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**The Effect of Exchange Rates on Chinese Trade:
A Dual Margin Approach**

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The Effect of Exchange Rates on Chinese Trade: A Dual Margin Approach

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Abstract: Previous studies investigating the effect of exchange rate changes on a country's exports have found little evidence that exchange rates matter. This “Exchange Rate Disconnect Puzzle” may stem from the fact that studies have mostly focused on aggregate data. We analyze the effect of real exchange rate fluctuations of the RMB by decomposing Chinese trade into its “extensive” and “intensive” margins using product-level data. Contrary to recent empirical evidence on the insignificant effects of exchange rate changes on trade, we estimate that real appreciation of the RMB has a significantly negative impact on Chinese exports. We also find that the major channel of effect is via the extensive margin. There is only weak evidence to indicate that imports are affected by exchange rates. With respect to exchange rate volatility, we generally find that it is negatively associated with exports, with no significant effect on imports. There appear to be major differences across China's major and non-major trading partners. Most of the exchange rate effects that we estimate are with China's non-major trading partners.

Keywords: Chinese Trade, Extensive Margin, Intensive Margin, Real Exchange Rate, Volatility

JEL Classifications: F14, F31

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1. Introduction

China's role in world trade has changed significantly since the last two decades. It has more than doubled its share in world trade since early 1990s; a record that no emerging-market economy has accomplished over such a short time horizon. However, China's exporting success and burgeoning current account surplus has been attributed by many to the Chinese authorities' manipulation of their currency.¹ Critics have also argued how this has contributed to the global imbalances and eventually led to the global financial crisis of 2008 (CEA 2009). Many academics and policymakers recommend that China should let their currency appreciate and provide a level playing field for the rest of the world to reduce these imbalances. But how would an appreciation of the renminbi (RMB) affect China's trade balance? Unfortunately, despite the heated discussions in the media and the policy circle, there is no consensus on the relation between exchange rates and trade balances.

The question of how RMB appreciation would impact China's trade is interesting because conventional wisdom does not always apply to the case of Chinese exports and imports. As stated by Freund, Hong, and Wei (2011), the profit margins of Chinese exporters are so large that the exporters can absorb the effect of any real appreciation that may occur. Second, a large proportion of China's exports and imports are in processing trade. This means many final products that are exported by China are assembled with the help of imported input materials. Hence both exports and imports might be less dependent on the RMB exchange rate fluctuations than would be the case in other countries. Third, more than half of Chinese trade is controlled by other multinationals that require significant global sourcing. Thus it may also be less sensitive to China's exchange rate movements. Finally, RMB appreciation might have an indirect effect on Chinese exports through their imports. The appreciation might lead to increased international R&D investment which can create productivity spillovers through import trade and can prompt domestic firms to lift the technical levels of their own products with a higher productivity. Thus, given the high import content of Chinese exports, appreciation of the RMB need not make Chinese exports more expensive to the rest of the world since the effective cost of the imported inputs would also fall. Despite these facts, there is relatively little empirical evidence on how responsive Chinese exports and imports are to currency movements, especially, since the middle of 2005 when China revalued their exchange rate and started allowing a moderate appreciation of the RMB. This paper aims to fill that gap.

Together with the movements in RMB appreciation, we also address the issue of exchange rate uncertainty. Since the breakdown of the Bretton-Woods System of fixed exchange rates, both real and nominal exchange rate volatility have increased sharply. The proponents of managed or fixed exchange rates have argued that this uncertainty is detrimental for trade, since it increases the riskiness of trading through uncertain adjustment costs and negatively affects the optimal allocation of resources and government policies (Cote 1994). A plethora of theoretical and empirical papers have investigated the link between exchange rate uncertainty and international trade flows. However, neither theoretical models nor empirical studies have provided a definitive answer. For example, Perek and Steinherr (1989) report that an increase in exchange rate volatility negatively affects trade; Sercu and Vanhulle (1992) report that it positively affects trade; whereas Viaene and de Vries (1992) and Lin (2012) report no overall effects.²

The conventional wisdom is that a real appreciation of the exchange rate should decrease

¹China's current account surplus reached more than 10 per cent of GDP in 2007, prior to the GFC.

²For other work in this area, see the survey by McKenzie (1999) who investigates the link between exchange rate uncertainty and trade flows and concludes that exchange rate volatility may impact differently on different markets and proposes that further tests using export market specific data be conducted.

exports and increase imports since the relative prices are altered. However, the empirical literature analyzing aggregate trade has generally found insignificant or small effects of exchange rate fluctuations on trade volumes. This insignificant estimates of exchange rate elasticity of net exports is the so-called “Exchange Rate Disconnect Puzzle” (Obstfeld and Rogoff 2000). Some recent studies cast doubt over the conflicting evidence. By focusing on disaggregated data at the firm level, these papers have found that both aggregate and firm level estimates are significantly negative.³ In this paper, we address this issue by decomposing the effects of exchange rate changes on exports and imports for China. The innovation of our paper is to frame the analysis of exchange rates and trade within the theory of dual margins of trade. Recent theoretical literature on trade has emphasized this distinction, as it has different implications for resource allocation and welfare gains.⁴ We investigate the impact of exchange rate fluctuations in levels and volatility on the dual margins of Chinese trade.

There is considerable debate about the roles played by each of the two margins in trade activity. The literature on the role of the dual margins in the growth of trade has reached two opposing conclusions. Some authors conclude that the extensive margin is the primary avenue for export growth. Hummels and Klenow (2005) find that extensive margin accounts for 60% of the exports for larger economies. Similarly, Evenett and Venables (2002) find that the extensive margin contributed significantly in the growth of developing country exports. Others have found the intensive margin to be more influential. Helpman, Melitz and Rubinstein (2008) found that intensive margin plays the dominant role in export growth. Felbermayr and Kohler (2009) reached the conclusion that intensive margin was a more important factor for export growth between 1970 and 1990s. The findings by Amurgo-Pacheco and Pierola (2008) provide mixed evidence. The authors study a sample of developed and developing countries and find that the intensive margin accounts for a greater share of overall trade growth in all regional trade; but for developing countries, the extensive margin is important and geographic diversification is more important than product diversification.

Other studies looking at individual countries or firm-level disaggregated data have also found contrasting evidence. Eaton et al. (2008) find that up to one half of Colombian firms exporting in any given year are new, but most export growth occurs on the intensive margin.⁵ Amiti and Freund (2007) investigate China’s trade growth with HS6 digit product-level data and observe that almost all of the growth is from intensive margin and did not find any significant evidence of the extensive margin. However, Frensch (2010) find robust evidence of stronger extensive margin effects, especially for intermediate and capital goods compared to consumer goods. In another recent study analyzing the effect of exchange rate uncertainty on trade, Lin (2012) has found that both extensive and intensive margins play a role. A reduction in uncertainty affects trade volumes through both these margins in such a way that the overall effect on trade volume becomes insignificant.

There are many factors that can impact the dual margin of trade. The theoretical models of Melitz (2003), Bernard et al. (2003) and Eaton, Kortum & Kramarz (2004) point out that a decline in trade costs can effectively promote the extensive margin while its impact on intensive margin is limited.⁶ However, a recent paper by Besedes and Prusa (2011) provide both theoretical and empirical support in favor of the primacy of the intensive margin. In summary, recent literature has stressed on the importance of the micro-structure of trade and

³See Dekle et al. 2007 for further details.

⁴For recent theoretical literature on trade margins, see Hummels and Klenow (2005), Chaney (2008) and Helpman, Melitz and Rubinstein (2008) among others.

⁵Their finding of new firms exporting small amounts and facing high export failure rates is also similar to the findings of Besedes and Prusa (2011) who found that most export relations are very short lived.

⁶Kang and Lynn (2009) stress on the importance of extensive margin of international trade and believes that the export price index will be underestimated without taking extensive margin into account.

its determinants, but definitive conclusions have yet to be reached. We provide new empirical evidence in support of the dual margin theory of trade using product-level trade data for China.

This study contributes to this debate by providing up-to-date estimates of the effect of real exchange rate movements and its volatility on Chinese trade. Given these contradictory evidences, one might appeal to empirical analysis using disaggregated data to find out which outcome the data would support. Taking account of the greater recent variability of the Chinese real exchange rate, this study analyzes the effect of real RMB movements on Chinese exports and imports. We also advance this analysis by further decomposing the effects of exports and imports into extensive and intensive margins by using disaggregated product level data. We investigate the impact of exchange rate fluctuations in levels and volatility on the dual margins of trade. To capture exchange rate volatility, we use the standard deviation of the monthly exchange rates.⁷ Our study adds to the literature by quantifying the effect of real exchange rate movements and volatility on the dual margins of Chinese trade. This is in line with recent developments in trade theory which have emphasized the “dual margin” framework of trade. The theoretical works by Melitz (2003) and Bernard et al.(2003) show how trade growth is achieved through both intensive and extensive margins.

The main results of the paper can be summarized as follows: Contrary to recent empirical evidence, we find that real exchange rate movements are positively associated with exports and negatively associated with imports. However, we find a significant effect more frequent for exports than imports. We generally find that the volatility of real exchange rate is negatively associated with exports, with no effect on imports. When we decompose exports into the extensive and intensive margins, we find that the main effect of RMB changes take place through the adjustment in the extensive margin. A depreciation of the RMB leads to an increase in the extensive margin of trade. There is, however, some weak evidence that an increase in real exchange rate volatility decreases the intensive margin of exports. Thus, the overall effect on exports is somewhat reduced due to movements in the exchange rate. This result is robust to the treatment of ‘zero’ trade in our sample, an econometric issue of vital importance in this literature. This reinforces the conclusion of some earlier studies, such as Marquez and Schindler (2007), that Chinese exports respond quite strongly to movements in the real exchange rate, and go against studies which find little effect of exchange rate changes on exports. For Chinese imports, we find some evidence that RMB depreciation has a negative effect that adjusts through the intensive margin. We find no evidence that real exchange rate volatility had any effect on imports.

Another important contribution of our paper is to quantify the effects of real exchange rate movements of China by distinguishing between its major and minor trading partners. As suggested by Freund, Hong, and Wei (2011), trade (exports and imports) of China with its trading partners might be less dependent on the real RMB fluctuations than would be the case in other countries. The profit margins of Chinese firms are large enough to absorb the effect of any unfavorable movement in the real exchange rate. Thus, one might expect relatively little effect of RMB changes on trade with major trading partners. Our results suggest that there appears to be major differences between how real exchange rate and its volatility affects trade with major and minor partners. We find that the adjustments in exports and imports happen mostly for minor trading partners of China. There is little evidence that either RMB fluctuations or its volatility affects trade with the major trading partners.

The rest of the paper is organized as follows. The next section provides a theoretical model to explain the link between exchange rate movements and the dual margins of trade. Section 3

⁷Some researchers have used variants of ARCH models as a proxy for exchange rate variability, while very few researchers have also used daily spot exchange rates to compute one-month ahead exchange rate volatility via a method based on Merton, 1980.

describes the data and measurement of the trade margins. Section 4 describes the dynamics of China's trade and the estimation results of overall Chinese trade. Section 5 analyzes the results of real exchange rate movements on the dual margins of trade. Section 6 provides robustness checks. Concluding remarks are offered in Section 7.

2. Theory

The purpose of this section is to present a theoretical framework for understanding how exchange rate uncertainty would affect a firm's decisions of entering the export market. The theoretical model presented is based on the earlier work by Chaney (2008) who present a "gravity model" with differentiated goods that allows for decomposition of trade into extensive and intensive margins. This model is used to motivate the specification of our empirical model. We begin by assuming that every country has $(H + 1)$ sectors; sector 0 provides a single homogeneous product and the other H ($H > 1$) sectors represent a continuum of differentiated products. The representative consumers' utility is given as:

$$U = q_0^{\mu_0} \prod_{h=1}^H \left(\int_{\Omega_h} q_h(\omega)^{\frac{\sigma_h-1}{\sigma_h}} d\omega \right)^{\left[\frac{\sigma_h}{\sigma_h-1} \right] \mu_h} \quad (1)$$

where q_0 is the consumption of product from sector 0, $q_h(\omega)$ is the units of each variety ω of products from sector h , Ω_h is the set of products from sector H , $\sigma_h > 1$ is the elasticity of substitution between two varieties of products h and μ 's are the shares where $\mu_0 + \sum_{h=1}^H \mu_h = 1$.

The product of sector 0 are homogeneous and can be traded freely and ω_h is the real wage rate associated with producing the sector 0 good with one unit of labor in country n . The price equals to 1 in country n . There are two types of trade costs. One takes the form of an "iceberg" variable trade cost where when one unit of good h is transported from country i to country j , only a fraction $\frac{1}{\tau_{ij}^h}$ reaches the destination and the rest "melts" on the way. Thus, the higher τ the higher is the variable trade cost.⁸ In addition, an export firm has to pay a fixed cost α_{ij}^h . The cost of producing q units of a product in country i and selling them in country j for a firm with productivity ψ is

$$c_{ij}^h(q) = \frac{\omega_i \tau_{ij}^h}{\psi} q + \alpha_{ij}^h \quad (2)$$

and ψ is the productivity level which is assumed to be Pareto distributed. Firms are price-setters. Given that demand functions are isoelastic, the optimal price charged in country j by a firm with productivity ψ from country i is a constant mark-up over the unit cost

$$p_{ij}(\psi) = \frac{\sigma_h}{\sigma_h - 1} \omega_i \frac{\tau_{ij}^h}{\psi} \quad (3)$$

Productivity shocks are drawn from a Pareto distribution distributed over $[1, +\infty)$ with shape parameter γ_h according to

$$P(\tilde{\psi}_h < \psi) = G_h(\psi) = 1 - \psi^{-\gamma_h} \quad (4)$$

where $\psi_h > \sigma_h - 1$. The parameter γ_h is an inverse measure of heterogeneity in sector h . Sectors with a high γ are more homogenous, which means outputs are concentrated among the smallest and the least productive firms.

⁸ $\tau_{ij} > 1$ for any $i \neq j$ and $\tau_{ij} = 1$ for $i = j$.

In general equilibrium, total exports X_{ij} in sector h from country i to country j are given by

$$X_{ij}^h(\psi) = \begin{cases} \mu_h \left(\frac{Y_i Y_j}{Y} \right) \left(\frac{\omega_i \tau_{ij}^h}{\theta_j^h} \right)^{-\gamma_h} (\alpha_{ij}^h)^{-\left[\frac{\gamma_h}{(\sigma_h - 1) - 1} \right]} & \text{if } \psi \geq \bar{\psi}_{ij} \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

where μ_h is the consumption share of sector h , Y is the total economic output; ω_i is the wage rate (a measure of workers' productivity); τ_{ij}^h is the variable cost of exports and α_{ij}^h is the fixed cost of exports; θ_j^h is the multilateral resistance, which is a measure of country j 's remoteness from the rest of the world; and $\bar{\psi}_{ij}$ is the productivity threshold.⁹ A necessary condition for a firm to export is that $\psi \geq \bar{\psi}_{ij}$. This provides insight into why some products and countries are not involved in exports.

A country's export can be expressed as the product of the number of export firms N and its export trade volume x ,

$$X_{ij} = x_{ij}^h N_{ij}^h \quad (6)$$

Hummels & Klenow (2005) define dual margin in the following way: the number of export firms is the extensive margin and the export volume of a single firm is the intensive margin. Chaney (2008) derive the export volume of a single firm as:

$$x_{ij}^h(\psi) = \begin{cases} \lambda \left(\frac{Y_j}{Y} \right)^{\frac{\sigma_h - 1}{\gamma_h}} \left(\frac{\theta_j^h}{\omega_i \tau_{ij}^h} \right)^{\sigma_h - 1} \psi^{\sigma_h - 1} & \text{if } \psi \geq \bar{\psi}_{ij} \\ 0 & \text{otherwise} \end{cases} \quad (7)$$

where the threshold

$$\bar{\psi}_{ij} = \eta \left(\frac{Y}{Y_j} \right)^{\frac{1}{\gamma_h}} \left(\frac{\omega_i \tau_{ij}^h}{\theta_j^h} \right) \alpha_{ij}^{\frac{1}{\sigma_h - 1}} \quad (8)$$

Thus, the intensive margin of exports is related to total output, multilateral resistance, wage (productivity) and the variable cost of a firm. The extensive margin is given as:

$$N_{ij} = \frac{X_{ij}^h}{x_{ij}^h} = \left(\frac{\sigma_h}{\sigma_h - 1} \right)^{\sigma_h - 1} \left(\frac{Y_i Y_j}{Y} \right) (\alpha_{ij}^h)^{-\left[\frac{\gamma_h}{\sigma_h - 1} \right]} \left(\frac{\omega_i \tau_{ij}^h}{\theta_j^h} \right)^{\gamma_h} \quad (9)$$

The extensive margin of trade is related to total output, multilateral resistance denoted by remoteness of country j from the rest of the world, workers' productivity, variable costs and fixed trade costs of a firm. Movements in real exchange rate (appreciation of the exchange rate) makes exports more expensive by changing the relative costs of exports to imports. It acts like a variable cost to a firm. However, real exchange rate volatility is an uncertainty faced by the firms. It acts as a burden by increasing the fixed costs since planning for the future becomes more difficult. Thus, both these variables are proxies for overall trade costs and will affect the extensive margins of trade. This model is the basis of our empirical gravity specification in the empirical section.

3. Data Description and Measurement of Variables

Our analysis uses data that cover Chinese exports and imports from 1992 to 2012 involving 165 countries. Our range of counties and the sample period are determined by the availability of the disaggregated trade data used to measure the dual margins of trade. We describe the data and construction of the variables below.

⁹Here, θ_j^h is similar to the multilateral resistance variable of Anderson & Eric Van Wincoop (2003).

3.1. Measurement of Extensive and Intensive Margins

To construct the extensive and intensive margins of trade, we use data from the UN COMTRADE database at the Harmonized System 6-digit (HS6) level of disaggregation, which has a total of 5017 product categories or lines.¹⁰ Most countries in the world have adopted the Harmonized System (HS) which is a six-digit classification of traded goods. Each country can, however, provide additional detail at eight- or ten-digit product level classification if they decide to. For China, the maximum level of disaggregation available in the UN COMTRADE database is at the six-digit level.

We create measures of extensive and intensive margins of trade based on the recent literature. Helpman et al. (2008) and Lawless (2010) define extensive margin of exports as the number of export firms, and intensive margin as the average export volume of a single firm. We use a similar classification for the dual margins of imports. Felbermayr and Kohler (2006) believe that extensive margin is the number of countries that establish bilateral relationship and intensive margin is the average trade volume of countries with existing partnership. We construct the measures of the bilateral extensive and intensive margins of trade based on Hummels and Klenow (2005) and Feenstra and Kee (2008).¹¹ We define the “extensive margin” as the weighted count of the sectors in which China exports to the importer in a given year. The weights correspond to the importance of the exported sectors in the total exports from China to the importer in a given year.¹² More precisely, the extensive margin of exports from China to country j in period t , denoted by EM_{jt} , is defined as:

$$EM_{jt} = \frac{\sum_{s_{jt}} X_{kjt}^s}{\sum_s X_{kjt}^s} \quad (10)$$

where k is the rest of the world (all importers excluding importer j). S_{jt} is set of products which China exports to country j in year t , $\sum_{s_{jt}} X_{kjt}^s$ is the total value of exports from the rest of the world to country j in the products that China exports to country j and $\sum_s X_{kjt}^s$ is the total value of exports from the rest of the world to country j in all products. In other words, the EM uses trade from the rest of the world to country m to measure the relative importance of the products that China exports to country m .

The “intensive margin” consists of the ratio of the value of goods that China exports to country m over the value of goods that the rest of the world exports to China in those products that China exports to country m . The intensive margin is defined as:

$$IM_{jt} = \frac{\sum_{s_{jt}} X_{jt}^s}{\sum_{s_{jt}} X_{kjt}^s} \quad (11)$$

where $\sum_{s_{jt}} X_{jt}^s$ is the total value of exports from China to country j . In other words, looking

¹⁰Adding all other explanatory variables, the sample reduces to 165 countries.

¹¹Feenstra (1994) and Feenstra & Kee (2004) provides micro-foundations of the construction of these indices. The measure of dual margins based on Hummels and Klenow (2005) have been followed by many studies like Lin (2012) and Dutt et al. (2013).

¹²There are multiple ways of defining the extensive margins of exports. As alternatives, some authors have defined extensive margins as counting the number of categories exported, counting categories over a certain size, or weighting categories in different ways.

just at the products that China exports to country m , IM measures what share of those goods does country m receive from China compared to from the rest of the world.

The above definitions of the extensive and intensive margins imply the following: First, when a country imports all the products from China which are imported by the rest of the world, the extensive margin of Chinese exports for that country should be 1; otherwise less than 1. Second, when a country imports a new product from China, its extensive margin increases; it does not affect the extensive margin of the other country. Third, when a country imports more of the same product from China, both extensive and intensive margins of Chinese exports to that country is affected.¹³

As defined by Hummels and Klenow (2005), the product of the two margins give us the share of country m 's imports received from China compared to the total value of imports it receives from the rest of the world. Thus, X_{jt} , the exports share of China to country j in year t is given as:

$$X_{jt} = EM_{jt} * IM_{jt} = \frac{\sum_{s_{jt}} X_{jt}^s}{\sum_s X_{kjt}^s} \quad (12)$$

3.2. Independent Variables

3.2.1. Real Exchange Rate and Exchange Rate Volatility

Our main variables of interest are the real exchange rate and the volatility of real exchange rate. The real exchange rate between China and its trading partner j at time t is defined as:

$$RER_{jt} = \frac{E_{jt}P_{jt}}{P_t}, \quad (13)$$

where E_{jt} is the nominal exchange rate between China and country j in year t defined as domestic currency per units of foreign currency, P_{jt} is the Consumer Price Index (CPI) of country j in year t and P_t is the CPI of China in year t . As suggested by the gravity model, we use the logarithm of RER in our regressions.

The real exchange rate volatility between China and its trading partner j in year t is measured as the standard deviation of the first difference of the logarithm of the quarterly real exchange rate between the two countries:

$$RERVOL_{jt} = stdev [\ln (RER_{jt,s}) - (RER_{jt,s-1})], s = 1, \dots, 4 \quad (14)$$

Quarterly exchange rate and CPI data were obtained from the IMF's International Financial Statistics (IFS).

3.2.2. Gravity Variables

We control for other factors that can facilitate or hamper trade between two nations in our regression specifications. We use traditional gravity variables such as country size, geographic distance, market access, common language and common border. To control for country size we use real GDP, measured as the logarithm of GDP in constant (2005) US dollars, data for which are obtained from the World Development Indicators. Geographic distance is measured as the logarithm of the distance (in kilometers) between the two most populous cities of China and the trading partner. To capture preferential market access, we look at trade liberalization under GATT/WTO. We construct a dummy variable which takes the value 1 if both trading

¹³The extensive margin of exports to any country should lie between 0 and 1, both inclusive. The lower bound of the intensive margin is zero, but it can be greater than 1.

partners are members of the GATT/WTO and 0 otherwise. Since China became a member of WTO in December 2001, this variable will always take a value of 0 before 2002. Data on dates of accession to the GATT/WTO are from the WTO website. Common language is captured by a dummy variable that equals one if a country shares a common official language with China and common border is measured as a dummy variable that takes the value 1 if a country shares a common border with China.

4. Exchange Rate Movements and Chinese Trade

We start by looking at the dynamics of China's exports, imports and real exchange rate. The evolution of the exports and imports for China over time are shown in Figure 1. It shows that both exports and imports of China has been steadily increasing over time, with a slight dip during the global financial crisis. It's exports have increased from 84.9 billion USD (2.22% of world exports) in 1992 to over 2 trillion USD (11.1% of world exports) in 2012. Similarly, China's imports have increased from 80.6 billion USD (2% of world imports) in 1992 to over 1.8 trillion USD (9.77% of world imports) in 2012.¹⁴ Figure 1 also plots the time-series of China's average real exchange rate (RER) across its trading partners for the period 1992 to 2012. We see that, on average, the RER has been appreciating when China allowed the RMB to be fully convertible for trade purposes since 1996; it had a brief period of depreciation during early 2000; and as China started to relax its capital controls gradually after joining the World Trade Organization in 2001, the currency had slowly but steadily appreciated since then.

Figure 1: Time-Series of China's RER, Exports and Imports: 1992-2012

¹⁴These figures are based on data from World Bank's World Development Indicators.

Our first task is to examine whether China’s exchange rate policy had any impact on its overall trade. To do so, we run gravity models to separately test for the impact of real RMB changes and its volatility on China’s exports and imports. One issue with estimating the impacts on trade is the distribution of the values of exports and imports. We will have several observations for exports and imports that take the value “zero” or are very close to zero. Figure 2 plots the distribution of exports (top panel) and imports (bottom panel) with their logarithmic values. As is evident from the graphs, the logarithm of the exports and imports better fit the distribution of the variables. Hence we prefer a logarithmic specification in the gravity model.

Figure 2: Distribution of Exports and Imports

4.1. Results from Export Regressions

Table 1 report the results of the gravity model for Chinese exports. Our key variables of interest are the changes in the real exchange rate and the volatility of the real exchange rate. We examine the effect of these variables by estimating different specifications of the gravity model. Column 1 present results from a random effects specification and column 2 presents a random effects model with time dummies. In columns 3 and 4, we run two specifications of correlated random effects model, a novel feature in this literature. The correlated random effects model produces the same output as fixed effects, but also allows one to include variables that do not change over time to compare their estimates. This allows one to do more carefully analysis and determine if the results are consistent with the previous literature. In column 5, we run a fixed effect specification with country-year fixed effects.

Across all the specifications we find that the coefficient on the log RER is positive and highly significant. As one would expect, an increase in RER (a real depreciation of the RMB) leads

Table 1: Export Regressions

	RE	RE	CRE	CRE	FE
	(1)	(2)	(3)	(4)	(5)
LOG (RGDP)	1.2057*** [0.087]	0.6520*** [0.060]	3.3132*** [0.477]	1.0703*** [0.283]	1.5568** [0.761]
LOG (DISTANCE)	-0.4442 [0.447]	-1.0772*** [0.280]	-0.7056*** [0.216]	-0.5024*** [0.187]	
GATT.WTO	1.6992*** [0.068]	-0.2713** [0.108]	0.9531*** [0.179]	-0.2322** [0.118]	0.1377** [0.062]
LANGUAGE	3.4839*** [0.932]	3.1761*** [1.188]	2.0001** [0.984]	2.2624** [0.961]	
BORDER	-1.7053** [0.845]	-1.5293*** [0.547]	-0.5972 [0.419]	-0.2737 [0.367]	
LOG (RER)	0.4708*** [0.116]	0.2945*** [0.092]	0.1456** [0.059]	0.1508** [0.076]	0.1800* [0.094]
LOG (RERVOL)	-0.1109*** [0.025]	-0.0512** [0.023]	-0.0303 [0.027]	-0.0479** [0.023]	0.0154 [0.015]
CONSTANT	-8.9419* [5.014]	14.0077*** [3.468]	4.5164* [2.677]	-15.8852 [12.519]	-338.9544*** [40.889]
Observations	2,647	2,647	2,647	2,647	2,647
R-squared	0.5165	0.6272	0.7379	0.7972	0.8971
Year Effects	No	Yes	No	Yes	
Country-Year Effects	No	No	No	No	Yes
Number of Partners	155	155	155	155	155

Note: The dependent variable is $\ln(\text{exports})$ for all the regressions. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

to an increase in Chinese exports. Even though this result is intuitive, many previous studies had failed to document it. We also find some evidence that the volatility of real exchange rate negatively affects Chinese exports. This suggests that real exchange rate uncertainty is a significant determinant of Chinese exports. Our gravity variables have the expected signs. The log of real GDP is positive and significant and log of distance is negatively correlated with exports. When both China and the importing country are a member of GATT-WTO, the export shares increase significantly. However, this finding is not robust to all the specifications. We find that countries sharing a common language with China significantly boosts exports. We did not find any evidence that sharing a common border with China had any significantly positive impact on overall Chinese exports to that country.

We run tests to compare the different specifications in Table 1. The results clearly reject the random effects specification in favor of the fixed effects one. Moreover, comparing the R-squared across the different models, the fixed effect estimates are clearly to be preferred vis-a-vis the random effects estimates. Thus, considering the correlated random effects model with time dummies and the fixed effects model to be our best specifications, we find that the elasticity of real RER changes to exports is positive. A 1 percent depreciation of the RMB leads to around 0.15 to 0.18 percent increase in the exports for China. This result is robust and significant across all the models. Similarly, the correlated random effects model shows that a 1 percent increase in the exchange rate uncertainty leads to a 0.48 percent decrease in Chinese exports. This results is, however, not significant for the fixed effects specification.

4.2. Results from Import Regressions

In table 2, we report results for the gravity model for Chinese imports. As in the case for exports, we have five different specifications for the import regressions. Columns 1 and 2 report the results of random effects models without and with time dummies; columns 3 and 4 report results of correlated random effects without and with time dummies; and column 5 is the fixed effects specification.

The general conclusion from the import regressions is as follows: Real RMB depreciation has no significant effect on Chinese imports. The results from the correlated random effect and fixed effect specifications show that the effects are negative, but insignificant. The results from the random effects specifications show that this effect is positive and significant, but when we compare the test results of the different models, the random effects specification turns out to be the worst model. Hence we do not trust the results of the random effects specifications. The estimates of real exchange rate volatility show that it has no significant effect on Chinese imports. Overall, the results from the different specifications indicate that there is not much evidence that either RER or its volatility affect Chinese imports.

5. Exchange Rate Movements and the Dual Margins of Trade

In the previous section, we find that RER has a significant effect on Chinese exports, and insignificant effect on Chinese imports. We now proceed to check which of the two margins of exports - extensive or intensive - are more affected by RER and its volatility. Does the impact of RER on export occur through both the channels? We also investigate whether the insignificant effect on imports are due to the opposing effects of the extensive and intensive margins of imports. Prior research on the effect on the dual margins of trade have provided contradictory evidences.

Figure 3 plots the extensive and intensive margins of Chinese exports over time. As is evident from the graph, liberalization of trade in China has led to increase in exports along both the margins. Moreover, since China's access into GATT-WTO, the extensive margin of trade have increased rapidly compared to the intensive margin.

Table 2: Import Regressions

	RE	RE	CRE	CRE	FE
	(1)	(2)	(3)	(4)	(5)
LOG (RGDP)	1.3288*** [0.126]	0.8543*** [0.097]	3.7391*** [0.432]	1.7514*** [0.424]	1.8219*** [0.647]
LOG (DISTANCE)	-1.3351** [0.669]	-1.8830*** [0.558]	-1.2515*** [0.447]	-0.8990** [0.388]	
GATT.WTO	1.9010*** [0.125]	-0.3742 [0.254]	1.0562*** [0.175]	-0.2973 [0.291]	0.4373*** [0.111]
LANGUAGE	3.9245*** [1.389]	3.7373** [1.661]	2.5277* [1.359]	2.2634* [1.332]	
BORDER	-2.3630** [1.183]	-2.2202** [1.083]	-0.9178 [0.884]	-0.0448 [0.721]	
LOG (RER)	0.4034*** [0.138]	0.2975** [0.120]	-0.0914* [0.055]	-0.0919 [0.059]	-0.0699 [0.078]
LOG (RERVOL)	-0.0936** [0.047]	0.0368 [0.050]	-0.0054 [0.046]	0.0357 [0.050]	0.0573 [0.039]
CONSTANT	-6.1210 [7.663]	14.6334** [6.285]	2.8491 [5.116]	-62.4856*** [9.279]	-329.1246*** [38.947]
Observations	2,568	2,568	2,568	2,568	2,568
R-squared	0.4096	0.4525	0.6003	0.6763	0.7059
Year Effects	No	Yes	No	Yes	
Country-Year Effects	No	No	No	No	Yes
Number of Partners	155	155	155	155	155

Note: The dependent variable is $\ln$ (imports) for all the regressions. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

Figure 3: Extensive and Intensive Margins of Exports

Figure 4 presents the extensive and intensive margins of Chinese imports for the same time period. The graph shows that the extensive margin of Chinese imports have been steady during early 1990s, but started to increase rapidly since the later part of that decade. On the contrary, intensive margin of imports was quite volatile during early 1990s, and it started to decrease gradually since then.

5.1. Model Specification

Our theoretical model predicts that the extensive and intensive margins of trade are a product of terms involving the variables in the gravity model (see equations 7 and 9). This leads us to the question of whether logging the dependent variable and using ordinary least squares (OLS), a common approach taken in the literature, is the appropriate method of estimation under these circumstances.¹⁵ Earlier work by Silva and Tenreyro (2006) and Tenreyro (2007) have shown that under heteroskedasticity, the parameters of log-linearized models estimated by OLS lead to biased estimates of the true elasticities. In the simplest form, the gravity equations for the extensive and intensive margins derived from the theoretical model states that the dual margins are proportional to the two country's GDP, inversely proportional to their distance, and related to the other factors that might hamper or promote trade. The standard practice is to log-linearize the model and estimate the parameters by OLS. There are two main problems with this procedure. First, it is unlikely that the variance of the error term will be independent of the country's GDP or measure of distance, i.e. the error term will not likely be homoskedastic. Whenever the variance of the error term depends on the regressors, the expected value of the

¹⁵See for example the work by Bergin and Lin (2008) and Lin (2012).

Figure 4: Extensive and Intensive Margins of Imports

logarithm of the variable also depend on the regressors violating the consistency of the OLS. Second, due to the presence of ‘zero’ trade, particularly at the HS6-digit product level, there is a loss of observations with logarithmic transformation giving rise to ‘sample selection bias’. In our estimation procedure, we address both these concerns.

Figures 5 and 6 plot the histograms for the extensive and intensive margins for exports and imports respectively. The left panels of figures 5 and 6 plot the distribution of the actual values of the dual margins, whereas the right panels plot the distribution of their logged values. The figures confirm that the logarithm of the dual margins of exports and imports (particularly the extensive margin of exports and imports), does not follow a normal distribution. Thus, due to the reasons discussed above, we estimate the untransformed values of the extensive and intensive margins of trade using Poisson regressions. However, as we shall see below, the introduction of country-specific time trends causes problems of convergence in the estimation of some models. Hence we also estimate the logged model with transformed values of the dual margins when the Poisson model with country-specific time trends does not converge.¹⁶

Our preferred model is the Poisson specification with country-specific time trends when we can estimate it. However, when we can’t due to convergence issues, we will report the Poisson regressions with time dummies. In addition, for the intensive margins (but not for the extensive margins), we also report OLS estimates using the logged values with country-specific time trends. We report this specification since the logged transformed values of the intensive

¹⁶There is another caveat. The logged extensive margin values are censored above at 0. This will cause a problem for us because the obvious solution, Tobit, cannot incorporate fixed effects. Hence we do not run this specification.

Figure 5: Distribution of Dual Margins of Exports

margins of exports (see figure 5) satisfy the normality conditions. Hence, we feel comfortable using OLS to estimate this specification.

We report three different specifications using Poisson and OLS regressions. Poisson is theoretically desirable and matches the data, but does not allow country-specific time trends. On the other hand, OLS with logged values allows country-specific time trends, but is econometrically less desirable than the Poisson.

5.2. Results for the Extensive and Intensive Margins of Exports

The results from estimating gravity specifications for the extensive and intensive margins of exports are reported in Table 3. Column 1 report the estimation results for the extensive margin of exports using a Poisson model with country-specific time trends. We find that RER affects the extensive margin of exports in the expected direction. The sign of RER is positive and highly significant. This implies that a real depreciation of the exchange rate leads to a positive and significant effect on the extensive margin of exports. Consistent with the theory, we do find that the extensive margin, i.e. the entry and exit decisions of the firms in a product or a country market, is affected by the movements in the RER. Exporting firms perceive RER movements to be significant costs which determine their entry and exit decisions at the margin. We also find strong evidence that RER volatility affects the extensive margin of exports. The signs of other gravity variables like GDP and GATT-WTO are as expected. They are positive and highly statistically significant.

Columns 2 and 3 report results for the intensive margin of exports. We find that real exchange rate negatively affects the intensive margin. But this result is not statistically significant. This implies that for firms already in business, exchange rate changes do not significantly

Table 3: Extensive and Intensive Margins of Exports

	EM	IM	IM
	(Poisson)	(Poisson)	(OLS)
LOG (RGDP)	0.5034*** [0.093]	-0.1686 [0.414]	0.0936 [0.301]
RGDP_SHARE	-2.6223*** [0.284]	-3.8144 [4.886]	
LOG (RGDP_SHARE)			0.3733 [0.398]
GATT_WTO	0.0605*** [0.018]	0.0648 [0.069]	0.0628* [0.035]
RER	0.0200** [0.008]	-0.0078 [0.017]	
RERVOL	-0.2992*** [0.072]	-0.6562* [0.336]	
LOG (RER)			-0.0177 [0.035]
LOG (RERVOL)			0.0178* [0.010]
Observations	2,239	2,239	2,241
R-squared			0.7101
Year Effects		Yes	
Country-Year Effects	Yes		Yes
Number of Partners	153	153	155

Note: The dependent variable is $\ln(\text{IM})$ for the OLS specification. All regressions include a constant. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

Figure 6: Distribution of Dual Margins of Imports

affect their export decisions. However, there is some mixed evidence that RER volatility is negatively associated with the intensive margin of exports. This would suggest that exchange rate uncertainty does affect the decisions of the exporting firms already in business. However, this result is not robust to the logged specification.

Thus, we find that the effect of real exchange rate changes on exports primarily occurs through the extensive margin. We also find some evidence that the volatility of real exchange rate affects its intensive margin.

5.3. Results for the Extensive and Intensive Margins of Imports

Table 4 present results from the estimation of dual margins of imports. Column 1 present results from the regression of the extensive margins using a Poisson specification, and columns 2 and 3 report the results of the intensive margins using Poisson and OLS models. From column 1, we do not find any evidence that RER or RER volatility affect the extensive margin of imports. From the Poisson specification in column 2, we do not find any evidence that RER affects the intensive margin of imports. The OLS specification in column 3 finds a negative and statistically significant effect of RER changes on the intensive margin. This suggests that a depreciation of the RER decreases imports as predicted by the theory. This affect takes place mainly through the intensive margin. Existing firms import less when the cost of imports go up due to a depreciation of the RMB. However, there is no effect of real exchange rate volatility on the intensive margin in either models.

6. Robustness Analysis

In this section, we perform some additional robustness checks for our dual margin analysis.

Table 4: Extensive and Intensive Margins of Imports

	EM	IM	IM
	(Poisson)	(Poisson)	(OLS)
LOG (RGDP)	0.5869** [0.273]	1.1418*** [0.439]	0.4194 [0.650]
RGDP_SHARE	16.1180*** [4.751]	-14.7146* [8.253]	
LOG (RGDP_SHARE)			1.6818 [1.034]
GATT_WTO	-0.2040 [0.131]	0.3549 [0.293]	-0.1132 [0.134]
RER	0.0137 [0.020]	-0.0622 [0.039]	
RERVOL	0.0394 [0.169]	0.5840 [0.803]	
LOG (RER)			-0.3328*** [0.105]
LOG (RERVOL)			-0.0323 [0.032]
Observations	2,769	2,769	2,769
R-squared			0.2939
Year Effects		Yes	
Country-Year Effects	Yes		Yes
Number of Partners	165	165	165

Note: The dependent variable is $\ln(\text{IM})$ for the OLS specification. All regressions include a constant. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

6.1. Selection Bias

There are several issues with “missing” observations or “zero” trade and the estimation procedures used should address that. As discussed earlier, several authors including Silva and Tenreyro (2006), Tenreyro (2007) and Helpman et al. (2008) have criticized the traditional gravity model that include only those observations where we can observe positive bilateral trade. Excluding the zeros while using the logged dependent variable creates a sample selection bias for the OLS estimates. This problem is particularly severe when we estimate the extensive and intensive margins of trade where the proportion of zero values in the sample can be quite high. Thus, we re-estimate our specifications using the Poisson model by including ‘zero’ trade values in our model.

Table 5 report the results of the extensive and intensive margins of exports. Columns 1 and 2 present results for the extensive and intensive margins of exports respectively with Poisson specifications. Column 3 report results of the intensive margin with OLS specifications. The effect of RER on the extensive margin of exports are positive and highly statistically significant. This result provides support to our earlier claim that RER affects exports through the extensive margin. The coefficient of RER is 0.039, which is slightly higher in magnitude to our earlier estimate of 0.020. We do not find any support of RER affecting exports through the intensive margin. This result is also in line with our previous claim. The effect of RER volatility on the extensive and intensive margins of exports is interesting. We find RER volatility negatively affects both the extensive and intensive margins of exports. This supports the argument that exchange rate uncertainty is an additional cost for the exporters. An increase in the uncertainty leads to a decrease in exports for the exporting firms. We do not report the results for the imports since adding ‘zeros’ did not add additional observations for the import specification.

Thus we do not find that adding ‘zeros’ affect the basic result from our earlier specifications that RER is positively and significantly related to the extensive margins of trade. Accounting for the zeros strengthens the result that RER volatility is negatively associated with the intensive margin of exports.

6.2. Major versus Minor Trading Partners of China

We want to understand whether the effects of RER and its volatility is similar across all trading partners of China. To analyze that, we decompose the effects of these changes between China’s major and minor trading partners. Table 6 below report the top 10 trading partners of China for four different time periods during 1992 - 2012. We find that there is a lot of stability over time in China’s largest trading partners. The top 10 trading partners account for between 75% and 90% of China’s total exports and imports during this period.

We divide the sample between China’s “major” trading partners and “minor” trading partners to see whether the effect of RER changes are similar across the two groups of countries. Our classification of major trading partner is defined as the any country that appears in the list of top 10 trading partners in the sample period. This leaves us with a list of 18 major trading countries for China.

We follow the same methodology as earlier to determine whether the effect of RER and its volatility on exports and imports occur through the intensive or the extensive margins. Table 7 report results for China’s major export partners. Column 1 report results for overall exports using a fixed effect specification. Columns 2 and 3 present results of the extensive and intensive margins of exports respectively using Poisson specifications. Across all the models we do not find any evidence that RER significantly affects exports or the dual margins of exports. We find that RER volatility affects the intensive margin of exports negatively, but this effect is not consistent across both the specifications. Thus, it seems like RER changes or volatility does not matter for exporters trading with the major trading partners. Exports to these countries

Table 5: Dual Margins of Exports with Zero Trade

	EM	IM	IM
	(Poisson)	(Poisson)	(OLS)
LOG (RGDP)	-0.1342 [0.270]	-0.0724 [0.531]	-0.0458 [0.050]
RGDP_SHARE	19.4749*** [4.750]	-6.9368 [7.468]	
LOG (RGDP_SHARE)			-0.0523 [0.049]
GATT_WTO	-0.3116*** [0.094]	-0.1553 [0.137]	0.0065 [0.007]
RER	0.0389*** [0.008]	-0.0089 [0.017]	
RERVOL	-0.4909** [0.249]	-1.2100** [0.601]	
LOG (RER)			0.0034 [0.004]
LOG (RERVOL)			-0.0014 [0.002]
Observations	2,646	2,646	2,769
R-squared			0.455
Year Effects		Yes	
Country-Year Effects	Yes		Yes
Number of Partners	155	155	165

Note: The dependent variable is $\ln(\text{IM})$ for the OLS specification. All regressions include a constant. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

Table 6: China's Top 10 Trading Partners: 1992-2012

EXPORTS							
1995		2001		2005		2011	
Country	Amount	Country	Amount	Country	Amount	Country	Amount
Hong Kong	36004	USA	54395	USA	163348	USA	324856
Japan	28466	Hong Kong	46503	Hong Kong	124505	Hong Kong	267516
USA	24744	Japan	45078	Japan	84097	Japan	147290
Korea	6688	Korea	12544	Korea	35117	Korea	82925
Germany	5672	Germany	9759	Germany	32537	Germany	76433
Singapore	3500	Netherlands	7294	Netherlands	25876	Netherlands	59482
Netherlands	3233	UK	6786	UK	18983	India	50489
UK	2791	Singapore	5795	Singapore	16716	UK	44113
Italy	2067	Italy	4005	Russia	13211	Russia	38886
France	1844	France	3706	France	11701	Singapore	35297

IMPORTS							
1995		2001		2005		2011	
Country	Amount	Country	Amount	Country	Amount	Country	Amount
Japan	29007	Japan	42810	Japan	100468	Japan	194410
USA	16123	USA	26221	Korea	76874	Korea	161673
Korea	10288	Korea	23396	USA	48995	USA	119164
Hong Kong	8599	Germany	13695	Germany	30668	Germany	92759
Germany	8035	Hong Kong	9424	Malaysia	20108	Australia	80930
Russia	3799	Russia	7959	Singapore	16531	Malaysia	62017
Singapore	3398	Malaysia	6206	Australia	16147	Brazil	52649
Italy	3116	Australia	5430	Russia	15886	Saudi Arabia	49545
Canada	2681	Singapore	5143	Thailand	13994	Russia	39043
France	2649	Thailand	4713	Philippines	12870	Thailand	39040

Note: All amounts are in millions USD.

Table 7: Major Export Partners of China

	Exports	EM	IM
	(FE)	(Poisson)	(Poisson)
LOG (RGDP)	3.5293*** [0.644]	0.2513 [0.176]	0.0383 [0.269]
RGDP_SHARE		-0.9632*** [0.187]	-2.1040*** [0.413]
GATT_WTO	0.1904*** [0.051]	-0.0085 [0.015]	0.0986* [0.055]
RER		-0.0008 [0.006]	0.0236 [0.025]
RERVOL		-0.2166** [0.096]	0.0020 [0.162]
LOG (RER)	-0.0262 [0.060]		
LOG (RERVOL)	-0.0015 [0.020]		
Observations	356	347	347
R-squared	0.973		
Country-Year Effects	Yes	Yes	Yes
Number of Partners	18	18	18

Note: The dependent variable is $\ln$ (exports) for the FE specification. All regressions include a constant. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

are very stable. One explanation for this could be that China's RER against the major trading partner has been very stable over this time period.

We find similar results for the import regressions with the major trading partners. Results from Table 8 suggest that RER has no effect on Chinese imports or the extensive and intensive margins of the same. Similarly, RER volatility does not have any affect on the extensive and intensive margins of imports.¹⁷

The results of minor trading partners are reported in Tables 9 and 10. In Table 9, we present the results for Chinese exports with its minor trading partners. Our sample consists of 137 countries. In column 1, we present the results of overall exports. We do find that RER had a significant positive effect on exports to minor trading partners. However, similar to our earlier finding for the pooled sample, we do not find any evidence of RER volatility affecting overall exports. The results for extensive and intensive margins of exports are reported in the next 3 columns. There is a strong evidence that RER positively affects the extensive margin of exports, a result that has consistently been established earlier. There is also some evidence that RER affects the intensive margin of exports, but this effect is not significant. RER volatility is

¹⁷We run a total of 12 different specifications of export, import and the dual margin regressions, but report the best specifications based on our earlier discussion to conserve space. The results are robust across all the specifications. The coefficients of RER and its volatility are always insignificant, except for the extensive margin of import regressions. These results are available upon request.

Table 8: Major Import Partners of China

	Exports	EM	IM
	(FE)	(Poisson)	(Poisson)
LOG (RGDP)	0.0271 [0.892]	0.2288 [0.192]	-0.6057 [0.369]
RGDP_SHARE		-1.4537*** [0.306]	0.0147 [0.469]
GATT_WTO	0.2627*** [0.072]	0.0414*** [0.014]	0.0159 [0.047]
RER		-0.0142 [0.009]	0.0258 [0.024]
RERVOL		-0.0489 [0.130]	-0.2353 [0.191]
LOG (RER)	-0.0004 [0.078]		
LOG (RERVOL)	-0.0023 [0.015]		
Observations	356	356	356
R-squared	0.955		
Country-Year Effects	Yes	Yes	Yes
Number of Partners	18	18	18

Note: The dependent variable is $\ln$ (imports) for the FE specification. All regressions include a constant. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

Table 9: Minor Export Partners of China

	Exports	EM	IM	IM
	(OLS)	(Poisson)	(Poisson)	(OLS)
LOG (RGDP)	1.4015*	-0.1225	-0.2346	0.0350
	[0.773]	[0.172]	[0.429]	[0.332]
RGDP_SHARE		13.0966***	-4.0412	
		[2.882]	[5.688]	
LOG (RGDP_SHARE)				0.7065
				[0.469]
GATT_WTO	0.1173	-0.0517	0.0755	0.0367
	[0.072]	[0.060]	[0.068]	[0.041]
RER		0.0345***	-0.0094	
		[0.007]	[0.019]	
RERVOL		-0.1628*	-0.7565**	
		[0.098]	[0.373]	
LOG (RER)	0.2675**			-0.0027
	[0.118]			[0.053]
LOG (RERVOL)	0.0173			0.0248**
	[0.017]			[0.012]
Observations	2,291	1,892	1,892	1,894
R-squared	0.891			0.667
Year Effects		Yes	Yes	
Country-Year Effects	Yes			Yes
Number of Partners	137	135	135	137

Note: The dependent variables are logged for the OLS specifications. All regressions include a constant. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

found to significantly affect both the margins of exports in a negative way. This implies that an increase in real exchange rate volatility will dampen exports along both the margins. It acts like an entry-cost for new exporting firms, as well as an “uncertainty cost” for existing exporters. This result is consistent with what the theory would predict.

The results for the overall imports and import dual margins are interesting. Table 10 report these results. In column 1, we do not find that RER or its volatility has any significant impact on Chinese imports from its minor trading partners. This is consistent with the earlier results for the overall sample. Similarly, we do not find any statistically significant effect of RER and RER volatility affecting the dual margins of imports.

Overall, segregating China’s major and minor trading partners, we find that the effects of RER and its volatility on either the exports or imports and their associated dual margins are primarily driven by the sample of minor trading partners. RER and RER volatility does not seem to have any significant effect on the major trading partners for China, either in exports or in imports.

Table 10: Minor Import Partners of China

	Exports	EM	IM	IM
	(OLS)	(Poisson)	(Poisson)	(OLS)
LOG (RGDP)	1.9569*** [0.677]	0.6606* [0.401]	1.2455** [0.577]	0.5332 [0.673]
RGDP_SHARE		14.4500*** [5.033]	-8.9919 [13.808]	
LOG (RGDP_SHARE)	-4.6468*** [0.935]			1.8595 [1.202]
GATT_WTO	0.4774*** [0.131]	-0.2133* [0.111]	0.3019 [0.410]	-0.1220 [0.158]
RER		0.0024 [0.025]	-0.0417 [0.043]	
RERVOL		0.1781 [0.171]	0.5087 [0.850]	
LOG (RER)	-0.1002 [0.108]			-0.4597*** [0.114]
LOG (RERVOL)	0.0702 [0.047]			-0.0312 [0.038]
Observations	2,212	2,413	2,413	2,413
R-squared	0.693			0.292
Year Effects		Yes	Yes	
Country-Year Effects	Yes			Yes
Number of Partners	137	147	147	147

Note: The dependent variables are logged for the OLS specifications. All regressions include a constant. Standard errors are in parentheses. ***, ** and * represent statistical significance at 1%, 5% and 10% levels respectively.

7. Conclusion

The issue of Chinese exchange rate fluctuations and how it affects its trade balance has been a hot topic for discussion over the last decade. Previous studies investigating the effect of exchange rate changes on a country's trade have found very little evidence of the same. This "Exchange Rate Disconnect Puzzle" stems from the fact that studies have mostly focused on aggregate data. In this paper, we analyze the effect of real exchange rate fluctuations of China by decomposing Chinese trade into the extensive and intensive margins. We measure exchange rate fluctuations by focusing on the changes in the bilateral real exchange rates as well as the volatility of the real exchange rates. Contrary to the recent empirical evidence on the insignificant effects of exchange rate changes on export volumes, we find that the real depreciation of RMB has a significantly positive impact on overall Chinese exports. When we decompose exports into the extensive and intensive margins, we find that the changes takes place through the extensive margin of exports. This implies that Chinese exporters perceive real exchange rate changes as real costs of trade. A real appreciation of RMB is a significant determinant of the entry or exit decisions of new firms in the market or of new products at the margin. In other words, we do find extensive margin to be important for Chinese exports. This reinforces the conclusion of some earlier studies, such as Marquez and Schindler (2007), which found that Chinese exports respond quite strongly to movements in the real exchange rate, and go against studies which find little effect of exchange rate changes on exports. Our study goes beyond some of the previous studies to quantify the channel of exports.

We also find some evidence that real exchange rate changes are negatively associated with imports. While this effect is not robust to the different specifications, we lend some support to the theory of exchange rate changes on trade. We, however, find a significant effect more frequently for exports than imports. This effect is not surprising given that a large amount of Chinese imports are processing goods. The effect of real exchange rate volatility on trade is found to be mixed. We generally find that RER volatility is negatively associated with exports, with no significant effect on imports.

Our econometric specification takes into account the problems associated with estimating gravity models of trade where we have a large proportion of observations to be zero or close to zero. We argue that studies that use logarithm of trade as the dependent variable in their gravity and estimate via OLS run are biased and inconsistent. To account for these problems, we use Poisson regressions. However, for the sake of comparison and when Poisson model is not suitable, we report the OLS estimates. We also address for sample selection bias by allowing for "zeros" in our sample. This does not affect our main results.

Finally, we analyze whether the effects of real exchange rate and its volatility as similar across the different trading partners of China. To study this, we divide our sample into the major and other trading partners of China. There appear to be major differences between how RER and RER volatility affects trade with major and minor trading partners. We find little evidence that either affects trade with major trading partners. The effect of RER and its volatility for the minor trading partners are consistent with our earlier findings. Both RER and RER volatility affects exports, with no significant impact on imports. The effect of RER primarily occurs through the adjustment in the extensive margin of trade.

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