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The Effect of the Firms' Effective Exchange Rates Changes on their Profits

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1. Motivation

- To examine the effect of exchange rate changes on firm behavior and performance, Which level of exchange rate should be used? (Bilateral exchange rate？ national level？ industry level？ firm level？)
- Most studies used national level or industry level exchange rates, such as Campa and Goldberg(1999,2001);Nucci and Pozzolo(2001,2010);Goldberg(2004);

- The preconditions of using national or industry level exchange rates to study firms issues is that each firm faces the same exchange rate.

- But in reality: **Different firms have different foreign trade objects and face different currencies; the exchange rate changes among different currencies are also different**.

- Such as: if a firm trade with Germany, then its trade is settled in Euros, if a firm trade with the United States, then its trade is settled in us Dollars. Moreover, the direction and extent of the RMB against the US dollar and the RMB against the Euro are different. Therefore, it is necessary to calculate and use the effective exchange rate at the firm level

- Some papers have calculated exchange rate at the firm level:

- (1) Firm aggregate effective exchange rate (Li et al.,2011; Dai and Shi,2013; Xu et al.,2015; Yu and Wang,2015)
- (2) Firm export effective exchange rate and import effective exchange rate (Di and Shi,2013)

- The usual method of calculation is:
- Export effective exchange rate：

$$XER_t^{\,i} = \sum_{j=1}^{n} w_t^{\,ij} rer_t^{\,j},\ \text{among them},\ w_t^{\,ij} = \frac{export_t^{\,ij}}{\sum_{j=1}^{n} export_t^{\,ij}}$$

- import effective exchange rate

$$MER_t^{\,i} = \sum_{j=1}^{n} w_t^{\,ij} rer_t^{\,j},\ \text{among them},\ w_t^{\,ij} = \frac{import_t^{\,ij}}{\sum_{j=1}^{n} import_t^{\,ij}}$$

- Aggregate effective exchange rate

$$AER_t^{\,i} = \sum_{j=1}^{n} w_t^{\,ij} rer_t^{\,j},\ \text{among them},\ w_t^{\,ij} = \frac{export_t^{\,ij} + import_t^{\,ij}}{\sum_{j=1}^{n} export_t^{\,ij} + \sum_{j=1}^{n} import_t^{\,ij}}$$

- The existing problems in the studies of the effect of the firm‘s exchange rate changes on the firm：

- (1) Most of the existing studies use the aggregate effective exchange rate weighted by the sum of the import and export of firms.
- (2) Because the effect of import and export of firms on the performance of firms is inconsistent, **we need a measure of exchange rate which can reflect both export income and import cost,** which have opposite directions.

- The main issues studied in this paper:

- (1) The **total effect** of exchange rate changes on firm profits (net effective exchange rate, aggregate effective exchange rate).
- (2) The **channels** of exchange rate changes affecting firm profits
- (3) The effect of exchange rate changes on the profits of **different types of firms** (different profit margins, different trade types, different types of export products)

2. Research Summary

- Forbes (2002), Dominguez and Tesar (2006), Fung and Liu (2009) have studied the effect of macro level exchange rate changes on firm profits.
- Goldberg (2004) calculates industry level exchange rates (import and export effective exchange rate) and examines the effect of their changes on firm profits.

- Some studies have examined the effect of exchange rate changes on firm performance such as sales revenue, import and export value, and firms' entry into or exit from the foreign trade market. Such as Head and Ries (1999), Campbell and Lapham (2004), Fung and Liu (2009), and Bagges et al. (2009).
- Some studies have examined the effect of exchange rate changes on firm investment and employment. Such as Campa and Goldberg (1999,2001), and Nucci and Pozzolo (2001,2010)

- We can see that: (1)the existing studies is either to study the effect of exchange rate changes on the macro (or industry) level of economic benefits, or the use of exchange rate variables is at the macro level; (2)few studies have examined the affect channels of exchange rate changes on firm profits.
- Therefore, using firm level exchange rate to examine the effect of exchange rate changes on firm profits, on the one hand provides a new research perspective, on the other hand, can also have a more profound understanding of this issue.

3. Theoretical framework

- This paper extends the model of **single** import and export market in Ekholm et al., (2012) to a model of **multiple** import and export markets, then designs the effective exchange rate indicator at the firm level, and then examines the effect of their changes on firm profits.

Consider a representative firm i, whose products are sold both in domestic market and in N foreign markets. p_i and p_{ik}^* are prices set at domestic market and foreign country k market respectively. x_i and x_{ik}^* are sold quantities at domestic market and foreign country k market respectively. e_k is the nominal exchange rate between the local currency and the k currency, which is expressed as units of domestic currency per unit of foreign currency. Consider the optimal income problem of firm i:

$$R_i = p_i x_i + \sum_{k=1}^{N} e_k p_{ik}^* x_{ik}^* \qquad (1)$$

We rewrite equation (1) as:

$$R_i = p_i (x_i + \sum_{k=1}^{N} x_{ik}^* / E_k) \qquad (2)$$

Among them, E_k is the real exchange rate expressed in output price. $E_k \equiv p_i/(e_k p_{ik}^*)$. An increase in E_k implies a real appreciation. Consider a small change in E_k, holding output constant, we get the elasticity of revenues with respect to E_k. That is:

$$\frac{\partial R_i}{\partial E_k}\frac{E_k}{R_i} = -\frac{e_k p_{ik}^* x_{ik}^*}{R_i} \equiv -\lambda_{ik} \qquad (3)$$

From the equation (3), it can be seen that for given output and prices, a one percent real appreciation of local currency to currency k decreases total revenues by λ_{ik} percent. Here, λ_{ik} is equal to the share of firm's exports to market k in its total sales. We call it the export dependence of firm i to country k.

Symmetrically, suppose that the inputs that firm i used purchased from local market and N foreign markets. q_i and q_{ik}^* are prices in local currency of domestic and imported inputs from country k respectively. v_i and v_{ik}^* are used quantities of domestic and imported inputs from country k respectively. Then we can define firm i's costs as:

$$C_i = q_i v_i + \sum_{k=1}^{N} e_k q_{ik}^* v_{ik}^* \qquad (4)$$

Similarly, we can rewrite firm i's costs as:

$$C_i = q_i (v_i + \sum_{k=1}^{N} v_{ik}^* / Q_k) \qquad (5)$$

Among them, Q_k is the real exchange rate expressed in inputs price. $Q_k \equiv q_i/(e_k q_{ik}^*)$. Consider a small change in Q_k, holding inputs constant, we get the elasticity of costs with respect to Q_k. That is:

$$\frac{\partial C_i}{\partial Q_k}\frac{Q_k}{C_i} = -\frac{e_k q_{ik}^* v_{ik}^*}{C_i} \equiv -\tilde{\lambda}_{ik} \qquad (6)$$

From the equation (6), it can be seen that for given inputs and prices, a one percent real appreciation of local currency to currency k decreases total costs by $\tilde{\lambda}_{ik}$ percent. Here, $\tilde{\lambda}_{ik}$ is equal to the share of firm's imported inputs from market k in its total costs. We call it the import dependence of firm i to country k.

If we do not consider the special factors within bilateral market, then we get $E_k=Q_k$ That is, the real exchange rate measured by output prices is equal to the real exchange rate measured by input prices. Then the elasticity of the firm's profits $(\pi_i = R_i - C_i)$ with respect to a change in the real exchange rate can be expressed as:

$$\frac{\partial \pi_i}{\partial E_k}\frac{E_k}{\pi_i} = \frac{E_k}{\pi_i}\left(\tilde{\lambda}_{ik}\frac{C_i}{E_k} - \lambda_{ik}\frac{R_i}{E_k}\right) = -\lambda_{ik} - \frac{(\lambda_{ik}-\tilde{\lambda}_{ik})}{\pi_i/C_i} = -\tilde{\lambda}_{ik} - \frac{(\lambda_{ik}-\tilde{\lambda}_{ik})}{\pi_i/R_i} \quad (7)$$

With reference to Ekholm et al., (2012), we define firm i's net export dependence on country k as the difference between the export share and the import share of firm i on country k. That is $\Lambda_{ik} = \lambda_{ik} - \tilde{\lambda}_{ik}$. A positive net export dependency (Λ_{ik}) implies that the effect on firm profits of a real appreciation (a rise in E_k) is negative. The greater the firm's 'net export dependence, the more negative the effect on its profits. The discrete form of equation (7) can be simply described as:

$$\Delta \ln \pi_{ik} = \left[-\tilde{\lambda}_{ik} - \frac{(\lambda_{ik}-\tilde{\lambda}_{ik})}{\pi_i/R_i}\right]\Delta \ln E_k = -\left[\tilde{\lambda}_{ik} + \frac{\Lambda_{ik}}{\pi_i/R_i}\right]\Delta \ln E_k \quad (8)$$

Assuming that each foreign market is independent, for a firm trading with N countries, the profits changes caused by exchange rate changes can be expressed as:

$$\Delta \ln \pi_i = \sum_{k=1}^{N}\left[-\tilde{\lambda}_{ik} - \frac{(\lambda_{ik}-\tilde{\lambda}_{ik})}{\pi_i/R_i}\right]\Delta \ln E_k = -[\sum_{k=1}^{N}(\tilde{\lambda}_{ik}) + \sum_{k=1}^{N}\frac{(\lambda_{ik}-\tilde{\lambda}_{ik})}{\pi_i/R_i}]\Delta \ln E_k \quad (9)$$

Correspondingly, we define $\sum_{k=1}^{N}(\lambda_{ik} - \tilde{\lambda}_{ik})$ as the firm's aggregate net export dependence.

We mark:

$$\Delta \ln NER_i = \sum_{k=1}^{N} (\lambda_{ik} - \lambda_{ik}) \Delta \ln E_k = \sum_{k=1}^{N} \Lambda_{ik} \Delta \ln E_k \quad (10)$$

$\Delta \ln \mathrm{NER_i}$ is the change of firm i's net effective exchange rate. It can be seen that $\Delta \ln \mathrm{NER_i}$ is calculated as a weighted average of the logarithmic form of the bilateral exchange rates, using the firm's net export dependence as the weighted weight.

Further, we can define the change of firm's effective exchange rate associated with the export and import of the firm: the change of firm's export effective exchange rate and the change of firm's import effective exchange rate.

$$\Delta \ln NER_i = \chi_i \left(\sum_{k=1}^{N} \omega_{ik}^{X} \Delta \ln E_k \right) - \alpha_i \left(\sum_{k=1}^{N} \omega_{ik}^{M} \Delta \ln E_k \right) = \chi_i \Delta \ln EER_i - \alpha_i \Delta \ln IER_i \quad (11)$$

Among them:

$$\chi_i = \sum_{k=1}^{N} (e_k p_{ik}^{*} x_{ik}^{*}) / (p_i \chi_i + \sum_{k=1}^{N} e_k p_{ik}^{*} x_{ik}^{*}) \quad (12)$$

$$\alpha_i = \sum_{k=1}^{N} (e_k q_{ik}^{*} v_{ik}^{*}) / (q_i v_i + \sum_{k=1}^{N} e_k q_{ik}^{*} v_{ik}^{*}) \quad (13)$$

$$\omega_{ik}^{X} = e_k p_{ik}^{*} x_{ik}^{*} / (\sum_{k=1}^{N} e_k p_{ik}^{*} x_{ik}^{*}) \quad (14)$$

$$\omega_{ik}^{M} = e_k q_{ik}^{*} v_{ik}^{*} / (\sum_{k=1}^{N} e_k q_{ik}^{*} v_{ik}^{*}) \quad (15)$$

We call $\Delta \ln EER_i$ and $\Delta \ln IER_i$ the change of the firms' export effective exchange rate and the change of the firms' import effective exchange rate respectively. It can be seen that, for $\Delta \ln EER_i$ and $\Delta \ln IER_i$, We calculate them by using the firm's export dependence and import dependence with its trading partners to weigh the bilateral exchange rate. From the above expressions, it can be seen that, χ_i and α_i are the total export dependence and the total import dependence of firm i respectively.

- When we calculate the firms' effective exchange rate in a given year, according to Goldberg (2004), in order to **avoid endogenous problems**, we use the firms' **lagged one period import and export dependence** as the weighted weight.

- We also calculate firm's **aggregate effective exchange rate** based on the sum of the import and the export volume as the weighted weight (we denoted them as AER_{it}).

4. Empirical specification and data

- 4.1 The empirical specification investigating the overall effect of firm's effective exchange rate changes on firm profits
- We set up a first-order difference specification :

$$\Delta \ln Profit_{it} = \beta_0 + \beta_1 \Delta \ln NER_{it} + \beta_2 \Delta \ln Worker_{it} + \beta_3 \Delta \ln TFP_{it} + \beta_4 \Delta \ln Lev_{it} + \varphi_j + \eta_t + \sigma_{it} \quad (16)$$

- 4.2 The empirical specification investigating the transmission channels through which firm's effective exchange rate changes affect its profits:

$$\Delta \ln Profit_{it} = \beta_0 + \beta_1 \chi_{it-1} \Delta \ln EER_{it} + \beta_2 \alpha_{it-1} \Delta \ln IER_{it} + \beta_3 \chi_{it-1} + \beta_4 \alpha_{it-1} + \beta_5 \Delta \ln Worker_{it} + \beta_6 \Delta \ln TFP_{it} + \beta_7 \Delta \ln Lev_{it} + \varphi_j + \eta_t + \sigma_{it} \quad (17)$$

- **Sample data:**
- The database used in this paper consists of two sets: China customs database and China industrial enterprise database. The sample time interval is from 2000 to 2006. We should match these two databases.
- **Matching methods (Ge Ying, 2011):**
- Step 1: Match with firm name and year;
- Step 2: match with the location zip, the contact, and the year;
- Step 3: match with the firm phone.

5. Empirical results and analysis

- 5.1 The effect of firm's net effective exchange rate changes on firm profits

Table 3 The effect of firm's net effective exchange rate changes on firm profits

	(1)	(2)
	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$
$\Delta \ln NER_{it}$	-0.488***	
	(0.179)	
$\Delta \ln AER_{it}$		-0.277**
		(0.124)
$\Delta \ln Worker_{it}$	0.647***	0.647***
	(0.012)	(0.012)
$\Delta \ln TFP_{it}$	1.532***	1.533***
	(0.030)	(0.030)
$\Delta \ln Lev_{it}$	-0.122***	-0.122***
	(0.010)	(0.010)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
Constant	-0.156***	-0.144***
	(0.022)	(0.023)
Number of observations	190 546	190 546
R^2	0.05	0.05

Description: The numbers in parentheses are the corresponding standard deviation of the regression coefficients, *, * *, * * * represent the significance levels at 10%, 5% and 1%, respectively.

- (1) The regression coefficient of $\Delta \ln NER_{it}$ is equal to -0.488.
- (2) We can calculate **the extent to which the changes in firm profits can be explained by the exchange rate changes**:
- During the sample period, the firm profits increased by 0.338% due to exchange rate changes, the mean value of firm profits increased by 12.321%, **we can get that 2.745% of firm profits changes can be explained by exchange rates changes**.
- (3) We also investigate the effect of firm's aggregate effective exchange rate changes ($\Delta \ln AER_{it}$) on firm profits. The results indicating that it also has a negative effect on firm profits.

5.2 The **transmission channels** of firm's effective exchange rate changes affect firm profits

- 5.2.1 Investigate the effect of firm's effective exchange rate changes on firm profits
- There have two main channels through which exchange rate changes affect firm profits:
- (1) exchange rate changes affect **exported product prices and sale revenues**, and then have an effect on firm profits;
- (2)exchange rate changes affect **imported inputs prices and production costs**, and then have an effect on firm profits.

Table 4 Investigating the effect of firm's effective exchange rate changes on firm profits from the perspective of transmission channels

	(1)	(2)
	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$
$\chi_{it-1}\Delta \ln EER_{it}$	-0.203**	
	(0.090)	
$\alpha_{it-1}\Delta \ln IER_{it}$	0.167*	
	(0.086)	
χ_{it-1}	0.002	
	(0.005)	
α_{it-1}	0.021***	
	(0.005)	
$\Delta \ln EER_{it}(1-\chi_{it-1})IP_{it-1}$		-1.002*
		(0.570)
$\Delta \ln NER_{it}$		-0.613***
		(0.192)
$\Delta \ln Worker_{it}$	0.659***	0.647***
	(0.015)	(0.012)
$\Delta \ln TFP_{it}$	0.625***	1.532***
	(0.025)	(0.030)
$\Delta \ln Lev_{it}$	-0.108***	-0.122***
	(0.010)	(0.010)
Year dummies	Yes	Yes
Industry dummies	Yes	Yes
Constant	0.007	-0.150***
	(0.023)	(0.022)
Number of observations	193 551	190 546
R^2	0.15	0.06

Description: The numbers in parentheses are the corresponding standard deviation of the regression coefficients, *, * *, * * * represent the significance levels at 10%, 5% and 1%, respectively.

- The regression coefficient of $\chi_{it-1}\Delta \ln EER_{it}$ is equal to -0.203.It shows that **firm's export effective exchange rate appreciation has a negative impact on firm profits, and the degree of the negative effect increases with the increase of firm's export dependence.**
- Numerically, as the mean value of the export dependence of the whole sample is 0.334, so from the overall sample, if the effective export exchange rate appreciates by 1%, the firm profits will decrease by 0.068%.

- The regression coefficient of $\alpha_{it-1}\Delta \ln IER_{it}$ is equal to 0.167. It shows that **firm's import effective exchange rate appreciation has a positive effect on firm profits, and the degree of this positive effect increases with the increase of firm import dependence.**
- Numerically, as the mean value of the import dependence of the whole sample is 0.180, from the overall sample, if the firm's effective import exchange rate appreciates by 1%, the firm profits will increase by 0.030%.

5.2.2 Investigating the effect of firm's effective exchange rate changes on firm profits from the import competition channel

- Exchange rate changes affect firm profits have another channel: import competition channel. We can simply analyze:
- **Exchange rate appreciation will make the prices of imported products decline, the market competitiveness of these products will increase, so the domestic manufacturers that produce the similar products will face greater competition, which will affect the sales of the domestic manufacturers, and then will led to reduced profits. For firms that sell more in the domestic market, the import competition channel will have greater negative effect on their profits.**

- In accordance with Nucci and Pozzolo (2010), we add a cross item to the specification (16):

$$\Delta \ln EER_{it}(1-\chi_{it-1})IP_{it-1}$$

- We call this cross item import competition channel.
- The regression coefficient of is equal to -1.002**.** This means that **exchange rate appreciation has a negative effect on firm profits through import competition channel, and this negative effect is greater for firms whose sales are more biased towards the domestic market.**

5.3 The effect of firm's net effective exchange rate changes on profits of different types of firms

- 5.3.1 The effect of firm's net effective exchange rate changes on the profits of firms engaged in different types of trade

Table 5 The effect of firm's net effective exchange rate changes on profits of firms engaged in different trading types

	(1)	(2)	(3)	(4)
	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$
	Firms engaged in general trade	Firms engaged in processing trade	Firms engaged in mixed trade	Firms engaged in general trade and firms engaged in mixed trade
$\Delta \ln NER_{it}$	-1.180***	-0.299	-0.504***	-0.592***
	(0.188)	(0.202)	(0.195)	(0.185)
$\Delta \ln Worker_{it}$	0.564***	0.542***	0.549***	0.560***
	(0.010)	(0.015)	(0.015)	(0.008)
$\Delta \ln TFP_{it}$	1.355***	1.194***	1.327***	1.345***
	(0.024)	(0.035)	(0.034)	(0.020)
$\Delta \ln Lev_{it}$	-0.078***	-0.107***	-0.077***	-0.078***
	(0.008)	(0.011)	(0.013)	(0.007)
$\Delta \ln NER_{it} * Dum$				-0.563**
				(0.255)
Dum				-0.005
				(0.005)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Constant	-0.066***	-0.129***	0.085***	-0.060***
	(0.015)	(0.025)	(0.020)	(0.013)
Number of observations	96142	46626	47778	143920
R^2	0.14	0.10	0.12	0.13

Description: The numbers in parentheses are the corresponding standard deviation of the regression coefficients, *, * *, * * * represent the significance levels at 10%, 5% and 1%, respectively.

- In column 2 of Table 5, the effect of firm's net effective exchange rate changes on profits of firms engaged in processing trade is not significant. The reason is that:
- (1) On the one hand, **these firms have higher import and export dependency** compared with the firms engaged in general trade, and **their import and export often correspond to the same country**, which has led to a relatively small decrease in their profits due to exchange rate appreciation.
- (2) On the other hand, **the processing income of many firms engaged in processing trade is fixed**, so their profits are less affected by exchange rate changes.

5.3.2 The effect of firm's net effective exchange rate changes on the profits of firms having different profit margins

- From the theoretical specification (9), we can see that, the profits of **firms with higher profit margins will be less affected** by exchange rate appreciation:
- (1)We divide the sample firms into two groups according to the profit margins.
- (2)We add item $(1 - Roa_{it-1})\Delta \ln NER_{it}$ in the specification (16). the regression coefficient of this item is equal to -0.708. It indicates that with the decline in firm profit margins, that is, with $(1 - Roa_{it-1})$ increase, the negative effect of firm's net effective exchange rate appreciation on firm profits will increase significantly.

Table 6 The effect of firm's net effective exchange rate changes on profits of firms having different profit margins

	(1)	(2)	(3)
	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$
	Firms with low profit margins	Firms with high profit margins	The whole sample
$\Delta \ln NER_{it}$	-0.489**	-0.049	
	(0.218)	(0.288)	
$(1-Roa_{it-1})\Delta \ln NER_{it}$			-0.708***
			(0.176)
$\Delta \ln Worker_{it}$	0.672***	0.579***	0.647***
	(0.015)	(0.019)	(0.012)
$\Delta \ln TFP_{it}$	1.421***	1.497***	1.532***
	(0.037)	(0.047)	(0.030)
$\Delta \ln Lev_{it}$	-0.121***	-0.079***	-0.122***
	(0.012)	(0.015)	(0.010)
Year dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Constant	-0.210***	0.286***	-0.156***
	(0.027)	(0.031)	(0.022)
Number of observations	108 809	81 737	190 546
R^2	0.06	0.05	0.06

Description: The numbers in parentheses are the corresponding standard deviation of the regression coefficients, *, **, *** represent the significance levels at 10%, 5% and 1%, respectively.

5.3.3 The effect of firm's net effective exchange rate changes on profits of firms with different types of exporting products

Table 7 The effect of firm's net effective exchange rate changes on profits of firms with different types of exporting products

	(1)	(2)	(3)	(4)
	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$
	Firms exporting single type of product	Firms exporting multi-type of products	Firms exporting fewer types of products	Firms exporting more types of products
$\Delta \ln NER_{it}$	0.176	-0.608***	-0.183	-0.743***
	(0.508)	(0.191)	(0.286)	(0.232)
$\Delta \ln Worker_{it}$	0.624***	0.651***	0.663***	0.629***
	(0.031)	(0.013)	(0.018)	(0.016)
$\Delta \ln TFP_{it}$	1.679***	1.497***	1.653***	1.393***
	(0.073)	(0.033)	(0.042)	(0.043)
$\Delta \ln Lev_{it}$	-0.110***	-0.124***	-0.138***	-0.105***
	(0.024)	(0.011)	(0.014)	(0.013)
Year dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Constant	0.049	0.065***	0.030	0.088***
	(0.054)	(0.023)	(0.032)	(0.028)
Number of observations	35 141	155 405	97 528	93 018
R^2	0.05	0.06	0.06	0.06

Description: The numbers in parentheses are the corresponding standard deviation of the regression coefficients, *, * *, * * * represent the significance levels at 10%, 5% and 1%, respectively.

- Why does firm's exchange rate appreciation has no significant effect on the profits of firms exporting single product?

- (1) **The quality and competitive advantage of exporting single product firms are better** than those of exporting multi products. Therefore, their ability to bear exchange rate risks is stronger.
- (2) Exchange rate appreciation will lead firms to **narrow the production scope and concentrate more on the production and exporting of their core products**.

5.3.4. Discussion of endogenous problems

- Using trade volume as weighted weigh to calculate firm's effective exchange rate, after exchange rate changes, the firm may adjust its import and export direction, thus would affect the relative import and export ratio of the firm to each import and export destination, which in turn would affect the firm's effective exchange rate, and thus lead to the endogenous problems.

- In order to solve this problem:
- (1) we use **firm's lagged one period import and export dependence as a weighted weight**;
- (2) We calculate **the trade share of the firms in the first year** to each import and export country, and then use this share as the weight to calculate the firm's effective exchange rate in each year;
- (3) we use **the lagged one period value of as its tool variable** for **two-stage least squares estimation**;
- (4) using the **three-year moving average import and export dependence** of the firm as the proxy variable of the firm's import and export dependence.

Table 8 The robust test of the effect of firm's effective exchange rate change on firm profits

	(1)	(2)	(3)
	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$	$\Delta \ln Profit_{it}$
$\Delta \ln NER\_fir_{it}$	-0.624***		
	(0.112)		
$\Delta \ln NER_{it}$		-0.944***	
		(0.335)	
$\chi_{3t} \Delta \ln EER_{it}$			-0.293**
			(0.119)
$\alpha_{3t} \Delta \ln IER_{it}$			0.352**
			(0.138)
χ_{3t}			-0.007
			(0.006)
α_{3t}			0.019***
			(0.007)
$\Delta \ln Worker_{it}$	0.555***	0.555***	0.853***
	(0.007)	(0.010)	(0.022)
$\Delta \ln TFP_{it}$	1.302***	1.206***	1.059***
	(0.017)	(0.022)	(0.038)
$\Delta \ln Lev_{it}$	-0.088***	-0.091***	-0.333***
	(0.006)	(0.008)	(0.016)
Year dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Constant	0.050***	0.123***	0.000
	(0.010)	(0.005)	(0.042)
Number of observations	193 545	120 701	193 551
R^2	0.12		0.14

Description: The numbers in parentheses are the corresponding standard deviation of the regression coefficients, *, * *, * * * represent the significance levels at 10%, 5% and 1%, respectively.

6. Conclusions

- Using China's Customs Database and Industrial Database, this paper investigates the effect of firm's effective exchange rate changes on firm profits. The paper calculates firm's net effective exchange rate, firm's export effective exchange rate, firm's import effective exchange rate and firm's aggregate effective exchange rate, and examines the issue from the aspects of overall effect and transmission channels.

- On the whole, exchange rate appreciation has significant negative effect on firm profits.

- Exchange rate appreciation has negative effect on firm profits through export income channel, while have positive effect on firm profits through import cost channel. Exchange rate changes also affect firm profits through import competition channel.

- The negative effect of firm's net effective exchange rate appreciation on the profits of firms engaged in processing trade is the smallest and the negative effect on the profits of firms engaged in general trade is the greatest;
- Firm's net effective exchange rate appreciation has greater negative effect on the profits of firms with lower profit margins;
- Firm's net effective exchange rate appreciation has no significant effect on the profits of firms exporting single products, and has significant negative effect on the profits of firms exporting more kinds of products.

- Thanks