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Sino-US Economic Policy Uncertainty and Spillover Effect of Asset Price Volatility in China

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Abstract: *By constructing a TVP-VAR-DY model, this paper investigates the dynamic spillover effect of Sino-US economic policy uncertainty on China's asset price volatility. The study finds that Sino-US EPU is the net exporter of China's asset price volatility spillover effect, and the net spillover effect of Sino-US EPU on China's asset prices volatility deviates from the EPU index trends of the respective countries. EPUs in China and the United States are observed in a state of mutual spillover. The network structure of the net spillover effect of asset price volatility between China and the United States shows a dynamic evolutional trend, and the spillover effect of EPU index on asset price volatility in China is heterogeneous in different periods and different levels.*

Keywords: *Economic Policy Uncertainty, Spillover Effect, Asset Price Volatility*

1. Introduction

Since the outbreak of the 2008 global financial crisis, the economic policy presented uncertain in various countries. Especially after the outbreak of COVID-19 pandemic, active measures have been adopted at first to rescue the financial market. Then in the face of rising inflation, the monetary policy of big countries has been tightened. The spillover effects of these economic policies have been transmitted to all countries through the linkage of the international financial market, impacting the financial asset prices.

Many literatures have verified the transnational spillover effect of economic policy uncertainty (EPU), and measured the size and direction of the spillover effect (Colombo, 2013; Stefan and Rodrigo, 2014)[1][2]. Views on the effect of EPU on the macro-economy of other countries tend to be consistent, agreeing that the rise of global EPU or EPU of the major developed countries will have a negative impact on the economic growth, exchange rates, financial market and other fields of other countries (Colombo, 2013; Kido, 2018)[1][3].

Economic policy uncertainty (EPU) is an important factor driving asset price volatility. As an important economic risk factor, the change of EPU will increase the volatility and correlation of stock prices (P P ÁSTOR L and VERONESI P, 2012)[4], and influence the expected return of stocks (Brogaard, 2015)[5]. For the bond market, EPUs can lead to increased volatility in bond risk premiums, especially for short-term bonds (Ioannidis and Kook, 2021)[6]. In addition, EPU is negatively correlated with the real estate market yield (Antonakakis et al., 2015; Oskooee and Ghodsi, 2017)[7][8]. EPU is also the main factor driving exchange rate fluctuations. The rise of home and US EPU will increase the exchange rate fluctuations of some currencies (Krol, 2014)[9]. The US EPU also shows a negative correlation with the exchange rate gains of currencies in countries with high interest rates (Kido, 2016)[10].

This paper creatively studies the correlation of Sino-US economic policy uncertainty and China's asset price volatility spillover effect, enriching the perspective of relevant field, contributing especially to the impact of EPU to China's asset price volatility spillover effect. In terms of research methods, this paper is based on the improved exponential spillover model (TVP-VAR-DY) of Antonakakis (2020)[11], which effectively avoids the problems of parameter instability and data loss, and allows us to fully capture the network structure and time-varying characteristics of asset price volatility spillover effects in different economic and financial environments. The discovery of this paper that Sino-US EPU has a net spillover effect on China's asset price volatility, and that this effect deviates from the EPU indexes of the respective countries, makes up for relevant empirical research.

The following of the paper is organized as follows. The second section introduces the methodology and the data, the third section shows the empirical research results, and the fourth section summarizes.

2. Methodology and Data

2.1 Methodology

The specific construction method of dynamic connectedness based on time-varying parameter vector autoregressions (TVP-VAR-DY) is as follows:

First, take the TVP-VAR (p) model as an example:

$$y_t = \alpha_t x_{t-1} + \varepsilon_t,\ \ \varepsilon_t|\Phi_{t-1} \sim N(0, \Omega_t) \quad (1)$$

$$vec(\alpha_t) = vec(\alpha_{t-1}) + \theta_t,\ \ \theta_t|\Phi_{t-1} \sim N(0, \Sigma_t) \quad (2)$$

with $x_{t-1} = \begin{pmatrix} y_{t-1} \\ y_{t-2} \\ \vdots \\ y_{t-p} \end{pmatrix}$, $\alpha_t' = \begin{pmatrix} \alpha_{1t} \\ \alpha_{2t} \\ \vdots \\ \alpha_{pt} \end{pmatrix}$, where Φ_{t-1} represents all available information until t-1, y_t and x_{t-1} are $n \times 1$ and $np \times 1$ vectors, respectively, α_t and α_{it} are $n \times np$ and $n \times n$ dimensional matrices, respectively, ε_t and θ_t are $n \times 1$ and $n^2 p \times 1$ dimensional matrices, respectively, time-varying variance-covariance matrices， Ω_t and Σ_t are $n \times n$ and $n^2 p \times n^2 p$ dimensional matrices, respectively, $vec(\alpha_t)$ is an $n^2 p \times 1$ dimensional vector.

Subsequently, TVP-VAR is converted into its vector moving average (VMA) representation based on Wold theorem:

$$y_t = \textstyle\sum_0^{\infty} \beta_{jt}\, \varepsilon_{t-j} \quad (3)$$

with $\beta_{jt} = J' M_t^j J (j = 0,1 \cdots)$, $M_t = \begin{pmatrix} \alpha_t & \\ I_{n(p-1)} & 0_{n(p-1)\times n} \end{pmatrix}$, $J = \begin{pmatrix} I \\ 0 \\ \vdots \\ 0 \end{pmatrix}$, where M_t is an $np \times np$ dimensional matrix, and J is an $n \times np$ dimensional matrix, β_{jt} is an $n \times n$ dimension matrix.

Generalized impulse response functions (GIRFs)$\Theta_{ij,t}(H)$) represents the response of all variables *j* following a shock in variable *i*:

$$GIRF_t(H, \gamma_{j,t}, \Phi_{t-1}) = E(y_{t+H}|\omega_j = \gamma_{j,t}, \Phi_{t-1}) - E(y_{t+J}|\Phi_{t-1}) \quad (4)$$

$$\Theta_{j,t}(H) = \frac{\beta_{H.t}\Omega_t \omega_j}{\sqrt{\Omega_{tt,j}}} \frac{\gamma_{j,t}}{\sqrt{\Omega_{tt,j}}},\ \ \gamma_{j,t} = \sqrt{\Omega_{tt,j}} \quad (5)$$

where ω_j is an $n \times 1$ selection vector with unity in the jth position and zero otherwise.

Generalized forecast error variance decompositions (GFEVD)$\Psi_{ij,t}(H)$）:

$$\Psi_{ij,t}(H) = \frac{\Sigma_{t=1}^{H-1} \Theta_{ij,t}^2}{\Sigma_{j=1}^{n} \Sigma_{t=1}^{H-1} \Theta_{ij,t}^2} \quad (6)$$

with $\Sigma_{j=1}^{n} \Psi_{ij,t}(H) = 1$, $\Sigma_{i,j=1}^{n} \Psi_{ij,t}(H) = n$.

Finally, the total connectedness index is defined as:

$$C_t(H) = \frac{\Sigma_{i,j=1,i\neq j}^{n} \Psi_{ij,t}(H)}{\Sigma_{i,j=1}^{n} \Psi_{ij,t}(H)} * 100 = \frac{\Sigma_{i,j=1,i\neq j}^{n} \Psi_{ij,t}(H)}{n} * 100 \quad (7)$$

The total directional connectedness to others is defined as:

$$C_{i\to j,t}(H) = \frac{\Sigma_{j=1,i\neq j}^{n} \Psi_{ji,t}(H)}{\Sigma_{j=1}^{n} \Psi_{ji,t}(H)} * 100 \quad (8)$$

The total directional connectedness from others is defined as:

$$C_{i\leftarrow j,t}(H) = \frac{\Sigma_{j=1,i\neq j}^{n} \Psi_{ij,t}(H)}{\Sigma_{i=1}^{n} \Psi_{ij,t}(H)} * 100 \quad (9)$$

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The net total directional connectedness is defined as:

$$C_{i,t}(H) = C_{i\to j,t}(H) - C_{i\leftarrow j,t}(H) \quad (10)$$

The net pairwise directional connectedness is defined as:

$$NPDC_{ij}(H) = (\Psi_{ji,t}(H) - \Psi_{ij,t}(H)) * 100 \quad (11)$$

2.2 Data

This paper adopts the economic policy uncertainty indexes of China (*CHN. EPU*) and the United States (*US. EPU*) from Baker et al. (2016) (www.policyuncertainty.com). In addition, four variables are adopted as indicators of China's asset prices. China's Shanghai-Shenzhen 300 Index, China Securities All Bond Index, the unit price of commercial housing sales and the central parity of RMB against the US dollar (direct pricing method) represents for stock price (*SP*), bond price (*BP*), real estate price (*HP*) and exchange rate (*ER*), respectively. The monthly sample from January 2005 to June 2022 is used.

Drawing on the existing literature, the data is treated as follows. Each variable is first standardized (adopting a mean-variance model) for dimensional unity. Then after taking first-order difference, the time series are proved stable by ADF and PP tests, and are thus applicable to the VAR model. The descriptive statistics and unit root test of each variable are shown in Table 1. The volatility time series is finally obtained by applying a GARCH (1,1) Model, based on the conditional heteroskedasticity of asset price variables.

Table 1: Descriptive Statistics and Unit Root Test.

Variables	Mean	Std. Deviation	Skewness	Kurtosis	J-B test	ADF test	PP inspection
CHNEPU	0.0128	0.3941	0.2262	7.1792	153.8765***	-15.4383***	-24.8080***
USEPU	0.0059	0.6955	0.0269	6.8506	129.1439***	-11.7756***	-34.3582***
SP	0.0140	0.2083	0.0773	6.1244	85.2175***	-4.7167***	-10.3716***
BP	0.0170	0.0317	0.2557	6.2674	95.2478***	-8.7027***	-8.4474***
HP	0.0143	0.0833	0.8146	6.7104	143.0035***	-3.8016***	-14.4972***
ER	-0.0129	0.0933	1.4379	9.1634	402.8264***	-8.5646***	-8.5459***

Note: * * * means significant at the 1% level.

3. Empirical Analysis

3.1 Total Spillover Effect

CHN.EPU, US.EPU, SP, BP, HP and ER are introduced into the TVP-VAR-DY model. In the lag order tests, AIC criterion and LR likelihood ratio statistic suggest the lag order of the model to be 4, while SC criterion and HQ criterion suggest that to be 2. In order to highlight the robustness of the study, a comparison study is conducted based on different lag orders (Lag = 2, 4) and prediction error equation decomposition periods (H = 1, 2, …, 10). The total spillover index is shown in Table 2. Based on the comparison study, the lag order of the model is set as 4, and the number of decomposition periods H of the prediction error equation is set as 10. The total spillover effect (TSI) of Sino-US EPU and China's asset price volatility is 21.2%, as shown in Table 3.

Table 2: Total spillover indices for different lag orders and prediction error equation decomposition periods.

Lag=2	H=1	H=2	H=3	H=4	H=5
TCI	-	-	13.3	13.8	14.2
Lag=2	H=6	H=7	H=8	H=9	H=10
TCI	14.5	14.7	14.9	15	15.2
Lag=4	H=1	H=2	H=3	H=4	H=5
TCI	-	-	-	-	19.9
Lag=4	H=6	H=7	H=8	H=9	H=10
TCI	20.3	20.6	20.9	21.1	21.2

Table 3: Total Spillover Effect Table.

	CHN.EPU	US.EPU	SP	BP	HP	ER	FROM
CHN.EPU	88.6	8.4	0.2	0.6	1.9	0.2	11.4
US.EPU	8.4	90.3	0.3	0.2	0.6	0.2	9.7
SP	4.8	4.2	85.9	0.2	0.2	4.7	14.1
BP	10	13.1	7.5	61.3	1.1	7.2	38.7
HP	12.3	6.3	4.8	0.2	73.7	2.8	26.3
ER	13	4.5	8.3	0.3	1.1	72.8	27.2
TO	48.4	36.4	21.1	1.5	4.9	15.1	127.5
NET	37	26.7	7	-37.2	-21.5	-12.1	TCI=21.2

Note: This table describes the total spillover indices based on the volatility of asset prices in China and the United States. The element in the jth column of the ith row is the contribution of the jth variable to the forecast error variance of the ith variable.

3.2 Dynamic analysis of net spillover effect

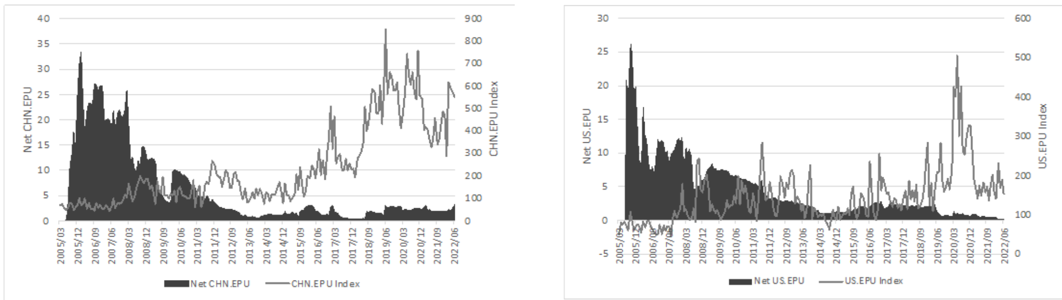

Figure 1: Sino-US EPU and Their Net Spillovers.

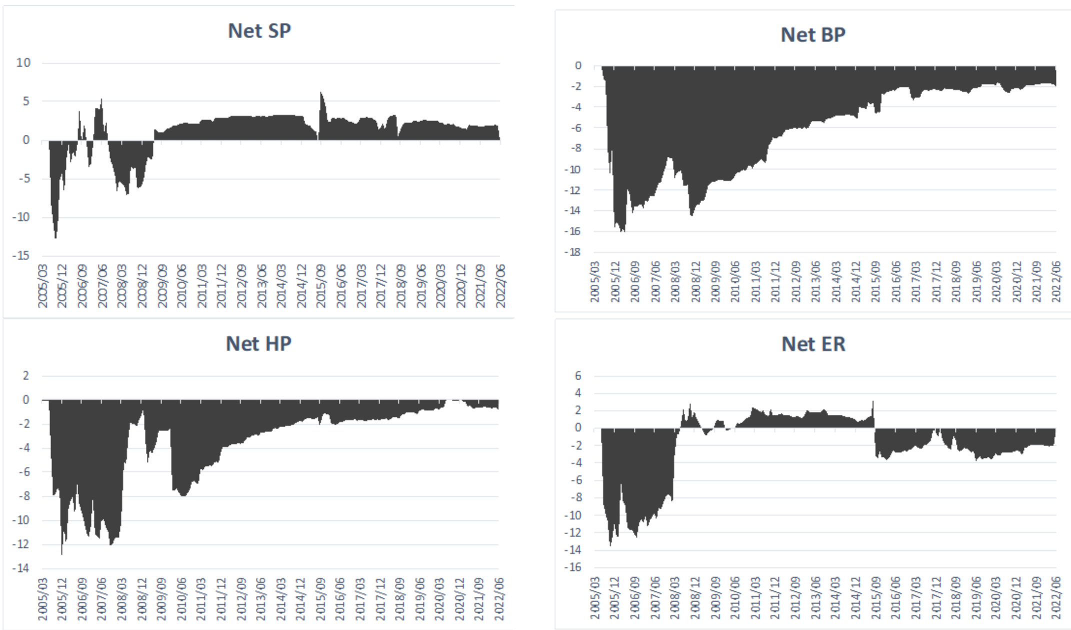

Figure 2: Net Spillovers of asset price volatility in China.

As shown in Figure 1 and Figure 2, the net spillover effects of EPU in both China and the United States are greater than 0. EPU in China and the United States is found to be the net exporter of the spillover effect of asset price volatility in China, among which the spillover effect of China's EPU on the domestic asset price volatility is more significant. Secondly, the net spillover effect of EPU on China's asset price volatility deviates from the trend of their respective EPU indices, and the net spillover effect of EPU on China's asset price volatility shows a declining trend during the overall rise of the EPU index.

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3.3 Pairwise Net Spillover Effect and Network Dynamic Analysis

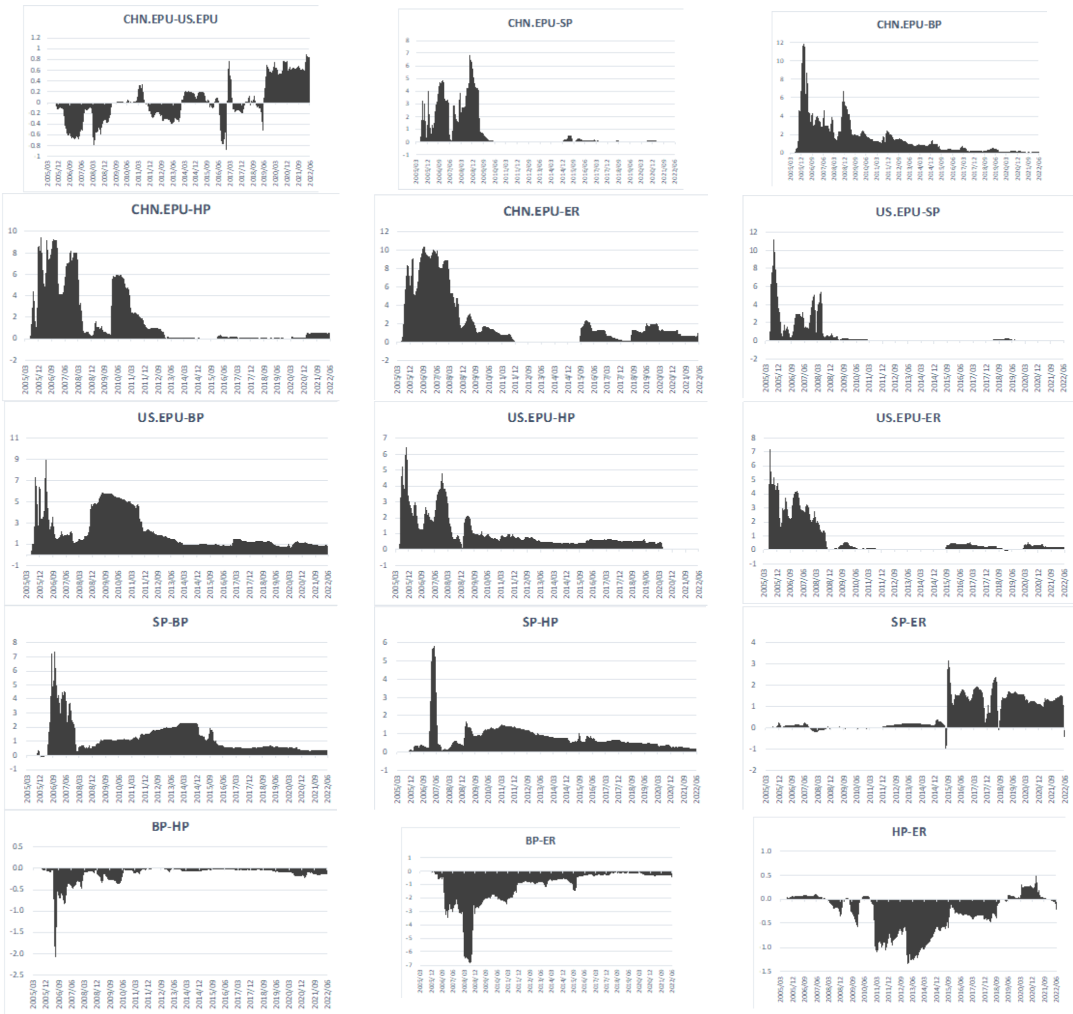
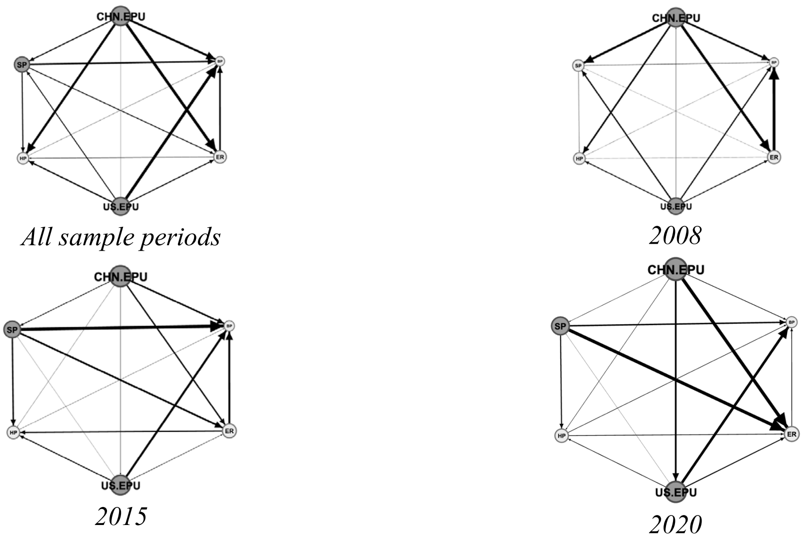


Figure 3: Net Pairwise Spillovers of Sino-US EPU and China's Asset Price Volatility.



Note: The node size represents the size of the net spillover effect, the dark (light) color node represents that the net spillover effect is positive (negative), the edge thickness represents the size of the directed spillover strength, the starting node represents the overflow side, and the terminal node represents the receiver.

Figure 4: Sample Network Volatility Spillovers in Different Periods.

In order to intuitively observe the transmission relationship of the dynamic spillover effects among variables and the network structure, we further decompose the net spillover effects of asset price volatility between China and the United States EPU and China into paired net spillover effects between variables, and draw the network diagram of spillovers in different periods.

We find that EPU in China and the United States are in a state of mutual spillover, and the net spillover effect significantly differ between the two periods. Before and during the 2008 financial crisis, the net spillover index of EPU in the United States to that in China is approximately 0.2%-0.6%. After the outbreak of COVID-19 pandemic, the net spillover index of China's EPU to the US EPU is roughly 0.5%-0.9%. In terms of China's asset market, we observe a change of the spillover effects of asset price fluctuations over time. The volatility of China's stock market has a net spillover effect on the price volatility of bond market and the real estate market. The price volatility of China's bond market is a net receiver of the spillover effect of other asset price volatility. In most sample periods observed, the price fluctuation of China's real estate market is a net receiver of the spillover effect of exchange rate volatility. Except for 2015, during China's exchange rate reformation, exchange rate volatility is observed to be the net receiver of stock market price volatility spillover, and the spillover effect of exchange rate volatility on bond market price volatility is particularly significant.

By comparing the network diagrams of spillover effects of variables in the full sample period, the financial crisis period in 2008, the unusual volatility period of China's stock market in 2015 and COVID-19 pandemic period in 2020, we find that the network structure of net spillover effects of asset price volatility between China and the United States shows a dynamic evolution trend. The spillover effect of EPU index on China's asset price volatility is heterogeneous in different periods and different levels. Taking COVID-19 pandemic period in 2020 as an example, strong spillover effects of China's EPU on both the US EPU and China's exchange rate volatility, of the US EPU on the bond market price volatility, and of the stock market price volatility on the exchange rate volatility is observed. Exchange rate fluctuations become a net recipient of spillover effects.

4. Conclusion

By constructing a TVP-VAR-DY model, this paper explores the Sino-US economic policy uncertainty and the dynamic spillover effect of China's asset price volatility. The study finds that Sino-US EPU is the net exporter of China's asset price volatility spillover effect, and that the net spillover effect of Sino-US EPU on China's assets price volatility deviates from the EPU index trends of the respective countries. EPUs in China and the United States are in a state of mutual spillover. A dynamic evolutional trend is observed for the network structure of the net spillover effect of asset price volatility between China and the United States, where the spillover effect of EPU index on asset price volatility in China is heterogeneous in different periods and different levels. The findings of this study provide an important reference for policy makers and financial regulators.

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