Stock Market Spillovers via the Global Production Network: Transmission of U.S. Monetary Policy\textsuperscript{1}

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NBER Summer Institute (ITM)  
July 7, 2020

\textsuperscript{1}The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Banks of New York or San Francisco.
Recent era of globalization

- Rise of international integration of firms’ production chains (e.g., Hummels et al., 2001; Yi, 2003)

- Increased correlation of world stock markets (e.g., Dutt et al., 2013)

- Literature has focused on financial integration in propagation of shocks, particularly of U.S. monetary policy, across borders (e.g., global financial cycle; Rey, 2013)
Recent era of globalization

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What is role of real linkages in transmission of shocks across international financial markets?
Our question

What is the role of the global production network in transmitting U.S. monetary policy shocks across stock markets?

We answer it in four steps:

- Extend a simple network model to multi-country setting

- Construct a new country-sector database that merges
  - World Input-Output Database (WIOD)
  - Firm-level stock market data (TREI)

  for 54 sectors and 26 countries for 2000–16

- Document relationship between country-sector distance in production network and stock return correlations

- Estimate panel spatial autoregression of U.S. monetary policy (MP) shocks effect on stock prices via the global production network
Main results

1. Returns of country-sector cells that are “closer” in the global input-output network are more correlated

2. Global product network accounts for at least 60% of the total impact of U.S. MP shocks on stock returns via demand (upstream) channel
   - Baseline analysis 2000–07, but robust to other time periods

3. *Direct* impact greater for U.S. sectors, while *network* impact greater for foreign markets

4. Results robust to controlling for global financial cycle variables, which tend to impact returns more directly
Story in a nutshell

U.S. monetary policy shock

U.S. stock returns

Foreign stock returns
Related literature

- Transmission of shocks through production linkages
  - **International:** Burstein et al. (2008), Bems et al. (2010), Johnson (2014), Eaton et al. (2016), di Giovanni et al. (2018), Baqee and Farhi (2019b), Huo et al. (2020)
  - **Domestic:** Foerster et al. (2011), Acemoglu et al. (2012), Carvalho et al. (2016), Atalay (2017), Grassi (2017), Ozdagli and Weber (2017), Boehm et al. (2019), Baqee and Farhi (2019a)

- International transmission of U.S. monetary policy shocks
  - **Effect on asset prices:** Many papers starting with Rey (2013), Miranda-Argippino and Rey (2020)
  - **Through banking:** Cetorelli and Goldberg (2012), Bruno and Shin (2015b), Avdjiev et al. (2018), Temesvary et al. (2018), Buch et al. (2019), Morais et al. (2019)
  - **Effect on capital flows:** Bruno and Shin (2015a), Avdjiev and Hale (2019)
  - **Through trade:** Brooks and Del Negro (2006), Todorova (2018), Du et al. (2019)
Theoretical framework: main ingredients


- Firms: decreasing returns to scale, fixed costs
- Wages: preset, do not adjust to monetary shocks
- Consumers: cash-in-advance constraint
- Exogenous money supply

Open economy:

- Multi-country, multi-sector model of production linkages: countries \( m, n \); industries \( i, j \)
- Balanced trade for each country
- LOOP after adjusting for an iceberg trade cost:

\[
p_{mi,n} = \tau_{mi,n} p_{mi}, \quad \tau_{mi,n} \geq 1
\]
Theoretical framework: solution

- Goods market clearing:

\[ y_{mi} = \sum_{n=1}^{N} c_{mi,n} + \sum_{j=1}^{J} \sum_{n=1}^{N} x_{mi,nj} \]

- Iceberg trade costs: \( p_{mi,n} = \tau_{mi,n} p_{mi}, \tau_{mi,n} \geq 1 \)
Theoretical framework: solution

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- Iceberg trade costs: \( p_{mi,n} = \tau_{mi,n} p_{mi}, \tau_{mi,n} \geq 1 \)

- Combining with FOCs, we get a recursive solution across country-sectors:
  \[ R_{mi} = \sum_{j=1}^{J} \sum_{n=1}^{N} b_{mi,n} \frac{1 - \lambda_{nj}}{\tau_{mi,n}} R_{nj} + \sum_{j=1}^{J} \sum_{n=1}^{N} \frac{\lambda_{nj} \omega_{mi,nj}}{\tau_{mi,n}} R_{nj} \]
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- Goods market clearing:
  \[ y_{mi} = \sum_{n=1}^{N} c_{mi,n} + \sum_{j=1}^{J} \sum_{n=1}^{N} x_{mi,nj} \]

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  \[ R_{mi} = \sum_{j=1}^{J} \sum_{n=1}^{N} \frac{b_{mi,n}(1 - \lambda_{nj})}{\tau_{mi,n}} R_{nj} + \sum_{j=1}^{J} \sum_{n=1}^{N} \frac{\lambda_{nj} \omega_{mi,nj}}{\tau_{mi,n}} R_{nj} \]

- Stacking across \( nj \) and express in matrix form:
  \[ (I - \tilde{\Omega}\Lambda)R = \sum_{j=1}^{J} \sum_{n=1}^{N} \frac{b_{mi,n}(1 - \lambda_{nj})}{\tau_{mi,n}} R_{nj} \]
  (1)
Money supply

- Cash-in-advance constraint:

\[ \sum_{i=1}^{J} \sum_{m=1}^{N} p_{mi,n} c_{mi,n} = \sum_{j=1}^{J} (1 - \lambda_{nj}) R_{nj} = \mathcal{M}_n, \]

where \( \mathcal{M}_n \) is domestic money supply in country \( n \)

- Combining with (1):

\[ (I - \tilde{\Omega} \Lambda) R = \tilde{b} \mathcal{M} \]
Money supply

- Cash-in-advance constraint:

\[ \sum_{i=1}^{J} \sum_{m=1}^{N} p_{mi,n} c_{mi,n} = \sum_{j=1}^{J} (1 - \lambda_{nj}) R_{nj} = \mathcal{M}_n, \]

where \( \mathcal{M}_n \) is domestic money supply in country \( n \)

- Combining with (1):

\[(I - \tilde{\Omega}\Lambda)R = \tilde{b}\mathcal{M} \]

- Substituting into profit equation, and log-linearizing around steady state:

\[ \hat{\pi} = \left( I - \tilde{\Omega}\Lambda \right)^{-1} \beta \hat{\mathcal{M}}, \]

or, specifically for the U.S. monetary policy shock:

\[ \hat{\pi} = \left( I - \tilde{\Omega}\Lambda \right)^{-1} \beta_{US} \hat{\mathcal{M}}_{US}, \quad (2) \]
Heterogeneous panel SAR model

Expressing (2) in spatial autoregressive (SAR) form:

$$\hat{\pi}_t = \beta \hat{M}_{US,t} + \rho W \hat{\pi}_t + \varepsilon_t,$$

where $W = \tilde{\Omega} \Lambda$ is standard input-output coefficient, adjusted for bilateral trade costs

Or with controls:

$$\hat{\pi}_t = \beta_1 \hat{M}_{US,t} + \beta_2 X_t + \rho W \hat{\pi}_t + \varepsilon_t$$

We allow for heterogeneity in $\beta$’s as well as “resistance” coefficient $\rho$ across country-sectors

Estimated using MLE following Aquaro, Bailey, Pesaran (2019), and use wild bootstrap for standard errors (Mammen, 1993)
Decomposition into direct and network effects

- The total impact of U.S. MP shock is
  \[ \text{Total} = (I - \rho W)^{-1} \beta \]

- Following Lesage and Pace (2009) this marginal effect for each \( m_i \) can be decomposed into a direct effect of the shock and the network effect as
  \[ \text{Direct} = \text{diag}(I - \rho W)^{-1} \beta \]
  \[ \text{Network} = \text{Total} - \text{Direct} \]
Data

- **Input-output**: WIOD
  - Input-output linkages for 43 countries 56 sectors for 1996-2014 ⇒ We use 26 countries and 54 industries

- **Matrix W**: 
  \[ w_{mi,nj} = \frac{Sales_{mi \rightarrow nj}}{Sales_{nj}} \]

- Trade costs computed using Head-Reis (2001) index at \((mi, n)\) level

- **Stock returns**: Thompson-Reuters Eikon (TREI)
  - Firm-level stock prices and market capitalization, 2000–16
  - Use NAICS information in Eikon to crosswalk to WIOD industries
    ⇒ **Monthly** market-cap weighted stock indexes and returns

- **Shocks**:
  - Monetary: Jarociński-Karadi (2020); [BRW, NS, OW]
  - Global financial cycle: VIX, 2yr Treas. rate, USD Broad Index
Weighted outdegree of input-output network

(a) World linkages
(b) International linkages

Source: WIOD, authors calculations; \( out_{mi} = \sum_{n=1}^{N} \sum_{j=1}^{J} w_{mi,nj} \).
Network distance and bilateral returns correlations

(a) World linkages

(b) International linkages

Source: WIOD, TREI, authors calculations.

A binary network \( (w_{mi,nj} < 0.05 \text{ set to 0, else 1}) \), where distance between two cells is defined as the length of the shortest path.
## Benchmark panel SAR

- **2000-2007**
- **JK monetary policy shock**

\[
\hat{\pi}_{mi,t} = \beta \hat{M}_{US,t} + \rho W \hat{\pi}_t + \varepsilon_{mi,t}
\]

<table>
<thead>
<tr>
<th></th>
<th>Avg. $\beta$ (1)</th>
<th>Avg. $\rho$ (2)</th>
<th>Avg. <strong>Direct</strong> (3)</th>
<th>Avg. <strong>Network</strong> (4)</th>
<th>Network/Total (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full sample</strong></td>
<td>-0.027*</td>
<td>0.675***</td>
<td>-0.035**</td>
<td>-0.053***</td>
<td>60%***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.157)</td>
<td>(0.020)</td>
<td>(0.012)</td>
<td>(0.164)</td>
</tr>
<tr>
<td><strong>International</strong></td>
<td>-0.023</td>
<td>0.681***</td>
<td>-0.031*</td>
<td>-0.052***</td>
<td>62%***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.158)</td>
<td>(0.019)</td>
<td>(0.020)</td>
<td>(0.045)</td>
</tr>
<tr>
<td><strong>USA</strong></td>
<td>-0.080***</td>
<td>0.600***</td>
<td>-0.087***</td>
<td>-0.065**</td>
<td>42%***</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.154)</td>
<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.008)</td>
</tr>
</tbody>
</table>

**OLS results**

**Distributions of direct and network effects**

**Time periods**

**Definitions**

**No trade costs**
**Panel SAR with global financial cycle variables**

\[
\hat{\pi}_{mi,t} = \beta_{MP} \hat{\mathcal{M}}_{US,t} + \beta_X X_t + \rho W \hat{\pi}_t + \varepsilon_{mi,t}
\]

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th></th>
<th>International</th>
<th></th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Direct effect of MP</td>
<td>-0.014</td>
<td>-0.035**</td>
<td>-0.029</td>
<td>-0.020**</td>
<td>-0.014</td>
</tr>
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<td></td>
<td>(0.010)</td>
<td>(0.017)</td>
<td>(0.023)</td>
<td>(0.011)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Network effect of MP</td>
<td>-0.036***</td>
<td>-0.068***</td>
<td>-0.064***</td>
<td>-0.045***</td>
<td>-0.045***</td>
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<td></td>
<td>(0.013)</td>
<td>(0.019)</td>
<td>(0.015)</td>
<td>(0.018)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Direct effect of VIX</td>
<td>-0.063***</td>
<td>-0.058***</td>
<td>-0.058***</td>
<td>-0.051***</td>
<td>-0.051***</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.018)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>Network effect of VIX</td>
<td>-0.079***</td>
<td>-0.068***</td>
<td>-0.068***</td>
<td>-0.063***</td>
<td>-0.063***</td>
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<tr>
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<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.016)</td>
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</tr>
<tr>
<td>Direct effect of T2y</td>
<td>0.060**</td>
<td>0.042***</td>
<td>0.041***</td>
<td>0.051***</td>
<td>0.051***</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.014)</td>
<td>(0.013)</td>
<td>(0.016)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>Network effect of T2y</td>
<td>0.077***</td>
<td>0.045***</td>
<td>0.045***</td>
<td>0.048***</td>
<td>0.048***</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.013)</td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Direct effect of USD</td>
<td>-0.150**</td>
<td>-0.101**</td>
<td>-0.091**</td>
<td>-0.212***</td>
<td>-0.212***</td>
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<tr>
<td></td>
<td>(0.082)</td>
<td>(0.050)</td>
<td>(0.051)</td>
<td>(0.079)</td>
<td>(0.079)</td>
</tr>
<tr>
<td>Network effect of USD</td>
<td>-0.343***</td>
<td>-0.155*</td>
<td>-0.155*</td>
<td>-0.156*</td>
<td>-0.156*</td>
</tr>
<tr>
<td></td>
<td>(0.088)</td>
<td>(0.106)</td>
<td>(0.106)</td>
<td>(0.118)</td>
<td>(0.118)</td>
</tr>
</tbody>
</table>

*Least-squares estimates*
Heterogeneity across countries and sectors

- Neither direct nor network effects correlated with country characteristics, such as country size, financial openness, current account....
Sectoral external financial dependence

- The magnitude of network effect is smaller (in absolute value) for sectors that are more reliant on external finance.

- No trade costs
Conclusion

- We quantify propagation of the U.S. monetary policy shocks to stock returns worldwide and find an important role for the global production network, via upstream demand channel.

- Production network plays a greater role for transmission across countries than within the U.S.

- Results robust to numerous specifications, including global financial cycle variables.

- Simple setup that can be extended in numerous ways, including incorporating exchange rate effects (both upstream and downstream).
Consumers

- Representative agent in country $n$ consumes goods from all industries $i$ in all countries $m$ and supplies labor to all industries $j$ in her country.

\[
\max_{\{c_{mi,n}\}, l_n} \sum_{i=1}^{J} \sum_{m=1}^{N} b_{mi,n} \log c_{mi,n} - l_n
\]

s.t.

\[
\sum_{i=1}^{J} \sum_{m=1}^{N} p_{mi,n} c_{mi,n} = w_n l_n + \pi_n + f_n,
\]

where $b_{mi,n}$ is a preference parameter for which we assume

\[
\sum_{i=1}^{J} \sum_{m=1}^{N} b_{mi,n} = 1
\]
Cobb-Douglas production function of industry $j$ in country $n$:

$$y_{nj} = z_{nj}^{\alpha_{nj}} \prod_{i=1}^{J} \prod_{m=1}^{N} x_{mi,nj}^{\omega_{mi,nj}}; \quad \alpha_{nj} + \lambda_{nj} < 1, \quad z_{nj} = 1 \forall nj$$

$$X_{nj} = \prod_{i=1}^{J} \prod_{m=1}^{N} x_{mi,nj}^{\omega_{mi,nj}}; \quad \sum_{i=1}^{J} \sum_{m=1}^{N} \omega_{mi,nj} = 1,$$

where $\omega_{mn,ij}$ is $nj$ usage of product of $mi$ (viz. total intermediates)

Firms maximize profit paying wage bill and a fixed costs, $f_{nj}$:

$$\pi_{nj} = (1 - \lambda_{nj} - \alpha_{nj}) R_{nj} - f_{nj},$$

where $R_{nj} = p_{nj} y_{nj}$
Matrices

\[ R \equiv (R_{11}, \ldots, R_{NJ})', \quad NJ \times 1, \]

\[ \Lambda \equiv \text{diag} \left( \{\lambda_{nj}\} \right), \quad NJ \times NJ, \]

\[ \tilde{\Omega} \equiv \tilde{\tau} \circ \Omega, \quad NJ \times NJ, \]

\[ \begin{pmatrix}
\omega_{11,11} & \cdots & \omega_{11,NJ} \\
\vdots & \ddots & \vdots \\
\omega_{NJ,11} & \cdots & \omega_{NJ,NJ}
\end{pmatrix}, \quad NJ \times NJ, \]

\[ \begin{pmatrix}
\left( \frac{1}{\tau_{11,1}} \right) \circ 1_{1 \times J} & \cdots & \left( \frac{1}{\tau_{11,N}} \right) \circ 1_{1 \times J} \\
\vdots & \ddots & \vdots \\
\left( \frac{1}{\tau_{NJ,1}} \right) \circ 1_{1 \times J} & \cdots & \left( \frac{1}{\tau_{NJ,N}} \right) \circ 1_{1 \times J}
\end{pmatrix}, \quad NJ \times NJ, \]
### Benchmark linear regressions

\[
\hat{\pi}_{mi,t} = \alpha + \beta^{LS} \hat{M}_{US,t} + \varepsilon_{mi,t}
\]

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP shock</td>
<td>-0.102***</td>
<td>-0.102**</td>
<td>-0.103**</td>
<td>-0.083***</td>
<td>-0.098***</td>
<td>-0.136***</td>
</tr>
<tr>
<td>(\beta^{LS})</td>
<td>(0.008)</td>
<td>(0.044)</td>
<td>(0.044)</td>
<td>(0.011)</td>
<td>(0.009)</td>
<td>(0.049)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.010***</td>
<td>0.010**</td>
<td>0.010*</td>
<td>0.010***</td>
<td>0.010***</td>
<td>0.010*</td>
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<td>(0.000)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.005)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimator</th>
<th>OLS</th>
<th>OLS</th>
<th>LS</th>
<th>Random coeffs</th>
<th>Mean Group (mi)</th>
<th>LS - country (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed effects</td>
<td>None</td>
<td>None</td>
<td>(mi)</td>
<td>Random</td>
<td>Group-specific</td>
<td>Clustered on (t)</td>
</tr>
<tr>
<td>St. errors</td>
<td>Regular</td>
<td>Clustered on (t)</td>
<td>Conventional</td>
<td>Group-specific</td>
<td>Clusted on (t)</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** There are 49,667 observations in columns (1)-(5), and 1,716 observations in column (6). Standard errors are in parentheses with *, **, and *** denoting coefficients significantly different from zero at the 1, 5 and 10% levels, respectively.

- **International** \(\beta^{LS}\): -0.134 (3); -0.092 (5); -0.134 (6)
- **U.S.** \(\beta^{LS}\): -0.171 (3); -0.179 (5); -0.173 (6)
Distributions of decompositions across country-sectors

(a) Direct, $\tau = 1$
(b) Network, $\tau = 1$
## Robustness of panel SAR

<table>
<thead>
<tr>
<th>Time period</th>
<th>Observations</th>
<th>Year for W</th>
<th>Share of network effect</th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Full sample</td>
<td>International</td>
<td>USA</td>
</tr>
<tr>
<td>2000–07</td>
<td>44,286</td>
<td>Average 2000–07</td>
<td>59%</td>
<td>62%</td>
<td>40%</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(0.141)</td>
<td>(0.013)</td>
<td>(0.007)</td>
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</tr>
<tr>
<td>2000–16</td>
<td>92,598</td>
<td>2000</td>
<td>74%</td>
<td>80%</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.349)</td>
<td>(0.240)</td>
<td>(0.124)</td>
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</tr>
<tr>
<td>2000–16</td>
<td>92,598</td>
<td>Average 2000–14</td>
<td>77%</td>
<td>84%</td>
<td>43%</td>
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<tr>
<td></td>
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<td></td>
<td>(0.364)</td>
<td>(0.202)</td>
<td>(0.106)</td>
<td></td>
</tr>
<tr>
<td>2000–07,09–16</td>
<td>87,230</td>
<td>2000</td>
<td>65%</td>
<td>68%</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td>(0.181)</td>
<td>(0.101)</td>
<td>(0.108)</td>
<td></td>
</tr>
<tr>
<td>2000–07,09–16</td>
<td>87,230</td>
<td>Average 2000–14</td>
<td>63%</td>
<td>66%</td>
<td>42%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.172)</td>
<td>(0.099)</td>
<td>(0.087)</td>
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</tbody>
</table>
### Other definitions of MP shock

\[ \hat{\pi}_{mi,t} = \beta \hat{M}_{US,t} + \rho W \hat{\pi}_t + \varepsilon_{mi,t} \]

<table>
<thead>
<tr>
<th>Specification</th>
<th>Share of network effect</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Full sample</td>
</tr>
<tr>
<td>Real returns, JK shock</td>
<td>66%</td>
</tr>
<tr>
<td></td>
<td>(0.156)</td>
</tr>
<tr>
<td>Nominal returns, BRW shock</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>(0.247)</td>
</tr>
<tr>
<td>Nominal returns, OW shock</td>
<td>57%</td>
</tr>
<tr>
<td></td>
<td>(0.138)</td>
</tr>
<tr>
<td>Nominal returns, NS shock</td>
<td>59%</td>
</tr>
<tr>
<td></td>
<td>(0.188)</td>
</tr>
</tbody>
</table>
Baseline SAR without trade costs

\[ \hat{\pi}_{mi,t} = \beta \hat{M}_{US,t} + \rho W \hat{\pi}_t + \epsilon_{mi,t} \]

<table>
<thead>
<tr>
<th></th>
<th>Avg. $\beta$</th>
<th>Avg. $\rho$</th>
<th>Avg. Direct</th>
<th>Avg. Network</th>
<th>Network/Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full sample</td>
<td>-0.019</td>
<td>0.748***</td>
<td>-0.026*</td>
<td>-0.093***</td>
<td>78%***</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.179)</td>
<td>(0.020)</td>
<td>(0.018)</td>
<td>(0.197)</td>
</tr>
<tr>
<td>International</td>
<td>-0.016</td>
<td>0.746***</td>
<td>-0.023</td>
<td>-0.091***</td>
<td>80%***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.179)</td>
<td>(0.019)</td>
<td>(0.020)</td>
<td>(0.084)</td>
</tr>
<tr>
<td>USA</td>
<td>-0.056*</td>
<td>0.768***</td>
<td>-0.066**</td>
<td>-0.122***</td>
<td>65%***</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.212)</td>
<td>(0.033)</td>
<td>(0.035)</td>
<td>(0.047)</td>
</tr>
</tbody>
</table>
Least-squares with global financial cycle variables

\[ \hat{\pi}_{mi,t} = \beta_{MP}^{LS} \hat{M}_{US,t} + \beta_{X}^{LS} X_t + \varepsilon_{mi,t} \]

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>International</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>MP shock</td>
<td>-0.061</td>
<td>-0.117**</td>
<td>-0.107**</td>
</tr>
<tr>
<td></td>
<td>(0.046)</td>
<td>(0.046)</td>
<td>(0.044)</td>
</tr>
<tr>
<td>VIX</td>
<td>-0.162***</td>
<td>-0.146***</td>
<td>-0.148***</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td></td>
<td>(0.036)</td>
</tr>
<tr>
<td>T2y</td>
<td>0.146*</td>
<td>0.091*</td>
<td>0.090*</td>
</tr>
<tr>
<td></td>
<td>(0.077)</td>
<td>(0.047)</td>
<td>(0.049)</td>
</tr>
<tr>
<td>USD</td>
<td>-0.546</td>
<td>-0.338</td>
<td>-0.332</td>
</tr>
<tr>
<td></td>
<td>(0.363)</td>
<td>(0.290)</td>
<td>(0.297)</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.060</td>
<td>0.030</td>
<td>0.02</td>
</tr>
<tr>
<td>Observations</td>
<td>49,667</td>
<td>46,357</td>
<td>3,310</td>
</tr>
</tbody>
</table>

Panel SAR estimates
Sectoral external financial dependence: no trade costs

Average network effect for each bin:

- Bins of financial dependence index:
  - -1.5
  - -1
  - -0.5
  - 0
  - 0.5
  - 1

Graph shows the average network effect for each bin in the financial dependence index.