The Growth of Chinese Exports: New Market Entry*

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March 2012

JEL codes: F14, P33

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* This research was begun when the first author was on sabbatical leave as a Research Fellow at the Adam Smith Research Foundation at the University of Glasgow. He thanks them for their superb hospitality. We also thank an anonymous referee for guidance and Jim Cassing, Asatoshi Maeshiro, and Tom Rawski for helpful comments. The usual proviso applies.
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Abstract

Over the period of 1995-2005 an increasing number of differentiated products have been exported from developing countries, and much of the growth in world trade at the extensive margin has come from these countries. The leading example of this type of trade expansion, both in terms of products and new markets, has been China. Using bilateral trade data of 128 countries over 144 products, we study the determinants of China's success in market access at the product level. We estimate a Probit model based on the heterogeneous-firm model at the product level for each year and find strong evidence that China's success in accessing foreign markets is due to productivity growth of industries, probably engendered by firm level technological advance of existing firms or entry of foreign firms that have begun to produce in and export from China. Using the same model, we find no evidence of technological advance for Japanese exporters. Rather, it is likely that some of the growth in Chinese exports is due outsourcing by Japanese manufacturers into China.

1. Introduction

Over the period 1995-2005 global trade grew at a remarkable pace. According to the *United Nations Commodity Trade Statistics Database*, between 1995 and 2005 the value of global trade (imports, nominal $US) doubled from $5 to $10 trillion. While a majority of the increase in the value of global trade has been at the intensive level, with a rise in trade of existing products with existing trading partners, in recent years an increasing amount of the growth in trade has occurred at the extensive level, with new countries and products entering the export market. For instance, the number of differentiated products exported from developing countries doubled over the years 1995-2005.

While trade has grown for virtually every country in the world during the past several decades, the single country most responsible for the increase in trade has been China. Between 1995 and 2005, the value of China's exports more than quintupled, rising from $149 billion to $762 billion. Much of China's export growth has been consistent with the patterns of overall trade growth. Increasingly, Chinese exports have become more sophisticated; at the same time Chinese exporters have targeted new markets.

In this paper, we are interested in the factors that determine whether or not a country enters the export market, and we focus particular attention on China. We estimate a Probit model that is based on the firm-level decision to export (Helpman, Melitz, and Rubinstein, 2008; hereafter HMR) and study the causes of the increasing involvement of developing countries in global trade at the product level. We estimate the HMR model for 144 products from the pairs of 128 countries for each year of 1995 and

2005. We compare the estimation results across exporters, products, and years and find strong evidence that the success of China's entry in global market is due to the expansion in the range of productivities for exporting firms. Our results indicate the important roles played by productivity growth of Chinese industries probably engendered by firm level technological advance and/or the contribution of technology from foreign firms that have begun to produce in and export from China.

The rest of the paper proceeds as follows. In section 2 we present an overview of the expansion in global trade, focusing on market access at the product level. In section 3, we estimate our industry-level version of the HMR model and compare the results from China, Japan, and the United States. The last section offers our conclusions.

2. An Overview of China's Market Access

In this section we provide an overview of the evolution of international trade patterns since 1995. In order to illustrate the growth in the number of trading partners at the product level in recent years, we restrict our attention to imports of differentiated manufacturing products disaggregated at the 3-digit SITC level.[1] Due to missing data for least developed countries for year 1995, we include data from years 1996 and 1997 to increase our sample to 128 countries.[2] This sample includes countries from every

[1] The data in this study are obtained from the *United Nations Commodity Trade Statistics Database*. Differentiated products are those as defined by Rauch (1999) and Hallak (2006). Most of these products are from 1-digit SITC sectors of 5-8.

[2] We use the following 128 countries: Albania, Algeria, Azerbaijan, Argentina, Australia (*), Austria (*), Bahamas (*), Bahrain (*), Bangladesh, Armenia, Bolivia, Brazil, Belize, Bulgaria, Burundi, Cameroon, Canada (*), Cape Verde, Central African, Chile, China, Colombia, Comoros, Costa Rica, Croatia (*), Cyprus (*), the Czech Republic (*), Denmark (*), Dominica, Ecuador, El Salvador, Ethiopia, Estonia (*), Finland (*), France (*), Gabon, Georgia, Gambia, Germany (*), Ghana, Kiribati, Greece (*), Grenada, Guatemala, Guinea, Guyana, Honduras, Hong Kong (*), Hungary (*), Iceland (*), Indonesia, Iran, Ireland (*), Israel (*), Italy (*), Côte d'Ivoire, Jamaica, Japan (*), Kazakhstan, Jordan, Kenya, South Korea (*), Kuwait (*), Kyrgyzstan, Lebanon, Latvia, Lithuania, Madagascar, Malawi, Malaysia, Maldives, Mali, Mauritius, Mexico, Mongolia, Moldova, Morocco, Mozambique, Oman, Netherlands (*), New Zealand (*), Nicaragua, Niger, Norway (*), Pakistan, Panama, Paraguay, Peru, Philippines, Poland (*), Portugal (*),

continent and at various standards of living; slightly less than one-third of the countries chosen in our sample (39 countries) are classified by the World Bank (*World Development Report*, 2009) as high income countries. We denote these 39 countries as developed or North countries and the remaining 89 countries as developing or South countries. Trade among these countries accounted for at least 90% of all world trade of differentiated products in each of the two years in our sample.

The first panel of Table 1 provides the export values ($US, billions) and the numbers of observation with positive trade (as pairs of country and product) for the subsets of developed and developing countries. Because we have the bilateral trade from 128 countries for 144 products, we have 2,340,860 potential observations of country-product pairs if each of the 128 countries imports all 144 products from the other 127 countries. In the last columns of Table 1, we summarize total trade for our sample of 128 countries. World import value doubled from $2,960 billion in 1995 to $5,871 billion in 2005, and the numbers of country-product pairs increased from 430,374 to 619,794. In 1995, 18.4% of potential country-product pairs report positive trade. Over the period we consider, the share of positive trade pairs increased from 18.4% to 26.5%.

Part 1.1 of Table 1 provides information on how trading patterns have changed over our sample period, focusing on developed and developing countries as exporters. While the number of country-product pairs for developing countries more than doubled from 153,525 to 351,619, the corresponding number for developed countries declined slightly

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Qatar (*), Romania, Russian Federation, Rwanda, St Kitts & Nevis, Saint Lucia, Saint Vincent and the Grenadines, Saudi Arabia (*), Senegal, Seychelles, India, Singapore (*), Slovakia (*), Viet Nam, Slovenia (*), Zimbabwe, Spain (*), Sudan, Suriname, Sweden (*), the Switzerland (*), Thailand, Togo, Trinidad and Tobago (*), Tunisia, Turkey, Uganda, Ukraine, Macedonia, Egypt, the United Kingdom (*), Tanzania, USA (*), Burkina Faso, Uruguay, Venezuela, and Zambia. We use the data from year 1996 for Albania, Azerbaijan, Bulgaria, Gabon, Georgia, Ghana, Mali, Mongolia, Russian Federation, Rwanda, Senegal, and Ukraine and from year 1997 for Bahamas, Armenia, Cape Verde, Guyana, Iran, Lebanon, and Viet Nam. (*) indicates high-income countries.

over the same period. In other words, there has been a sharp increase in the number of differentiated products shipped from developing countries in recent years. This finding indicates that the increase in the extensive margin of trade (e.g., Helpman et al, 2008) stems mainly from the increased participation of developing countries in global trade as exporters. Section 1.2 of Table 1 reports the changes in the number of country-product pairs for developed and developing countries as importers. There appears to be no significant development-related bias in demand for foreign products. Both import values and non-zero observations of country-product pairs have increased at similar rates. These results indicate that developing countries have increasingly involved in global trade particularly as exporters.

[Insert Table 1 about here]

Table 2 provides a list of the 5 countries whose non-zero observations increased the most as exporters and importers. We also provide the corresponding statistics for Japan and the United States. According to the table, the United States exported $435 billion in 1995, which is more than twice of the corresponding Chinese exports. With an average annual growth rate of 16.2%, the value of Chinese exports increased from $189 to $850 billion.[3] In terms of combinations of countries and products, the largest change in the

[3] We can decompose the growth in Chinese exports value from 1995 to 2005 into three components: (1) product margin, (2) market margin, and (3) intensive margin. The product margin is the increase in exports contributed from the introduction of new products, which were not exported at all in 1995 but started to export by 2005. The market margin is the increase in export volumes caused from the exploitation of new markets for existing products. For example, China exported a type of machine only to Japan in 1995 but begun to export it to other countries by 2005. Chinese exports of the product to the additional trading partners in 2005 (i.e., the importer countries of the product from China other than Japan) were counted as the market margin. Finally, the intensive margin is the contribution caused from the increase in exports for existing products for existing markets. If China exported a product to a market in both 1995 and 2005, the increase or decrease in the two values were counted as intensive margin. For China, almost full value of this increase during the period had caused from the increase in the volume of the products that had already exported to the partner countries in 1995 (intensive margin). In other words, the introduction of new products or the entry of existing products to new markets does not contribute for the rise of Chinese exports

absolute numbers is China by 4,752, followed by several other emerging market economies, Turkey, India, Thailand, and Indonesia. The corresponding numbers are relatively stable for Japan and the United States. For the importer countries, both developed (Poland, Canada, and Spain) and developing (India and Mexico) countries appear in the list.

[Insert Table 2 about here]

Table 3 summarizes the number of export markets for each of the 144 products in our study for China, Japan, and the United States. Unlike virtually all of the other developing countries in our sample, each of these countries exported goods from all 144 product categories in both 1995 and 2005 to at least some foreign markets. The average of export markets for China was 82 in 1995; this rose by 33 additional markets to 115 in 2005. The minimum number of Chinese markets more than doubled from 14 to 34 over this same span of time.[4] American and Japanese export patterns were relatively stable during this era. The average number of foreign markets for American and Japanese exports increased only slightly (from 109 to 116 for the United States and from 87 to 98 for Japan). The minimum number of export markets was essentially constant for Japan; it rose by about 20 percent for the United States.

[Insert Table 3 about here]

In Table 4, we provide information on the product categories where trade expanded the most in terms of the number of foreign markets over the period 1995-2005 for China, Japan, and the United States. There is little overlap across the three countries. None of

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during the period. The results are consistent even when we use the highly disaggregated SITC 5-digit level product data.

[4] The minimum for China in 1995 is "Silver and Platinum" (SITC, 681) and that in 2005 is "Cine Film" (SITC, 833).

the product categories appears in all three columns, although several categories are shared by China and Japan (SITC 597, SITC 059) and several others by China and the United States (SITC 111, SITC 583, SITC 896, and SITC 675). It is surprising that labor-intensive products are listed for Japan and the United States. For example, "Trunks and Suit-Cases" (SITC 831) and "Textile Articles" (SITC 658) rank second and fourth for Japan and "Manufactured Leather" (SITC 612) and "Clothing for Men" (SITC 843) rank second and fifth for the United States. For China, not only industrial machinery such as "Steam Turbines" (SITC 712) and "Engine and Motors" (SITC 714) but also "Chocolate" (SITC 073) and "Fruit and Vegetable Juices" (SITC 059) are included in the top 15 product groups.

[Insert Table 4 about here]

As summarized in Tables 3 and 4, between 1995 and 2005 China expanded exports both in terms of trading partners and export product lines. In 2005 the number of product-country pairs shipped from China exceeded Japan and caught up the United States. In the remainder of this paper we build and estimate a model of the decision by firms to enter into the export market. We use these results to understand better how China has been able to move so quickly into the lead position as a world exporter. We turn now to discuss the model.

3. Firm-Heterogeneity and Market Access

3.1. Firm-Level Decision to Enter Global Markets

In this section we provide a model of this decision as well as empirical estimates based on the model of firm heterogeneity (Melitz, 2003). The empirical approach we take is based on a model developed by Helpman, Melitz, and Rubinstein (2008). We modify it to the product-level so that we can study the causes of success in China's market access.

Demand in each country l is obtained from a two-tier utility function of a representative consumer. The upper tier of this function is separable into sub-utilities defined for each product i = 1, …,144: $U^l = U[u_1^l, ..., u_i^l, ..., u_{144}^l]$. The representative consumer uses a two-stage budgeting process. The first stage involves the allocation of expenditure across products. In the second stage, the representative consumer determines her demand for each variety ω in product i subject to the optimal expenditure (Y_{it}^l) obtained from the first stage.[5]

The sub-utility index u_i^l is a standard CES (Constant Elasticity of Substitution) utility function:

$$u_i^l = \left[\int_{\omega \in B_{it}^l} [q_{it}^l(\omega)]^{\alpha_i} \, d\omega \right]^{1/\alpha_i}.$$

Here, $q_{it}^l(\omega)$ is the consumption of variety ω in product i in time t chosen by a consumer in country l, B_{it}^l is the set of varieties in product i available for country l at t, and the time-invariant product-specific parameter α_i determines the elasticity of substitution across varieties so that $\varepsilon_i = 1/(1-\alpha_i) > 1$. From the utility maximization problem of a representative consumer, we can find the demand function for each variety:

$$q_{it}^l(\omega) = \frac{[p_{it}^l(\omega)]^{-\varepsilon_i} Y_{it}^l}{(P_{it}^l)^{1-\varepsilon_i}} \text{ where } P_{it}^l = \left[\int_{\omega \in B_{it}^l} [p_{it}^l(\omega)]^{1-\varepsilon_i} \, d\omega \right]^{1/(1-\varepsilon_i)}. \tag{1}$$

A firm in country k produces one unit of output with a cost minimizing combination of inputs that costs c_{it}^k, which is country, industry, and time specific cost for unit production. $1/a_{it}^k$ is firm-specific productivity measure (i.e., a firm with a lower

[5] See Hallak (2006) for the similar product-level estimations of gravity model.

value of a_{it}^k is more productive and that with a higher value of a_{it}^k is less productive) whose product-specific cumulative distribution function $G_i(a_{it}^k)$ does not change over the period and has a time- and country-specific support $[\underline{a}_{it}^k, \bar{a}_{it}^k]$.

We assume that each variety ω is produced by a firm with productivity a_{it}^k. If this firm sells in its own market, it incurs no transportation costs. If this firm seeks to sell the same variety in country l, it has to pay two additional costs: one is a fixed cost of serving country l (f_{it}^{kl}) and the other is an iceberg transport cost (τ_t^{kl}). Since the market is characterized by monopolistic competition, a firm in country k with a productivity measure of a_{it}^k maximizes profits by charging the standard mark-up price: $p_{it}^k(a_{it}^k) = c_{it}^k a_{it}^k/\alpha_i$. If the firm in country k produces a variety in product i and exports it to consumers in country l, the delivery price of the variety is

$$p_{it}^{kl}(a_{it}^k) = (\tau_{it}^{kl} c_{it}^k a_{it}^k)/\alpha_i \ . \tag{2}$$

As a result, the associated operating profits from the sales to country l are

$$\pi_{it}^{kl}(a_{it}^k) = (1-\alpha_i)\left(\frac{\tau_{it}^{kl} c_{it}^k a_{it}^k}{\alpha_i P_{it}^l}\right)^{1-\varepsilon_i} Y_{it}^l - f_{it}^{kl} \ .$$

Since the profits are positive in the domestic market for surviving firms (Melitz, 2003), all N_{it}^k firms are profitable in home country k. However, sales to an export market such as country l are positive when a firm is productive enough to cover both the fixed and variable costs of exporting. Therefore, we define the cut-off productivity level $\underline{a}_{it}^{kl}$ by setting $\pi_{it}^{kl}(\underline{a}_{it}^{kl}) = 0$:

$$(1-\alpha_i)\left(\frac{\tau_{it}^{kl} c_{it}^k \underline{a}_{it}^{kl}}{\alpha_i P_{it}^l}\right)^{1-\varepsilon_i} Y_{it}^l = f_{it}^{kl} \ . \tag{3}$$

We follow HMR and assume that firm productivity, $1/a_{it}^{k}$, is Pareto distributed. Thus, we define $G_i(a_{it}^k) = [(a_{it}^k)^{\kappa_i} - (\underline{a}_{it}^k)^{\kappa_i}] / [(\bar{a}_{it}^k)^{\kappa_i} - (\underline{a}_{it}^k)^{\kappa_i}]$ where $\kappa_i > \varepsilon_i$ -1 and κ_i captures the shape of the distribution. The shape of the distribution is identical for each product across countries but, as we defined, the supports are different for countries and industries for each year to capture technological progress from the productivity of the most productive firm in country k ($\underline{a}_{it}^{k}$). Then, we define the portion of firms in country k that succeed to export to market l, V_{it}^{kl}, as follows:

(4) $$V_{it}^{kl} = \begin{cases} \int_{\underline{a}_{it}^k}^{\underline{a}_{it}^{kl}} (a_{it}^k)^{1-\varepsilon_i} \, dG_i(a_{it}^k) = \dfrac{\kappa_i [\underline{a}_{it}^k]^{\kappa_i - \varepsilon_i + 1}}{(\kappa_i - \varepsilon_i + 1)[(\bar{a}_{it}^k)^{\kappa_i} - (\underline{a}_{it}^k)^{\kappa_i}]} W_{it}^{kl} & \text{for} \quad \underline{a}_{it}^{kl} \geq \underline{a}_{it}^k \\ 0 & \text{otherwise} \end{cases}$$

where $W_{it}^{kl} = \max\left\{ (\underline{a}_{it}^{kl} / \underline{a}_{it}^{k})^{\kappa_i - \varepsilon_i + 1} - 1, 0 \right\}$.

The selection of firms into export markets is summarized in W_{it}^{kl}, which is determined by the parameters of Pareto distribution and $\underline{a}_{it}^{kl} / \underline{a}_{it}^{k}$. Here, we refer to $\underline{a}_{it}^{kl} / \underline{a}_{it}^{k}$ as the range of productivities for firms in country k's industry i that succeed to enter market l. The cut-off value ($\underline{a}_{it}^{kl}$) is determined by the zero profit condition in equation (3).

Now, let us pick the most productive firm in country k in industry i at year t and define the latent variable Z_{it}^{kl} as

(5) $$Z_{it}^{kl} = \frac{(1-\alpha_i)(P_{it}^{l}\alpha_i / c_{it}^{k}\tau_{it}^{kl})^{\varepsilon_i - 1} Y_{it}^{l} (\underline{a}_{it}^{k})^{1-\varepsilon_i}}{f_{it}^{kl}}.$$

This is the ratio of export profits for the most productive firm to the fixed export cost for exporting from k to l. Positive exports are observed if and only if $Z_{it}^{kl}>1$.[6] In addition, W_{it}^{kl} is a monotonic function of Z_{it}^{kl}; $W_{it}^{kl}=(Z_{it}^{kl})^{(\kappa_i-\varepsilon_i+1)/(\varepsilon_i-1)}-1$ according to the characteristics of the Pareto distribution.

Let $f_{it}^{kl}=\exp(\varphi_{it}^{l}+\varphi_{it}^{k}+\lambda_{it}\varphi_{it}^{kl}-e_{it}^{kl})$ where e_{it}^{kl} is random variable, φ_{it}^{l} is a fixed trade barrier for product i imposed by the importing country on all exporters in year t, φ_{it}^{k} is a measure of fixed export costs common across all export destinations, φ_{it}^{kl} is an observed measure of any additional country-pair specific fixed trade costs. Using this specification together with $(\varepsilon_i -1)\ln(\tau_{it}^{kl}) = \gamma_{it}d^{kl} - u_{it}^{kl}$ where d^{kl} is the log of distance between countries k and l and u_{it}^{kl} is a random error, the latent variable $z_{it}^{kl} = \ln(Z_{it}^{kl})$ can be expressed as

$$z_{it}^{kl}=\beta_{it}+\beta_{it}^{k}+\beta_{it}^{l}-\gamma_{it}d^{kl}-\lambda_{it}\varphi_{t}^{kl}+\eta_{it}^{kl} \tag{6}$$

where $\eta_{it}^{kl}=u_{it}^{kl}+e_{it}^{kl}$ is random error; β_{it}^{k} is an exporter fixed effect that captures $(1-\varepsilon_i)\ln(c_{it}^{k})$, $(1-\varepsilon_i)\ln(\underline{a}_{it}^{k})$, and φ_{it}^{k}; β_{it}^{l} is an importer fixed effect that captures (ε_i-1) $\ln(P_{it}^{l})\ln(Y_{it}^{l})$, and φ_{it}^{l}; and the remaining variables are constant (β_{it}).

Now, define the indicator variable T_{it}^{kl} to be 1 when country k exports product i to country l in year t and 0 when it does not. Let ρ_{it}^{kl} be the probability that product i of

[6] The HMR model is based on the firm-heterogeneity model by Melitz (2003). Because the Melitz model predicts the systematic sorting of firms' entry to foreign markets according to firm-specific productivity levels, the existence of bilateral trade between the two countries depends solely on the most productive firm in the exporter country. For example, assume that the most productive electronics firm in China is Haier. We would observe the positive exports of refrigerators from China to Zimbabwe if Haier earns a positive profit from those sales. However, Haier might fail to enter the market in Botswana because it requires not only significant land transportation costs from Zimbabwe to Botswana but also fixed costs to set up a representative office in Botswana. If Haier is not able to enter the market in Botswana, the second most productive electronics firm, say Konka, is also not able to export to the same market. Thus, firm-level productivity, fixed and variable costs of transportations, and factor costs are all important factors for successful market entry.

country *k* exports to country *l* conditional on the observed variables. We can specify the following Probit equation,[7]

$$\rho_{it}^{kl} = \Pr(T_{it}^{kl} = 1 \mid \beta_{it}, \beta_{it}^{k}, \beta_{it}^{l}, d^{kl}, \varphi_t^{kl}) \\ = \Phi(\beta_{it} + \beta_{it}^{k} + \beta_{it}^{l} - \gamma_{it} d^{kl} - \lambda_{it}\varphi_t^{kl} + \eta_{it}^{kl}) \qquad (7)$$

where Φ is the cdf of the normal distribution.

3.2. Estimation Results

Equation (7) is the empirical heart of our model.[8] To estimate this equation for each product for each year (1995 or 2005), we employ data on bilateral trade across 128 countries (16,256 country pairs) for 144 3-digit differentiated products.[9] We prepare the following bilateral indexes for the estimation of equation (7): dummy variables for common border ($Border^{kl}$), common language ($Language^{kl}$), regional trade agreements (FTA_t^{kl}), and common WTO membership (WTO_t^{kl}).[10] The dummy variables for the degree of trade costs ($Trade^{kl}$), time costs ($Time^{kl}$), and business start-up costs ($Startup^{kl}$) are developed from the World Bank Development Indicators.[11] We use the sum of each index from the two (exporter and importer) countries to create these variables.

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[7] See Baldwin and Harrigan (2011) for the product-level estimations of a Probit equation from the trade data of the United States. The results from the Logit model are similar to those from the Probit equation. Following HMR, we report the results from the Probit model. The results from the Logit model are available upon request.

[8] Note that since this is not a structural model, we do not need firm level data to estimate equation (7). Indeed, in their empirics HMR (2008) use aggregate bilateral trade data. Rather, as we discussed in footnote 6, if we observe exports at all, then according to the model that is evidence that the most productive firm in the sector has achieved the productivity cut-off point that allows it to enter into that particular market.

[9] We use trade measured at the 3-digit level due to the enormous number of zero trade observations at further levels of disaggregation.

[10] These dummy variables as well as the bilateral distances are obtained from the CEPII website. See Head et al. (2010) for detail.

[11] The World Bank Development Indicators data set does not include information on any of these three series for 1995. Consequently, in our empirical work we use 2005 data for both years.

We report the estimation results of equation (7) for each of the 144 differentiated products in Table 5. For each product, we have at most 16,256 observations. The median value of observations is 14,732, of which 21 percent are zeros in year 1995. Although we have 16,256 observations for each product, we have to drop the observations if a country exports that product to all 127 trading partners, imports that product from all 127 countries, or does not export or import the product at all. For example, Japan exported passenger vehicles to all 127 countries in 2005. In this case, we cannot estimate the probability of exports for Japanese auto industry since the observed probability is 100 percent. Given the large number of estimates we have for each product, we do not report all the results. Instead, in the table we provide summary statistics for the estimated coefficients, the proportion of coefficients that have the expected sign, and the proportion of those that are significant at the 5% level.

[Insert Table 5 about here.]

Consider the table. The probability of successful exports from country k to l (ρ_{it}^{kl}) is negatively related to the log of distance between them. 100 percent of industry-level estimates have negative signs and are statistically significant for both 1995 and 2005. Similar to the results reported by Baldwin and Harrigan (2011), geographic separation helps to explain the zero export observations. Estimated coefficients on FTA dummy variables are expected to be positive since countries involved in an FTA share lower trade barriers. As expected, most of the signs are positive in 1995: 88.9 percent are positive and 75.7 percent are statistically significant at the 5% level; however, in 2005 only 25.7 percent of 144 product groups are positive. We find the similar tendency for the common WTO membership dummy variable. In addition, for both years, many of the coefficients on the business- and trade-related variables (*Cost*, *Time*, *Startup*) are significant with predicted signs, supporting the important roles played by trade costs related to market entry that play a major part in the Melitz model.

Next, we report exporter-specific coefficients for China and Japan ($\hat{\beta}_{it}^{k}$) for years 1995 and 2005. We set the exporter-specific fixed effect variable for the United States to zero for each product and year. Thus, the reported values in Table 5 for China and Japan are relative to the United States. Using 1995 data, China's probabilities of successful exports are lower than the United States for 75.0 percent of the 144 products in the sample and 47.9 percent are statistically significant at the 5% level. This pattern reversed over the period we consider. Using 2005 data, China's probabilities of exporting are lower than the United States for 29.9 percent of the 134 products[12], of which only 9.0 percent are statistically significant at the 5% level. Finally, in contrast to the case of China, there is virtually no obvious change in the sign pattern for Japanese exporter fixed effects over the period: 88.2 percent in 1995 and 80.6 percent in 2005 carry negative signs.

According to our theoretical model, more firms will choose to enter an export market over time if they are increasingly able to achieve a necessary productivity cut-off level. As we discussed above, this could be due to any of a number of factors including rising standards of living throughout the world, technological advances in transportation technology, or country specific advances in production technology at the industry level. While our empirical model does not allow us to identify exactly which of these factors may be paramount in explaining export success, it is crucial to observe relatively stable

[12] We were forced to drop 10 products in 2005 because China, Japan, or the United States exported to all 127 trading partners.

coefficients on the trade-related variables. For example, the median value of log of distance is -0.874 in 1995 and that is -0.897 in 2005, indicating there were no significant advancement in decline in transportation costs. We find the similar evidence for the variables such as common border, common language, and business- and trade-related cost variables.

Thus, conditional to the changes in the importer-side, the most important variable to explain the distinctive success of Chinese industries in entering foreign markets is China's exporter fixed effect. According to the theoretical discussion above, β_{it}^{k} mainly captures the unit production cost of Chinese industries (i.e., $\ln(c_{it}^{k})$) and the productivity of the most productive firm in i (i.e., $\ln(\underline{a}_{it}^{k})$). While the product-level productivities that correspond to our 144 products are not available from the existing data, we can access the changes over the period 1995-2005 in the unit cost of production such as wages. As well known, the wages and rental rates in China increased over the period as real GDP per capital increased. Thus, it is not likely that the reduction in unit cost contributed to the growth at the extensive margin. Thus, it indicates that the remaining factor, productivity growth of Chinese industries, might play the essential role for the success of China' market entry. Using the heterogeneous-firm framework of Melitz, Demidova (2008) shows that technological advances in one country could raise welfare there while reducing it in its trading partners. Although we make no attempt at measuring welfare, our findings present an empirical example of the type of advances she is modeling in her work.

3.3 Estimating the Productivity Margin at the Product Level

It is possible to use it to estimate the product level cutoff productivity levels necessary to insure participation in a particular export market.[13] Remember that $\hat{\rho}_{it}^{kl}$ is the predicted probability of exports of product *i* from country *k* to *l* in year *t*, using the estimates from (7). Let $\hat{z}_{it}^{kl} / \sigma_{\eta_{it}} = \Phi^{-1}(\hat{\rho}_{it}^{kl})$ be the predicted value of the latent variable. Then, an estimate for W_{it}^{kl} is obtained from $\hat{W}_{it}^{kl} = (\hat{Z}_{it}^{kl})^{(\kappa_i - \varepsilon_i + 1)/(\varepsilon_i - 1)} - 1$ for non-zero observations. Assuming that the distribution parameters of firms for each product, κ^i and ε^i, are constant over time, we can show the relationship between our estimates of the latent variable and the relative cut-off point of productivity, or productivity margin, for each product:

$$\text{(8)} \qquad \hat{z}_{it}^{kl} = (1/\sigma_{\eta_{it}})(\varepsilon_i - 1)\ln(\underline{\hat{a}}_{it}^{kl} / \underline{\hat{a}}_{it}^{k})$$

where we have at most 18,288 observations (144 products for 127 importer countries) for each exporting country *k* for each year 1995 or 2005.

Figures 1.1 through 1.3 provide scatter plots of the productivity margin of product *i* for importing country *l*, equation (8), for year 1995 against that for year 2005 for three exporting countries: the United States, Japan, and China, respectively. Because ε^i in equation (8) is time-invariant and $\hat{\sigma}_{\eta_{it}}$ does not change much over the period according to Table 5, the scatter plots show the relative changes in the cut-off relative productivities. We have 17,599 cut-off relative productivities for the United States, 17,500 for Japan, and 17,372 for China. Interestingly, there are no significant changes over the period we consider for the United States and Japan. In each case the plots are distributed along the

[13] Note, however, that given the across the board growth of Chinese exports relative to the exports of other countries, demand conditions and transport cost technology (which would have impacted all potential entrants) probably were not as important as technological innovations in China.

45^o line. According to our model, this suggests that the number of firms in these two countries choosing to export remained essentially constant between 1995 and 2005. This is because there was no change of the cut-off points of productivities to entry into export markets, i.e. the $\underline{a}_{it}^{kl}$ relative to the productivity levels of the most efficient firms ($\underline{a}_{it}^{k}$), indicating relatively static conditions for American and Japanese exports.

In contrast, it is interesting to observe an across the board shift in productivity cut-off points for Chinese exporters. In virtually all the cases, the observations in Figure 1.3 lie above the 45^o line. Since the cut-off relative to the most productive firm's productivity have increased, our model suggests that the number of Chinese firms with the capacity to export successfully to foreign markets has increased dramatically and these increases have been across virtually all products and in virtually all markets in our sample.

While we have chosen to interpret our findings solely in the context of the HMR model, it is possible that some of the productivity advances illustrate in Figure 1.3 may be of a different kind. In a recent paper, Ahn et al (2011) develop an extension to the Melitz (2003) model that allows firms to get around high levels of exporting costs to use intermediary firms to market their goods in foreign markets.[14] That is, firms can choose between direct and indirect export modes to enter particular markets. In their model, choosing to use an intermediary requires a lower fixed cost but yields lower profits. Thus, even in this case, the decision to export requires achieving a cut off productivity level sufficiently low to be able to cover the costs of the intermediary.

[14] Their empirical work focuses on China and find that roughly 20% of the value of Chinese exports in 2005 was handled by intermediaries.

4. Conclusions

In this paper we focus on the expansion of world trade in recent years. We show that the expansion has been at the external margin, with of the entry of new countries and products into world trade flows. This is manifest in our data sample by a growth in trade partner-product pairs from about 430 thousand in 1995 to almost 620 thousand in 2005. Most of this growth has occurred because more and more developing or emerging market countries are entering the market as exporters. The most prominent example of this has been China, which currently ranks as the leading world exporter. Our interest in this paper is on the growth in Chinese trade at the external margin. We develop a firm level model based on the work of Helpman et al (2008) of the decision to enter the export market. Using data from 128 countries and 144 industrial sectors, we then estimate this model for the years 1995 and 2005. We report strong evidence that rising firm-level productivity levels in China, either in overcoming the costs of direct exports or of engaging trade intermediates provides the best explanation for the observed pattern of the growth in trade-product partner pairs.

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Tables and Figures

Table 1. Summary statistics

1.1. Subsets of exporters

	North as exporters			South as exporters			All countries		
	1995	2005	05/95	1995	2005	05/95	1995	2005	05/95
Export value (billions, $US)	2454	4203	1.713	503	1668	3.314	2957	5871	1.985
Country × Product	276849	268175	0.969	153525	351619	2.290	430374	619794	1.440

1.2. Subsets of importers

	North as importers			South as importers			All countries		
	1995	2005	05/95	1995	2005	05/95	1995	2005	05/95
Import value (billions, $US)	2456	4645	1.891	501	1227	2.447	2957	5871	1.985
Country × Product	199298	268384	1.347	231076	351410	1.521	430374	619794	1.440

Note : The numbers are estimated from import values (billions, $US) from 128 countries.
We have 144 3-digit product categories.

Table 2. Top 5 countries of changes in country-product pairs

2.1. Exporters

Rank	Name	Export value (billions, $US)			Country × Product			
		1995	2005	05/95	1995	2005	Change	05/95
1	China	189	850	4.497	11746	16498	4752	1.405
2	Turkey	13	50	3.885	6541	11240	4699	1.718
3	India	21	58	2.763	8966	13378	4412	1.492
4	Thailand	36	85	2.375	7296	11577	4281	1.587
5	Indonesia	17	42	2.457	5537	9734	4197	1.758
53	Japan (*)	387	525	1.357	12469	14132	1663	1.133
68	USA (*)	435	655	1.504	15689	16686	997	1.064

2.2. Importers

Rank	Name	Import value (billions, $US)			Country × Product			
		1995	2005	05/95	1995	2005	Change	05/95
1	Poland (*)	18	65	3.600	3113	7650	4537	2.457
2	Canada (*)	125	227	1.810	6792	9998	3206	1.472
3	Mexico	52	166	3.183	5128	8195	3067	1.598
4	India	13	46	3.564	3703	6660	2957	1.799
5	Spain (*)	69	181	2.616	6462	9103	2641	1.409
65	USA (*)	537	1121	2.087	8810	10256	1446	1.164
97	Japan (*)	159	245	1.542	5754	6668	914	1.159

Note : (*) indicates developed countries.

Table 3. Summary statistics for product-level data of market access

	China				Japan				USA			
	1995	2005	Change	05/95	1995	2005	Change	05/95	1995	2005	Change	05/95
Maximum	123	127	85	5.048	125	127	31	1.821	126	127	26	1.442
Minimum	14	34	2	1.016	15	17	-10	0.815	46	55	-11	0.898
Mean	82	115	33	1.609	87	98	12	1.164	109	116	7	1.072
Standard deviations	29	19	16	0.663	28	27	7	0.149	15	12	6	0.075
Median	91	124	32	1.350	96	108	11	1.116	114	121	6	1.060
Sum	11746	16498	4752	1.405	12469	14132	1663	1.133	15689	16686	997	1.064

Table 4. Top 15 products with the changes in the number of export markets for China, Japan, and USA

	China					Japan					USA				
	SITC	1995	2005	Δ	Product name	SITC	1995	2005	Δ	Product name	SITC	1995	2005	Δ	Product name
1	811	21	106	85	Prefabricated buildings	635	72	103	31	Wood manufactures	896	83	109	26	Works of art and antique
2	597	32	103	71	Prepared additives	831	86	116	30	Trunk and suit-case	612	86	109	23	Leather (manufactured)
3	812	55	124	69	Plumbing equipment	597	78	106	28	Prepared additives	677	52	75	23	Railway track
4	59	37	103	66	Fruit and vegetable juices	658	92	119	27	Textile articles	681	59	82	23	Silver and platinum
5	111	30	96	66	Non-alcohol beverage	56	57	83	26	Vegetables (preserved)	843	95	116	21	Clothing for men
6	583	40	105	65	Monofilament	553	79	105	26	Perfume and cosmetics	551	98	117	19	Essential oil
7	562	34	97	63	Fertilizer	48	60	85	25	Cereal	714	89	108	19	Engines and motors
8	674	35	98	63	Flat-rolled plated iron	842	62	87	25	Knit clothing for women	675	81	98	17	Flat-rolled steel
9	896	55	116	61	Works of art and antique	659	71	95	24	Floor coverings	111	95	111	16	Non-alcohol beverage
10	73	28	88	60	Chocolate	845	89	113	24	Other textiles	661	100	116	16	Lime stone and cement
11	675	34	93	59	Flat-rolled steel	873	92	116	24	Meters and counters	248	87	102	15	Wood (simply worked)
12	711	29	86	57	Boilers	59	28	51	23	Fruit and vegetable juices	583	81	96	15	Monofilament
13	677	18	74	56	Railway track	554	80	103	23	Soap and cleaners	735	101	116	15	Parts for machinery tools
14	662	71	126	55	Construction material	737	88	111	23	Metal working machinery	841	105	120	15	Knit clothing for men
15	718	44	99	55	Power generating machine	581	90	112	22	Plastic tube and pipe	844	96	111	15	Clothing (knit and women)

Note : Δ indicates the changes from 1995 to 2005.

Table 5. Probit Estimates for 144 Differentiate Products

	Expected signs	Sign match (%)	Sign match & 5% significance	Median	Max	Min	St. Dev
Year: 1995							
Coefficients							
log($distance^{kl}$)	-	100.0	100.0	-0.874	-0.517	-1.210	0.116
$Border^{kl}$	+	100.0	92.4	0.467	0.928	0.101	0.166
$Language^{kl}$	+	100.0	100.0	0.484	0.969	0.276	0.112
FTA_t^{kl}	+	88.9	75.7	0.311	0.700	-0.287	0.206
WTO_t^{kl}	+	100.0	99.3	0.716	1.376	0.117	0.207
$Cost^{kl}$	-	91.0	60.4	-0.820	0.707	-1.965	0.544
$Time^{kl}$	-	97.9	68.1	-0.590	0.374	-1.895	0.396
$Startup^{kl}$	-	95.8	75.7	-0.196	0.128	-0.403	0.099
China exporter dummy	-	75.0	47.9	-0.512	0.819	-2.724	0.791
Japan exporter dummy	-	88.2	65.3	-0.616	0.911	-2.362	0.593
Observations				14732	16256	6087	1919
# of coefficients				251	263	164	17
% of non-zero observations				0.210	0.307	0.101	0.048
st errors of regression				0.613	0.664	0.535	0.026
McFadden r-squared				0.244	0.272	0.202	0.015
Year: 2005							
Coefficients							
log($distance^{kl}$)	-	100.0	100.0	-0.897	-0.457	-1.199	0.127
$Border^{kl}$	+	99.3	95.8	0.510	0.905	-0.150	0.164
$Language^{kl}$	+	100.0	100.0	0.480	1.084	0.249	0.094
FTA_t^{kl}	+	25.7	1.4	-0.041	0.133	-0.259	0.066
WTO_t^{kl}	+	62.5	9.0	0.013	0.115	-0.095	0.040
$Cost^{kl}$	-	97.9	79.2	-0.898	0.815	-2.103	0.434
$Time^{kl}$	-	92.4	72.2	-0.622	0.334	-1.584	0.394
$Startup^{kl}$	-	96.5	92.4	-0.240	0.113	-0.477	0.098
China exporter dummy	-	29.9	9.0	0.401	2.285	-1.841	0.739
Japan exporter dummy	-	80.6	56.0	-0.562	1.083	-2.179	0.657
Observations				15748	16256	7063	1497
# of coefficients				259	263	176	13
% of non-zero observations				0.274	0.447	0.115	0.077
st errors of regression				0.603	0.649	0.491	0.027
McFadden r-squared				0.267	0.301	0.217	0.018

Note : We do not report the following 10 SITC groups (658, 691, 713, 743, 764, 781, 846, 892, and 893) for China and Japan exporter dummy variables for 2005. For example, China exported textiles (SITC 658) to all 127 countries and Japan exported passenger vehicles (SITC 781) to all 127 countries.

Figure 1.1. Ratio of the Most Efficient to Export Cut-off Productivities (USA)

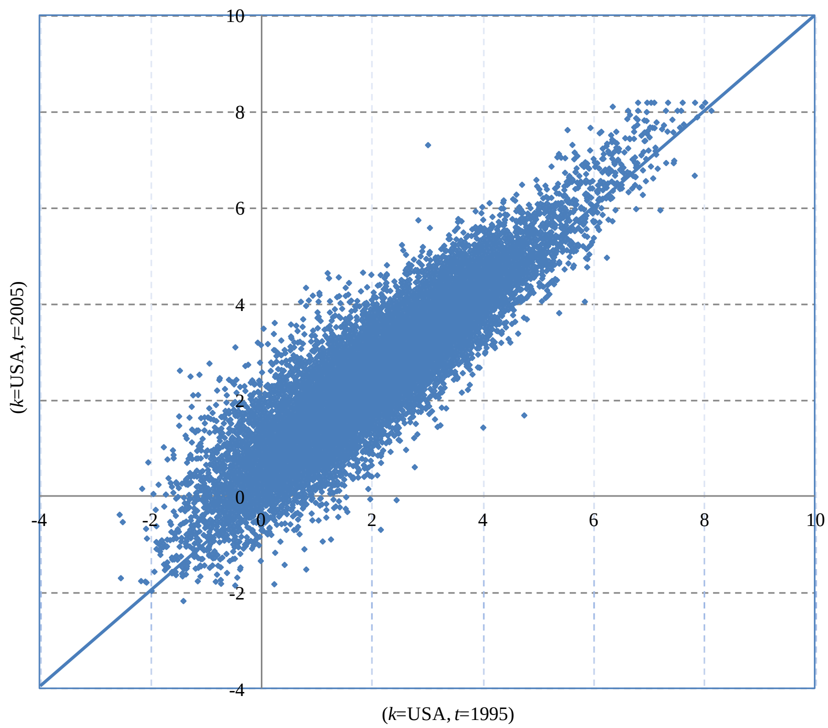

Figure 1.2. Ratio of the Most Efficient to Export Cut-off Productivities (Japan)

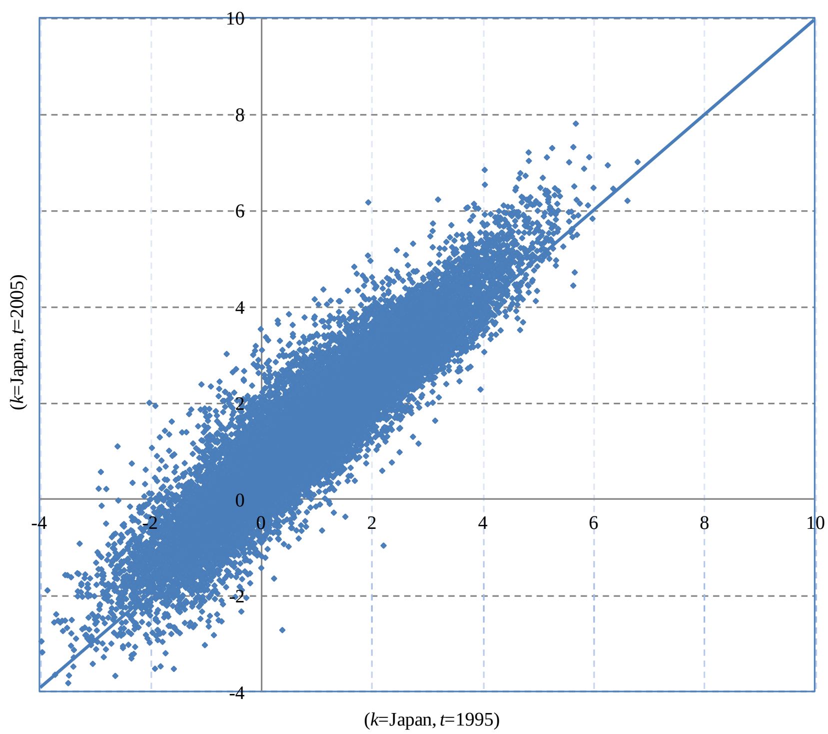

Figure 1.3. Ratio of the Most Efficient to Export Cut-off Productivities (China)