Firm heterogeneity and exporting behavior: Evidence from China's manufacturing firms

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Abstract

Using data from China's Annual Survey of Industrial firms from 1998 to 2005, we find strikingly different patterns of firm productivity and exporting behavior between China's indigenous firms and foreign multinationals operating in China. Among indigenous firms, exporters are more productive than non-exporters, and the more productive firms self-select to become exporters. But the results for foreign multinationals are just the opposite. We then propose an explanation to our findings by expanding the scope of firm heterogeneity from mere productivity differences to include differences in the fixed costs of exporting relative to local sales across firms of different national origins.

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1. Introduction

Traditional trade theories treat firms as homogeneous.[1] Since mid 1990s, however, there has been increasing evidence suggesting that exporting behavior varies significantly across firms even after controlling for industry and region effects (see, for example, Bernard and Jensen (1995)). A unanimous finding in the literature is that exporters are more productive than non-exporters. Subsequent empirical studies reveal that more productive firms self-select to become exporters in the presence of fixed costs for exporting.[2] Along with these empirical studies, efforts have been made by Bernard, Jensen, Eaton and Kortum (2003), Bernard, Redding and Schott (2007), and Melitz (2003) to incorporate firm heterogeneity into the traditional trade theories. The main source of firm heterogeneity considered in the literature is the variation in productivity across firms. The positive impact of firm productivity on exporting behavior – arguably the most important result in the theory of heterogeneous firms and trade – rests upon the assumption that the fixed cost for exporting to foreign markets is higher than that for sales in the local markets.

In this paper, using data from China's Annual Survey of Industrial Firms from 1998 to 2005, we find strikingly different patterns of firm productivity and exporting behavior between China's indigenous firms and foreign multinationals operating in China. Among China's indigenous firms, exporters are indeed more productive than non-exporters, and the more productive firms self-select to become exporters. But the results for foreign multinationals are just the opposite: exporters are less productive than non-exporters, and the less productive firms self-select to become exporters. We reason that the assumption of a higher fixed cost for exporting to foreign markets compared to sales in the local market holds for China's indigenous firms but not for foreign multinationals operating in China. This is because, for

[1] By traditional trade theories, we include both the theory of Ricardo, Heckscher and Ohlin of comparative advantage for inter-industry trade and the theory of horizontal product differentiation for intra-industry trade (Helpman and Krugman, 1985).

[2] Bernard and Jensen (2004), Bernard and Wagner (1997), Clerides, Lach and Tybout (1998), and Greenaway and Kneller (2004) find positive impacts of productivity on exporting behavior using data from the United States, Germany, Columbia, Mexico, Morocco, and the United Kingdom respectively.

those foreign multinationals, exporting to foreign markets may well be sales in their home markets or markets in which they have a presence through other subsidiaries, whereas sales in China's local markets could encounter high distribution costs. Our paper thus suggests another source of firm heterogeneity other than firm productivity – differences in the fixed costs for exporting and local sales across firms of different national origins.

We use the data of China's manufacturing firms to test the robustness of the main results of heterogeneous firms and trade, primarily because the appearance of firm heterogeneity in China is a very demonstrative example. Before 1978, China was a centrally planned economy, with most, if not all, enterprises state-owned. Deprived of material incentives, those enterprises became extremely inefficient and the economy was in a precarious state. Since 1978, China has adopted the twin strategies of "opening up the door to foreign investment" and "reforming domestic Chinese enterprises." Aggregate foreign direct investment in China increased from virtually zero in 1978 to US$ 317 billion in 2005, with the massive entry of over 200,000 foreign-invested enterprises (China Statistical Yearbook, 2006). Meanwhile, China has taken a gradual approach to reforming its state-owned enterprises and semi-public enterprises (Cao, Qian and Weingast, 1999; Bai, Li, Tao and Wang, 2000; Bai, Lu and Tao, 2006), and slowly improved the institutional environment for China's indigenous privately-owned enterprises. (Henceforth, all foreign-invested enterprises operating in China are called **foreign affiliates**, and all Chinese firms comprising of both state-owned and other enterprises are referred to as **China's indigenous firms**.) Studies have documented significant variations in productivity among China's indigenous firms because of the differences in the degree of state ownership and in the institutional environment across China's various regions. The same is true for foreign affiliates, because of the variations in technology and management know-how across foreign investors of different national origins and the variations in the timing and modes of entry. Most importantly, foreign affiliates are found to be much more productive than China's indigenous firms.

The layout of the paper is as follows. In Section 2, we introduce our dataset – China's Annual Survey of Industrial Firms for the period of 1998 to 2005. The differences between exporting firms and non-exporting firms (called **the export premium**) are presented in Section 3. Similar to the results in the existing literature, China's exporters are found to be larger in terms of employment, fixed assets and value added than non-exporters. However, compared with non-exporters, China's exporters are found to have lower capital labor ratio. While this

result is consistent with the predictions of the comparative advantage theory, it does cast doubt on the robustness of a puzzling finding in the existing literature – namely, a higher capital labor ratio for exporters no matter whether they are located in the developed or developing countries (Bernard, Jensen, Redding, and Schott, 2007). Our most surprising result is that higher productivity for exporters than non-exporters – the unanimous and arguably most important finding in the literature of heterogeneous firms and trade – holds only for China's indigenous firms but not for foreign affiliates. The effect of firm productivity on exporting is subsequently analyzed in Section 4. We find that, for China's indigenous firms, higher firm productivity increases the propensity for exporting and it is the more productive firms that self-select to become exporters. For foreign affiliates, again, the findings are just the opposite: lower productivity implies a higher propensity for exporting, and it is the less productive foreign affiliates that self-select to export. In Section 5, we revisit the basic assumptions for the self-selection hypothesis, and offer an explanation for the strikingly different patterns between China's indigenous firms and foreign affiliates.

There is an emerging literature on China's exports, the rise of which represents one of the most dramatic changes in the world's trading patterns of the last twenty-five years.[3] Earlier studies were focused on policy changes external to firms, such as decentralization of trading authority, devaluation of the Chinese currency, and China's joining of the World Trade Organization, as possible causes for the rise of exports (see, for example, Lardy, 2002). More recent studies examine the competitiveness of China's exports in terms of the penetration of product categories and value added within each product category.[4] Most related to this paper are studies about the relationship between firm productivity and exporting behavior. In probably the only formal study on whether China's firms self-select to export, Xu (2005) finds no evidence for the self-selection hypothesis in a sample of 1,500 China's manufacturing firms.

None of the existing studies on China's exports, however, differentiates China's indigenous

[3] China's export increased from a mere US$ 10 billion in 1978 to US$ 762 billion in 2005, making China the world's fourth largest exporter. China's imports had equally impressive growth during the same time period, increasing from US$ 11 billion in 1978 to US$ 660 billion in 2005.

[4] Rodrik (2006) points out that China is an "outlier" as it exports much more comprehensive products than what would be normally expected based on China's level of income. Xu (2006) finds that, once the quality of commodities within each class of goods is adjusted, China is not as special as suggested by Rodrik (2006). An earlier study by Schott (2006) shows that China's exports are too sophisticated in terms of the penetration in product category index but not when judged by unit value within each product category, thereby reconciling the seemingly inconsistent findings of Rodrik (2006) and Xu (2006).

firms from foreign affiliates. Indeed, even in the general trade literature, there are few studies examining the differences between indigenous firms and foreign affiliates. Baldwin and Gu (2003) and Kneller and Pisu (2004) are two exceptions, using data from Canada and UK respectively, but neither has found any significant difference between indigenous firms and foreign affiliates. Presumably, the sample sizes for foreign affiliates in these two countries are not large enough. The advantage of using the data of China's manufacturing firms is that we have sufficient sample sizes for both indigenous firms and foreign affiliates, and we can uncover different patterns between these two types of firms, which cast doubt on the robustness of existing literature results and call for an extension of the theoretical explanation.

2. Data

The data set for this study comes from China's Annual Survey of Industrial Firms (ASIF) for the time period of 1998-2005. Conducted by the National Bureau of Statistics of China, the annual survey covers all state-owned enterprises and other types of enterprises with annual sales of five million Renminbi (about $650,000) or more.[5] It provides detailed information on firms' identification, operations and performance, including total output and exported output, which are of special interest to this study. According to the classification of the National Bureau of Statistics of China, industrial firms include those in the following three industrial sectors: (1) mining, (2) manufacturing, (3) production and distribution of electricity, gas and water. For this study, we focus on firms in the manufacturing sector only, because the other two sectors are not export-intensive in China.[6] As reported in Table 1a, the number of manufacturing firms with valid information of total output and exported output varies from over 140,000 in the late 1990s to over 243,000 in 2005. The percentage of China's total exports contributed by firms in our dataset was just below 70% in late 1990s, and was as high as 76% in 2005, indicating that our data set is highly comprehensive.

The focus of this study is on firm heterogeneity and its interactions with exporting behavior. In particular, we would like to examine if China's indigenous firms behave differently from foreign affiliates. According to the classification of the National Bureau of Statistics of China,

[5] It should be pointed out that the ASIF data, like large-scale longitudinal panel data sets of other countries, fails to represent small firms.

[6] Calculations by authors reveal that, in 2005, less than 10% of output is exported in the mining sector, and the number for the production and distribution of electricity, gas and water is also of the same magnitude.

foreign affiliates are firms in which 25% or more equity shares are held by foreign multinationals or firms from Hong Kong, Macau, and Taiwan. The remaining firms are called China's indigenous firms.[7]

As shown in Table 1b, over the period of 1998 to 2005, an average of 27.14% of China's manufacturing firms (including both China's indigenous firms and foreign affiliates) exported. Foreign affiliates were much more export-oriented than China's indigenous firms: 62.93% of foreign affiliates were exporters whereas the corresponding number for China's indigenous firms was 18.68%. The difference between these two types of firms in export intensity is even greater: the percentage of output exported hovered around 10.48% for China's indigenous firms over the sample period, whereas that for foreign affiliates increased from 39.23% in 1998 to 44.60% in 2005.[8] Taken together, the percentage of China's total export exported by foreign affiliates increased from 59.66% in 1998 to 70.98% in 2005, showing that foreign multinationals were the driving force behind the spectacular rise of China's export.

Exporting behavior of China's manufacturing firms varies significantly across its regions. As shown in Table 1c, both China's indigenous firms and foreign affiliates located in the coastal region have higher degrees of participation in the international market than their national averages (22.0% over 18.68% for China's indigenous firms and 66.0% over 62.93% for foreign affiliates) and have higher levels of export intensity than their national averages (13.2% over 10.48% for China's indigenous firms and 47.1% over 40.95% for foreign affiliates). As a result, 93.8% percent of China's total exports were made by firms located in the coastal region, and 71.4% of these exports were from foreign affiliates in the region.[9]

Besides the differences across regions, there are also significant variations in firm exporting behavior across industries. As the technology content of China's exports has become an interesting topic, we look at the patterns of firm exporting behavior across the low-tech, medium-tech, and high-tech industries classified according to the OECD standard. Several patterns emerge from the results summarized in Table 1d: (1) 51.8% of China's export was

[7] Our main results of contrasting patterns between China's indigenous firms and foreign affiliates remain robust if firms from Hong Kong, Macau and Taiwan are excluded from the sample.

[8] From the 2002 U.S. census of manufacturers, it is found that 20% of U.S. manufacturing plants exported and the exporters shipped 15% of their output abroad (Bernard, Jensen, Redding and Schott, 2007). The percentage of exporters in the French manufacturing industries is also 20%, though the export intensity is lower at 10% (Eaton, Kortum and Kramarz, 2004).

[9] Compared to the national average, there was a higher percentage of indigenous firms exporting in the central region (23.2% versus 18.68%) though the export intensity was much lower (5.3% versus 10.48%).

from the high-tech industries, followed by 32.0% in the low-tech industries and 16.2% in the medium-tech industries. Given China's comparative advantages, it seems puzzling that China exports large amounts of both high-tech goods and low-tech goods (Rodrik, 2006). (2) In the high-tech industries and low-tech industries, compared with the national averages, both foreign affiliates and China's indigenous firms have higher propensity to export and higher export intensities, accounting for the high exports in these two types of industries. (3) Foreign affiliates were responsible for 82.8% percentage of exports from the high-tech industries, indicating that much of the worry about the rise of China's exports might well be misguided (Gilboy, 2004).

The above results suggest that both industry and regional differences should be taken into account when analyzing exporting behavior of China's manufacturing firms.

3. Exporter Premia

In this section, we document the differences between exporters and non-exporters **(called "exporter premia")**, along with a whole range of performance indicators. In the next section, building upon the work of exporter premia, we investigate the determinants for exporting behavior. All these analyses, however, may encounter the problem of selection bias due to some unobservable firm-specific effects. To deal with this econometric problem, it is useful to have a balanced panel data set and implement dynamic estimation procedures with lagged endogenous variables.

Of the original data set, there is a balanced sample of 33,584 firms that appeared in the dataset for all eight years from 1998 to 2005. As the focus of our study is on the possible differences between China's indigenous firms and foreign affiliates, we further exclude 1,213 firms that switched, one time or more, from indigenous to foreign affiliated, or vice versa. Note that one of the key performance indicators over which exporters and non-exporters may differ is total factor productivity (TFP). Four variables are used to estimate the total factor productivity: value added, employment, fixed assets, and intermediate inputs. Because of missing data or misreporting related to these four variables, 5,875 are further deleted from the sample, and the final sample size of the balanced panel is 26,496.

Summary statistics of the balanced panel and the full sample are listed in Table 2 for the beginning and ending years of the sample period (i.e., 1998 and 2005). Throughout the sample period, firms of the balanced panel were more likely to be exporters than those of the full sample, but there was no significant difference in export intensity. Note that firms in the balanced panel were larger than those of the full sample in terms of employment per firm and output per firm. As exporting behavior has been found to be concentrated among bigger firms in many studies, however, the bias of the balanced panel toward larger firms is less of a concern.

Using the balanced panel data set, we estimate possible differences between exporters and non-exporters by regressing firm performance measures on exporting status while controlling for firm size, as well as including industry, region and year dummies. The specification is as follows:

$$\ln(Y_i) = \alpha + \beta_1 Exporter_i + \beta_2 Size + \beta_3 Industry + \beta_4 Province + \beta_5 Year + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots (1).$$

Here $\ln(Y_i)$ is the logarithm of performance indicator Y_i, $Exporter_i = 1$ if firm i is an exporter, firm size is measured by the logarithm of total assets, and, there are also 4-digit industry, province, and year dummies. Exporter premia, computed from the estimated coefficient β_1 as $100 * (\exp(\beta_1) - 1)$, show the average percentage difference between exporters and non-exporters, controlling for the characteristics included in the model. The performance indicators considered in this study include: employment, fixed asset, value added, capital (fixed asset) labor ratio, value added per worker, value added per unit of capital (fixed asset), and total factor productivity. In estimating the total factor productivity, we allow for the existence of unobservable productivity shocks. Specifically, we follow Levinsohn and Petrin (2003) and use intermediate inputs as a proxy for unobservable productivity shocks.[10]

Columns 1, 2, and 3 of Table 3a report exporter premia for all firms, China's indigenous firms, and foreign affiliates, respectively. Consistent with the results in the existing literature, we find that exporters are relatively larger than non-exporters in terms of employment, fixed

[10] We use the STATA extension called "LEVPET" provided by Levinsohn, Petrin and Poi (2004). And we estimate TFP using inputs and outputs at constant value. See Appendix for further information on the construction of price deflators.

assets, and value added.[11] Our results on capital productivity are also consistent with the existing literature: indigenous exporters are 18.6 percent more productive than indigenous non-exporters while foreign affiliated exporters are 2% more productive than foreign affiliated non-exporters.

However, we find that in the case of China, exporters have lower labor productivity than non-exporters, a sharp contrast to the unanimous result of higher labor productivity for exporters found in the existing literature (see Bernard and Jensen (2004), Bernard and Wagner (1997), Clerides, Lach and Tybout (1998), and Greenaway and Kneller (2004) for the cases of United States, Germany, Colombia, Mexico and Morocco, respectively), and the United Kingdom. As shown in Table 3a, in terms of value added per worker, China's indigenous exporters are 9.3 percent less productive than indigenous non-exporters while foreign affiliated exporters are 23.4 percent less productive than foreign affiliated non-exporters.

Exporters are generally found to be more capital-intensive than non-exporters in most existing studies including those using data from developing countries (see Bernard and Jenson (1999) for the case of the United States and Van Biesebroeck (2005) for the case of sub-Saharan African countries). However, our findings from China's manufacturing firms are just the opposite: China's indigenous exporters are 23.6% more labor-intensive than indigenous non-exporters, while foreign affiliated exporters are 24.9% more labor-intensive than the corresponding non-exporters. These results are consistent with the predictions from comparative advantage trade theory. They could also explain why China's exporters are less labor-productive than the non-exporters but more capital-productive than the non-exporters.

Most interestingly, we find significant differences between China's indigenous firms and foreign affiliates in the exporter premium for total factor productivity. Consistent with the literature findings, China's indigenous exporters have 12.1% higher total factor productivity than non-exporters; but foreign affiliated exporters have 2.3% lower total factor productivity than their non-exporting counterparts. According to Wagner (2005)'s review, exporters are found to be more productive than non-exporters in all fifteen micro-econometric studies that use TFP as the measurement of productivity. To our knowledge, this is the first study reporting negative exporter premia for total factor productivity.

[11] See Wagner (2005) for a summary of the existing results on exporter premia.

To check the robustness of positive TFP premia for indigenous exporters and negative TFP premia for foreign affiliates, we run our model year by year with exclusion of year dummies. Results reported in Table 3b show that for indigenous firms, exporter TFP premia are positive for all years, while for foreign affiliates, exporter TFP premia are negative for all years except 2005. We also estimate exporter TFP premia using the full sample, and the results are similar to those of the balanced panel (see Table 3c for details).

4. Determinants for Firm Export Decision

The exporter premia reported in the previous section may come from self selection of firms with relevant characteristics. This section investigates this possibility through a formal study of the determinants for firm exporting behavior. As in the previous section, we pay particular attention to possible differences between China's indigenous firms and foreign affiliates in the determinants of exporting behavior.

Many studies have revealed that, compared with firms that did not export in the previous year, those that did are more likely to export in the current year. This feature of path-dependence has been explained by the possible existence of fixed cost for exporting. Firms that exported in the previous year need not pay the fixed cost of exporting again and hence are more likely to export in the year under study. Thus a key determinant for a firm's export decision is its *export status in the previous year*.

There are other firm characteristics that may play a role in a firm's export decision. Of particular interest is the logarithm of the firm's total factor productivity. Here we would like to find out if more productive firms self-select to become exporters, which could then explain the correlation between exporting behavior and firm total factor productivity reported in the previous section. We also control for firm size (proxied by the logarithm of total employment), capital labor ratio, R&D intensity (proxied by the share of new product in its total output),[12] and ownership effects (proxied by share of foreign ownership and share of state ownership).[13]

[12] New products are products that are produced using new technologies, new designs, or new materials. According to the classifications of the National Bureau of Statistics of China, a product can be identified as a new product only if it is produced for the first time within a geographic unit at least as large as a province.

[13] Note that firms formally classified as foreign affiliates by China's National Bureau of Statistics may have some state capital, as they could be joint ventures between foreign multinationals and China's state-owned

Studies have documented various channels through which indigenous firms may learn from the exporting behavior of foreign affiliates (Aitken, Hanson, and Harrison, 1997). Following Bernard and Jensen (2004), we consider three proxies for the spillover effect of foreign affiliated exporters. (1) Province-specific spillover effect is measured by the percentage of exporters among foreign affiliates in the same province but outside the 4-digit industry. (2) Industry-specific spillover is constructed in a similar way as that of province-specific spillover. (3) Province-specific and industry-specific spillover effect is measured by the percentage of exporters in the same province and the 4-digit industry.

To summarize, the basic estimation equation for the export decision is as follows:

$$Y_{it} = \alpha Y_{i,t-1} + \beta X_{i,t-1} + \gamma Z_{i,t-1} + \varepsilon_{it} \quad \text{..... (2)}$$

Here, Y_{it} stands for firm $i's$ export status in year t. $Y_{i,t-1}$ is the firm's export status in the previous year. $X_{i,t-1}$ is a vector of other firm characteristics that may affect the firm's export decision (logarithm of total factor productivity, logarithm of total employment, fixed asset to labor ratio, share of new product in its total output, share of foreign ownership, and share of state ownership). $Z_{i,t-1}$ is a vector of three proxies for the spillover effect of foreign affiliated exporters on the exporting behavior of China's indigenous firms.

Estimation methods commonly used in the literature include: linear probability models (with or without firm fixed effects), first-difference GMM estimation (Arellano and Bond, 1991), and system-GMM estimation (Blundell and Bond, 1998). The system-GMM estimator combines a set of first-differenced equations with equations in levels. Instruments for endogenous variables are internally generated: lagged first differences of the endogenous variables are used as instruments in the levels equations while lagged levels dated t-2 and earlier are used as instruments in the first-differenced equations. For instruments to be valid in the system GMM estimation, the correlation between those instruments and errors needs to be

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enterprises. Similarly, firms formally classified as China's indigenous firms may have some foreign capital due to partial acquisition by foreign investors.

checked using the Sargan test; and the validity of instruments can also be examined through testing second-order serial correlation in first-differenced residuals (see Bond (2002), for more details).

In this study, we prefer to use the system-GMM estimation, because it is especially appropriate when: (1) the number of observations is large but the time-span is short as in our data sample, (2) the explanatory variables are endogenous, and (3) the unobserved firm-specific effects are correlated with other regressors.[14] For both comparison and robustness check, we also report results using linear probability estimations (with and without firm fixed effects).

Estimation results using the system-GMM estimator for all firms, foreign affiliates, and China's indigenous firms are reported respectively in Columns 1-3 of Table 4a. We find that the lagged exporting status has a large, positive, and statistically significant impact on firm export decision in each of the three columns. Specifically, exporting status in the previous year raises the probability of exporting in the current year by 57.6% for all firms (column 1). These results suggest the existence of large fixed costs for exporting and are consistent with the results reported in the existing literature using data from other countries (Wagner, 2005). Interestingly, the impact of lagged exporting status on current exporting behavior is larger for China's indigenous firms (59.8%) as compared with foreign affiliates (48.0%). One possible explanation is that China's indigenous firms may face higher fixed costs of exporting than foreign affiliates, hence the more pronounced path-dependence effect.

Besides the impact of firm's previous exporting status, we are also interested in the effect of firm total factor productivity on exporting behavior. We find that higher total factor productivity increases the propensity to export for China's indigenous firms, but the result for foreign affiliates is just the opposite.[15] These results confirm our findings, reported in Table 3a, that indigenous exporters enjoy positive productivity premia compared to indigenous non-exporters while the contrary is true for foreign affiliates.

[14] Practically, we employ system-GMM analyses with the XTABOND2 extension in STATA developed by Roodman (2005).

[15] When indigenous firms and foreign affiliated firms are grouped together in the regression analysis, total factor productivity has a positive and statistically significant effect on firm export decision.

A unanimous empirical finding in the existing literature is that more productive firms are more likely to export (see Wagner 2005 for a review). Theoretical models illustrate that, in the presence of fixed costs for exporting, only highly productive firms enter the export market, while less productive firms serve only the domestic market (Melitz, 2003). Our findings of contrasting impacts of productivity on firm exporting behavior between China's indigenous firms and foreign affiliates presents a challenge to the existing theoretical explanation. In Section 5, we argue that our empirical findings call for an expansion of the scope of firm heterogeneity theory beyond just firm productivity.

The impacts of other firm characteristics on firm exporting behavior have also been controlled. We find that firm size (logarithm of employment) – indicative of past success – has a positive and significant effect on export decision for both indigenous firms and foreign affiliates, consistent with the results in the existing literature (see for example, Bernard and Jenson (2004)). We also find that R&D intensity (represented by the share of new product in a firm's total output) has a positive and statistically significant impact on export decision, though the effect is much smaller for foreign affiliates as compared with China's indigenous firms. Presumably, multinationals may choose not to conduct R&D activities in China given its lack of protection for intellectual property rights, and hence the new product ratio is a less effective measure of the difference in R&D intensity across firms for foreign affiliates as compared with China's indigenous firms.

Previous studies have found that, in both developed and developing economies, exporters are more capital intensive than non-exporters (Bernard and Jenson, 1995, Table 4; Van Biesebroeck, 2005, Table 3). The finding for developed countries is consistent with the predictions of the comparative advantage theory, but that for developing economies is not. In section 3, we report that China's exporters, both indigenous and foreign affiliated, are more labor-intensive than non-exporters, which is strikingly different from the finding in the literature but consistent with China's comparative advantage in labor-intensive industries. As shown in Table 4a, the regression analysis on the determinants for exporting behavior further confirms that, for both China's indigenous firms and foreign affiliates, labor-intensive firms are more likely to export.

Regression results on the export decision show that firms with higher shares of foreign ownership are more likely to export, whereas the opposite holds for firms with higher shares

of state ownership. Presumably, foreign investors have informational advantages regarding exports (Aitken, Hanson, and Harrison, 1997), and hence the positive impact of foreign ownership on exporting behavior. Meanwhile firms with significant shares of state ownership tend to be burdened with various social objectives and therefore lack the incentive for profit-making activities, including exporting (Bai, Li, Tao and Wang (2000), and Bai, Lu and Tao (2006)).

Sys-GMM estimations reported in column 3 of Table 4a show that all three variables for the spillover effect (province-specific, industry-specific, and industry- and province-specific) have positive and statistically significant impacts on firms' propensity to export, consistent with the findings in the literature (Bernard and Jensen, 2004). These results support our earlier conjecture that indigenous firms can learn from the exporting behavior of foreign affiliates, which could have important government policy implications.

Diagnostic tests for the sys-GMM estimations are reported at the bottom of Table 4a. Sargan tests marginally accept the hypothesis that the instruments used are not correlated with the residuals. The validity of GMM estimators is also supported by AR(2) test which shows that there is no second-order serial correlation with the first differenced errors. Nevertheless, for comparison and robustness check, we use both the OLS level estimations and OLS firm fixed effect estimations to investigate the determinants for firm exporting behavior, and report the results in Table 4b and Table 4c respectively. In dynamic models, the OLS level estimates of the autoregressive coefficient (such as the coefficient for *previous exporting status*) are likely to lie above the true parameter because of the positive correlation between the lagged dependent variable and the error term. Meanwhile the direction of the bias tends to be negative for OLS firm fixed effect estimations (see Bernard and Jensen (2004) page 565). Indeed, the OLS level and OLS firm fixed effect coefficient estimates for the *previous exporting status* are the highest (0.719) and the lowest (0.221) among the three estimation methods, respectively, with the estimate of sys-GMM model (0.576) lying in the middle. The results for other explanation variables of firm exporting behavior, however, are robust to the OLS level and OLS firm fixed effect estimations.

5. Sources of Firm Heterogeneity

We have found significant differences between China's indigenous firms and foreign affiliates with respect to firm productivity and exporting behavior. China's indigenous exporters are more productive than their non-exporting counterparts; but the opposite holds for foreign affiliates. Among China's indigenous firms, the more productive firms self-select to become exporters. For foreign affiliates, however, it is the less productive firms that self-select to become exporters.

While our findings related to China's indigenous firms are consistent with the results in the existing literature, those about foreign affiliates are not and they pose challenges to the theory of heterogeneous firms and trade. The focus of this section is to re-examine some of the building blocks behind the existing theory, and try to reconcile the theory with our empirical findings.

There are two basic foundations in the theoretical explanation of why more productive firms may self-select to become exporters. One is that the fixed cost for exporting to an international market is higher than that for sales in the local market. Presumably, exporting to international markets requires knowledge about these markets, and subsequent setting up and management of expensive sales and service networks. The other is that of firm heterogeneity in productivity, which has been well supported by empirical studies. Taken together, it is the more productive firms that can afford the higher fixed cost associated with exporting, hence their self-selection to become exporters.

In the case of China, the assumption of firm heterogeneity in productivity remains valid, but that of higher fixed costs for exporting compared to local sales does not hold for all types of firms in China. In particular, for foreign affiliates, exporting to international markets may well be sales in their home markets or markets in which they have had presence through their other subsidiaries. In contrast, the domestic market of China could be quite *foreign* to foreign affiliates, and they have to deal with distribution hurdles specifically set up for them on top of the local protectionism that makes the Chinese market fragmented (Bai, Du, Tao and Tong, 2004; Bai, Tao and Tong, 2007). Thus, it is quite reasonable to have another source of firm heterogeneity, namely, that firms of different national origins may have different fixed costs

for exporting compared to local sales. Specifically, for China's indigenous firms, the usual assumption of higher fixed costs for exporting holds, and hence it is the more productive firms that self-select to become exporters. For foreign affiliates, however, the fixed cost for sales in China's domestic market could be higher than that for exporting to international markets, thereby explaining why it is the less productive firms that self-select to export. As China's internal market gradually opens up as part of its obligations for the joining of the World Trade Organization, we would expect the negative export premium of productivity associated with foreign affiliates to be decreasing over time.

In summary, our empirical findings suggest more sources of firm heterogeneity, such as the differences in the fixed cost of exporting versus local sales across firms of different national origins. The explanatory power of the theory of heterogeneous firms and trade can be further strengthened once these additional sources of heterogeneity are incorporated.

6. Conclusion:

In this paper, we use a large and comprehensive data set of China's manufacturing firms to examine the relation between firm heterogeneity and exporting behavior. We find significant differences between China's indigenous firms and foreign affiliates in the exporter premia and the determinants for the export decision. In particular, the empirical findings about China's indigenous firms are consistent with the literature results and could be readily explained by the theory of heterogeneous firms and trade, whereas those for foreign affiliates are not and they pose challenges to the existing theory. We subsequently argue for incorporation of additional sources of firm heterogeneity, which will further strengthen the explanatory power of the theory of heterogeneous firms and trade.

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Table 1a: Representativeness of the full sample in China's total export

	1998	1999	2000	2001	2002	2003	2004	2005
Number of firms in the cross-sectional sample	144,161	140,903	142,549	152,345	162,769	178,467	156,017	243,332
Export in the sample (100 million USD)	1,265	1,351	1,712	1,917	2,374	3,200	3,959	5,816
China's total export (100 million USD)	1,837	1,949	2,492	2,661	3,256	4,382	5,933	7,620
Percentage in China's total export	69%	69%	69%	72%	73%	73%	67%	76%

Note: Data on China's total export come from China Statistical Yearbook (various years).

Table 1b: Different export patterns for indigenous firms and foreign affiliates, full sample

Year	Percentage of exporters in all firms	Percentage of exporters in foreign affiliates	Percentage of exporters in indigenous firms	Percentage of output exported in all firms	Percentage of output exported in foreign affiliates	Percentage of output exported in indigenous firms	Percentage of total export exported by foreign affiliates
1998	24.32%	62.03%	16.84%	18.33%	39.23%	10.25%	59.66%
1999	24.37%	61.13%	16.63%	18.14%	37.87%	9.96%	61.21%
2000	25.83%	62.28%	17.64%	19.43%	39.14%	10.58%	62.42%
2001	26.54%	62.90%	18.05%	19.35%	39.02%	10.21%	63.98%
2002	27.62%	63.03%	19.17%	20.47%	41.46%	10.51%	65.20%
2003	28.32%	63.89%	19.57%	21.32%	41.91%	10.84%	66.30%
2004	29.83%	64.06%	20.98%	22.24%	44.35%	10.66%	68.52%
2005	30.27%	64.12%	20.53%	23.41%	44.60%	10.83%	70.98%
Average	**27.14%**	**62.93%**	**18.68%**	**20.33%**	**40.95%**	**10.48%**	**64.78%**

Table 1c: Description of exporter and export intensity by region, full sample, 2005

Regions	Share in China's total export	Percentage of exporters in foreign affiliates	Percentage of exporters in indigenous firms	Percentage of output exported in foreign affiliates	Percentage of output exported in indigenous firms	Share of total export exported by foreign affiliates
	1	2	3	4	5	6
Coastal	93.8%	66.0%	22.0%	47.1%	13.2%	71.4%
Central	4.5%	41.6%	23.2%	13.7%	5.3%	27.6%
Western	1.7%	30.2%	8.2%	9.3%	4.7%	17.1%

Note: Numbers in column 1 represent accumulated shares in China's total export for corresponding regions, while numbers in other columns represent simple averages of values for provinces in the corresponding regions. Coastal region includes Liaoning, Beijing, Tianjin, Hebei, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Guangxi, and Hainan; Central region includes Heilongjiang, Jilin, Inner Mongolia, Shanxi, Henan, Anhui, Hubei, Hunan, and Jiangxi; and western region includes Shaanxi, Gansu, Ningxia, Qinghai, Xinjiang, Guizhou, Yunnan, Chongqing, Sichuan, and Tibet.

Table 1d: Description of exporter and export intensity by R&D intensity, full sample, 2005

Industry categorized by OECD R&D intensity standard	Share in China's total export	Share of total export exported by foreign affiliates	Percentage of exporters in foreign affiliates	Percentage of exporters in indigenous firms	Percentage of output exported in foreign affiliates	Percentage of output exported in indigenous firms
	1	2	3	4	5	6
High	51.8%	82.8%	65.0%	19.9%	55.3%	13.4%
Medium	16.2%	46.6%	53.2%	15.7%	20.9%	7.1%
Low	32.0%	56.4%	68.7%	25.4%	44.1%	13.0%

Table 2: Representativeness of the balanced panel in the full sample, selected years

	1998				2005			
	Full sample		Balanced panel		Full sample		Balanced panel	
	Exporters	Non-exporters	Exporters	Non-exporters	Exporters	Non-exporters	Exporters	Non-exporters
No. of firms	35,055	109,106	9,789	16,707	72,587	170,745	10,901	15,595
% of sample	24%	76%	37%	63%	30%	70%	41%	59%
Exports/ output	35%	0%	37%	0%	40%	0%	34%	0%
% of total employment	45%	55%	56%	44%	52%	48%	64%	36%
% of total output	52%	48%	63%	37%	55%	45%	68%	32%
Average size (output, million RMB)	85.5	25.0	121.8	42.1	158.4	54.7	331.9	108.5
Average size (employees)	638	252	781	353	416	161	775	305

Table 3a: Exporter premia for all firms, indigenous firms, and foreign affiliates

Performance indicators	All firms		Indigenous firms		Foreign affiliates	
	Exporter premia %	R^2	Exporter premia %	R^2	Exporter premia %	R^2
Employment	26.5***	0.62	35.0***	0.71	43.0***	0.52
Fixed asset	5.8***	0.82	3.2***	0.83	7.3***	0.79
Value added	18.0***	0.67	22.4***	0.67	9.5***	0.66
Fixed asset labor ratio	-16.4***	0.37	-23.6***	0.35	-24.9***	0.49
Value added per worker	-6.7***	0.24	-9.3***	0.24	-23.4***	0.36
Value added per unit of fixed asset	11.6***	0.21	18.6***	0.24	2.0*	0.17
Total factor productivity	8.8***	0.54	12.1***	0.52	-2.3***	0.55

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 3b: Exporter TFP premia for separate years

	All firms		Indigenous firms		Foreign affiliates	
Year	Exporter premia %	R^2	Exporter premia %	R^2	Exporter premia %	R^2
1998	8.0***	0.43	13.4***	0.43	-2.2	0.39
1999	7.7***	0.47	12.2***	0.46	-2.6	0.48
2000	9.8***	0.50	13.1***	0.48	-2.3	0.53
2001	8.5***	0.50	12.8***	0.49	-3.4*	0.53
2002	7.2***	0.51	9.6***	0.49	-4.2**	0.54
2003	5.8***	0.52	8.9***	0.50	-4.4**	0.58
2004	8.4***	0.69	7.4***	0.68	-1.3	0.68
2005	9.8***	0.51	12.2***	0.49	0.8	0.57

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 3c: Exporter TFP premia in the full sample

	All firms		Indigenous firms		Foreign affiliates	
Year	Exporter premia %	R2	Exporter premia %	R2	Exporter premia %	R2
All years	13.8***	0.54	13.4***	0.53	-4.1***	0.54
1998	23.6***	0.47	21.2***	0.47	-3.9***	0.42
1999	21.8***	0.47	20.3***	0.47	-2.4*	0.45
2000	19.6***	0.49	18.3***	0.49	-2.2	0.48
2001	12.3***	0.50	12.8***	0.50	-7.6***	0.48
2002	12.0***	0.49	11.8***	0.48	-4.9***	0.49
2003	7.3***	0.51	9.1***	0.50	-7.4***	0.51
2004	2.7***	0.84	5.5***	0.84	-4.6***	0.83
2005	5.2***	0.52	8.2***	0.51	-7.3***	0.53

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4a: System GMM estimations for export decision

	Dependent variable: exporter dummy					
	(1)		(2)		(3)	
Independent variable	**All firms**		**Foreign affiliates**		**Indigenous firms**	
Exporting status $_{t-1}$	0.576	(0.006)***	0.480	(0.010)***	0.598	(0.008)***
TFP	0.007	(0.001)***	-0.005	(0.002)**	0.008	(0.001)***
Labor	0.038	(0.003)***	0.049	(0.006)***	0.037	(0.004)***
New product ratio	0.104	(0.009)***	0.050	(0.015)***	0.121	(0.013)***
Capital labor ratio	-0.009	(0.003)***	-0.017	(0.006)***	-0.012	(0.003)***
Foreign share	0.123	(0.008)***	0.040	(0.012)***	0.003	(0.022)
State share	-0.016	(0.005)***	-0.005	(0.017)	-0.018	(0.006)***
Province-specific spillover effect					0.639	(0.031)***
Industry-specific spillover effect					0.060	(0.013)***
Province- and industry-specific effect					0.034	(0.006)***
Diagnostic Tests						
Sargan	0.121		0.085		0.092	
AR(1)	0.000***		0.000***		0.000***	
AR(2)	0.094		0.158		0.128	
number of firms	26496		7839		18657	
number of observations	184496		54712		129784	

Note: (1) *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
(2) Year dummies are included in each model.
(3) Asymptotically robust standard errors are reported in parentheses.
(4) All firm characteristics and proxies for spillovers are lagged one year, that is, they are for year t-1.

Table 4b: Linear probability estimations for export decision (levels)

	Dependent variable: exporter dummy		
Independent variables	**All firms**	**Foreign affiliates**	**Indigenous firms**
Exporting status t-1 or export intensity t-1	0.719***	0.620***	0.737***
	(0.0017)	(0.0034)	(0.0022)
TFP	0.000755	-0.00485***	0.00213**
	(0.0008)	(0.0015)	(0.0011)
Labor	0.0278***	0.0288***	0.0290***
	(0.0008)	(0.0016)	(0.0011)
New product ratio	0.0448***	-0.0123	0.0624***
	(0.0045)	(0.0093)	(0.0059)
Capital labor ratio	-0.00695***	-0.00306**	-0.00556***
	(0.0007)	(0.0014)	(0.0010)
Foreign share	0.104***	0.0661***	0.0535***
	(0.0023)	(0.0047)	(0.0160)
State share	-0.00634***	0.00213	-0.00706***
	(0.0021)	(0.0094)	(0.0026)
Province-specific spillover effect			0.235***
			(0.0360)
Industry-specific spillover effect			0.0379***
			(0.0093)
Province- and industry-specific effect			-0.00321
			(0.0043)
Year dummies	Yes	Yes	Yes
2-digit industry dummies	Yes	Yes	Yes
Province dummies	Yes	Yes	Yes
Number of observations	184918	54793	130125
R-squared	0.77	0.69	0.74

Note: (1) *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.
(2) Standard errors are reported in parentheses.

Table 4c: Linear probability estimations for export decision (firm fixed effects)

	Dependent variable: exporter dummy		
Independent variables	**All firms**	**Foreign affiliates**	**Indigenous firms**
Exporting status t-1 or export intensity t-1	0.221***	0.175***	0.242***
	(0.0025)	(0.0044)	(0.0034)
TFP	0.000623	-0.00195	0.00211
	(0.0010)	(0.0018)	(0.0014)
Labor	0.0410***	0.0206***	0.0482***
	(0.0019)	(0.0038)	(0.0025)
New product ratio	0.0205***	-0.0236**	0.0390***
	(0.0057)	(0.0110)	(0.0079)
Capital labor ratio	-0.0173***	-0.0155***	-0.0136***
	(0.0015)	(0.0032)	(0.0020)
Foreign share	-0.00292	-0.00166	-0.00484
	(0.0067)	(0.0078)	(0.0180)
State share	-0.00558*	-0.015	-0.00195
	(0.0034)	(0.0110)	(0.0043)
Province-specific spillover effect			0.412***
			(0.0320)
Industry-specific spillover effect			-0.00245
			(0.0084)
Province- and industry-specific effect			0.0000729
			(0.0039)
Year dummies	Yes	Yes	Yes
Number of observations	184918	54793	130125
Number of firms	26496	7839	18657
R-squared	0.05	0.03	0.07

Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Appendix: Price deflators

We constructed price deflators of output and inputs for each 4-digit manufacturing industry based on the ASIF data, the 1997 version of China's Input-Output Table, and data from China Statistics Yearbooks.

One advantage of the ASIF data is that, for most firms, output at both current value and constant value (1990 price) are provided. We constructed output deflator for every 4-digit industry by dividing industry's total output in current value by industry's total output in 1990 price. For firms with constant output value, we used constant output reported by firm. For firms without constant output value, we relied on 4-digit industry level output deflators.

We also constructed *price deflator of capital input* and *price deflator of intermediate input* for every sector in the 1997 version of China's Input-Output Table.[16] In constructing the price deflator of capital input, we weighted the output deflator of every capital intermediate input sector by its accumulated coefficient with every manufacturing sector.[17] In constructing the price deflator of intermediate inputs we weighted the output deflator of every non-capital intermediate input sector by its accumulated coefficient with every manufacturing sector.

[16] In the 1997 version of China's Input-Output Table, manufacturing industries were classified into 71 input-output sectors. Those sectors are more aggregated than 3-digit industry classifications but more detailed than 2-digit industry classifications.

[17] *Capital intermediate input sectors* include machinery and equipment, transport equipment, electric equipment and machinery, electronic and telecommunication equipment, instruments, meters, cultural and office machinery sectors. Non-capital intermediate input sectors include all other sectors. Price deflators for sectors other than those in the ASIF data come from China Statistics Yearbooks for various years.