The Transmission Mechanisms of International Business Cycles:
Output Spillovers through Trade and Financial Linkages

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We study the international transmission of U.S. monetary shocks and their effects on output abroad.

Motivation:

– The U.S. economy is large and open.

– The dollar is a global, dominant currency.

– Methods to identify U.S. monetary shocks are available in the literature.

Main findings:

– U.S. monetary shocks have sizeable output effects abroad, comparable to domestic effects.

– The output responses are relatively large in countries more open to international trade.

– Indirect transmission through the international trade network accounts for 40% to 50%.

– The role of financial linkages is overall nuanced.

Estimation

Local projections with instruments (LPIV):

$$y_{i,t+h} = \alpha_i^h + \beta^h r_t + \sum_{k=1}^{4} \gamma_k^h y_{i,t-k} + \sum_{k=1}^{4} \delta_k^h r_{t-k} + \sum_{k=1}^{4} \zeta_k^{h\,\prime} \mathbf{s}_{t-k} + \boldsymbol{\theta}_i^{h\,\prime} \mathbf{x}_t + \varepsilon_{i,t+h}^h$$

$y_{i,t}$ is the logarithm of real GDP per capita in country i, quarter t.

r_t is the U.S. monetary policy shadow interest rate, instrumented with $\mathbf{s}_t$.

$\mathbf{s}_t$ is a vector of monetary shocks.

$\mathbf{x}_t \equiv (t\ t^2)'$ is a deterministic trend.

β^h measures the output response abroad, pooled across countries, after h quarters.

Data

Macro panel:
- – 44 countries: 1995–2017, quarterly
- – real GDP per capita
    (IMF, OECD, Penn World Tables)
- – interest rates (various sources)
- – aggregate exports, imports (World Bank)
- – international investment positions (IMF)

Bilateral linkages:
- – gross and value-added trade flows
    (U.N. Comtrade)
- – banking claims
    (BIS; 18 countries starting 2005)
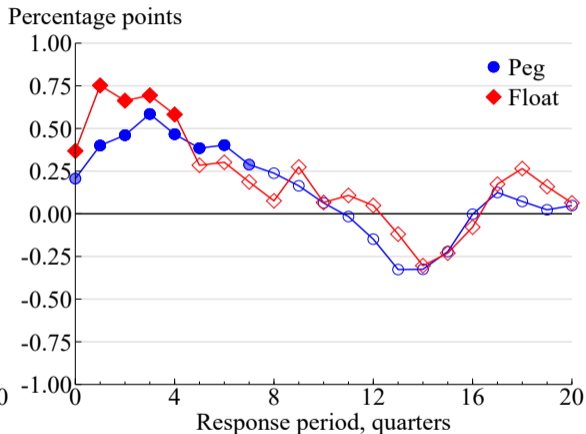
U.S. interest rates:
- – monetary shocks, identified using
    high-frequency methods
    (Gürkaynak, Sack & Swanson 2005;
    Gertler & Karadi 2015)
- – monetary policy shadow rates
    (Wu and Xia 2016)
- – Treasury yields

Responses to a 1 percentage point U.S. monetary tightening

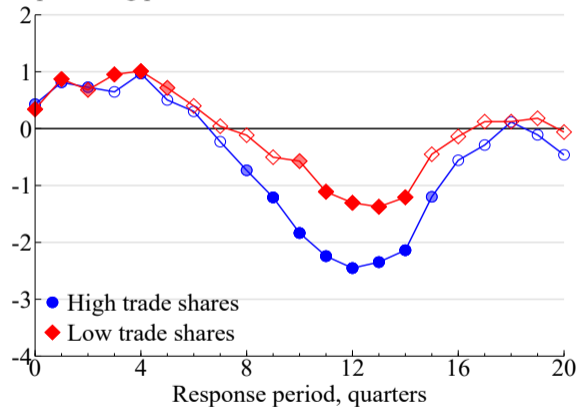**Foreign output per capita**
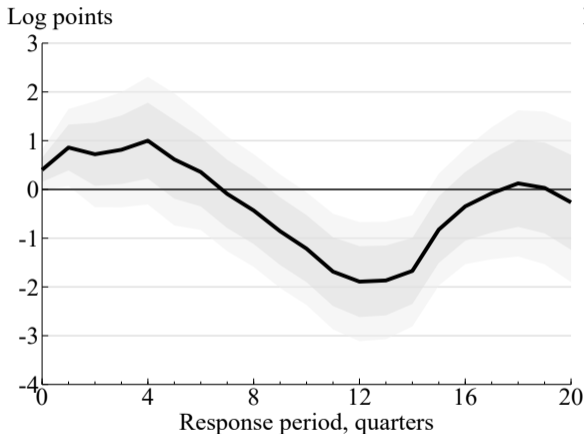
Foreign interest rates

Shaded areas indicate 90% and 68% confidence intervals.
Standard errors are two-way clustered at time and countries.
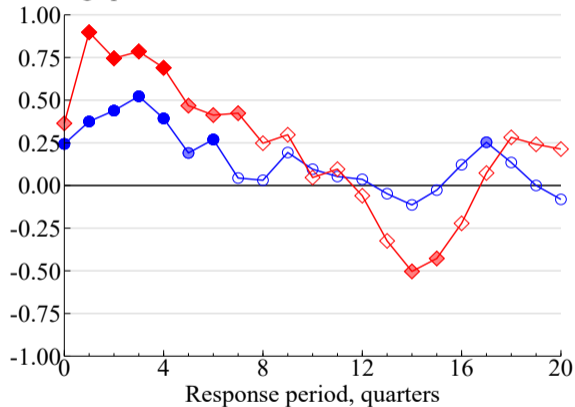
Responses by trade openness

Foreign output per capita
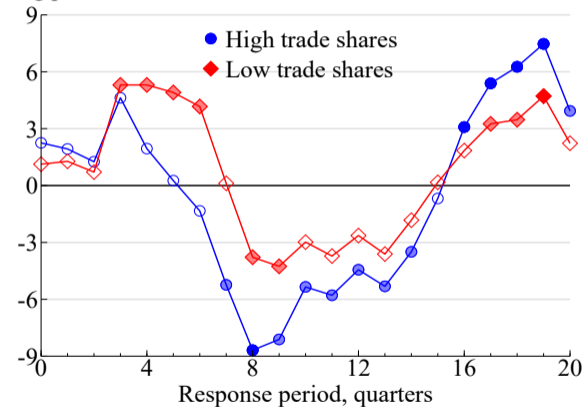
Foreign interest rates

The high (low) trade group is defined based on the total-trade share in GDP being above (below) the median.
The trade shares are fixed at their 1995 values.
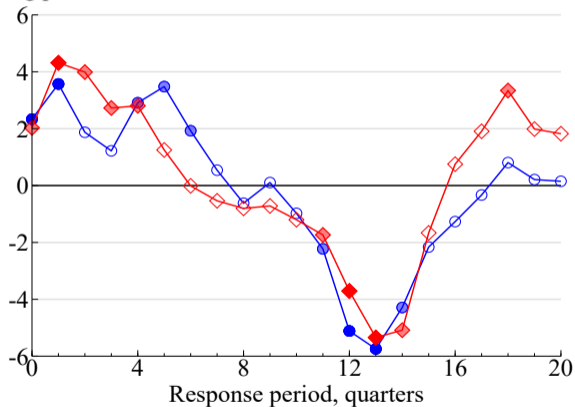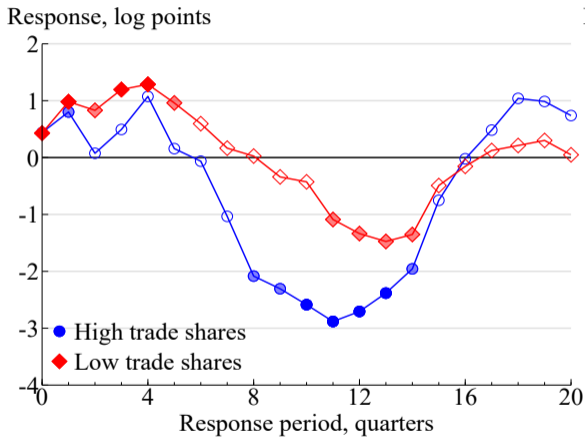
Transmission mechanism

USD / local currency unit

Real exports + imports per capita
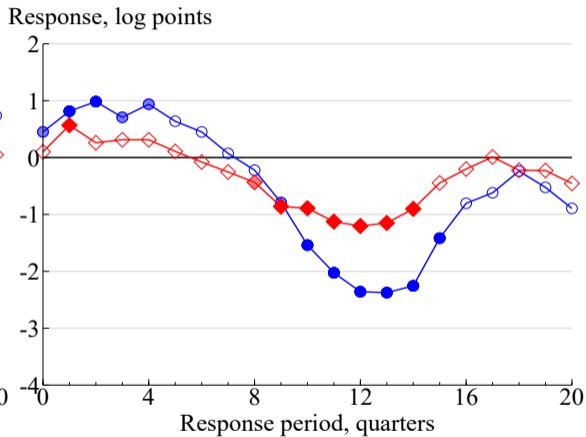
Responses by international investment positions (IIP)

Low IIP countries   **High IIP countries**
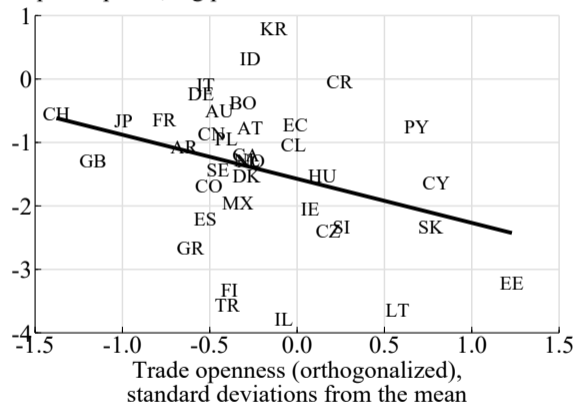
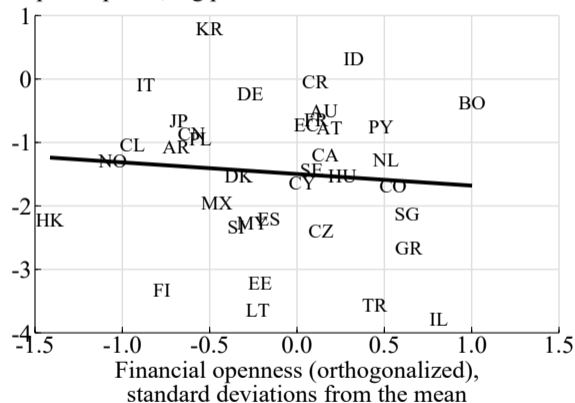# Trade openness versus financial openness

Output response, log points

Trade openness (orthogonalized),
standard deviations from the mean

Output response, log points

Financial openness (orthogonalized),
standard deviations from the mean

Estimating network spillovers

Specification:

$$\boldsymbol{y}_t = \boldsymbol{\beta}\, r_t + \rho\, \boldsymbol{W}\boldsymbol{y}_t + \text{Controls} + \text{Error}$$

Total effects:

$$\frac{\partial \boldsymbol{y}_t}{\partial r_t} = \underbrace{(\boldsymbol{I} - \rho\, \boldsymbol{W})^{-1}}_{\equiv \boldsymbol{J}} \times \boldsymbol{\beta}$$

Decomposition:

$$\frac{\partial \boldsymbol{y}_t}{\partial r_t}^{\text{direct}} = \text{diag}(\boldsymbol{J}) \times \boldsymbol{\beta}$$

$$\frac{\partial \boldsymbol{y}_t}{\partial r_t}^{\text{indirect}} = \big(\boldsymbol{J} - \text{diag}(\boldsymbol{J})\big) \times \boldsymbol{\beta}$$

Example (country 1 perspective)
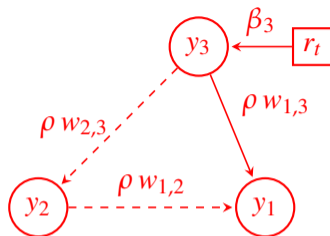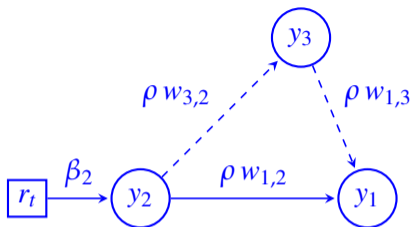
$$\frac{\partial y_{1,t}}{\partial r_t} = \overbrace{\beta_2 \times \left(\rho\, w_{1,2} + \rho^2\, w_{1,3} w_{3,2}\right) \times |\boldsymbol{J}|}^{\text{Indirect effect through } y_2} + \overbrace{\beta_3 \times \left(\rho\, w_{1,3} + \rho^2\, w_{1,2} w_{2,3}\right) \times |\boldsymbol{J}|}^{\text{Indirect effect through } y_3}$$

$$+ \underbrace{\beta_1 \times \left(1 - \rho^2\, w_{2,3} w_{3,2}\right) \times |\boldsymbol{J}|}_{\text{Direct effect}}$$

International trade network

The size and the shading of the nodes correspond to the degree of network centrality, measured by the average share of a country in the total trade for every other country (column average). Weights are based on total trade as a share in GDP in 1995. Thicker and darker arrows represent larger weights. Only weights larger than 5% are shown.

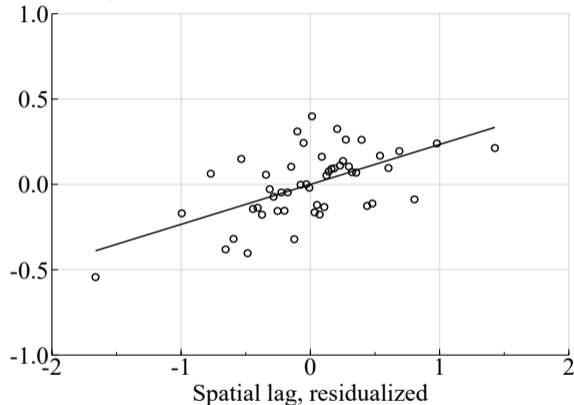# The international spatial correlation of output growth is strong.
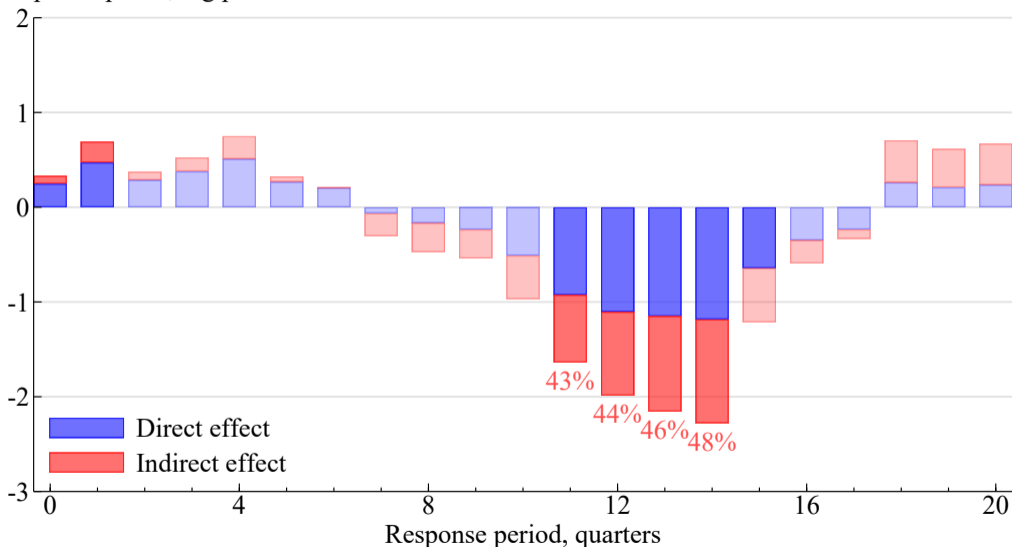
Raw
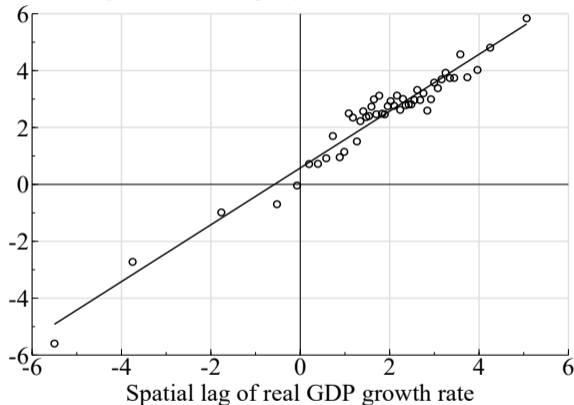
Residualized

The scatterplots comprise 50 bins.
All variables in the right panel are orthogonal to country, time fixed effects and four lags of GDP growth.
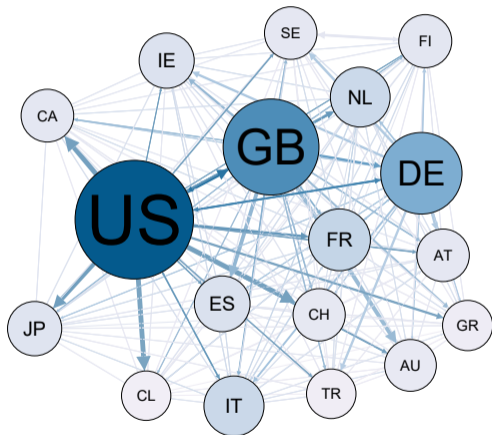
Estimates of the spatial Durbin model
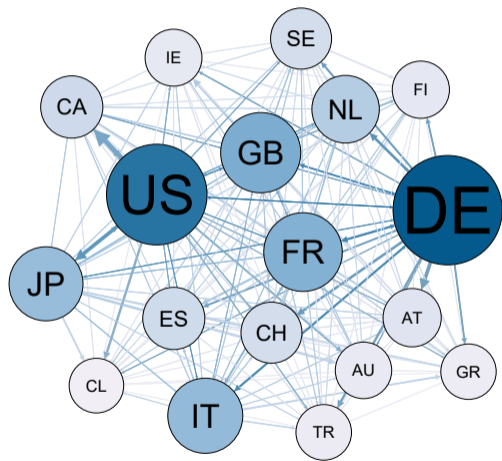
Output response, log points

The spatial correlation at the peak response horizon is 0.506 (standard error = 0.058).

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Comparison of trade and financial linkages

Financial network

Trade network (constant sample)

The linkages are for the constant sample of 18 countries.

Financial linkages appear to be weaker than trade linkages, and the indirect effects are small.

	11 quarters (1)	12 quarters (2)	13 quarters (3)	14 quarters (4)	15 quarters (5)
(a) Financial linkages					
Spatial lag, ρ	0.230 (0.190)	0.193 (0.176)	0.196 (0.179)	0.153 (0.195)	0.076 (0.197)
Indirect effect	−0.25 (0.28)	−0.23 (0.27)	−0.23 (0.29)	0.03 (0.15)	0.11 (0.29)
% of total	23.6	19.7	19.9	13.3	7.3
(b) Trade linkages (constant sample)					
Spatial lag, ρ	0.371* (0.205)	0.344 (0.228)	0.335** (0.170)	0.336** (0.143)	0.206* (0.119)
Indirect effect	−0.57 (0.43)	−0.60 (0.48)	−0.38 (0.34)	0.23 (0.30)	0.36 (0.25)
% of total	39.8	35.9	34.7	31.4	20.3

The data are quarterly and cover 18 countries from 2005 through 2017.

Final remarks

<u>Summary</u>:

– U.S. monetary shocks have sizeable effects on output abroad.

– These effects are larger in countries relatively more open to trade.

– Bilateral trade linkages serve as an important propagation channel.

– The network amplification is quantitatively strong.

<u>Implications</u>:

– International spillovers and trade linkages may have a role in the optimal policy design.

– Open economy models that do not account for network effects are likely incomplete.