Impact of RMB exchange rate changes on Jiangsu's foreign trade

ABSTRACT

The acceleration of globalization makes the whole world economy full of uncertaintyDevelopment has strongly promoted the growth of global trade, on the other hand, the financial crisis of globalization will have a more profound impact on every economy, thus disrupting the balance of the global economy.

GARCH model is used to calculate the volatility of exchange rate, and the empirical part analyzes the impact of RMB exchange rate changes on the export trade of Jiangsu Province.A total of 70 periods of monthly data from 2018 to 2023 are used, including two periods of exchange rate reform and epidemic that have a great impact on RMB exchange rate fluctuations.The empirical results show that, the change of exchange rate has a significant impact on the import and export trade volume of Jiangsu Province, and the exchange rate fluctuation has a significant negative impact on the export trade scale of Jiangsu province, which is greater than the import;

Finally, for the foreign trade industry of Jiangsu province how to deal with the volatility of RMB exchange rate, this paper puts forward corresponding countermeasures and suggestions from the perspective of government and enterprises respectively.

Keywords:Exchange rate fluctuations； Jiangsu Province； foreign trade； johansen cointegration test

1. INTRODUCTION

1.1 Trade status of Jiangsu Province is very important

Jiangsu Province is located in the coastal area of China, with superior transportation conditions and close to Shanghai, Hangzhou and other economically active cities. It has the advantages of capital, talent and science and technology. Its export trade volume has always been in the forefront of China, showing an overall trend of increasing year by year. Sufficient high-end talent reserve, perfect government policy support, comprehensive infrastructure and facilities, solid economic foundation, good market environment and so on provide strong conditions for the development of import and export trade in Jiangsu Province. The approval of Jiangsu Free Trade Zone also provides better institutional advantages for the export of high-tech products in Jiangsu province, and provides a good opportunity for the further development of export trade. In 2022, the GDP will account for 10% of the country's total GDP, ranking second only to Guangdong Province, and the gap with Guangdong province is decreasing year by year. At present, the development momentum of international trade is good. In 2022, the import and export of Jiangsu Province will reach 5.45 trillion yuan, up 4.8% year on year, and the scale will reach a new record high. As a strong coastal trade province in eastern China, Jiangsu Province has made full use of its advantages in geography and industrial base, and achieved rapid development under the background of globalization. At present, Jiangsu province has increasingly participated in international economic and trade activities, and its exportation is also constantly improving. The main export commodities are mechanical and electrical products and high-tech products, which have a high year-on-year growth. High-tech products, including laptop computers, integrated circuits and electronic components, are moving towards the international market, and related industries are increasingly closely linked with the international market. Meanwhile, the export value of RCEP visas ranks first in China. China is establishing a new system of open economy and opening up to the outside world more and more, which makes Jiangsu, as a strong trade province, stand in the vanguard position of foreign trade development demonstration, and the fluctuation of RMB exchange rate will have an important impact on the economy of Jiangsu province and even the national economy through the foreign trade of Jiangsu Province. The development of foreign trade in Jiangsu Province will have an important impact on the economy of Jiangsu Province and even the whole country. Therefore, it is not only necessary but also very important to study the influencing factors of foreign trade development in Jiangsu Province.

1.2 Exchange rate fluctuations on the impact of imports and exports increased

As a core price index in the open economy, exchange rate affects the allocation of resources in a country or even the world. For foreign trade, exchange rate is an important factor. At present, China is constantly exploring the exchange rate system that is in line with China's national conditions. For example, in 2005, China carried out the reform of the exchange rate system, which caused the huge fluctuation of the exchange rate. As a result, Jiangsu's foreign trade import changed the trend of higher growth rate than export for many consecutive years, and the growth rate dropped rapidly. The data are shown in the following table, which can intuitively see the far-reaching impact of exchange rate fluctuations on import and export trade. It can be seen that the impact of exchange rate fluctuations on bilateral import and export trade is prominent, and it is urgent to carry out the subject research of RMB exchange rate and how it affects the development of foreign trade in Jiangsu Province.

2. LITERATURE REVIEW

2.1 Impact of exchange rate fluctuations on import and export trade

About the impact of exchange rate fluctuations on import and export trade. In the early days, changes in exchange rates were mainly measured by nominal exchange rates.

Chowdhury (1993) established a multivariate error correction model for G-7 countries and found that exchange rate fluctuations had a significantly negative impact on the export volume of G-7 member countries. Caporale also verified the significant negative correlation between real exchange rate volatility and trade volume by using GARCH model. Olayungbo (2011) concluded through empirical research that exchange rate fluctuations promoted the import and export trade of most African countries. Vicarelli& Pappalardo (2012) analyzed the impact of exchange rate fluctuations on the bilateral trade between euro area countries and India at the enterprise level, and concluded that exchange rate fluctuations had a positive effect on their bilateral trade. Baek (2013) took the industrial data of bilateral trade between Japan and South Korea as samples, and found through the method of autoregressive distributed lag that South Korea's import and export would be affected by exchange rate fluctuations in the short term, but the results showed that in the long term, this effect was minimal. Bahmani-Oskooee et al. (2008) studied the impact of JPY/USD exchange rate changes and its volatility on the manufacturing import and export trade between Japan and the United States, and concluded that RMB exchange rate fluctuations did not have an important impact on its major industries in the medium and long term. There is also uncertainty about the impact of RMB exchange rate fluctuations in the short term.Cardebat&Figuet (2019) analyzed the influencing factors of French wine import and export trade, and concluded that exchange rate fluctuations had a significant impact on French wine export. Cengiz Tunc & Nihat Solakoglu (2018) concluded that bilateral exchange rate fluctuations promote export trade, and pointed out that the trade intensity and economic development degree of bilateral trading countries are related to the impact of exchange rate fluctuations on export trade. Pham Thi Tuyet Trinh (2014) studied the relationship between exchange rate fluctuations and national trade balance in Vietnam. Thus, it shows that currency depreciation can lead to an improvement in the trade balance. There are also a few scholars who believe that the impact of exchange rate fluctuations on trade is non-significant. Based on micro enterprise data, Hericourt and Poncet (2015) found that RMB exchange rate fluctuations would reduce the export scale of enterprises.

3 EMPIRICAL ANALYZE

3.1 MEASUREMENT OF VOLATILITY

The volatility of exchange rate can not be obtained directly, but is generally calculated by using models or formulas. There are many methods to measure exchange rate fluctuations, such as the residual sum of squares obtained by using ARIMA model, before calculation. The average difference between the forward and current exchange rates for the period, using the conditional variance obtained from the GARCH model. This paper uses GARCH model to measure the volatility of RMB real effective exchange rate.

This paper uses the monthly data of RMB nominal exchange rate from the General Administration of Customs of ChinaEVIEWS13.0 measurement software is conducted on the selected monthly data between January 2018 and October 2023 Measurement of exchange rate volatility.

（1）Statistical feature analysis

First, we differentiate the RMB exchange rate and obtain the yield sequence diagram of the RMB nominal exchange rate. The yield distribution of RMB real effective exchange rate is shown in the figure.

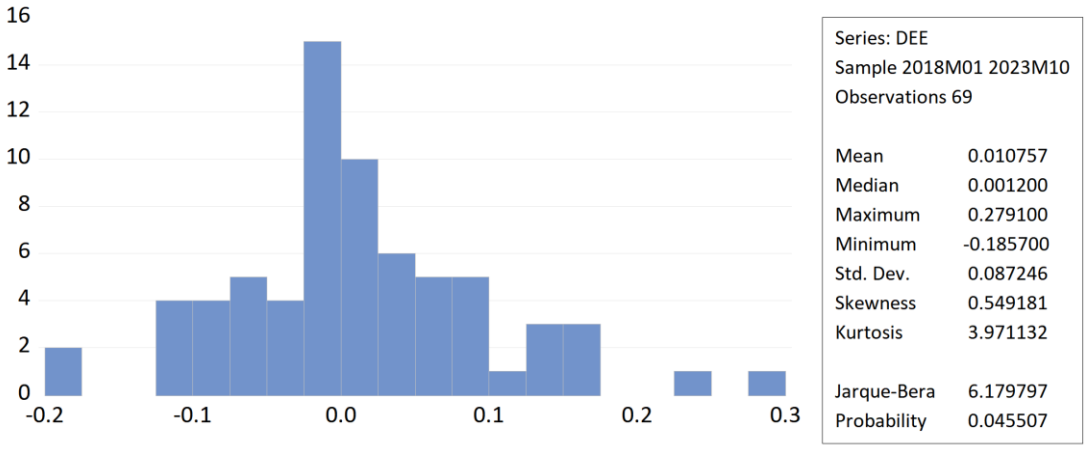

Fig 1. Descriptive statistics

As can be seen from the histogram, the standard deviation is small, which indicates that the gap between the selected data is small, and the data show a trend of aggregation, which is characterized by clustering. As can be seen from the histogram, most of the data cluster between -0.1 and 0.2. The skewness is positive, indicating that the data are left-skewed, and the kurtosis 3.971132 is greater than 3, indicating that the data are steeper than the normally distributed data. According to the analysis of skewness, kurtosis and JB statistics, it can be seen that the rate of return has the characteristics of left trailing, peak distribution and non-normal distribution.

（2）Test for stationarity

Table 1. Test for stationarity

		T-statistics			
Prob.*	ADF	1%	5%	10%	conclusion
0.0004	-5.1115	-4.0987	-3.4773	-3.1662	Refuse***

Based on the ADF test method and SIC criterion, the ADF statistic of the original series of return rate series is -5.1115, which is smaller than the three critical values. With a p-value less than 0.05, the series can be considered to have passed the stationarity test. That is, the series is stationary. GARCH models can be built

（3）GARCH model results

As for the values of p and q in the GARCH(p,q) model, they are usually 1 and 2. Four models, GARCH(1.1), GARCH(1,2), GARCH(2,1) and GARCH(2,2), were established. The coefficient significance is compared, and the appropriate model is selected by using the minimum principle of AIC

In this case, the values of AIC, SC and HQC of GARCH(1,1) model are the smallest, and the coefficients of the model are all significant at the significance level of 5%. This paper chooses GARCH (1,1) model to analyze the characteristics of return volatility.

Table 2.Test for stationarity

Variance Equation	
C	0.00143
RESID(-1)^2	0.05393
GARCH(-1)	0.70151

The upper part is the mean equation, the lower part is the variance equation, the coefficient of RESID(−1)^2 represents the coefficient of ARCH first-order lag term, and the coefficient of GARCH(−1) represents the coefficient of GARCH term. The coefficient of GARCH term 0.70151 indicates that the volatility of return in the early stage has a significant impact on the volatility of return in the later stage. There is a risk premium phenomenon, the higher volatility, the higher risk, the higher return.

According to the model output results, the mean equation form is obtained.

$$\sigma_t^2 = 0.00143 + 0.05393\,\varepsilon_{t-1}^2 + 0.70151\sigma_{t-1}^2$$

Therefore, we obtain the equation to measure the volatility of exchange rate, namely, the volatility.

3.2Selection of variables

Generalized AutoRegressive Conditional Heteroskedasticity (GARCH) model is a time series model widely used in the analysis of financial market data, mainly used to predict the volatility of asset returns.

Table 3 Descriptive statistics

	LNEX	LNE	LNEV	LNGDP	LNCPI
Observations	70	70	70	70	70
Mean	17.4341	1.9102	2.1360	7.1118	4.6256
Maximum	17.7809	1.9718	3.5112	7.9917	4.6578
Minimum	16.9472	1.8402	-0.3278	5.7734	4.6012
Std. Dev.	0.1788	0.0408	0.6626	0.6090	0.0123

1. Variable explained ln ex_t

This paper takes the foreign trade of Jiangsu Province as the research object, focusing on the impact of RMB exchange rate changes on China's export trade scale.

2. Explanatory variables ln e_t和 ln ev_t

As for the selection of influencing factors of import and export trade, it can be seen from literature review that exchange rate fluctuations have a certain impact on foreign trade, but many scholars point out that exchange rate fluctuations are not the only important variable affecting the scale of foreign trade. Therefore, we need to introduce other important variables into the model construction of the impact of RMB exchange rate on the trade scale of Jiangsu Province. The traditional balance of payments theory holds that exchange rate fluctuations are important factors affecting import and export trade. Specifically, when a country's exchange rate appreciates, that is, its currency becomes more valuable relative to the currencies of other countries, then its exports become more competitive in international markets because the same product can now be purchased with less currency. On the contrary, the price of imported products will rise because more domestic currency is needed to buy the same product. Therefore, exchange rate appreciation usually leads to a decrease in exports and an increase in imports, resulting in a deficit in the balance of payments.

3. Explanatory variables ln gdp_t

On the one hand, with the increase of income, the domestic labor cost will also rise, which may cause some labor-intensive export industries to lose competitiveness. Markusen (1986) and Bergstrand (1990) have written that countries with higher per capita income export higher quality products because these products are capital intensive. Flam and Helpman (1987), Murphy and Shleifer (1997), and Matsuyama (2000) argued that the higher quality of products produced in rich countries was due to their comparative technological advantage in producing high-quality products. On the other hand, as incomes rise, people's demands for quality of life will also rise, which may promote the development of some high value-added export industries. The income level can be replaced by GDP, that is, the GDP of Jiangsu province that has an impact on the import and export trade of Jiangsu Province and the weighted GDP of other countries that have trade with Jiangsu Province are adopted.

4. Explanatory variablesln cpi_t

The fluctuation of the price index (CPI) of a country or region will also affect the level of its import and export scale. When the domestic price index of a country rises, it means that the production cost of the country is also rising, which may lead to the price rise of export goods. If the price increase of the export commodity exceeds that of other countries, then the competitiveness of the export commodity of the country in the international market will decrease, which may lead to a reduction in the export volume. Therefore, this paper introduces the variable of consumer price index analysis in Jiangsu Province.

5. Explanatory variablesepd

epd represents the dummy variable of the impact of the epidemic, which is a variable factor that cannot be ignored in the period selected in this paper.

3.2 Model Setting

$$ln(\mathrm{ex_t}) = \ln(\mathrm{c}) + \alpha\ln(\mathrm{e_t}) + \beta\ln(\mathrm{ev_t}) + \gamma\ln(\mathrm{GDP\_j_t}) + \eta\ln(\mathrm{cpi_t}) + \theta\mathrm{epd}_t$$

Where ext represents the export and import volume of Jiangsu Province in each month from 2018 to 2023, t represents the time, et represents the monthly nominal exchange rate of RMB, evt represents the monthly volatility of the real effective exchange rate of RMB, GDP_jt represents the gross product of Jiangsu Province, Pt represents the commodity price index of Jiangsu Province, α, β, γ, η, θ represents the elasticity coefficient corresponding to each variable in the export trade equation, and c represents the unknown coefficient.

3.3 Unit root test

Before the regression step, the data of each index should be tested for stationarity first to avoid the phenomenon of spurious regression. If the test results show that the data are

stationary, we can directly conduct the model. If the data is not stationary, we generally have two ideas for the next step of research. The first is to transform the data into stationary data and then perform equation regression steps, such as differential transformation of the series to make the data stationary. However, this will often lose some unbalanced information, so the second idea is to conduct cointegration test for the unstable series of the same order and single integration to investigate whether there is an equilibrium relationship.

Table 4. ADF test results after first difference of each logarithmic variable in the equation

Variables	P	ADF	T			Conclusion
			1%	5%	10%	
lnex	3.93E-03	-4.4169	-4.0966	-3.4763	-3.1656	stable***
dlne	4.04E-04	-5.1336	-4.0987	-3.4773	-3.1662	stable***
dlnev	1.49E-06	-11.2680	-4.0987	-3.4773	-3.1662	stable***
dlngdp	4.06E-12	-12.7144	-4.1157	-3.4852	-3.1708	stable***
dlncpi	6.64E-06	-6.3279	-4.0987	-3.4773	-3.1662	stable***
epd	4.02E-08	-8.2066	-4.0987	-3.4773	-3.1662	stable***

It can be seen from the above table that after first-order difference, the ADF test value of each original logarithmic variable is smaller than the critical value at the level of 1%, indicating that the first-order difference data series of each logarithmic variable is stationary. The variables are all integrated I(1), so the empirical analysis in the following section can be continued.

3.4 Johansen Cointegration test

Cointegration test is a method used to detect the long-run equilibrium relationship among multiple non-stationary time series and prevent spurious regression phenomenon. The precondition for the cointegration test is that the series must be integrated of the same order, which has been verified above.

Table 5. Order of lag

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-220.8162375	NA	4.82E-05	7.088007	7.290403	7.167741
1	67.65364372	513.837	1.82E-08	-0.801676	0.615091	-0.24354
2	148.0820147	128.1827	4.67E-09	-2.190063	0.441076*	-1.153524*
3	180.8204421	46.03841	5.58E-09	-2.088139	1.757372	-0.573198
4	211.2905758	37.13548	7.72E-09	-1.91533	3.144552	0.078013
5	259.2929082	49.50241	6.94E-09	-2.290403	3.983851	0.181342
6	334.8467337	63.74854*	3.15e-09*	-3.526460*	3.962165	-0.576312

Note: * denotes the lag order chosen according to the criteria
LR: sequentially modified LR test statistic (each test at 5% level)
FPE: final forecast error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The results of the export equation show that the lag of order 2 is considered to be the optimal order for the most criteria. Therefore, this paper chooses order 2 and order 5 as the optimal order of the import and export equation respectively.

Table 6. factor loading coefficients

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.** Critical Value
None *	0.6063	133.8581	95.7537	0.0000
At most 1 *	0.3328	71.4038	69.8189	0.0372
At most 2	0.2829	44.2930	47.8561	0.1040
At most 3	0.2388	22.0083	29.7971	0.2980
At most 4	0.0434	3.7237	15.4947	0.9245
At most 5	0.0112	0.7519	3.8415	0.3859

Trace test indicates 2 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

3.5 Equation of cointegration

The Johansen cointegration test results show that the import equation can be considered as having at least two long-term stable equilibrium relationships among variables at the significance level of 5%. Next we use the vector correction model to fix the equations that deviate from the equilibrium state in the short term to the equilibrium state, and then conduct the study.

$$ln(\mathrm{ex_t}) = -35.4784 + 5.3278\ln(\mathrm{e_t}) - 0.0332\ln(\mathrm{ev_t}) - 0.0002\ln(\mathrm{GDP\_j_t}) - 4.0109\ln(\mathrm{cpi_t}) \\ - -0.1564\mathrm{epd}$$

In terms of the core explanatory variables, from the perspective of the exchange rate level, there is a strong positive correlation between the RMB exchange rate level lne and the export trade volume, indicating that the RMB depreciation caused by the bilateral exchange rate rise can promote the development of Jiangsu province's export trade in general, while the RMB appreciation caused by the exchange rate decline inhibits the expansion of Jiangsu province's export trade scale. The elasticity coefficient of RMB export exchange rate is 5.3278, indicating that the impact of exchange rate changes on the scale of import and export trade in Jiangsu Province is very significant. Through the relative price mechanism, RMB appreciation will raise the foreign currency price of China's export products, weaken the import demand of countries along the Belt and Road for China's export products to a certain extent, reduce the international competitiveness of export products, and thus hinder the development of export trade. This is in line with the theory's expectations; From the perspective of exchange rate fluctuations, the regression coefficient of RMB bilateral exchange rate fluctuations is significantly negative, indicating that the increase of RMB exchange rate fluctuations is not conducive to the development of Jiangsu province's export trade. On the other hand, it may be because although the exchange rate of USD against RMB has changed to a certain extent in recent years, the fluctuations between the currencies of the first few relatively large trading partners of Jiangsu Province and RMB are relatively small. Therefore, it shows that export is more sensitive to exchange rate, which is consistent with the research conclusions of most domestic scholars.

In terms of the cointegration results of other control variables, the gdp of Jiangsu Province gdpj is positive, indicating that both the economic development of the province and the increase of the GDP of each trading partner can significantly drive our total trade. The

more fully developed the economy is, the higher the market demand and supply capacity is, and the stronger the desire for trade is, which is also in line with the basic expectation. Economic scale has a significantly positive effect on trade development. The coefficient of exchange rate reform ref is negative and has a large elasticity, which is consistent with the coefficient of exchange rate fluctuation ev, indicating that exchange rate fluctuation will have an impact on the export trade of Jiangsu Province, which is consistent with the research conclusions of Zhou Huali (2023) and Sauer and Bohara (2001). During the epidemic, many countries and regions implemented lockdown measures, which directly led to a decline in global demand, thus affecting the value of exports, and factories stopped work and production, which led to a significant decline in the value of exports, consistent with the significantly negative epd coefficient of the epidemic variable in the equation

Table 7 factor loading coefficients

Pairwise Granger Causality Tests	F	P	Conclusion
LNE does not Granger Cause LNEX	4.4330	0.0158	Refuse
LNEX does not Granger Cause LNE	3.4998	0.0362	Refuse
GDP does not Granger Cause LNEX	5.3451	0.0072	Refuse
LNEX does not Granger Cause GDP	13.8473	0.0000	Refuse
EPD does not Granger Cause LNEX	4.4745	0.0152	Refuse
LNEX does not Granger Cause EPD	3.8671	0.0261	Refuse
LNEV does not Granger Cause LNEX	1.4936	0.1772	Accept
LNEX does not Granger Cause LNEV	1.8569	0.0794	Refuse
LNCPI does not Granger Cause LNEX	0.9801	0.3775	Accept
LNEX does not Granger Cause LNCPI	1.0051	0.3683	Accept

From the causal relationship table of variables in the export trade equation, it can be seen that the explanatory variable exchange rate fluctuation lne, the gross product of Jiangsu Province lngdpj, the commodity price index of Jiangsu Province lncpi, and the impact of epidemic on epd are all Granger causes of the explained variable total export of Jiangsu Province lnex. Among them, there is a causal relationship between the three independent variables of Jiangsu Province's gdp, exchange rate fluctuations and the impact of the epidemic on epd and the explained variable total export. Although the contribution of exchange rate volatility lnev to the forecast target is not large, the theoretical background of economics shows that there may be some interaction between them, it may play a moderating role in the model, or there is some complex interaction relationship with other variables. In addition, considering the possible information loss caused by the difference, we retain this variable based on the dual background considerations of statistics and economics.

From the export trade equation, all explained variables Granger cause the import trade scale of Jiangsu Province. There is a causal relationship between the impact of the epidemic and the fluctuation of RMB exchange rate and the scale of import trade in Jiangsu Province.

This shows that the model is stable.

5. CONCLUSION AND OUTLOOK

5.1 Conclusion

From the perspective of typical regional economy, this paper takes the foreign trade research of Jiangsu Province as the object to study the impact of exchange rate fluctuations on its import and export trade. Through the theoretical analysis of the internal influence mechanism of exchange rate on trade, describe and analyze the change of exchange rate and its volatility and the impact of the provincial import and export trade, empirical analysis

of the specific impact of exchange rate and other factors on import and export trade. The research conclusions obtained are as follows.

In the model, johansen cointegration test is used to study the long-term equilibrium relationship, and Granger causality test is used to analyze the impact of causality. The empirical results show that the impact coefficient of RMB REER changes on Jiangsu's export trade is 5.3278, which is significant. The influence coefficient of exchange rate fluctuation on export trade is − 0.03, which is relatively small. In general, the conclusions obtained through the econometric model analysis are basically consistent with some traditional theories and the actual economic situation.

5.2 Suggestions

In the short term, the government's goal is to expand profit margins by reducing unit costs for foreign trade processing companies, making up for the profits eaten up by the appreciation of the yuan. Our country should make full use of the ways such as science and technology education, information service and infrastructure construction to increase the government's emphasis on foreign trade; In addition, the government should establish and improve the insurance subsidy system for foreign trade enterprises, carry out the pilot insurance for high-tech enterprises, give full insurance subsidies to the products that earn foreign exchange from export, reduce and exempt the inspection fees and tariffs of export commodities, vigorously support the export publicity and promotion of the products of advantageous industries in the country, and further support and expand the export of advantageous commodities. The provincial government should focus on supporting the targeted foreign trade enterprises, especially the small and medium-sized export processing enterprises, which may suffer from the change of exchange rate in a specific direction. Through the above empirical analysis, the export of labor-intensive products is more negatively affected by the appreciation of RMB exchange rate than that of capital-intensive products. The government should strengthen the support for export processing enterprises, help foreign trade enterprises improve their operation and management in the environment of RMB appreciation and terms of trade deterioration, and carry out normative construction for enterprises, so as to help enterprises resist the risks faced by the tide of globalization.

AUTHOR'S CONTRIBUTION

Author WuHao designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author XuYongqi managed the literature searches. All authors read and approved the final manuscript.

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