Global Impacts of US Monetary Policy Uncertainty Shocks

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This project has received funding from the European Social Fund under a grant agreement with the Research Council of Lithuania (LMTLT)

Motivation (I)

- Policy uncertainty [i.e. ability to forecast the future path of policy] affects the behavior of investors, households and firms
- Increasing integration between economies $\Rightarrow$ a potential transmission channel of uncertain shocks.

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- How does US monetary policy uncertainty (US-MPU) affect other economies?
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We propose a new econometric model that extends the global vector autoregressive (GVAR) framework to estimate the global impacts of an increase in the volatility of US monetary policy shocks.

Motivation (II): Contributions

- Single economy versus **global economy**
  - US along with 32 other countries: 90% of world output
  - Investigate “heterogeneous” spillover effects to other economies and spillback effects to US economy
- Proxy of uncertainty versus **a unified, internally model-based uncertainty**.
  - Uncertainty of a structural shock
  - Endogenous versus exogenous uncertainty (Ludvigson et al. [forthcoming])
- Explore the role of different channels of transmission:
  - Trade versus Financial linkages, before and after the GFC
- Contribute to the global macroeconomic modeling literature: a marginal model of stochastic volatility-in-mean into its standard framework
  - Paves the way for applications on global uncertainty well beyond the scope of this paper.

Related Literature

- **Economic policy uncertainty shocks**: Mumtaz and Zanetti [2013], Born and Pfeifer [2014], Fernandez-Villaverde et al. [2015], Baker et al. [2016], Creal and Wu [2017], Mumtaz and Surico [2018], Husted et al. [2019]
- **Broader uncertainty shocks**: Bloom et al. [2018], Cesa-Bianchi et al. [2019], Bonciani and Ricci [2020], Mumtaz and Theodoridis [2015], and Crespo Cuaresma et al. [2020]
- **GVAR literature**: Pesaran et al. [2004], Chudik and Pesaran [2011, 2013], Crespo Cuaresma et al. [2016], Huber [2016], Crespo Cuaresma et al. [2019]
- **Spillover of US uncertainty shocks**: Bhattarai et al. [2019]
  - Panel VAR, US stock market uncertainty shock to 15 emerging economies + Two-step process

Econometric Framework (I)

The VARX model for country i:

$$\boldsymbol{x}_{it} = \boldsymbol{a}_i + \sum_{\ell=1}^{p_i} \boldsymbol{\Phi}_{i\ell} \boldsymbol{x}_{i,t-\ell} + \sum_{\ell=0}^{q_i} \boldsymbol{\Lambda}_{i\ell} \boldsymbol{x}^*_{i,t-\ell} + \sum_{\ell=0}^{s_i} \boldsymbol{\Psi}_{i\ell} \boldsymbol{h}_{i,t-\ell} + \boldsymbol{u}_{it}, \tag{1}$$

- $\boldsymbol{x}_{it}$: vector of endogenous variables- output growth, inflation, short-term interest rate, and the real exchange rate growth (Clarida et al., 2001, Gali and Monacelli, 2005, Dees et al., 2014)
- $\boldsymbol{x}^*_{it}$; cross-sectional averages, proxying for the common unobserved factors: $\boldsymbol{x}^*_{it} = \bar{\boldsymbol{W}}_i \boldsymbol{x}_t = \sum_{j=1}^{N} w_{ij} \boldsymbol{x}_{jt}$ where $w_{ii} = 0$ and $\sum_{j=0}^{N} w_{ij} = 1$ for all $j = 0, 1, \ldots, N \Rightarrow$ spillover effects = f($\bar{\boldsymbol{W}}_i$, $\boldsymbol{\Lambda}_{i\ell}$)
- $\boldsymbol{h}_{it} = [h_{i1t}, h_{i2t}, ..., h_{ik_it}]$ vector of log volatility of structural shocks (Basu and Bundick, 2017, Born and Pfeifer, 2014, Fernandez-Villaverde et al., 2015, Mumtaz and Theodoridis, 2015)

Econometric Framework (II)

Reduce-form innovations $\boldsymbol{u}_{it}$ and Structural shocks $\boldsymbol{e}_{it}$

$$\boldsymbol{u}_{it} = \Omega_{it}^{1/2} \boldsymbol{e}_{it},\ \boldsymbol{e}_{it} \sim N(\boldsymbol{0},\ \boldsymbol{I}) \tag{2}$$

$$\boldsymbol{\Omega}_{it} = \boldsymbol{A}_i^{-1} \boldsymbol{H}_{it} \boldsymbol{A}_i^{-1\prime}, \tag{3}$$

$$\boldsymbol{H}_{it} = \begin{pmatrix} \exp(h_{i1t}) & 0 & 0 & 0 \\ 0 & \exp(h_{i2t}) & 0 & 0 \\ 0 & 0 & \exp(h_{i3t}) & 0 \\ 0 & 0 & 0 & \exp(h_{i4t}) \end{pmatrix} \tag{4}$$

Econometric Framework (II)

Volatility dynamics:

$$\boldsymbol{h}_{it} = \boldsymbol{c}_i + \sum_{\ell=1}^{m_i} \boldsymbol{\Upsilon}_{i\ell} \boldsymbol{h}_{i,t-\ell} + \sum_{\ell=1}^{q_i} \boldsymbol{\Xi}_{i\ell} \boldsymbol{x}_{i,t-\ell} + \boldsymbol{\eta}_{it} \tag{5}$$

$$\boldsymbol{\eta}_{it} \sim N(\mathbf{0},\ \boldsymbol{Q}_i) \text{ and } \mathbb{E}(\boldsymbol{e}_{it},\ \boldsymbol{\eta}_{it}) = \mathbf{0},$$

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- $\boldsymbol{\eta}_{it} = \boldsymbol{B}_i \boldsymbol{\varepsilon}_{it}$, where $\boldsymbol{B}_i \boldsymbol{B}_i^{'} = \boldsymbol{Q}_i \Rightarrow$ exogenous shocks to uncertainty
- $\sum_{\ell=1}^{m_i} \boldsymbol{\Upsilon}_{i\ell} \boldsymbol{h}_{i,t-\ell}$: capture persistence of volatility process
- $\sum_{\ell=1}^{q_i} \boldsymbol{\Xi}_{i\ell} \boldsymbol{x}_{i,t-\ell}$: feedback effects $\rightarrow$ endogenous response of volatility, i.e. high uncertainty in recession.

Econometric Framework (III)

Identification of US Monetary Volatility Shocks

$$\Omega_{it} = \boldsymbol{A}_i^{-1} \boldsymbol{H}_{it} \boldsymbol{A}_i^{-1\prime}, \tag{6}$$

- Baseline: adopting the sign restrictions on $\tilde{\boldsymbol{A}} = \boldsymbol{A}^{-1}$ (Mumtaz and Zanetti [2013])

$$\tilde{\boldsymbol{A}} = \begin{pmatrix} 1 & 0 & 0 \\ a_{2,1}^{(-)} & 1 & 0 \\ a_{3,1}^{(-)} & a_{3,2} & 1 \end{pmatrix}$$

An increase in interest rates causes a contemporaneous fall in output growth and inflation

Econometric Framework (IV)

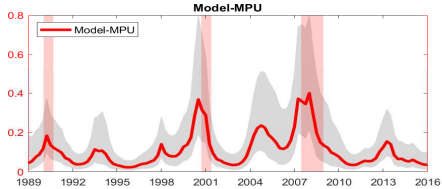
Global Model:

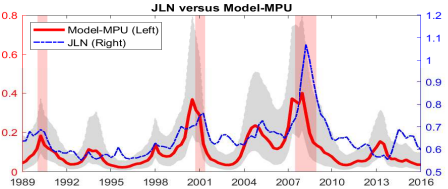
$$\boldsymbol{x}_t = \boldsymbol{x}_0 + \sum_{\ell=1}^{p_z} \boldsymbol{K}_\ell \boldsymbol{x}_{t-\ell} + \sum_{\ell=0}^{s} \boldsymbol{\Theta}_\ell \boldsymbol{h}_{t-\ell} + \boldsymbol{v}_t. \tag{7}$$

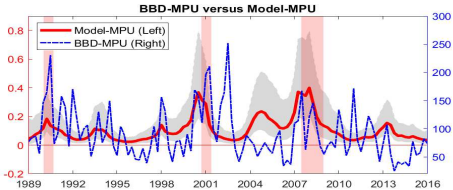
The stochastic volatility process:

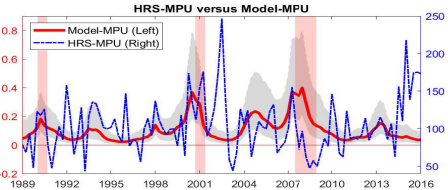
$$\boldsymbol{h}_t = \boldsymbol{h}_0 + \sum_{\ell=1}^{m} \boldsymbol{\Upsilon}_\ell \boldsymbol{h}_{t-\ell} + \sum_{\ell=1}^{q} \boldsymbol{\Xi}_\ell \boldsymbol{x}_{t-\ell} + \boldsymbol{\eta}_t. \tag{8}$$

Results: US Monetary Policy Uncertainty

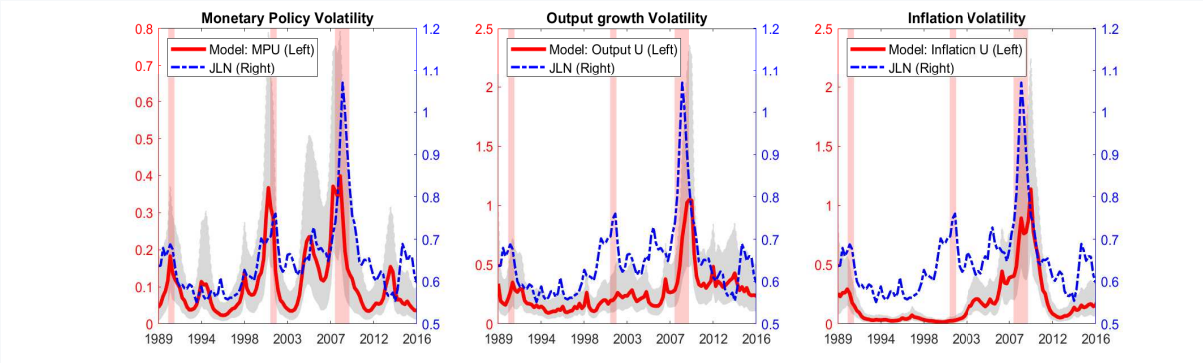






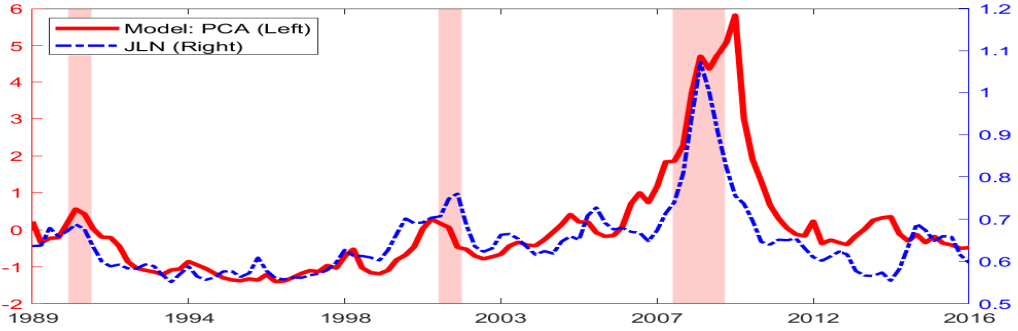


Results: US Volatilities of Shocks



Notes: Figure presents monetary policy volatility (1st column), output volatility (2nd column), and inflation volatility (3rd column) in comparison with the JLN macroeconomic uncertainty measure (right axis in each column).

Results: US Macro Uncertainty



Notes: Figure presents the first principal component of three (standardized) measures of volatilities from our model (i.e. monetary policy volatility, output volatility and inflation volatility) in comparison with the JLN macroeconomic uncertainty measure.

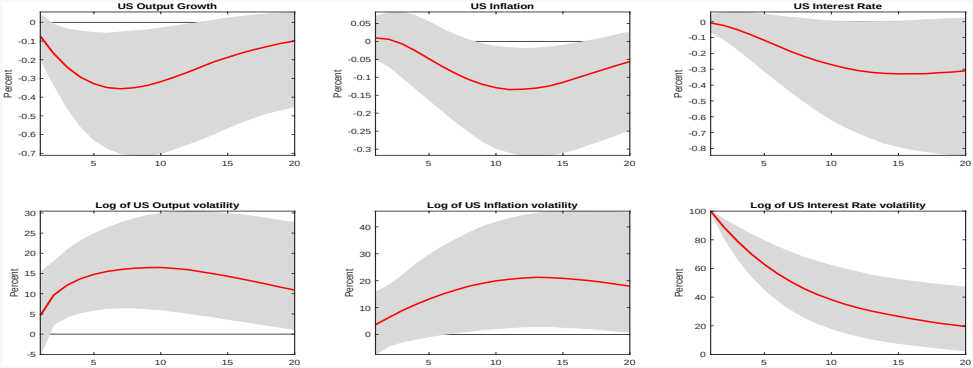
Results: Estimates of log volatility equations- US

	$h_{r,t}$	$h_{y,t}$	$h_{p,t}$
$h_{r,t-1}$	**0.88**	**0.06**	0.03
	[0.81,0.94]	[0.01,0.12]	[-0.02,0.08]
$h_{y,t-1}$	0.09	**0.49**	0.02
	[-0.05, 0.25]	[0.16,0.75]	[-0.10,0.15]
$h_{p,t-1}$	0.05	**0.06**	**0.87**
	[-0.01,0.12]	[0.006,0.13]	[0.79,0.93]
r_{t-1}	0.03	-0.03	-0.004
	[-0.004,0.07]	[-0.08,0.01]	[-0.03,0.03]
y_{t-1}	0.02	**-0.08**	**-0.05**
	[-0.04, 0.08]	[-0.17, -0.02]	[-0.10,-0.002]
p_{t-1}	-0.05	-0.03	-0.02
	[-0.11, 0.01]	[-0.11,0.03]	[-0.07,0.03]

Notes: Table shows the median estimates of coefficients in the log volatilities equation for the US, together with 68 percent credible intervals in brackets. r, y, p denote interest rate, output growth and inflation, respectively.

Results

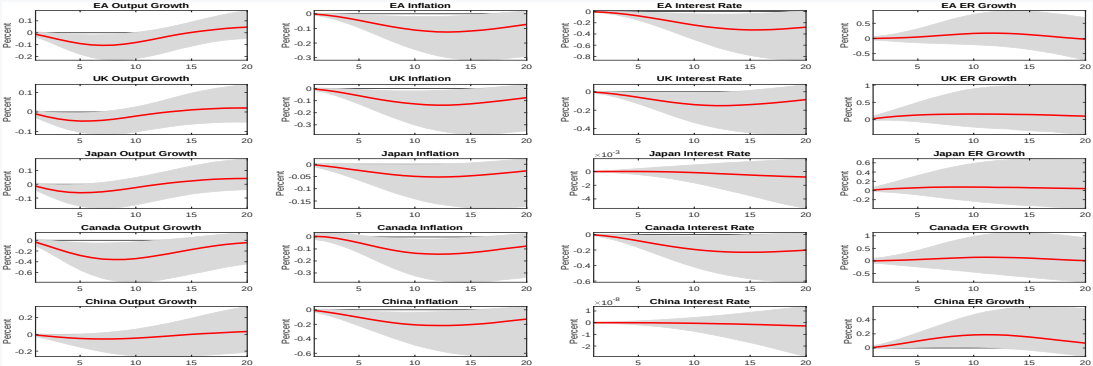
An increase in US MP uncertainty raises output and inflation volatilities, and causes output slump, deflation and a drop in the interest rate



Notes: Figure presents the response of US macroeconomy to an unexpected increase by 100 percent in the US interest rate volatility. Each entry shows the median (solid line), and the 68% intervals (shaded area).

Results

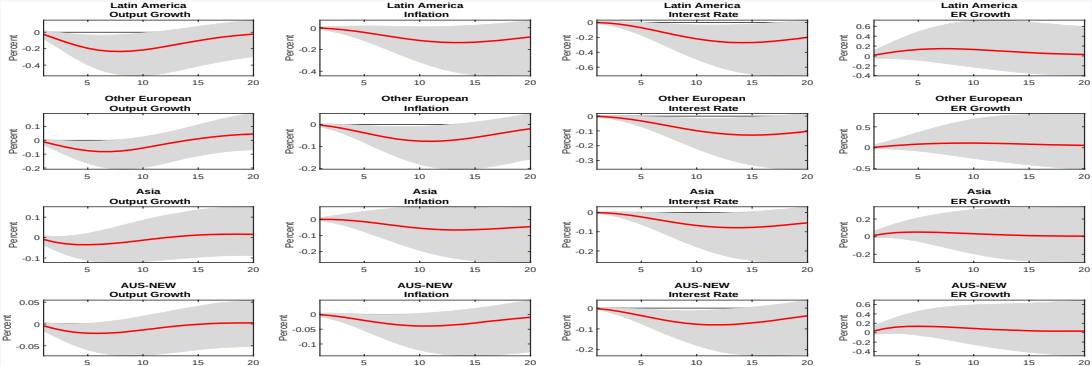
... making the world move in a very synchronous way, trade gravity matters (trade weight)



Notes: Figure presents the global spillover effects of an unexpected increase by 100 percent in the US interest rate volatility. Each entry shows the median (solid line), and the 68% intervals (shaded area).

Results

... the closer the stronger hit



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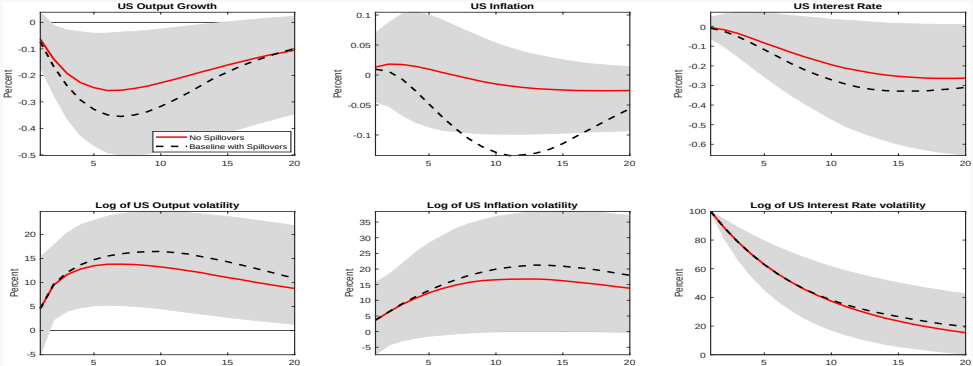
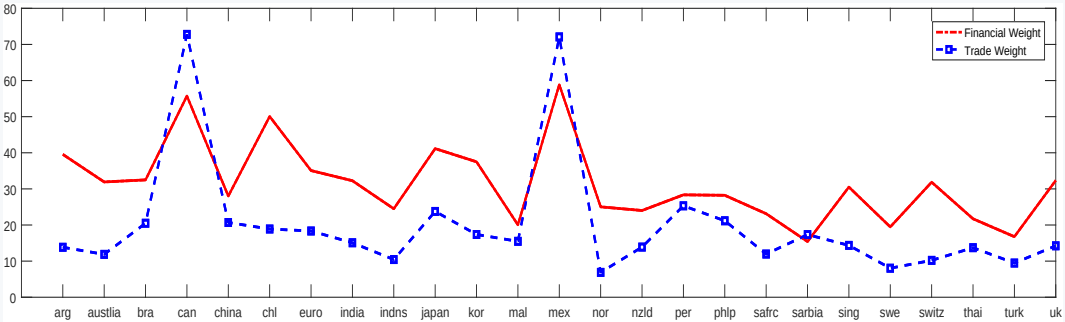
Results: No spillover - No spillback

A smaller effect on output growth, barely any effect on inflation and a less pronounced reaction in interest rates ⇒ important spillback effects even for the US economy



Notes: Figure presents the response of US macroeconomy to an unexpected increase by 100 percent in the US interest rate volatility if spillovers to and spillbacks from the rest of the world to the US economy are close: in each case, the red solid line and the shaded area are the median response and the 68 percent intervals in the case of no spillovers and spillbacks; the black dashed line is the corresponding response in the baseline.

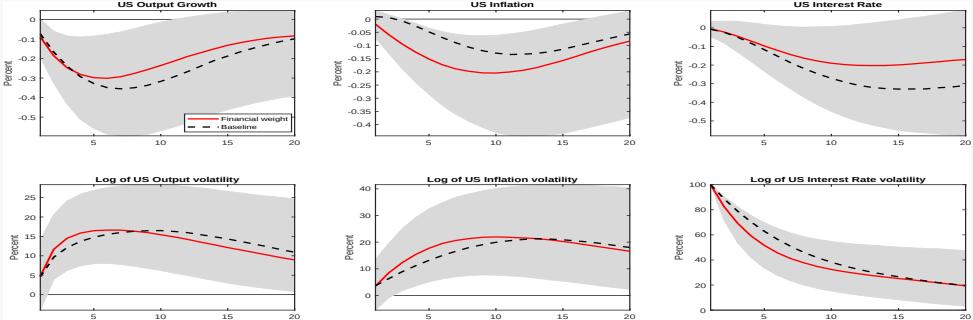
Results: Financial Channel



Notes: Figure shows the financial and trade linkage with US for each country. The financial weight is the average of main facets of financial integration, namely: outward portfolio investment, inward portfolio investment, outward foreign direct investment, inward foreign direct investment, outward claims of domestically headquartered banks and inward claims of foreign-headquartered banks. The data are from Eickmeier and Ng [2015].

Results: Financial Channel (cont)

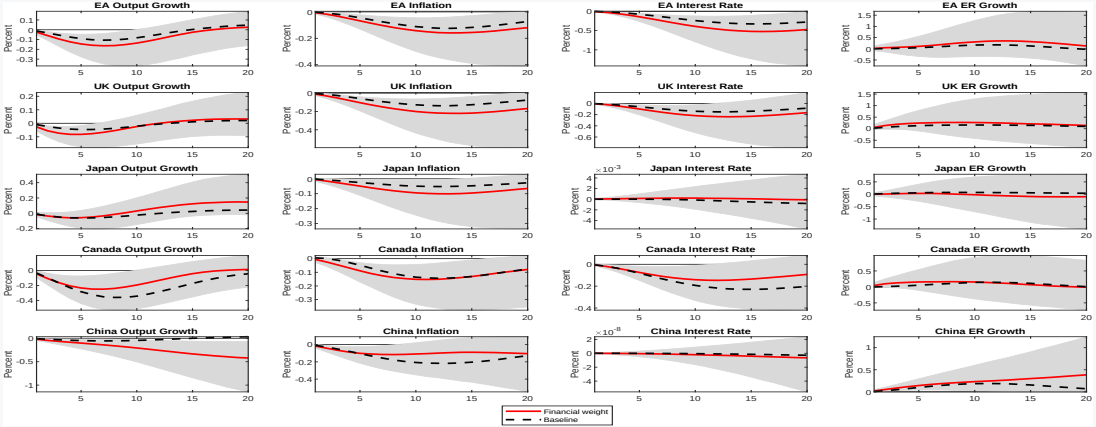
More deflationary



Notes: Figure presents the response of the US macroeconomy to an unexpected increase by 100 percent in the US interest rate volatility using the financial weight: in each entry, the red solid line and the shaded area are the median response and the 68 percent intervals; the black dashed line is the corresponding response in the baseline.

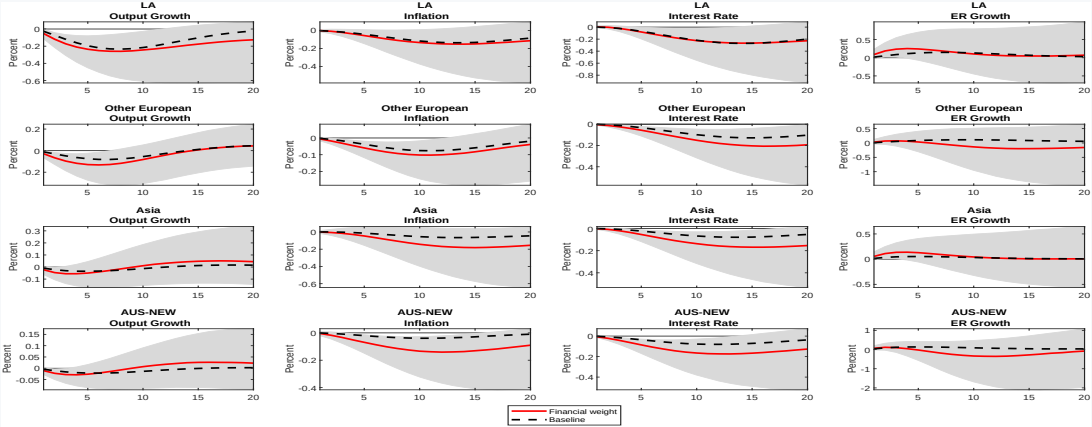
Results: Financial Channel (cont)

Confirm the prominent role of the US as a financial center in transmitting shocks globally



es: Figure presents the global spillover effects of an unexpected increase by 100 percent in the US interest rate volatility using the financial weight. In each plot, the red solid line and the shaded area are the median response and

Results: Financial Channel (cont)



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Take away

- An unexpected increase in US interest rate uncertainty :
  - drives US output and inflation volatilities
  - causes output slump, deflation and a drop in the interest rate
  - generates strong global impacts, making the world move in a very synchronous way, via both trade and financial channels
- Spillback effects are found to be important even for the US economy

Thank you