Do Domestic and US Economic Policy Uncertainty Increase China's Macro-Financial Connectedness?

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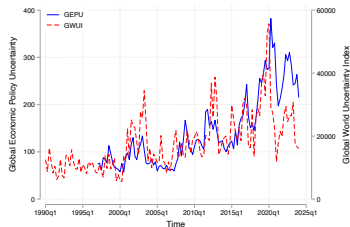
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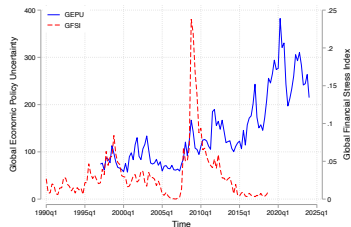[2]IDE, JETRO

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Aug. 28, 2024   @Rin Workshop series
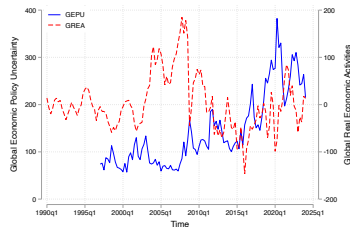
Background

(a) GEPU and GWUI   (b) GEPU and GFSI   (c) GEPU and GREA

The global financial crisis that erupted in 2008, the China-US trade conflict beginning in 2018, the reduction in US policy interest rates announced by the Federal Reserve in July 2019, the global COVID-19 pandemic starting in late 2019, and the Russia-Ukraine war that broke out in February 2022.

- All events accompanied by increased uncertainty. (Fig. (a))
- This heightened uncertainty has caused significant challenges for policymakers in various countries.
- The effects of economic policy uncertainty (EPU) are also considered a potential risk factor, leading to volatility in the **macroeconomic sector** and **financial markets** (Choi et al., 2023). (Figure (b), (c))

Motivation

- This phenomenon is especially pronounced for emerging markets. In fact, emerging markets are not only susceptible to the impacts of **internal** EPUs but also to secondary effects from **external** EPUs.
- China, as a representative emerging market, is chosen as the focus of this study for several reasons:
  - Internal:
    - China's financial system is currently underdeveloped (Guariglia et al., 2011): when faced with domestic EPU shocks, non-performing loans increase, making financial institutions the sources of financial risk transmission.
    - SOEs' investment behavior is "pro-policy:" When policies aiming to stimulate (or tighten) the economy are adopted, SOEs comply by increasing (or curtailing) investments (Wang et al., 2014), which means they are more significantly affected by EPU, potentially becoming sources of macroeconomic risk.
  - External:
    - When faced with external monetary policy uncertainty (MPU) shocks, exchange rate volatility can adversely affect the performance of an economy (Krol, 2014; Chen et al., 2020).
    - Foreign exchange intervention policies can quickly deplete foreign exchange reserves, further increasing the risk of currency depreciation, thereby acting as a channel for external financial risk transmission.
    - The rise in US trade policy uncertainty reduced firm-level investment, R&D expenditures, and profits by 2.3%, 2.3%, and 11.5%, respectively (Benguria et al., 2022).

Therefore, compared to other emerging markets, these **internal** and **external** characteristics make China an ideal subject for studying the impact of EPU on risk connectedness between financial and real economic activities, filling a gap in the literature.

Literature Review

- The effects of EPU on *real economic activities*.
  - Capital investment: Baker et al. (2016); Gulen and Ion (2016); Chen et al. (2019); Liu and Zhang (2020); Fujitani et al. (2023)
  - Employment: Mumtaz and Zanetti (2013); Creal and Wu (2017)
  - Foreign trade: Novy and Taylor (2020); Sharma and Paramati (2021); Handley and Limão (2017); Carballo et al. (2018); Jia et al. (2020)
  - (Spillover effects.) The effects of Major Economies' EPU (US, Euro area, China): Colombo (2013), Trung (2019), Caggiano et al. (2020), Kim et al. (2020)
- The effects of EPU on *financial market variables*.
  - Housing prices and volatility: André et al. (2017), Christou et al. (2017), Aye (2018), Balcilar et al. (2021a)
  - Stock returns and volatility: Phan et al. (2018), Christou and Gupta (2020), Li et al. (2020)
  - Exchange rate returns and volatility: Balcilar et al. (2016); Beckmann and Czudaj (2017); Kido (2016, 2018); Chen et al. (2020)
  - Bank: Ashraf and Shen (2019), Danisman et al. (2020), Tian et al. (2022), Shabir et al. (2022)
  - Financial stability: Phan et al. (2021), Orlowski (2023)

Nearly all research focuses on the impact of EPU (domestic or from major economies) on real economic activities or financial market variables. However, these studies overlook the interaction (mutual effects) between macroeconomic and financial market sectors when subjected to EPU shocks.

Literature Review (Cont'd)

- In fact, there is a substantial spillover mechanism between the macroeconomy and the financial market.
  - ▶ Tail risks in the financial market ⇒ reduction in capital expenditures ⇒ negative externalities on Macroeconomy (Allen et al., 2012; Caldara et al., 2016; Brownlees and Engle, 2017).
  - ▶ Downside risks in the macroeconomy ⇒ asset quality of financial institutions is impaired ⇒ investors to revise their expectations downwards ⇒ exacerbating volatility in financial markets (Shleifer and Vishny, 2010; Paye, 2012).

There is a lack of literature focusing on the continuous impact of economic policy uncertainty on macro-financial risk connectedness.

- Risk Spillover (connectedness) framework
  - ▶ Seminal work: Diebold and Yılmaz (2014)
  - ▶ TVP-VAR model with time-varying parameters: Ngene (2021); Ngene and Tah (2023)
  - ▶ Mixed-frequency MF-VAR model to address the issue of disparate data frequencies observed in financial markets and macroeconomic variables: Cotter et al. (2023); Jiang et al. (2024)

There is a scarcity of literature on the measurement of macro-financial risk connectedness that incorporates time-varying, mixed-frequency, and tail-risk perspectives.

This Paper
Contribution

- We are the *first* to study the effects of **exogenous domestic and US EPU shocks** on **China's macro-financial risk connectedness**.
  - ▶ We emphasize the causal relationship of EPU as an exogenous shock on the macro-financial risk connectedness.
  - ▶ We employ a *smooth local projection* (SLP) method to construct impulse responses.
- We are the *first* to construct China's macro-financial risk connectedness network **using a novel econometric method.**
  - ▶ We use the *tail risk* of these macroeconomic and financial variables. This focus on tail risk emphasizes the downside risk of these variables, providing a more precise description of risk and risk connectedness.
  - ▶ We combine the strengths of both TVP-VAR and MF-VAR to create a new approach for calculating connectedness, which we call **TVP-LB-MF-VAR**.
- We not only focus on domestic **overall EPU** and **categorical EPUs** but also on US EPU and categorical EPUs.
- We not only explore a plausible **transmission channel** through which EPU shocks impact macro-financial risk connectedness, but also examine the effects across different **economic cycles** and during **major emergencies**.

Empirical Method

Tail risk of macroeconomic and financial variables

We employ the expected shortfall (ES) to measure the tail risk of these variables. The methods for calculating ES differ between macroeconomic and financial variables.

- Macroeconomic variables: Growth-at-Risk (GaR) methodology proposed by Adrian et al. (2019).

  1. Construct the following quantile regression model:

  $$\widehat{Q}_{g_{i,t+h}|x_{i,t}}\left(q|x_{i,t}\right) = x_{i,t}\hat{\beta}_i,$$

  2. Employ a skewed t-distribution to fit and smooth the quantile function and recover a probability density function:

  $$\{\hat{\mu}_{t+h}, \hat{\sigma}_{t+h}, \hat{\alpha}_{t+h}, \hat{\nu}_{t+h}\} = \underset{\mu,\sigma,\alpha,\nu}{\arg\min} \sum_{q} \left[\widehat{Q}_{g_{i,t+h}|x_{i,t}}\left(q|x_{i,t}\right) - F^{-1}\left(g_{i,t}; \mu_t, \sigma_t, \alpha_t, \nu_t\right)\right]^2,$$

  3. Employ the following approach to calculate the ES for the growth rate of macroeconomic variable i at the 5th percentile of the left tail:

  $$ES_{i,t} = \frac{1}{\pi}\int_0^{\pi} F^{-1}_{g_{i,t+h}|x_{i,t}}\left(q|x_{i,t}\right)dq, \quad \text{where } \pi = 5\%.$$

Empirical Method

Tail risk of macroeconomic and financial variables (Cont'd)

- Financial variables: Realized-GARCH model, based on Hansen et al. (2012).
  1. The model setting is as follows:

$$r_{j,t} = c + \phi r_{j,t-1} + \sqrt{h_{j,t}} z_{j,t}, \quad z_{j,t} \sim i.i.d. \text{ skewed-}t\left(0, 1, \xi, \nu\right), \tag{1}$$

$$\ln h_{j,t} = \omega + \beta \ln h_{j,t-1} + \gamma \ln RRV_{j,t-1}, \tag{2}$$

$$\ln RRV_{j,t} = \kappa + \pi \ln h_{j,t} + \tau_1 z_{j,t} + \tau_2\left(z_{j,t}^2 - 1\right) + \varepsilon_{j,t}, \quad \varepsilon_{j,t} \sim i.i.d. \ N\left(0, \sigma_\varepsilon^2\right), \tag{3}$$

  All three equations' parameters are simultaneously estimated through the maximization of the joint log likelihood of the Realized GARCH model.

  2. The value-at-risk (VaR) for financial variable j in the subsequent week, $t+1$, is computed as follows:

$$VaR_j^\alpha\left(t+1|t\right) = \hat{c} + \hat{\phi} r_{j,t} + \sqrt{\exp\left(\hat{\omega} + \hat{\beta} \ln h_{j,t} + \hat{\gamma} \ln RRV_{j,t}\right)} c_{\alpha, \hat{\xi}, \hat{\nu}}^{\text{skewed-t}},$$

  3. The one-week-ahead forecast for the ES of the weekly return $ES_{j,t}$ with probability α is calculated by simulating 10000 times as follows:

$$ES_{j,t} = E\left[r_{j,t}|r_{j,t} \leq VaR_j^\alpha\left(t\right), \Theta_{t-1}\right].$$

Empirical Method

MF-TVP-LBVAR risk connectedness model

- Our quantitative measure of connectedness utilize the DY spillover methodology developed by Diebold and Yılmaz (2014), and its extension through the large Bayesian time-varying parameter vector autoregressive (TVP-LBVAR) model by Korobilis and Yilmaz (2018).

- Given that the expected shortfall of macroeconomic and financial variables are often sampled at different frequencies—with financial series usually available on a weekly basis and macroeconomic series on a monthly basis—we adopt Cotter et al. (2023)'s mixed-frequency VAR (MF-VAR) model.

- We contribute to the literature by combining two methods above:
  - ▶ Combine the high- and low-frequency sample following the work by Ghysels (2016):

$$
\text{stacked vector } y_t = \left[\underbrace{\left[\begin{array}{c} z_{H,1}(t,1) \\ \vdots \\ z_{H,1}(t,m) \end{array} \right]'}_{z_{H,1}(t)} \cdots \underbrace{\left[\begin{array}{c} z_{H,K_H}(t,1) \\ \vdots \\ z_{H,K_H}(t,m) \end{array} \right]'}_{z_{H,K_H}(t)} \quad z_L(t)' \right]',
$$

where $z_L(t)$ is a K_L-dimension vector of low-frequency macroeconomic observations; $z_{H,1}(t)', \cdots, z_{H,K_H}(t)'$ are K_H m-dimension vectors; y_t is a $K_z \equiv m K_H + K_L$ dimension vector.

Empirical Method

- (Cont'd)
  - We estimate a TVP-LBVAR model proposed by Korobilis and Yilmaz (2018) as the empirical approximating model to uncover the underlying connectedness framework:

  $$y_t = a_{0t} + \sum_{j=1}^{p} A_{jt} y_{t-j} + \varepsilon_t \quad \Leftrightarrow \quad \text{(state-space form)} \begin{cases} y_t = b_t x_t + \varepsilon_t, \\ b_t = b_{t-1} + \eta_t, \end{cases} \quad (4)$$

  the evolution of the parameters b_t and Σ_t can be calculated using a Bayesian MCMC methods.
  - We calculate the macro-financial connectedness using a generalized forecast error variance decomposition (GFEVD) method proposed by Diebold and Yilmaz (2014):

  $$\text{GFEVD matrix: } \theta_{ij}(H) = \frac{\lambda_{ij}(H)}{\mu_i(H)} = \frac{\sigma_{jj} \sum_{h=0}^{H-1} \left(e_i' B_h e_j\right)^2}{\sum_{h=0}^{H-1} \left(e_i' B_h \Sigma B_h' e_i\right)}, \text{ where } y_t = \sum_{i=0}^{\infty} B_i \varepsilon_{t-i}$$

  - Transfer the $K_z \times K_z$ GFEVD matrix $\theta(H)$ to a $K \times K$ matrix $d(H)$, and then normalize to $D(H)$:

  $$d_{kl}(H) = \frac{\sum_{i \in \mathcal{I}_k, j \in \mathcal{J}_l} \lambda_{ij}(H)}{\sum_{i \in \mathcal{I}_k} \mu_i(H)}, \quad D_{kl}(H) = \frac{d_{kl}(H)}{\sum_{l=1}^{K} d_{kl}(H)}, \quad TC^H \quad = \frac{1}{K} \sum_{l,k=1, l \neq k}^{N} D_{kl}^H.$$

  total connectedness

Empirical Method

Smooth local projection model

We use the smooth local projection (SLP) method to calculate the impacts of domestic and US economic policy uncertainty on China's macro-financial total connectedness.

- Baseline specification:

$$TC_{t+h} = \alpha^h + \beta^h EPU_t + \sum_{l=1}^{L} \gamma_l^h TC_{t-l} + \sum_{i=1}^{N} \rho_i^h X_{it} + e_{t+h}^h. \tag{5}$$

  - TC_{t+h} denotes the total connectedness at period $t+h$ over varying prediction horizons $h = 1, 2, \cdots, H$
  - EPU_t is the measure of economic policy uncertainty at period t
  - β^h is the impulse response coefficient of interest
  - X_{it} is a set of macroeconomic control variables that contains year-over-year growth rates of nominal GDP, investment, consumption, import, export, and CPI.
  - e_{t+h}^h is a zero-mean prediction error term with $\mathrm{var}\left(e_{t+h}^h\right) = \sigma_h^2$.

- We approximate the coefficient β^h using a linear B-splines basis function expansion in the forecast horizon h,

$$TC_{t+h} \approx \sum_{k=1}^{K} a_k B_k^h + \sum_{k=1}^{K} b_k B_k^h EPU_t + \sum_{l=1}^{L} \sum_{k=1}^{K} c_{lk} B_k^h TC_{t-l} + \sum_{i=1}^{N} \sum_{k=1}^{K} r_{ik} B_k^h X_{it} + e_{t+h}^h. \tag{6}$$

Empirical Method

Although there is a possibility that total connectedness might influence China's economic policy uncertainty, we believe this concern is unlikely to substantially affect our interpretation.

- Theoretical evidence: policymakers have clear policy objectives when formulating policies.
  - Monetary policy: According to the *Law of the People's Republic of China on The People's Bank of China*, the main objectives of China's monetary policy are to **maintain price stability** and **boost economic growth**.
  - Foreign exchange policy: From a foreign exchange perspective, the goal of monetary policy is to keep the RMB exchange rate at an "**adaptive and equilibrium level**".
  - Fiscal policy: also focuses on price stability and economic growth, in addition to ensuring **reasonable income distribution** and **resource allocation**.
  - Trade policy: According to the *Foreign Trade Law*, China's trade policy aims to **accelerate its opening to the outside world**, **develop foreign trade**, and **promote sound economic development**.

  Given these policy objectives, the macro-financial connectedness is not within the scope of these policy goals.

- Empirical evidence: Li et al. (2024) use a small-scale SVAR model with shock-based restrictions to investigate the endogeneity of China's EPU. Their findings indicate that China's EPU acts as an exogenous driver.

Data and Preliminary Analysis

- Explanatory variable
  - China's Economic Policy Uncertainty (EPU)
    - ⋆ Source: Huang and Luk (2020) utilize 10 mainland Chinese newspapers covering the period from January 2002 to March 2023.
    - ⋆ Categorical EPUs: fiscal policy uncertainty (CN_FPU), monetary policy uncertainty (CN_MPU), trade policy uncertainty (CN_TPU), and exchange rate and capital account policy uncertainty (CN_FXPU).
  - US EPU
    - ⋆ Source: Baker et al. (2016) employ text search methods to explore the digital archives of 10 leading US newspapers.
    - ⋆ Categorical EPUs: fiscal policy uncertainty (US_FPU), monetary policy uncertainty (US_MPU), and trade policy uncertainty (US_TPU).
- Dependent variable: macro-financial risk connectedness (TC), data used to calculate TC are below

Sectors	Variables	Frequency	Definition	Sources
Financial Sectors	Stock Market	Weekly	Shanghai Stock Exchange (SSE) Composite Index	WIND
	Bond Market	Weekly	ChinaBond Composite Index	WIND
	Foreign Exchange Market	Weekly	Mid-rate of the RMB to USD exchange rate	WIND
Macroeconomic Sectors	GDP	Monthly	Year-on-year growth rate of "NomGDP", seasonally adjusted	Higgins et al. (2016)
	Investment Sector	Monthly	Year-on-year growth rate of "NomInvestment", seasonally adjusted	Higgins et al. (2016)
	Consumption Sector	Monthly	Year-on-year growth rate of "NomConsumption", seasonally adjusted	Higgins et al. (2016)
	Import Sector	Monthly	Year-on-year growth rate of "NomImports", seasonally adjusted	Higgins et al. (2016)
	Export Sector	Monthly	Year-on-year growth rate of "NomExports", seasonally adjusted	Higgins et al. (2016)
	CPI	Monthly	Year-on-year growth rate of "CPI", seasonally adjusted	Higgins et al. (2016)

Data and Preliminary Analysis
Business, Crdit, and Trade Cycle

- Business cycle: based on year-on-year growth rate of China and US quarterly GDP
  - Method: BP filter method by Christiano and Fitzgerald (2003), medium cycle frequency band is set to 24-84 quarters.
  - China's business (downturn) cycle: 2005Q3-2013Q1, and 2021Q2-2023Q1.
  - US business (downturn) cycle: 2004Q1-2009Q1, 2014Q1-2017Q2, and 2022Q1-2023Q1.
- Credit cycle: based on private sector credit-to-GDP ratio for China
  - Method: same to business cycle
  - China's credit (downturn) cycle: 2002Q2-2006Q2, 2010Q2-2013Q1, 2015Q3-2019Q1, and 2022Q3-2023Q1.
- China-US trade cycle: year-over-year growth rate of the monthly total import and export trade volume between China and the United States.
  - Method: If the growth rate is less than 0, it is considered a downturn period.
  - China-US trade (downturn) periods: 2009M1-2009M12, 2016M1-2016M12, 2019M1-2020M6, and 2023M1-2023M3.

Data and Preliminary Analysis

Major emergencies and Confidence/Sentiment indices

Major emergencies:

- Global financial crisis: 2007M11-2009M6.
  - ▸ Start period: In November 2007, China's stock market experienced a significant decline, with the Shanghai Stock Exchange (SSE) index dropping by 18.19%. For a period of time thereafter, both the SSE index and the GDP growth rate exhibited a downward trend.
  - ▸ End period: It was not until July 2009 that the SSE index resumed a stable trend and the GDP growth rate in the third quarter returned to over 10%.
- China-US trade conflict: 2018M3-2019M8.
  - ▸ Start period: On March 23, 2018, President Trump directed the United States Trade Representative to investigate the application of tariffs on Chinese goods based on *Section 301 of the Trade Act of 1974*.
  - ▸ End period: On August 1, 2019, President Trump announced on Twitter that an additional 10% tariff would be levied on the remaining 300 billion dollar of goods.

Confidence/Sentiment indices:

- Consumer Confidence Index (CCI): reflecting the strength of consumer confidence.
  - ▸ monthly basis, base period set at the end of 1997, compiled by China's NBS.
- Chinese Stock Market Investor Composite Sentiment Index (CICSI): belief formed by investors based on their expectations of future cash flows and investment risks of assets.
  - ▸ monthly basis, spanning from January 2000 to March 2023, compiled by Yi and Mao (2009).

Data and Preliminary Analysis

Macro-financial connectedness table (cross-sectional, averaged over the whole period)

	Stock	Bond	Exchange	GDP	Investment	Consumption	Import	Export	CPI	**From others**
Stock	7.11	12.54	22.4	10.12	6.61	8.44	8.92	7.65	16.21	92.89
Bond	6.39	11.25	22.45	10.8	6.85	8.55	9.06	7.84	16.82	88.75
Exchange	7.4	12.27	24.2	9.12	6.17	8.54	10.09	7.63	14.57	75.8
GDP	7.23	11.6	21.55	10.69	6.95	8.5	10.02	8.34	15.12	89.31
Investment	8.7	12.49	22.75	9.86	5.2	9.85	8.88	7.08	15.2	94.8
Consumption	8.95	11.55	20.75	9.67	6.13	12.43	9.7	7.97	12.86	87.57
Import	6.93	12.12	22.3	9.11	6.85	8.44	11.07	8.23	14.95	88.93
Export	8.2	13.1	22.78	9.26	6.42	8.34	9.3	7.67	14.93	92.33
CPI	8.15	12.01	22.02	10.35	6.7	8.15	9.51	7.91	15.2	84.8
To others	61.95	97.67	176.99	78.29	52.67	68.8	75.48	62.66	120.66	**88.35**
Net	-30.94	8.92	101.19	-11.02	-42.13	-18.77	-13.45	-29.67	35.87	

- Row k column l represents the connectedness level from variable l to variable k
- **To_others** indicates the directional connectedness level from this variable to other variables.
- **From_others** indicates the directional connectedness level from other variables to this variable.
- The exchange rate market primarily functions as the main transmitter of tail risk.
- The investment sector and stock market primarily receive tail risk from other sectors,

Data and Preliminary Analysis

Descriptive statistics

	N	mean	min	max	median	std	skewness	kurtosis	ADF test
Total connectedness	252	88.35	77.95	92.75	88.69	1.78	-2.67	13.77	-5.16
CN_EPU	252	127.68	39.53	238.32	130.73	38.75	0.2	2.91	-5.17
CN_FPU	242	119.95	25.42	450.73	113.28	65.23	1.08	5.12	-7.44
CN_MPU	242	113.51	26.62	358	102.38	61.47	0.9	3.57	-4.72
CN_TPU	242	147.95	25	1031.01	103.75	140.94	3.54	19	-8.6
CN_FXPU	242	111.97	24.07	412.05	90.28	70.31	1.45	5.42	-6.7
US_EPU	252	107.94	37.27	503.01	91.15	60.44	2.65	14.16	-4.62
US_MPU	252	87.25	17.62	304.29	71.44	55.34	1.46	5.52	-7.37
US_FPU	252	116.68	23.05	433.29	99.9	73.67	1.59	5.73	-4.96
US_TPU	252	122.4	7.67	1946.68	50.36	218.33	4.33	27.65	-6.06

- Low variability in macro-financial connectedness.
- The std. of China's categorical EPUs are higher than that of CN_EPU, with CN_TPU exhibiting a std. of 140.94 and a maximum value exceeding 1000.
- Average economic policy uncertainty in the US is lower than in China, its volatility is greater.
- The average of the US categorical EPUs are lower than their Chinese counterparts, but the std. for FPU and TPU are higher in the US.

Data and Preliminary Analysis

Graph: EPU and macro-financial total connectedness
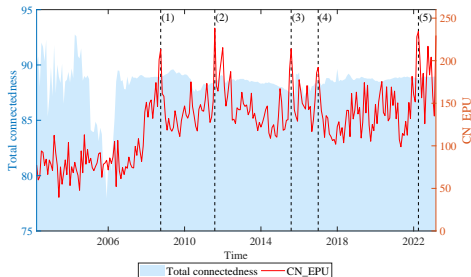
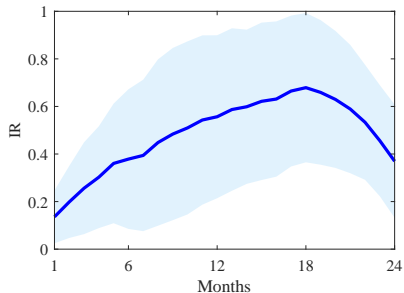(d) China's EPU and macro-financial total connectedness
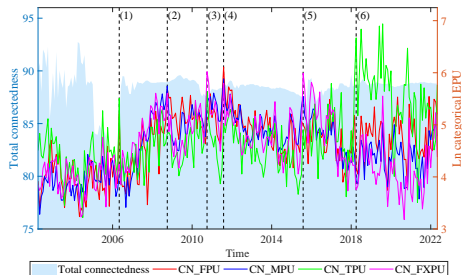
(e) China's categorical EPUs and macro-financial total connectedness

- Following the peaks in China's EPU, the macro-financial total risk connectedness level generally rises over several months.
- The timing of peaks in China's categorical EPUs and CN_EPU do not always coincide, but they similarly exhibit predictive power for macro-financial total risk connectedness levels

Impact of China's EPU
Baseline results and Robustness checks
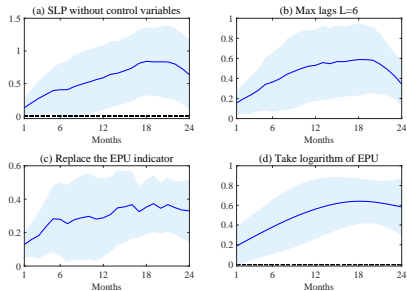
(f) IR of total connectedness to China's EPU   (g) Robustness tests

- An increase in China's EPU significantly raises macro-financial total risk connectedness as expected and reveal that this effect has notable persistence.
- The increase in China's EPU has a robust positive impact on macro-financial total connectedness, and verify that this effect is both economically and statistically significant.

Impact of China's EPU

Financial and macro variables' Directional connectedness to China's EPU
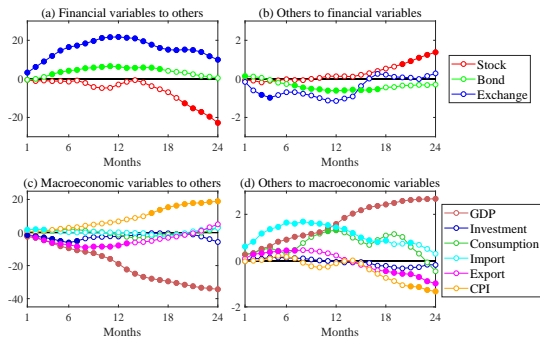
Figure: IR of financial and macro variables' directional connectedness to China's EPU

- An increase in China's EPU primarily raises the To_others level of financial variables (foreign exchange and bond market) while increasing the From_others level of macroeconomic variables (GDP, import, and export).

- The rise in the domestic EPU causes financial markets to act more as transmitters of risk, while macroeconomic sectors act more as receivers of risk.

Impact of China's EPU

Impact of China's categorical EPUs

Figure: IR of total connectedness to China's categorical EPUs
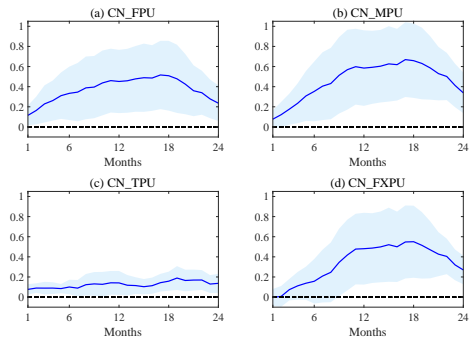
- China's MPU has the greatest effect on macro-financial total risk connectedness.
- The impulse response to China's TPU is also significantly positive within the 1 to 24-month period but does not exhibit a clear upward trend, with response values relatively lower, ranging between 0.1% and 0.2%.

Impact of China's EPU

Impact under different economic cycles
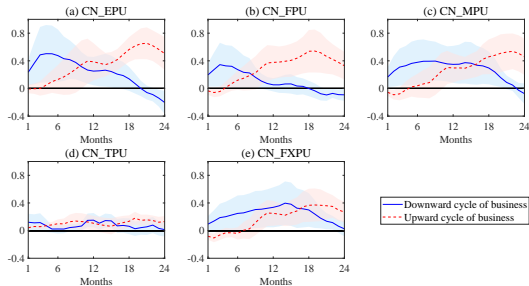
(a) IR of total connectedness to China's EPUs under downward and upward business cycle
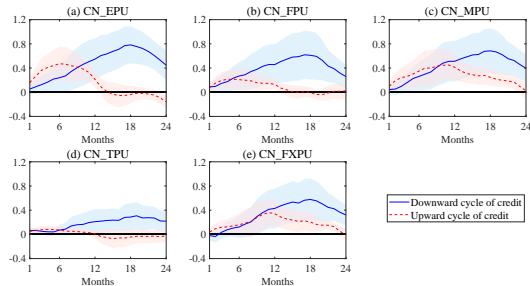
(b) IR of total connectedness to China's EPUs under downward and upward credit cycle

- During economic downturns (upturns), an increase in China's EPU can enhance macro-financial total connectedness in the short (long) term.
- Although there is a lag in materializing during the downturn period of the credit cycle, the maximum effect of rising EPUs is significantly higher than that during the upward credit cycle.

Impact of China's EPU

EPU and risk connectedness: confidence channels
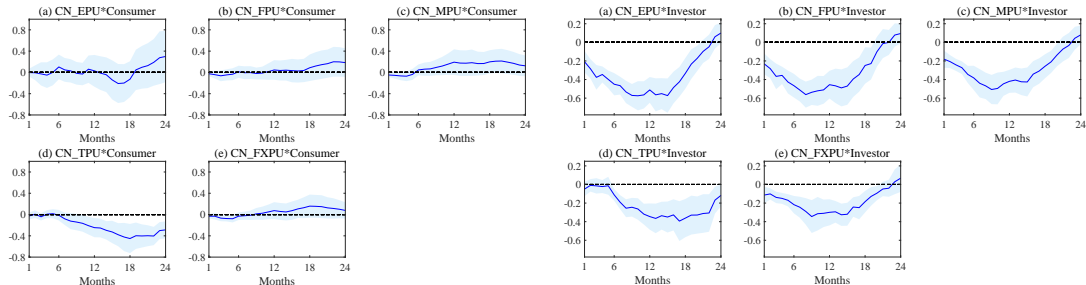
(c) IR of total connectedness to interaction between China's EPUs and consumer's confidence

(d) IR of total connectedness to interaction between China's EPUs and investor's confidence

- The long-term (after 10 months) impulse effects of China's TPU with consumer confidence are significantly negative.
- The impulse responses of the interaction terms of China's EPU, FPU, MPU, and FXPU with investor confidence are significantly negative for most periods, and the impact of China's TPU with investor confidence is also significantly negative after 6 months.

Impact of China's EPU

Impact during major emergencies
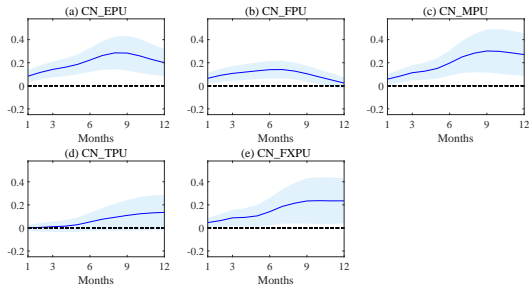
(e) IR of total connectedness to China's EPUs during global financial crisis
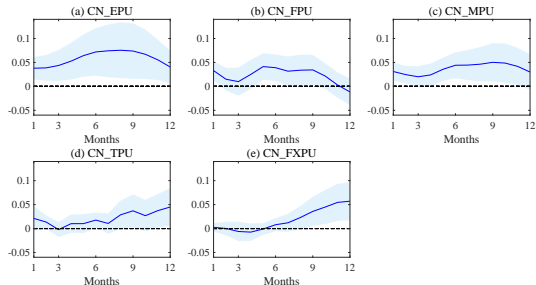
(f) IR of total connectedness to China's EPUs during China-US trade conflict

- During the global financial crisis, the impulse impact of China's TPU on macro-financial total connectedness was not significant.
- During the US-China trade conflict period, the impulse impact of China's TPU was significantly positive for several of the forecast periods.

Impact of US EPU

Graph: US EPUs and China's macro-financial total connectedness
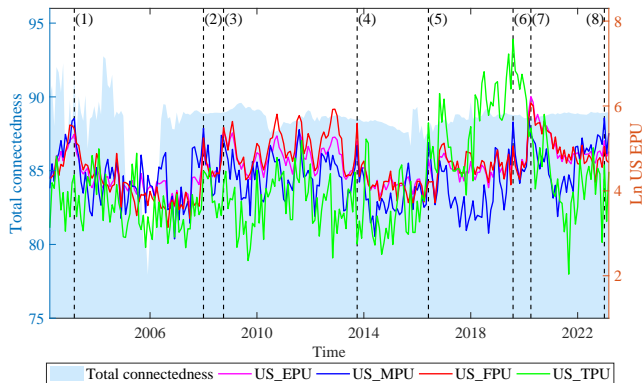
- Peaks in US EPU or categorical EPUs are typically followed by an increase in China's macro-financial total connectedness, preliminarily suggesting that uncertainties in US might lead to an increase in China's macro-financial risk connectedness.

Impact of US EPU

Impact of US EPUs on total connectedness
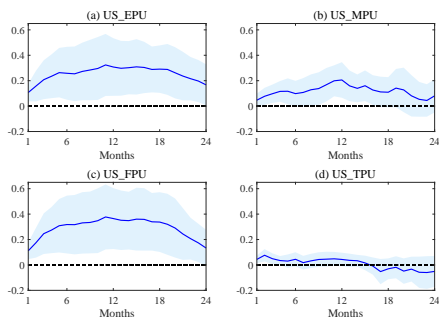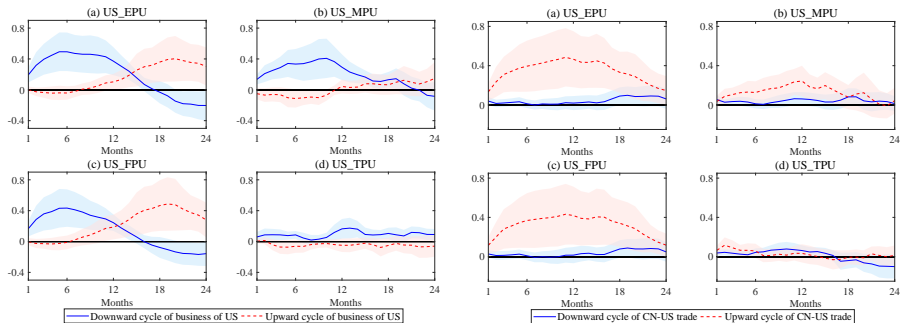

(g) IR of total connectedness to US EPUs
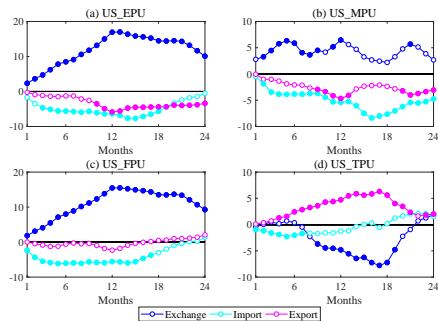
(h) IR of open economy variables' net connectedness to US EPUs

- Increases in US EPU, MPU, and FPU also increase China's macro-financial risk connectedness, though the impact is lower in magnitude and shorter in duration.
- The foreign exchange market continues to serve as the primary risk transmitter, spreading risk to various macroeconomic and financial sectors.

Impact of US EPU

Impact of US EPUs under different economic cycles

(i) IR of total connectedness to US EPUs under downward and upward business cycle of US

(j) IR of total connectedness to US EPUs under downward and upward cycle of China-US trade

- Similar to those observed in China, US EPU shocks transmitting risk more quickly during the business cycle downward period.
- During the downturn period of China-US trade conflicts, the impact of US EPU shocks on China's macro-financial risk connectedness is no longer significant.

Impact of US EPU

Impact of US EPUs during major emergencies
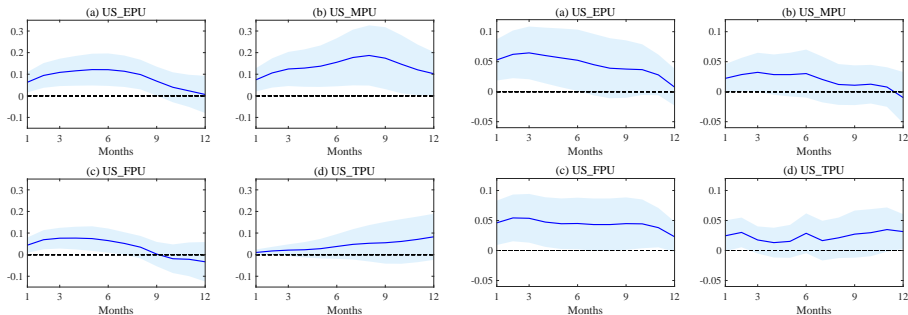
(k) IR of total connectedness to US's EPUs during global financial crisis

(l) IR of total connectedness to US's EPUs during China-US trade conflict

- For US categorical EPUs, the impulse impact of a rise in US MPU on China's macro-financial total connectedness is higher in magnitude and more prolonged.
- The impulse responses of China's macro-financial total connectedness level to the rise in US EPUs are not significant after 6 months.

Concluding Remarks

- An increase in domestic EPU leads to a significant rise in macro-financial total risk connectedness for at least two years.
  - Our findings are **robust** to a series of tests.
- The increase in domestic EPU elevates the risk connectedness from financial markets (foreign exchange and bond markets) to all other sectors, and from all other sectors to the macroeconomic sectors (GDP, consumption, and import).
  - Financial markets act more as **transmitters** of risk, while macroeconomic sectors act more as **receivers** of risk.
- We find relatively homogeneous results for macro-financial total connectedness in response to EPUs. However, there are still differences in the magnitude of the effects among the various categorical EPUs.
  - $MPU > \cdots > TPU$
- The downturn period of the business cycle can transmit risk more quickly (than upswing period). However, there is a lag in materializing during the downturn period of the credit cycle.
- Increases in US EPU, MPU, and FPU also increase China's macro-financial risk connectedness, though the impact is lower in magnitude and shorter in duration.

Concluding Remarks

Policy implications

- Since financial markets, especially the foreign exchange market, act more as transmitters of risk, implementing policies to stabilize exchange rates is reliable in terms of reducing the transmission of risk from external to internal sources. However, it is also necessary to ensure sufficient foreign exchange reserves to carry out foreign exchange interventions.

- Compared to consumer confidence, when financial market investors' confidence is higher, the likelihood of herd behavior and sell-off activities is lower, thereby reducing the level of risk transmission between the financial market and macroeconomic sectors. Therefore, controlling excess market optimism or pessimism is crucial (Miwa, 2016). Since investor sentiment inherently contains information about future long-term growth expectations, it is possible to formulate relevant policies using this index to avoid irrational sentiment.

- Since the downturn period of the business cycle can transmit risk more quickly than the upswing period, implementing policies that can mitigate the length of the downturn period and reduce the severity of economic crises can alleviate the risk transmission caused by EPU shocks. However, at the same time, policy changes during these major emergencies can themselves increase EPUs, making it even more important to manage the trade-off effectively.