Global Supply Chains in the Pandemic

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Cross-Border Supply Chains Transmit Shocks

- Covid-19 led to lockdowns of varying intensity across the world

- Most of the world interconnected by cross-border supply chains

- Questions:

  1. What is the GDP impact of transmission through supply chains of the pandemic shock?

  2. Should supply chains be "renationalized"?

What We Do

① Build a quantitative model with trade and production

- ○ 64 countries, 33 sectors, 23 occupations, based on Huo, Levchenko, Pandalai-Nayar (2020)

- ○ analytical influence vector to calculate impact of shocks

- ○ accounting decomposition: impact of domestic shocks vs transmission, PE vs GE effects

② Evaluate role of global supply chains in response to "Pandemic" (labor supply) shock

- ○ shock calibration: shares of sectors that can work from home, country lockdown stringency

- ○ counterfactual: what would happen if "pandemic" shock occurred in autarky?

Main Findings

1. GDP impacts large and heterogeneous: avg $\approx -30\%$

2. Role of production network: avg one-quarter of decline due to transmission

3. Renationalization of supply chains: average GDP decline similar
   - reducing reliance on foreign supply chains increases reliance on domestic supply chains
   - whether or not renationalization helps depends on relative intensity of home lockdown
   - renationalizing individual sectors makes little difference

Production

- $N = 64$ countries, $J = 33$ sectors, $\mathcal{O} = 23$ occupations

- Sectoral production with fixed capital

$$Y_{nj} = Z_{nj} \left(K_{nj}^{\alpha_j} H_{nj}^{1-\alpha_j} \right)^{\eta_j} X_{nj}^{1-\eta_j}$$

- Armington international goods trade in inputs

$$X_{nj} = \left(\sum_{m=1}^{N} \sum_{i=1}^{J} \mu_{mi,nj}^{\frac{1}{\varepsilon}} X_{mi,nj}^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

- Composite labor aggregates inputs across occupations

$$H_{nj} = \left(\sum_{\ell=1}^{\mathcal{O}} \varkappa_{nj\ell}^{\frac{1}{\kappa}} L_{nj\ell}^{\frac{\kappa-1}{\kappa}} \right)^{\frac{\kappa}{\kappa-1}}$$

Household

- Representative household with workers specialize in different occupations

$$\max_{\mathcal{F}_n, \{L_{n\ell}\}} \mathcal{F}_n - \sum_{\ell=1}^{\mathcal{O}} \frac{1}{1 + \frac{1}{\psi}} \left(\frac{L_{n\ell}}{\xi_{n\ell}} \right)^{1 + \frac{1}{\psi}}$$

$$\text{s.t.} \qquad P_n \mathcal{F}_n = \sum_{\ell=1}^{\mathcal{O}} W_{n\ell} L_{n\ell} + \sum_{j=1}^{J} R_{nj} K_{nj}$$

  - country-occupation specific labor supply shock $\xi_{n\ell}$

- Two-level CES demand: more substitutable within group, $\rho \ll \gamma$

$$\mathcal{F}_n = \left[\sum_q \zeta_{nq}^{\frac{1}{\rho}} D_{nq}^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}, \qquad D_{nq} = \left[\sum_{j \in \mathcal{G}_q, m} \vartheta_{mnj}^{\frac{1}{\gamma}} D_{mnj}^{\frac{\gamma-1}{\gamma}} \right]^{\frac{\gamma}{\gamma-1}}$$

GDP Accounting and Model Solution

- GDP changes in country n are related to labor composite changes

$$\ln V_n = \sum_{j=1}^{J} \omega_{nj} \, (1 - \alpha_j)\eta_j \, \ln H_{nj}$$

  ○ $\omega_{nj} \equiv \frac{P_{nj}Y_{nj}}{V_n}$: pre-shock Domar weights

- Analytical solution for $\ln \mathbf{H}$:

$$\ln \mathbf{H} = \underbrace{(\mathbf{I} - \boldsymbol{\mathcal{G}})^{-1}}_{\text{global IO-GE}} \underbrace{\boldsymbol{\Pi}^{\mathcal{O}} \boldsymbol{\Delta}^{-1}}_{\text{labor market}} \ln \boldsymbol{\xi}$$

Domestic Influence v.s. Foreign Transmission

- Together with the expression for labor changes, GDP changes in country n is

$$\ln V_n = \sum_{j=1}^{J} \omega_{nj} (1-\alpha_j)\eta_j \ln H_{nj} = \underbrace{\sum_{\ell} s_{nn\ell} \ln \xi_{n\ell}}_{\mathcal{D}_n} + \underbrace{\sum_{m \neq n} \sum_{\ell} s_{mn\ell} \ln \xi_{m\ell}}_{\mathcal{T}_n}$$

  ○ $\mathcal{D}_n$: domestic influence, response to domestic shocks

  ○ $\mathcal{T}_n$: foreign transmission, response to foreign shocks

Trade vs Renationalization

- Without trade, no response to foreign shocks, but respond to domestic shocks differently:

$$\ln V_n^R = \sum_\ell s_{nn\ell}^R \xi_{n\ell}$$

- Difference in GDP change:

$$\ln V_n - \ln V_n^R = \underbrace{\sum_\ell \left(s_{nn\ell} - s_{nn\ell}^R\right) \ln \xi_{n\ell}}_{\text{Change in Domestic Influence}} + \quad \mathcal{T}_n$$

- A further look at the changes in domestic influence

$$\mathcal{D}_n - \mathcal{D}_n^R = \sum_{j=1}^J (1-\alpha_j)\eta_j \left[\underbrace{\left(\omega_{nj} - \omega_{nj}^R\right) \sum_\ell \mathbf{D}_{n\ell,nj} \ln \xi_{n\ell}}_{\text{PE}} + \underbrace{\sum_\ell \left(\omega_{nj} \mathbf{\Gamma}_{n\ell,nj} - \omega_{nj}^R \mathbf{\Gamma}_{n\ell,nj}^R\right) \ln \xi_{n\ell}}_{\text{Domestic GE}} \right]$$

Data

- Labor shock:

$$\ln \xi_{n\ell} = - \left(1 - \texttt{work from home}_\ell\right) \times f\left(\texttt{GRT}_n\right)$$

  - work from home shares: Dingel and Neiman (2020)
  - $\texttt{GRT}_n$: Oxford Blavatnik School of Government Coronavirus Government Response Tracker
  - Rank-preserving transformation to match average Δ Industrial Production

- Sectoral occupation composition: BLS-based for all countries

- Other data:
  - OECD Inter-Country Input-Output Tables for 2015 (64 countries, 33 sectors, 3 groups)
  - KLEMS, OECD-STAN (sectoral labor shares)
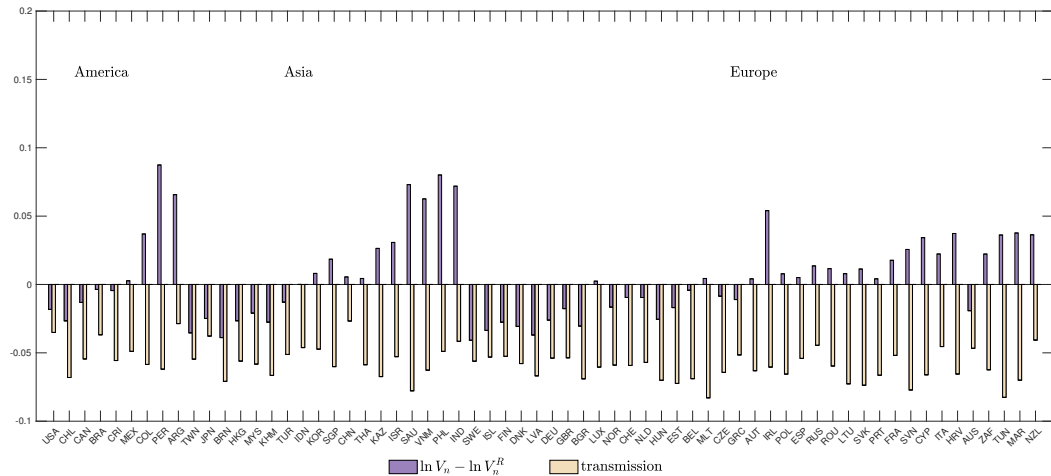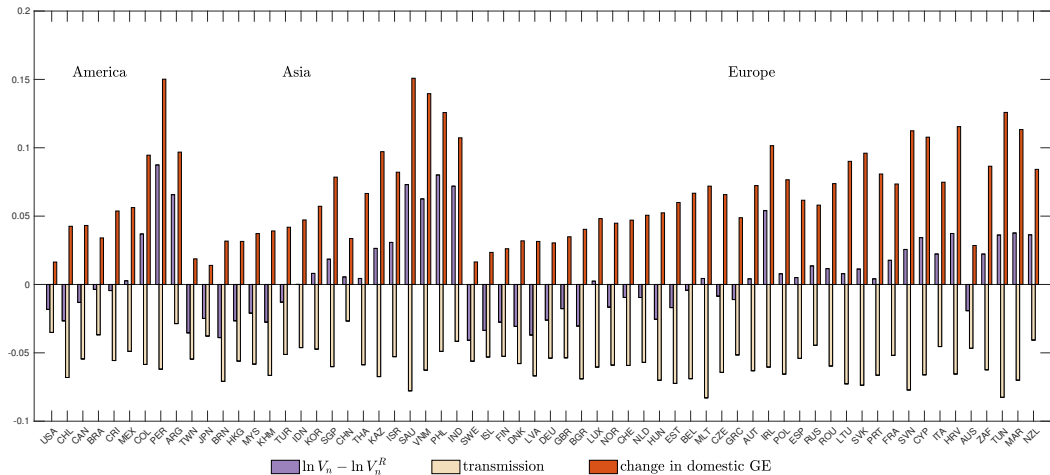
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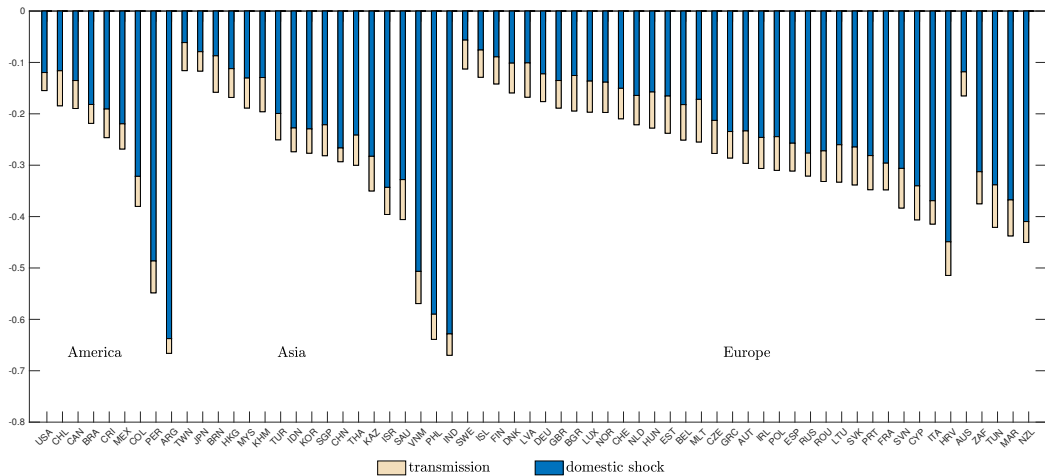
GDP Responses

Renationalization

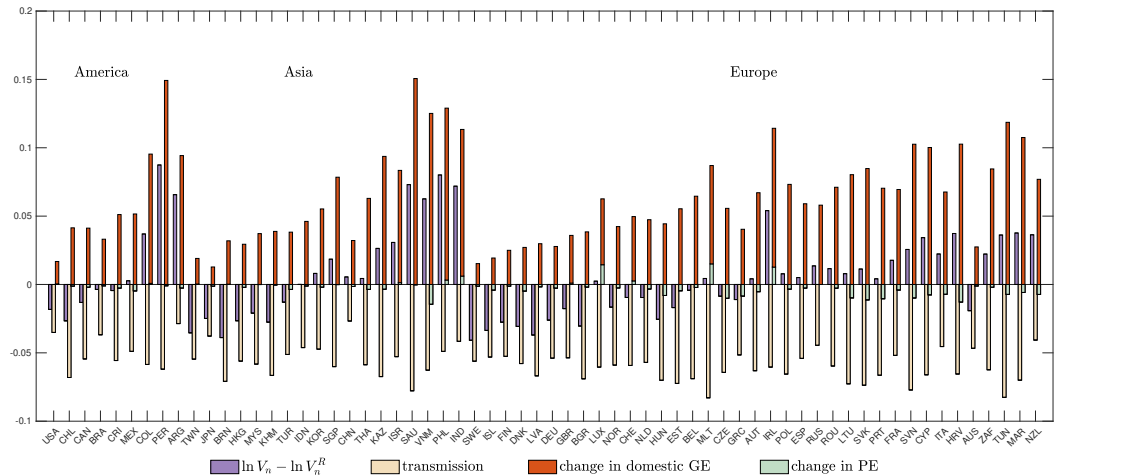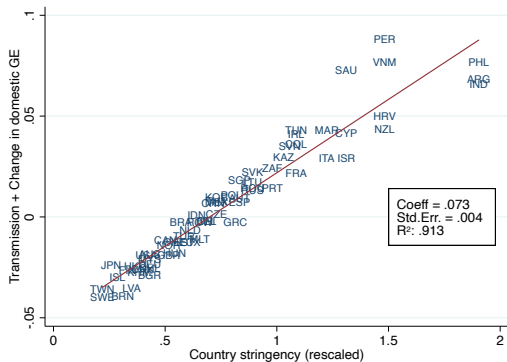$\square$ $\ln V_n - \ln V_n^R$
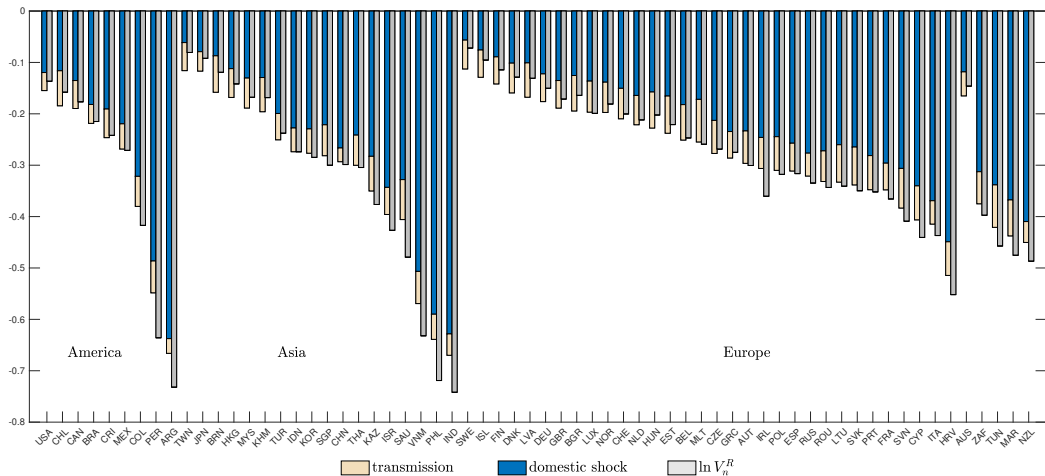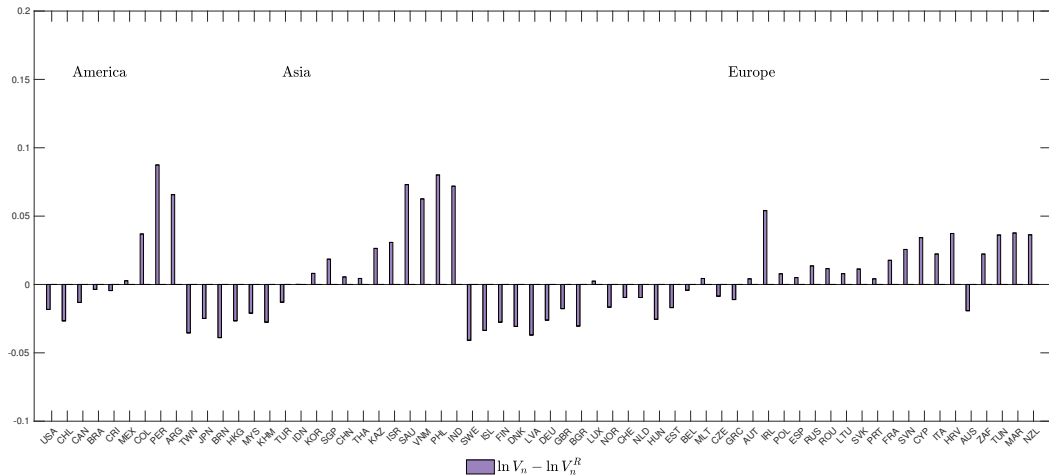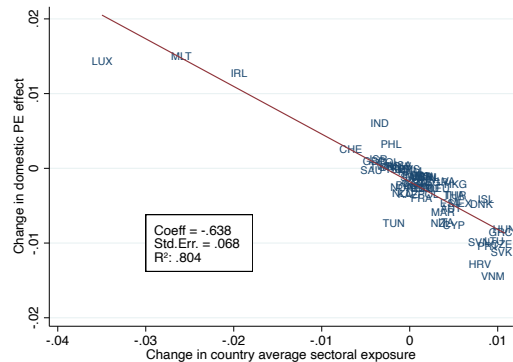
Renationalization

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What Factor Explains Whether Renationalization is Beneficial?

Transmission and change in domestic GE ($\mathcal{T}_n$+GE)

Change in domestic PE

Conclusion

- Renationalization will not make economies more resilient to future pandemic shocks

  - Some insulation only in countries that impose looser lockdowns, and vice versa.