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Keywords: Outward Direct Investment, Exchange Rate, Distribution

JEL: F2, F3, L8

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This paper examines the impact of exchange rate movements on firm outward direct investment (ODI), accounting for the heterogeneous effects between distribution and production ODI. Overall, home currency depreciation tends to increase ODI due, in large part, to the growing emergence of distribution ODI, as predicted by the theoretical model. Using rich Chinese firm-level ODI decision data over 2000 to 2008, intensive empirical analysis shows strong support for the model's prediction of a complementary relationship between distribution ODI and exports. In response to home currency depreciation, Chinese firms set up more distribution trade affiliates to promote exports. The results are robust to different econometric methodologies, empirical specifications, and time spans.

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1 Introduction

The effect of exchange rate movements on firms' outward direct investment (ODI) is an important and interesting topic in empirical international economics. Most previous work in this area finds that home exchange rate depreciation boosts firm-specific foreign direct investment (FDI). The economic rationale is that home currency depreciation lowers home exports, which in turn hampers production and its affiliated sales in foreign markets. This is especially true if exports are a substitute for ODI (Blonigen, 2001) due, in large part, to the trade-off between proximity and concentration (Brainard, 1997). The seminal works of Froot and Stein (1991) and Blonigen (1997) find that home currency depreciation lowers ODI. In particular, Froot and Stein (1991) argue that home currency depreciation leads to more foreign acquisition of home assets since intrafirm internal financing is cheaper than external financing in the presence of imperfect information. Similarly, Blonegin (1997) shows that real Japanese yen appreciation increases the probability of Japanese acquisition FDI in US industries because acquisitions involve firm-specific assets that can generate returns in foreign currencies.

Different from such findings, the present paper shows that depreciation of the home currency, particularly the Chinese yuan (or renminbi, henceforth RMB), tends to foster Chinese ODI. This result is mainly attributable to the presence of distribution-oriented ODI, which refers to the phenomenon of home parent manufacturing firms penetrating foreign markets through business-service trade affiliates or wholesale firms that resell exportable goods (Hanson, Mataloni, and Slaughter, 2001). In response to real depreciation of the RMB, Chinese firms set up more service trade affiliates to promote their exports. Because such distribution ODI accounts for around half of China's entire ODI, overall we see a complementary pattern between real depreciation of the home currency and ODI.

To provide theoretical guidance for our empirical analysis, we incorporate the real exchange rate into the firm heterogeneity model inspired by Helpman, Melitz, and Yeaple (2004) and Berman, Martin, and Mayer (2012). In addition to standard export or FDI fixed costs, we introduce a novel distribution communications cost variable into the model, which is different from the production-motivated FDI fixed costs. With these features, our theoretical model predicts that in response to RMB depreciation, Chinese manufacturing firms increase their exports but decrease production ODI. More importantly, the novel prediction is that firms also self-select to increase their distribution ODI. Using rich Chinese firm-level ODI decision and production data over 2000–08, our empirical analysis shows strong support for the model's prediction of a positive relationship between distribution ODI and exchange rate movements. After controlling for endogeneity issues and possible econometric rare event bias raised by the limited number of Chinese firms engaging in ODI activities, our estimates show that home depreciation leads to an increase in distribution ODI.

Our paper contributes to the literature in at least three important ways. First, the paper speaks to the ambiguous relationship between the exchange rate and FDI. Some existing research finds that home currency appreciation fosters ODI (see, for example, Froot and Stein,1991; Brainard, 1993; Blonigen, 1997; Osinubi and Amaghionyeodiwe, 2009) due, in large part, to the following three possible reasons: (i) the cost-saving effects of overseas expansion, (ii) the substitution between exports and FDI, and (iii) FDI serving as a means of internal financing in incomplete financial markets. By contrast, some other studies find that home currency appreciation hampers ODI (*e.g.*, Görg and Wakelin, 2001) in the sense that current appreciation leads to the expectation of future appreciation. In response to appreciation expectation, firms are willing to wait for the cost of FDI to be even lower in the future. However, all these studies abstract away the service-oriented distribution FDI activities that are related to business offices or retail and wholesale foreign affiliates. Different from such studies, in the current paper, we focus on the important role of distribution FDI and find that a large amount of distribution FDI indeed plays a vital role in the complementary relationship between emerging FDI and increasing exports caused by home currency depreciation.

Second, our paper sheds light on the importance of the growing role of distribution ODI. ODI includes two main categories: distribution-oriented and production-oriented ODI. Distribution ODI accounts for around half of total ODI. FDI stock in the business services sector accounted for roughly 30% of total FDI in 2013, ranking at the top among all industries. Wholesale FDI ranked fourth and accounted for 14% of the total FDI stock. In sharp contrast, manufacturing production FDI only accounted for 6% in the same period.[1]

Although distribution ODI is an important and popular type of FDI in developed and developing countries, there is relatively scant research on distribution ODI, with some exceptions, like Horstmann and Markusen (1996) and Hanson, Mataloni, and Slaughter (2001). More recent research, including Kimura and Lee (2006); Head, Mayer, and Ries (2009); and Ramasamy and Yeung (2010), explores factors that impact exports and FDI in service industries. Breinlich and Criscuolo (2011) and Buch, Koch, and Koetter (2011) investigate the role of firm heterogeneity in the nexus of exports and FDI in the business consulting, banking, and software industries. Most of these studies find that, similar to other research on manufacturing industries, more productive and larger firms with higher export intensity in service industries are more likely to invest in more destinations. However, Tanaka (2015) finds that for service industries, geographic distance increases FDI, which is different from the standard findings for manufacturing sectors. Davies and Guillin (2011) study the spatial decision on FDI in services and find that the export platform effect dominates in developed destinations, while the complex vertical effect dominates in developing host countries. Importantly, Oldenski (2012) finds that the cost of cross-border communication is crucial in explaining why the probability of FDI is much higher in service industries than manufacturing. However, there is not much research on Chinese FDI in services.[2] Only very recently, Tian and Yu (2020) find a complementary relationship between distribution ODI and exports, but they are silent on the nexus with exchange rate movements. The present paper aims to fill this gap.

Third, the current paper enriches our understanding of the Chinese economy and, partic-

[1] In developed countries like the United States, wholesale foreign affiliates accounted for over 20% of total foreign sales by multinationals (Hanson et al. 2001). In emerging countries like Brazil, the stock of distribution FDI accounted for 22% of total non-financial outward FDI in 2009. In India, the flow of distribution FDI reached 18% of total FDI outflows. In developing countries in Africa, the service sector is the largest sector in the stock of FDI, and business services accounted for 37% of the total outflow of FDI in 2014.

[2] One exception is Chen and Tang (2014), who use firm-level data to document the stylized fact that over half of Chinese outward FDI is in service industries.

ularly, its ODI and exchange rate movements. As the second largest economy in the world, China's ODI has increased substantially in the new century. In 2020, China's ODI flows became the largest in the world, at US$133 billion. The share of manufacturing ODI in China's total ODI increased from 12.1% in 2015 to 18.3% in 2016. However, there has been relatively little research on China's ODI using micro-level data. Most of the literature focuses more on the determinants and patterns of China's inward FDI. A few exceptions, including Chen and Tang (2014), instead focus on the motives and consequences of China's ODI in Africa. Chen, Tian, and Yu (2019) find that Chinese manufacturing state-owned multinational corporations are even more productive than manufacturing private multinational corporations due to the domestic input distortion against private firms.

Turning to movements in China's exchange rate, the Chinese RMB real effective exchange rate has continued on an increasing trend in the new century. This phenomenon is evident during the sample period of 2000–08, during which the RMB maintained a fixed exchange rate against the US dollar before 2005 but appreciated after 2006. Previous studies on the RMB exchange rate pay much more attention to its nexus with trade (Wang and Yu, 2020) and job flows (Dai and Xu, 2017). Only limited research examines the relationship between the exchange rate and China's ODI. Different from those previous works using macro-level FDI data, the present paper relies on micro firm-level ODI data. Equally importantly, we construct measures of firm-specific RMB real exchange rates to estimate the effect of exchange rate movements on firm ODI, although our main findings are robust to conventional bilateral exchange rate measures.

The rest of the paper is organized as follows. Section 2 presents a theoretical framework to guide the following empirical exercises. Section 3 describes the data and measures of key related variables. Section 4 discusses our econometric methodology and reports the empirical findings. Section 5 concludes.

2 Model

We extend the models of Helpman, Melitz, and Yeaple (2004) and Berman, Martin, and Mayer (2012) to provide theoretical guidance for our empirical estimations. We study how exchange rate variation affects the sorting pattern of multinational firms at the extensive margin. In particular, we distinguish distribution FDI from production FDI and allow FDI and exports to vary with the exchange rate.

2.1 Setup

Following Helpman, Melitz, and Yeaple (2004), manufacturing firms produce differentiated products in an industry with a market structure of monopolistic competition. Each product is indexed by $\omega \in \Omega$, in which Ω is the set of all products. Consumers in country j face the following constant elasticity of substitution (CES) utility function:

$$U_j = (\int_{\Omega} x_j(\omega)^{\frac{\sigma-1}{\sigma}} d\omega)^{\frac{\sigma}{\sigma-1}},$$

where $x_j(\omega)$ is consumption of product ω, and σ is the CES between differentiated products.

Firms can enter the industry by paying a sunk cost f_E (unit of labor). After paying the entry costs, firms observe productivity φ which follows a Pareto distribution with $Pr(\varphi > x) = \left(\frac{b}{x}\right)^k$, where $k > \sigma - 1$ and $b > 1$. Once the firm observes its productivity draw, it decides whether to say in the market as it bears a fixed cost of production, f_D.

After choosing to stay in the domestic market, the firm decides whether to paticipate in foreign markets and, if so, how. There are three possible avenues for engaging in foreign markets. The first way is to export, in which the firm pays the exporting fixed cost, f_X . The second option is to invest and set up a physical plant in a foreign country by paying the extra fixed cost f_{IX}. The third avenue is to both export and set up a foreign distribution affiliate to promote the firm's exports; the cost of doing so is also fixed and denoted by f_X+ f_{IS}. The costs f_D and f_X are denominated in home labor whereas f_{IS} and f_{IM} are denominated in foreign labor. Without loss of generality, we assume that $f_{IM} > f_{IS} + \frac{f_X}{q_{ij}} > \frac{f_X}{q_{ij}} > \frac{f_D}{q_{ij}}$ in which q_{ij} is the bilateral real exchange rate between countries i and j.

Non-FDI firms must pay additional costs for cross-border communication with consumers (Oldenski, 2012). The cost of cross-border communication is η_j (units of labor in country j). However, FDI firms (including distribution-oriented and production-oriented firms) have no need to pay such cross-border communication costs as they are able to communicate with local consumers directly.

The firm's exporting bears iceberg transport cost and tariffs, which are denoted as $\tau_{ij} > 1$ units of products produced at home. But if firms choose to set up foreign distribution affiliates, the iceberg transportation cost decreases to $\mu\tau_{ij}$ where $0 < \mu < 1$ since foreign distribution affiliates can serve in the role of trade intermediates, thus saving transport costs. By contrast, if firms build overseas production plants, there is no transportation cost. So the marginal costs of domestic production, exporting, distribution FDI, and production FDI are $MC^d = \frac{w_i}{\varphi}$, $MC^e = \frac{w_i \tau_{ij}}{\varphi \epsilon_{ij}} + \eta_j w_j$, $MC^s = \frac{\mu w_i \tau_{ij}}{\varphi \epsilon_{ij}}$, and $MC^m = \frac{w_j}{\varphi}$ respectively, where w_i and w_j denote wages in country i and j, respectively. The nominal bilateral exchange rate (home currency/foreign currency), ϵ_{ij}, is proportional to the real exchange rate $q_{ij} = \epsilon_{ij} w_j / w_i$.

2.2 Domestic Production, Exporting, Distribution and Production FDI

This subsection derives the firm's profit. Denoting the population of country j as L_j, the demand function for a firm with productivity φ is $X_j(\varphi) = Y_j P_j^{\sigma-1} \left[p_j^c(\varphi)\right]^{-\sigma}$, where country j's total income equals labor income $Y_j = w_j L_j$. The exact price index in country j is defined as follows.

$$P_j \equiv \left[\int_{\varphi\in\Omega} \left[p_j^c(\varphi)\right]^{1-\sigma} M dG(\varphi)\right]^{\frac{1}{1-\sigma}}$$

where the price of product φ in country j is $p_j^c(\varphi)$ and $c = d, e, s$ and m represent domestic production, exporting (only), exporting and distribution FDI, and production FDI, respectively.

By taking marginal revenue equal to marginal cost, the profit of firms in country i at different modes are the following:

$$\pi_i^d = \left(\frac{w_i}{\varphi}\right)^{1-\sigma} B_i - w_i f_D$$
$$\pi_i^e = \left[\left(\frac{\tau_{ij}}{q_{ij}\varphi} + \eta_j\right) w_j\right]^{1-\sigma} B_j - \frac{w_j f_X}{q_{ij}}$$

$$\pi_i^s = \left(\frac{\mu\tau_{ij}}{q_{ij}\varphi}w_j\right)^{1-\sigma} B_j - \frac{w_j f_X}{q_{ij}} - f_S w_j$$
$$\pi_i^m = \left(\frac{w_j}{\varphi}\right)^{1-\sigma} B_j - f_M w_j$$

where $B_k \equiv \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} Y_j P_j^{\sigma-1}$, $k \in i, j$. Here, π_i^d is the firm's profit in the domestic market (denoted in home currency) and π_i^e, π_i^s, and π_i^m are the firm's profits via exporting, exporting and distribution FDI, and production FDI, respectively, which are dominated in foreign currency.

We can derive the productivity cutoff point of domestic production (φ_d^*), exporting (φ_e^*), exporting and distribution FDI (φ_s^*), and production FDI (φ_m^*) by setting $\pi_i^d(\varphi_d^*) = 0$, $\pi_i^e(\varphi_e^*) = 0$, $\pi_i^s(\varphi_s^*) = \pi_i^e(\varphi_s^*)$, $\pi_i^m(\varphi_m^*) = \pi_i^s(\varphi_m^*)$. The productivity cutoff points satisfy the following:

$$\left(\frac{1}{\varphi_d^*}\right)^{1-\sigma} = f_D \frac{w_i^\sigma}{B_i} \tag{1}$$
$$\left(\frac{\tau_{ij}}{q_{ij}\varphi_e^*} + \eta_j\right)^{1-\sigma} = \frac{f_X w_j^\sigma}{q_{ij} B_j} \tag{2}$$
$$\left(\frac{\mu\tau_{ij}}{q_{ij}\varphi_s^*}\right)^{1-\sigma} - \left(\frac{\tau_{ij}}{q_{ij}\varphi_s^*} + \eta_j\right)^{1-\sigma} = f_S \frac{w_j^\sigma}{B_j} \tag{3}$$
$$\left(\frac{1}{\varphi_m^*}\right)^{1-\sigma} - \left(\frac{\mu\tau_{ij}}{q_{ij}\varphi_m^*}\right)^{1-\sigma} = \left(f_M - f_S - \frac{f_X}{q_{ij}}\right)\frac{w_j^\sigma}{B_j} \tag{4}$$

According to the free entry condition, the firm's expected profit equals the sunk cost of entry $w_i f_E$.[3]

$$\int_{\varphi_d^*}^{\infty} \pi_i^d dG(\varphi) + \sum_{j=1, j\neq i}^{N} \epsilon_{ij}\left[\int_{\varphi_e^*}^{\varphi_s^*} \pi_i^e dG(\varphi) + \int_{\varphi_s^*}^{\varphi_m^*} \pi_i^s dG(\varphi) + \int_{\varphi_m^*}^{\infty} \pi_i^m dG(\varphi)\right] = w_i f_E \tag{5}$$

where $G(\varphi)$ is the cumulative density function of the productivity draw φ. The equilibrium cutoffs φ_d^*, φ_e^*, φ_s^*, φ_m^* and B_j/w_j^σ can be solved from Equations (1) to (5), where $B_j/w_j^\sigma = \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} X_j(\varphi)\left[p_j(\varphi)/w_j\right]^\sigma$ indeed represents the real income of country j. For notational simplicity, we suppress all subscripts between bilateral countries i and j in all the cutoffs.[4]

[3] Only when $\frac{\mu\tau_{ij}}{q_{ij}} > 1$, equally there is real iceberg transportation cost, φ_m^* exists.

[4] Clearly, the equilibrium is irrelevant to population. A special case is when all countries are symmetric, i.e.$\tau_{ij} = \tau, \eta_j = \eta$,and purchasing power parity holds so that $q_{ij} = 1, \forall ij$,all countries have the same productivity cut-off and real income: $\bar{\varphi}_d^*$, $\bar{\varphi}_e^*$, $\bar{\varphi}_s^*$, $\bar{\varphi}_m^*$, and $\frac{B}{w^\sigma}$.

2.3 Exchange Rate and Patterns of ODI

In this subsection, we first explore the productivity sorting patterns, followed by how the exchange rate affects the pattern of ODI at the extensive margin.

Proposition 1 *If countries are symmetric and purchasing parity power holds, and if* $f_X > \tau^{1-\sigma} f_D$, $f_X^{\frac{1}{1-\sigma}} - \frac{1}{\mu}(f_X + f_S)^{\frac{1}{1-\sigma}} > \eta\Delta$, $f_M > f_X + f_S \frac{\mu^{\sigma-1}}{1-\mu^{\sigma-1}}(\tau^{\sigma-1} - 1)$ *where* Δ *is any upper bound of* $(B/w^{\sigma})^{\frac{1}{1-\sigma}}$*, the following productivity sorting pattern holds:* $\varphi_d^* < \varphi_e^* < \varphi_s^* < \varphi_m^*$*, suggesting that the most productive firms invest in production FDI, the next invests in distribution FDI, the even next only export, the less productive firms only sell domestically, whereas the least productivity firms exit.*

Proof. *See Appendix A.* ■

Proposition 1 suggests that the most productive firms engage in production FDI, the next most productive firms engage in distribution FDI and exports; the next most productive firms only export, after those, the next most productive firms do not export but only sell in the domestic market, and the least productive firms exit. The intuition is straightforward: only the most productive firms can overcome the high fixed costs to build an overseas production plant and benefit from the cost-saving effects of cross-border communications and transportation. Less productive firms, like most of the Chinese ODI firms, can only afford the fixed costs of building international business services or distribution centers to reduce their cross-border communications costs and promote their exports.

The next propostion addresses how the exchange rate affects the pattern of ODI at the extensive margin.

Proposition 2 *Holding the real exchange rates of all other country pairs unchanged, a decrease in* q_{ij} *leads to increases in* φ_e^* *and* φ_s^* *but a decrease in* φ_m^**, suggesting that appreciation of the home currency hampers export and distribution FDI but fosters production FDI.*

Proof. *See Appendix B.* ■

Proposition 2 suggests that the appreciation of home currency (i.e., a decrease in q_{ij}) squeezes out the least productive distribution FDI firms but promotes the most productive production-oriented FDI firms. The former effect comes from the reduction in cross-border communications costs, which played an important role before but no longer matter so much. The latter effect results from the higher cost of exporting which makes distribution-oritented FDI less profitable than production-oriented FDI. By contrast, if the home currency depreciates, some productive non-FDI exporters and some less productive production-oriented FDI producers may switch to engage in distribution-oriented FDI. Indeed, this theoretical prediction contributes toward explaining the boom of distribution-oriented FDI in developing countries during the global financial crisis in 2008.

3 Data and Measures

The data used for the empirical analysis are from a combination of three data sets: ODI data, firm-level manufacturing production data, and transaction-level trade data. The ODI data collected by the Ministry of Commerce provide the names of ODI firms in China since 1980. The firm-level manufacturing production data compiled by China's National Bureau of Statistics offer basic accounting information, which enables us to calculate the measured total factor productivity (TFP) and control for other firm-level information, like ownership, labor, capital, total sales, and exports. Firms trade with different countries, so exchange rate variation generates heterogeneous shocks to firms. To capture these shocks, we rely on transaction-level trade data from China's General Administration of Customs to construct a firm-level exchange rate index. Related exchange rate data are from the World Bank, and country-level variables, like gross domestic product and the price level, are from the World Development Indicators.

3.1 Data

FDI Decision Data. The firm-level ODI decision data were obtained from the Ministry of Commerce of China, which releases information on new FDI firms every year. According to the official requirement, since 1980, it has been mandatory for any firm seeking to engage in overseas investment to apply to the Ministry of Commerce (or its former counterpart, the Ministry of Foreign Trade and Economic Cooperation of China) for approval and registration. Such firms are required to report information including the firm's name, the name of the firm's foreign subsidiaries, the investment mode (e.g., distribution affiliates, mining-oriented affiliates), and the amount of foreign investment (in US dollars) for both state-owned enterprises (SOEs) and private firms. The amount of firms' outward investment is not widely available since it is considered highly confidential to firms. Thus, this data set is particularly ideal for exploring the extensive margin of firms' ODI.

Firm Production Data. The data set includes two types of manufacturing firms: universal SOEs and non-SOEs whose annual sales are more than RMB 5 million (or roughly equivalent to US$830,000 under the current exchange rate), accounting for 95% of China's total annual output in all manufacturing sectors. The data set provides more than 100 firm-level variables listed in the main accounting statements, such as sales, capital, labor, and intermediate inputs, which are essential for calculating the measure of TFP. It covers around 162,885 firms in 2000 and 410,000 firms in 2008, among which some samples are noisy and misleading, largely due to mis-reporting by some firms. To ensure that the sample used in the estimations is reliable and accurate, we screened the sample and omitted outliers, as suggested by Cai and Liu (2009) and Yu (2015).[5] Roughly half of the observations were deleted from the sample after this rigorous filtering.

Transaction Trade Data. These data were accessed from China's General Administration of Customs. As the data set is disaggregated at the Harmonized System (HS) eight-digit product level, it records rich information on each export or import transaction for all trading firms, including trading price, quantity, value, and trade mode, which distinguishes processing trade from ordinary trade. From these data, we know the import value of each product from each originating country, which we further use to construct the firms' average exchange rates. The

[5] We adopted the following criteria. First, firms with fewer than eight employees were eliminated since such entities are identified as self-employed. Second, firms with key financial variables (e.g., gross value of industrial output, sales, total assets, and net value of fixed assets) missing were dropped. Third, we included firms based on the requirements of the generally accepted accounting principles.

data set contains 118,333,831 observations during the sample period from 2000 to 2006, during which more than 286,000 firms engaged in international trade.

Data Merging. The firm-level production data set provides information on firms' production behavior. However, it is silent on firms' ODI behavior. Therefore, to understand firms' ODI behavior, we merged the firm-level production data with the universal ODI decision data. Further, to construct the firm-level exchange rates, we used firms' export (and even import) information and transaction trade data. For this task, we proceeded by following three steps. First, we matched the manufacturing firm data and customs data a là Yu (2015) by using the firms' name and year, zip code, and the last seven digits of the telephone number as common identification variables. The merged data skew toward large firms, as the matched sample has more exports, more sales, and more employees. Second, we merged the ODI data with the production data. Unfortunately, the coding systems of the two data sets are completely different. Hence, we used two other methods to match the two data sets. First, we matched them by using each firm's Chinese name and year following Chen, Tian, and Yu (2019). If a firm had the exact same Chinese name in a particular year, it was identified as the same firm. Still, this method may have missed some firms since a company's Chinese name may not have the same exact Chinese character in the two data sets, although the characters may share some common strings.[6] We then used another matching method to serve as a supplement. Namely, we decomposed the firm's name into several "fragments" referring to its location, industry, business type, and specific name, respectively. If a company had all identical fragments, the firm in the two data sets was classified as an identical firm.[7]

3.2 Measures

Types of outward FDI. The firm ODI dummy variable equals zero if the firm never invested overseas until the present year, and one otherwise. In addition, the ODI data set reports 11

[6] For example, "Ningbo Hangyuan communication equipment trading company," shown in the ODI data set, and "(Zhejiang) Ningbo Hangyuan communication equipment trading company," shown in the NBS production data set are the same company but do not have exactly the same Chinese characters.

[7] For example, the location fragment is "Ningbo," the industry is "communication equipment," the business type is "trading company," and the specific name is "Hangyuan."

types of FDI, including trade intermediary, trade office, production, processing trade, research and development, construction, resource exploration, retail and wholesale, product design, and consulting. Following Hanson, Mataloni, and Slaughter (2001), we attribute trade intermediary and trade office to distribution FDI. Distribution FDI accounts for around 48% of ODI before merging with the manufacturing firm data. After merging, the proportion increases to around 59% due, in large part, to the fact that manufacturing FDI firms usually are larger than non-manufacturing FDI firms.

Firm-Level Exchange Rate. To capture firms' responses to exchange rate variation, we construct a firm-level, weighted average exchange rate index, using firm export share as the weight, following Dai and Xu (2017) and Wang and Yu (2021). The index is constructed as follows:

$$REER_{ft} = \prod_{j=1}^{n} RER_{jt}^{w_{fj,t-1}}, \text{ where } w_{fj,t-1} = \frac{x_{f,t-1}^{j}}{\sum_{j=1}^{n} x_{f,t-1}^{j}}$$

and RER_{jt} is the RMB real exchange rate against country j in year t based on price level in year 1999, $x_{f,t-1}^{j}$ is the export of firm f to country j in year $t-1$. We use the one-year lagged export share as the weight to reduce possible reverse causality of FDI on export value. Similarly, we construct the RMB real exchange rate using the import share as the weight. Namely, in the following expression, $im_{f,t-1}^{j}$ is the import of firm f to country j in year $t-1$.

$$REER_{ft}^{IM} = \prod_{j=1}^{n} RER_{jt}^{w_{fj,t-1}}, \text{ where } w_{fj,t-1} = \frac{im_{f,t-1}^{j}}{\sum_{j=1}^{n} im_{f,t-1}^{j}}.$$

This index can represent the exchange rate shock faced by firms. However, if a firm does not export to one country, the exchange rate variation has no effect on it. This is not a serious problem given that our main interest is to explore the impact of the exchange rate on firms' ODI. Previous studies, such as Conconi *et al.* (2014), have found that firms usually export before investing in other countries. As shown in Table 1, the firm-level real exchange rate index increased over 2000 to 2007, suggesting that overall, the RMB depreciated during this period.

[Insert Tables 1 and 2]

4 Exchange Rates and Firm FDI

Figure 1 shows the trends in the real effective RMB exchange rate, distribution ODI, and manufacturing ODI from 2004 to 2013. Since 2004, the RMB exchange rate is no longer pegged to the US dollar but floats against a basket of currencies. Figure 1 shows that the RMB depreciated gradually over this period. Simultaneously, China's ODI experienced rapid growth, from US$5.49 billion in 2004 to US$107.84 billion in 2013. Manufacturing ODI increased relatively slowly compared with distribution FDI. This observation contradicts the common sense that home currency depreciation fosters exports and discourages ODI given the presumption that ODI is a substitute for exports. Instead, the observation provides a hint that distribution ODI, as a complement of exports, was intensively enhanced by depreciation of the RMB and finally led to the large increase in China's total ODI as its major driving force.

[Insert Figure 1]

Figure 2 plots the linear correlation between the RMB exchange rate and the share of distribution/manufacturing ODI. The figure shows that the RMB exchange rate is positively correlated with distribution FDI and negatively correlated with manufacturing FDI. In the following, we formally investigate how exchange rate variation affects firms' ODI choice among the different types of FDI.

[Insert Figure 2]

4.1 Benchmark Estimates

To examine how exchange rates affect firm's decision to engage in FDI, we consider the following empirical specification by taking distribution FDI as one type of FDI:

$$\Pr(D_{ijt}^{FDI} = 1) = \beta_0 + \beta_1 REER_{it} + \beta_2 X_{it} + \varpi_i + \eta_t + \epsilon_{it}, \tag{6}$$

where D_{it}^{FDI} is the FDI indicator for firm i in year t. $REER_{it}$ is the firm-level real exchange rate index. X_{it} is other firm level control variables, including firm TFP–measured following

Ackerberg, Caves, and Frazer (2015) (ACF)–to mitigate the issues of simultaneity and selection bias in conventional TFP measures), size (proxied by the log of firm employment), and ownership. For example, larger firms more often take part in FDI activities. Compared with SOEs, private firms are more likely to engage in ODI (Chen, Tian, and Yu, 2019). In addition, it is easier for exporters to invest in foreign markets as they have the advantage of having access to extra information on foreign markets compared with non-exporting firms (Oldenski, 2012). The error term is decomposed into three components: (i) firm-specific fixed effects, ϖ_i to control for time-invariant factors such as a firm's location; (ii) year-specific fixed effects, η_t, to control for firm-invariant factors such as movement in China's interest rate or other firm-invariant macroeconomic variables; and (iii) an idiosyncratic effect, μ_{it}, with normal distribution $\mu_{it} \sim N(0, \sigma_i^2)$ to control for other unspecified factors.

A simple linear probability model (LPM) is adopted to kick off our empirical analysis. The attractiveness of the LPM method is that it can control firm-level fixed effects to absorb possible uncontrolled firm-specific characteristics. We therefore control for firm-specific fixed effects in column (1) in Table 3. It turns out that the coefficient of the real exchange rate is positive but statistically insignificant. Strikingly, the coefficient of firm TFP (measured following ACF) is negative and significant. We suspect that these unanticipated results are caused by the inclusion of firm-level fixed effects or the adoption of the LPM method. The FDI data released by China's government are pooled cross-section data *per se* as only new FDI firms are recorded. Specifically, only firms that never before invested and invest in a certain country for the first time are included in the regression samples.[8] Standard firm-specific fixed effects are used to identify the variation at the firm-destination level across different years. To this end, it may be more appropriate to control for industry-level fixed effects. We therefore include Chinese industry classification (CIC) two-digit-level fixed effects in column (2), yielding a positive and statistically significant coefficient of the real exchange rate and a positive coefficient of firm TFP as anticipated. Equally interestingly, the coefficients of both the SOE indicator and the foreign indicator are negative

[8] Indeed, this is a cleaner experiment that allows us to exclude any possible effects of "learning by investing" as continuing FDI firms are more likely to engage in FDI.

and statistically significant, suggesting that private firms, as the default group, are more likely to engage in FDI, as found by Chen, Tian, and Yu (2019).[9]

However, a well-known drawback of using the LPM approach is the lack of justification for why the specification is linear. Perhaps even worse, the predicted probability of the FDI indicator could be less than zero or greater than one, which does not make sense at all. Therefore, to address this concern, we perform a simplified logit estimate as follows:

$$\Pr(D_{ijt}^{FDI} = 1) = \digamma(\beta_0 + \beta_1 REER_{it} + \beta_2 X_{it} + \varpi_i + \eta_t + \epsilon_{it}) \tag{7}$$

$$= \frac{\exp(\beta_0 + \beta_1 REER_{it} + \beta_2 X_{it} + \varpi_i + \eta_t + \epsilon_{it})}{1 + \exp(\beta_0 + \beta_1 REER_{it} + \beta_2 X_{it} + \varpi_i + \eta_t + \epsilon_{it})} \tag{8}$$

where $\digamma$ is the logistic cumulative density function. The coefficients in column (3) in Table 3 with the logit regression indeed are highly consistent with those in column (2), suggesting that the out-of-range predicted probability problem is not a big concern. We also realize that different industries adopt different states of technology and hence firm TFP cannot be compared across industries. Therefore, we adopt an even more parsimonious measure of firm TFP by normalizing the ACF-type TFP in the rest of regressions. The coefficients of firm TFP are positive and (mostly) statistically significant in the regressions in columns (3) to (10).

[Insert Table 3]

4.2 Estimates with Rare Events Corrections

As is discussed in Chen, Tian, and Yu (2019) and Tian and Yu (2020), China's FDI data exhibit a clear rare event feature. Only a very small proportion of Chinese firms engage in FDI activity—the share of FDI is less than 0.5% in all years over 2000–07. As highlighted by King and Zeng (2001), standard logit or probit estimates would underestimate the probability of rare events, although their corresponding maximum likelihood estimators are still consistent. Our estimates in column (4) in Table 3 ascertain this wisdom: the coefficient of the real exchange rate, in absolute value, is much larger than its counterpart in column (3).

[9] To save space, we do not report the coefficients of all the control variables; however, they are available upon request.

Still, the rare event feature of Chinese firms' ODI activity masks another possible estimation bias, which is that the probability distribution of firms engaged in FDI activity in response to exchange rate variation demonstrates faster convergence toward the true probability. Standard LPM or even logit estimates cannot handle this challenge. Therefore, we run complementary log-log regressions in the rest of Table 3, which allow for faster convergence.

Another possible concern is the destinations of Chinese FDI firms. Some firms invest in tax haven destinations for tax exemption purposes but not for production purposes (Chen, Tian, and Yu, 2019). Since the present paper aims to explore Chinese firms' foreign production response to exchange rate variation, we drop the tax haven observations in the rest of the regressions. In column (5) in Table 3, the result is similar to that in column (4). A related concern is about multinational firms that are owned by foreign companies. With their own global investment strategy, multinational firms' response to exchange rate variation would be different from that of Chinese FDI firms. To avoid possible estimation contamination, foreign firms are dropped in the rest of Table 3. Columns (6) and (7) show that the coefficient of the real exchange rate is still positive and significant after dropping observations with tax haven destinations and foreign firms, respectively.

4.3 Firm Choice to Distribution outward FDI

Proposition 2 in section 3 suggests that home currency appreciation hampers exports, leading to two opposite results: it squeezes out distribution FDI while boosting production FDI. To verify this, we divide the sample with positive FDI into two broad categories according to mode: distribution FDI and non-distribution FDI. Thus, an increase in the exchange rate would induce a positive impact on distribution FDI compared with non-distribution FDI. In column (1) in Table 4, by applying LPM estimation, we regress the exchange rate on a dummy that equals one if it is the firm's first time engaging in distribution FDI and zero otherwise. Similar to the corresponding benchmark regressions in Table 3, we include industry fixed effects and year fixed effects. A positive sign suggests that depreciation of the RMB is associated with an increase in distribution ODI. In columns (2) to (4) in Table 4, we conduct probit, logit, and rare event logit regressions, respectively, which yield consistent results. In columns (5) to (10), we apply complementary log-log regression. As argued for Table 3, we drop foreign firms in column (6) and additionally drop switching SOEs in column (7). Merger and acquisition (M&A) deals are further dropped in columns (8) and (9). In column (10), contract-intensive sectors a là Nunn (2007) are dropped. All these regressions yield results that are consistent with those in Table 3.

[Insert Table 4]

Apart from changing the cost of exports, the exchange rate may also affect firms' ODI decision via changing the cost of imports. Hence, in Table 5, we add the import-weighted, firm-level exchange rate to the regressions to control for the role of imports. Replicating the first four columns in Table 4, Table 5 shows that exchange rate depreciation boosts ODI through exports other than on the import side, although the magnitude shrinks by about half, which again is in line with the rationale of our model.

[Insert Table 5]

4.4 Multinomial Logit Estimates for FDI modes

We divide the ODI firms into two types, distribution FDI and non-distribution FDI, to investigate the impact of exchange rate variation on firms' choice on engaging in FDI. Table 6 shows the results of multinomial logit regression in which the regressands in the odd columns are distribution FDI, whereas those in the even columns are non-distribution FDI. The non-ODI samples serve as the omitted group. The estimates in columns (1) and (2) are benchmark regressions that include all firms, whereas the rest of the estimates include non-foreign firms only. The regressions show that an increase in the firm-level exchange rate has a significantly larger impact on the extensive margin of distribution FDI compared with non-distribution FDI, which is consistent with our prediction. However, an increase in the exchange rate is also related to a higher probability of entry of non-distribution FDI. This contradicts our model's prediction. We suspect that this may be attributed to the classification of non-distribution FDI, which includes not only manufacturing FDI, but also processing trade and other vertical FDI. For example, resource exploration is an important type of ODI in China and depreciation of the RMB makes imports more expensive, which consequently fosters such FDI. Using the share of exports as the weight in the firm-level exchange rate may cause an endogeneity problem as exports would respond to the exchange rate variation. In addition, other macroeconomic policy shocks may simultaneously affect exports and FDI and hence generate an endogeneity problem as well. To overcome such possible challenges, we use firms' export share in their initial export years to re-construct the firm-level exchange rate in columns (3) and (4) in Table 6. The estimation results are insensitive to this change.

[Insert Table 6]

We preform several robustness checks in Table 7. All the columns contain multinomial logit estimates in which the regressands in the odd columns are distribution FDI, whereas those in the even columns are non-distribution FDI. We drop switching SOE firms in columns (1) to (6), drop firms engaging in M&A activities in columns (3) and (4), and drop 20 three-digit CIC industries with high contract intensity according to Nunn (2007) in columns (5) and (6). The estimates in columns (7) and (8) control for import-weighted exchange rates but drop manufacturing firms engaged in mining FDI activities. All the estimations show that the coefficients of the exchange rate are positive and statistically significant for distribution FDI firms, but they are statistically insignificant for non-distribution FDI firms, suggesting that home currency depreciation fosters distribution ODI.

[Insert Table 7]

4.5 Further Robustness Checks

We conduct additional robustness checks to explore possible industry heterogeneity. We first check whether industrial monopoly power affects our estimation findings. The economic rationale is as follows. Firms with low elasticity of demand in highly monopolized industries are usually large importers since such firms can charge higher markups and exhibit lower exchange rate pass-through. Therefore, compared with firms in competitive industries, they are less harmed in the export market when the home currency appreciates (Amiti, Itskhoki, and Konings, 2014), and thus the probability of those firms engaging in distribution ODI is less likely to be discouraged. We hence divide the whole sample into two categories by the Herfindahl-Hirschman Index (HHI). We calculate the HHI for each CIC two-digit industry and divide the industries into two groups according to the median HHI of the industry.

Table 8 reports the regression results. The probit estimates in columns (1) and (2) regress the ODI indicator on the exchange rate, controlling for year fixed effects and industry fixed effects. We see that home currency appreciation hampers ODI in competitive industries and has no significant impact in monopolized industries. In columns (3) to (6), we run multinomial logit on firm choice between distribution ODI and non-distribution ODI. The results show that home currency appreciation only has a significant impact on the entry of distribution ODI in competitive industries, but the impacts are insignificant on non-distribution ODI, regardless of the monopoly power of the industry. These findings are consistent with our model's predictions.

[Insert Table 8]

By the same token, firms in industries with a larger share of exports in total sales face relatively lower elasticity of demand and hence are less affected by exchange rate shocks. The data show that industries like apparel and textiles (HS two-digit codes: 61 and 62), machinery and mechanical appliances (HS two-digit code: 84), and electrical machinery and equipment (HS two-digit code: 85) have the highest shares of exports. These industries are classified as the high export share group and the others as the low export share group. As shown by the probit estimates in columns (1) and (2) in Table 9, the impact of exchange rate variation on firms' FDI decision is statistically significant only in low export share industries but not in high export share industries. These findings are maintained in the multinomial estimates shown in columns (3) to (6).

[Insert Table 9]

Finally, we examine how processing and non-processing firms react differently in response to exchange rate variation given that processing trade accounts for half of China's exports (Yu, 2015). Processing firms are less capable of starting ODI given that these firms usually have a low level of productivity (Dai et al., 2016). They are also less likely to be affected by exchange rate variation given that processing firms possess more stable international sales networks. As a result, processing firms are less responsive to exchange rate variation in ODI. Table 10 replicates the regressions in table 8. Again, both the probit estimates and the multinomial estimates show that exchange rate variation has significant effects on the FDI decision for ordinary firms but not for processing firms, as anticipated.

[Insert Table 10]

5 Concluding Remarks

Most previous studies have found that home currency depreciation hampers firm-specific FDI. Different from those findings, the present paper has shown that depreciation of the home currency tends to foster Chinese ODI. This result is mainly attributed to the presence of distribution ODI serving as a complement to firm exports.

To provide theoretical guidance for our empirical analysis, we incorporated movements in the real exchange rate and introduced a novel distribution communications cost variable to the firm heterogeneity model. Using rich Chinese firm-level ODI decision data over 2000–08, the results of the empirical analysis showed strong support for the model's prediction of a complementary relationship between distribution ODI and exports. In response to home currency depreciation, Chinese firms set up more distribution trade affiliates to promote exports. The large amount of distribution FDI indeed plays a vital role in understanding the complementary relationship between emerging FDI and increasing exports caused by home currency depreciation.

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Table 1: Firm-level Real Exchange Rates

Year	2000	2001	2002	2003	2004	2005	2006	2007
Export-weighted	0.432	0.429	0.426	0.427	0.428	0.427	0.424	0.423

Notes: The table is calculated by the authors.

Table 2: Summary Statistics of Major Variables

	# of Obs.	Mean	Std.	Min	Max
outward FDI Dummy	299094	0.002	0.047	0	1
outward FDI Starter Dummy	1410	0.473	0.499	0	1
outward FDI Type	299094	0.006	0.101	0	2
Firm-Level REER	80121	0.515	0.4	0.001	1.28
Firm-Level REER(Initial Year Weighted)	34523	0.423	0.398	0.001	1.08
TFP	299094	3.4	1.11	-7.07	10.4
SOE Dummy	299094	0.025	0.157	0	1
FIE Dummy	299094	0.449	0.497	0	1

Note: FIE = foreign-invested enterprises; ODI = outward direct investment; REER = real effective exchange rate; SOE = state-owned enterprise; TFP = total factor productivity.

Table 3: Benchmark Regressions of outward FDI

Regressand: FDI Indicator	LPM	LPM	Logit	Rare Event Logit	Complementary Log-Log					
Measure of TFP	ACF		Relative ACF measure							
Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Real Exchange Rate	0.001	0.004***	0.261***	0.683***	0.693***	0.676***	0.496**	0.543***	0.513**	0.562***
	(0.72)	(5.52)	(5.89)	(5.79)	(5.92)	(4.44)	(2.52)	(2.66)	(2.58)	(2.73)
Firm TFP	-0.001**	0.001***	0.437***	1.172***	0.286	1.155***	1.019*	1.189**	0.958*	1.122*
	(-1.99)	(4.38)	(3.65)	(3.74)	(1.12)	(2.99)	(1.85)	(2.08)	(1.72)	(1.94)
Foreign Firms Dropped	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Switching SOE Dropped	No	No	No	No	No	No	No	Yes	No	Yes
M&A Deals Dropped	No	No	No	No	No	No	No	No	Yes	Yes
Industry Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	No	No	No	No	No	Yes	No	No	No
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	79,415	79,415	76,116	76,116	79,415	76,116	27,136	20,943	27,131	20,938

Note: The regressand is the FDI indicator. The numbers in parentheses are t-values clustered at the firm level. *** (**,*) denotes significance at the 1 (5, 10) percent level. All columns except column (1) include industry dummies at the CIC two-digit level and year dummies. Column (1) includes firm fixed effects. Columns (1) to(5) include foreign-invested firms whereas all other columns drop those firms. Columns (8) and (10) drop switching SOEs (i.e., switching from SOEs to private firms, or vice versa). Columns (9) and (10) drop M&A deals. Firm TFP is measured using the ACF (2015) approach in columns (1) and (2) and then normalized between the range [0, 1] within each CIC two-digit level. In all columns, we control for SOE indicator, foreign firm indicator, log of firm labor, and exporter indicator. ACF = Ackerberg, Caves, and Frazer; CIC = Chinese industry classification; FDI = foreign direct investment; LPM = linear probability model; M&A = merger and acquisition; SOE = state-owned enterprise; TFP = total factor productivity.

Table 4: Firm Choice to Distribution outward FDI

Regressand:	LPM	Probit	Logit	Rare Event	Complementary Log-Log					
Distribution outward FDI Indicator				Logit						
Measure of TFP	ACF	Relative ACF measure								
Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Real Exchange Rate	0.003***	0.291***	0.810***	0.844***	0.804***	0.685***	0.787***	0.707***	0.813***	0.667***
	(5.50)	(5.64)	(5.65)	(5.89)	(4.28)	(2.85)	(3.18)	(2.91)	(3.25)	(2.62)
Firm TFP	0.000	0.112	0.260	-0.476	0.252	0.162	0.297	0.125	0.258	0.308
	(1.22)	(0.86)	(0.72)	(-1.58)	(0.55)	(0.25)	(0.44)	(0.19)	(0.38)	(0.44)
Foreign Firms Dropped	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Switching SOE Dropped	No	No	No	No	No	No	Yes	No	Yes	No
M&A Deals Dropped	No	No	No	No	No	No	No	Yes	Yes	No
Contract Sectors Dropped	No	No	No	No	No	No	No	No	No	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	79,415	70,364	70,364	79,415	70,364	26,632	20,554	26,627	20,548	23,828

Note: The regressand is the distribution ODI indicator. The numbers in parentheses are t-values clustered at the firm level. *** denotes significance at the 1 percent level. All columns except column (1) include industry dummies at the CIC two-digit level and year dummies. Columns (1) to (5) include foreign-invested firms whereas all other columns drop those firms. Columns (7) and (9) drop the switching SOEs (i.e., switching from SOEs to private firms). Columns (8) and (9) drop M&A deals. Column (10) drops the contract-intensive sectors a l?Nunn (2007). TFP is measured using the ACF (2015) approach in column (1) and TFP in the other columns is normalized between the range [0, 1] within each CIC two-digit level. In all columns, we control for SOE indicator, foreign firm indicator, log of firm labor, and exporter indicator. ACF = Ackerberg, Caves, and Frazer; CIC = Chinese industry classification; LPM = linear probability model; M&A = merger and acquisition; ODI = outward direct investment; SOE = state-owned enterprise; TFP = total factor productivity.

Table 5: Firm Choice to Distribution outward FDI controlling for import-weighted Exchange Rate

Regressand:	LPM	Probit	Logit	Rare Event
Distribution outward FDI Indicator				Logit
Measure of TFP	ACF	Relative ACF measure		
Variable:	(1)	(2)	(3)	(4)
Real Exchange Rate	0.004*	0.173*	0.438*	0.410*
(Export-weighted)	(1.77)	(1.90)	(1.77)	(1.71)
Real Exchange Rate	-0.004**	0.087	0.225	0.307
(Import-weighted)	(-2.28)	(0.95)	(0.93)	(1.29)
Firm TFP	-0.000	0.331	0.942	0.013
	(-0.48)	(1.47)	(1.56)	(0.03)
Foreign Firms Dropped	No	No	No	No
Switching SOEs Dropped	No	No	No	No
M&A Deals Dropped	No	No	No	No
Contract Sectors Dropped	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes
Observations	34,716	28,726	28,726	34,716

Note: The regressand is the distribution ODI indicator. The numbers in parentheses are t-values clustered at the firm level. *** (**,*) denotes significance at the 1 (5, 10) percent level. All columns except column (1) include industry dummies at the CIC two-digit level and year dummies. All columns include foreign-invested firms. TFP is measured using the ACF (2015) approach in column (1) and TFP in the other columns is normalized between the range [0, 1] within each CIC two-digit level. All estimates control for import-weighted exchange rates. In all columns, we control for SOE indicator, foreign firm indicator, log of firm labor, and exporter indicator. ACF = Ackerberg, Caves, and Frazer; CIC = Chinese industry classification; LPM = linear probability model; M&A = merger and acquisition; ODI = outward direct investment; SOEs = state-owned enterprises; TFP = total factor productivity.

Table 6: Multinomial Logit Estimates of Exchange Rate on FDI Decision (2000-08)

Regressand:	Dist.	Non-Dist.	Dist.	Non-Dist.
	(1)	(2)	(3)	(4)
	All firms		Non-foreign firms	
Export weight construction:	current year		initial year	
Exchange Rate	0.759***	0.583***	0.73**	0.15
(Export-weighted)	(4.93)	(2.86)	(2.01)	(0.38)
Firm TFP	1.336***	3.202***	0.21	0.73***
	(3.10)	(5.83)	(1.39)	(4.41)
Year FE	Yes		Yes	
Industry FE	Yes		Yes	
Initial Year Weighted	No		Yes	
Control variables	Yes		Yes	
Observations	79,411		34,394	

Note: Numbers in parentheses are t-values. *** (**, *) denotes significance at the 1 (5, 10) percent level. The omitted group is non-FDI firms. All columns are multinomial logit estimates in which the regressands in the odd columns are distribution FDI, whereas those in the even columns are non-distribution FDI. Estimates in columns (1) and (2) include all firms, whereas those in the even columns include non-foreign firms only. Estimates in columns (3) and (4) use export share in initial year to generate the exchange rate index. In all columns, we control for SOE indicator, foreign firm indicator, log of firm labor, and exporter indicator. Dist. = distribution; FDI = foreign direct investment; FE = fixed effects; SOE = state-owned enterprise; TFP = total factor productivity.

Table 7: Multinomial Logit Estimates of Exchange Rate on FDI Decision (2000-08), Robustness Checks

Regressand:	Dist.	Non-Dist.	Dist.	Non-Dist.	Dist.	Non-Dist.	Dist.	Non-Dist.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exchange Rate	0.614***	0.296	0.747***	0.221	0.576***	0.421	0.459*	0.289
(Export-weighted)	(3.18)	(1.11)	(3.61)	(0.77)	(2.84)	(1.47)	(1.80)	(0.86)
Exchange Rate							0.212	-0.149
(Import-weighted)							(0.87)	(-0.44)
Firm TFP	1.443**	3.329***	1.598***	3.458***	1.610***	2.757***	1.345**	2.750***
	(2.57)	(4.49)	(2.67)	(4.26)	(2.71)	(3.52)	(2.04)	(3.07)
Foreign firms Dropped	Yes		Yes		Yes		Yes	
M&A Deals Dropped	No		Yes		No		No	
Switching SOEs Dropped	Yes		Yes		Yes		No	
Contractable sectors Dropped	No		No		Yes		Yes	
Year FE	Yes		Yes		Yes		Yes	
Industry FE	Yes		Yes		Yes		Yes	
Control variables	Yes		Yes		Yes		Yes	
Observations	29,556		24,022		26,631		34,701	

Note: Numbers in parentheses are t-values. *** (**, *) denotes significance at the 1 (5, 10) percent level. The omitted group is non-FDI firms. All columns are multinomial logit estimates in which the regressands in the odd columns are distribution FDI whereas those in the even columns are non-distribution FDI. The estimates in all columns include non-foreign firms only. Estimates in columns (1) to (6) drop switching SOE firms. Estimates in columns (3) and (4) drop switching firms engaging in M&A activities. Estimates in columns (5) and (6) drop 20 three-digit CIC industries with high contract intensity a l?Nunn (2007). Estimates in columns (7) and (8) control for import-weighted exchange rates but drop manufacturing firms engaged in mining FDI activities. In all columns, we control for SOE indicator, foreign firm indicator, log of firm labor, and exporter indicator. CIC = Chinese industry classification; Dist. = distribution; FDI = foreign direct investment; FE = fixed effects; M&A = merger and acquisition; SOEs = state-owned enterprises; TFP = total factor productivity.

Table 8: Firm-Level REER and ODI, by Industry Monopoly

Empirical Methodology	Probit		Multinomial Logit			
	(1)	(2)	(3)	(4)	(5)	(6)
ODI Choice	ODI or Not	ODI or Not	Distri.	Non-distr.	Distri.	Non-distri.
Group by HHI	Low	High	Low	Low	High	High
Firm Exchange Rate	0.21***	0.02	0.76**	0.22	0.54	-0.69
	(2.69)	(0.09)	(1.97)	(0.52)	(0.51)	(-0.48)
Log of TFP	0.15***	0.26***	0.16	0.71***	0.53	0.95*
	(4.55)	(24.18)	(0.97)	(4.02)	(1.38)	(1.88)
Year Fixed Effectss	Yes	Yes	Yes		Yes	
Industry Fixed Effectss	Yes	Yes	Yes		Yes	
Control variables	Yes	Yes	Yes		Yes	
Observations	63,352	7,814	64,443		15,254	

Note: Numbers in parentheses are t-values. *** (**,*) denotes significance at the 1 (5, 10) percent level. In all columns, we control for SOE indicator and foreign firm indicator. We calculate the HHI index for each CIC two-digit industry and divide them into two groups by the median level of the industry. In columns (1) and (2), we regress the firm ODI dummy on firm exchange rate, controlling year fixed effects and industry fixed effects. In Columns (3) to (6), we run multinomial logit on firm choice between distribution ODI and non-distribution ODI. CIC = Chinese industry classification; Dist. = distribution; HHI = Herfindahl-Hirschman Index; ODI = outward direct investment; REER = real effective exchange rate; SOE = state-owned enterprise; TFP = total factor productivity.

Table 9: Firm-Level REER and ODI, by Industry Export Share

Empirical Methodology	Probit		Mutilnomial logit			
	(1)	(2)	(3)	(4)	(5)	(6)
ODI Decision	ODI	ODI	Distri.	Non-distri.	Distri.	Non-distri.
Industry Export Share	Low	High	Low		High	
Firm REER	0.27***	0.09	1.79***	-0.38	-0.22	0.72
	(2.65)	(0.72)	(2.94)	(-0.69)	(-0.42)	(1.19)
Log of TFP	0.13***	0.21***	0.25	0.49**	0.16	1.06***
	(2.99)	(5.33)	(1.20)	(2.22)	(0.73)	(4.08)
Year Fixed Effects	Yes	Yes	Yes		Yes	
Industry Fixed Effects	Yes	Yes	Yes		Yes	
Control variables	Yes	Yes	Yes		Yes	
Observations	16,396	7,640	23,710		10,684	

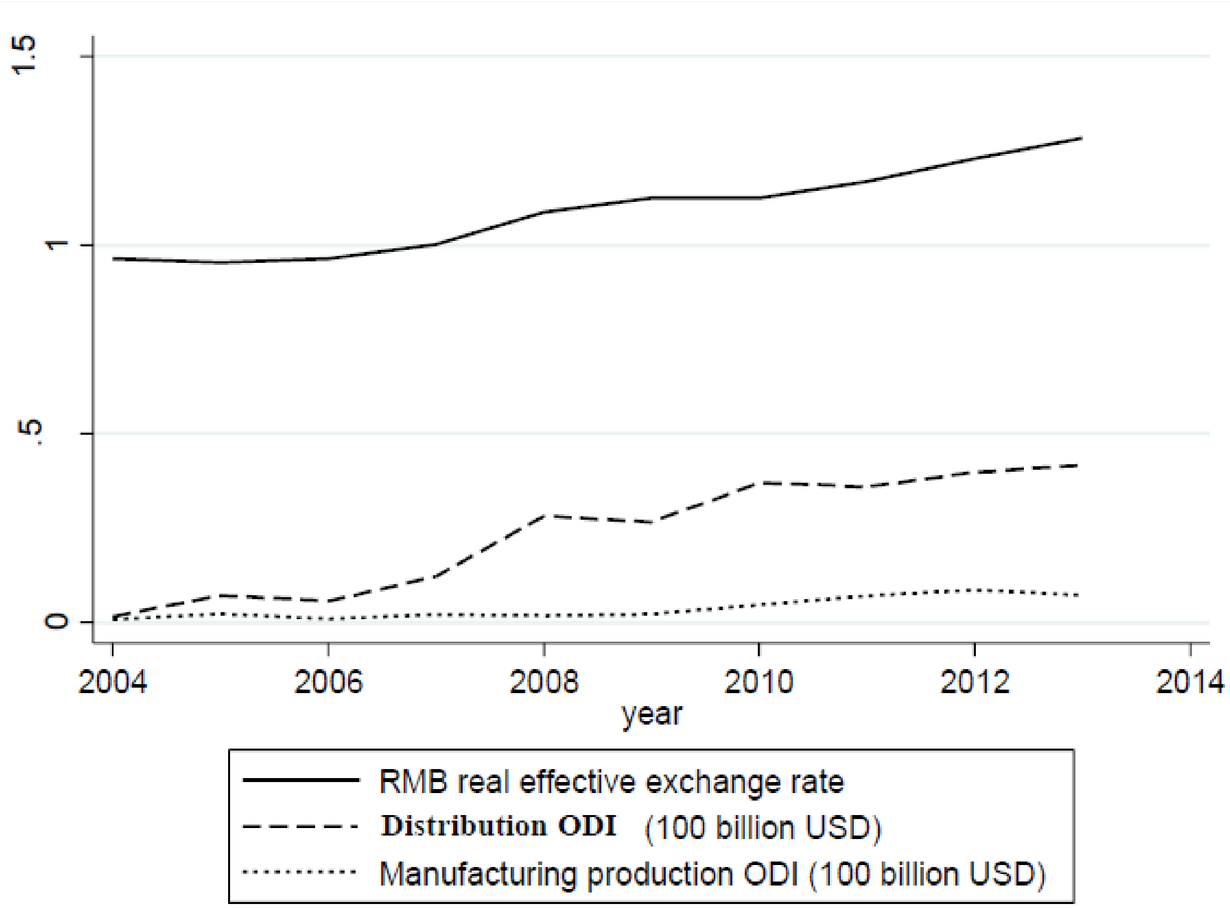
Note: Numbers in parentheses are t-values. *** (**,*) denotes significance at the 1 (5,10) percent level. In all columns, we control for SOE indicator and foreign firm indicator. According to United Nations Comtrade data, the four industries with the highest export share are HS two-digit industries: 61, 62, 84, and 85, corresponding to CIC two-digit industries: 17, 18, 37, and 39. These industries are classified as the high export share group, while others are the low export share group. In columns (1) and (2), we regress firm ODI dummy on firm exchange rate, controlling year fixed effects and industry fixed effects. In columns (3) to (6), we run multinomial logit on firm choice between distribution ODI and non-distribution ODI. CIC = China industry classification; Dist. = distribution; HS = Harmonized System; ODI = outward direct investment; REER = real effective exchange rate; SOE = state-owned enterprise; TFP = total factor productivity.

Table 10: Firm-Level REER and ODI, by Processing & Non-Processing Trade

Empirical Methodology	Probit		Mutilnomial Logit			
	(1)	(2)	(3)	(4)	(5)	(6)
ODI Decision	ODI	ODI	Distri.	Non-distri.	Distri.	Non-distri.
Processing Firms:	No	Yes	No	No	Yes	Yes
Firm REER	0.28***	0.12	0.82*	0.76	0.69	-0.67
	(2.63)	(1.57)	(1.77)	(1.45)	(1.17)	(-0.97)
Log TFP	0.09***	0.28***	0.13	0.36*	0.32	1.38***
	(2.96)	(5.07)	(0.68)	(1.70)	(1.26)	(4.54)
Year Fixed Effects	Yes	Yes	Yes		Yes	
Industry Fixed Effects	Yes	Yes	Yes		Yes	
Control variables	Yes	Yes	Yes		Yes	
Observations	11,965	8,806	19,711		14,683	

Note: Numbers in parentheses are t-values. *** (**,*) denotes significance at the 1 (5, 10) percent level. In all columns, we control for SOE indicator and foreign firm indicator. We examine how processing and non-processing firms react differently in response to exchange rate variation. In columns (1) and (2), we regress firm ODI dummy on firm exchange rate, controlling year fixed effects and industry fixed effects. In columns (3) to (6), we run multinomial logit on firm choice between distribution ODI and non-distribution ODI. Dist. = distribution; ODI = outward direct investment; REER = real effective exchange rate; SOE = state-owned enterprise; TFP = total factor productivity.

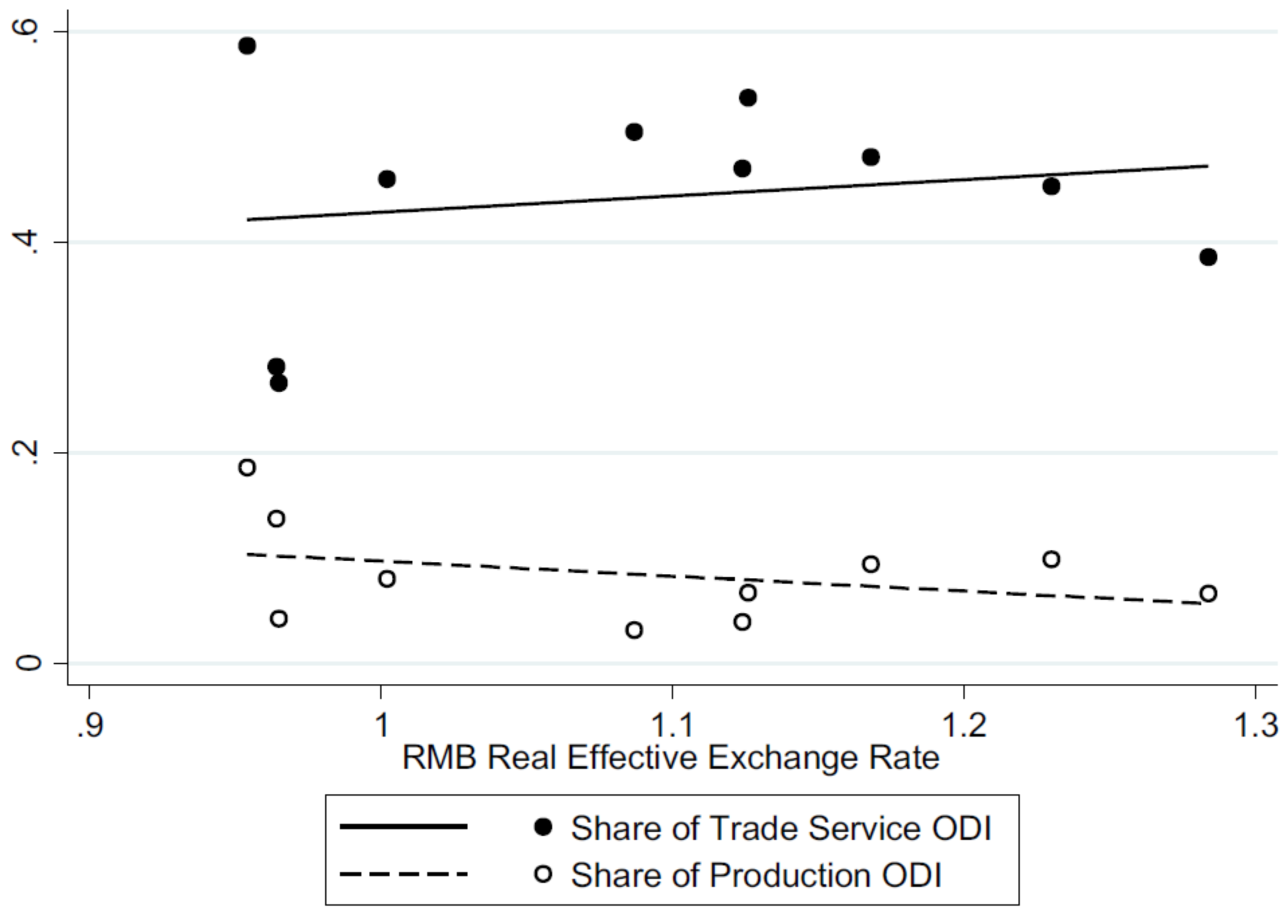
Figure 1: RMB REER, Distribution outward FDI and Manufacturing outward FDI



Data source: Statistical Bulletin of China's Outward Foreign Direct Investment 2013; UNCTAD.

Note: ODI is flow data, and RMB REER is calculated based on year 2000. Distribution ODI contains retail and wholesale, and lease and business services. ODI = outward direct investment; REER = real effective exchange rate.

Figure 2: Share of Distribution outward FDI and Production outward FDI and RMB REER



Data source: Statistical Bulletin of China's Outward Foreign Direct Investment 2013; UNCTAD.

Note: ODI is flow data, and RMB REER is calculated based on year 2000. Distribution ODI contains retail and wholesale, and lease and business services. ODI = outward direct investment; REER = real effective exchange rate.

6 Appendices (Online Only, Not for Publication)

6.1 Appendix A: Proof of Proposition 1

Proof: The derived demand for a firm with productivity φ is

$$X_j(\varphi) = w_j L_j P_j^{\sigma-1}[p_j^c(\varphi)]^{-\sigma}.$$

When every country is symmetric, $q_{ij} = 1, \forall i, j$, and the productivity cut-off and aggregated demand level are the same across countries, denoted as φ_d^*, φ_e^*, φ_s^*, φ_m^*, and $\frac{B}{w^\sigma}$. L_j is labor income in country j; $p_j^c(\varphi) = \frac{\sigma}{\sigma-1}MC^c$; $c = d$, e, fs, and fm are the prices of product φ if it is sold domestically, exporting without distribution foreign affiliates, exporting with distribution affiliates, or exporting with production affiliates, respectively. P_j is the aggregate price level, where

$$P_j = w_j \left\{ \begin{array}{c} \sum_{h=1,h\neq j}^{N} \frac{\sigma}{\sigma-1} L_h \left[\int_{\varphi_{ehj}^*}^{\varphi_{shj}^*} (\frac{\tau_{hj}}{\varphi} + \eta_j)^{1-\sigma} dG(\varphi) + \int_{\varphi_{shj}^*}^{\varphi_{mhj}^*} (\frac{\mu_j \tau_{hj}}{\varphi})^{1-\sigma} dG(\varphi) \right] \\ + \int_{\varphi_{mhj}^*}^{\infty} (\frac{1}{\varphi})^{1-\sigma} dG(\varphi) + \frac{\sigma}{\sigma-1} L_j \int_{\varphi_{dj}^*}^{\infty} (\frac{1}{\varphi})^{1-\sigma} dG(\varphi) \end{array} \right\}^{\frac{1}{1-\sigma}}$$

From Equ. (1) and (2), we know that when $\frac{f_X}{f_D} > (\tau + \varphi_d^* \eta)^{1-\sigma}$, $\varphi_d^* < \varphi_e^*$. So by assuming $b > 1$, when $\frac{f_X}{f_D} > \tau^{1-\sigma}, \varphi_d^* < \varphi_e^*$.

Deriving the left hand side (LHS) of Equ. (3) with respect to $\frac{1}{\varphi}$,we get $d\left[(\frac{\mu\tau}{\varphi})^{1-\sigma} - (\frac{\tau}{\varphi} + \eta)^{1-\sigma} \right] / d\left(\frac{1}{\varphi}\right) = (1-\sigma)\tau \left[\left(\mu^{\frac{\sigma-1}{\sigma}} \tau \frac{1}{\varphi}\right)^{-\sigma} - \left(\tau\frac{1}{\varphi} + \eta\right)^{-\sigma} \right] < 0$, which means that a higher φ induces higher relative returns to distribution investment compared with exports without foreign direct investment (FDI). Thus Equ. (3) has a single solution. Similarly, we derive the LHS of Equ. (4) with respect to $\frac{1}{\varphi}$ to get $d\left[(\frac{1}{\varphi})^{1-\sigma} - (\frac{\mu\tau_{ij}}{\varphi})^{1-\sigma} \right] / d\left(\frac{1}{\varphi}\right) = (1-\sigma)\left[1 - (\mu\tau)^{1-\sigma}\right]\left(\frac{1}{\varphi}\right)^{-\sigma} < 0$. So the higher is φ, the more profitable is building a production plant relative to a distribution affiliate.

Because the LHS of Equ. (3) is increasing with φ, $\varphi_e^* < \varphi_{fs}^*$ equals

$$(\frac{\mu\tau}{\varphi_e^*})^{1-\sigma} - (\frac{\tau}{\varphi_e^*} + \eta)^{1-\sigma} < (\frac{\mu\tau}{\varphi_{fs}^*})^{1-\sigma} - (\frac{\tau}{\varphi_{fs}^*} + \eta)^{1-\sigma} = \frac{f_{IS}}{B} w^\sigma$$

i.e., $(\frac{\mu\tau}{\varphi_e^*})^{1-\sigma} < \frac{f_X}{B} w^\sigma + \frac{f_{IS}}{B} w^\sigma$. Solving $\frac{\tau}{\varphi_e^*}$ from Equ. (2) and inserting into the inequality, then we get:

$$\left(\frac{B}{w^\sigma}\right)^{\frac{1}{1-\sigma}} < \frac{1}{\eta}\left[f_X^{\frac{1}{1-\sigma}} - \frac{1}{\mu}(f_X + f_{IS})^{\frac{1}{1-\sigma}} \right]$$

Thus, if Δ is one upper bound of $\left(\frac{B}{w^{\sigma}}\right)^{\frac{1}{1-\sigma}}$,then $\Delta < \frac{1}{\eta}\left[f_X^{\frac{1}{1-\sigma}} - \frac{1}{\mu}(f_X + f_{IS})^{\frac{1}{1-\sigma}}\right]$ensures that $\varphi_e^* < \varphi_{fs}^*$.The existence of Δ is shown below.

From Equations (3) and (4), we get

$$\left(\frac{\varphi_{fm}^*}{\varphi_{fs}^*}\right)^{1-\sigma} = \frac{f_{IS}\left[(\mu\tau)^{\sigma-1} - 1\right]}{f_{IM} - f_{IS} - f_X} \times \frac{1}{1 - \left(\frac{1}{\mu} + \frac{\eta\varphi_{fs}^*}{\mu\tau}\right)^{1-\sigma}} < \frac{f_{IS}\left[(\mu\tau)^{\sigma-1} - 1\right]}{f_{IM} - f_{IS} - f_X}\frac{1}{1-\mu^{\sigma-1}}$$

So when $f_{IM} > f_X + f_{IS}\frac{\mu^{\sigma-1}}{1-\mu^{\sigma-1}}(\tau^{\sigma-1}-1)$,the above equation is less than 1, then $\varphi_{fs}^* < \varphi_{fm}^*$.

Now we turn to the proof of the existence of Δ. Since φ follows the Pareto distribution, we have $\int_{\overline{\varphi}}^{\infty} dG(\varphi) = \left(\frac{b}{\overline{\varphi}}\right)^k$, $\int_{\overline{\varphi}}^{\infty}(\frac{1}{\varphi})^{1-\sigma}dG(\varphi) = \frac{kb^k}{k-(\sigma-1)}\left(\frac{1}{\overline{\varphi}}\right)^{k-(\sigma-1)}$.

Combining Equations (1) to (4), we have the following equation:

$$\int_{\varphi_{di}^*}^{\infty}\left[\left(\frac{1}{\varphi}\right)^{1-\sigma}\frac{B_i}{w_i^{\sigma}} - f_D\right]dG(\varphi) + \sum_{j=1,j\neq i}^{N} q_{ij}\left[\begin{array}{c} \int_{\varphi_{eij}^*}^{\varphi_{fsij}^*}\left[\left(\frac{\tau_{ij}}{q_{ij}\varphi} + \eta_j\right)^{1-\sigma}\frac{B_j}{w_j^{\sigma}} - \frac{f_X}{q_{ij}}\right]dG(\varphi) \\ + \int_{\varphi_{fsij}^*}^{\varphi_{fmij}^*}\left[\left(\frac{\mu\tau_{ij}}{q_{ij}\varphi}\right)^{1-\sigma}\frac{B_j}{w_j^{\sigma}} - f_{IS} - \frac{f_X}{q_{ij}}\right]dG(\varphi) \\ + \int_{\varphi_{fmij}^*}^{\infty}\left[\left(\frac{1}{\varphi}\right)^{1-\sigma}\frac{B_j}{w_j^{\sigma}} - f_{IM}\right]dG(\varphi) \end{array}\right] = f_E \tag{9}$$

When countries are symmetric, from Equ.(A5) we get

$$\frac{B}{w^{\sigma}} = \frac{EF}{VProfit1 + (N-1)\int_{\varphi_e^*}^{\varphi_{fs}^*}\left(\frac{\tau}{\varphi} + \eta\right)^{1-\sigma}dG(\varphi)}$$

where EF is the expected fixed cost of entry

$$\begin{aligned} EF &= f_E + f_D(\frac{b}{\varphi_d^*})^k + (N-1)f_X\left((\frac{b}{\varphi_e^*})^k - (\frac{b}{\varphi_{fs}^*})^k\right) \\ &\quad +(N-1)\left(f_X + f_{IS}\right)\left((\frac{b}{\varphi_{fs}^*})^k - (\frac{b}{\varphi_{fm}^*})^k\right) + (N-1)f_{IM}(\frac{b}{\varphi_{fm}^*})^k \\ &= f_E + f_D(\frac{b}{\varphi_d^*})^k + (N-1)f_X(\frac{b}{\varphi_e^*})^k \\ &\quad +(N-1)f_{IS}(\frac{b}{\varphi_{fs}^*})^k + (N-1)\left(f_{IM} - f_X - f_{IS}\right)(\frac{b}{\varphi_{fm}^*})^k \\ &> f_E \end{aligned}$$

$VProfit1$ is the expected of variable profit from selling domestically, exporting with distribution FDI and building an overseas production plant.

$$
\begin{aligned}
VProfit1 &= \frac{kb^k}{k-(\sigma-1)}\left[\begin{array}{c}(\frac{1}{\varphi_d^*})^{k-(\sigma-1)}+(N-1)\left(\mu\tau\right)^{1-\sigma}\left((\frac{1}{\varphi_{fs}^*})^{k-(\sigma-1)}-(\frac{1}{\varphi_{fm}^*})^{k-(\sigma-1)}\right)\\ +(N-1)(\frac{1}{\varphi_{fm}^*})^{k-(\sigma-1)}\end{array}\right]\\
&= \frac{kb^k}{k-(\sigma-1)}\left[\begin{array}{c}(\frac{1}{\varphi_d^*})^{k-(\sigma-1)}+(N-1)\left(\mu\tau\right)^{1-\sigma}(\frac{1}{\varphi_{fs}^*})^{k-(\sigma-1)}\\ +(N-1)\left(1-\left(\mu\tau\right)^{1-\sigma}\right)(\frac{1}{\varphi_{fm}^*})^{k-(\sigma-1)}\end{array}\right]
\end{aligned}
$$

We assume $b>1$, so $0<(\frac{1}{\varphi^*})^{k-(\sigma-1)}<1$ for any φ^*.Thus, the above equation satisfies $VProfit1<\frac{kb^k}{k-(\sigma-1)}N$.

$(N-1)\int_{\varphi_e^*}^{\varphi_{fs}^*}\left(\frac{\tau}{\varphi}+\eta\right)^{1-\sigma}dG(\varphi)$ is the expected profit from export without FDI, and

$$
\begin{aligned}
(N-1)\int_{\varphi_e^*}^{\varphi_{fs}^*}\left(\frac{\tau}{\varphi}+\eta\right)^{1-\sigma}dG(\varphi) &< (N-1)\int_{\varphi_e^*}^{\varphi_{fs}^*}\left(\frac{\tau}{\varphi_{fs}^*}+\eta\right)^{1-\sigma}dG(\varphi)\\
&= (N-1)b^k\left(\frac{\tau}{\varphi_{fs}^*}+\eta\right)^{1-\sigma}\left((\frac{1}{\varphi_e^*})^k-(\frac{1}{\varphi_{fs}^*})^k\right)\\
&< (N-1)b^k\left(\frac{\tau}{\varphi_{fs}^*}+\eta\right)^{1-\sigma}<(N-1)b^k\eta^{1-\sigma}
\end{aligned}
$$

So $\frac{B}{w^\sigma}>\frac{f_E}{\frac{kb^k}{k-(\sigma-1)}N+(N-1)b^k\eta^{1-\sigma}}$,and $\Delta=\left(\frac{f_E}{\frac{kb^k}{k-(\sigma-1)}N+(N-1)b^k\eta^{1-\sigma}}\right)^{\frac{1}{1-\sigma}}$ is an upper bound of $\left(\frac{B}{w^\sigma}\right)^{\frac{1}{1-\sigma}}$.

6.2 Appendix B: Proof of Proposition 2

When the real exchange rate holds constant, $\frac{B_j}{w_j^\sigma}$does not change, q_{ij} decreases, and from Equ. (1), we know that φ_{dij}^* does not change. Take the logarithmic linearization of Equ. (2) and rewrite it as $\frac{\partial\varphi_{eij}^*}{\partial q_{ij}}=-\frac{\varphi_{eij}^*}{q_{ij}}\left(\frac{\sigma}{\sigma-1}\right)-\frac{\eta\varphi_{eij}^{*2}}{\tau(\sigma-1)}<0$,equally φ_{eij}^* increases. Take total derivative of (3): $\frac{\tau_{ij}}{q_{ij}}d\left(\frac{1}{\varphi_{fsij}^*}\right)+\frac{1}{\varphi_{fsij}^*}d\left(\frac{\tau_{ij}}{q_{ij}}\right)=0$, so when q_{ij} decreases,φ_s^* increases. Take the total derivative of Equ. (4) and we get $\left[1-\left(\frac{\mu\tau_{ij}}{q_{ij}}\right)^{1-\sigma}\right]\left(\frac{1}{\varphi_{fmij}^*}\right)^{-\sigma}d\left(\frac{1}{\varphi_{fmij}^*}\right)=\left[\left(\frac{\mu\tau_{ij}}{q_{ij}}\right)^{1-\sigma}\left(\frac{1}{\varphi_{fmij}^*}\right)^{1-\sigma}\tau_{ij}+\frac{f_Xw_j^\sigma}{B_j(\sigma-1)}\right]d\left(\frac{1}{q_{ij}}\right)$,so when q_{ij} decreases,φ_m^* decreases.

6.3 Appendix C: Details on the Distribution ODI in China

Business services, mining, finance, wholesale and retail, and manufacturing are the industries with the most outward direct investment (ODI) in China. China's ODI was US$660.48 billion in 2013, with business services ranking at the top, reaching US$195.47 billion and accounting for 30% of total ODI. Finance and mining were the next largest industries. Wholesale and retail ranked number 4, reaching US$87.65 billion and 14% of total ODI. Manufacturing only ranked in fifth place, at US$41.98 billion and 6% of the total. Business services and wholesale and retail had the most distribution FDI in China, together accounting for roughly 40% of the total ODI. Table C1 shows the statistical description of the different types of ODI from 2004 to 2013, where apparently business services and wholesale and retail were close to 50%, while manufacturing only accounted for less than 10%. In the case when the RMB depreciated, exports were boosted. Although the incentive to build overseas plants was discouraged, firms were more willing to set up trading offices or distribution centers in foreign markets to promote their exports. As a consequence, the overall ODI increased.

Table C1: China's Outward Direct Investment, by Industry (US$, 10,000's)

Year	Retail & Wholesale		Lease & Business Service		Manufacturing		Others	
	Value	Percent	Value	Percent	Value	Percent	Value	Percent
2004	79,969	14.55	74,931	13.63	75,555	13.74	319,344	58.08
2005	226,012	18.43	494,159	40.3	228,040	18.6	277,906	22.67
2006	111,391	5.26	452,166	21.36	90,661	4.28	1,462,178	69.09
2007	660,418	24.92	560,734	21.15	212,650	8.02	1,216,807	45.91
2008	651,413	11.65	2,171,723	38.85	176,603	3.16	2,590,978	46.34
2009	613,575	10.85	2,047,378	36.22	224,097	3.96	2,767,849	48.96
2010	672,878	9.78	3,028,070	44.01	466,417	6.78	2,713,766	39.44
2011	1,032,412	13.83	2,559,726	34.29	704,118	9.43	3,169,148	42.45
2012	1,304,854	14.86	2,674,080	30.46	866,741	9.87	3,934,678	44.81
2013	1,464,682	13.58	2,705,617	25.09	719,715	6.67	5,894,357	54.66

Data Source: Statistical Bulletin of China's Outward Foreign Direct Investment 2013.