

## **Research on Foreign Exchange Exposure of Enterprises in China: Taking Manufacturing Multinational Enterprises as an Example**

*(Full Paper)*

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### **ABSTRACT**

This study measures the exposure of sample corporates to the three types of foreign exchange and then determines factors affecting foreign exchange exposure through the cross-sectional regression model. The study finds: Firstly, the proportion of samples with significant foreign exchange exposure is about 50.79%, while the EUR exposure accounts for the highest proportion at 23.91%, and the USD exposure possess the lowest proportion at 10.08%; Secondly, the average of absolute value of USD exposure is the largest, suggesting that USD exchange rate fluctuations has a greater impact on the corporate values, compared to the EUR and the JPY. Finally, the corporate's scale is significantly positively correlated with the USD exposure, and the corporate's leverage level is significantly positively correlated with the EUR exposure.

*Keywords:* Manufacturing multinational enterprises, foreign exchange exposure, corporate characteristics.

### **INTRODUCTION**

In recent years, China's foreign trade has achieved phenomenal growth. At the same time, as one of the important components of the national industry, China's manufacturing industry has also made great achievements and become a "world factory" that delivers products to the world. In 2016, the government launched the "Made in China 2025" program, which strengthened the determination to make China's manufacturing industry bigger and stronger and enhance its international competitiveness. Meanwhile, after years of development, the form of cross-border import has changed from personal act as purchasing agency to the standardization of cross-border shopping. With the application of artificial intelligence, VR and other manufacturing technologies, shopping experience and satisfaction of consumers will be further improved. With the promotion of "One Belt And One Road", new impetus will be injected into cross-border e-commerce. Therefore, with the frequent exchanges of international trade, manufacturing companies will inevitably be affected by exchange rate fluctuations.

With the implementation of the exchange reform in 2005, the unilateral exchange rate system between China and the United States has withdrawn from the historical arena and replaced by a managed floating exchange rate system. In 2016, the RMB was officially included in the SDR basket of currencies, which indicates that the RMB is becoming more international and market-oriented, and its exchange rate fluctuations will show a more obvious trend. As the dependence between China's economy and the external economy continues to rise, exchange rate fluctuations will cause listed companies engaged in foreign business to face huge foreign exchange exposure. The existence of foreign exchange exposure will affect the final profit of the enterprise through various factors such as cost and price. This is not conducive to the business development of the enterprise, but also causes a certain risk of evaporation of the stock market value of the enterprise. This was confirmed in the corporate survey report issued by the Ministry of Industry and Information Technology in 2010. Although during the 2008 financial crisis, as an emergency measure to stabilize the Chinese economy, China briefly restored the exchange rate system pegged to the USD, this only partially relieved the difficulties of enterprises under the financial crisis. With the gradual increase of the volatility of the RMB exchange rate, the import and export business of enterprises is still inevitably hit, and some enterprises have gone bankrupt because they cannot control the exchange rate risk in time.

Many scholars have previously noticed that the exchange rate fluctuation of the RMB against the USD will give enterprises a certain exposure to foreign exchange risk. Because the USD is the main pricing currency for commodities, its exchange rate fluctuations will have a certain impact on China's stock market by affecting the price of bulk commodities. However, the EUR and the JPY as international currencies not only have the characteristics of stable currency and economic stability of the issuing countries, but also one of the most common currencies in China's trade. Therefore, studying the exposure caused by the exchange rate changes between the EUR and the JPY also has certain research significance and value.

This paper empirically studies the foreign exchange exposure of Shanghai and Shenzhen A-share manufacturing multinationals due to changes in the three foreign exchange rates of the USD, the EUR and the JPY after the exchange rate reform in 2005, and make the In-depth exploration on factors that cause the exposure. Finally, based on the above research and analysis, the conclusion of this paper is drawn.

This paper will be divided into two parts. The first part reviews the theoretical analysis and empirical research on foreign exchange exposure, then uses Krapl's (2017) method to measure the exposure of Chinese manufacturing multinationals to the three foreign exchange currencies of the USD, the EUR and the JPY, and conduct relevant descriptive statistical analysis. The second part uses the significant exposure obtained in the first part to further discuss the influencing factors of foreign exchange exposure of manufacturing multinationals. Finally, the conclusions of this paper are given.

### LITERATURE REVIEW

For the measurement of foreign exchange exposure, early research tends to use corporate financial indicators. However, due to the limitation of the company's information disclosure, some companies' financial indicator data cannot be easily obtained. In order to solve this difficulty, Adler and Dumas (1984) defined the foreign exchange exposure as the elasticity of the company's cash flow for exchange rate fluctuations, and took the "enterprise value is the discounted value of the company's future cash flow" as basic idea to use enterprise value replacing the present value of the company's future cash flow.

Based on the research results of Adler and Dumas (1984), Jorion (1990) introduced the market income factor and proposed the most widely used capital market model. After the introduction of Jorion's capital market model, scholars continued to use the model to conduct empirical tests using national data. Doukas *et al.* (1999) showed that 14.3% of Japanese companies have significant exchange rate risk exposures due to fluctuations in the USD exchange rate. Bartram (2004) found that 7.8% of non-financial companies in Germany have significant exchange rate risk exposures due to fluctuations in the USD exchange rate. Luo and Jiang (2007) used sample data of all listed companies in Shanghai and Shenzhen stock markets, and found that 17.8% of Chinese companies have significant foreign exchange exposure. Zhang (2013), based on the sample data of listed companies in Chinese energy industry, found that the sample of foreign exchange exposure was about 82%. Wang and Hu (2015) believed that among the Chinese manufacturing enterprises, the sample with significant foreign exchange exposure was about 11%.

However, the use of the traditional Jorion model to analyze foreign exchange exposure still has certain shortcomings. Bartram (2008) and Krapl (2017) have shown that although it is common practice to incorporate market yield control variables into the model, when the market yield factor exists in the model, the model measures only the exposure relating to the market index. Based on the comprehensiveness of the research, Krapl (2017) proposed a new measurement model of foreign exchange exposure including short-term interest rates and maturity spreads based on the original capital market model.

In addition, according to the results of Allayannis and Ofek (2001) with Li (2013), the exposure factors affecting foreign exchange risk can be roughly divided into the following three types: financial value preservation factors, operational preservation factors and corporate financial indicators.

Among them, financial value preservation mainly refers to the use of hedging instruments such as forward settlement and sale of foreign exchange to reduce the exposure of foreign exchange risk faced by enterprises. Li (2013) showed that the use of financial derivatives can reduce corporate exposure to foreign exchange risk. Gu and Deng (2007) believed that the fair use of futures and options can substantially eliminate the foreign exchange exposure of foreign-invested enterprises. Therefore, this paper hereby anticipates that foreign exchange exposure is inversely related to the use of corporate financial derivatives.

Operational preservation mainly refers to that enterprises can improve the company's operating level through strategic planning, thereby eliminating the long-term foreign exchange exposure faced by enterprises. This kind of strategic planning is mainly reflected in the overseas transfer of business operations. If the number of countries in which the company operates is more, the foreign exchange exposure will often be reduced or eliminated due to the inconsistency in the direction of currency exchange rate fluctuations in these countries. Pantzalis *et al.* (2001) used the number of countries in which overseas branches of enterprises exist in empirical research, and found that the more countries in which overseas branches are located, the smaller the foreign exchange exposure of enterprises. On the other hand, the overseas sales income ratio will also affect the size of foreign exchange exposure to a certain extent. Jorion (1990) showed that the company's foreign exchange exposure had a positive correlation with the company's export ratio, indicating Companies with higher export ratios tend to have greater exposure to foreign exchange. Therefore, this paper hereby makes an expectation: the foreign exchange exposure is positively correlated with the proportion of foreign sales, and negatively correlated with the number of countries or regions where the overseas branches of the enterprise are located.

In the choice of financial indicators of enterprises, Nance *et al.* (2008) showed that large enterprises often benefit from hedging foreign exchange risks due to economies of scale. However, large companies could also better acquire knowledge about risk management, so large companies were more likely to hedge foreign exchange risk. Similar ideas are able to apply to growth opportunities, liquidity and leverage. According to the optimal hedging theory, those growth-oriented companies were more likely to hedge foreign exchange risk to alleviate the problem of insufficient investment faced by enterprises. He and Ng (1998) showed that companies with low liquidity and high leverage had more incentives to hedge foreign exchange risk.

### SAMPLE SELECTION, VARIABLE DEFINITION, AND MODEL SETTING

China started to implement a managed floating exchange rate system based on market supply and demand with reference to a basket of currencies in July 2005, making the RMB exchange rate mechanism more flexible. Therefore, this paper chose the

monthly data of RMB exchange rate from August 2005 to December 2017. As for the choice of foreign exchange currency, we choose three currencies, namely USD, EUR and JPY, because these three currencies are the world's major currencies and are frequently used in China's foreign trade activities.

The empirical research object selected in this paper is the multinational manufacturing enterprises listed in Shanghai and Shenzhen a-shares. Generally speaking, the sample enterprises should first meet the following three characteristics: Having international business; Belonging to manufacturing enterprises; Mainboard and small and medium enterprise board are listed. We take listed companies that meet the above three characteristics as the initial samples. On this basis, in order to ensure the integrity and continuity of data, we will further eliminate those enterprises that meet the following conditions: Suspension for more than half a year due to non-reform; the listing date was later than the sample start date of August 2005.

The data collected showed that a total of 507 listed companies met the above selection criteria at the same time. The data of sample enterprise information and related indicators are collected from the RESSET database, WIND database and BVD -- Osiris database.

Although there are a lot of literature with traditional Jorion model to analyze the foreign exchange exposure, but Krapl (2017) argue that, although the market yields control variables included in the model is a very common practice, but when the model yield factors exist in the market, the model is measured by the portion of the exposure associated with the market index. Therefore, Krapl (2017) proposed the foreign exchange exposure measurement model including short-term interest rate and term spread, as shown in Equation (1):

$$R_{i,t} = \alpha_{i,t} + \delta_i^D R_{x,t}^D + \delta_i^E R_{x,t}^E + \varphi_{1,i} R_{ST,t} + \varphi_{2,i} R_{DS,t} + \varepsilon_{it} \tag{1}$$

Among them, the  $R_{i,t}$  as the stock yield,  $R_{x,t}^D$  and  $R_{x,t}^E$  for two kinds of exchange rate yield,  $R_{DS,t}$  is a short-term interest rate control variables,  $R_{DS,t}$  for the term spreads control variables.

This paper follows the model of Krapl (2017) and adopts the RMB exchange rate against the USD, EUR and JPY to establish the model as shown in Equation (2):

$$R_{i,t} = \alpha_{i,t} + \delta_i^U R_{x,t}^U + \delta_i^E R_{x,t}^E + \delta_i^Y R_{x,t}^Y + \varphi_{1,i} R_{ST,t} + \varphi_{2,i} R_{DS,t} + \varepsilon_{it} \tag{2}$$

The description of variables in the foreign exchange exposure measurement model described in Equation (2) is shown in Table 1.

**Table 1: Explanation for Variables Used to Estimate Exposure**

Variables	Explanation
$R_{i,t}$	The monthly return on the stocks of the sample enterprise i in the period t
$\alpha_{i,t}$	Constant term
$R_{x,t}^U$	The monthly rate of return of the RMB to the USD (the intermediate rate) under the direct quotation method of the period t
$\delta_i^U$	The regression coefficient of USD yield, namely the foreign exchange exposure of sample enterprise i (USD)
$R_{x,t}^E$	The monthly rate of return of the RMB to the EUR (the intermediate rate) under the direct quotation method of the period t
$\delta_i^E$	The regression coefficient of EUR yield, namely the foreign exchange exposure of sample enterprise i (EUR)
$R_{x,t}^Y$	The monthly rate of return of the RMB to the JPY (the intermediate rate) under the direct quotation method of the period t
$\delta_i^Y$	The regression coefficient of JPY yield, namely the foreign exchange exposure of sample enterprise i (JPY)
$R_{ST,t}$	The control variable of short-term interest rate in t period is the one-year Treasury bond rate
$\varphi_{1,i}$	The regression coefficient of the control variable of short-term interest rate
$R_{DS,t}$	The time spread control variable of t period is used for one-year and 15-year Treasury bond rates
$\varphi_{2,i}$	The regression coefficient of the term spread control variable
$\varepsilon_{it}$	Residual item

In this paper, according to the practices of most previous literatures, the calculation methods of the monthly return rate of a single stock and the monthly return rate of exchange rate are all based on the first-order logarithmic difference of the monthly closing price. As for the calculation of short-term interest rate and term spread, this paper adopts the method of Bartram (2008) and Krapl (2017) to calculate the formula as shown in Equations (3) and (4) :

$$R_{ST} = \Delta SR / (1 + LR) \tag{3}$$

$$R_{DS} = \Delta(LR - SR) / (1 + LR) \quad (4)$$

Among them,  $\Delta$  represents the difference between the current and previous values.  $SR$  is short-term interest rates,  $LR$  is long-term interest rates.

Next, this article will use the three groups of corresponding significant exposure of foreign exchange obtained by Equation (2), further reveals the affecting factors of enterprise foreign exchange exposure. Combined with the views of Li (2013) and Krapl (2017), the following variables are selected in the cross-sectional regression model:

**The size of enterprise ( $S_i$ ).** The size of the company is represented by the total market value of the company's stock. The data is derived from the 2013-2016 annual report, and the average value of the four-year data is taken. Because this data value is large, it is processed logarithmically.

**Enterprise's existing growth opportunities ( $M_i$ ).** The current growth opportunity of enterprise I is represented by the book value ratio. The data is from the 2013-2016 annual report, and the average value of the data is obtained in 4 years.

**Liquidity of enterprise ( $L_i$ ).** The liquidity of enterprise is represented by the quick ratio, which is derived from the 2013-2016 annual report, and takes the average of 4 years of data.

**The level of leverage for enterprise ( $LV_i$ ).** The liquidity size of enterprise I is represented by the long-term debt ratio. The data is derived from the 2013-2016 annual report, and the average value of the data is taken for 4 years.

**The export ratio of enterprise ( $FS_i$ ).** The ratio of overseas business revenue to the total business revenue of the company is expressed as the ratio of overseas business revenue to the total business revenue of the company. The data is from the 2013-2016 annual report, and the average of the data is taken for 4 years. The specific formula is as follows.

**The number of countries or regions in which the overseas subsidiaries of enterprise are located ( $B_i$ ).** Refers to the number of countries or regions in which the parent company's overseas subsidiaries are located.

**The use of financial derivatives to hedge foreign exchange risk ( $D_i$ ).** This refers to whether an enterprise uses financial derivatives such as forward trading to avoid foreign exchange risks during 2013-2016. If the enterprise carried out such business, it takes 1 for  $D_i$ ; if it does not, it takes 0 for  $D_i$ .

**A control variable of the manufacturing sub-industry to which enterprise belongs  $Ind_j$ .** This is expressed as a dummy variable.

All the above data are from the CSMAR database, the RESSET database, the annual report released by the China Central Depository & Clearing Co., Ltd. and enterprises.

Therefore, based on the above views and ideas, the following cross-section regression model is proposed in this paper:

$$\delta_i = \alpha + \beta_1 S_i + \beta_2 M_i + \beta_3 L_i + \beta_4 LV_i + \beta_5 FS_i + \beta_6 B_i + \beta_7 D_i + \beta_j \sum_{j=1}^n Ind_j + \varepsilon \quad (5)$$

## EMPIRICAL RESULTS

In this chapter, we will expand into two parts. First, in the first section, we will use the foreign exchange exposure measurement model to measure the exposure of each currency and conduct relevant descriptive statistics. Then, in the second section, we will use the foreign exchange exposure obtained in the first part to establish a cross-sectional regression model and conduct relevant descriptive statistical analysis of its influencing factors.

### 4.1 Descriptive Statistics of the Foreign Exchange Rate Exposure Measurement Model

For the dependent variables and major independent variables involved in the measurement of foreign exchange rate exposure, such as sample enterprise stock yield and the return of currency, their descriptive statistical results are shown in Table 2. There is no unit root of the variable data used in the model, and all variable sequences are stable sequences.

Table 2 reports the descriptive statistical results for the following variables in the exposure measurement model: Stock yield ( $R_{i,t}$ ), inflation-adjusted monthly returns of three kinds of currency ( $R_{x,t}^U$ ,  $R_{x,t}^E$ ,  $R_{x,t}^Y$ ), short-term interest rate ( $R_{ST,t}$ ) and term-spread variables ( $R_{DS,t}$ ).

**Table 2: Summary Statistics**

Variable	Quantile			Median	Standard Deviation	Skewness	Kurtosis
	P25	mean	P75				
$R_{i,t}$	-6.820%	0.880%	9.350%	0.880%	15.878%	-0.533	6.975
$R_{x,t}^U$	-0.400%	-0.150%	0.010%	-0.160%	0.587%	1.243	6.545
$R_{x,t}^E$	-1.440%	-0.160%	1.360%	0.000%	2.261%	-0.393	1.211
$R_{x,t}^Y$	-1.810%	-0.160%	1.450%	-0.120%	2.436%	-0.073	0.520
$R_{ST,t}$	-1.830%	0.001	2.650%	0.005	0.055	-0.586	4.236
$R_{DS,t}$	2.760%	-0.001	2.220%	-0.003	0.051	0.345	4.482

Table 2 results show that average stock return of samples is 0.88%, which means the enterprise value of sample is on the rise during the period of statistics. At the same time, we find that the standard deviation of the stock return of the sample is 15.878%, indicating that the overall stock price of the sample in the manufacturing industry fluctuated greatly during this period. In addition, the skewness of the return of USD is greater than 0, indicating that in the USD fluctuations, large positive fluctuations (appreciation) occur more frequently than large negative fluctuations (depreciation). However, the standard deviation of the return of USD is relatively small compared with the EUR and JPY indicating that the return of USD is relatively stable. In addition, we can find that the skewness of the return of EUR and JPY is -0.393 and -0.073, both of which are less than 0, indicating that large negative fluctuations (depreciation) occur more frequently than large positive fluctuations (appreciation) in the returns of EUR and JPY. The average return of USD is -0.15%, the average return rate of EUR is -0.16%, and the average return rate of JPY is -0.16%, indicating that the average return level of these three currencies is relatively close during the statistical period.

In addition, we also carry out Pearson correlation analysis for five independent variables in the model and use the Variance Inflation Factor (VIF) indicator to detect the multicollinearity between the model independent variables. Table 3 is divided into two parts. The first part describes the degree of correlation between variables by showing the correlation coefficient. The second part explains the multicollinearity size in the model by showing the VIF index.

**Table 3: Statistical Analysis Results between Variables**

Panel A: Correlation coefficients: currency returns and interest rate control variables					
	$R_{x,t}^U$	$R_{x,t}^E$	$R_{x,t}^Y$	$R_{ST,t}$	$R_{DS,t}$
$R_{x,t}^U$	1	-0.007	0.109	-0.021	0.000
$R_{x,t}^E$		1	0.199**	-0.074	0.218***
$R_{x,t}^Y$			1	-0.172**	0.047
$R_{ST,t}$				1	-0.791***
$R_{DS,t}$					1

  

Panel B: The VIF indicator between the independent variables				
	$R_{x,t}^U$	$R_{x,t}^E$	$R_{x,t}^Y$	$R_{ST,t}$
$R_{x,t}^E$	1.145			
$R_{x,t}^Y$	1.118	1.054		
$R_{ST,t}$	2.945	2.805	2.668	
$R_{DS,t}$	2.995	2.728	2.668	1.000

It can be seen from the Panel A that the correlation coefficient of the five variables does not exceed 0.3 except that the correlation coefficient between the short-term interest rate variable and the term spread variable is 0.791.

According to the general opinion of Gao (2000), when the VIF index is no less than 10, the multicollinearity problem between independent variables may be serious, and may have an important influence on the estimation value under the least square method. In our test results showing in Panel B, the VIF results between all independent variables are far less than 10, so it can be considered that there is no serious multicollinearity problem in the regression model.

Using the model shown in Equation (2) and the collected sample data, this paper respectively measured the foreign exchange exposure of the sample enterprises to the three currencies of USD, EUR and JPY. Table 4 reports the overall descriptive statistics of the three foreign exchange exposures.

**Table 4: The Overall Descriptive Statistics**

	Number	Mean	Minimum	Quantile			Maximum
				P25	Median	P75	
FX exposures	257	-0.472	-7.51	-1.306	-0.760	1.209	11.52

According to the results shown in Table 4, the average value of foreign exchange exposure of all sample is -0.472, which indicates

that when the average return of foreign exchange rate is positive (foreign currency appreciation and local currency depreciation), there is a negative impact on the stock prices of Chinese manufacturing enterprises.

Then, we conduct descriptive statistics on the three types foreign exchange exposure, and the results are shown in the Panel A and B of Table 5. Panel A classifies the foreign exchange exposure according to the different foreign exchange currencies, and reports the number and proportion of samples corresponding to each foreign exchange exposure, while Panel B conducts a descriptive statistical analysis of each foreign exchange exposure.

**Table 5: The Overall Descriptive Statistics**

Panel A: Statistical significance of three types of exposures						
Significant level	$\delta_i^U$		$\delta_i^E$		$\delta_i^Y$	
	Number	Proportion	Number	Proportion	Number	Proportion
Sig.10	23	4.55%	43	8.50%	36	7.31%
Sig.05	19	3.75%	59	11.86%	37	7.51%
Sig.01	9	1.78%	18	3.56%	10	1.98%
Total	51	10.08%	121	23.91%	85	16.80%

  

Panel B: Summary statistics for three types of exposures			
	$\delta_i^U$	$\delta_i^E$	$\delta_i^Y$
Number	51	121	83
Mean	-3.623	1.201	-1.009
Median	-4.120	1.210	-1.064
P25	-4.806	1.061	-1.254
P75	-3.525	1.441	-0.908
Maximum	11.52	2.48	1.05
Minimum	-7.51	-1.14	-1.77
Mean of absolute value	4.50	1.28	1.10
The maximum of the absolute value	11.52	2.48	1.77

The results presented in Panel A show that, on the whole, the proportion of samples with significant foreign exchange exposure is about 50.79%. Among them, EUR foreign exchange exposure accounted for the highest at 23.91% indicating that among Chinese manufacturing enterprises, those affected by EUR are the most. It was followed by JPY exposure at 16.80%, while USD foreign exchange exposure was the lowest at 10.08%. The above conclusions are in line with Li (2013) that the foreign exchange exposure of USD, EUR and JPY are roughly equal to each other.

According to the results shown in Panel B, the average foreign exchange exposure of USD and JPY was negative in all the significant foreign exchange exposure of the sample enterprises, indicating that the appreciation of USD and JPY against RMB would have a negative impact on the stock price for these enterprises as a whole. The average foreign exchange exposure of EUR (1.441) is positive, suggesting that for these companies as a whole, the appreciation in the EUR against the RMB would have a positive impact on share prices.

In terms of the absolute value of foreign exchange exposure, the USD has the largest exposure, at 11.52, followed by the EUR at 2.48 and then the JPY at 1.77. Among them, the average value of the absolute USD exposure is about 3.52 times of the EUR and 4.09 times of the JPY, indicating that among the three foreign currencies, the fluctuation of the USD exchange rate has the biggest impact on the stock prices of listed companies in the manufacturing industry.

#### 4.2 Descriptive Statistics of The Exposure Factor Variables

The following is a detailed description of the factor analysis results of the three foreign exchange exposures of USD, EUR and JPY. Table 6 reports the results of a descriptive analysis, which is conducted on the mean value of the influencing factor variables of the three data sets.

**Table 6: The Mean Value of Three Types of Foreign exchange exposure Factors**

	$\delta_i^U$	$\delta_i^E$	$\delta_i^Y$
$S_i$	15.869	15.893	16.108
$M_i$	1.080	1.132	1.103
$L_i$	1.250	1.255	1.268
$Lv_i$	0.162	0.168	0.188
$FS_i$	0.470	0.456	1.095
$B_i$	0.870	0.953	1.441

From the results shown in Table 6, we can see that the influencing factors of the three types of foreign exchange exposure groups have the following characteristics in the following aspects:

**The enterprise scale.** The average size of the three groups is similar, among which the size of the JPY group is relatively large, which is 16.108, followed by the EUR group is 15.893, and the size of the USD group is relatively small, which is 15.869.

**Business growth opportunities.** In terms of enterprise growth opportunities, the book value of the USD group which was 1.080, was relatively small compared with the average value of the other two groups, indicating that there were more high-growth companies in the USD group.

**Enterprise liquidity.** In terms of corporate liquidity, the average liquidity of the three groups is similar, among which the companies with the JPY group have relatively higher liquidity, whose quick ratio is 1.268.

**Corporate leverage.** The average level of leverage of the three groups is close, among which the companies of the JPY group have higher leverage, whose average long-term debt ratio is 0.188, while the USD group have lower leverage, whose average long-term debt ratio is 0.162.

**Enterprise export ratio.** In terms of the export ratio, the USD group and the EUR group have a similar export ratio of 0.470 and 0.456 respectively, while the JPY group had a significantly higher export ratio than the other two groups, which was 1.095.

**Distribution of overseas subsidiaries.** In terms of the number of foreign subsidiaries, the subsidiaries of companies with the JPY group are more dispersed on average, with 1.441, the EUR group is followed by 0.953, while the foreign subsidiaries of companies with USD group are relatively more concentrated, with 0.870.

The following is a regression analysis of three groups of factors affecting foreign exchange exposure. Table 7 reports the regression coefficients of the three groups and the relevant VIF indicators.

**Table 7: Determinants of Foreign Exchange Exposure**

	$\delta_i^U$		$\delta_i^E$		$\delta_i^Y$	
	coefficient	VIF	coefficient	VIF	coefficient	VIF
$S_i$	1.037*	2.728	0.037	1.723	-0.002	1.720
$M_i$	0.260	3.457	0.027	1.847	-0.085	2.498
$L_i$	0.215	2.240	0.035	1.633	-0.019	1.634
$Lv_i$	-2.208	2.760	0.502*	1.636	0.069	1.647
$FS_i$	1.856	2.013	0.125	1.431	-0.077	1.721
$B_i$	-0.288	2.452	-0.025	1.782	0.004	2.073
$D_i$	-0.061	1.431	0.118	1.626	-0.052	1.840
Industry control	Yes		Yes		Yes	
Observations	51		121		83	

According to the results shown in Table 7, there is a significant positive correlation between company size and USD exposure. It suggests that the larger the company is, the higher the corporate dollar risk exposure is, which seems to contradict the traditional view offered by Nance *et al.* (1993) that large companies tend to benefit from the hedging of foreign exchange risk due to economies of scale. However, in the study by Gu (2012), we find a similar conclusion that companies with high leverage do not have lower foreign exchange exposure. According to the opinions of Gu (2012), the possible explanation for this phenomenon is that on the one hand, large enterprises are engaged in relatively more foreign trade activities; on the other hand, since China has not established a relatively mature and sound exchange rate hedging market mechanism, they will inevitably have greater foreign exchange exposure. By contrast, for companies in countries with relatively mature financial markets, as they can conduct trading operations in relevant exchange rate hedging markets, large companies are often able to reduce their foreign exchange exposure by their economies of scale. As Krapl (2017) has concluded, there is a significant negative correlation between the size and foreign exchange exposure of multinational listed companies in the United States.

Next, we will analyze the factors affecting EUR exposure. According to the results shown in Table 7, corporate leverage level and EUR exposure shows a significant positive correlation, indicating that the higher corporate leverage level is, the higher corporate EUR exposure is. This seems to contradict the conventional opinion offered by He and Ng (1998) that companies with high levels of leverage have more incentives to hedge foreign exchange risks. However, in the study by Gu (2012), we find a similar conclusion that companies with high leverage do not have lower foreign exchange exposure. According to Wang (2005) and Gu (2012), the possible explanation for this phenomenon is that when Chinese enterprises conduct financing, foreign debt is often favored by enterprises due to the features of large financing amount and long-term use, although foreign debt carries some foreign exchange risk. For companies with high levels of leverage in the EUR group, they may have large foreign exchange exposure because of their high levels of external debt.

Then, we analyze the impact factors of JPY exposure, and the results are shown in Table 7. According to the results shown in Table 7, we find that the regression coefficients of all the seven types of explanatory factor variables in the model are not significant at the level of 10%, indicating that the seven factors provided by the model had no significant impact on the JPY exposure of enterprises.

### CONCLUSION

Through the foreign exchange exposure measurement model proposed by Krapf (2017), this paper conducts an empirical analysis of Chinese manufacturing multinational enterprises. The analysis shows that among the 507 sample companies, 257 companies have significant foreign exchange exposure. The impact of exchange rate fluctuations in different foreign exchange currencies on corporate value is also different.

In the descriptive statistics of all significant foreign exchange exposures, it is found that at the 10% level of significance, the proportion of samples with significant foreign exchange exposure is approximately 50.79%. In addition, the average value of foreign exchange exposure of all sample companies is -0.76, indicating that the average rate of return on foreign exchange rates is positive (foreign currency appreciation, local currency depreciation), which adversely affects the stock price of listed companies in China's manufacturing industry.

In descriptive statistics on foreign exchange exposures that distinguish foreign exchange types, it is found that the proportion of companies with exposure to EUR foreign exchange risk is the highest, at 23.91%, indicating that among Chinese manufacturing companies, the companies affected by the EUR were the most. Moreover, the proportion of companies with exposure to the JPY is 16.80%, while the proportion of companies with USD foreign exchange exposure is the lowest, at 10.08%.

In the significant foreign exchange exposure of all sample companies, the average foreign exchange exposures of the USD and the Japanese yen (-3.623 and -1.09) are negative, indicating that the appreciation of the USD and the Japanese yen relative to the RMB for these enterprises will adversely affect the market price. The EUR's average foreign exchange exposure (1.441) is positive, indicating that for these companies as a whole, the appreciation of the EUR relative to the renminbi will have a positive impact on the stock price.

From the absolute value of foreign exchange exposure, the dollar risk exposure is the largest at 11.52, following by the EUR risk exposure at 2.48 and the yen risk exposure at 1.77. Among them, the average value of the absolute value of the USD risk exposure is about 3.52 times that of the EUR and 4.09 times of the yen. This indicates that among the three kinds of foreign exchange, the fluctuation of the USD exchange rate has the biggest impact on the stock price of listed companies in the manufacturing industry. The impact of exchange rate fluctuations on the stock price of listed companies in manufacturing is minimal.

In the analysis of foreign exchange exposure factors, it is found that the company size and the dollar risk exposure showed a significant positive correlation, which is contrary to expectations, indicating that the larger the company size, the higher the corporate dollar foreign exchange exposure. Possible explanations for this phenomenon are that large enterprises are inevitably having greater foreign exchange risk because they are engaged in relatively large foreign trade activities on the one hand, and China has not yet established a relatively mature and sound exchange rate hedging market mechanism.

In addition, it is also found that the company's leverage level and the EUR risk exposure showed a significant positive correlation, which is contrary to expectations, indicating that the greater the company's leverage level, the higher the corporate risk exposure. A possible explanation for this phenomenon is that for companies with high leverage levels in the EUR risk exposure group, they may have a large foreign exchange exposure because of the higher level of external debt. Correspondingly, manufacturing multinationals with exposure to the EUR can also reduce the company's own foreign exchange exposure by appropriately reducing the company's leverage.

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