Proceedings of the 3rd International Conference on Business and Policy Studies
DOI: 10.54254/2754-1169/80/20241902

The Impact of Economic Policy Uncertainty on Real Effective Exchange Rate and Systemic Risks

--Based on TVP-VAR Modeling

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Abstract: Today's international situation is complex and volatile, and the impact of economic policy uncertainty on systemic financial risk has attracted much attention. In this essay, the TVP-VAR model is used to investigate the mechanism of economic policy uncertainty on systemic financial risk and real effective exchange rate. It is found that its effect on both was characterized by time-varying and nonlinear, and the impact on systemic financial risk is mainly long-term, while the impact of real effective exchange rate is mainly short- and medium-term as long as. Meanwhile, the impact of economic policy uncertainty on systemic financial risk and real effective exchange rate under some specific risk events is more lasting.

Keywords: economic policy uncertainty, real effective exchange rate, systemic financial risk, TVP-VAR

1. Introduction

The normal operation of the financial system is related to the healthy development of the entire economy and society, and once systemic financial risks occur, it will cause a huge impact on our financial system and even the whole society. China is in an important strategic period of great changes not seen in a hundred years, yet a series of problems such as high leverage, high debt, shadow banking, real estate bubble, financial disintermediation have gradually emerged in the financial system, resulting in the continuous accumulation and release of systemic risks. Therefore, China has regarded the prevention and resolution of systemic risks as the top priority of our three major battles. Especially after the 2019 new crown epidemic shock, the recovery situation of the world economy is still uncertain, so the smooth development of the financial system becomes more and more important and urgent under the double pressure of the intricate international situation and domestic risk monitoring and reform. Therefore, against this background, this paper adopts the TVP-VAR model to study the impact of economic policy uncertainty on the real effective exchange rate as well as systemic risk at different points in time in different periods, which is of significance for effectively preventing and resolving systemic financial risks and promoting the smooth operation of the economy.

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2. Literature Review

Economic Policy Uncertainty (EPU), refers to a variety of unpredictable factors included in future economic-related policy changes. Recently, the impact of the international financial crisis, geopolitical conflicts, and sudden public events has increased the uncertainty of overall global economic. In addition, in order to cope with the changes in the international environment as well as to accelerate the process of structural reform of the domestic economy, China has implemented intensive economic regulation. This has also led to a rise in China's economic policy uncertainty system. Synthesizing the relevant studies of Dicks et al. [1], Yang Zihui [2]and other relevant studies with the typical examples of recent international financial risk outbreaks, it can be seen that the contributing factors of systemic risk do not only originate from the financial system itself, and the uncertainty shocks in the macroeconomic system can likewise result in the aggravation and contagion of systemic risk.

Among the many indicators for measuring systemic risk, the most influential is the Financial Stress Index (FSI) constructed by Illing & Liu. For the first time, the index constructs a Canadian Financial Stress Index that better responds to the actual stresses experienced by financial markets.After this, scholars have taken more ways to measure systemic financial risk, for example, He Qing et al. [3]constructed a systemic risk index using principal component analysis quantile regression (PCQR). As for the impact, Zhou Shangyao and Wang Sheng [4]conducted counterfactual simulations using the DSGE model and found that the accumulation of systemic financial risk will constrain long-term economic growth; David [5]& Hakkio [6]identified the existence of a transfer zone system of systemic financial risk using the MS-VAR model, and high risk will deteriorate the macroeconomy.

Marczak and Beissinger [7]defined the real effective exchange rate (REER) is a weighted average exchange rate, which measures a country's competitiveness in the international market. Ba Shusong et al. [8]believe that the REER to make up for the defects in the real exchange rate to reflect the external value of the national currency, can more objectively and comprehensively reflect a country's "bargaining power" in international trade. However, in the process of economic globalization, the international division of labor and the mode of production have undergone great changes, which makes those countries deeply involved in globalized trade intermediate products in the proportion of exports increased. This has called into question the applicability of the traditional REER proposed by Armington [9], which assumes that exports do not contain any intermediate inputs, and Bems and Johnson [10]enrich Armington's [9]theoretical framework by constructing a real effective exchange rate based on trade value added (TVA), which is based on cross-border inputs from the supply side.

3. Theoretical analysis

3.1. The impact of economic policy uncertainty on systemic financial risk

The inherent inherent instability and vulnerability of financial institutions is the intrinsic root cause of systemic risk. High financial and operating leverage, balance sheet cash flow mismatch, and agent risk may lead to the accumulation and contagion of systemic financial risk. Existing research generally believes that economic policy uncertainty will cause changes in financial institutions' risk-taking willingness, balance sheet structure, capital decisions, etc., thus affecting the systemic risk of financial institutions, and there are three main views on the effect of its impact: mitigating, exacerbating, and indeterminate three views.

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3.1.1. Mitigation Theory

According to the mitigation theory, the higher the economic policy uncertainty is, financial institutions will tend to take active risk aversion or surplus management in order to avoid losses, etc. Ng et al. [11]found that commercial banks will predict possible future loan losses based on the economic policy uncertainty index, and respond to the increase in economic policy uncertainty by increasing the loan loss pre-crisis. Therefore, the allowance for credit losses moves in the same direction as economic policy uncertainty, and systemic financial risk is mitigated in this way by increasing the allowance for loan losses.

3.1.2. Exacerbation Theory

The exacerbation theory argues that although commercial banks will take corresponding countermeasures based on the level of economic policy uncertainty, it is prone to herd behavior or pro-cyclical operation, which further exacerbates the risk exposure of financial institutions, and ultimately exacerbates systemic financial risk.Bordo et al. [12]found that high economic policy uncertainty characterization tends to occur during the recession and recovery phases, at which time, if financial institutions through the lending channels to curb credit growth will further exacerbate the pro-cyclical characteristics of credit and prolong the recovery process.

3.1.3. Uncertainty Theory

The indeterminacy theory, on the other hand, argues the result cannot be determined by considering the heterogeneity of the impact of various factors.Lee [13]found that long-term economic policy uncertainty positively affects financial institutions' decision to take leverage decisions, while the opposite is true for short-term economic policy uncertainty. Meanwhile economic policy uncertainty interacts with interbank decisions and banks' own leverage decisions to enhance or mitigate the impact from leverage.

3.2. The impact of economic policy uncertainty on the real effective exchange rate

3.2.1. Devaluation Theory

Economic policy uncertainty will change the expectations of individuals in the market, when economic policy uncertainty rises, investors expect the risk of devaluation of the local currency, so investors will sell a lot of local currency to avoid the current exchange rate risk. This will lead to the supply of the local currency in the foreign exchange market is greater than the demand, and the local currency depreciates [14]. At the same time, frequent policy adjustments will create negative psychological expectations for enterprises and consumers [15], according to the preventive savings theory, in order to prevent the risk of uncertainty, consumers will increase savings and reduce consumption, enterprises will transfer assets to low-risk countries, the willingness to hold the local currency decreases, and the local currency depreciates.

3.2.2. Appreciation theory

Jiang Yuanying et al. [16] argue that fluctuations in economic policy will trigger a large amount of hot money into real estate, stocks and other more liquid markets with more speculative opportunities, which will indirectly lead to the appreciation of the local currency.

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3.3. Impact of the real effective exchange rate on systemic financial risk

A depreciation of the local currency will lead to the over-investment of local and foreign currency loans by financial institutions, while the absorption of local and foreign currency deposits will decrease. Changes in deposits and loans, which are the two main components of financial institutions' assets and liabilities, respectively, will lead to mismatches in the flow of assets and liabilities, which in turn will lead to an increase in systemic financial risks.

3.3.1. Currency mismatch

In general, financial institutions involved in overseas operations have liabilities denominated in foreign currencies, while revenues are usually denominated in local currencies. In the context of economic globalization, exchange rate fluctuations lead to large changes in the assets and liabilities of financial institutions, exacerbating the asymmetry between the two ends of the balance sheet. In the event of a currency devaluation, this not only increases the debt burden of financial institutions, but also increases the risk of default, which can lead to the accumulation of systemic risks and ultimately to the outbreak of a financial crisis.

3.3.2. Credit inflation

In the presence of expectations of RMB appreciation, domestic and foreign investors will increase their purchases of various products and assets based on the local currency, convert large amounts of foreign exchange into their own currencies, or borrow large amounts of the local currency for investment purposes by overseas investors in the hope of obtaining greater returns after the exchange rate has appreciated. This will trigger the phenomenon of "over-borrowing", leading to a short-term credit boom in the domestic financial market but exacerbating the accumulation of bubbles and undermining the soundness of the financial system in the long run.

3.3.3. Default on external debt

As mentioned above, expectations of appreciation of the domestic currency will lead to overborrowing, thus exacerbating bubble accumulation. However, in the event of a reversal of financial flows and a sharp depreciation of the domestic currency instead, this would lead to losses for non-hedge-currency debtors, which would need to be repaid in more domestic currency, thus increasing the risk of default and the vulnerability of the financial system.

4. Research Design

4.1. Introduction of the model

This project proposes to use TVP-VAR model to quantitatively assess the impact of EPU on the RBCN and SRISK and its mechanism of action in different periods and at different time points. Since the model is based on the extension of the VAR model, its biggest advantage is that it assumes that the parameter and covariance matrices are time-varying. This assumption facilitates the characterization of nonlinear linkages between variables. The model is able to respond to changes in both the size of the shock and the path of transmission, and the basic form of the TVP-VAR model is as follows:

$$y_t = X_t\beta_t + A_t^{-1}\sum_t \varepsilon_t \ , t = s+1, \ldots, n, \ \varepsilon_t \sim N(0, I_k) \tag{1}$$

Where y_t is a k ×1 dimensional observable vector. $X_t = I_k \otimes (y'_{t-1}, \ldots y'_{t-s})$, β_t is a vector of dimensionally time-varying coefficients of $k^2s \times 1$.Referring to the treatment of Nakajima J et al.

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[17], assume that A_t and Σ_t are lower triangular and diagonal matrices of order k.In the above model, the coefficient vector β_t, the matrix A_t and the covariance matrix Σ_t are time-varying, which implies that the effect of the i-th variable shock on the j-th variable is constantly changing over time. The model can be estimated using Markov Monte Carlo (MCMC) method under Bayesian inference.

4.2. Variable selection

The sample interval of data selected in this paper is January 2005-November 2023, and missing values are treated by mean interpolation.

4.2.1. Systematic risk measurement.

This paper adopts the SRISK methodology proposed by Brownlees and Engle.The main idea is to utilize publicly available market data to calculate the expected capital shortfall of each financial institution, i.e., SRISK.

The SRISK index comprehensively takes into account the leverage ratio of financial institutions, the scale effect and the correlation with the volatility of the market, so it is very reasonable for this paper to choose it as a proxy variable for systemic risk. The monthly data used in this paper comes from the official website of V-lab website.

4.2.2. Economic policy uncertainty

The data come from www.policyuncertainty.com, using the China Economic Policy Uncertainty Index (EPU) constructed by Baker et al. The specific method is that based on the Southern Morning Post, articles related to economic policy uncertainty are screened by keywords, and then the EPU index is obtained after statistical and standardization processing. The index is published once a month, from January 1995 until now. It can be seen that the index has a good continuity, therefore, it is chosen as the EPU in this paper.

4.2.3. Real Effective Exchange Rate Index (RBCN)

The data comes from the monthly broad real effective exchange rate index updated on December 19, 2023 by the Bank for International Settlements (BIS). The REER is an exchange rate calculated on the basis of a basket of currencies and thus provides a truly accurate picture of the real situation of the national currency.

5. Empirical results

5.1. Descriptive statistical analysis

First, the model variables were analyzed with descriptive statistics and the results were as follows:

Table 1: Descriptive statistics for key variables.

	EPU	SRISK	RBCN
Mean	317.25	6150.00	89.43
Std. Error of Mean	17.56	409.03	0.80
Median	211.78	5047.00	93.39
Mode	103.44 a	0.00	76.74 a
Std. Deviaton	264.63	6162.60	12.01

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Table 1: (continued).

Skewness		0.88	0.81	-0.51
Std. Error of Skewness		0.16	0.16	0.16
Kurtosis		-0.52	-0.42	-1.09
Std. Error of Kurtosis		0.32	0.32	0.32
Percentiles	25	100.68	203.00	79.90
	50	211.78	5047.00	93.39
	75	516.49	10385.00	99.28

a. Multiple modes exist. The smallest value is shown

The results of descriptive statistics show that the mean values of economic policy uncertainty (EPU), systemic financial risk (SRISK), and real effective exchange rate (RBCN) during the sample period are 317.25, 6150.00, and 89.43, respectively, a result that is closer to the existing literature.

5.2. Smoothness test

Before establishing the TVP-VAR model for empirical analysis, this paper uses the ADF method to test the smoothness of each variable.

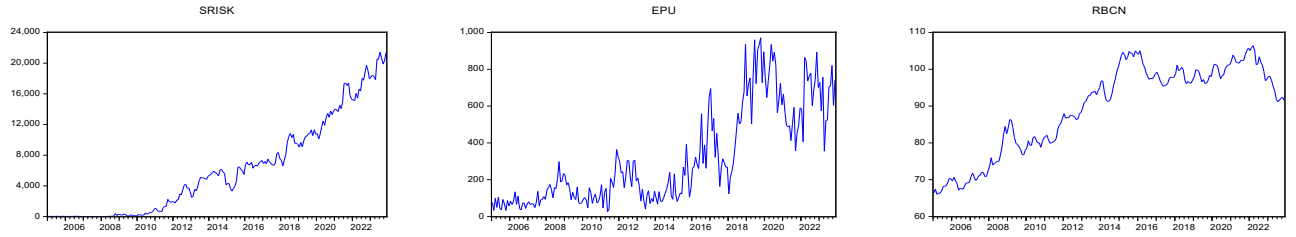

Figure 1: SRISK, EPU, RBCN Timing Chart.

As can be seen from the figure, the SRISK indicator, the EPU indicator, and the RBCN all have obvious time-trend characteristics, from which it can be judged that the original monthly data is a non-stationary series. If regression is performed on the non-stationary series, false correlations of pseudo-regression may be obtained. So the original series is next differenced once. The data series obtained after the first-order differencing of the SRISK series is named DSRISK, and similarly the series obtained after the first-order differencing of EPU is named DEPU.

Table 2: DSRISK, DEPU, DRBCN Unit-root results.

	t-Statistic	Prob.*
DSRISK	-15.43087	0.0000
DEPU	-14.97307	0.0000
DRBCN	-10.53013	0.0000

*Mac Kinnon(1996) one-sided p-values.

According to the output of the ADF test, it can be seen that the probability of concomitance of the ADF statistics of the three sequences after the first-order differencing is 0.0000, which is significantly smaller than the significance level of 5%, and the original hypothesis can be rejected that the two sequences do not have a unit root, and they are a smooth sequence and are first-order single-integrated.

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5.3. MCMC parameter estimation results

According to the marginal likelihood function criterion, the lag order of the model is chosen to be 2, and 10,000 times sampling is performed in Matlab using Markov Monte Carlo simulation. The specific parameter estimation results are shown in Table 3.

Table 3: MCMC estimation results.

Parameter	Mean	Stdev	95%U	95%L	Geweke	Inef .
sb1	0.0023	0.0003	0.0019	0.0030	0.747	15.94
sb2	0.3729	0.0371	0.3010	0.4469	0.102	33.97
sa1	0.0055	0.0015	0.0033	0.0091	0.103	77.12
sh1	0.0054	0.0014	0.0034	0.0090	0.494	68.62
sh2	0.0056	0.0016	0.0034	0.0097	0.474	63.78

From the above figure, it can be seen that the CD convergence values are all significantly less than 1.96 (critical value), indicating that the Markov chain tends to concentrate at 5% level of significance. At the same time, the smaller the value of the null factor, the better the simulation fit, from the results can be found that the maximum value of the null factor is 77.12, which is significantly smaller than the sampling number of 10,000, indicating that it meets the estimation requirements of the model.

The first line of the subplot is the sample autocorrelation coefficient graph, which can be seen that the autocorrelation level quickly converges to zero, indicating that the autocorrelation of the sample can be effectively eliminated in the iteration; the second line of the subplot is the path diagram of the parameter values, the sample fluctuates up and down around the mean value, and there are fewer cases of extremes, which indicates that the smoothness is relatively strong. The subplot in the third row represents the density plot of the posterior distribution, all of which are approximated to be normally distributed, showing its convergence properties. Therefore the MCMC sampling fit is high.

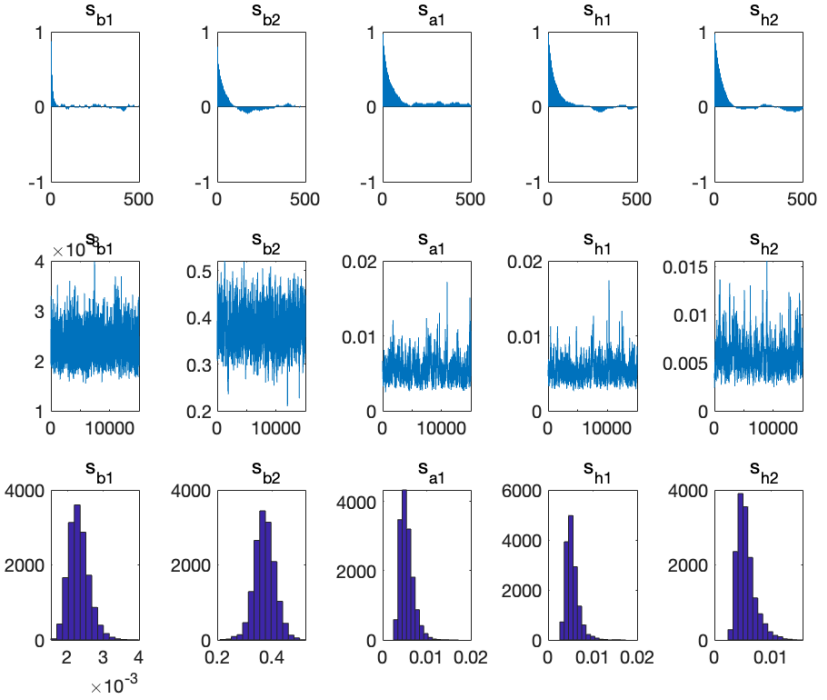

Figure 2: Plot of parameter estimation results.

DOI: 10.54254/2754-1169/80/20241902

5.4. Impulse response analysis

Considering that economic policy transmission is time-sensitive, this paper explores the degree of response of one variable to the shock of another variable by analyzing the impulse function of TVP-VAR model. This paper adopts the equal interval impulse response function and different time point impulse response function.

5.4.1. Equally spaced impulse response analysis

Equal-interval impulse response functions are used to explain the effect of a variable receiving a unit-standard positive-image shock on other response variables over a fixed time interval. In this paper, the shocks are selected for 1 month, 3 months, and 6 months time intervals to portray the impulse relationships in the short, medium, and long term, respectively.

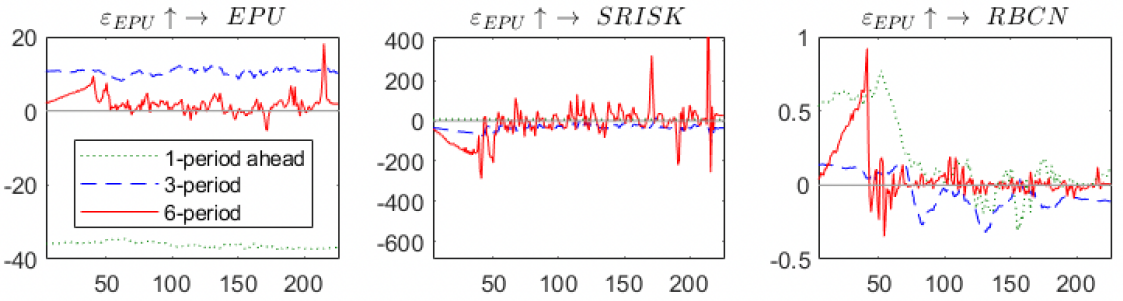

Figure 3: Equally spaced impulse response function plots.

The three graphs above reflect the impulse responses to SRISK and RBCN given a one-unit standardized positive shock to EPU. The results of the second figure show that the SRISK response fluctuates around zero in the short and medium term, and fluctuates around zero in the long term after reversing to positive in 2009, with an increase in intensity in individual periods, suggesting that EPU plays a more significant role in SRISK in the long run, and less volatile in the short and medium term. This trend may be due to the fact that since the financial crisis in 2008, the Chinese government has increased the supervision of risk, and financial institutions have realized the importance of risk diversification and strictly carried out risk control, thus reducing the probability of systemic risk in the short and medium term. However, the continuous policy regulation and the pro-cyclical risk prevention behavior of financial institutions have led to the accumulation of long-term systemic financial risks.

The third graph shows that EPU had a significant positive impact on the RBCN before 2010, and then there is a tendency for it to turn from positive to negative and fluctuate around zero, and the duration of the positive impact in the short and medium term is longer than that in the long term. The reason may lie in the fact that the mechanism of the financial market was not sound enough before 2010, and the fluctuation of economic policies led to a large number of speculators flocking to highly speculative markets such as stocks and real estate, which in turn caused the RBCN to rise in the short and medium term.

5.4.2. Impulse response analysis at different time points

In this paper, three representative time points, June 2008, May 2015 and January 2020, are selected for impulse. The idea of time point selection is as follows: the outbreak of the global financial crisis in June 2008, the collapse of China's stock market in May 2015 after a year of bull market rise, resulting

DOI: 10.54254/2754-1169/80/20241902

in a "stock market crash", and the outbreak of the new crown epidemic in January 2020, the global economic development is in crisis. The results are shown in Figure 4.

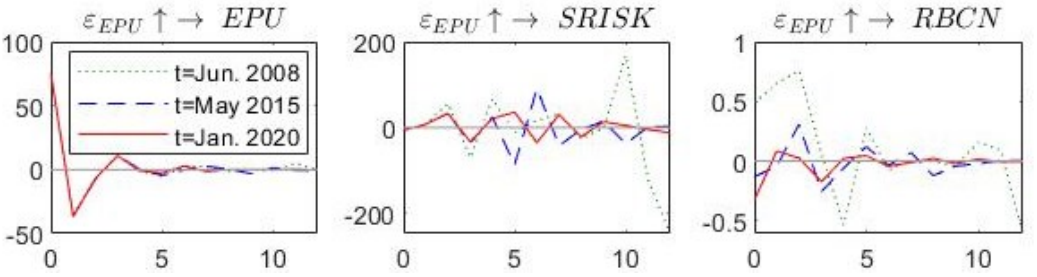

Figure 4: Plot of impulse response function at different time points.

The second figure reflects the impact of EPU on SRISK at different points in time, and the response trajectory shows that the impact of EPU on SRISK is more persistent, fluctuating up and down around the value of zero, with an "M"-shaped trend. The "stock market crash" in May 2015 and the new crown epidemic in January 2020 still had an impact after a lag of 5 periods, and the impact did not nearly disappear until a lag of 8 periods. The global financial crisis of 2008, on the other hand, still had a persistent negative impact on systemic risk after lag 10, which may be the long-term result of the severity of this financial crisis that led governments and individual institutions to engage in risk management.

The third panel reflects the impact of EPU on the RBCN at different points in time, and the response trajectory shows that the real effective exchange rate gradually decreases to zero after 4 periods of lagging, and the 2008 financial crisis has a positive impact on the real effective exchange rate in the short run, but still has a negative impact after 10 periods of lagging, which may be due to the fact that short-term speculative capital leaves the market after making profits. This may be caused by short-term speculative capital leaving the market after making profits. While the "stock market crash" in 2015 and the new crown epidemic in January 2020 had some negative impact in the short term, they were rapidly reduced to around zero after a four-period lag, due both to the effectiveness of government intervention and the continued development of market mechanisms.

6. Research Conclusions and Recommendations

This paper utilizes the data from January 2005 to November 2023 to build a TVP-VAR model for EPU, SRISK, and RBCN. Attempts to use the model to study the impact of EPU on SRISK and RBCN, and draws the following conclusions: first, the impact is time-varying, with the effect on systemic financial risk being more pronounced in the long run and less so in the short to medium term. Second, it had a positive impact on the real effective exchange rate until 2010, which may be related to the influx of "hot money". Third, the effect was non-linear. Economic policy uncertainty at a particular point in time may lead to a significant time lag in systemic financial risk, but the impact on the real effective exchange rate is more significant in the short term.

Based on the above conclusions, this paper puts forward the following suggestions: first, pay close attention to the volatility of the financial system risk, in order to improve the precise regulation of economic policy, to avoid the enhancement of systemic risk due to the frequent fluctuations in policy, especially in the period of severe fluctuations in the financial market, the accurate and immediate implementation of economic regulation policies can effectively mitigate the systemic financial risk, stabilize the real effective exchange rate, and ensure the country's competitiveness in international trade. Second, improve financial laws and regulations, and promote the competitiveness of the country in international trade. When economic policy uncertainty rises, this move can effectively reduce market speculation, reduce the panic of individual investors, and then stabilize the internal

DOI: 10.54254/2754-1169/80/20241902

financial market and the external real effective exchange rate. Third, accelerate the improvement of the macroprudential policy framework, and strengthen the "two-pillar" coordination between monetary policy and macroprudential policy. Macroprudential policy is committed to maintaining financial stability, and the central bank should strengthen macroprudential management of localized risk points in the financial market. In formulating policies, the impact of current events should not be the only consideration, and the "after-effects" of previous risk events should also be taken into account.

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