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Exchange Rates and the Margins of Trade: Evidence from Chinese Exporters

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Abstract

This article studies how real exchange rate movements affect firm export behavior, using monthly data that cover the universe of Chinese export transactions over the period of 2000–2006. Specifically, we examine exchange rate effects on an exporter's extensive (entry, exit, and product churning) and intensive margins of exports. We find significant effects on the extensive margin. A 10% real appreciation of the renminbi is associated with a 1 percentage point decline in the probability of entry, and a 0.2 percentage point increase in the probability of exit. The effects among foreign-invested enterprises almost double for both entry and exit. Despite the seemingly large effect on the extensive margins, exchange rates alone can only explain about 4% of entries and about 1.6% of exits during the sample period. The exchange-rate elasticity of exports is estimated to be around 0.4 in the first year after the shock, with most of the adjustment taking place in the first six months. This finding of a relatively fast response to exchange rate shocks is consistent with anecdotal evidence about intense competition in the Chinese export sectors. (JEL codes: F14, F31, F32)

Keywords: exchange rates, pass-through, margins of trade, export participation, product churning

1 Introduction

Many regard China's currency policy as a main driver of the looming global imbalance. Despite the heated discussions in the media and among policymakers, there is little evidence or consensus on the relation between bilateral real exchange rates and countries' trade balances with China.[1] The large literature that focuses on developed countries finds a small exchange rate elasticity of net exports, adding another example to the 'Exchange Rate Disconnect' puzzle (Obstfeld and Rogoff 2000).[2]

[1] Among the small literature on this issue, Marquez and Schindler (2007) find a low exchange rate elasticity of exports, while Cheung et al. (2009) find estimates of US–China's exchange rate elasticities of imports that contrast the standard model predictions. On the other hand, using data on Chinese exports to 33 destination countries, Thorbecke and Smith (2010) find an exchange rate elasticity of exports of 0.4 for processing exports, and a unit elasticity for ordinary exports. Other work such as Cerra and Saxena (2003) and Eckaus (2004) do not find stable and consistent results.

[2] For developed countries, among others, Hopper et al. (2000) find a exchange rate elasticity of trade below unity for OECD countries. Most other work find an elasticity less than 2.

However, recent studies cast doubt about the evidence of a low exchange rate elasticity. It is claimed that the estimates based on aggregate data can be biased if firm heterogeneous responses to exchange rate shocks are not properly controlled for in the estimation.[3] With existing evidence in hand, how much can we say about the impact of a revaluation of China's currency, the RMB, on global trade balances?

In this article, we examine the underlying mechanisms behind the potential lack of correlation between exchange rate changes and aggregate trade balance. To this end, we use a data set that covers the universe of China's trade transactions at monthly frequency between 2000 and 2006. We analyze the relations between exchange rate changes and export responses on the intensive and extensive margins. On the intensive margin, we estimate firms' exchange rate elasticity of export supply. On the extensive margin, we study how exchange rate shocks affect exporters' export participation, exit from export markets, as well as product adding and dropping. Our data cover the universe of export transactions in China, circumventing the usual sample selection biases in estimating the exchange-rate elasticity equation. See Figure 1 for the outline of the paper.

Our sample period covers 2000–2006, when the RMB was pegged with the US dollar most of the time, but exhibited significant fluctuations in real terms.[4] Of note, the real effective exchange rate of the RMB appreciated by 9% between 2000 and the end of 2001, before depreciating by 17% by early 2005. Between July 2005 and the end of 2006, when the RMB was temporarily unpegged from the dollar, it appreciated again by about 4% (Figure 2). In addition to the time-series variation, which may appear to be small at first sight, our identification of the exchange rate effects relies on the much more significant changes in the bilateral real exchange rates across destination countries of an exporting firm.

By using firm-level data, our article has several strengths compared to most existing studies. First, data available at the firm–product–country level permit an identification of the exchange rate effects across markets within a firm-year. This research approach allows us to control for firm fixed effects to isolate any firm-specific unobservable determinants of

[3] See Dekle et al. (2009) for a theoretical derivation of both types of biases in aggregate trade flow estimation. In particular, they find a significant difference between firm-level and macro estimates of exchange rate elasticity, of which 15% of it can be attributed to firm heterogeneity not controlled for in aggregate estimation. For the USA, where aggregate export elasticity has traditionally been found to be insignificant, firm-level evidence shows a significant relationship between currency depreciation and exports (Bernard and Jensen 2004).

[4] From 1994 to July 2005, the Chinese government fixed the RMB at 8.28 RMB per US dollar. The RMB was repegged with the dollar at the onset of the financial crisis in September 2008.

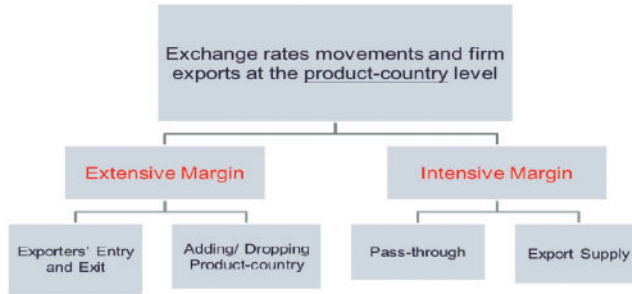

Figure 1. Structure of the article.

trade flows. Second, we can exploit various dimensions of our data set to gain an understanding towards the channels through which an exporter responds to exchange rate shocks. In particular, in addition to export supply, we provide evidence on firms' entry and exit, as well as their product adding and dropping. Finally, a growing literature emphasizes firm heterogeneity in response to exchange rate shocks (Berman et al. 2012). Using transaction-level data, we can examine the existence and relevance of such heterogeneity. Consequently, our results are immune from aggregation biases, and can potentially shed light on the degree of the biases.

Besides quantifying the contribution of different margins to aggregate trade responses to exchange rate shocks, our article adds to the existing literature by highlighting the role of the extensive margin in shaping trade patterns (e.g. Chaney 2008; Arkolakis 2010; Eaton et al. 2011). Although previous numerical exercises have found limited effects of entry and exit on aggregate outcomes (Alessandria and Choi 2007; Atkeson and Burnstein 2008), there are reasons to revisit the evidence for China. First, the Chinese economy features frequent entries, exits, and product churning. As is shown in Figure 3, firms' net entry accounts for 28% of export growth between 2001 and 2006 on average, while net product addition contributes another 25%. These findings contrast sharply with Bernard et al. (2009), who find for the USA that the intensive margin drives most of the year-to-year export growth. Second, the extensive margin, especially the product-churning margin, has been under-studied in the literature on exchange rate effects on export behavior.[5]

[5] Bernard and Jensen (2004) and Beggs et al. (2009) study the impact of exchange rates on export participation, using US and Canadian firm-level data, respectively. To our understanding, we are the first one who uses a developing country's micro-level data to study the exchange rate elasticity of product-churning.

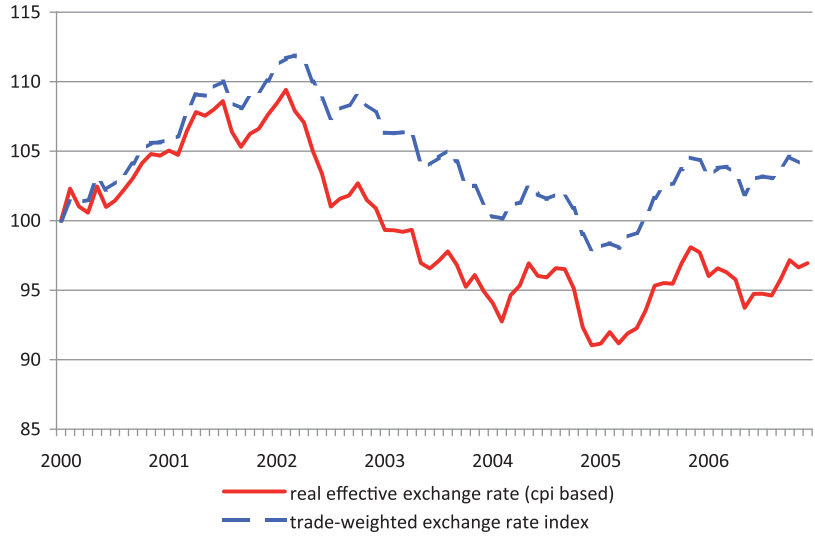

Figure 2. Monthly RMB exchange rate index (2000–2006). *Note*: Real effective exchange rates (CPI-deflated) and nominal exchange rates are from International Financial Statistics of International Monetary Funds. Trade weighted are calculated by authors using China transactions data. Numbers are normalized to 100 for January 2000.

To examine the exchange-rate effects on the two extensive margins of trade, we estimate a probit model to study the relations between real exchange rate appreciation, firms' export participation, and within-firm product churning. Controlling for destination countries' import demand and a host of firm-level characteristics, we find that a 10% real depreciation of the RMB in a year is associated with about 1 percentage point increase (0.2 percentage point decrease) in the probability of entering a market (exiting a market) within a sector-year. These relations are more statistically and economically significant among foreign-invested enterprises, lending support to the studies that find higher volatility of offshoring industries compared to the corresponding ones in the source countries (Bergin et al. 2009, 2011). Despite the seemingly large effect on the extensive margins, exchange rates alone can only explain about 4% of entries and about 1.6% of exits during this sample period over which China went through active creative destruction (Brandt et al. 2012).

In terms of entering a product–country market, a 10% real depreciation of the RMB is associated with about 2 percentage point increase

Recently, Bernard et al. (2010, 2011) examine the impact of trade liberalization on within-firm allocation of resources across products, in the presence of fixed cost of product addition.

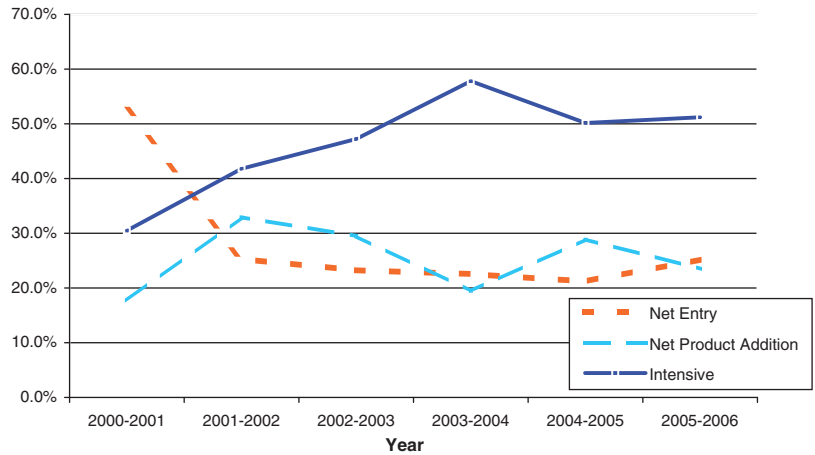

Figure 3. Contributions of different margins to China's aggregate export growth (2000–2006). *Source*: China's transaction-level trade data set. *Note*: See equation (1) in the main text for calculation of each margin.

(2 percentage point decrease) in the probability of adding a new product to a market (dropping an existing product). There is no systematic difference in the pattern of product churning between domestic and foreign firms. These product–country add-drop results remain quantitatively robust to controlling for firm fixed effects, which capture all firm-specific time-invariant capability of production and innovation.

In addition to the extensive margin, we investigate how exchange rate fluctuations affect the intensive margins of trade, that is, the elasticity of export supply to exchange rate changes. The conventional view is that when the exporter's currency appreciates, expenditure switching in the importing countries would result in an improvement in the trade balance. However, if the Chinese exporters react to a RMB appreciation by cutting prices substantially, keeping the foreign-currency price relatively stable, the net effect of exchange rates on China's trade balance is ambiguous.

To this end, we correlate the first-difference of the firm's (log) export value to a product–country market with the rate of bilateral RMB appreciation. To take into account the potential sluggish responses in export supply, we exploit the high-frequency nature of our data to include a number of lagged exchange rate appreciation terms to estimate both short-run and long-run exchange rate elasticities of exports. We find that a 10% real appreciation of the RMB is associated with 3.1% increase in a firm's export sales in 3 months, and only 4.4% in a year. These results suggest that the export sector is competitive, with exporters adjusting export supply rather quickly in response to exchange rate shocks.

Related literature: our article relates to several strands of literature. First, it relates to the extensive empirical studies on the exchange rate elasticity of trade. The standard argument is that trade balance would improve as a result of real exchange rate depreciation, as it increases the competitiveness of the domestic producers (Marshall 1923; Lerner 1944). Despite the sound argument, existing evidence shows a rather low exchange rate elasticity of aggregate exports or trade balance, for both developed and developing countries. For example, Campa (2004) finds an aggregate exchange rate elasticity of exports equal to 0.14 for Spain. Regarding China's trade balance and its currency, Marquez and Schindler (2007) and Thorbecke and Smith (2010) find a low exchange rate elasticity of exports, while Cheung et al. (2009) find estimates of US–China's exchange rate elasticities of imports that are inconsistent with the standard model predictions.

Our article also relates to the literature that highlights the importance of the extensive margin in international trade (Hummels and Klenow 2005; Chaney 2008; Helpman et al. 2008; Arkolakis and Muendler 2010; Eaton et al. 2011, among others). Based on a multi-product model extension of Melitz (2003), Bernard et al. (2009) find that in the short run, the intensive margin is the dominant driving force of export growth, while the extensive margin, which consists of both net firm entry and net product addition, plays a more significant role in the long run. Related to the exchange rate effects on the extensive margin of exports, Baldwin and Krugman (1989) and Dixit (1989) show theoretically how the existence of sunk entry costs can generate hysteresis in entry, exit, and thus export responses to exchange rate shocks. Based on this 'sunk cost' argument, Das et al. (2007) build a dynamic general-equilibrium model to structurally estimate the fixed export cost. They find that Colombian exporters pay on average 400 000 US dollars (up to 40% of annual sales) to start exporting. Despite the large magnitude, simulation results in Alessandria and Choi (2007) show little effect of the extensive margin on aggregate trade dynamics, due to the small size of both the entrants and the exiters.

Our article adds to the new literature that uses firm-level trade data to study the exchange rate effects on trade dynamics. In this literature, Beggs et al. (2009) show that the impact of real exchange rate changes on firm survival is far larger than the effect of CUSTA tariff reduction. On the other hand, Gopinath and Neiman (2010) find that the entry–exit margin plays a small role in explaining import adjustments of Argentine firms during the 2001 currency crisis, while product churning (the sub-firm extensive margin) is significantly more important. A recent study by Berman et al. (2012) examines firms' adjustments in prices and export volume in response to exchange rate movements. They show theoretically that in the presence of distribution costs denominated in destination

currencies, firms' pricing behavior depends on firm productivity. In their model, high-productivity firms tend to raise mark-ups rather than quantities when the producers' currency depreciates; low-productivity firms adopt the opposite strategy. They find supporting evidence using French firm-level export data.

Finally, our work sheds light on the discussion of China's exchange rate policy. In this literature, Goldstein and Lardy (2009) analyze the implications of China's exchange-rate policy for many aspects of the Chinese economy, including the effectiveness of monetary policy, the banking system, the structure of output and demand, and the risk of protectionism abroad. Other studies have focused on estimating the equilibrium exchange rate of the RMB and the magnitude of its undervaluation (i.e., Cline and Williamson 2008; Cheung et al. 2009).

The article is organized as follows. The next section discusses the data for our analysis, the recent trend and the pattern of China's trade. Section 3 introduces our regression specifications and discusses the empirical results. The last section concludes.

2 Data and China's export dynamics

2.1 Transaction-level trade data

Our analysis uses data that cover the universe of all Chinese import and export transactions in each month between 2000 and 2006.[6] It contains values (in US dollars) of imports and exports at the HS 8-digit classification (with 7000 product categories) from a firm to each country, allowing us to have the finest unit of observation available for empirical research in international trade – i.e. at the firm–product–country-month level. The top export destinations of China are listed in Table A1 in the Appendix.

For each transaction reported by an exporting firm, the data set contains information on quantities, country of destination, ownership type of the firm (e.g. foreign, private, state, collectively owned), customs regime (e.g. export processing versus ordinary trade), and region or city in China from where the product was exported. In our analysis, prices are calculated as unit values. Table 1 provides key statistics of the data.

In a short time span of about three decades, China has transformed itself from a largely isolated economy to the world's largest exporter. Export growth has continued to be a major engine supporting China's drastic economic growth. Stimulated by China's entry into WTO in late 2001, the first decade of 21st century saw most remarkable export growth for China. As Table 1 shows, China's exports exhibited an average annual

[6] The same data set has been used by Manova and Zhang (2010) and Ahn et al. (2011).

growth rate of 26% between 2000 and 2006 (our sample period), with 2001 being an outlier having only about 7% growth rate. Over the same period, China's trade surplus jumped from 24 billion to 177 billion dollars.

Table 1 also shows that the total number of exporting firms increased from less than 63 000 to over 170 000 in 2006; while the average size of an exporter grew by 42%. As is now well-known in the trade literature (e.g. Eaton et al. 2011), these average numbers mask important firm heterogeneity in export sales and evolution. Notice that the number of firms grows much faster than that of the average export sales, suggesting an active extensive margin. The next section will have a more formal analysis on this.

Another extensive margin to examine is about the number of products (HS 8-digit) exported and the number of countries served. The average number of products exported by an exporter increased from 14 to 17 over 2000–2006, with the average number of countries served fluctuated between 7 and 8. The corresponding numbers for the median firm are substantially smaller. The median firm produced 3 to 4 products in a year and served only 2 to 3 markets. This drastic difference between the averages and the medians suggest a flat right tail in the exporters' size distribution, a well-known feature that is also observed in other countries (e.g. Eaton et al. 2008 for Colombia; Eaton et al. 2011 for France).

The most impressive export performance in China came from foreign-invested firms and domestic private firms that engage in export processing for foreign buyers. Table 2 shows the evolution of the ownership structure of Chinese exporters between 2000 and 2006. Continuous privatization of state-owned enterprises (SOEs) results in a diminishing prominence of SOEs in all sectors in China's economy, with the export market shares being taken up by both private and foreign firms over time. As of 2006, almost 60% of Chinese exports were accounted for by foreign firms (both joint ventures and wholly owned foreign enterprises). Another feature of China's exports that is worth examining is the prevalence of export processing, which involves foreign parts and components being imported, then assembled into final products using low-cost Chinese labor for exports. Compared with ordinary trade, market shares of export processing have been increasing over time in recent years. In addition, the share of foreign ownership (including investors from Hong Kong, Macau, and Taiwan) in export-processing exports has increased over time. As of 2006, 85% of processing exports came from foreign firms. These patterns suggest a complementary relationship between exports and foreign direct investments.

Another aspect of China's export market that was understudied previously due to data limitation is the active firms' entry and exit from export participation. Table 3 decomposes the number of exporters into entrants,

Table 1 China's Trade Growth (2000–2006)

	Total exports (billion USD)	Total imports (billion USD)	Trade balance (billion USD)	Export growth (%)	Total number of exporters	Average export value per exporter (million USD)	Number of products per exporter		Number of countries per exporter	
							Mean	Median	Mean	Median
2000	249.20	225.09	24.11	28.19	62 771	3.97	14.4	3	6.8	2
2001	266.10	243.55	22.55	6.78	68 072	3.90	14.0	3	7.0	2
2002	325.60	295.17	30.43	22.36	78 612	4.14	15.2	3	7.4	3
2003	438.23	412.76	25.47	34.59	95 629	4.58	15.4	3	7.6	3
2004	593.32	561.23	32.09	35.39	120 589	4.92	15.2	3	7.7	3
2005	761.95	659.95	102.00	28.42	144 030	5.29	15.9	4	8.0	3
2006	968.94	791.46	177.48	27.17	171 205	5.66	17.0	4	8.3	3

Note: Authors' calculation based on China transactions data.

Table 2 Ownership and trade type of Chinese exporters (percentage of export value)

	2000	2001	2002	2003	2004	2005	2006
All trade							
State	47.5	42.9	37.8	31.5	25.9	22.1	20.5
Collective	3.9	5.3	5.8	5.7	5.4	4.8	4.7
Private	0.9	2.0	4.3	7.9	11.7	14.7	15.3
Foreign	47.7	50.0	52.2	54.9	57.0	58.3	59.5
Ordinary trade							
State	72.4	65.8	57.7	50.2	41.3	35.3	30.0
Collective	5.9	8.2	9.3	9.4	9	7.8	7.6
Private	1.8	3.9	8.7	14.9	22.5	28.6	33.4
Foreign	19.9	22.2	24.3	25.5	27.2	28.3	29.1
Processing trade							
State	27.4	24.4	21.6	16.3	13.4	11.2	8.8
Collective	2.3	3.0	2.9	2.7	2.4	2.3	2.6
Private	0.1	0.4	0.7	2.3	2.9	3.2	3.5
Foreign	70.2	72.3	74.8	78.7	81.2	83.2	85.1

Source: Authors' calculation from China transactions data.

continuing firms and exiters, as well as their corresponding rates of entry and exit. As is discussed in Table 1, the number of exporters has increased two-fold in 6 years. Behind this net increase, there were significant gross exits. Here, we define entrants as any exporters that did not export in the previous year, but started exporting in the current year. Thus, we do not have entry defined for 2000, the first year in our sample. Exits are defined as those that export in the current year, but not the following year. Thus, we do not have exits defined for 2006, the last year in our sample. For instance, in 2005, about 40 000 firms entered into exporting, while close to 19 000 exits from the export market. The average entry rate (the ratio of new exporters to total exporters) is 28% over the sample period, while the average exit rate (the ratio of exiters to total exporters) is 14%. The findings of such large entry and exit rates motivate us to study the impact of exchange rate shocks on the extensive margins of trade.

Notice that the average export sales of the entrants and the exiters are significantly smaller than those of the continuing exporters. For 2005, the average export sales of entrants is about 17% of the average export sales of continuing exporters, while the corresponding fraction is 14% for

exiters. These numbers are significantly larger than the numbers documented by Eaton et al. (2008) for Colombian exporters.[7]

2.2 Construction of the real exchange rate

Our main regressor of interest is the bilateral real exchange rate of the Chinese currency, the RMB, relative to each country's currency at monthly frequency. Data on bilateral nominal exchange rate (E) , defined as the foreign currency value of a RMB, are obtained from the International Financial Statistics (IFS) of the International Monetary Fund. To compute real exchange rate changes, we use consumer price index (CPI) as deflators.[8] Data on CPI and GDP of both China and destination countries are also obtained from the IFS data set.[9]

We define the real exchange rate in a standard way as follows:

$$q_c = \frac{E_c P_c}{P},$$

where E_c is country c's currency price of a RMB, P_c is the CPI of country c, and P is the CPI of China. A increase in q_c implies a real *depreciation* of the RMB.

Since the CPI is an index number with its value set to 1 in an arbitrary base year, the index is not comparable across countries in a given year, and thus the level of the real exchange rate cannot be computed. However, the *change* in the real exchange rate can be constructed using index numbers. In our regression analysis, we use the log difference in the real exchange rate between period $t-1$ and t (where t can represent months or years) as follows:

$$\triangle q_{ct} = \ln\left(\frac{E_{ct}}{E_{c(t-1)}}\right) + \ln\left(\frac{P_{ct}}{P_{c(t-1)}}\right) - \ln\left(\frac{P_t}{P_{t-1}}\right).$$

$q_{ct} > 0$ implies a real depreciation.

3 Results

Before discussing the main findings of the article, we present evidence on the contribution of different margins of trade to China's aggregate export growth. The goal is to highlight the relative importance of the two

[7] This small size is captured by the simulation exercise in Alessandria and Choi (2007).

[8] Alternative price indices, such as producer price index and unit labor costs are not available for a large sample of countries at the month frequency.

[9] The IMF IFS data have no information of CPI for Taiwan. CPI indices for Taiwan are obtained from National Statistics of Republic of China (http://eng.stat.gov.tw/).

Table 3 Chinese exporters' entry and exit rates (2000–2006)

	Total number of exporters	Number of entrants	Number of exiters	Number of continuing exporters	Entry rate	Exit rate	Average export sales of entrants (US Dollar)	Average export sales of exiters (US Dollar)	Average export sales of continuing exporters (US Dollar)
2000	62 771		10 627	52 144		0.17		618 634	4 653 669
2001	68 072	15 928	10 843	57 229	0.23	0.16	926 559	537 517	4 542 623
2002	78 612	21 383	10 090	68 522	0.27	0.13	903 218	528 816	4 674 352
2003	95 629	27 107	12 686	82 943	0.28	0.13	1 060 944	591 296	5 193 877
2004	120 589	37 646	16 583	104 006	0.31	0.14	1 050 362	677 283	5 599 803
2005	144 030	40 024	19 225	124 805	0.28	0.13	1 034 384	839 167	5 973 211
2006	171 205	46 400			0.27		1 320 883		
Average	105 844	31 415	13 342	81 608	0.28	0.14	1 049 392	632 119	5 106 256

Source: Authors' calculation based on China transactions data. Exiters are defined as those firm that export in current year but not in next year. Entrants are defined as those firms that export in the current year but not in the previous year. Continuing firms are defined as those firms that export in the current year and next year.

extensive margins (net entry and net product addition) in China's export growth.

3.1 Time-series variation in China's export growth

Following Bernard et al. (2009), we decompose the first difference in exports (in billion US dollars) between t and $t-1$ into changes due to new firms (N), exiting firms (E), and continuing firms (C), according to the following identity:

$$\triangle x_t = \sum_{f \in N} x_{ft} - \sum_{f \in E} x_{ft-1} + \sum_{f \in C} \triangle x_{ft},$$

where f indexes firm.

For continuing firms ($f \in C$), we can further decompose their export growth into that due to adding or dropping country–products (the extensive margin), and that due to expansion and contraction of continuing country–products (the intensive margin):

$$\sum_{f \in C} \triangle x_{ft} = \sum_{j \in A_f} x_{fjt} - \sum_{j \in D_f} x_{fjt-1} + \sum_{j \in G_f} \triangle x_{fjt} + \sum_{j \in S_f} \triangle x_{fjt}, \qquad (1)$$

where j indexes the category a transaction belongs to, which includes a set of new country–product trade relationships (A_f); a set of dropped country–product relationships (D_f); a set of existing country–product relationships that expand (G_f); and a set of country–product relationships that shrink (S_f).

Table 4 shows the decompositions of annual export growth between 2000 and 2006 in three categories: export growth from (i) net entry of exporters; (ii) net addition of products or countries by continuing exporters; (iii) growth from continuing firm-product-country.[10] Our results contrast sharply with the findings for the USA. According to Bernard et al. (2009), short-run (annual) changes in US exports are almost exclusively driven by changes in the intensive margin. For China, the intensive margin accounts for about only half of total export growth between 2000 and 2006 (Table 4), while firm net entry and product–country net addition each contributes about 25%. The decomposition of 2000–2001 growth looks different from other years. One explanation is that Chinese government liberalizes trading rights before WTO entry, resulting in a significant net entry of exporters.

[10] A product is defined as a HS 8-digit category here.

3.2 Regression results

With the findings that the extensive margin plays an important role in driving Chinese exports, we proceed to estimate the effects of exchange rate movements on different margins of exports. Following Bernard et al. (2009), we decompose the aggregate volume of exports to country c in a year (year subscript is suppressed here for simplicity) into different margins, which include the number of unique exporters to country c (F_c); the number of unique HS6 products exported, (N_c); the density of exports defined as the fraction of firm–product combinations with positive exports (D_c); and the average value of exports per firm–product exported to c, conditional on exporting ($\overline{X}_c$).[11] Formally, the value of exports to country c equals exactly the multiplication of the four terms, and is expressed as follows:

$$X_c = F_c N_c D_c \overline{X}_c,$$
$$\text{where } D_c = \frac{o_{pfc}}{F_c N_c} \text{ and } \overline{X}_c = \frac{1}{o_{pfc}} \sum_f \sum_p X_{cpf}, \tag{2}$$

and o_{pfc} is the number of positive firm–product transactions in country c.

We now regress each component in equation (2) to provide aggregate-level evidence on how exchange rate changes affect each margin of exports. The results are reported in Table 5. Using a country-level panel over 2000–2006 and controlling for the size of the market, as well as country and year fixed effects, we find no evidence that a RMB depreciation is associated with an increase in aggregate bilateral exports (Column (1)). The coefficient on the first difference of ln(RER) is positive but not statistically significant. However, in Column (2), we find that a RMB depreciation is associated with export growth on the extensive margin. Specifically, a 10% RMB depreciation is associated with a 1.7% increase in the number of entries selling to the destination country. We also find a fairly significant (at the 10% significance level) and positive correlation between a RMB depreciation with respect to a country and the number of new products sold to the country (the elasticity is about 0.15). There is little evidence that the average export value (per firm–product) increases as a result of currency depreciation. The density of exports also does not appear to be affected.

[11] Notice that the density measure, D_c, ranges between min $\{1/F_c, 1/N_c\}$ and unity. As the number of exporters or the number of products exported increase, the number of firm–product combinations expand multiplicatively. If the average number of products an exporter exports remains relatively stable, the density of exports is likely to decline when an exchange shock results in an increase in the number of products or exporters.

Table 4 Time-series variation in China's export growth

		2000–2001		2001–2002		2002–2003		2003–2004		2004–2005		2005–2006	
		b$	Share (%)	b$	Share (%)	b$	Share (%)	b$	Share (%)	b$	Share (%)	b$	Share (%)
Exporter entry and exit	Exporter births	17	104.9	23	38.3	34	29.9	46	29.5	50	30.0	73	35.4
	Exporter deaths	9	52.3	8	13.0	7	6.6	11	7.0	15	8.8	21	10.1
	Net entry	9	52.6	15	25.3	26	23.2	35	22.5	36	21.2	52	25.2
Product-country adds and drops by continuing firms	New product–country	45	273.2	69	115.7	91	80.7	84	53.8	128	76.4	144	69.6
	Retired product–country	42	255.5	50	82.8	57	51.2	54	34.4	80	47.5	95	46.1
	Net product–country change	3	17.7	20	32.9	33	29.5	30	19.4	48	28.9	49	23.5
Intensive margin	Export growth of continuing firm–product–country	5	30.5	25	41.8	53	47.2	90	57.8	84	50.1	106	51.2
	Total export change	16	100.0	60	100.0	112	100.0	156	100.0	168	100.0	207	100.0

Notes: This table decomposes China's year-to-year export growth into three sources, similar to Bernard et al. (2009): (1) net increase from entry and exit; (2) net increase from product- country add and drop; (3) net increase from intensive margin. A product is defined as a HS 8-digit category. We report both dollar value and the share in total export increase.

Table 5 Exchange rate movements and aggregate export growth (2000–2006)

First differences Dependent var:	ln(total)	ln(# exporters)	ln(# products)	ln(density)	ln(avg exports)
ln(RER)	0.207	0.170**	0.151*	−0.063	−0.0413
(increase = depreciation)	(1.31)	(2.14)	(1.81)	(−0.92)	(−0.28)
ln(Real GDP)	0.279	0.328	0.199	−0.0904	−0.0675
	(0.40)	(1.31)	(0.52)	(−0.46)	(−0.13)
N	633	633	633	633	633
R-sq	0.193	0.509	0.369	0.503	0.146

Notes: The dependent and all independent variables are first-differenced (from year $t-1$ to t). t stats, based on standard errors clustered at the country level, are reported in parentheses. A product is defined as a HS 6-digit category. * and ** indicate significance at the 10 and 5% levels, respectively.

The results based on aggregate data are suggestive of an active extensive margin of exports in China. Next, we use micro-level data to examine the impact of exchange rate shocks on different margins of exports. First, we focus on the effect on the two extensive margins of trade–the firm's entry-and-exit margin and the product-churning margin. There are several advantages of using firm-level data to study the relationship between exchange rates and trade dynamics. First, a growing literature emphasizes firm heterogeneity in responses to shocks (Berman et al. 2012). Using transaction-level data, we can examine the existence and relevance of such heterogeneity. Second, information available at firm–product–country level in our data set permits an identification of the effects of exchange rate shocks across markets within a firm-year cell, which can hardly be done in previous studies due to data limitation. Relying on within-firm variation for identification isolates the effects of unobserved firm-specific determinants of trade flows, allowing export behavior to vary across markets served by the same firm.

3.2.1 *Entry and exit*

To formally examine the response on the entry–exit margin, we estimate the following probit model:

$$\Pr(Exit_{it} = 1) = \Phi(\beta \triangle q_{it} + Z_{it-1}\gamma + [F_t + F_s]), \tag{3}$$

where i, s and t stand for firm, sector and year, respectively. To avoid the problem due to firms' infrequent exports, especially for durable products, we use annual data to define exit even though we have access to data at higher frequency. Specifically, *Exit* is set to 1 if firm i exports in year $t-1$

but not in year t. The firm-specific real exchange rate, q_{it}, is defined as the weighted average of (log) real exchange rates, with weights equal to the share of exports to different countries in total firm exports in year $t-1$. q_t is the first difference in q_{it} from $t-1$ to t. Z_{it-1} includes the export-weighted average of the destination countries' aggregate imports. Also included as controls are an indicator for whether the firm also imports, and a dummy indicating whether the firm is a trading company (intermediary). All firm-level variables are constructed using information in year $t-1$. F_t is the year fixed effect, controlling for any global business-cycle effects. F_s is the sector fixed effect, capturing the trend that are specific to the firm's main sector. To check robustness, we also estimate the above specification using a linear probability model. To take into account within-sector and within-year correlation of residuals, we cluster standard errors at the sector-year level.[12]

Standard theory predicts that a real depreciation of the RMB ($q_{it} > 0$) increases firm i's competitiveness, *decreasing* the likelihood of its exit. Thus, it is expected that $\beta < 0$.

Table 6 reports the estimates of equation (3). Columns (1)–(3) report probit estimates whereas Columns (4)–(6) report linear probability model estimates. We find that an increase in the real exchange rate (depreciation of the RMB) *reduces* an exporter's probability of exit (or increases its odd of survival). Our estimates of the marginal effect at the mean shows that a 10% real depreciation decreases the probability of exit by 0.23 percentage points, as is shown in Column (1). This reduction in the exit rate accounts for about 1.6% of the average exit rate, as reported in Table 3 and Figure 4. Exporters with larger sales in the previous year, a proxy for capability, are found to be less likely to exit. Compared with direct exporters, trading companies are less affected by exchange rate shocks and is less likely to be forced exit. An explanation is that trading companies do not own capital that are specific to production and are more flexible to switch products and countries in response to changing business environments. We will confirm this conjecture with our product-dropping analysis below. The probability of exit is significantly lower for exporters selling to larger markets. Exporters that are also importers appear to have higher probability to stay in an export market. A reason is that a stronger domestic currency implies a decline in competitiveness, but also an increase in purchasing power over imported inputs. Compared with exporters that purchase only domestic inputs, importer–exporter have a relatively lower production cost when the domestic currency strengthens.

[12] Notice that the country level is collapsed as we define export participation as starting to export to any countries.

Table 6 Firm exit regressions

Sample	Probit regressions			Linear probability regressions		
	All firms	Foreign-invested firms	Domestic firms	All firms	Foreign-invested firms	Domestic firms
ΔExchange rate (increase = depreciation)	−0.125***	−0.263***	−0.079	−0.032***	−0.034***	−0.031**
	(0.047)	(0.079)	(0.059)	(0.009)	(0.012)	(0.014)
ΔDestination import (weighted)	−0.126**	−0.110	−0.151**	−0.063***	−0.036**	−0.060***
	(0.051)	(0.098)	(0.062)	(0.011)	(0.015)	(0.015)
ln(total export)	−0.226***	−0.237***	−0.223***	−0.047***	−0.038***	−0.056***
	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Importer dummy	−0.151***	−0.283***	−0.064***	−0.020***	−0.044***	−0.002*
	(0.005)	(0.007)	(0.006)	(0.001)	(0.001)	(0.001)
Trading firm dummy	−0.086***	0.289**	−0.132***	−0.022***	0.063***	−0.019***
	(0.007)	(0.027)	(0.008)	(0.001)	(0.004)	(0.002)
Ownership dummy	yes	no	no	yes	no	no
Sector fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes
Marginal effect of ΔExchange rate	−0.023***	−0.036***	−0.018			
	(0.009)	(0.011)	(0.013)			
pseudo R-sq or R-sq	0.165	0.181	0.168	0.134	0.113	0.163
N	566 767	304 534	262 233	566 767	304 534	262 233

Notes: Standard errors clustered at the sector-year level are reported in parentheses. *, **, and *** indicate significance at the 10, 5, and 1% levels, respectively.

Columns (2)–(3) provide probit estimates for foreign-invested (FIEs) and domestic firms, respectively. We find that the exchange rate movements have a larger impact on FIEs than domestic firms (both private and state-owned enterprises). In particular, the impact of a RMB depreciation decreases foreign exporters' probability of exiting a market by 3.6 percentage points, compared with 2.3 when the whole sample is used. For domestic firms, we do not find a significant relation between currency depreciation and the likelihood of exit.

In the last three columns, we report the estimation results based on a linear probability model. The estimates on the marginal effect of exchange rate shocks on exits are of the similar order of magnitude of the corresponding probit estimates. Column (5) indicates that a 10% real depreciation is associated with a 1.3 percentage point reduction in the probability of exit. The estimates for different ownership categories exhibit the same pattern we find based on the probit estimates.

The natural next step is to examine the symmetric responses to exchange rate shocks, that is, whether exchange rate changes affect the entry of new exporters. The regression specification for export participation is almost identical to the one for exits:

$$\Pr(Entry_{it} = 1) = \Phi(\beta' \triangle q_{it} + Z_{it}\gamma' + [F_t + F_s]), \tag{4}$$

$Entry_{it} = 1$ if firm i does not export in year $t-1$, but starts exporting in year t; $Entry_{it} = 0$ if firm i exports in both year t and $t-1$. Since we do not have information of non-exporters (i.e. the counterfactual state), the probit estimates are interpreted as the probability of observing a new exporter serving a market.[13] In other words, the estimates should not be interpreted as entering a market versus staying put. The regressors are the same as those defined for equation (3). The only difference is that Z_{it} are constructed based on information in the year of entry, instead of information from the previous year, which are not observable. Traditional theory predicts that $\beta' > 0$, since a real currency depreciation ($q_{it} > 0$) increases competitiveness of a potential exporter relative to foreign producers, and thus induces entry.

The estimates of equation (4) are shown in Table 7. Standard errors are once again clustered at the sector-year level. In Column (1), there is a statistically significant and positive relation between a RMB depreciation and the probability of entry. The marginal effect implies that a 10% RMB depreciation increases the probability of observing a new exporter selling to the market by 1 percentage point. This marginal effect accounts for

[13] We are in the process of merging the Customs data with a annual comprehensive manufacturing firm survey data from China that would allow us to compare entrants with non-exporters.

Table 7 Firm entry regressions

	Probit regressions			Linear probability regressions		
Sample	All firms	Foreign-invested firms	Domestic firms	All firms	Foreign-invested firms	Domestic firms
ΔExchange rate	0.358***	0.751***	0.056	0.102***	0.202***	0.019
(increase = depreciation)	(0.040)	(0.060)	(0.055)	(0.012)	(0.015)	(0.018)
ΔDestination import (weighted)	0.309***	0.448***	0.370***	0.076***	0.117***	0.112***
	(0.042)	(0.071)	(0.054)	(0.013)	(0.019)	(0.018)
ln(total export)	−0.213***	−0.217***	−0.208***	−0.063***	−0.058***	−0.068***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Importer dummy	−0.229***	−0.026***	−0.393***	−0.064***	0.002	−0.121***
	(0.005)	(0.006)	(0.005)	(0.001)	(0.002)	(0.001)
Trading firm dummy	−0.029***	0.355***	−0.0387***	−0.016***	0.117***	−0.009***
	(0.005)	(0.020)	(0.005)	(0.002)	(0.006)	(0.001)
Ownership dummy	Yes	No	No	Yes	No	No
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Marginal effect of ΔExchange rate	0.102***	0.184***	0.018			
	(0.011)	(0.014)	(0.017)			
pseudo R-sq or R-sq	0.144	0.113	0.133	0.134	0.113	0.163
N	673 435	343 965	329 470	673 435	343 965	329 470

Notes: Standard errors clustered at the sector-year level are reported in parentheses. *** indicates significance at the 1% level.

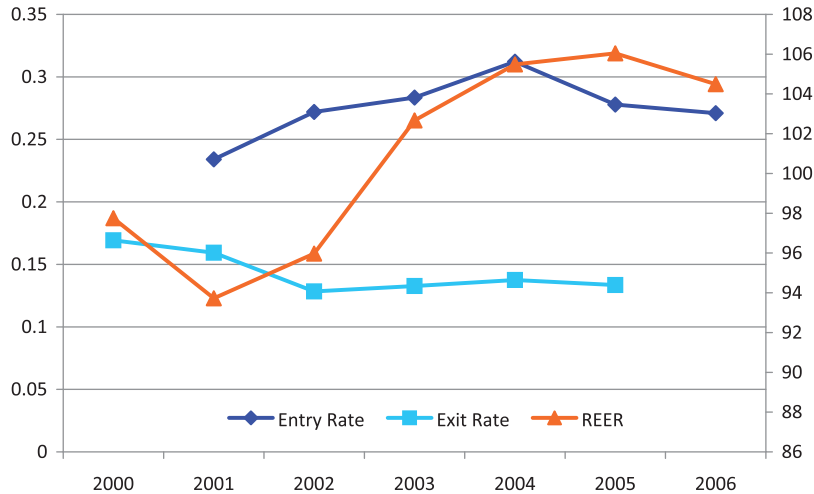

Figure 4. Trade-weighted real exchange rates and average entry and exit rates (2000–2006) *Note*: Real effective exchange rates (CPI-deflated) are from International Financial Statistics of International Monetary Funds. Annual average entry rates are calculated as the ratio of new exporters to all exporters in a year, using China's transaction-level trade data. Annual average exit rates are calculated as the ratio of firms that exported in the previous year but stop exporting in the current year to all exporters in a year, using the same data set.

about 4% of the average entry rate during the sample period (Table 3 and and Figure 4). This effect rises to 1.8 percentage points for FIEs, and is insignificant for domestic firms. The estimates based on the linear probability model are similar in magnitude to the probit estimates.

3.2.2 *Product churning*

In addition to the entry/exit decision, we exploit the rich data structure to examine the effects on another extensive margin — the decision to add or drop a product–country market. To this end, we estimate the following probit models for adding and dropping a product–country, respectively:

$$\Pr\left(Add_{ijct}=1\right)=\Phi\left(\beta_a \triangle q_{ijct}+Z_{it}\gamma_a+\left[F_t+F_j+F_c\right]\right); \tag{5}$$

$$\Pr\left(Drop_{ijct}=1\right)=\Phi\left(\beta_d \triangle q_{ijct}+Z_{it}\gamma_d+\left[F_t+F_j+F_c\right]\right), \tag{6}$$

where i, j, c and t stand for firm, product, country and year, respectively. The control variables are the same as those in the entry/exit regressions,

besides that we always use contemporaneous firm-level controls, instead of those with a lag. We now have enough degree of freedom to include country fixed effects (F_c) in both specifications. The hypothesis is that similar to entry, firms may need to incur fixed costs to introduce a new product to a market. A weaker RMB implies higher profits of selling a new product abroad. When the expected profits exceed the fixed cost of adding the product, the exporter would add the product. This rationale implies that $\beta_a > 0$ (and $\beta_d < 0$), that is, a real depreciation of the domestic currency induces product adding (and reduce product dropping) to that country. We also estimate the above specifications using a linear probability model, controlling for firm fixed effects. In other words, the fixed-effects estimates permit us to examine whether an exporter adjusts product scope in response to an exchange rate change relative to the destination country, controlling for time-invariant production capability of production, innovation, and other unobserved firm determinants of product churning.

Table 8 shows the estimates of specification (5). We find that a real RMB depreciation reduces the probability of dropping an existing product/country. Specifically, a 10% real depreciation of the RMB (with respect to a destination market) is associated with a 2.3 percentage point decline in the probability of dropping an existing product sold to that country (Column (1)). Interestingly, a larger increase in the foreign markets' imports is associated with a higher probability of dropping a product. This appears to be counterintuitive at first sight, but is in fact consistent with the argument that exporters exploit opportunities to specialize in their core competence (Bernard et al., 2010b). Supporting our earlier conjecture that trading companies have more flexibility to switch products and thus avoid exit, we find that trading companies are more likely to drop products on average. The exchange-rate effects are observed and are of similar magnitude for both domestic and foreign firms (columns (2) and (3)). Using a linear probability model controlling for firm fixed effects reveals a slightly weaker exchange rate effect, but the impact remains statistically significant.

In Table 9, we repeat the same analysis by replacing the dependent variable by an indicator of adding new product. We find results consistent with the product-dropping findings. A 10% real depreciation of the RMB relative to a destination country increases the probability of adding a new product to that country by 2.4 percent. The magnitude is slightly higher for FIEs. In the linear probability model estimation, we always control for firm fixed effects. The exchange rate effects on product adding remains quantitatively similar. These results imply that conditional on the same production technology, exporters are more likely to expand to a market that is associated with a stronger currency.

Table 8 Product–country drop regressions

	Probit regressions			Linear probability regressions		
	All firms	Foreign-invested firms	Domestic firms	All firms	Foreign-invested firms	Domestic firms
ΔExchange rate	−0.654***	−0.580***	−0.670***	−0.210***	−0.197***	−0.213***
(increase = depreciation)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
ΔDestination import (weighted)	0.627***	0.592***	0.622***	0.221***	0.170***	0.231***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
ln(total export)	−0.195***	−0.193***	−0.196***	−0.066***	−0.069***	−0.064***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Importer dummy	−0.108***	−0.223***	−0.076***			
	(0.001)	(0.002)	(0.002)			
Trading firm dummy	0.054***	0.241***	0.046***			
	(0.001)	(0.001)	(0.001)			
Ownership dummies	Yes	No	No	No	No	No
Firm fixed effects	No	No	No	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Marginal effect of ΔExchange rate	−0.228***	−0.201***	−0.233***			
	(0.002)	(0.004)	(0.002)			
pseudo R-sq or R-sq	0.106	0.105	0.083	0.097	0.132	0.086
N	15 749 032	3 612 350	12 136 682	15 749 032	3 612 350	12 136 682

Notes: Standard errors clustered at the sector-year level are reported in parentheses. *** indicates significance at the 1% level.

Table 9 Product–country add regressions

	Probit regressions			Linear probability regressions		
	All firms	Foreign-invested firms	Domestic firms	All firms	Foreign-invested firms	Domestic firms
ΔExchange rate	0.703***	0.783***	0.682***	0.240***	0.261***	0.233***
(increase = depreciation)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
ΔForeign import	0.748***	0.695***	0.757***	0.236***	0.215***	0.237***
	(0.000)	(0.002)	(0.000)	(0.000)	(0.001)	(0.000)
ln(total export)	−0.187***	−0.188***	−0.187***	−0.064***	−0.068***	−0.062***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Importer dummy	−0.152***	−0.142***	−0.156***			
	(0.001)	(0.002)	(0.001)			
Trading firm dummy	0.033***	0.255***	0.030***			
	(0.000)	(0.001)	(0.001)			
Ownership dummies	Yes	No	No	No	No	No
Firm fixed effects	No	No	No	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	No	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Marginal effect of ΔExchange rate	0.243***	0.279***	0.234***			
	(0.002)	(0.004)	(0.002)			
pseudo R-sq or R-sq	0.095	0.101	0.079	0.101	0.133	0.091
N	17 060 643	4 128 844	12 931 799	17 060 643	4 128 844	12 931 799

Notes: Standard errors clustered at the sector-year level are reported in parentheses. *** indicates significance at the 1% level.

3.2.3 *Intensive margin*

We now examine the effects of exchange rate movements on export supply at the transaction-level, which has been the focus of the existing studies that use aggregate data. We estimate the following regression specification:

$$\triangle \ln(x_{ijct}) = \sum_{k=0}^{3} \delta_k \triangle q_{ic(t-k,t-k-3)} + Z_{ct}\lambda + \left[F_i + F_j + F_c + F_t\right] + \varepsilon_{ijct}, \quad (7)$$

where i, p, c, t represent firm, product, country and *month* , respectively. $F's$ stand for fixed effects and ε_{ijct} is the residual. In addition to country and product fixed effects, we include both month and firm fixed effects to isolate any unobserved time-specific and firm-specific characteristics that affect export growth. To take into account the potentially sluggish export responses to exchange rate shocks, as postulated by the standard arguments for the J-curve, we exploit the high frequency nature of the data and include a number of lagged exchange rate depreciation terms ($q_{ic(t-k,t-k-3)}$). It is worth noting that we use the exchange rate change calculated over a 3-month period, instead of a horizon that moves along with the length of the lag, which can be 3, 6 or 9 months. Our main interest is the sum of the elasticity coefficients over 1-year period (or 4 quarters), i.e. $\sum_{k=0}^{3} \delta_k$. In unreported results, we also include lagged exchange rate changes beyond a year horizon in the regression. The main results remain quantitatively similar.

Table 10 reports the results of estimating equation (7). According to our baseline estimates over all exporters (Column (1)), the short-run (one quarter) elasticity of export value is 0.31, which means that a 10% depreciation would increase a firm's export value by 3.1% in the first 3 months. For such short period of time, this number seems large. However, we find that most of the responses take place within the first 6 months after the shock, with the effects of the shocks vanishing within a year. The exchange rate elasticity of exports over a year is 0.44, only slightly higher than the 3-month elasticity and is within the range of exchange rate elasticity estimated using French firm-level data by Berman et al. (2012).[14] Our firm-level estimates of the exchange rate elasticity trade are generally lower than those in existing studies using aggregate trade data from China. To our understanding, only Thorbecke and Smith (2010) find an exchange rate elasticity of export lower than 1, but for export processing trade only.

[14] As a comparison, the recent study by Berman et al. (2012) found an exchange rate elasticity of exports ranging between 0.36 and 0.69 over a year for French exporters.

Table 10 Regression results of intensive margin

	(1) All	(2) Exclude intermediaries	(3) Exclude USA	(4) Exclude USD-pegged countries	(5) EU Only	(6) Ordinary trade	(7) Processing trade
Δ 3 months	0.313***	0.341***	0.325***	0.327***	0.284***	0.347***	0.278***
(increase = depreciation)	(17.21)	(15.64)	(16.34)	(16.67)	(8.54)	(14.21)	(13.21)
Δ 6 months	0.112***	0.100***	0.112***	0.114***	0.113***	0.142***	0.090***
	(13.31)	(11.23)	(10.21)	(10.24)	(5.01)	(9.32)	(8.98)
Δ 9 months	0.065***	0.059***	0.064***	0.063***	0.075***	0.071***	0.061***
	(7.24)	(5.01)	(5.12)	(4.78)	(3.78)	(4.43)	(4.65)
Δ 12 months	−0.047***	−0.042***	−0.041***	−0.039***	−0.048***	−0.045***	−0.048***
	(6.65)	(5.98)	(5.64)	(4.72)	(3.25)	(4.12)	(4.01)
Sum of coefficients	0.443	0.458	0.460	0.465	0.424	0.515	0.381
N	12 745 672	9 098 432	11 698 815	9 359 254	2 234 829	6 135 987	6 452 378

Notes: This table reports the estimates of exchange rate change effects on the intensive margin, as specified in equation (7). Firm, product, destination, and year fixed effects are always included. Standard errors are clustered at the product–country level. The numbers in parentheses are *t*-statistics. ***significant at 1% level.

We exploit the complexity of our data to examine the export supply elasticity to exchange rate shocks using different subsamples. In recent studies by Ahn et al. (2011) and Tang and Zhang (2011), the export behavior of trading companies (intermediaries) differ remarkably from manufacturing firms in China. In Column (2), we exclude trading companies.[15]

With respect to the USA and destination countries that have their currency pegged with the dollar like China (before July 2005), the bilateral real exchange rates can only fluctuate due to time-varying inflation differentials. In theory, identification is still feasible for these countries, but one may be concerned that the pricing of exported goods to the USA and the dollar peggers is potentially more sticky. A possible reason is that due to the lack of nominal exchange rate uncertainty, terms for export transactions with buyers from these countries are more likely to be specified in longer term contracts. In light of these considerations, we exclude USA and the dollar peggers from the sample in Columns (3) and (4), respectively. Similarly, there is concern whether the prevalence of using the US dollar as the invoicing currency may affect our results. We therefore restrict our sample to exports to European Union (EU) countries in Column (5), where a substantial fraction of exports are invoiced in euros, which allow a higher degree of price variation in RMB. Importantly, using different country samples, the estimates on all exchange rate effects on the intensive margin of exports remain statistically significant. Both short-run and long-run exchange rate elasticity of exports remain surprisingly similar. One-year exchange rate elasticity of exports ranges from 0.42 for the EU countries to 0.47 for the non-dollar-peggers.

In the next two columns, we separate the samples into one for export-processing firms, who assemble imported components for foreign sales, and one for ordinary exporters, who produce and export own goods. Export processing accounted for about 60% of Chinese exports in recent years (Fernandes and Tang 2010). To the extent that a large fraction of export-processing firms' export sales come from the cost of imported inputs, exchange rate movements would have a dampened impact on export supply. A hypothesis is that since export-processing firms use imported inputs, when the RMB depreciates, the higher cost of imported materials may increase the marginal cost of production and dampen the positive effects of depreciation on export value. Columns (6) and (7) report regression results for ordinary trade and export processing, respectively. The export supply elasticity to exchange rate movements is larger for ordinary exporters than export processing plants, both in the short run

[15] We identify intermediary firms by the presence of the word 'importer/exporter' or 'trading' in their Chinese firm names. See Tang and Zhang (2011) for details.

and in the long run. These results are consistent with our conjecture and existing studies that also find a larger exchange rate elasticity for ordinary exporters than export-processing plants in China (Ahmed 2009; Thorbecke and Smith 2010).

4 Conclusion

Using data that cover the universe of export transactions in China over 2000–2006, we examine the impact of exchange rate movements on firms' export behavior. We find that exchange rate movements have a significant impact on various extensive margins of exports. A real exchange rate appreciation increases the probability of firm exit from exporting, and decreases the probability of firm entry into exporting. Specifically, a 10% real appreciation of the renminbi is associated with a 1 percentage point decline in the probability of entry, and a 0.2 percentage point increase in the probability of exit. The effects among foreign-invested enterprises almost double for both entry and exit. Despite the seemingly large effect on the extensive margins, exchange rates alone can only explain about 4% of entries and about 1.6% of exits during the sample period.

A real exchange rate appreciation of the Chinese currency also lowers the firm's likelihood of adding a new product to a market, and raises its likelihood of dropping a product. The exchange-rate elasticity of exports is estimated to be around 0.4 in the first year after the shock, with most of the adjustment taking place in the first 6 months. The finding of a relatively fast response to exchange rate shocks is consistent with anecdotal evidence about intense competition in the Chinese export sectors.

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Appendix A

Table A1. Top export destinations of China

Rank	2000		2006	
Total Imports from China (billion USD)				
1	USA	37.6	USA	169.00
2	Hong Kong	33.1	Hong Kong	141.00
3	Japan	28.9	Japan	74.00
4	Korea Rep.	7.3	Korea Rep.	35.40
5	Germany	6.04	Germany	32.80
6	Singapore	4.69	The Netherlands	26.10
7	The Netherlands	4.62	Singapore	19.20
8	UK	4.25	UK	18.70
9	Taiwan	3.35	Taiwan	17.40
10	France	2.46	Canada	11.70
Number of Exporters				
1	Hong Kong	25270	USA	57195
2	Japan	20569	Hong Kong	47571
3	USA	18703	Japan	43142
4	Korea Rep.	11362	Korea Rep.	36676
5	Germany	9976	Germany	31667
6	Taiwan	9389	UK	27941
7	UK	8679	Canada	25657
8	Singapore	8297	Australia	25390
9	Australia	8238	Taiwan	24718
10	Canada	7497	Italy	24266
Number of HS8 Products				
1	Hong Kong	5008	Hong Kong	5553
2	Japan	4507	Japan	5458
3	USA	4109	USA	5425
4	Korea Rep.	3897	Korea Rep.	5272
5	Singapore	3349	Germany	4518
6	Taiwan	3290	Taiwan	4498
7	Germany	3037	Singapore	4489
8	Malaysia	2947	Malaysia	4369
9	Australia	2891	Thailand	4335
10	UK	2741	Australia	4309