Firm-specific Exchange Rate Exposure and Employment Adjustment: Evidence from China[1]

Mi Dai[2] Jianwei Xu[3]

First Draft: March 2013
This Draft: May 2013

This paper investigates how exchange rate fluctuations affect employment using Chinese firm-level data with information on exports by destination and imports by source country. Unlike previous studies, we are able to exploit both the variation of trading partner distributions and the variation of export and import intensity at the firm level. We use these to identify the impact of exchange rate movements. We incorporate these elements into a theory-consistent firm-specific exchange rate exposure and relate it to firm employment changes. We find that incorporating firm trading partner distributions is important to consistently and precisely estimate the employment impact of exchange rate movements. Regression results suggest a significant but modest exchange rate effect on employment. The effect varies substantially across firms. In addition, job creation is more responsive than job destruction.

---

[1] We thank seminar participants at Peking University, Beijing Normal University and China Academy of Social Science for helpful comments. All errors are our own.

[2] School of Economics and Business Administration, Beijing Normal University. Email: daimi002@gmail.com

School of Economics and Business Administration, Beijing Normal University. Email: xujianwei@gmail.com

1. Introduction

How does the firm exchange rate exposure affect employment decisions? While numerous studies consider the impact of exchange rate movements on jobs, there are at least two reasons why this literature needs further improvement. First, most existing empirical studies on the topic are conducted at the country level or industry level. However, it is well documented that a large volume of gross job flows actually occur within narrowly defined industries. As a result, any investigation that uses aggregate employment data would easily hide the effects on intra-sector job reallocation. Second, the few existing firm level studies have implicitly assumed that trading partner distribution does not vary across firms within a country. This assumption may be appropriate for some of the countries studied but clearly does not apply to all of the world's major trading countries.

In this paper, we provide evidence of the impact of exchange rate movements on employment in China, which is a country whose distribution of trading partners varies widely across firms. To identify the impact of exchange rate movements, we use the rich firm-destination trade information in the data to propose a theory consistent, *firm-specific* exchange rate exposure. The seminal study of Campa and Goldberg (2001) uses *industry-level* export and import intensity as well as *industry-specific* exchange rates to identify the impact of exchange rate movements on the employment of U.S. industries. We similarly incorporate two corresponding *firm-specific* elements into the exchange rate exposure: (1) the *firm* export and import intensity (2) the *firm-specific* exchange rate, constructed as the weighted average of bilateral exchange rates with weights reflecting the distribution of export destinations and import sources of a particular firm. This approach is in contrast to existing firm-level studies, in which the exchange rate exposure incorporates the effective exchange rates measured at some aggregate (i.e., country or industry) level.

We argue that the exchange rate exposure measure used in our study has several advantages. First, the application of firm-specific effective exchange rates can correct the aggregation bias induced by use of aggregate effective exchange rates to estimate the impact of exchange rate movements on firms. In theory, the degree to which a bilateral exchange rate in a particular country affects a firm depends on the extent of the firm's involvement in international trade with that particular country. Firms differ in their trading partner distributions, and bilateral exchange rates with these trading partners differently shift. Therefore, the effective exchange rate movements that will have a real impact should vary across firms. For example, assuming the RMB appreciates against the dollar but depreciates against the Euro, firms that only trade with the U.S. dollar will face an appreciation while firms that only trade with the Euro will face a depreciation. Simply incorporating the aggregate exchange rates into the estimation implicitly assumes that all firms are faced with identical exchange rate shocks, and this assumption may bias the estimated impact of exchange rate movements, especially when the distribution of trading partners (and the firm-specific exchange rate movements) has a large variation across firms. Second, since an aggregate effective exchange rate that is identical for all firms actually amounts to a time-effect. Therefore, previous studies identified the impact of exchange rate movements by exploiting the differential impact of this time-effect on firms with different export and import intensity.[4] This approach suggests that the estimated impact may actually capture the effect of unobserved shocks that differentially impact firms with different export and import intensity (say, a reduction in import tariffs that benefit importing firms or an expiration of export quotas that benefit exporting firms). Our approach, however, allows identification by also exploiting the variation of firm-level distribution of trading partners and the variation of related bilateral exchange rate movements, making the estimation less likely to be affected by unobserved confounding shocks.

To account for the varying distribution of trading partners across firms, we first

[4] Considering only two groups of firms, exporters (importers) and non-exporters (non-importers), reduces the estimation strategy to a simple difference-in-difference.

extend the model of Campa and Goldberg (2001) to include multiple export destinations and import sources. The model shows that the employment response to exchange rate fluctuations depends on the firm-specific exchange rate exposure, which is further determined by a firm's external orientation (reflected by its export and import intensity) as well as its trading partner distribution (reflected by its firm-specific effective exchange rates). Then, we empirically construct the exchange rate exposure and relate it to firm employment changes.

We find a significant but modest impact of exchange rate movements on firm employment. A 10% real appreciation of the RMB against all currencies will only reduce employment in the Chinese manufacturing sector by 0.12%. Notably, accounting for firm heterogeneity in trading partner distribution makes a difference. The incorporation of firm-specific exchange rates, instead of aggregate exchange rates, into the exchange rate exposure creates estimation results that are much closer to the theoretical predictions. We also find that the employment response to exchange rate movements depends on firm ownership and capital intensity, but there is little dependency on productivity. In addition, exchange rate movements have a larger impact on job creation than job destruction.

This paper contributes to the large literature on the impact of exchange rate fluctuations on employment. Most previous works empirically investigate the exchange-employment relationship at the country level or industry level.[5] Empirical investigations at the firm level have only recently begun to emerge. Nucci and Pozzolo (2010) use a panel of Italian manufacturing firms to study the response of net employment to exchange rate fluctuations and focus on identifying different transmission mechanisms behind the exchange rate-employment relationship. Ekholm et al. (2012) investigates the employment response of Norwegian manufacturing firm panel to the appreciation of the Norwegian Krone in the early 2000s. Both papers

[5] See Branson and Love (1988); Revenga (1992); Burgess and Knetter, (1998); Goldberg and Tracy (2000); and Campa and Goldberg (2001) on exchange rate variations and net employment. See Gourinchas (1998, 1999); Klein et al. (2002, 2003) on exchange rate variations and gross job flows.

relate firm employment to a measure of exchange rate exposure that incorporates the changes of *aggregate* effective exchange rate and firm level export and import intensity. Our study follows this approach because our new exchange rate exposure measure also incorporates export and import intensity as important determinants of the employment response to exchange rate fluctuations. Our study is different because we further use the cross-firm variation of the distribution of export destinations and import sources to isolate the effect of exchange rate movement from other confounding variables. For countries such as China, where firms vary substantially in their distribution of trading partners, this dimension of firm heterogeneity serves as a powerful tool to identify the exchange rate impact on real economic outcomes.

Our paper is also related to the literature on effective exchange rate measurement. The traditional effective exchange rate is a piece of macroeconomic data computed with price and trade flow series at the national level.[6] However, the aggregate effective exchange rate does not effectively capture changes in industry competitive conditions induced by moves in specific bilateral exchange rates (Goldberg, 2004). Therefore, the industry-level empirical studies on the real economic impact of exchange rate movements have generally used "industry-specific effective exchange rates" that are constructed using industry level trade weights.[7] In regard to micro level studies using firm-level data, however, even the industry-specific effective exchange rates will miss the dominant proportion of the cross-firm variation in exchange rate movements.[8] To the best of our knowledge, our study is the first to construct firm-specific effective exchange rates and apply them to investigate the impact of exchange rate movements on firms. In addition, a recent paper by Bems and Johnson (2012) proposed a "value-added effective exchange rate" to gauge the international competitiveness of countries in an environment of vertical specialization.

---

[6] See Chinn (2006) for a review of the construction methods and applications of the aggregate effective exchange rates.

[7] See Revenga (1992), Goldberg et al.(1999), Gourinchas (1999), Campa and Goldberg (2001), Goldberg (2004)

[8] We discuss this argument in detail in section 4.

The exchange rate exposure in our study can be observed as a value-added exchange rate at the firm level because the bilateral exchange rates are weighted by a firm's value added in its exports.

The rest of the paper is organized as follows. Section 2 describes the theoretical background of our analysis and derives the firm-specific exchange rate exposure. Section 3 describes the empirical strategy. Section 4 describes the data and conducts a preliminary analysis. Section 5 reports the benchmark results and checks for robustness. Section 6 discusses firm heterogeneity and other issues. The last section concludes the paper.

2. Theory

For a firm trading with multiple countries, the firm employment response to exchange rate movements will depend not only on the extent of external orientation but also the trading partner distributions. We show this situation in a simple theoretical model in Appendix A. The model is an extended version of Campa and Goldberg (2001) to multiple exporting destinations and importing sources so that the distributions of trading partners can vary across firms. Firms may operate in the home country and a multiple of foreign countries with imperfectly competitive markets. Labor demand is derived from a firm's first order conditions and the Euler's equation. Labor supply is assumed to be a simple linear function of wage and aggregate demand. Bilateral exchange rate affects equilibrium firm employment through the firm's changing marginal revenue of export and marginal cost of importing intermediate inputs from a particular market. The direction and magnitude of each channel further depends on the firm's export orientation and reliance on imported inputs from that market. The total employment change induced by exchange rate movements for a firm trading with multiple markets is the summation of the effects in each individual market.[9]

In Appendix A, we show that the impact of exchange rate movements on firm employment can be summarized in the following equation:

$$\Delta \ln L = \sum_{k=1}^{N} \Delta \ln L_k = -\frac{1}{\phi\beta} \sum_{k=1}^{N} [\chi_k - \alpha_k] \Delta \ln e_k \qquad (1)$$

where $\Delta \ln L$ is the percentage change of a firm's total employment, which equals the summation of percentage change of employment associated with bilateral exchange rate movement in each of the firm's individual market ($\Delta \ln L_k$). $\Delta \ln e_k$ is the percentage change of bilateral exchange rate of country k (expressed as the units of foreign currency per home currency such that an increase in e_k indicates appreciation). χ_k is the share of export revenue in market k over total revenue. α_k is the share of expenditure of imported intermediate inputs in market k over total cost. ϕ summarizes a set of other variables that affect firm employment responses to exchange rates, such as markups and the rate of exchange rate pass-through on product and input prices, as well as the wage elasticity of labor supply. β is the share of labor costs over total revenue.

We will call the term $\sum_{k=1}^{N} [\chi_k - \alpha_k] \Delta \ln e_k$ in the right hand side of (1) the change of "firm-specific exchange rate exposure"($\Delta EXPOSURE$), which is a weighted average of bilateral exchange rate movement with the weights reflecting the firm's net export share in a specific market. This firm-specific exposure reveals the key

[9] We assume that independent firm operation in each destination market, which precludes the possibility that the exchange rate movements in one market may affect the output and pricing decisions of the firm in its other export destinations and import sources. The assumption of independent operation in each market is standard in heterogeneous firm trade models, such as Melitz (2003) and Eaton et al. (2011).

transmission channels at the heart of the exchange rate-employment relationship. In addition, the firm-specific exposure is closely related to the exchange rate exposure commonly used in the previous literature. We subsequently discuss these issues.

2.1 Interpreting the firm-specific exchange rate exposure: transmission mechanism

Equation (1) clearly indicates that the employment elasticity of bilateral exchange rate ($\frac{\Delta \ln L_k}{\Delta \ln e_k}$) depends on two firm-destination specific terms, $-\chi_k$ and α_k. These terms characterize two offsetting channels by which exchange rate movements affect firm employment. $-\chi_k$ characterizes how exchange rate movements affect firm employment through the export revenue channel. The negative sign suggests that an appreciation of the home currency against the currency in market k reduces employment. An appreciation reduces the marginal revenue of export in market k and contracts labor demand. A firm's higher export share in market k indicates that employment will be more severely reduced by an appreciation. In contrast, α_k summarizes the impact of exchange rate on employment through the import cost channel. The positive sign suggests that an appreciation against the currency in market k will increase employment. The appreciation makes the imported inputs from market k cheaper, reducing the firm's costs and leading to employment expansion. Similarly, a higher firm share of a firm's import share in market k indicates that firm employment will be more positively affected by an appreciation. The net effect of an appreciation against the currency in market k on the firm's employment will depend on the relative forces of the export revenue and the import cost channel, which is reflected in the firm's net export in market k, $\chi_k - \alpha_k$.

2.2 interpreting the firm-specific exchange rate exposure: relation to the previous

literature

To see how the exchange rate exposure measure in our study relates to the previous literature, we can re-write the change of firm-specific exchange rate exposure as:

$$\Delta EXPOSURE = \sum_{k=1}^{N}[\chi_k - \alpha_k]\Delta \ln e_k = \chi(\sum_{k=1}^{N}\omega_k^X \Delta \ln e_k) - \alpha(\sum_{k=1}^{N}\omega_k^M \Delta \ln e_k) \quad (2)$$
$$\equiv \chi \Delta EXFEER - \alpha \Delta IMFEER$$

where χ and α denote the export and import intensity of the firm, and $\Delta EXFEER$ and $\Delta IMFEER$ are the change of export-weighted and import-weighted *firm-specific effective exchanges*. These effective exchange rates are firm-specific because we use the export and import share of each firm with its trading partners to weigh the bilateral exchange rate.[10] This expression has close antecedents in the literature. Previous studies on the impact of exchange rate movements on firm outcomes (e.g., Nucci and Pozzolo, 2010; Ekholm et al., 2012) construct the exchange rate exposure of a firm as the interaction term between export/import intensity (or net export intensity in Ekholm et al., 2012) and the *aggregate* effective exchange rate. Unlike previous studies, a *firm-specific* effective exchange rate interacts in this paper. We believe that this modification has several advantages.

First, firms export to and import from different countries whose exchange rates against the RMB may move very differently, indicating that firms are theoretically affected by different effective exchange rate movements. However, nearly all previous studies applied the aggregate effective exchange rate and implicitly assume that all firms are faced with identical exchange rate shocks. As emphasized in the

---

[10] Specifically, $\omega_{ik}^X = (p_{ik}^* q_{ik}^* / e_k) / (\sum_{k=1}^{N} p_{ik}^* q_{ik}^* / e_k)$, $\omega_{ik}^M = (s_k^* z_{ik}^* / e_k) / (\sum_{k=1}^{N} s_k^* z_{ik}^* / e_k)$

introduction, such treatment in firm level empirical studies will lead to inconsistency when the trading partner distribution is diversified across firms.

Second, the incorporation of firm-specific exchange rates into the key regressor adds another source of cross-firm variation other than firm export and import intensity to identify the impact of exchange rate movement. This approach allows us to isolate the impact of unobserved firm characteristics that simultaneously correlate with firm export and import intensity and employment decisions. In section 4, we will show that an application of the firm-specific exchange rates yields estimation results that are closer to theoretical predictions compared with an application of the aggregate exchange rates.

3. Background and Data description

3.1 Background: China's exchange rate

China's exchange rate regime has experienced drastic changes since the 1990s. Prior to 1994, China adopted a "dual track" exchange rate system, in which an official exchange rate represents the planned system, and a swap exchange rate represents the market system. The market-determined exchange rate played an increasingly important role, and the government ultimately unified the dual exchange rates into a single market exchange rate at 8.61 RMB per dollar, which was fixed for the entire period of 1994-2005. The effective exchange rate during this period experienced a gradual appreciation of over 20% from 1994-2001, followed by a gradual depreciation of approximately 15% from 2001-2005. In July 2005, however, the government switched the strict pegging of the RMB to the dollar to a more flexible managed-floating regime, in which the exchange rate is allowed to fluctuate within a certain band around the par determined by the exchange rates against an unannounced basket of currencies. The exchange rate regime reform put the RMB back on the appreciation track. From 2005-2006, the real effective exchange rate appreciated by 1.6%. The pattern of nominal and real effective exchange rate movement is depicted in Figure 1.

Although it is widely known that the RMB was fixed against US dollars from

1998-2005, the bilateral exchange change rate against the currencies of China's other major trading partners evolved in quite different patterns. In Figure 2, we selected four of China's biggest trading partners, the U.S., the Euro zone, Japan and Korea, and depicted their currency exchange rates against the RMB. It is apparent that these rates have very different trajectories. For example, the exchange rate against the U.S. dollar remains constant (due to pegging) in 2000-2005. However, the Yen and Won rates appreciated from 2000-2002 and depreciated after 2002. At the end of 2005, the Yen and Won nearly returned to their 2000 value. For the Euro, however, the RMB is generally depreciating, with value decreases of more than 20% from 2000-2005. These differences became even more pronounced after exchange rate regime reform in 2005. From 2005-2007, the RMB simultaneously showed sharp appreciated against the Yen (nearly 20%), modest appreciation against the U.S. Dollar (approximately 5%), and depreciation against the Euro and the Won. The different trajectories of different bilateral exchange rates imply that firms trading with different countries are faced with very different exchange rate shocks. We will use this cross-sectional variation in exchange rate movements to isolate the effect of exchange rates from other confounding variables.

3.2 Data description

Firm level production data. The firm level data in this paper comes from Annual Surveys of Manufacturing Firms conducted by the National Bureau of Statistics of China from 2000 to 2006. The survey includes all State Owned Enterprises (SOE) and those Non-State Owned Enterprises with annual sales of RMB five million (or equivalently, about $650,000) or more. The dataset includes information from balance sheets, firm profit and loss statements, and cash flow statements, incorporates approximately 80 variables, and provides detailed information on firm identification, employment, ownership, export status, capital stock, revenue, and other factors. These firms contribute approximately 98% of total Chinese manufacturing exports in the aggregate trade data. We cleaned the data by following Feenstra et al. (2011) and dropping observations that report missing or negative values for any of the following variables: total sales, total revenue, total employment, fixed capital, export value, intermediate inputs, if export value exceeds total sales or if share of foreign asset exceeds one. We include firms with at least eight employees. However, these data do not provide information about firm exports locations, the value exported to each country, or firm imports.

Transaction level trade data. The transactions level customs data are from China's General Administration of Customs from 2000-2006. The data contain disaggregate transaction level information of a firm's trading partners by country, trading mode, trading price, quantity and value at the HS8 digit level. Importantly, this dataset let us calculate each firm's export and import value from any specific country, which allows us to construct the trade weight in the firm-specific exchange rate exposure. The data are recorded monthly, but we aggregate it to the annual level to merge with the firm level data recorded annually.

Matching the Two Datasets. Matching the firm level data with the transactions level data is challenging because the two datasets use different firm identifiers, nine digit ID in the firm level data vs. an eleven digit ID in the customs data, with no common elements. Following the approach of Tian and Yu (2012), we merge the two datasets using firm name, telephone number and zip code. We are able to merge 90590 firms with export values accounting for 54% of the total export value in the firm level production data.

Exchange rate and price index data. Nominal exchange rate data comes from International Financial Statistics (IFS), and the price index comes from the consumer price index data in Penn World Tables 7.0.

Table 1 reports the basic information of the final sample used for subsequent analysis. The sample includes 97648 firms, which conduct 1.42 trillion exports and 1.01 trillion imports over the sampled years.[11] Very importantly, these firms trade

---

[11] Among the 261867 firm-year pairs, 29.5% only export, 13.9% only import, and 56.6% both export

with a diverse basket of countries with different national currencies. The number of exporting destinations and importing sources are 170 and 166, respectively, and 131 different types of currencies are adopted in these countries. This diversity of trading partners and their associated national currencies suggest that the exchange rate movements faced by different Chinese manufacturing firms may exhibit huge difference.

4. Firm-specific exchange rate exposure and firm-specific effective exchange rates

4.1 Construction

We construct the change of firm-specific exchange rate exposure according to equation (1) using firm-destination specific exports (EX_{ikt-1}), imports (M_{ikt-1}), firm total sales (R_{it-1}) and bilateral exchange rates relative to base year value (E_{kt}/E_{k0}) as follows:

$$\Delta EXPOSURE_{it} = \sum_{k=1}^{n} [(EX_{ikt-1} - IM_{ikt-1}) / R_{it-1}] \Delta \ln(E_{kt} / E_{k0}) \qquad (3)$$

All trade and sales variables are lagged one period to avoid possible endogeneity issues. We choose 2000 as the base year for E_{k0}.[12]

Another method of constructing firm-specific exchange rate is based on Equation (2).From this perspective, the change of exchange rate exposure can be decomposed

---

and import.

[12] Brodsky (1982) proved that the base year choice does not alter the growth rate of effective exchange rate when effective exchange rate is calculated as the geometric average of bilateral exchange rates, as in this paper.

into an interaction between export intensity (χ_{it-1}) and the change of firm-specific export-weighted effective exchange rate ($\Delta EXFEER_{it}$), as well as an interaction term between import intensity (α_{it-1}) and the change of firm-specific import-weighted effective exchange rate ($\Delta IMFEER_{it}$). This expression is quite useful to understand the impact of exchange rate movements through the revenue and cost channel, and we empirically construct the change of firm-specific export (import)-weighted effective exchange rates (in logs) as a weighted average of bilateral exchange rate changes, with weights reflecting firm export (import) share with each of its trading partners. That is,

$$\Delta EXFEER_{it} = \sum_{k=1}^{n} (EX_{ik,t-1} / \sum_{k=1}^{n} EX_{ik,t-1}) \Delta \ln(E_{k,t} / E_{k,0}) \qquad (4)$$

$$\Delta IMFEER_{it} = (\sum_{k=1}^{n} IM_{ik,t-1} / \sum_{k=1}^{n} IM_{ik,t-1}) \Delta \ln(E_{k,t} / E_{k,0}) \qquad (5)$$

4.2 Preliminary analysis

One advantage of the firm-specific exchange rate exposure is the ability to exhibit substantial cross-firm variation that can be exploited to identify the impact of exchange rate movements. To show this feature, Figure 3 graphs the kernel density distribution of the firm-specific exchange rate exposure changes from 2005-2006.[13] For comparison, we also graph the distribution of the aggregate exchange rate exposure changes used in previous firm-level studies (e.g., Nucci and Pozzolo,2010; Ekholm et al., 2012).[14] The firm-specific exchange rate exposure clearly exhibits

---

13 The results of other periods are very similar and are available upon request.

14 Constructed as $\Delta EXPOSURE\_AGG_{it} \equiv \chi_{i,t-1} \Delta EXAEER_t - \alpha_{i,t-1} \Delta IMAEER_t$. Where $EXAEER_t$ and $IMAEER_t$ are the aggregate export-weighted and import-weighted effective exchange rate. We calculate these aggregate rates as follows. We first aggregate the merged sample firm level trade information to the country level and obtain the aggregate value of trade with each of China's trading partners. We then replace the firm level export and import values with their country level

considerably larger cross-firm variation than its aggregate counterpart because the cross-firm variation of firm-specific exchange rate exposure stems from two sources: the variation of export and import intensity as well as the variation of firm-specific exchange rates, whereas only the former influences the variation of the aggregate exchange rate exposure.

In countries, such as China, that diversified trade among many countries, it is important to account for the cross-firm variation of effective exchange rates. Figure 4 plots the cross-firm distribution of the firm-specific effective exchange rate changes from 2005-2006, a period when RMB effective appreciation began.[15] It is apparent that the firm-specific effective exchange rates have quite a dispersed distribution. From 2005-2006, the RMB appreciated by a modest 1.57% in the aggregate effective exchange rate. However, our calculation indicates that only 61% of firms experienced an appreciation in the export-weighted FEER, and 17% of firms actually experienced an effective depreciation. The other firms had a constant FEER. Over 30% of firm effective exchange rates appreciated by more than 5%, and over 21% appreciated by more than 10%. Therefore, a mere examination of the aggregate effective exchange rate will miss the substantial variation in exchange rate movements cross firms.

In industry level studies, the industry-specific effective exchange rate is commonly adopted to capture the cross-industry variation in exchange rate movements.[16] Does this industry-specific exchange rate sufficiently capture the variation of exchange rate movements across firms and correct the estimation bias inherent in the micro level study of aggregate effective exchange rate? To answer this

---

counterparts and use equations (5) and (6) to calculate the export-weighted and import-weighted aggregate effective exchange rates.

[15] To ensure the validity of the firm-specific exchange rate calculation, Appendix B graphs the mean of firm-specific effective exchange rate changes for comparison with the changes of the aggregate effective exchange rate. The two rates are quite similar. We compare the kernel density distribution of the firm-specific effective exchange rate changes from 2001-2002, when the RMB depreciated, and 2005-200, when the RMB appreciated. We see that the distribution shifts to the right from 2005-2006, confirming an appreciation for the majority of firms.

[16] E.g. Revenga (1992); Burgess and Knetter (1998); Goldberg and Tracy (2000); and Campa and Goldberg (2001).

question, we follow Helpman et al. (2012) and decompose the total variation of firm-specific exchange rate movements (Tt) into a within-industry component (Wt) and a between industry component (Bt).

$$T_t = W_t + B_t \tag{6}$$

where

$$T_t = \frac{1}{N_t}\sum_l \sum_{i\in l} (\Delta FEER_{it} - \Delta \overline{FEER_t})^2 \tag{6a}$$

$$W_t = \frac{1}{N_t}\sum_l \sum_{i\in l} (\Delta FEER_{it} - \Delta \overline{FEER_{lt}})^2 \tag{6b}$$

$$B_t = \frac{1}{N_t}\sum_l N_{lt}(\Delta \overline{FEER_{lt}} - \Delta \overline{FEER_t})^2 \tag{6c}$$

where i , l and t denotes firm, industry and time, respectively. $FEER_{it}$, $\overline{FEER_{lt}}$, $\overline{FEER_t}$ are the firm level exchange rate, the average FEER within industry l, and the average FEER in time t (all in logs). We separately decompose the export and import FEER and report the results in Table 2. It is shown that within-industry variation played a dominant role and accounted for over 90% of the total variation of the firm-specific effective exchange rate movements, while the between-industry variation account for less than 10%. At the micro level, the industry-specific exchange rate will miss the majority of variation in the exchange rate movements and generate biased estimates. It should be noted, however, that the industry-specific exchange rates are appropriate for industry level studies, as in Campa and Goldberg (2001).

5. Firm-specific exchange rate exposure and employment adjustment

5.1 Econometric specification

According to Equation (1), we use the following specification to relate a firm's log employment changes ($\Delta \ln L_{it}$) to its exchange rate exposure changes ($\Delta EXPOSURE_{it}$) calculated in section 4:

$$\Delta \ln L_{it} = \alpha + \beta \Delta EXPOSURE_{it} + \Delta X_{it} + v_j + \lambda_t + \varepsilon_{it} \qquad (7)$$

ΔX_{it} is a set of control variables (in changes), including the firm's domestic sales (in logs) to control for domestic demand shocks, and firm level markup to control for the impact of market power.[17] The summary statistics of the main variables are reported in Table 3. We include a full set of industry dummies (v_j) and year dummies (λ_t) to control for the impact of intrinsic industry characteristics and macroeconomic conditions on employment. ε_{it} is an error term with standard properties. We estimate equation (7) with ordinary least squares and cluster the standard errors at the 4-digit industry level.

Furthermore, we separately evaluate the impact of the exchange rate movements through the export revenue and import cost channel by decomposing the exchange exposure into an interaction between export intensity (χ_{it-1}) and firm-specific export-weighted effective exchange rate change ($\Delta EXFEER_{it}$), as well as an interaction term between import intensity (α_{it-1}) and firm-specific import-weighted effective exchange rate change ($\Delta IMFEER_{it}$), as in equation (2). To be more precise, we adopt the following specification:

$$\Delta \ln L_{it} = \alpha + \beta_X \chi_{it-1} \Delta EXFEER_{it} + \beta_M \alpha_{it-1} \Delta IMFEER_{it} + \Delta X_{it} + v_j + \lambda_t + \varepsilon_{it} \qquad (8)$$

where the two firm-specific exchange rate terms are calculated as a weighted average

[17] Markup is calculated by the firm's total sales over total sales minus profit, as in Keller and Yeaple (2009).

of bilateral exchange rates, as in equation (4) and (5). The control variables and estimation methodology are identical to equation (7).

5.2 Benchmark results

Table 4 reports the equation (7) estimation result. In Column (1), we simply regress the log employment on the firm-specific exchange rate exposure and a set of year dummies. According to the theory, the expected sign of the coefficient of interest, β, should be negative. Indeed, the coefficient is negative and significant at the 1% level in Table 4, implying that an effective RMB appreciation reduces employment for a firm with positive net exports. This finding is consistent with the theoretical prediction in section 2. In Columns (2) and (3), we add industry dummies and firm total sales and markup as additional control variables. The negative sign before the exchange rate exposure continues to hold.

To assess the magnitude of the impact, we conduct a back-of-the-envelope calculation by imputing the point estimate of β in Column (3) β and the actual change of the real exchange rate exposure[18] The results show that the average impact of exchange rate on employment is very small. The year-on-year employment change induced by exchange rate movements is generally less than 0.1%, which explains less than 3% of the actual employment change in the sampled firms. From 2005-2006, the effective appreciation reduced employment by only 0.042%, while the actual employment increased by 4.74%. The detailed results are reported in Table C1 .We also simulate the scenario that all bilateral exchange rates appreciate by 10% and find that the associated employment change is only 0.12%.

While a consideration of the average effect is informative, the most interesting

---

[18] We calculate the predicted employment change induced by the exchange rate movements as $\Delta \ln \hat{L}_{it} = \hat{\beta} \Delta EXPOSURE_{it}$, where $\hat{\beta}$ is the point estimate of β in Column (3) of Table 4 and $\Delta EXPOSURE_{it}$ is the actual change in firm-specific exchange rate exposure.

component of our study investigates how the impact of exchange change rate movements varies across firms. This variation can result from the difference in firm export (import) intensity and firm distributions of trading partners and firm-specific effective exchange rates. For every year in the sample, we notably find that the predicted employment change median is actually zero. For every year that the exchange rate movements induced expanded employment in approximately half of the firms, the other half contracted employment. This finding always holds true regardless of whether the RMB exchange rate is effectively appreciating or depreciating at the aggregate level. However, even for the greatest affected firms, the employment reduction (expansion) is still less than 1%. The detailed results are reported in Table C2 .

We separately investigate the impact of the export revenue channel and import cost channel by estimating equation (8). The results are reported in Columns (4) to (6) of Table 4. Consistent with the theoretical prediction, the coefficient before the export interaction term is negative and significant, implying that an effective appreciation of the exchange rate reduces employment in exporting firms by reducing export revenue and labor demand. On the contrary, the coefficient before the import interaction term is positively significant and consistent with the theoretical predictions. An effective appreciation reduces the cost of imported intermediate inputs, inducing a production expansion and increased labor demand.

5.3 Firm-specific exchange rate exposure vs. Aggregate exchange rate exposure

As the theory section describes, our approach is primarily different from previous firm-level studies because we incorporate the “firm-specific effective exchange rate”, instead of the aggregate effective exchange rate, into the exchange rate exposure measure. We argue this extension will help correct the bias that results from ignoring the cross-firm variation of effective exchange rate movements and increase the estimation’s precision by introducing more sources of variation.

To see whether our approach is better than the approaches generally used in the literature, we repeat the regressions of equations (7) and (8) using the aggregate exchange rate exposure. The first column in Table 5 shows that the coefficient before the exchange rate exposure is still negative but not significant. This result may be caused by the ignorance of the variation of trading partner distributions across firms. Both the coefficient before the export interaction and the import interaction are negative in column (2), which is inconsistent with the theory predictions in section 2. In China and other countries with diversified trading partner distributions, it is important to account for the cross-firm variation of effective exchange rate movements to obtain consistent estimations of the real economic impact of exchange rate movements on firms.

5.4 Robustness

We have conducted a series of checks to ensure the robustness of the benchmark results**.** First, we use the nominal exchange rates instead of real exchange rates to calculate the exposure and repeat the regressions in equation (7). Second, we use the current trade share instead of lagged trade share to weigh the firm-specific effective exchange rates. Third, we include industry-year fixed effects as additional regressors to rule out the potential impact of industry-specific demand and supply shocks on firm employment.

In addition to the revenue channel and the cost channel explicitly modeled in section 2, exchange rate movements may also affect firm employment by changing the extent of import competition (Campa and Goldberg, 2001). Home currency appreciation makes foreign products relatively cheaper, increases the import competition faced by domestic firms, and reduces labor demand. To check whether exchange rate affects firm employment through this additional channel, we follow Ekholm et al.(2012) and add to equation (7) an interaction term between the industry import penetration ratio and the aggregate effective exchange rate change.

The results in Table 6 show that the benchmark results hold well in all sensitivity checks. In Column (7)-(8), the coefficient before the import competition term is negative but not significant. Therefore, the results suggest that exchange rate changes may not significantly impact employment by changing the industry’s extent of import competition.

6. Further Discussions

6.1 Selection and the extensive margin.

Notably, we used the matched trade-production data for our analysis and therefore focus on the behavior of a sample of trading firms, i.e., firms that are exporters, importers or both. Firms that neither export nor import will not appear in the sample.[19] Therefore, we cannot observe the employment change at the "extensive margin", i.e., employment changes of firms that enter the sample by becoming an exporter or an importer or quit the sample by ceasing exporting and importing at the same time. We cannot observe the employment changes caused by firm birth and death. Admittedly, our data are not able to perfectly account for this employment change at the extensive margin. However, we argue that it is not very likely that this limitation will qualitatively alter our conclusion.

A firm quits our sample only when it ceases both exporting and importing. i.e., a firm remains in the sample if it ceases exporting (importing) but keeps importing (exporting). Exchange rate movements have opposite effects for exports and imports and theoretically cannot increase (or decrease) both exports and imports at the same time. Therefore, it is unlikely that a firm leaving from the sample is caused by exchange rate fluctuations. In this case, the change of employment at the extensive margin will neither correlate with exchange rate movements nor affect the consistency of our estimation.[20]

Admittedly, firms that enter or quit markets may show different labor adjustment decisions compared with other firms that remain in the market. Mixing both samples

[19] It is not correct to set the exchange rate exposure as zero for the unmatched firms. Firms that are not matched could still be exporters or importers.

[20] A possible exception is processing trade, where firms import for re-export (Dai et al., 2012; Yu,2012). Under the processing regime, the exchange rate movement may potentially lead to the co-movements of exports and imports (Xing,2012).

together is still likely to induce estimation bias. To gauge whether this potential problem is important, we can actually test how exchange rate movements affect employment changes at the extensive margin by focusing on the firms that changed either their exporting status or importing status (but not both). To do this, we generate four switching dummy variables $ENTER\_EXP_{it}$, $ENTER\_IMP_{it}$, $EXIT\_EXP_{it}$, $EXIT\_IMP_{it}$, which equals 1 when firm i enters exporting, enters importing, exit exporting and exit importing at year t, respectively. We then run the regressions (in first-difference) separately for each switching subsample, i.e., the subsample with one of the switching dummies equal to 1. These regressions examine how exchange rate movements affect the employment change at the extensive margin. For comparison, we run the regression on the firm-year pairs that do not exhibit exporting and import status switching. These regressions examine employment change at the intensive margin.

The results are reported in Table 7. Columns (1) to (4) examine the employment response for firms that enter exporting, exit exporting, enter importing and exit importing, separately. The results show that exchange rate movements have a relatively large, significantly impact firms that enter exporting (Column 1) and exit importing (Column 4). However, exchange rate movements do not have a significant impact on employment for firms entering exporting, entering importing or exit importing (Column 2 and 3). These results suggest that exchange rate movements generally have mixed impacts on employment changes at the extensive margin. In contrast, Columns (5) to (7) suggest that exchange rate movements have a significant impact on the intensive margin. The impact of exchange rate movements are significant and have expected signs for firms that continue to export, continue to import or continue both activities. We are not able to perfectly recover the employment changes at the extensive margin, but the above analysis suggests that these limitations are not likely to qualitatively overturn our basic conclusions about the exchange rate-employment relationship.

6.2 Firm heterogeneity

Thus far, all results in the last section are under the restriction that the employment elasticity with respect to exchange rate is identical for all firms. However, one advantage of using firm-level data is the ability to observe different responses from firms with different characteristics. Table 8 explores the role of firm heterogeneity in three dimensions: capital intensity, productivity and ownership.

We first divide all firms into two subsamples according to labor intensive industries or capital intensive industries.[21] Columns (1) and (2) show that the coefficients are negative and significant for firms in labor intensive industries but not for capital intensive firms, which suggests that labor intensive firms have a larger employment response to exchange rate movements. This finding is not consistent with the theoretical predictions in Appendix A because the employment response to exchange rate movements decreases in the model's ratio of labor cost. One possible reconciling explanation is that capital intensive firms may have more capital to participate in hedging activities and alleviate any real exchange rate movement impact.

The second dimension of heterogeneity is productivity. The recent literature on firm heterogeneity has emphasized the role of productivity differences among firms when determining their optimal response to exchange rate movements. To investigate how productivity differences affect firm employment decisions following an exchange rate swing, we run the equation (7) regression on the subsample of high productivity and low productivity firms, respectively. We measure productivity by total factor productivity (TFP) following the algorithm developed by Olley and Pakes (1996). High (low) productivity firms are defined as firms with TFP above (below) their 4-digit industry median. The results show that both high productivity and low productivity firms have significant responses to exchange rate movements, while the

[21] We group all industries into two equally sized categories, capital intensive and labor intensive, according to the median capital labor ratio of each industry. In unreported results, we also define firms to be "capital intensive firms" or "labor intensive firms" according to whether their capital labor ratio is higher or lower than the 4-digit industry median. The results are qualitatively similar.

response from low productivity firms is slightly larger. This finding is basically consistent with the finding in Berman et al. (2012) indicating that low productivity firms adjust to exchange rate movements at the quantity margin while high productivity firms adjust at the price margin. If employment is more responsive to trade quantity than trade prices, then low productivity firms may have a larger employment response.

To investigate the employment response variation with firm ownership, we repeat the regression for the subsample of state owned enterprises (SOEs), foreign invested enterprises (FIEs) and private owned enterprises (POEs), respectively. The results show that SOE employment does not significantly react to exchange rate movements, while private enterprises have relatively larger reactions. This result is consistent with the special characteristics of SOEs in China. The employment decisions of SOEs in China are restricted by a centrally planned system (*bianzhi* in Chinese), which is unlikely to be responsive to changes in market conditions.

6.3 Job creation and job destruction

Net employment changes can result from both job creation and job destruction. Some previous studies find that exchange rate movements have asymmetric effects on job creation and job destruction. Klein et al. (2003) find that job destruction is more responsive than job creation in the United States. Moser et al. (2010), however, find that employment adjustment (among surviving firms) primarily operates through job creation rather than job destruction in Germany.

We investigate this question by separately repeating our benchmark regression on job creation and job destruction. Analogous to Davis and Haltiwanger (1990), we measure job creation (job destruction) as the log employment change for firms with positive (negative) employment growth. The results are reported in Table 9. We show that the coefficient of interest is negatively significant for job creation but insignificant for job destruction. Therefore, only job creation seems to be responsive to exchange rate movements for Chinese firms. This finding is in contrast to Klein et al. (2003) for the U.S. economy but similar to Moser et al. (2010) for Germany.

7. Conclusion

This paper uses firm-level micro data to revisit the impact of exchange rate movements on employment. We improved the identification strategy of previous studies by exploiting the variation in firm external orientation and trading partner distributions. These elements are incorporated into a theory-consistent and *firm-specific exchange rate exposure* to re-examine the exchange rate-employment relationship in Chinese manufacturing firms. We show that the incorporation of trading partner distributions into the exchange rate exposure yields estimation results that are closer to theoretical predictions compared with the method used in previous studies.

Based on this method, we find that the exchange rate fluctuations significantly affect firm employment decisions by affecting export revenue and import cost yet produce an economically modest effect. A 10% appreciation of the RMB against all currencies will produce an employment decline in the sampled firms by only 0.12%. We also find that the effect is not uniform across firms. A large proportion of firms cut employment due to the appreciation, but a comparable proportion of firms raise employment. Moreover, job creation is found to be more responsive than job destruction.

Our findings have important policy implications. Governments in developing countries usually fear real appreciation due to potential negative effects on employment and social stability. Our results show that the employment effect of the appreciation is not large, at least when the appreciation is not drastic in a short period. Therefore, some flexibility in exchange rate formulation is unlikely to disturb the real economy.

References

Bems R. and R.C. Johnson, 2012, "Value-added exchange rates", *NBER Working Paper*, No. 18498.

Berman N., P. Martin, T. Mayer, 2012, "How do different exporters react to exchange rate changes?", *The Quarterly Journal of Economics*, Vol.127(1), pp. 437-492.

Bernard A.B. and J.B. Jensen，1999, "Exceptional exporter performance: cause, effect, or both?", *Journal of International Economics*, Vol. 47(1), pp.1-25.

Branson W.H. and Love J.P., 1986, "Dollar appreciation and manufacturing employment and output", *NBER Working Paper*, No.1972.

Branson W.H. and Love J.P., 1987, "The real exchange rate and employment in US manufacturing: state and regional results", *NBER Working Paper*, No. 2435.

Burgess S.M. and M. Knetter, 1998, "An international comparison of employment adjustment to exchange rate fluctuation", *Review of International Economics*, Vol.6(1), pp. 151-163.

Campa J.M. and L.S. Goldberg, 2001, "Employment versus wage adjustment and the US dollar", *The Review of Economics and Statistics*, Vol. 83(3), pp. 477-489.

Das, S., Roberts, M. J., and Tybout, J.R.,2007, "Market Entry Costs, Producer Heterogeneity, and Export Dynamics", *Econometrica*, 75(3), 837-873.

Dell'Ariccia G., 1999, "Exchange rate fluctuations and trade flows: evidence from the European Union", *IMF Staff Papers*, Vol. 46(3), pp. 315-334.

Eaton, J., Kortum, S., Kramarz, F., 2011. An Anatomy of International Trade: Evidence from French Firms. Econometrica 79(5), 1453-1498.

Ekholm,Karolina, Moxnes,Andreas and Ulltveit-Moe, Karen-Helene (2012), "Manufacturing Restructuring and The Role of Real Exchange Rate Shocks" *Journal of International Economics*, 86,101-117

Goldberg L.S., 2004, “Industry-specific exchange rate for the US”, *Economic Policy Reivew*, Vol. 10(1), pp.1-16.

Gourinchas P.O.，1999, “Exchange rate do matter: French job reallocation and exchange rate turbulence: 1984-1992”, *European Economic Review*, Vol.43(7), pp.1279-1316.

Hooper P. and S.W. Kohlhagen, 1978, “The effect of exchange rate uncertainty on the prices and volume of international trade”, *Journal of International Economics*, Vol.8(4), pp. 483-511.

Hua P., 2007, “Real exchange rate and manufacturing employment in China”, *China Economic Review*, Vol.18(3), pp. 335-353.

Keller W. and S.R. Yeaple, 2009, “The gravity of knowledge”, *NBER Working Paper*, No. 15509.

Klein M.W., S. Schuh, R.K. Triest, 2003, “Job creation, job destruction, and the real exchange rate”, *Journal of International Economics*, Vol.59(2), pp. 239-265.

Melitz, M.J., 2003. The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity. Econometrica 71, 1695-1725

Mao R.S. and J. Walley, 2011, “Ownership Characteristics, Real Exchange Rate Movements and Labor Market Adjustment in China”, *NBER Working Paper*, No.17565.

Nucci F. and A.F. Pozzolo, 2010, “The Exchange Rate, employment and hours: What firm-level data say”, *Journal of International Economics*, Vol. 82(2), pp.112-123.

Olley S. and A. Pakes, 1996, “The dynamics of productivity in the telecommunications industry”, *Econometrica*, Vol. 64(6), pp. 1263-1297.

Revenga A., 1992, “Exporting jobs? The impact of import competition on employment and wages in US manufacturing”, *Quarterly Journal of Economics*, Vol.107(1), pp. 255-284.

Roberts, M.J., and Tybout, J.R. ,1997. “The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Cost”, *American Economic Review*, 87, 545-564.

Yu, M. and W. Tian, “China’s Processing Trade: A Firm-Level Analysis,” in Huw McMay and Ligang Song (eds.) Rebalancing and Sustaining Growth in China, Australian National University E-press, pp.111-148, 2012.

Appendix A : a simple model of exchange rate movement and firm employment with multiple export destinations and import sources.

In order to capture the fact that firms face different exchange rate movements because of different destination structure of their exports and imports, we extend the model of Campa and Goldberg(2001) and Nucci and Pozzolo (2010) by incorporating multiple export destinations and import sources. This allows us to examine the employment response when a firm is exposed to simultaneous exchange rate changes from its multiple trading partners.

Consider the profit maximizing problem for a representative firm that can potentially sell its products in the home market and export to N foreign countries, given the following conditions: (1) demand in the home and foreign markets are described by the downward-sloping demand function $q(p)$ and $q_k^*(p_k^*)$, respectively, where p is the price in the domestic market, p_k^* is the price in the foreign market k (denominated in the currency of country k). (2) Technology is described by a constant returns to scale production function, $q = f(L, z, \mathbf{z}^*)$, where L is the amounted of labor input, z is the level of domestically purchased non-labor inputs, and $\mathbf{z}^* = (z_1^*, z_2^*, ..., z_k^*, ..., z_N^*)$ is the level of imported non-labor inputs from N countries , with each element representing the level of imported inputs from country k (in the case that a firm doesn't import from market k, $z_k^* = 0$). (3) price of domestically purchased inputs given as s and the price of imported inputs given as $\mathbf{s}^* = (s_1^*, s_2^*, ..., s_k^*, ..., s_N^*)$ (4) nominal exchange rate in country k exogenously given as e_k, which is expressed as the unit of foreign currency per home currency (so an increase in e_k means an appreciation of the home currency against the currency in country k). Under these assumptions, the profit maximization problem of the firm can be written as:

$$\max_{q,q_k^*,L,z,z_k^*}[p(q)q+\sum_{k=1}^{N}\frac{p_k^*(q_k^*,e_k)q_k^*}{e_k}-sz-\sum_{k=1}^{N}\frac{s_k^*(z_k^*,e_k)z_k^*}{e_k}-wL] \quad (1)$$

$$s.t. q+\sum_{k=1}^{N}q_k^*=f(L,z,\mathbf{z}^*)$$

Taking the derivatives with respect to q, q_k^*, L, z, z_k^* yields the following regular first order conditions:

$$\frac{\partial p(q)}{\partial q}q+p-\lambda=0 \quad (2)$$

$$(\frac{\partial p_k^*(q_k^*,e_k)}{\partial q_k^*}q_k^*+p_k^*)\frac{1}{e_k}-\lambda=0 \quad (3)$$

$$\lambda\frac{\partial f(L,z,\mathbf{z}^*)}{\partial L}-w=0 \quad (4)$$

$$\lambda\frac{\partial f(L,z,\mathbf{z}^*)}{\partial z}-s=0 \quad (5)$$

$$\lambda\frac{\partial f(L,z,\mathbf{z}^*)}{\partial z_k^*}-\frac{s_k^*}{e_k}=0 \quad (6)$$

Where $\lambda=p(1+\frac{1}{\eta})=p_i^*(1+\frac{1}{\eta_i^*})$ is the Lagrangian multiplier for the technology constraints. η and η_i^* are the elasticity of demand in the home and foreign market, respectively. These F.O.C.s determine the optimal demand for labor. Using the Euler's theorem, the labor demand of the firm can be expressed as firms' total cost minus the cost of purchasing intermediate inputs.

$$\ln L = \ln[\frac{pq}{\mu} + \sum_{k=1}^{N} \frac{p_k^* q_k^*}{\mu_k^* e_k} - sz - \sum_{k=1}^{N} \frac{s_k^*(e_k) z_k^*}{e_k}] - \ln w \qquad (7)$$

Where $\mu = \frac{\eta}{1+\eta}$ and $\mu_k^* = \frac{\eta_k^*}{1+\eta_k^*}$ are the mark-ups in the home and foreign markets, respectively.

In order to solve for the equilibrium level of employment, we follow Campa and Goldberg (2001) and adopt a simple labor supply function: $\ln L = a_0 + a_1 \ln w + a_2 y$, where y represents the aggregate demand in the economy. Replacing $\ln w$ in equation (7) with the labor supply function, and then take derivatives with respect to e_k. After some manipulation, we can express the elasticity of equilibrium employment with respect to e_k as follows:

$$\frac{\partial \ln L}{\partial \ln e_k} = \frac{\partial L}{\partial e_k}\frac{e_k}{L} = -\frac{1}{\phi\beta}[\chi_{ik} - \alpha_{ik}] \qquad (8)$$

Where $\phi = \frac{a_1 \mu}{(1+a_1)(1-\xi)}$, $\xi \in [0,1]$ is the exchange rate elasticity of output and input prices in terms of the local currency, i.e. the pass-through rate [22], β is the share of labor cost over total revenue, $\chi_{ik} \equiv (p_{ik}^* q_{ik}^* / e_{ik}) / (p_i q_i + \sum_{k=1}^{N} p_{ik}^* q_{ik}^* / e_{ik}) \in [0,1]$ is the firm's exports to market k as a share of its total exports. ; $\alpha_{ik} \equiv (s_{ik}^* z_{ik}^* / e_k) / [(p_i q_i + \sum_{k=1}^{N} p_{ik}^* q_{ik}^* / e_k) / \mu] \in [0,1]$ is the firm's import costs of inputs from market k as a share of its total costs.

---

[22] We assume that the pass-through rate is identical for output and input prices. We also assume the markups are identical across markets. i.e. $\mu = \mu_k^*$ for any k.

Re-write equation (8) in its discrete form, the log change of equilibrium employment induced by the log change of bilateral exchange change rate can be expressed as

$$\Delta \ln L_k == -\frac{1}{\phi\beta}[\chi_k - \alpha_k]\Delta \ln e_k \qquad (9)$$

Under the assumption that demand in each foreign country is independent, the total employment change induced by exchange rate movements for a firm trading with multiple countries is simply the summation of the effects with each of its trading partners.

$$\Delta \ln L = \sum_{k=1}^{N} \Delta \ln L_k = -\frac{1}{\phi\beta}\sum_{k=1}^{N}[\chi_k - \alpha_k]\Delta \ln e_k \qquad (10)$$

Appendix B: Description of firm-specific effective exchange rates

[Insert Figure B1]

[Insert Figure B2]

Appendix C: Economic Magnitude

[Insert TableC1]

[Insert TableC2]

Tables and figures

Table 1 Data summary

Number of firms	
Exporters	85,585
Importers	75,594
Trade value（trillion USD）	
Exports	1.42
Imports	1.01
Number of trading partners	
Export	170
Import	166
Number of currencies used by trading partners	137
Export	137
Import	135

Table 2 Exchange rate growth decomposition: within-industry v.s. between-industry variation

Exchange Rate Type	Within Industry（%）	Between Industry(%)
Export weighted FEER	95.7	4.3
Import weighted FEER	94.8	5.2

Note: This table reports the contribution of within-industry variation and between industry variation to the total variation of firm-specific exchange rate changes. Within industry contribution= W_t / T_t. Between industry contribution= B_t / T_t. T_t, W_t, B_t are calculated based on 6a-6c.

Table 3 Summary statistics of the main variables

Variables	Mean	Median	Standard deviation	25th Quantile	75th Quantile
ΔEXPOSURE	-0.0010	0	0.0463	-0.0040	0.0062
ΔEXFEER	-0.0017	0	0.0472	-0.0030	0.0044
ΔIMFEER	0.0003	0	0.0371	-0.0024	0.0010
Export Intensity	0.2983	0.1495	0.3292	0.0137	0.5444
Import Intensity	0.1272	0.0189	0.205	0	0.1728
Log Employment	4.8036	4.7209	1.1042	4.0545	5.4717
Log Domestic Sales	8.7153	9.3775	3.0867	8.5236	10.3224
Markup	1.0262	1.02	0.1196	1	1.0621

Table 4 Benchmark regression results

Dependent Variable is $\Delta \ln L_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta EXPOSURE_{it}$	-0.077***	-0.073***	-0.071***			
	(-3.32)	(-3.16)	(-3.08)			
$\chi_{it-1}\Delta EXFEER_{it}$				-0.085***	-0.081***	-0.079**
				(-2.73)	(-2.60)	(-2.54)
$\alpha_{it-1}\Delta IMFEER_{it}$				0.107**	0.101**	0.105**
				(2.47)	(2.32)	(2.41)
Δ Dom. Sales			0.004***			0.004***
			(10.71)			(7.87)
Δ Markup			0.177***			0.178***
			(14.59)			(12.17)
Constant	0.022***	0.020***	0.019***	0.029***	0.020**	0.020**
	(7.36)	(3.09)	(2.95)	(6.68)	(2.33)	(2.28)
Industry FE	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147,108	147,108	147,106	90,879	90,879	90,878
R-squared	0.001	0.003	0.006	0.001	0.004	0.008

Note: This table reports the regression results of equation (7), standard errors are clustered at the 4-digit industry level. T values in the parenthesis. *, ** and *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table 5 Regression results using aggregate effective exchange rate

Dependent Variable is $\Delta \ln L_{it}$

	(1)	(2)
$\Delta EXPOSURE\_agg_{it}$	-0.115	
	(-1.42)	
$\chi_{it-1}\Delta EXFEER_{it}$		-0.131***
		(-3.23)
$\alpha_{it-1}\Delta IMFEER_{it}$		-0.052
		(-1.06)
Δ Dom. Sales	0.004***	0.004***
	(10.07)	(10.08)
Δ Markup	0.177***	0.177***
	(14.45)	(14.42)
Constant	0.019***	0.027***
	(2.97)	(3.85)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Observations	141,608	141,608
R-squared	0.006	0.006

Note: This table reports the regression results using aggregate effective exchange rate to construct the exchange rate exposure. $\Delta EXPOSURE\_agg_{it} = \chi_{it-1}\Delta \ln EXAEER_t - \alpha_{it-1}\Delta \ln IMAEER_t$ standard errors are clustered at the 4-digit industry level. T values in the parenthesis. *, ** and *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table 6 Robustness Tests

Dependent Variable is $\Delta \ln L_{it}$

	Nominal Exchange Rate		Current Trade Share		Incl. Industry-year FE		Incl. import competition	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta EXPOSURE_{it}$	-0.133**		-0.069***		-0.068***		-0.068***	
	(-2.53)		(-3.02)		(-2.86)		(-2.87)	
$\chi_{it-1}\Delta EXFEER_{it}$		-0.129*		-0.040**		-0.071**		-0.072**
		(-1.83)		(-1.37)		(-2.23)		(-2.29)
$\alpha_{it-1}\Delta IMFEER_{it}$		0.165*		0.122***		0.129***		0.108**
		(1.65)		(2.79)		(2.90)		(2.45)
Δ Dom. Sales	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***	0.004***
	(10.70)	(7.86)	(10.72)	(7.88)	(10.69)	(7.91)	(10.62)	(7.63)
Δ Markup	0.177***	0.178***	0.177***	0.178***	0.177***	0.177***	0.176***	0.177***
	(14.60)	(12.17)	(14.59)	(12.17)	(14.56)	(12.09)	(14.35)	(12.04)
$IMP * \ln AEER_t$							-0.0248	-0.0128
							(-0.63)	(-0.27)
Constant	0.018***	0.019**	0.019***	0.018**	0.042***	0.055***	0.019***	0.019**
	(2.85)	(2.26)	(3.00)	(2.01)	(46.13)	(47.23)	(2.98)	(2.18)
Industry FE	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Industry-year FE	No	No	No	No	Yes	Yes	No	No
Observations	147,106	90,878	147,106	90,878	147,106	90,878	144,820	89,485
R-squared	0.006	0.007	0.006	0.008	0.009	0.010	0.006	0.007

Note: This table reports the regression results of equation (7).Column (1)-(2) use nominal exchange rates to construct the exchange rate exposure. Column (3)-(4) use current period shares to construct the exchange rate exposure. Column (5)-(6) include industry-year fixed effects. Column (7)-(8) include industry import penetration ration interacted with the change of aggregate effective exchange rate. Standard errors are clustered at the 4-digit industry level. T values in the parenthesis. *, ** and *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table 7 Extensive and Intensive Margin

Dependent Variable is $\Delta \ln L_{it}$

	Extensive Margin				Intensive Margin		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Enter Expt.	Exit Expt.	Enter Impt.	Exit Impt.	Continue Expt.	Continue Impt.	Continue Expt. And Impt.
$\Delta EXPOSURE_{it}$	-0.157**	0.026	-0.055	-0.339***	-0.063**	-0.056**	-0.054**
	(-2.00)	(0.32)	(-0.49)	(-2.90)	(-2.57)	(-2.38)	(-2.11)
Δ Dom. Sales	0.002	0.004**	0.007***	0.007***	0.004***	0.004***	0.004***
	(1.48)	(2.44)	(4.12)	(4.20)	(9.61)	(8.50)	(7.77)
Δ Markup	0.165***	0.150***	0.234***	0.247***	0.180***	0.165***	0.169***
	(3.73)	(2.76)	(4.10)	(4.19)	(13.72)	(12.95)	(12.55)
Constant	0.036	0.044	-0.016	0.008	0.016**	0.025***	0.022***
	(1.25)	(1.50)	(-0.63)	(0.24)	(2.34)	(3.64)	(3.00)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,156	7,624	8,797	8,579	124,546	123,950	108,765
R-squared	0.010	0.008	0.021	0.013	0.006	0.006	0.006

Note: This table reports the regression results of equation (7) on firms with different export and import status. Standard errors are clustered at the 4-digit industry level. T values in the parenthesis. *, ** and *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table 8 Firm Heterogeneity

Dependent Variable is $\Delta \ln L_{it}$

	Capital Intensity		Productivity		Ownership		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Low	High	High	Low	SOE	FIE	POE
$\Delta EXPOSURE_{it}$	-0.094***	-0.029	-0.058**	-0.058*	-0.062	-0.042*	-0.164**
	(-3.23)	(-0.75)	(-2.26)	(-1.83)	(-0.43)	(-1.69)	(-2.56)
Δ Dom. Sales	0.003***	0.007***	0.004***	0.004***	0.035***	0.003***	0.006***
	(7.46)	(8.18)	(7.07)	(7.25)	(5.15)	(7.36)	(7.83)
Δ Markup	0.165***	0.191***	0.130***	0.190***	0.273***	0.173***	0.150***
	(9.99)	(10.71)	(7.25)	(11.1)	(4.07)	(13.04)	(4.95)
Constant	0.004	0.015**	0.009	0.037***	-0.055*	0.021***	0.038***
	(0.84)	(2.10)	(0.94)	(4.07)	(-1.94)	(2.72)	(2.99)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	92,787	54,319	74,140	69,924	6,744	99,704	42,319
R-squared	0.006	0.007	0.006	0.007	0.033	0.008	0.007

Note: This table reports the regression results of equation (7). Industries with high (low) capital intensity are classified according to the median capital labor ratio of each two-digit industry. High (low) productivity firms are firms with productivity above (below) their 4-digit industry median. SOE= State Owned Enterprises,FIE= Foreign Invested Enterprises, POE= Private Owned Enterprises. Standard errors are clustered at the 4-digit industry level. T values in the parenthesis. *, ** and *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table 9 Job Creation and job destruction

Dependent Variable is $\Delta \ln L_{it}$

	(1) Job Creation	(2) Job Destruction
$\Delta EXPOSURE_{it}$	-0.113***	0.007
	(-4.16)	(0.20)
Δ Dom. Sales	0.002***	0.003***
	(5.06)	(5.29)
Δ Markup	0.079***	0.114***
	(5.95)	(6.32)
Constant	0.304***	-0.282***
	(37.47)	(-30.54)
Observations	74,351	53,274
R-squared	0.020	0.030

Note: This table reports the regression results of equation (7). Column (1) uses subsample with ΔlnL>0, Column (2) uses subsample with ΔlnL<0. Standard errors are clustered at the 4-digit industry level. T values in the parenthesis. *, ** and *** represent statistical significance at the 10%, 5% and 1% level, respectively.

Table C1 Economic Magnitude: Average effect

Year	(1) $\Delta \ln \hat{L}_{it}$ (%)	(2) $\Delta \ln L_{it}$ (%)	(3) Fraction Explained (%)
2000-2001	-0.058	2.29	2.53
2001-2002	0.034	4.45	0.76
2002-2003	0.112	5.89	1.90
2003-2004	0.048	5.12	0.93
2004-2005	0.032	5.48	0.58
2005-2006	-0.042	4.74	-0.89

Note: Column (1) reports the predicted employment change induced by exchange rate movements. Column (2) reports the actual employment change of the sampled firms, Column (3) reports the fraction of employment change explained by exchange rate movements. i.e. (3)=(1)/(2)

Table C2 Economic magnitude: differential impacts across firms

Year/Quantile	5%	10%	25%	50%	75%	90%	95%
2000-2001	-0.87	-0.48	-0.078	0	0	0.27	0.59
2001-2002	-0.26	-0.13	-0.001	0	0.043	0.27	0.48
2002-2003	-0.33	-0.13	-0.001	0	0.13	0.61	0.94
2003-2004	-0.15	-0.04	0	0	0.007	0.25	0.5
2004-2005	-0.38	-0.21	-0.07	0	0.003	0.1	0.22
2005-2006	-0.41	-0.22	-0.05	0	0.002	0.09	0.2
Average	-0.40	-0.20	-0.03	0.00	0.03	0.27	0.49

Note: This table reports the predicted employment change at different quantiles for each year.

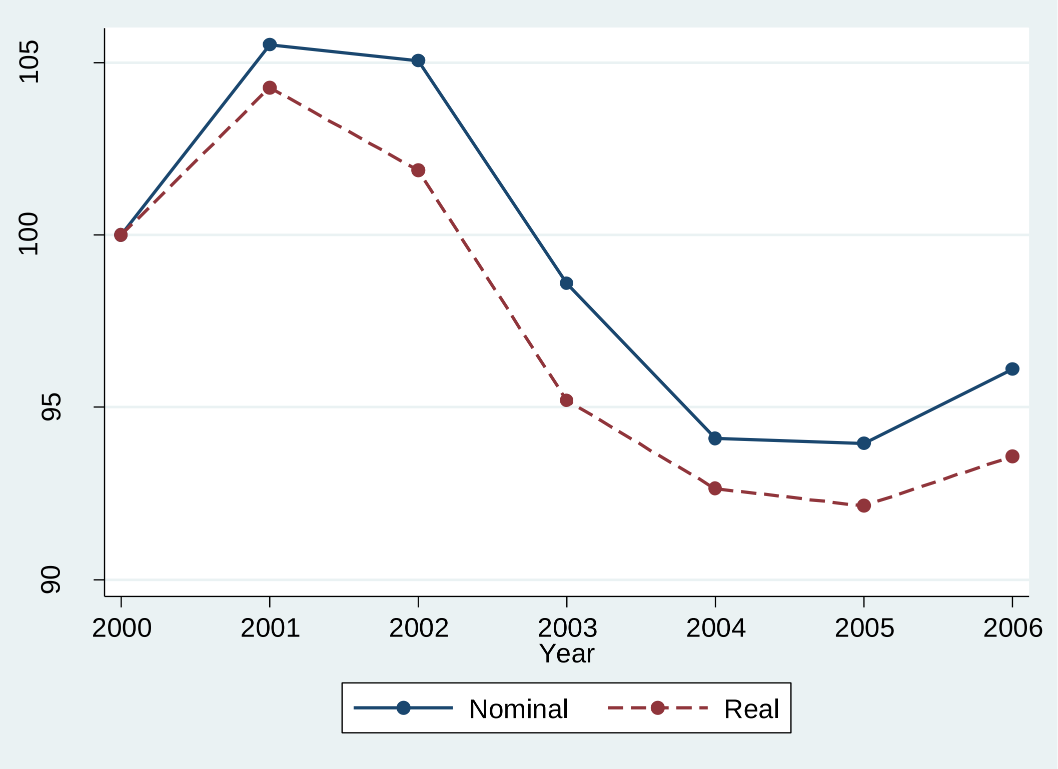

Figure1 Nominal and real effective exchange rate of the RMB (2005=100)

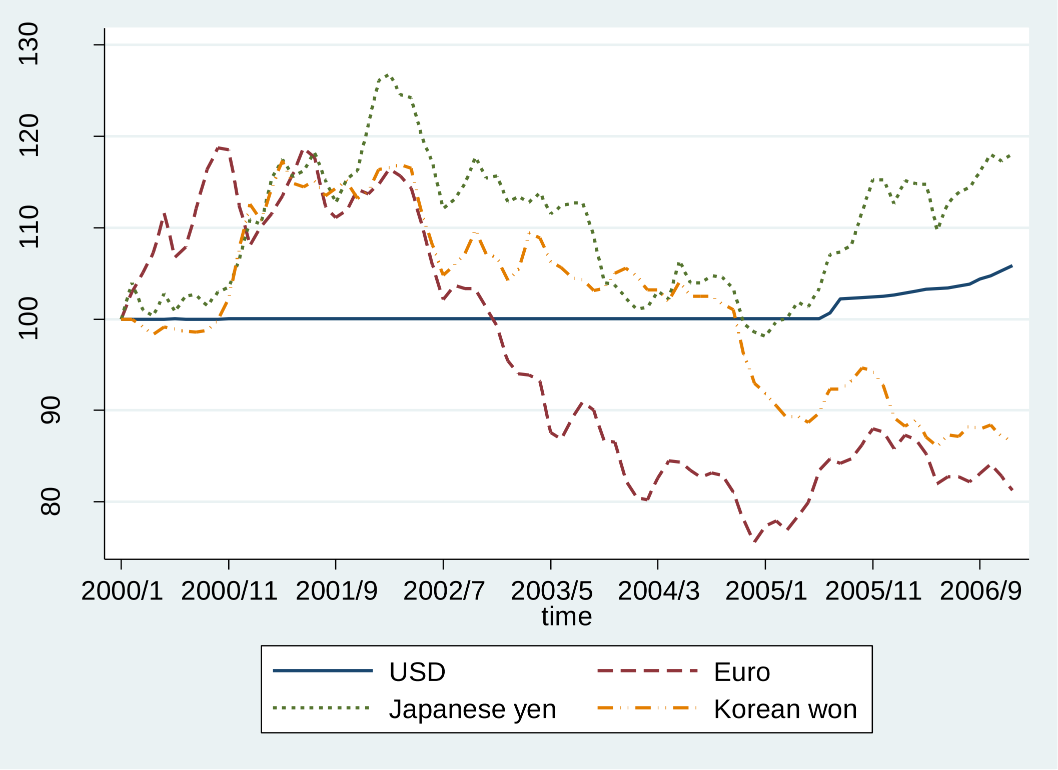

Figure2 Exchange rate of the RMB against the USD, Euro , Japanese yen and Korean won

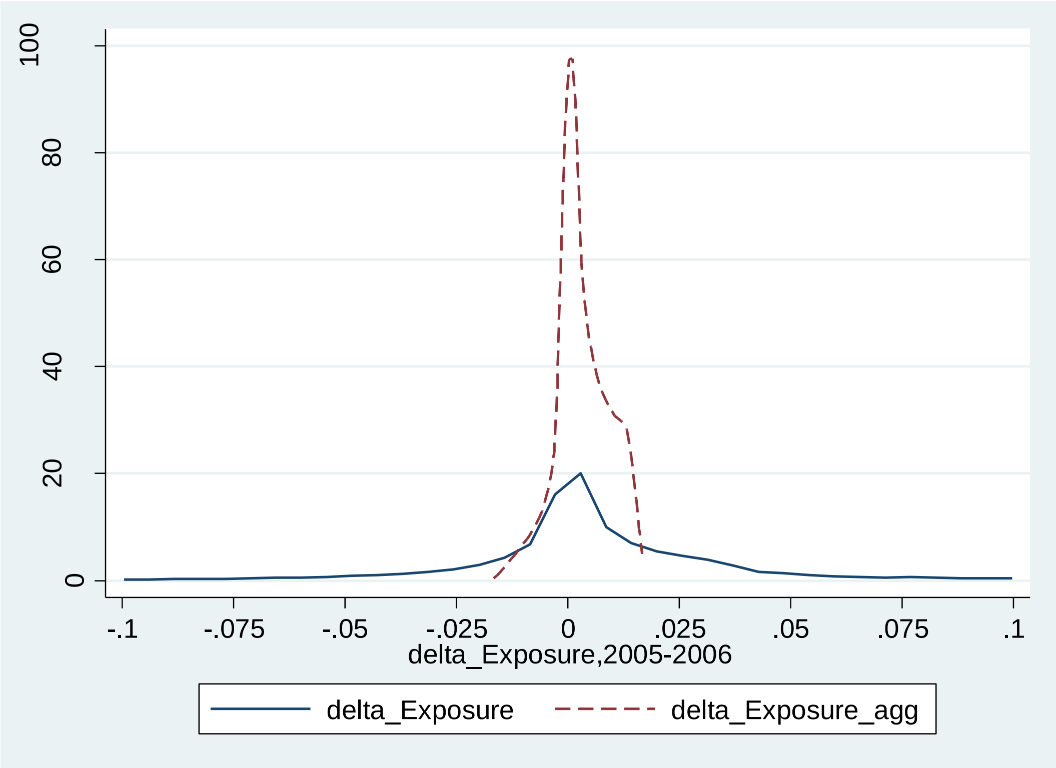

Figure3 Exposure comparison, firm v.s. aggregate, 2005-2006

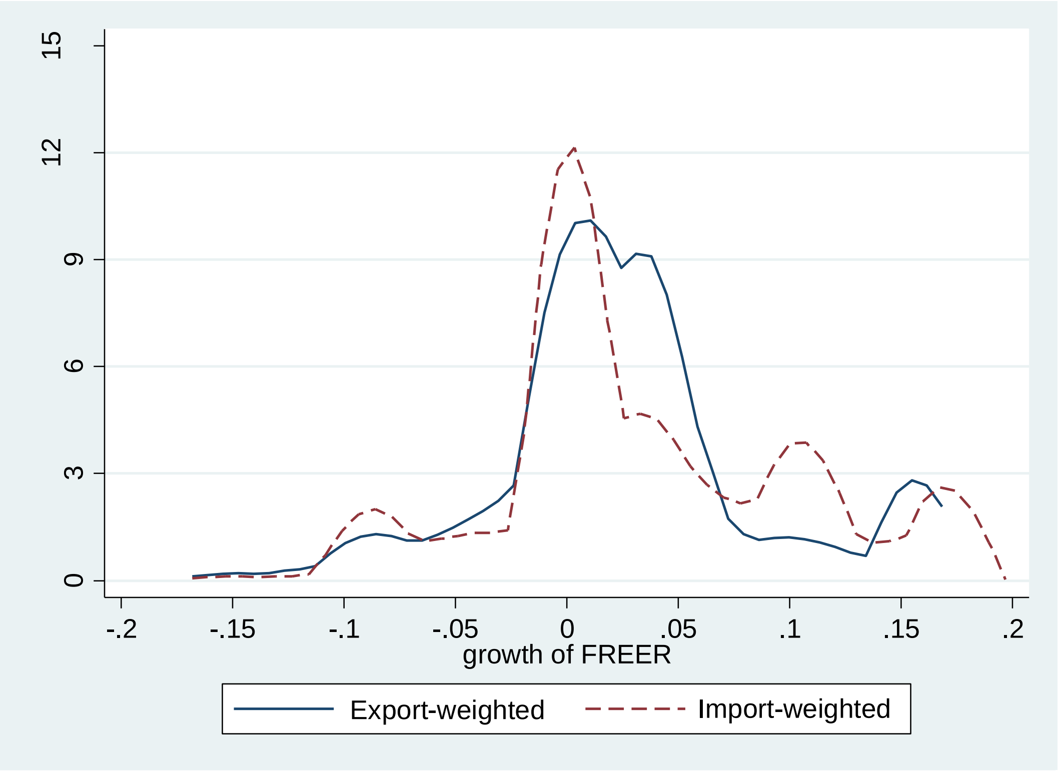

Figure 4 Kernel density distribution of firm-specific real exchange rate growth,2005-2006

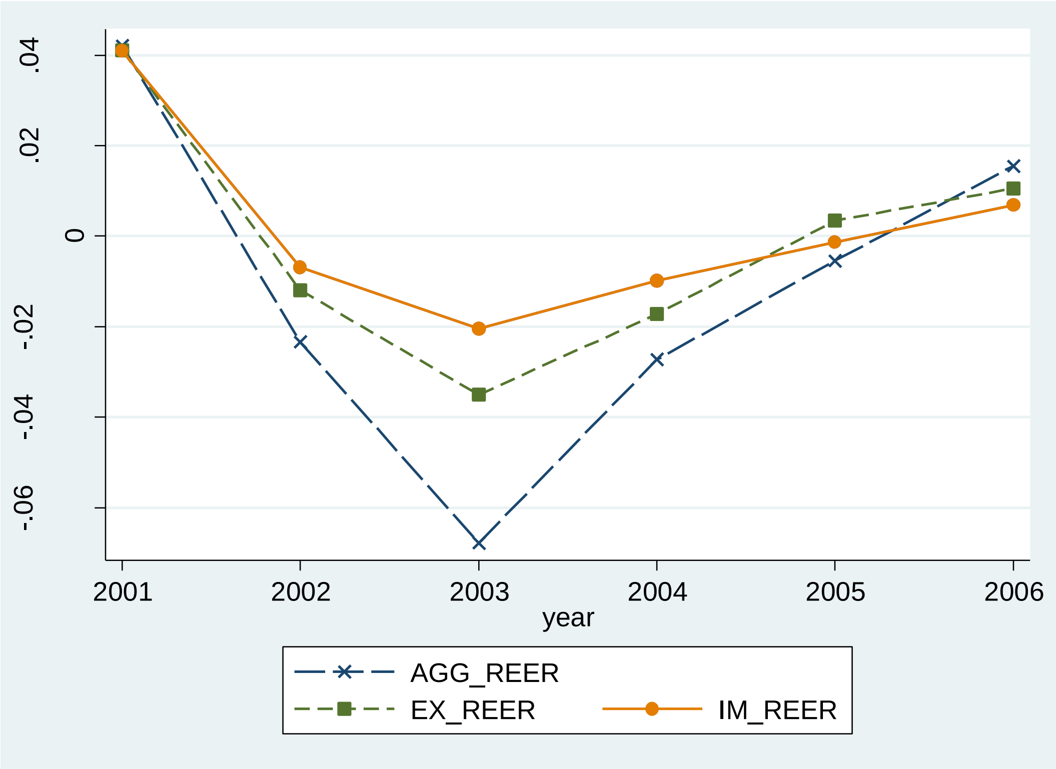

Figure B1 Growth rate of firm-specific effective real exchange rates and aggregate effective real exchange rates

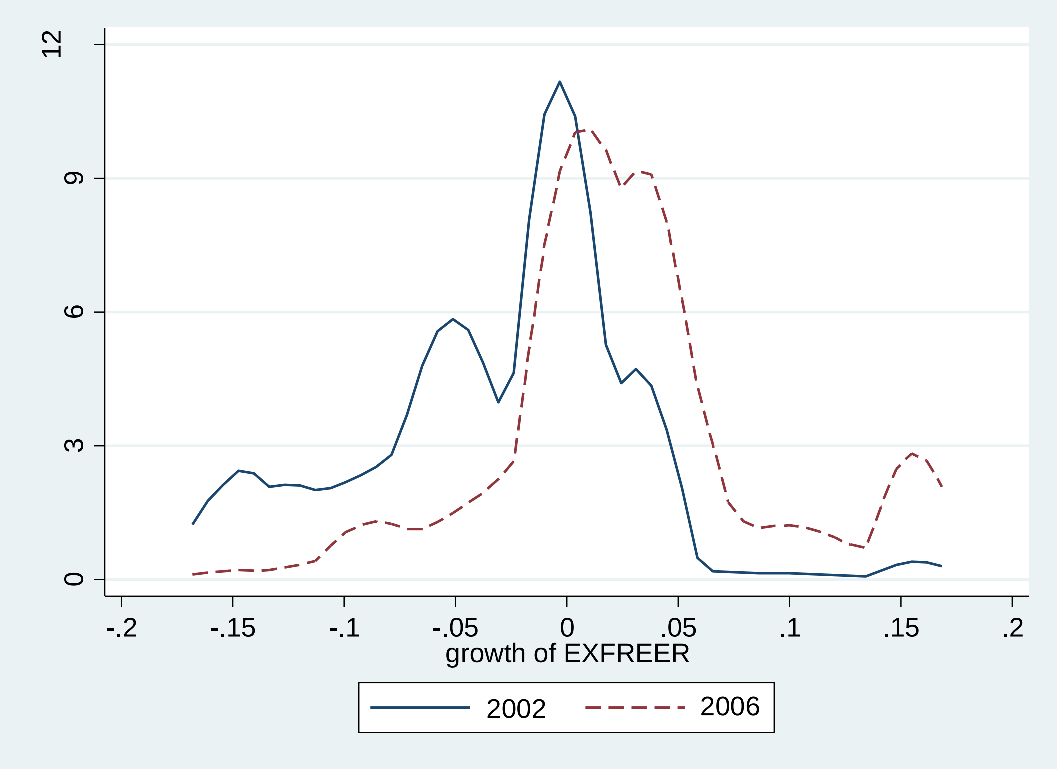

Figure B2 Kernel density distribution of firm-specific real exchange rate growth, 2001-2002 v.s. 2005-2006