Dynamic analysis of RMB-ASEAN exchange rate under the background of the Belt and Road Initiative

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Abstract:

The proposal of the Belt and Road strategy provides a win-win option for developing countries. However, with the increasing complexity of the international environment, the risk of uncertainty has also seriously affected the normal order of the economic environment. Under this background, through the construction of a TVP-SV-VAR model of geopolitical risks, economic policy uncertainty and RMB exchange rate changes, the dynamic time-varying of the RMB-ASEAN exchange rate is analyzed. The results show that geopolitical risks and economic policy uncertainties have obvious long-term effects on exchange rate fluctuations in the sample countries, and are roughly positive in the short term, and the impact is the most significant after the Belt and Road Initiative was put forward.

Keywords: Geopolitical risk, Economic policy uncertainty, China–ASEAN Free Trade Area, The Belt and Road.

I. INTRODUCTION

In January 2010, China-ASEAN Free Trade Area was officially established, becoming the largest free trade area among developing countries. At the same time, it marks the deepening of political and economic relations between China and ASEAN in a comprehensive and friendly manner, which contributes to the solidarity, cooperation and mutual assistance among developing countries. China and ASEAN have entered into a number of economic cooperation agreements in the areas of infrastructure and investment, which have contributed to the trade and economic development of both sides. Moreover, ASEAN countries become China's top trading partner in 2020 0, with the trade volume between the two sides exceeding one-seventh of China's total foreign trade. Data show that the trade volume between the two sides has grown 85 times from less than USD 8 billion in 1991 to USD 684.6 billion in 2020, and by October 2021, the trade volume in the Free Trade Area has reached USD 703.3 billion, an increase of 30% year-on-year. Moreover, the trade volume between the two sides is expected to reach a new record high, laying a solid economic foundation for promoting the construction of China-ASEAN Free Trade Area 3.0.

With the deepening of China's openness to the outside world, exchange rates, as the relative prices of different currencies, affect the scale, flow and layout of countries' import and export trade. Exchange rate

risk is the main market risk that countries are exposed to in international trade activities. Bilateral real exchange rate changes have a significant impact on the import trade between China and ASEAN countries, and the exchange rate systems of the countries along The Belt and Road differ greatly, and exchange rate changes are frequent and violent. Therefore, it is essential to strengthen the coordination of monetary policies with related countries to avoid large fluctuations in exchange rates in order to stabilize trade 0. Since the financial crisis swept the world in 2008, economic stability and the financial market environment have been changing rapidly, and the international economic environment has become increasingly complex. The resulting economic policy uncertainty in China has also started to rise due to the divergent economic views and policy implementation dilemmas, and has dramatically increased after the Sino-US trade friction. At the same time, the intense international trade war, the COVID-19 outbreak and other shocking risk events are causing continuous changes in the geopolitical environment and increasing geopolitical tensions among countries. The advancement of "The Belt and Road" strategy will definitely have a profound impact on the geopolitical relations of the countries along the route and even the world. Geopolitical risk (GPR) is one of the five major risks affecting the future global economic development, and its changing trend has great geopolitical significance for the development and cooperation of China-ASEAN Free Trade Area.

In the context of China's long-term trade surplus with ASEAN and China's efforts to promote The Belt and Road Initiative, exchange rate is a key factor that must be addressed. On the one hand, the potential exchange rate fluctuations may lead to the loss of investment income; on the other hand, behind the exchange rate fluctuations may lie underlying problems of economic fundamentals0. In the context of the networked and complicated global geopolitical pattern and economic and trade relations, it is of great value to examine the impact of uncertainty risk on the economic and trade development of China-ASEAN Free Trade Area0. Therefore, by studying the geopolitical risk and economic policy uncertainty and the dynamic changes of RMB exchange rate against ASEAN countries and its time-varying nature①, we can better analyze the relationship between trade and RMB exchange rate of various countries and reasonably cope with the external uncertainty risk faced by each country. Moreover, it will help to balance the trade interests of China to different countries and promote the steady development of the trade in the China-ASEAN Free Trade Area, which is of great theoretical economic significance and practical significance.

Compared with the existing literature, the potential contributions of this paper are: (1) It incorporates geopolitical risk, economic policy uncertainty and RMB exchange rate volatility into a unified framework, analyzes the impact of uncertainty risk on exchange rate volatility at the empirical level, and extends the research on geopolitical risk, economic policy uncertainty and RMB exchange rate. (2) Based on the time-varying impulse response perspective, it analyzes the impact direction of geopolitical risk and economic policy uncertainty on the foreign exchange market of the sample countries, and takes four major events as important nodes to provide empirical references for the subsequent promotion of The Belt and Road Initiative and the continuous development of China-ASEAN Free Trade Area.

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① Due to data limitations, this paper examines the exchange rate fluctuations of RMB against currencies of Indonesia, Malaysia, the Philippines and Thailand in the ASEAN Free Trade Area along The Belt and Road under the indirect quotation method.

This paper is organized as follows: Part 2 is a literature review, which qualitatively analyzes the current status of research on geopolitical risk and economic policy uncertainty and their effects on exchange rate fluctuations. Part 3 is about data sources and model building. Part 4 presents the empirical analysis, which is divided into three parts: parameter estimation tests, impulse responses for four sample countries with different lags and different time points. Part 5 presents the research conclusions and policy recommendations.

II. LITERATURE REVIEW

2.1 Impacts of Geopolitical Risk and Economic Policy Uncertainty

2.1.1 Geopolitical risk

Western geopolitics argues that geographic factors have an important influence on national policies, especially in terms of controlling maritime lines of communication and securing strategic locations for national interests. Chinese scholars believe that in the current situation, China has been placed in an unprecedentedly complex geopolitical environment and geopolitical network, and has become a participant in regional and global geopolitics. However, the geopolitical difficulties and obstacles that China encounters far outweigh the opportunities.

In this context, The Belt and Road policy was proposed and promoted. While we anticipate the considerable geopolitical benefits arising from it, we must also pay attention to the prominent geopolitical consequences it will cause [0]. According to Jiang (2021), the geopolitical risks of the countries along The Belt and Road are mainly derived from the host country, the region, and the global level. The host country has a precarious democracy, complex ethnicity, and declining rule of law; there is ongoing regional territorial strife and infiltration of multiple nefarious forces; attitudes vary widely among countries, and the great powers play political games while the less powerful countries take wait-and-see attitudes and make bets [0]. The geopolitical risk index (GPR) proposed by Caldara & Iacoviello (2018) is now commonly used to measure geopolitical risk and it is defined as the risk associated with war, acts of terrorism and tensions between states that affect the peaceful and normal functioning of international relations [0].

2.1.2 Economic policy uncertainty

In public economics, it is believed that there are three unavoidable time lags in any policy: the time lag of policy awareness, the time lag of policy formulation, and the time lag of policy effectiveness. The first two are endogenous time lags, while the time to wait for policies to take effect is usually uncontrollable, and is therefore called an exogenous time lag. Since the market itself is constantly changing, policy formulation can seldom reflect the market economy as it should be, it is very difficult to stabilize the economy with economic policy, which is also affected by many uncertainties. In the current stage of development, China has to deal simultaneously with the slowdown in economic growth, making difficult structural adjustments, and absorbing the effects of previous economic stimulus policies. While the general

public and society have high expectations for the state's macroeconomic control, they cannot ignore the market volatility caused by economic policy uncertainties resulting from a series of economic policy interventions [0].

Based on the PVAR model, Huang and Guo (2015) found that economic policy uncertainty has a negative short-term effect on total economic output, investment, consumption and inflation in China. It indicates that economic policy uncertainty has a negative effect on consumption at the aggregate level [0]. Due to the depressed economic environment in recent years, the Chinese government has introduced many economic policies to narrow the "divergence" between the growth rate of residents' income and the growth rate of consumption. While warming up the consumer market, it has also increased economic policy uncertainty, which in turn has a significant negative effect on residents' consumption (Li and Yu et al., 2021)[0]. Zhang et al. (2016) found that uncertainty in China's economic policy presents a positive shock effect on output growth during economic downturns, while it has a significant negative shock effect on the economy during boom periods [0]. Feng et al. (2020) constructed a Bayesian estimated time-varying parameter model and found that the increase in EPU index is an important reason for the increase in systemic financial risk in the stock market [0]. For the measurement of economic policy uncertainty, the most representative method is the economic policy uncertainty index (EPU) proposed by Baker et al. in 2016 [0].

2.2 Relations between Geopolitical Risk, Economic Policy Uncertainty and Exchange Rate Fluctuations

2.2.1 Geopolitical risk

Based on the GARCH-MIDAS model, Bu et al. (2021) revealed that the response of exchange rate levels in countries to their national geopolitical risk shocks is not uniform in terms of direction and magnitude. For example, positive uncertainty shocks are caused to the exchange market fluctuations in economies such as Russia and Mexico, while negative uncertainty shocks are caused to the foreign exchange markets in economies such as India and Colombia [0]. However, due to the sample limitation, we cannot tell whether it is associated with the economic development level of each country. Based on the UCSV-RV model, Wang et al. (2021) found that the impact of external geopolitical risk on the uncertainty of exchange rate expectations is characterized by gradual decay and is a net recipient of internal economic policy uncertainty spillover [0]. Liu et al. (2021) argued that geopolitical risk affects the foreign exchange market mainly from the sentiment channel and financial channel, and that the rise in risk has a negative impact on the confidence of participants and causes exchange rate depreciation. Moreover, they established a TVP-VAR model and analyzed that geopolitical risk exacerbates the depreciation pressure in the foreign exchange market, and that the foreign exchange market pressure is a net recipient of geopolitical risk spillover [0]. Therefore, it is an effective way to alleviate the pressure in the foreign exchange market by strengthening the monitoring of geopolitical risks.

2.2.2 Economic policy uncertainty

Li et al. (2020), based on the associative network perspective, argue that economic policy uncertainty will cause liquidity crunch, shrinkage of foreign exchange reserves and increased exchange rate risk, and it has a significant cross-country contagion effect [0]. Wang et al. (2021) used the UCSV-RV model to measure the uncertainty of RMB exchange rate expectations. The results show that the impact of internal economic policy uncertainty on exchange rate expectation uncertainty features a gradual increase. Compared with the external geopolitical risk, the impact of internal economic policy uncertainty is more significant [0]. Cao et al. (2021) measured the extreme risk spillover effect of EPU index on financial markets based on a copula model. They found that an increase in the EPU index leads to a decrease in money market liquidity, stock and commodity prices, and exchange rate depreciation to a significantly greater extent than the inverse effect on the financial submarkets when the EPU index decreases [0]. Wang used the GRACH model for empirical analysis of the volatility spillover and mean spillover. The results indicated that the rise in U.S. economic policy uncertainty, on the one hand, would intensify the volatility of the RMB-USD exchange rate, and on the other hand, it would drive the appreciation of the exchange rate of RMB against the USD, and the volatility spillover effect increased significantly after the "8-11" exchange rate reform and during the Sino-US trade friction [0].

2.3 Literature Review

In summary, the existing literature has been perfected in the study of the actual effects of EPU, and GPR and other uncertainties. However, their research perspectives are mostly limited to the effects of uncertainty on economic variables such as stock market price volatility, consumer demand impact, and money market liquidity. However, there is less analysis on the influence mechanism and effect of exchange rate price fluctuation, and the research on foreign exchange market is less related to RMB exchange rate. Geopolitical risk and economic policy uncertainty have been the key research topics both in China and abroad. Geopolitical risk and economic policy uncertainty have become research hot spots in recent years, but they mostly stay in the study of the impact of one of them on each economic factor, but rarely consider the relationship between the two on the macroeconomy and the global foreign exchange market. Compared with foreign studies, the research on uncertainty risk in China is not complete in terms of methodology and analysis, and the depth of research lags behind that of foreign studies. This paper focuses on the impact of China's economic policy uncertainty index and geopolitical risk index on the price volatility of RMB exchange rate. The TVP-SV-VAR model is used to explore the time-varying responses of the currencies of major ASEAN countries to geopolitical risk and economic policy uncertainty shocks. Thus, the study can provide empirical reference for better promoting the development of the Free Trade Area, and provide a reference basis for formulating effective monetary and economic policies and perfect macro foresight and early warning mechanisms in the future.

III. DATA SOURCES AND MODEL BUILDING

3.1 Data Sources

Due to data limitations, the sample interval of this paper was from January 2001 to December 2020. The EPU index of China based on South China Morning Post constructed by Baker and Bloom et al. (2016) was selected as a proxy variable for economic policy uncertainty. The GPR index constructed by Caldara and Iacoviello (2018) was selected as a proxy variable for geopolitical risk. After considering the economic development level, exchange rate system and data availability of ASEAN countries, the exchange rate of RMB against the currencies of Indonesia, Thailand, Malaysia and the Philippines in the interval was selected as a proxy variable for exchange rate changes under the indirect quotation method. The above data were monthly and standardized using Eviews. The EPR and GPR indices were derived from the Economic Policy Uncertainty Index website and the exchange rate data from the Investing website.

3.2 Model Building

The Vector Auto Regression model (VAR) is assumed to have fixed parameters and is a static model that does not reflect the structural changes among variables. The Time Varying Parameter - Stochastic Volatility - Vector Auto Regression model (TVP-SV-VAR) is assumed to be time-varying in both the coefficient matrix and the covariance matrix. Therefore, it can make different responses according to the change of the shock size and the change of the transmission path, which makes up for the deficiency of the VAR model. Therefore, the TVP-SV-VAR model with time-varying characteristics will be selected in this paper, and the building of the TVP-VAR-SV model is briefly described below.

First, a standard structural TVP-SV-VAR model is defined:

$$By_s = E_1 y_{s-1} + \cdots + E_i y_{s-i} + \mu_s, s = i + 1, \cdots, n \tag{1}$$

Where, y_s is a $k \times 1$ dimension observation vector, B is a $k \times k$ dimension coefficient matrix, $E_1 \ldots E_i$ is a $k \times k$ dimension lag coefficient matrix, and the perturbation term μ_s is a $k \times 1$ dimension structural shock. Assuming that $\mu_s \sim N(0, \sum\sum)$, where

$$\Sigma = \begin{pmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_k \end{pmatrix} \tag{2}$$

It is also assumed that B is the lower triangular matrix, i.e.

$$A = \begin{pmatrix} 1 & 0 & \cdots & 0 \\ a_{21} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & a_{k,k-1} & 1 \end{pmatrix} \tag{3}$$

The standard model (1) is organized in the following simplified form:

$$y_s = D_1 y_{s-1} + \cdots + D_i y_{s-i} + B^{-1} \sum \varepsilon_s \tag{4}$$

Where,

$$D_m = B^{-1} E_m, m = 1, \cdots, i, \varepsilon_s \sim N(0, I_k) \tag{5}$$

Each row of elements in the stacking matrix D_m is written as a $k^2 s \times 1$ dimension vector β, and $X_S = I_K \otimes (y'_{s-1}, \cdots, y'_{s-i})$ is defined, where $\otimes$ is the Kronecker product, so that the model can be transformed into:

$$y_s = X_s \beta + B^{-1} \sum \varepsilon_s \tag{6}$$

Where, letting $a_s = (a_{21,s}, a_{31,s}, a_{32,s}, a_{41,s}, \cdots, a_{kk-1s})'$ be the column vector formed by the stack of elements other than 0 and 1 in the lower triangle B_S, and letting

$$g_s = (g_{1s}, \cdots, g_{ks})', g_{js} = \log \sigma_{js}^2, j = 1, \ldots, k, s = i + 1, \cdots, n \tag{7}$$

$$\beta_{s+1} = \beta_s + \mu_{\beta s} \tag{8}$$

$$\alpha_{s+1} = \alpha_s + \mu_{\alpha s} \tag{9}$$

$$g_{s+1} = g_s + \mu_{gs} \tag{10}$$

$$\begin{pmatrix} \varepsilon_s \\ \mu_{\beta s} \\ \mu_{\alpha s} \\ \mu_{gs} \end{pmatrix} \sim N \begin{pmatrix} 0, \begin{pmatrix} I & 0 & \cdots & 0 \\ 0 & \Sigma_\beta & \ddots & \vdots \\ \vdots & \ddots & \Sigma_\alpha & 0 \\ 0 & \cdots & 0 & \Sigma_g \end{pmatrix} \end{pmatrix} \tag{11}$$

Where, $s = i + 1, \cdots, n, \beta_{m+1} \sim N(\mu_{\beta 0}, \Sigma_{\beta 0}), \alpha_{m+1} \sim N(\mu_{\alpha 0}. \Sigma_{\alpha 0}), g_{m+1} \sim N(\mu_{g0}, \Sigma_{g0})$, $\Sigma_\beta, \Sigma_\alpha, \Sigma_g$ are all diagonal matrices.

IV. EMPIRICAL ANALYSIS

Since the TVP-SV-VAR model does not require the selected variables to satisfy the condition of stationarity, only the data are normalized and then fed into the model for calculations. In this paper, a

time-varying parameter vector autoregressive model with geopolitical risk, economic policy uncertainty and exchange rates of Indonesia, Malaysia, Philippines and Thailand was constructed to investigate the time-varying dynamic relationship between the variables. The main feature of the model is that the time-varying coefficients and covariance can respond accordingly with the change of time, which can be more accurate to analyze the correlation between time-varying parameters.

4.1 Parameter Estimation Results and Tests

In this paper, the MCMC algorithm was used to simulate and estimate the model. Using Oxmetrics6 software, the number of simulations was set to 10,000, and the posterior mean, standard deviation, 95% confidence interval, and Geweke test for convergence probability of the parameters were estimated, and the invalid effect factor was estimated. The estimation results are shown in Table I.

TABLE I. Parameter estimation results of the TVP-VAR model

PARAMETER	MEAN	STANDARD DEVIATION	95% CONFIDENCE INTERVAL	GEWEKE TEST	INVALID FACTOR
sb1	0.0232	0.0027	[0.0185,0.0292]	0.7780	12.3400
sb2	0.0226	0.0026	[0.0183,0.0284]	0.1420	11.3300
sa1	0.0673	0.0198	[0.0400,0.1161]	0.0540	77.0000
sa2	0.0644	0.0179	[0.0388,0.1065]	0.4470	83.2400
sh1	0.5006	0.0965	[0.3347,0.7169]	0.0470	39.7100
sh2	0.3383	0.0723	[0.2127,0.4868]	0.6490	56.9900

According to the results in Table 1, the posterior means of all parameters fell within the 95% confidence interval, and the standard deviations of all parameters were small, which indicated that the parameter estimation results were good. Since the Geweke test values were all less than the critical value of 1.96 at the 95% significance level, the original hypothesis that the parameters all converged to the posterior distribution could not be rejected. The results in Table 1 also showed that the invalid factors of all parameters were less than 100, with the maximum value of 83.24. It indicated that 120 uncorrelated samples were obtained by the MCMC algorithm, which could meet the needs of the posterior inferential statistics and also indicated that the model was well simulated.

In Fig. 1, the sample autocorrelation, the convergence trajectory and the posterior density are shown from top to bottom, respectively. From the graph, we can see that the autocorrelation of the samples gradually converged to zero with the increase of the number of simulations, which suggested that the number of 10,000 simulations set in this paper can well eliminate the autocorrelation among the parameters. It also verified the results in Table 1 above, showing that the sample data obtained by the

MCMC algorithm in this paper are uncorrelated and can effectively simulate the distribution of the parameters.

4.2 Impulse Response Function Analysis with Different Lag Periods

In order to better study the temporal causes of China's exchange rate movements towards ASEAN countries, this paper first analyzes the impulse response functions at different lag periods. Fig. 2 and Fig. 3 show the impulse responses of shocks of geopolitical risks and economic policy uncertainty to Indonesian rupiah and Malaysian ringgit and the impulse responses of geopolitical risk, economic policy uncertainty to Philippine peso and Thai baht at short term (4 months), medium term (8 months) and long term (12 months), respectively.
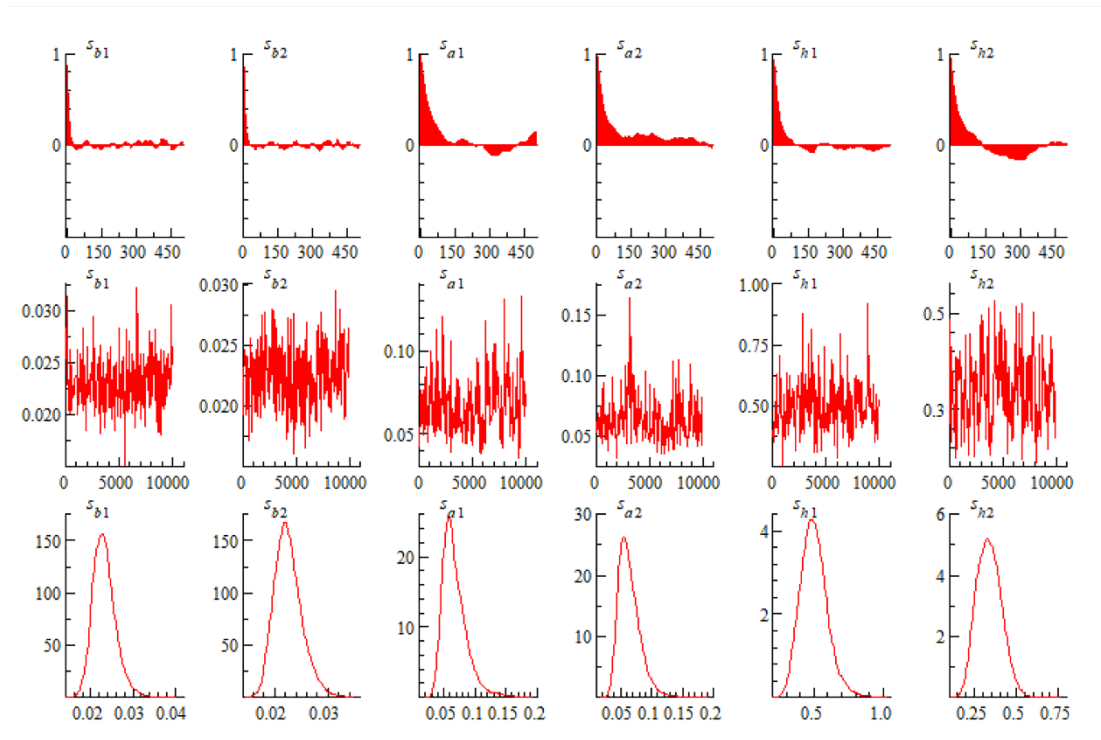

Fig 1: Sample autocorrelation, sample path and posterior density plots

4.2.1 Response analysis to shocks in Indonesian rupiah and Malaysian ringgit

From the first plot (a) in the first row of Fig 2, it can be seen that the impulse response functions of the geopolitical risk to shocks in the Indonesian rupiah followed approximately the same trend under the conditions of lags of 4, 8 and 12 periods. The impulse response values were positive for all three lag periods before 2011, negative between 2011 and 2016, and positive after 2016. The largest fluctuation was observed at a 12-period lag, with the maximum impulse response of about 0.096 and the minimum response of about -0.069. The impact of geopolitical risk on the Indonesian rupiah varied across different

lag periods in both 2010 and 2013, showing a low intensity of shocks in the short term and a strong intensity in the medium and long term. The impact of geopolitical risk on the Indonesian rupiah varied across different lag periods in both 2010 and 2013, showing a low intensity of shocks in the short term and a strong intensity in the medium and long term. However, the shock in 2013 was negative. In 2010, the impact of geopolitical risk on the exchange rate movement of Indonesian rupiah was positive at different lag periods. In 2010, China-ASEAN Free Trade Area was formally launched and an exchange rate coordination mechanism was established, which reduced the transaction cost of currency exchange with ASEAN countries. The shock effect of geopolitical risk on the exchange rate of Indonesian rupiah was weakened, causing the positive intensity of the exchange rate to decrease. Under the indirect quotation method, the increase in the exchange rate indicates the increase in the value of China's currency, and also indicates that the depreciation of Indonesia's currency is gradually decreasing at this time. After that, the response value gradually decreased and fell to zero in 2011 and reached the bottom in 2013. China's cooperation initiative "The Belt and Road" proposed in 2013 has also contributed to the growth of Indonesian economy to some extent. It makes the shock of geopolitical risk increase negatively and the impact on exchange rate fluctuation increases inversely, which further decreases the exchange rate of RMB against Indonesian rupiah and makes Indonesian rupiah appreciate.

From the graph (b) of Figure 2, it can be seen that the impulse functions of the three lag periods basically overlapped before 2008, and after 2008 there were minor differences and the trends were almost the same. In the time frame from 2012 to 2013, the impulse effect dropped to zero for different lag periods. From 2013, the unit shock of geopolitical risk was a small positive value in the short run and a negative value in the medium and long run. It indicated that the introduction of China's "The Belt and Road" policy would produce a positive shock in the short term, which would promote the rise of the exchange rate of the RMB against the Malaysian ringgit, while in the medium to long term, it would inhibit the rise of the exchange rate. In other words, the Malaysian ringgit would appreciate in a certain period of time, although it would fall slightly in a short time. It also showed that China's "The Belt and Road" policy has a lag in exchange rate fluctuations. In the short term, the construction and development of "The Belt and Road" would accelerate the export of Chinese products and boost China's economic growth, resulting in higher foreign exchange rates for China. In the long run, it is mutually beneficial. Malaysia's total bilateral trade with China has been growing at a faster rate, reaching 10.1% in 2013, which will stimulate the rapid growth of the Malaysian economy and lead to the smoothing of exchange rate movements.

As shown in the first graph (c) in the second row, the impulse response values of different periods ahead were positive until 2011 and negative after 2011, and the impulse function plots had similar trends, except for the greater difference in fluctuations around 2014. The impulse response intensity during 2014 was the lowest in the short run and the highest in the long run, indicating a stronger suppressive effect on the exchange rate in the medium and long run. From the last graph (d) of Figure 2, it can be seen that the response intensity of a 4-period lag was basically positive in the sample interval, indicating that the increase in economic policy uncertainty could promote the increase in the exchange rate of RMB against the Malaysian ringgit in the short term and depreciate the Malaysian ringgit. After 2013, the fluctuation trajectory of the lag periods started to differ significantly, and the impulse response was negative in the

medium and long term, which indicates that the introduction of "The Belt and Road" has created room for the Malaysian ringgit to appreciate in the medium and long term. After 2015, the negative effect in the medium and long term started to decrease and gradually converged to zero. Because of the exchange rate reform in China in 2015, the economic policy uncertainty increased. In the short term, the increase in economic policy uncertainty contributes to the growth of the RMB's foreign exchange rate, while in the medium and long term, it has a dampening effect, causing the foreign currency to depreciate in the short term. After the implementation of China's "exchange rate reform" policy, the RMB exchange rate has been the least volatile among the world's major currencies, making the RMB gradually one of the most stable currencies in the world. Because of this, the impulse effects at different lag periods leveled off after 2019.
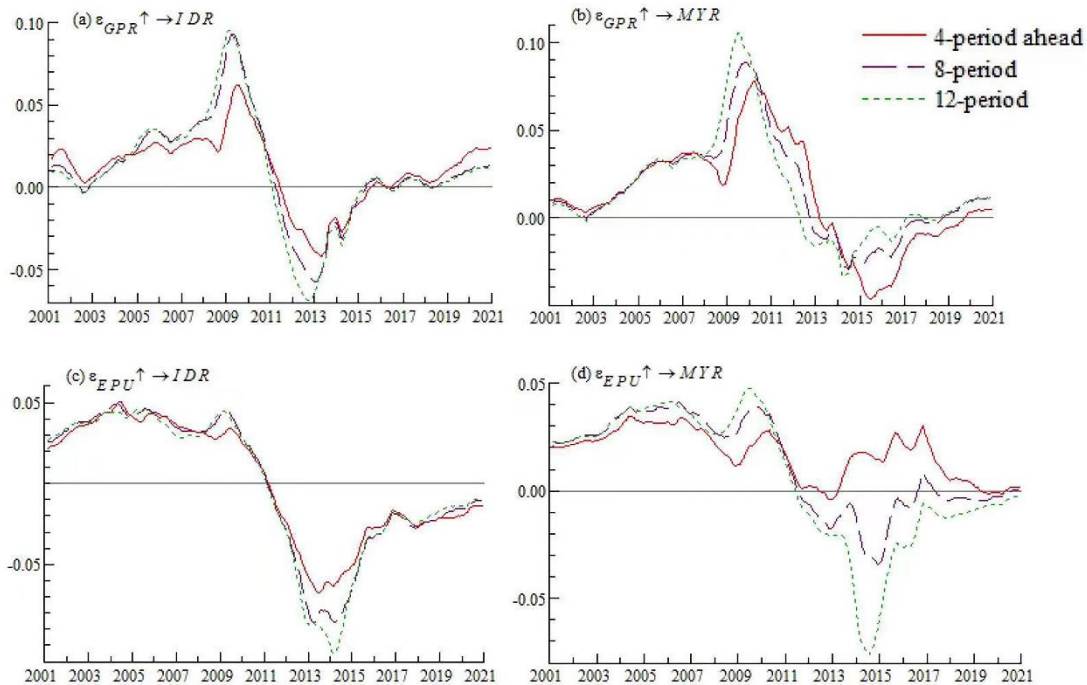

Fig 2: Impulse response plots at different lag periods

4.2.2 Response analysis of shocks to the Philippine peso and Thai baht

Looking at the first plot (a) in the first row of Figure 3, we can find that the impulse intensity of geopolitical risk on Philippine peso fluctuated around zero. The long-term geopolitical risk had the greatest impact on the exchange rate volatility of the Philippine peso until 2013, and it can be concluded that the long-term geopolitical risk had a significant contribution to the exchange rate volatility until 2012. In the whole sample interval, the intensity of the shock was the highest in 2010, which indicates that the China-ASEAN Free Trade Area established in 2010 has a significant positive impact on the growth of RMB exchange rate and suggests a more far-reaching impact in the long run, and also verifies the effectiveness of the implementation of the policy from the side. From the second plot (b), it can be seen that under the shocks with different lag periods, there was little difference in the trend and fluctuations

except for the significant difference in the shocks to the Thai baht from 2005 to 2011. As a result of the financial crisis in 2008, the geopolitical risk had rapidly increased its impact on the exchange rate and has shown an opposite effect. The short- and medium-term responses were negative, while the long-term impulse responses were positive. It showed that geopolitical risk had a dampening effect on the growth of the RMB exchange rate in the short and medium term and a facilitating effect in the long term under the impact of the financial crisis. During the 2008 financial crisis, the value of the Philippine peso depreciated in the short and medium term, but appreciated in the long term instead of decreasing. After the construction of "The Belt and Road" in 2013, it can be seen that geopolitical risk has gradually reduced its inhibitory effect on exchange rate growth and has been able to promote exchange rate growth to a limited extent after 2016.

From the first plot (c) in the second row, we can see that 2011 is the cut-off point for the positive and negative impulse response strength, which was negative until 2011 and reached its lowest point in 2013. Afterwards, the negative impact of economic policy uncertainty on the Philippine peso reduced significantly, especially for the medium and long term. The trend of the impulse plot at this point revealed that the introduction of "The Belt and Road" had a strong impact on the Philippine exchange rate volatility in the short run, while the impact on the exchange rate volatility gradually decreased in the medium and long run. According to the last plot (d), the impulse response of economic policy uncertainty to the Thai baht was zero in both 2005 and 2011, and the trajectory of the impulse curves with a lag of 4, 8 and 12 periods after 2011 had a large difference. In 2013, the short-term shock effect was significantly smaller than that in the medium and long term, which indicates that the introduction of "The Belt and Road" policy has a stronger dampening effect on the increase of the Thai baht exchange rate in the medium and long term. After 2015, the dampening effect on the growth of the exchange rate decreased significantly at the 8-period and 12-period lags, and gradually approached a steady state. In the short term, it was affected by the trade frictions between the US and China in 2018, during which the negative shock intensified and then the shock reached its lowest point in the short term. It suggested that trade frictions between the U.S. and China have the greatest impact on the Thai baht's short-term exchange rate, while in the long run it has little impact on exchange rate movements.
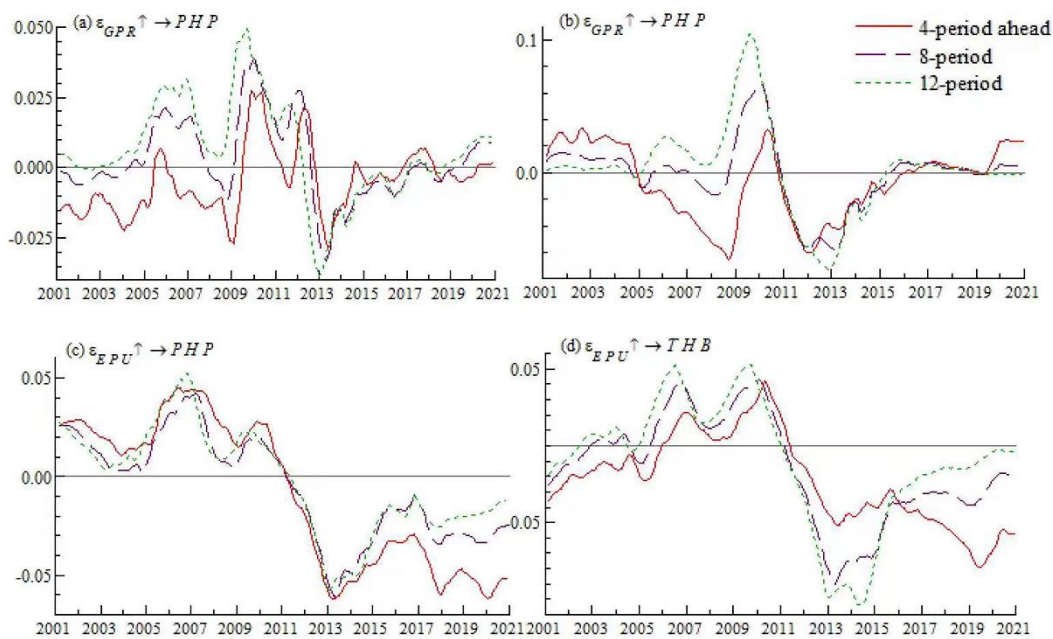
Fig 3: Impulse response plots at different lag periods

4.3 Impulse Response Function Analysis at Different Timing Points

The previous analysis indicated that geopolitical risk and economic policy uncertainty affected the exchange rates of the four ASEAN countries to varying degrees at different lag periods. Since both geopolitical risk and economic policy uncertainty are subject to constant changes in the development of countries, the paper will then randomly select different time points to further analyze the impact of both on the exchange rate movements of the four countries. The three randomly selected time points are August 2013 (t=152), August 2015 (t=176), and August 2018 (t=212). In the following section, the impact of unit shocks of geopolitical risk and economic policy uncertainty on the exchange rates of Indonesian rupiah, Malaysian ringgit, the Philippine peso and Thai baht are analyzed at these three time points.

4.3.1 Response analysis to shocks in Indonesian rupiah and Malaysian ringgit

As can be seen from the first plot (a) in the first row of Fig. 4, the impulse functions at the three time points did not move in the same direction. In the short run, the shock intensity in August 2013 was positive, while the shock intensity in the remaining two time points was negative. And after a 2-month interval, the time-point shock effects in August 2015 and August 2018 both exhibited positive values, and both leveled off after 1 year. On the contrary, in August 2013, the effect of geopolitical risk on Indonesian rupiah changed from positive to negative after 2 months, and the negative effect increased consistently. It reflects that geopolitical risk has a strong dampening effect on the increase in the exchange rate of RMB against the Indonesian rupiah, indicating that the exchange rate of the Indonesian rupiah rises and the currency

value rises, which is consistent with the results of the analysis above. By observing the second plot (b), it can be seen that the effect of the time-point shock in August 2013 was positive in the short run, indicating a boost in the rise of the foreign exchange rate. Similar to the first plot, a negative shock also continued after the second month, causing the foreign currency to appreciate. The effect in August 2015 and August 2018 was shown to be inhibitory in the sample interval. The effect gradually dropped to zero over time, with a faster convergence to zero in 2018. It also illustrates the short duration of the impact of shocks arising from trade frictions between the US and China on the movement of the Malaysian ringgit exchange rate.

From the first plot (c) in the second row, it can be seen that the negative effect was observed at all points in the interval except for August 2015 which showed a positive shock in the short run. Among them, the strongest negative shock was in 2013, while the other two points of time saw the changes level off after five months. It suggested that the introduction of The Belt and Road Initiative in 2013 had a stronger dampening effect on China's foreign exchange rate growth than the "exchange rate reform" in 2015 and the trade frictions between China and the US in 2018. Moreover, it is also more able to promote the appreciation of the Indonesian rupiah. By analyzing the impulse function trend at three time points for 2 months, it can be seen that the impulse intensity was less in the short run, while the negative impulse response exhibited in the long run was significantly greater than that in the short run. It also validates the above analysis of the Indonesian rupiah based on different lag periods. The analysis of the last plot (d) revealed that the impulse response values of all three time points changed from positive to negative in the medium term, and were highly coincident in August 2013 and August 2015 after the medium term. It showed that the implementation of "exchange rate reform" and "The Belt and Road" suppressed the growth of China's foreign exchange rate in the medium term, while effectively appreciating the Malaysian ringgit. In the case of the shock at the point in time August 2018, although the impulse effect showed a negative shock, the dampening effect was significantly smaller than the effect at other time points. It also demonstrated that the US-China trade frictions in 2018 had a lower impact on the exchange rate movement of the Malaysian ringgit.
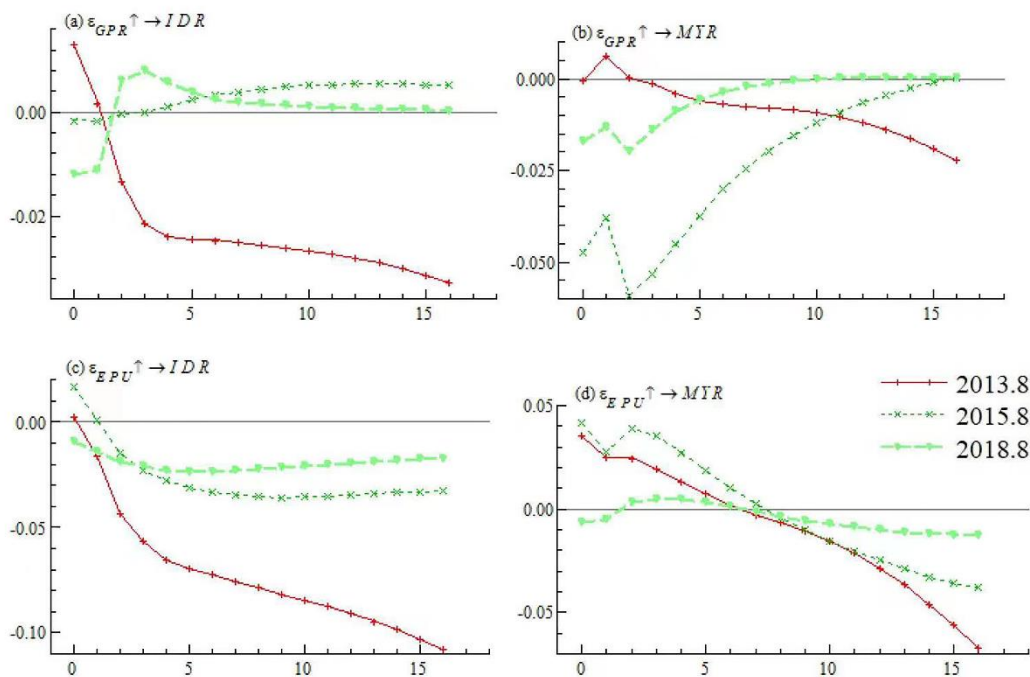
Fig 4: Impulse response plots for different time points

4.3.2 Response analysis of shocks to the Philippine peso and Thai baht

By observing the first plot (a) of Fig. 5, it can be seen that the response values of the time points August 2015 and August 2018 increased from negative to zero at the third month and both converged to zero after 15 months, and the trend of both time points was approximately the same during this period. In contrast, the time-point shock in August 2013 was negative throughout the sample interval and leveled off after the medium term. In the short run, each time point reacted quickly in the face of economic policy uncertainty, with sharp fluctuations in August 2013 and August 2018, and the smallest range of variation in August 2015. It indicated that the introduction of The Belt and Road Initiative and the US-China trade war had the greatest impact on the Philippine exchange rate movement. As can be seen in the second plot (b), the trajectories of the three time points were similar in the first two months, with the lowest point in the entire sample interval occurring within one month. Thereafter, the trend leveled off in both August 2013 and August 2018, while it did not level off at the time point of August 2015 until one year later. At the time of the shock in August 2013, the impact of the geopolitical risk shock on the Thai baht was negative. It also showed that the geopolitical risk had a strong influence on the Thai baht exchange rate movement under the influence of The Belt and Road Initiative in 2013, which had a similar effect on the Philippine peso.

According to the first plot (c) in the second row, the rest of the shocks were negative in the sample interval, except for a short positive shock at the point in time in August 2013. It showed that in the face of economic policy uncertainty shocks at different points in time, the movements of the Philippine peso

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exchange rate all exhibited negative movements and all reached negative maxima in the short run respectively, which also brought different degrees of appreciation for the Philippine peso. From the last plot (d), it can be obtained that the unit shock of economic policy uncertainty to the Thai baht in August 2018 was negative in the interval and converged to zero after 15 months. In the face of the economic policy uncertainty shocks in August 2013 and August 2015, they both changed from positive to negative after two months. These changes gradually diminished and leveled off after five months compared to August 2015, and after the shock intensity turned negative in August 2013, its dampening intensity kept increasing. It also indicated that the introduction of The Belt and Road Initiative had a significant impact on promoting the increase in the exchange rate of the Thai baht.
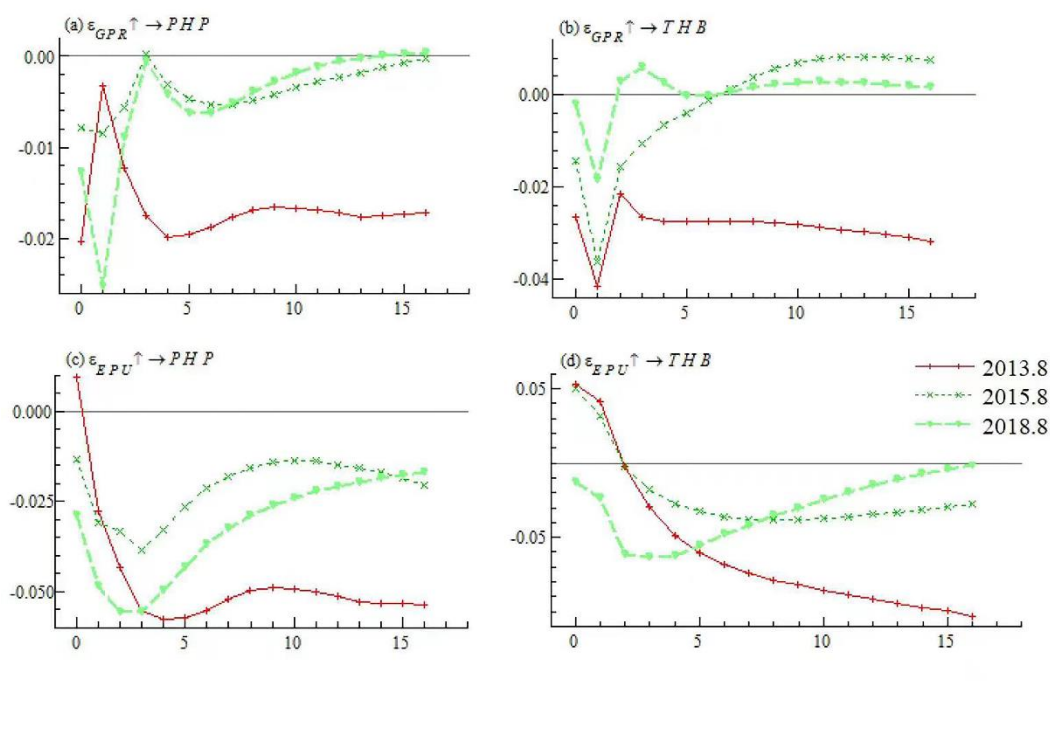

Fig 5: Impulse response plots for different time points

V. CONCLUSION

5.1 Research Conclusion

In order to better study the impact of RMB on the exchange rate of ASEAN currencies and to make the conclusions of this paper more innovative, two variables, economic policy uncertainty and geopolitical risk, were introduced in this paper. Moreover, the effects of the shocks at several important time points in the sample interval were analyzed from two perspectives: lag periods and time points. At the same time, the conclusions obtained from these two perspectives can be mutually verified. In this paper, the time-varying characteristics of geopolitical risk and economic policy uncertainty on the exchange rate movements of Indonesian, Malaysian, Philippine and Thai currencies were dynamically analyzed by using the

TVP-SV-VAR model, which can reflect the time-varying characteristics. The four countries were analyzed in different lag periods and at different points in time. The important facts included the establishment of China-ASEAN Free Trade Area in 2010, China's Belt and Road Initiative in 2013, China's exchange rate reform in 2015, and the Sino-US trade friction in 2018. Moreover, the impact of geopolitical risk and economic policy uncertainty on the exchange rate movements of four ASEAN countries was analyzed in the context of "The Belt and Road" and the following conclusions were reached:

1. From all impulse response plots, both geopolitical risk and economic policy uncertainty caused different degrees of shocks to the foreign exchange rate of RMB, indicating that both indicators can affect the exchange rate movement. From different time points, the impulse trajectory changed most obviously around 2013, which indicates that the exchange rate fluctuation was the most pronounced under the influence of The Belt and Road Initiative.

2. After the introduction of the Belt and Road Initiative, the geopolitical risk has generally had a catalytic effect on the growth of exchange rates in countries, which is beneficial to the appreciation of their currencies. Although there may be a minor dampening effect in the short run, the promotion effect in the long run is much greater than the dampening effect in the short run. It shows that the implementation of "The Belt and Road" policy has a favorable impact on the exchange rate rise of the countries in the long run.

3. Under the influence of The Belt and Road Initiative, economic policy uncertainty has also contributed to the appreciation of currencies of ASEAN countries. However, due to the time lag in the implementation of the policy, the impact on exchange rate volatility is different in the short and long term. In the short run, there are different degrees of positive shocks, i.e., a small increase in the RMB foreign exchange rate and a depreciation of foreign currencies. However, in the long run, economic policy uncertainty has a negative impact on the exchange rates of currencies in all four countries, causing foreign currencies to appreciate and the exchange rate to increase.

The findings of this paper have implications for both investors and policy makers. For investors, the findings of this paper can provide a reference for making investment decisions and avoiding certain unsystematic risks in exchange rate transactions, thus increasing the rate of return and reducing losses. For policy makers, the findings of this paper can provide a theoretical basis for the subsequent formulation of exchange rate policies to prevent the devaluation of the domestic currency due to drastic fluctuations in the exchange rate market, as well as to strengthen the regulation of the domestic macroeconomy in order to promote the stable and healthy development of the economy.

5.2 Policy Recommendations

Based on the above findings, the authors offer the following recommendations, hoping to provide references for the control of uncertainty risks to promote more effective cooperation in the Free Trade Area: 1

1. Macro-monitoring should be reinforced and quantitative indicators should be established. Under the influence of The Belt and Road, both geopolitical risk and economic policy uncertainty will cause changes in China's foreign exchange rate. In order to effectively monitor the variation of the two indicators and prevent the exchange rate from rising or falling significantly, China should include geopolitical risk and economic policy uncertainty into the scope of macroeconomic supervision for effective control. Moreover, quantitative indicators should be established according to the domestic situation to provide a reliable basis for China's research and response to exchange rate fluctuations.

2. The time-varying characteristics of indicators should be fully taken into account and policies should be formulated in a targeted manner. The implementation of various policies will result in different degrees of lag. The impact of the lag may vary in the short and long term, and unintended effects may be produced in the long term. Therefore, when formulating targeted policies, policy makers are required to consider not only the external influencing factors and enforceability, but also the time-varying nature of the indicators. Moreover, they should not only focus on the impact in the short term, but also take into account its long-term effects.

3. Regional economic complementarity should be strengthened to achieve a win-win situation for all parties. It has become a trend to globalize the economy today. To cope with the changes of geopolitical risk and economic policy uncertainty, China needs to be actively involved in global governance, to promote economic changes at home and abroad, to strengthen exchanges and cooperation among countries, and to create a community with a shared future. Moreover, it should strengthen regional economic complementarities, promote economic growth of multiple parties, take measures to cope with geopolitical risks and uncertainties, and achieve a mutually beneficial and win-win situation.

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