is computed using

(3) $$\lambda = -2[\log L_T - (\log L_P + \log L_{TR})],$$

where L_T, L_P, L_{TR} are likelihoods for the tobit model, the first-stage probit specification, and the second-stage truncate specification, respectively. The large sample distribution of λ is chi-squared, with degrees of freedom equal to the number of restrictions imposed. In our function, the degrees of freedom are 67.

We run the regression on the explanatory variables with one-year and two-year lag times at the expense of losing a proportion of observations to provide a more robust estimation of the causal relationship. The impact of its characteristic on the export performance of a firm may be diverse across different ownership status and industry sectors. Taking the analysis of general manufacturing firms as a point of departure, we divide the data into two ownership groups: domestic firms and foreign firms, including Hong Kong, Macau, and Taiwan-funded enterprises, according to the ownership status of the firms recorded in the database. Identical regression is run on these two groups of data to obtain the comparative results. Similarly, the comparative analyses are also implemented on the labor-intensive (i.e., textile, wearing apparel, leather, furniture, toys, and miscellaneous products) and the high-tech sectors (i.e., aircraft, pharmaceuticals, electronic and communication equipment, and precision instruments and office machinery).[4]

Table 3 provides the summary statistics of the data and variables. Around one-third of the Chinese manufacturing firms examined in this study exported in the period of 2001-2003. Less than one-quarter of them were foreign-owned. The statistic summary of the

[4] The classification of the labor-intensive and high-tech sectors is seen in Table 8 in Appendix. Table 8 also presents the harmonization of manufacturing sectors and product standards ISIC Rev. 3.1, SITC Rev. 3, and Chinese GB/T 4754-2002, which is used in our database. The manufacturing sectors such as food products, beverages and tobacco (ISIC code 15 and 16) and wood, pulp, paper, paper products, printing and publishing (ISIC code 20, 21, 22) are included in the low-technology industries in the OECD's classification, but they are not included in the labor-intensive sectors examined in this paper. China's competitiveness in these sectors is not as overwhelming as in the other low-technology sectors such as textile, footwear, furniture and toy etc. Our classification of the labor-intensive sectors is justified by the econometric analysis result shown in Table 4, in which the industry sector dummy variable of the textile, footwear, furniture and toy sectors are significant.

variables reveal that 75 percent of the Chinese manufacturing firms did not conduct R&D or launch the new products in our observation period.

(Here insert Table 3)

4. Estimation Results and Discussion

According to the estimation results (Tables 4, 5, and 6), the values of λ in no lag, one-year lag, and two- year lag models are all much greater than the chi-square statistics of the degree of freedom of 67 at the 99 percent level, which is 96.83. The tobit specification is accordingly rejected at the 99 percent level. Thus, we report only the result of the probit specification, which discloses the determinants of the probability of a firm's exporting and the result of a truncate specification, which denotes the factors affecting the export intensity of a firm. Accordingly, if a firm is considered competitive, it either has higher probability of exporting or higher export intensity.

(Here Insert Table 4, Table 5 and Table 6)

A theoretical analysis based on Figure 1 shows that reducing labor costs leads to international competitiveness. However, our empirical analysis demonstrates that unit labor cost does not determine whether Chinese manufacturing firms could export, as nearly all of its coefficients are insignificant in the probit specifications and significantly positive in the truncate specifications, which means that reducing unit labor cost doesn't help firms enter foreign markets. Rather, among exporting firms, those spending more on compensation export more. The positive coefficients of unit labor cost in the analyses of export determinants are not uncommon since they appear in several previous studies. Braunerhjelm (1996) found R&D expenditures and investment in skilled labor have a positive effect on the export intensity of Swedish firms, while cost factors have no impact. He interpreted this finding as indicating that the international competitiveness of a firm depends on investment in knowledge, not on cost reductions. Wakelin (1998) argued that the reason that unit labor cost is positively associated with the exporting possibility of British innovating firms is that the firms exporting higher quality products are less price sensitive. Van Reenen (1996) suggested that employees could be better compensated when firms achieved abnormally high profits from their export business. The theoretical reasoning of Van Reenen (1996) could explain our finding that no link between unit labor cost and export probability exists, given the fact that the data show the profit-to-sales ratio of exporting firms is 5.44 percent higher than that of a non-exporting firm, which is 4.68 percent. For Chinese manufacturing firms, factors such as cooperation with foreign investors and product innovation capability, which will be discussed below, are stronger determinants of export competitiveness than labor costs.

The coefficients of the size of a firm are significantly positive in all probit specification results, which demonstrates that larger manufacturing firms in China have a higher probability of exporting. Nevertheless, the results of the truncate specification indicate that the scale is negatively associated with the export intensity of exporting firms, except for foreign firms and firms in high-tech sectors. The no-lag truncate function estimation result reveals that for a domestic and labor-intensive firm, one percent increase of the firm size variable value, i.e. the ratio of the number of employees to the number of employees of the firm which hires most employees in the particular four-digit sector, leads to a 0.556 percent and a 0.0667 percent decrease in export intensity, respectively. In contrast, for the foreign firms one percent increase of the firm size variable value could increase the export intensity by 0.794 percent. This indicates that the smaller domestic exporting firms and the smaller firms in the labor-intensive sectors export relatively more than larger ones. The sharp contrast between the coefficients of the probit specification and the truncate specification further justifies the two-stage specification, which discriminates between the impact of the explanatory variables on whether a firm exports and how much it exports.

Except for domestic firms, the R&D investment contributes to neither the export probability nor the export intensity of a manufacturing firm. We observe a statistically significant causal relationship between R&D investment and export probability of domestic firms, but the truncate specification results show that R&D intensity does not lead to the export intensity of domestic firms. Bearing in mind the fact that China surpassed the United States and the European Union to become the biggest exporter of information technology goods in 2004 (OECD, 2005), surprisingly, we fail to find evidence that R&D investment led to the stellar export performance of the high-tech firms. According to the definition of OECD (2003), high R&D investment intensity, namely the high ratio of R&D expenditure to value-added, is the hallmark of high-tech sectors. Therefore, how is the success of high-tech Chinese firms in global markets unrelated to their investment in R&D? We suggest processing trade as an explanation to this paradox.

Research by Lemoine and Unal-Kesenci (2004), China's National Bureau of Statistics (2005), and Fung (2005) has attributed the recent expansion of China's exports in machinery, electrical equipment, and electronic products, in large part to processing trade and the global division of labor, especially in East Asia. For many producers in high income economies such as Japan, South Korea, and Taiwan, transferring manufacturing departments to low-cost countries is imperative if they are to retain market share among strong competition. They have shipped high value-added components (normally developed in their homelands) to China for assembly, taking advantage of low production costs there, and then exported the end products through their affiliates to Western markets. According to a report by the Chinese Ministry of Commerce, the share of processing trade export accounted for 55 percent of China's total exports in 2004 (Xinhua Net, 2004).

Foreign-funded enterprises controlled more than 70 percent of China's high-tech exports in the last several decades. Their share in total high-tech exports reached 87 percent in 2002 (Table 7). China's Ministry of Commerce reported that of the approximate $400 billion in high-tech export products from China in 2005, less than ten percent of the products were exported with the brand name of the manufacturer or with independent intellectual property rights (Xinhua Net, 2005). Furthermore, both in 1995 and 2002, the average R&D intensity of all high-tech firms in China was higher than that of foreign-funded firms (Table 7), indicating that domestic firms were more committed to R&D

investment than foreign firms. This information, derived from the data of *China Statistics Yearbook on High Technology Industry* is fully supported by the results of our analysis. As Gilboy (2004) asserted, Chinese industrial firms were deeply dependent on designs, critical components, and manufacturing equipment they imported from advanced industrialized countries.

(Here insert Table 7)

Because foreign firms and their subsidiaries dominated China's high-tech export industry and invested less in R&D than domestic firms, the average R&D intensity of Chinese high-tech sectors was much lower than that of their counterparts in advanced OECD countries. According to our data, 75 percent of the manufacturing firms in China did not conduct R&D or launch new products in the period of 2001-2003 (see Table 3). The R&D intensity of China's electronic and communication equipment and precision instruments and office machinery was 2.47 percent and 2.15 percent in the 2001-2003 period, respectively. However, the R&D intensity of the radio, TV and communications equipment sector in the 12 OECD countries was 22.4 percent (OECD, 2003, p.156).[5] In these OECD countries, the R&D intensity of the office, accounting, and computing machinery and medical, precision, and optical instrument sectors was 15.1 percent and 11.9 percent, respectively, compared with that of China, which was 2.15 percent. The meager R&D investment in China's high-tech sectors is the principal reason for the appearance of an insignificant coefficient of R&D intensity in our estimation results.

[5] The 12 OECD countries are United States, Canada, Japan, Denmark, Finland, France, Germany, Ireland, Italy, Spain, Sweden and United Kingdom.

Although the coefficients of the new product intensity are all significantly positive in probit specification results, they are universally significantly negative in the truncate specification results. This finding indicates that higher new product intensity increases the probability that Chinese firms will enter international markets. However, firms exporting more exhibit a lower ratio of new product value to total production value, which shows new product intensity as a "qualification threshold" for the Chinese manufacturing firms to enter the export business. Firms with higher new product intensity are more likely to export, but for those that pass the threshold, their export intensity turns out to be negatively associated with new product intensity. International user-producer interaction, we argue, may explain the finding that product innovation leads to a greater likelihood that Chinese firms will enter international markets. The firms themselves might not be pressured to innovate as frequently if they supply a stagnant market, but if they have to meet varying demand throughout the world, they are likely to launch new products more rapidly (Lundvall, 1992).

Foreign capital intensity is universally positively correlated with export competitiveness according to the results of various specifications, which denotes that knowledge about foreign markets, technology, and management skills brought in by foreign investors of joint ventures are critical to firms' expansion in international markets. The foreign capital to total capital ratio, i.e., foreign equity share, has a larger impact on the domestic firms since the coefficients of the domestic firms are greater than those of the foreign firms. Similarly, cooperation with foreign investors leads to higher export probability and export intensity in high-tech sectors than in labor-intensive sectors. This finding also supports our argument that high-tech sectors in China are more dependent on foreign investors than labor-intensive sectors, in which Chinese firms possess an overwhelming comparative advantage.

The fiercer competition plays a significant role in aiding firms in the labor-intensive and high-tech sectors to start to expand their business outside of China, but its effect on foreign and domestic firms is not statistically significant, indicating that the effect of sector competition is distinct in the labor-intensive and the high-tech sectors, but not in the other sectors. When we group the firms by their ownership status, the firms from different sectors are mingled so that the effect of competition could not be distinguished. Results show that the coefficients of HHI are consistently significantly in the truncate specification results except for the high-tech firms. Generally, competition, explained by Porter's "domestic rivalry" hypothesis, has a positive impact on the export probability of Chinese manufacturing firms in the labor-intensive and high-tech sectors. The more rigorous competition in the sector is, the more likely the firms are to export.

The significant coefficients of certain sector dummy variables in the no lag probit specification demonstrate that the Chinese manufacturing firms that are more inclined to export are in the labor-intensive and high-tech sectors such as the following: textile, garment, leather, and toy (sub-sectors in cultural, education, and sports products), and electronics and telecommunications, precision instruments, and office equipment, respectively. The results pertaining to the province dummy variables show that firms located in the eight coastal provinces of Fujian, Guangdong, Jiangsu, Liaoning, Shandong, Shanghai, Tianjin, and Zhejiang are more competitive than those located elsewhere.[6]

5. Policy Implications and Conclusions

This study finds that Chinese exporting firms do not rely on reducing labor costs to succeed in foreign markets. On the contrary, firms that better compensate their employees are more likely to export. This finding is relevant to the debate on the lowest salary policy in the Chinese coastal regions where the exporting firms are concentrated. Some entrepreneurs are worried about if local governments raised salaries in these regions, the development of the exporting industry there would be hindered and unemployment would eventually ensue. Our finding contradicts this belief. We argue that the more serious threats to the export industry are the severe working conditions of under-compensated migrant laborers in some plants in coastal provinces and their exclusion from basic social benefits

In addition, this study confirms that China's manufacturing export competitiveness, particularly in high-tech products, is not determined by the dedication of the firms to R&D investment, which not only devalues the explosive growth of high-tech Chinese exports, but also casts doubt on the ability and potential of Chinese industry to move up the ladder in the global value chain. At the same time, if Chinese firms continuously obsess about the trivial profits generated by processing trade without endeavoring to

[6] The estimation result of sector and province dummy variables in the no lag truncate specification is not significantly different from that of the probit specification. To simplify, the sector and province dummy variable results in the remaining regressions are not reported.

develop their own technological advantage, their current international competitiveness cannot be sustained. To meet the challenges of achieving a competitive advantage, policymakers in China and other developing countries must promote effective policy actions that help domestic firms absorb state-of-art technology and management knowledge to achieve stronger technological competitiveness. In fact, China's central government already made an ambitious move in March 2006, announcing its "home-grown" innovation strategy for a period of 2006 to 2020.[7] The principal objective of this strategy is to foster indigenous R&D and innovation activity in Chinese industry and reduce its dependence on foreign technology.

An additional finding of this study is that rigorous domestic competition contributes to the export success of China's manufacturing firms in labor-intensive and high-tech sectors. This evidence justifies a past policy, implemented in these sectors, that aimed to deregulate industry, encourage competition, and break up monopolies. The gradual divesture of government capital from the sectors in the past two decades has triggered the entry of private and foreign firms, bringing in keen competition that significantly enhances competitiveness among domestic firms in the global arena. The best examples of competitive domestic firms are the sub-sectors of consumer electronics, personal computers, and cell phones. When state-owned enterprises exited from these sectors, foreign investors grabbed a significant market share with their superior technological and

[7] The concrete goals set in the blueprint include bringing the ratio of gross expenditures on R&D to GDP to 2.5 percent in 2020, seeing technological progress contribute to 60 percent of economic growth, increasing business expenditures in R&D to double those in technology transfer. (as the degree of dependence on foreign technology is reduced below a 30 percent level), and increasing the number of invention patents granted to Chinese citizens and the citation of international scientific papers so that both will rank among the top five in the world (State Council, 2006).

management capability and forced domestic firms to restructure their backward production, management, and sales systems. Thanks to spillover and learning capability, domestic firms benefited from "cut-throat" competition and gained on foreign rivals in terms of market share several years after the deregulation of the sector. The more successful domestic firms attained dominant market positions and began to expand globally. Thus, to reproduce the success of these sectors in other industries, Chinese policymakers must encourage competition, attract more foreign investors, foster technological learning and catching-up in domestic firms. These actions remain primary challenges to both Chinese policymakers and their counterparts in other developing countries.

Appendix

(Here insert Table 8)

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Table 1: China's Export Structure Change: 1985-2003

Category of Commodity	Export Volume (Unit: Billion RMB, 1990 Constant Price)[1] Data between Parentheses: Share of Total Export Volume (Percentage)			Ratio of 2003 Export Volume to 1985 or 1995 Export Volume[3]
	1985[2]	1995	2003	
Total	113.8	694.0	1914.2	16.8
Live Animals & Animal Products	4.5 (4.0)	20.9 (3.0)	23.0 (1.2)	5.1
Vegetables; Fruits and Cereals	10.3 (9.1)	19.3 (2.8)	33.1 (1.7)	3.2
Animal and Vegetable Oils;	0.6 (0.5)	2.1 (0.3)	0.6 (0.0)	1.0
Food; Beverages; Tobacco	3.2 (2.8)	21.6 (3.1)	33.5 (1.8)	10.3
Minerals	29.7 (26.1)	31.4 (4.5)	55.6 (2.9)	1.9
Chemicals and Related Products	5.7 (5.0)	39.3 (5.7)	80.9 (4.2)	14.3
Plastics and Rubber Products[3]	N.A.	20.0 (2.9)	54.7 (2.9)	*2.7*
Leather and Furs Products	**0.5 (0.4)**	**26.3 (3.8)**	**50.6 (2.6)**	**99.6**
Wood and Wooden Products[3]	N.A.	10.0 (1.4)	19.0 (1.0)	*1.9*
Paper and Paper Products[3]	N.A.	5.2 (0.7)	13.2 (0.7)	*2.6*
Textile Products	26.8 (23.5)	167.4 (24.1)	320.4 (16.7)	12.0
Footwear	**1.1 (0.9)**	**38.1 (5.5)**	**68.3 (3.6)**	**63.8**
Cement, Ceramic and Glass Products	**0.9 (0.8)**	**12.4 (1.8)**	**30.3 (1.6)**	**32.1**
Pearls; Precious Stones and Precious Metal[3]	N.A.	8.2 (1.2)	14.4 (0.8)	*1.8*
Base Metals Products	**1.8 (1.6)**	**56.4 (8.1)**	**109.7 (5.7)**	**61.9**
Machinery; Electric Equipment and Electronic Products	**1.5 (1.3)**	**129.1 (18.6)**	**752.7 (39.3)**	**497.0**
Transportation Equipment	**1.1 (1.0)**	**19.1 (2.8)**	**68.1 (3.6)**	**63.0**
Optical Products and Precision Instruments Products	**0.3 (0.2)**	**21.9 (3.2)**	**57.2 (3.0)**	**215.0**
Others	17.8 (15.7)	45.4 (6.5)	128.7 (6.7)	7.2

Source: Source: Various issues of *China Statistical Yearbook.*

Note: 1. The export volume reported in *China Statistical Yearbook* is with the unit of 100 million US Dollars. The RMB constant price export value is attained by multiplying the US Dollar value by annual average exchange rate and then dividing the result by GDP deflator. Annual average exchange rate is from various issues of *China Statistical Yearbook.* The GDP deflator is provided by the World Bank.

2. The export volume data of 1985 in *China Statistical Yearbook* are reported in line with the classification which is not consistent with that of the 1995 afterwards data. For instance, the 1995 afterwards data of Cereals and Cereals Products are reported in two different categories, namely a) Vegetables, Fruits and Cereals and b) Food, Beverages, Liquor and Vinegar, Tobacco and Tobacco Substitutes. The 1985 and 1990 data of Cereals and Cereals Products export volume are reported in the single category, i.e. Food and Edible Live Animal. The authors harmonize the 1985 and 1990 data according to the classification system of the 1995 afterwards data. The methodology is halving the amount of the 1985 and 1990 data and reporting each half in the two different categories of the 1995 afterwards data, respectively.

3, The Ratio of the volume of 2003 to the volume of 1995 (italic text) is presented when the data of several categories of commodity are not available for the year of 1985.

Table 2: The Variables

Variable	Name	Definition and Note
Y	Export Intensity	Export Value/Sales Value
X_1	Unit Labor Cost	Employee Compensation Value/Added Value
X_2	Firm Size	Number of Employees/ Number of Employees of the Firm which Hires Most Employees in the Particular Four-digit Sector
X_3	R&D Intensity	R&D Expenditure/Added Value
X_4	New Product Intensity	New Product Output Value/Total Output Value
X_5	Foreign Capital Intensity	Received Capital from International Investors (Including Hong Kong, Macau and Taiwan Investors)/All Received Capital
X_6	Herfindahl-Hirschman Industrial Concentration Index (HHI)	$\sum_{j=1}^{n}$ (Market Share (Percentage) of *j* Firm in the Specific Industry at Four Digit Sector Level)^2,
$X_{7,\ldots}$ X_{34}	Sector Dummy Variables	Variables represent the 29 two digit sectors.
$X_{35,\ldots}$ X_{64}	Province Dummy Variables	Variables represent the 31 provinces.
X_{65} and X_{66}	Year Dummy Variables	Variables represent the 3 years.

Table 3: Summary Statistics

Number of the Firms

Year	Exporting Firms	Not-Exporting Firms	Domestic Firms	Foreign Firms	Firms in the Labor-intensive Sectors	Firms in High-technology Sectors
2001	29781	65735	72884	22622	20440	6632
2002	30838	64679	72806	22701	20405	6637
2003	31054	64464	72774	22730	20161	6902

Variables

Year		Export Intensity	Unit Labor Cost	Firm Size	R&D Intensity	New Product Intensity	Foreign Capital Intensity	Herfindahl-Hirschman Industrial Concentration Index (HHI)
2001	Mean	.196	.410	.070	.006	.032	.173	.029
	75^{th} Percentile	.155	.429	.071	0	0	0	.034
	Standard Deviation	.360	2.89	.126	.231	.140	.342	.047
2002	Mean	.201	.497	.071	.005	.031	.174	.029
	75^{th} Percentile	.184	.420	.072	0	0	0	.034
	Standard Deviation	.361	20.1	.126	.046	.136	.344	.046
2003	Mean	.200	.444	.066	.008	.030	.175	.028
	75^{th} Percentile	.192	.415	.067	0	0	0	.031
	Standard Deviation	.360	4.17	.119	.753	.133	.346	.043

Table 4: Estimation Result: General Manufacturing Firms[1]

	No Lag Probit	One Year Lag Probit	Two Years Lag Probit	No Lag Truncate	One Year Lag Truncate	Two Years Lag Truncate
Unit Labor Cost	2.39E-4(3.31E-4)	-4.27E-4(6.09E-4)	2.60E-3(2.06E-3)	1.94E-3(4.84E-4)***	2.31E-3(5.67E-4)***	1.32E-3(6.29E-3)**
Firm's Size	2.09(.0234)***	2.03(.0280)***	2.00(.0396)***	-.214(.0107)***	-.204(.0130)***	-.219(.0186)***
R&D Intensity	1.44E-3(7.68E-3)	.0646(.0392)*	.0461(.0464)	-.0187(8.54E-3)**	-.0199(9.20E-3)**	-8.18E-3(6.36E-3)
New Product Intensity	.784(.0191)***	.669(.0231)***	.607(.0323)***	-.374(.0118)***	-.382(.0147)***	-.384(.0208)***
Foreign Capital Intensity	1.30(8.65E-3)***	1.30(.0107)***	1.30(.0151)***	.177(.00381)***	.174(.00469)***	.163(6.69E-3)***
HHI	-.180(.0669)***	3.19E-3(.0787)	.135(.109)	-.370(.040)***	-.410(.0481)***	-.350(.0667)***
Two-digit Industry Sector Dummy Variables Whose Coefficients are Significant	Textiles; Wearing Apparel and Other Fiber Products; Leather, Fur, Down and Related Products; Wood, Bamboo, Cane, Palm, and Straw Products; Furniture; Culture, Education and Sport Products; Chemicals and Chemical Products; Pharmaceutical Products; Rubber Products; Smelting and Pressing of Non-ferrous Metals; Metal Products; General Machinery; Electrical Equipment; Electronic and Communication Equipment; Precision Instruments and Office Machinery; Miscellaneous Products.			Wearing Apparel and Other Fiber Products; Leather, Fur, Down and Related Products; Bamboo, Cane, Palm, and Straw Products; Furniture; Culture, Education and Sport Products; Miscellaneous Products.		
Province Dummy Variables Whose Coefficients are Significant	Fujian, Guangdong, Jiangsu, Liaoning, Shandong, Shanghai, Tianjin, Zhejiang			Fujian, Guangdong, Hainan, Heibei, Liaoning, Shandong, Shanxi, Tianjin, Zhejiang		
Number of Observation	286554	190869	95445	91674	61893	31056
Log Likelihood	-130065.9	-87225.7	-43728.6	-18172.3	-12141.1	-6084.8
Tobit Likelihood	-162869.8	-108920.3	-54557.5			
λ	29263.2	19107	9488.2			

Note: 1. *** denotes significance at 1% level, ** denotes significance at 5% level, * denotes significance at 10% level.

Table 5: Estimation Result: Foreign and Domestic Firms[1]

	No Lag Probit	One Year Lag Probit	Two Years Lag Probit	No Lag Truncate	One Year Lag Truncate	Two Years Lag Truncate
			Foreign Firms			
Unit Labor Cost	-2.12E-4(2.97E-4)	-2.95E-4(3.82E-4)	8.95E-3(3.78E-3)**	1.53E-3(4.82E-4)***	1.85E-3(5.23E-4)***	1.07E-3(5.72E-4)*
Firm's Size	1.73(.0555)***	1.78(.0686)***	1.80(.0999)***	.0794(.0124)***	.0919(.0152)***	.0876(.0223)***
R&D Intensity	-2.89E-3(.0253)	-2.73E-3(.0277)	.101(.155)	-5.62E-3(5.32E-3)	-8.11E-3(5.64E-3)	-2.79E-3(5.40E-3)
New Product Intensity	.346(.0389)***	.199(.0467)***	.205(.0638)***	-.268(.0143)***	-.270(.0178)***	-.240(.0244)***
Foreign Capital Intensity	.652(.0167)***	.661(.0209)***	.671(.0301)***	.120(5.82E-3)***	.116(.00725)***	.112(.0106)***
HHI	.174(.127)	.0900(.153)	.204(.216)	-.251(.0448)***	-.286(.0542)***	-.248(.0765)***
Number of Observation	68053	44796	22111	44610	29623	14726
Log Likelihood	-36906.6	-24141.3	-11857.3	-9969.5	-6623.2	-3345.4
Tobit Likelihood	-53225.1	-34786.7	-17056.6			
λ	12698	8044.4	3707.8			
			Domestic Firms			
Unit Labor Cost	1.13E-3(2.51E-3)	9.73E-4(3.50E-3)	4.06E-4(5.31E-3)	.0130(2.40E-3)***	.0203(3.42E-3)***	.0110(4.29E-3)**
Firm's Size	2.20(.0261)***	2.13(.0313)***	2.09(.0442)***	-.556(.0212)***	-.545(.0257)***	-.571(.0362)***
R&D Intensity	.235(.0645)***	.401(.0867)***	.311(.127)**	-1.90(.138)***	-1.96(.172)***	-2.35(.259)***
New Product Intensity	.911(.0219)***	.809(.0266)***	.730(.0377)***	-.364(.0198)***	-.386(.0249)***	-.435(.0367)***
Foreign Capital Intensity	.995(.0396)***	.883(.0517)***	.731(.0770)***	.158(.0205)***	.128(.0278)***	.188(0423)***
HHI	-.342(.0806)***	-.0481(.0934)	.110(.129)	-.595(.0785)***	-.605(.0924)***	-.490(.124)***
Number of Observation	218464	144898	72147	218464	31715	15773
Log Likelihood	-90691.4	-60746.6	-30366.0	-5820.3	-3776.2	-1788.8
Tobit Likelihood	-103962.6	-69426.4	-34667.1			
λ	14901.8	9807.2	5024.6			

Note: 1. *** denotes significance at 1% level, ** denotes significance at 5% level, * denotes significance at 10% level.

Table 6: Estimation Result: Manufacturing Firms in Labor-intensive and High-technology Sectors[1]

	No Lag Probit	One Year Lag Probit	Two Years Lag Probit	No Lag Truncate	One Year Lag Truncate	Two Years Lag Truncate
			Firms in Labor-intensive Sectors			
Unit Labor Cost	2.11E-4(9.65E-4)	2.26E-4(1.12E-3)	.0726(.0135)***	1.97E-3(7.43E-4)***	7.12E-3(1.39E-3)***	4.51E-3(1.65E-3)***
Firm's Size	2.83(.0702)***	2.74(.0835)***	2.54(.115)***	-.0667(.0137)***	-.0714(.0169)***	-.0851(.0249)***
R&D Intensity	.526(.396)	.558(.467)	-.0935(.320)	-4.53E-3(4.87E-3)	-.0147(5.35E-3)***	-9.36E-3(5.59E-3)*
New Product Intensity	.921(.0650)***	.624(.0761)***	.419(.102)***	-.227(.0166)***	-.219(.0207)***	-.195(.0293)***
Foreign Capital Intensity	.979(.0167)***	.958(.0208)***	.966(.0300)***	.0708(4.33E-3)***	.0686(5.39E-3)***	.0625(7.76E-3)***
HHI	-4.55(.206)***	-4.80(.260)***	-4.81(.403)***	-.847(.0690)***	-.958(.0899)***	-1.06(.141)***
Number of Observation	61006	39755	19400	35764	23712	11585
Log Likelihood	-33711.8	-21904.8	-10720.9	-6084.0	-4141.0	-2075.4
Tobit Likelihood	-50197.5	-32631.5	-15967.8			
λ	20803.4	13171.4	6343			
			Firms in High-technology Sectors			
Unit Labor Cost	5.19E-3(4.31E-3)	2.62E-3(6.32E-3)	3.03E-3(8.92E-3)	2.57E-3(1.37E-3)*	4.17E-3(2.19E-3)*	1.90E-3(2.73E-3)
Firm's Size	2.20(.0804)***	2.20(.101)***	2.16(.148)***	-.0250(.0280)	2.55E-4(3.63E-2)	-.0451(.0540)
R&D Intensity	-.122(.0618)**	-.274(.179)	.0202(.0925)	-.0456(.0430)	-.772(.148)***	.0242(.0289)
New Product Intensity	.411(.0433)***	.322(.0535)***	.255(.0753)***	-.179(.0238)***	-.188(.0305)***	-.221(.0443)***
Foreign Capital Intensity	1.33(.0283)***	1.29(.0359)***	1.29(.0523)***	.441(.0138)***	.433(.0178)***	.410(.0263)***
HHI	-2.08(.180)***	-2.02(.229)***	-1.59(.335)***	-.251(.0842)***	-.127(.104)	.0311(.144)
Number of Observation	20153	12613	5997	8717	5434	2615
Log Likelihood	-10048.0	-6350.9	-3046.4	-1211.4	-671.85	-333.6
Tobit Likelihood	-12085.4	-7517.9	-3605.6			
λ	1652	990.3	451.2			

Note: 1. *** denotes significance at 1% level, ** denotes significance at 5% level, * denotes significance at 10% level.

Table 7: Foreign Enterprises in China's High-tech Sectors: 1995 and 2002 Data[1]

		1995	2002
Total High-tech Enterprises in China	Export Volume (Unit: Billion RMB, Current Price)	112.5	602
	R&D Expenditure/ Added Value (Percentage)	1.7	5.0
Foreign High-tech Enterprises	Export Volume (Unit: Billion RMB, Current Price)	83.0	523.0
	R&D Expenditure/Added Value (Percentage)	0.5	3.0
Share of Foreign Enterprises' High-tech Export in Total High Technology Export in China (Percentage)		73.8	86.9

Source: *China Statistics Yearbook on High Technology Industry 2003*

1. Foreign enterprises include Chinese-foreign equity joint ventures, contract joint venture and wholly foreign-invested enterprises.

Table 8: Harmonization of Manufacturing Sector Classification of ISIC Rev. 3.1, SITC, Rev. 3 and Chinese Industry Sector Classification GB/T 4754-2002 (Utilized in the Database)

International Standard Industrial Classification of All Economic Activities, Revision 3.1, (ISIC Rev. 3.1)	ISIC Rev. 3.1 Code	Standard International Trade Classification, Revision 3 (SITC, Rev. 3)	SITC Rev. 3 Code	Chinese GB/T 4754-2002	GB/T 4754-2002 Code
Labor Intensive Sectors where China Traditionally Holds Comparative Advantage					
Manufacture of textiles	D17	Textile fibers (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)	26	Manufacture of Textiles	17
		Textile yarn, fabrics, made-up articles, n.e.s., and related products	65		
Manufacture of wearing apparel; dressing and dyeing of fur	D18	Articles of apparel and clothing accessories	84	Manufacture of Wearing Apparel and Other Fiber Products	18
		Footwear	85		
Manufacture of wearing apparel; dressing and dyeing of fur	D18	Leather, leather manufactures, n.e.s., and dressed fur skins	61	Manufacture of Leather, Fur, Down and Related Products	19
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	D19	Travel goods, handbags and similar containers	83		
Manufacture of furniture; manufacturing n.e.c.	D36	Furniture, and parts thereof; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings	82	Manufacture of Furniture	21
Manufacture of furniture; manufacturing n.e.c.	D36	Printed matter	892	Manufacture of Culture, Education and Sport Products	24
		Baby carriages, toys, games and sporting goods	894		
		Office and stationery supplies, n.e.s.	895		
		Musical instruments and parts and accessories thereof; records, tapes and other sound or similar recordings (excluding goods of groups 763 and 883)	898		
Manufacture of furniture; manufacturing n.e.c.	D36	Works of art, collectors' pieces and antiques	896	Manufacture of Miscellaneous Products	43
High Technology Sectors (OECD's Definition)[1]					
Manufacture of aircraft and spacecraft	D353	Aircraft and associated equipment; spacecraft (including satellites) and spacecraft launch vehicles; parts thereof	792	Aircraft and Spacecraft	377
Manufacture of pharmaceuticals, medicinal chemicals and botanical products	D2423	Medicinal and pharmaceutical products	54	Medicine and Pharmaceuticals	27

Manufacture of radio, television and communication equipment and apparatus	D32	Telecommunications and sound-recording and reproducing apparatus and equipment	76	Manufacture of Electronic and Communication Equipment	41
Manufacture of office, accounting and computing machinery	D30	Office machines and automatic data-processing machines	75	Manufacture of Precision Instruments and Office Machinery	42
Manufacture of medical, precision and optical instruments, watches and clocks	D33	Professional, scientific and controlling instruments and apparatus, n.e.s.	87		
		Photographic apparatus, equipment and supplies and optical goods, n.e.s.; watches and clocks	88		

Note: 1, OECD’s high technology definition is seen in OECD (2003, p.156).

Figure 1: Firm's Export Price and Production Cost