How Does RMB Exchange Rate impact Chinese Manufacturing Firms' Embeddedness in Global Value Chains?

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Abstract—As Chinese manufacturing firms may be involved in both export and domestic markets, it is possible that RMB exchange rate will affect the competitive position of enterprises in the global market which is mainly reflected in their embeddedness in global value chains. This paper will verify the influence and explore its path. Method: In this paper, the RMB/USD exchange rate is used as a characterizing variable in the foreign exchange market, and correlation analysis, regression analysis, mechanism analysis and subgroup regression are used to explore its impact on the embeddedness of Chinese manufacturing firms in global value chains, and to identify a reliable path of influence in order to propose policy recommendations and corporate strategies to face the foreign exchange market. Conclusion: The appreciation and fluctuation of RMB exchange rate both have negative impact on the embeddedness of Chinese manufacturing firms in global value chains during which process, FDI is a mediating effect.

Keywords—RMB exchange rate, FDI, mediating effect, subgroup regression

I. INTRODUCTION

The embeddedness in Global Value Chains (GVC) refers to the degree of China's participation in the international division of labor, which is mainly represented by the share of undertaking intermediate goods processing and the proportion of intermediate goods export in the added value of global value chain. Similarly, the companies' embeddedness in GVCs means their participation and position in the global trading market.

With the regionalization of the layout of global value chains (GVCs) and the increasing contraction of complex value chains (Yao, 2023), it is of great significance for Chinese manufacturing enterprises to grasp the macroeconomic situation, broaden the boundaries of market and enrich the forms of trade. Therefore, it is vital to study the embeddedness in GVCs to upgrade China's manufacturing base and modernize its industrial chain.

As an important macroeconomic indicator, RMB exchange rate plays a essential role in influencing the GVCs embedding and its influence path. Under the background of dual circulation, the economy is gradually recovering and the process of RMB internationalization is accelerated, which enhance the material foundation of RMB value. Nowadays, the RMB exchange rate is gradually showing a new normal of bi-directional volatility. At the same time, with the rapid development of global financial liberalization and integration, the trade of various countries are closer related. Thus, studying the impact of RMB exchange rate change on the embedding of GVCs can help enterprises to improve their

resilience to the risk of the money market, strengthen their competitive position in global trade, and provide the government with recommendations to deal with RMB exchange rate.

Because of the control variate method used in the following research, many factors related to the companies themselves will be included in the model as control variables. Moreover, some other macro factors are taken into consideration in regression by group. Thus, RMB related variables will be the only independent variable in the passage.

II. HYPOTHESES

A. The RMB Exchange Rate and the Degree of Embeddedness of Firms in Global Value Chains

The change of RMB exchange rate includes the level of RMB value and the volatility in RMB exchange rate.

The export substitution effect makes the appreciation of RMB a deterrent to domestic exports, which has a negative impact on the embeddedness in GVCs. The appreciation of RMB brings about higher prices of Chinese products for foreign consumers, which discourages export greatly (Zhou and Chen, 2020). Therefore, the reduction in the international competitiveness of products makes it easier for enterprises to passively reduce their position in the GVC.

Furthermore, the appreciation of RMB will cause foreign capital to flee due to higher cost of investment, which prevent Chinese companies from embedding in GVCs (Xie and Du, 2007). According to the "relative wealth effect" in classical cross-border investment theory, the appreciation of RMB will increase foreign investors' costs to invest (Zhou *et al.*, 2022), in which case, foreign capital will flee to other countries. If Chinese companies do not receive foreign capital, they may lose the chance to internationalize business practices and operating mechanisms. Therefore, it will be hard for them to enhance international competitiveness and improve their position in the GVCs. Accordingly, hypothesis one is formulated.

H1: RMB's appreciation reduces the participation of manufacturing firms in GVC.

B. RMB Exchange Rate Volatility and the Degree of Embeddedness of Firms in Global Value Chains

Fluctuation of RMB exchange rate brings risk. Exchange rate fluctuations increase the uncertainty of income and costs in the import and export process (Wang *et al.*, 2022). Exchange rate risk is a major risk factor for enterprises when they conduct cross-border operations. Excessive exchange

rate volatility both increases the risk in choosing the source of raw materials and the uncertainty of revenue in the global market. The uncertainty of cost and revenue puts companies at a disadvantage compared to firms in countries with stable exchange rates or local companies, leading to its position in global value chains shaken.

Worse still, high exchange rate volatility discourages overseas investors, which means international capital flowing to markets with more stable bilateral exchange rates. When the volatility of RMB exchange rate increases, the return of foreign investment settled with the foreign currency is riskier (An, 2019). Based on the risk decision-making theory, foreign investors will reduce their investment in Chinese companies.

Thus, with the decrease of foreign capital received by companies, both the explicit and implicit benefits of international financing will be reduced, which will affect the embeddedness of Chinese enterprises in the GVC.

H2: Increased volatility of the RMB exchange rate will reduce the participation of manufacturing firms in GVC.

C. Firm Heterogeneity and the Embeddedness of Firms in GVCs

Previous research suggests that exchange rate change has a negative impact on firms' embeddedness in GVC. And firm heterogeneity affects the sensitivity of a firm's GVC embeddedness to exchange rate. As a core indicator of firms' performance, total factor productivity captures the contribution of those factors in a firm's production process that cannot be measured quantitatively, including technology, entrepreneurial talent, human capital, openness to the outside world and so on. The higher the firm's TFP is, the more international businesses are likely to be involved in. The more attention a firm receives from international capital, the greater the share of foreign investment it receives. Once a huge change in the RMB exchange rate occurs, the exchange rate will have a greater negative impact on high-TFP firms (Xiao *et al.*, 2019).

In addition to the firm's heterogeneity, geographical advantages also affect the sensitivity of enterprises' GVC embeddedness to exchange rate changes. Compared to non-coastal corporations, coastal ones have inherently trade transportation advantages, which make it easier to develop enterprises' export trade and attract foreign capital (Zhang, 2017). With such advantage, coastal enterprises have a higher level of participation in international markets and are more likely to impacted negatively by exchange rate changes.

H3: Compared to low-TFP manufacturing firms, changes in the RMB exchange rate have a greater negative impact on the degree of participation in global value chains by high-TFP manufacturing firms.

H4: Compared to non-coastal manufacturing firms, changes in the RMB exchange rate have a greater negative impact on the degree of participation in global value chains by coastal manufacturing firms.

III. STUDY SAMPLE AND DATA

A. Sample Selection and Data Sources

With the financial crisis that erupted in the US in 2008, major developed economies fell into recession and developing economies' growth slowed down. Moreover, the central bank promoted the reform of RMB exchange rate mechanism in 2015. To avoid potential heterogeneity of RMB exchange rate, the period of 2009-2015 is chosen as the study period. Data of the embeddedness of enterprises in global value chains is mainly obtained from the China Industrial Enterprises Database and the China Customs Import and Export Database. Data of exchange rate is from the International Financial Statistics database and data of listed enterprises is from CSMAR.

With reference to the existing literature, the initial sample was screened as follows: (1) Exclude the samples with missing values of the control variables in the model. (2) Exclude the abnormal samples. (3) Exclude the samples of financial enterprises with ST and *ST. (4) To exclude the influence of outliers, all continuous variables in the model are winsorized at the 1% and 99% levels. Finally, this paper obtained 1080 manufacturing enterprises, with a total of 5157 valid observations.

B. Model Setting

Table 1. Variable names and definitions

Variables	Variable name	Variable symbols	Variable definitions
Explained variables	The extent to which firms are embedded in global value chains	FVAR	Measured using a methodology that considers trade agent issues
Explanatory variables	Nominal exchange rate	Exrt	Renminbi to US Dollar Nominal Exchange Rate
	Nominal exchange rate volatility	vol	RMB/USD annual exchange rate level standard deviation
Controls	Number of companies	Num	Total number of employees of the enterprise for the year
	Size of the company's assets	Size	Natural logarithm of the total assets of the enterprise at the end of the year
	Corporate leverage	Lev	Total assets/total liabilities
	Net asset margin	ROA	Net profit/average total assets
	Overhead rate	Mfee	Administrative expenses/operating income
	Asset turnover rate	ATO	Operating income/average total assets
	Real exchange rates	Exrt2	Nominal exchange rate less inflation
Other relevant variables	Share of international financing received by micro enterprises	FDI	Percentage of foreign capital among the top ten shareholders of the enterprise
	Total factor productivity of enterprises	tfp_1	Above the industry-wide average of total factor productivity is assigned a value of 1, otherwise 0
	Is the business located on the coast	Unb	Location is assigned a value of 1 for coastal areas, 0 otherwise

To examine the impact of exchange rate changes and firm heterogeneity factors on the embeddedness of firms in global value chains, this paper sets the following model.

$$FVAR_{(i,t)} = \alpha_0 + \alpha_1 X_{(i,t)} + Controls_{(i,t)} + \sum Year + \sum Industry + \varepsilon_{(i,t)}$$

In this model, i and t represent firm types and time respectively. The explanatory variable X_1 represents the firm's annual nominal exchange rate, while X_2 represents firm-level exchange rate volatility. The explanation of other variables is shown in Table 1.

Our aim is to examine a1, which is the coefficient of the firm's exchange rate. If a1 is significantly less than 0, we can assert that hypotheses 1 and 2 are verified.

C. Definition and Calculation of Key Variables

1) Firm's embeddedness in global value chains

We use FVAR to represent the global value chain embeddedness, which considers the effects of trade agents.

Due to restrictions on import and export rights, many Chinese enterprises rely on intermediary firms to import and export indirectly. These enterprises may use overseas products as intermediate inputs, which are purchased indirectly from intermediate traders. In this case, the real added value of an enterprise's exports should be:

$$FVAR = \frac{V_{AF}}{X} = \frac{M_A^P + X^o[M_{Am}^o/(D + X^o]}{X}$$

where V, X, D, M and MAm denote the firm's actual foreign value added, the firm's export volume, domestic sales volume, actual processing trade imports and actual general trade intermediate input imports respectively. Since it is impossible to directly observe data on indirect imports by firms through intermediate traders, the method suggested by Ahn *et al.* and Zhang *et al.*, are used.

Firstly, the paper identifies intermediate traders whose names included "import and export", "economic and trade", "trade", "science and trade" or "foreign economic". Then we calculate the total imports of the specific product k (which has 6-digit HS code) and let mo represent the cumulative share of imports by such intermediate traders in the total imports. Assume that the share of indirect imports through intermediate traders by other enterprises is equal to mo. Finally, the following formula is used to estimate the actual processing trade imports and the actual general trade imports of intermediate inputs by enterprises.

$$M_A^P = \sum k \frac{M_k^P}{1 - m^k} \qquad M_{Am}^o = \sum j \frac{M_{mj}^o}{1 - m^j}$$

2) Nominal exchange rates, nominal exchange rate volatilities, real exchange rates

Indirect quotation method is used to measure the exchange rate, so an increase in value represents an appreciation of RMB. For the exchange rate volatility, this paper obtains the nominal rate of change of the RMB/USD exchange rate on a monthly basis and calculates its annual standard deviation to obtain the exchange rate volatility indicator. The specific calculation formulae are as follows.

$$e_m = \frac{1}{n} \times \sum_{d=1}^{n} e_d \qquad e_Y = \frac{1}{12} \times \sum_{m=1}^{12} e_m$$

$$vol_t = \sqrt{\frac{1}{12} \times \sum_{m=1}^{12} [e_m - e_Y]^2}$$

Once the nominal exchange rate is obtained, we collect the CPI of China and the US, and adjust it according to the following formula to calculate the real exchange rate after removing the effect of inflation.

$$s = S \times (P^* / P)$$

where denotes the actual exchange rate, denotes the nominal exchange rate under the direct markup method, denotes the domestic price level, and denotes foreign price levels.

3) Total factor productivity of enterprises

Drawing on the methods in former research (Lu and Lian, 2012; Leah *et al.*, 2018; Song *et al.*, 2021), this paper calculates the total factor productivity of enterprises through the idea of OP method to estimate the following model.

$$\ln Y_{it} = \beta_0 + \beta_k \ln K_{it} + \beta_l \ln L_{it} + \beta_a Age_{it} + \beta_s State_{it} +$$
$$\beta_e EX_{it} + \sum_m \delta_m Year_j + \sum_n \lambda_n Prov_n + \sum_k \gamma_k Ind_k + \varepsilon_{it}$$

In this model, i, j, t respectively represent companies, industry type and time. Yit is the total output, measured by operating income, Lit is the labor input, measured by the number of employees in the business. Kit is the capital input, measured by the net value of fixed assets, and Mit is the intermediate input. Specifically, due to the significant losses in the investment accounts of listed enterprises, we use the net cash paid by enterprises to construct long-term assets as the current investment amount of enterprises. Age represents the age of the enterprise, State denotes whether the firm is a state-owned enterprise, and EX indicates whether the firm is involved in export activities.

D. Descriptive Statistics

Table 2 presents the means, SD, minimum, median and maximum values among the variables.

Table 2. Descriptive statistics

Variable name	Var	Obs	Mean	Std. Dev.	Min	Median	Max
Degree of embeddedness in global value chains	FVAR	5.157	0.191	0.356	0.000	0.005	1.000
Nominal exchange rate	Exrt	5.157	0.157	0.006	0.146	0.158	0.163
Nominal exchange rate volatility	Vol	5.157	0.001	0.001	0.000	0.001	0.003
Size of the company's assets	Size	5.157	21.745	1.093	19.288	21.587	26.961
Corporate leverage	Lev	5.157	0.386	0.205	0.008	0.374	1.109
Net asset margin	ROA	5.157	0.050	0.058	−0.449	0.046	0.460
Overheads	Mfee	5.157	0.092	0.066	0.005	0.081	1.224
Asset turnover rate	ATO	5.157	0.742	0.476	0.024	0.648	7.871

Under the Indirect Quotation method, the average nominal exchange rate of CNY/USD was 0.1571 and the exchange rate volatility was 0.13% during the period 2009–2015. The average value of the embeddedness in GVCs is only 0.1911, indicating that Chinese listed manufacturing enterprises have not taken the lead globally.

IV. ANALYSES OF EMPIRICAL RESULTS

A. Spearman's Correlation Test

First, this paper explores the correlation between the RMB exchange rate and manufacturing firms' embeddedness in GVCs. The Spearman correlation coefficient is calculated as following.

$$r_s = \frac{\sum_{i=1}^{N}(X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum_{i=1}^{N}(X_i - \overline{X})^2 \sum_{i=1}^{N}(Y_i - \overline{Y})^2}}$$

The correlation coefficient between exrt and FVAR is −0.04 (significant at 5%), indicating that they are negatively related. Thus, RMB appreciation will lead to weaker embeddedness in GVCs for manufacturing firms. Similarly, the correlation coefficient between vol and FVAR is −0.042 (significant at 5%), indicating that they are negatively related. Therefore, in the short term, volatility of RMB value will also lead to a lower degree of embeddedness in the global value chain for these firms.

B. OLS Regression

The OLS model is as follows:

$$FVAR_{it} = \alpha_0 + \alpha_1 vol_t + \sum Controls_{it} + \sum Industry + \sum Year + \varepsilon_{it}$$
$$FVAR_{it} = \alpha_0 + \alpha_1 exrt_t + \sum Controls_{it} + \sum Industry + \sum Year + \varepsilon_{it}$$

In this regression model, the annual exchange rate (exrt) and its volatility (vol) are introduced as explanatory variables. FVAR is introduced as the explained variable. The results are shown in Table 3.

Table 3. Regression results

Var	FVAR (1)	FVAR (2)	FVAR (3)	Var	FVAR (4)	FVAR (5)	FVAR (6)
exrt	−1.588*	−5.694***	−4.683***	vol	−19.162***	−27.757***	−22.830***
	(−1.75)	(−3.82)	(−3.20)		(−3.81)	(−3.82)	(−3.20)
controls	YES	YES	YES	controls	YES	YES	YES
Obs	5.157	5.157	5.157	Obs	5.157	5.157	5.157
R-squared	0.045	0.048	0.106	R-squared	0.047	0.048	0.106
Industry	NO	NO	YES	Industry	NO	NO	YES
Year	NO	YES	YES	Year	NO	YES	YES
*** p<0.01, ** p<0.05, * p<0.1							

The results show that both the RMB exchange rate and its volatility have a significant negative impact on the embeddedness in GVCs of manufacturing firms.

Columns (1)(2)(3) are the results of the first model. The annual average exchange rate of RMB has a significant negative impact on the firms' GVC embeddedness. Thus, the appreciation of the RMB will reduce the position of manufacturing firms in the global market. Columns (4)(5)(6) show the results of the second model. Similarly, higher exchange rate volatility weakens the embeddedness of firms in GVCs (significant at 1%).

This result suggests that higher exchange rate risk can have a negative impact on a firm's position in the global trade, which means the rise of RMB value and the fluctuation of RMB both lead to the drop of embeddedness in GVCs. When under such a situation, companies' participation in the global market can be weaken and they may face a disadvantage in international trading. The worst situation is that Chinese companies lose the chance to gain a large margin in products and end in becoming cheap manufacturers.

C. Intermediary Effects

FDI-share is used as a mediator of the mechanism analysis,

the logic is as follows. Higher value of RMB means higher potential costs for foreign investors in China. Likewise, more intensive volatility of RMB exchange rate increases the risk investment. Previous research shows that higher investment costs and risks can discourage investment. Thus, the proportion of FDI as a percentage of equity may decrease. In this case, the firm may lack access to international trade platforms and foreign customer resources, which will lead to weaker embeddedness in GVCs. To verify such a mechanism, the following mediating effect models are built.

$$FVAR_{it} = c \cdot exrt_{it} + m_1 \sum Controls_{it} + e_1$$

$$FDI\_share_{it} = a \cdot exrt_{it} + m_2 \sum Controls_{it} + e_2$$

$$FVAR_{it} = c' \cdot exrt_{it} + b \cdot FDI\_share_{it} + m_3 \sum Controls_{it} + e_3$$

The empirical results are as follows.

From the results, the mediator FDI-share explains both models. The proportion of mediating effects to the total effect in Fig. 1 is 0.0385 and that in Table 2 is 0.0385 as well. Both are in the range 0–1, which means FDI-share partially mediates the impact in both processes.

D. Robustness Tests-replacement of Exchange Rate Indicators

Due to the relative inflation rates of the two countries, nominal RMB exchange rate does not necessarily reflect the real exchange rate. According to the price levels of the two countries, nominal exchange rate is adjusted.

$$s = (S \times P^*)/P$$

Lowercase s — the actual exchange rate, great S—the nominal exchange rate under the direct markup method, P — the domestic price level, P*—the foreign price levels.

Table 4. Mechanistic analysis of exrt on FVAR.

Variables	FVAR (1)	FDI (2)	FVAR (3)
FDI			0.254***
			(5.31)
exrt	−4.683***	0.710*	−4.503***
	(−3.20)	(−1.67)	(−3.09)
Constant	0.150	0.174**	0.105
	(0.60)	(2.39)	(0.42)
Observations	5.157	5.157	5.157
R-squared	0.106	0.052	0.111
Controls	YES	YES	YES
Industry	YES	YES	YES
Year	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

The real exchange rate is used to verify the previous results. In the Table 4, the results are consistent with our previous results.

E. Regression by Group

1) Subgroup regression based on firm heterogeneity

The self-selection effect of the new-new trade theory (Clerides *et al.*, 1998) states that only firms with higher productivity can enter and gain profits in export markets due to the barriers of entrance. Therefore, we conjecture that firms with higher TFP are more likely to be internationalized and vulnerable to RMB exchange rate risk.

TFP is used as the standard to divide manufacturing firms into two groups: one with lower TFP (tfp_1=0) and the other with higher TFP (tfp_1=1). A subgroup regression is conducted to investigate the different impact of RMB exchange rate and its volatility on firms' embeddedness in GVCs with different TFP.

From the left part of Table 5, it can be found for high-TFP firms, the coefficient of exchange rate volatility (vol) is −29.334 while for low-TFP firms, that of is −19.115. They both suggest that exchange rate volatility negatively influences firms' embeddedness into GVCs and high-TFP firms are more vulnerable to it. In conclusion, companies which stay at a mature stage should pay more attention to the negative impacts of RMB value change.

Table 5. Mechanistic analysis of vol on FVAR

Variables	FVAR (1)	FDI (2)	FVAR (3)
FDI			0.254***
			(5.31)
vol	−22.830***	−3.461*	−21.950***
	(−3.20)	(−1.67)	(−3.09)
Constant	−0.534***	0.070	−0.552***
	−3.51)	(1.58)	−3.64)
Observations	5.157	5.157	5.157
R-squared	0.106	0.052	0.111
Controls	YES	YES	YES
Industry	YES	YES	YES
Year	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

2) Group regression based on heterogeneity in the degree of development of the location of the firm

On the one hand, as is shown in Fig. 3, it can be found that over 75% of trade exports are from coastal areas, which means coastal firms are more internationalized, and therefore they are more vulnerable to RMB exchange rate changes.
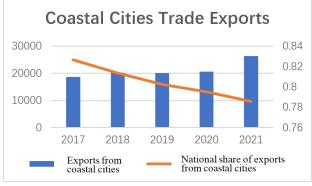

Fig. 1. Coastal cities' trade export volumes.

Therefore, we guess that it is harder for coastal firms to be embedded in GVCs when exposed to exchange rate risks than non-coastal ones. To verify this hypothesis, manufacturing firms are divided into two groups: coastal (Unb=1) and non-coastal (Unb=0). Results are in Table 6.

Table 6. Robustness test results

Variables	FVAR (1)	FVAR (2)	FVAR (3)
exrt2	−1.651**	−4.336***	−3.566***
	(−1.97)	(−3.82)	(−3.20)
controls	YES	YES	YES
Observations	5.157	5.157	5.157
R-squared	0.045	0.048	0.106
Industry	NO	NO	YES
Year	NO	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Grouped regressions of total factor productivity

variables	FVAR (TFP=1)	FVAR (TFP=0)	variables	FVAR (TFP=1)	FVAR (TFP=0)
vol	−29.334**	−19.155**	exrt	−6.017**	−3.929**
	(−2.45)	(−2.22)		(−2.45)	(−2.22)
Obs	2.331	2.826	Obs	2.331	2,826
R-squared	0.143	0.078	R-squared	0.143	0.078
Controls	YES	YES	Controls	YES	YES
Industry	YES	YES	Industry	YES	YES
Year	YES	YES	Year	YES	YES

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8. Subgroup regressions for coastal cities

variables	FVAR (Unb=1)	FVAR (Unb=0)	variables	FVAR (Unb=1)	FVAR (Unb=0)
vol	−22.855***	−17.305	exrt	−4.688***	−3.550
	(−2.63)	(−1.40)		(−2.63)	(−1.40)
Obs	3.456	1.701	Obs	3.456	1,701
R-squared	0.105	0.172	R-squared	0.105	0.172
Controls	YES	YES	Controls	YES	YES
Industry	YES	YES	Industry	YES	YES
Year	YES	YES	Year	YES	YES

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

From the left part of Table 6, we can see that for coastal firms, the coefficient of vol is −22.855, indicating that volatility of RMB value negatively impacts firms' embeddedness in GVCs. For non-coastal firms, the coefficient of vol is not significant, that means it has no significant impact on the firms' integration into GVCs. Therefore, compared to non-coastal firms, coastal ones are harder to be embedded in GVCs when subjected to exchange rate volatilities.

From the right part of Table 6, similar conclusions can be drawn. Moreover, compared to non-coastal firms, coastal firms are harder to be further embedded in GVCs when facing RMB appreciation.

The results suggest that the methods to manage the risk of RMB value should be different according to the different locations of companies.

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

It is safe to conclude that the exchange rate, plays an important role in enhancing the manufacturing firms' embeddedness in GVCs. This path is mediated by FDI in Chinese enterprises: the exchange rate affects the foreign investors' decisions, which influences the available capital, overseas customers and other resources. Thus, Chinese enterprises' division of labor in the global market will be changed.

In this process, the firm's TFP and location partially influence the depth of the above path, which means different firms should take different measures. Therefore, the following suggestions can be made for the reference of the government and enterprises:

1) The government should strengthen supervision and take timely measures towards exchange rate.

2) Manufacturing enterprises, especially those in coastal areas or with high TFP, should pay more attention to the negative impact of exchange rate risks.

3) Manufacturing enterprises should set up subsidiaries overseas, adopt the local currency for settlement to occupy a favorable position in the global market.

VI. RELATED EVENTS AFTER THE RESEARCH PERIOD

The research period ends in 2015, but after that, many relevant events took place. Thus, it is also important to consider the incidents after 2015 to verify the significance of this research.

For example, in 2022, the Federal Reserve Raised interest rates greatly, leading to the intensive drop of RMB value against dollar. Almost during the whole 2022, the export of Chinese products to the US is strengthened and therefore many Chinese companies which mainly rely on export trading actually earn profits more than that in the previous years.

The situation above suggests that it is vital for companies to pay attention to the macro environment and RMB value change.

VII. LIMITATIONS OF THIS ARTICLE

A. Simple Construction of the RMB Related Variables

RMB against other main currencies, such as Yen, is not included in the research. This may distort the nature of RMB value and the conclusions may not be universal because when RMB against dollar rises, RMB against Yen may probably drops. Further research can be conducted to solve the problem.

B. Lack of Updated Data

Because some of the data is from the database called China Industry Business Performance Data, the most recent data available is in 2015. Thus, further research can be based on the newly released data in the future.

C. Robustness Test with RMB Volatility

Due to the limitations of data, real RMB volatility is not available. Therefore, robustness test with volatility is not conducted in the research. The conclusions related to RMB volatility are not necessarily reliable without robustness test.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Wanxin Shi conducted the literature review; Kexin Qian, Zhangqing Luo and Wanxin Shi collected and analyzed the data together; Yuechen Yang was responsible for mathematical modeling; Kexin Qian and Wenqiu Li wrote the paper together; all authors had approved the final version.

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