COVID-19 was an unprecedented shock characterized by:

- Extreme sectoral heterogeneity.
- Inequality in fiscal space across countries.
  - Fiscal transfers were largest in Advanced Economies (AEs).
  - Early narrative was that US stimulus would spill over to Emerging Economies (EMs).
Fiscal Spending (% of GDP)

(a) Advanced Economies

(b) Emerging Markets

Source: IMF Fiscal Policy Tracker
COVID-19 was an unprecedented shock characterized by:

- Extreme sectoral heterogeneity.
- Inequality in fiscal space across countries.
  - Fiscal transfers were largest in Advanced Economies (AEs).
  - Early narrative was that US stimulus would spill over to Emerging Economies (EMs).

This paper tackles two questions:

- Did fiscal stimulus help support aggregate activity?
- How big are cross-border spillovers?
Recent literature looks at the role of I-O networks in:

- Complementarities in demand/production may lead to amplification.
  - **Closed economy**: Baqae & Farhi 2022a, Guerrieri, Lorenzoni, Straub & Werning 2022
  - **Open economy**: Baqae & Farhi 2022b, Benadio, Huo, Levchenko & Pandalai-Nayar 2021, Çakmaklı, Demiralp, Kalemli-Özcan, Yeşiltaş & Yıldırım, 2021, Huo, Levchenko & Pandalai-Nayar 2022
    - **All assume Current Accounts are 0**
Recent literature looks at the role of I-O networks in:

- Complementarities in demand/production may lead to amplification.
  - **Closed economy**: Baqae & Farhi 2022a, Guerrieri, Lorenzoni, Straub & Werning 2022
  - **Open economy**: Baqae & Farhi 2022b, Benadio, Huo, Levchenko & Pandalai-Nayar 2021, Çakmaklı, Demiralp, Kalemli-Özcan, Yeşiltaş & Yıldırım, 2021, Huo, Levchenko & Pandalai-Nayar 2022
  - All assume Current Accounts are 0

We develop and calibrate a global GE production network model where:

- Each country & sector is subject to a rich set of COVID shocks.
- **Intertemporal model** – current accounts **endogenously** react to COVID and fiscal policy.
- Based heavily on Baqae & Farhi (2022a)
A Global Intertemporal Production and Trade Model
Intratemporal Bloc (1)

- **Supply**: firms in country $n$ and sector $j$ produce output $y_{nj}$ with fixed factors $k_{nj}$, effective labor $A_{nj}L_{nj}$ and intermediate inputs $m_{nj, mk}$.

$$y_{nj} = \left( \alpha_{nj}k_{nj}^{\phi-1} + \beta_{nj} (A_{nj}L_{nj})^{\phi-1} + \gamma_{nj}m_{nj}^{\phi-1} \right)^{\frac{\phi}{\phi-1}}; \quad m_{nj} = \left( \sum_k \sum_m \vartheta_{nj, mk} m_{nj, mk}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}.$$

- **Labor Market**: rigid wages and labor supply shock $x_{nj} < 1$.

$$L_{nj} \leq x_{nj} \bar{L}_{nj}; \quad w_{nj} = \bar{w}_{nj}$$

- **Supply-constrained sector**: $L_{nj} = x_{nj} \bar{L}_{nj}$
- **Demand-constrained sector**: $L_{nj} < x_{nj} \bar{L}_{nj}$
Intratemporal Bloc (2)

- **Demand**: firms within sectors sell differentiated varieties (nested CES demand)

\[
D_n = \left[ \sum_j \xi_{nj} D_{nj}^{(\eta-1)/\eta} \right] ^{\eta/(\eta-1)}, \quad D_{nj} = \left( \sum_m \zeta_{n,mj} d_{n,mj}^{(\rho-1)/\rho} \right)^{\rho/(\rho-1)}
\]

\(\xi_{nj}\): sectoral demand shocks – redistributes demand between sectors

- **Sectoral Demand Curve**

\[
p_{nj} y_{nj} = \sum_m \omega_{m,nj} p_m D_m + \sum_m \sum_k \Omega_{mk,nj} p_{mk} y_{mk}
\]

- **Value Added**:

\[
V_n = \sum_j (1 - \gamma_{nj}) p y_{nj}
\]

*Implies (In matrix form):*

\[
PD = \mathcal{M}(\xi, p)V, \quad TB = V - PD = (I - \mathcal{M}(\xi, p))V
\]

- **Other work**: Find \(p\) s.t. \(TB = 0\)
- **This paper**: Inter-temporal block gives \(TB = f(V, \ldots)\)
• **Simplified set-up:**
  - Two periods: present (COVID, fixed wages) and future (\(*\), flexible wages).
  - Each country is small and takes the global nominal interest rate \(i\) as given.
  - Global equilibrium ensures that \[\sum_n TB_n = \sum_n TB_{n*} = 0.\]

• **Heterogenous Households:** share \(0 < \mu_n < 1\) are *hand-to-mouth*; remaining share \((1 - \mu_n)\) are *Ricardian* with log-preferences and discount factor \(\delta_n\).
  - Precautionary shock \((\uparrow \delta_n)\) needed to match increased private savings.

• **Fiscal Transfers:** Transfer \(T_n\)
  - Financed by debt with per-capita future tax \(t_{n*} = T_n(1 + i)/\bar{L}_n\).
Aggregate Demand Determination

\[ P_n D_n = \mu_n (V_n + T_n) + (1 - \mu_n)(1 - \delta_n) \left( V_n + \frac{V_{n^*}}{1 + i} \right) \]  
\[ TB_n = (1 - \mu_n) \left( \delta_n V_n - (1 - \delta_n) \frac{V_{n^*}}{1 + i} \right) - \mu_n T_n. \]

(1) determines aggregate nominal expenditures. (2) is the country’s trade balance.

- HtM households needed for fiscal policy \( T_n \) to matter. MPC of 1.
- Unemployment lowers income \( V_n \), reducing aggregate demand (Keynesian cross).
- Precautionary shock and higher interest rate reduce aggregate demand of Ricardian HHs.
- **Trade balance:** twin deficits and role of precautionary shocks
Details on Solving the Model

- Intertemporal + Demand System are *Nominal*.
  - Need two nominal anchors to solve model.
  - Equivalent to specifying monetary policy

- We pick a reference country that targets nominal GDP.
  - Specifically, a country that is advanced, ‘isolated,’ and less likely to be affected by COVID: *New Zealand*.

- All other countries fix their exchange rate relative to the reference country.
  - Saves us specifying country-by-country monetary policy
  - The results should be interpreted as *upper bounds of the effect of fiscal policy*. 
From the Model to the Data
 Calibration

Elasticities: \((\eta, \rho, \phi, \sigma) = (1, 2, 0.6, 0.2)\)
- As in, Baqee & Farhi (2022b) and di Giovanni, Kalemli-Özcan, Silva & Yıldırım (2022).

COVID shocks: vary by country and sector (36 ICIO sectors)
- Labor utilization constraint \((\hat{L}_{nj} \leq \hat{x}_{nj})\):
  - Feasibility of remote work (Dingel & Neimam, 2020) × lockdown intensity (OGRT).
- Productivity shock \((\hat{A}_{nj} \leq 1)\): Assume remote workers are 20% less productive.
  - Change in the number of remote workers (ACS, O*NET) × lockdown intensity (OGRT).
- Sectoral demand shock \((\hat{\xi}_{nj})\):
  - Reliance on face-to-face interaction (O*NET) × mobility intensity Google Mobility Index.

Fiscal policy & other parameters
- \(T_n\) from IMF’s COVID fiscal tracker (above the line spending).
- HtM estimates \(\mu_n\) for European countries (Almagren, Gallegos, Kramer & Lima, forthcoming).
Sector-Specific Demand Shocks

(a) Sector-Specific Demand (O*NET)

(b) Demand Shock Intensity (Google Mobility)

Supply Shocks
Results
## Fiscal Multiplier and Activity Reallocation

<table>
<thead>
<tr>
<th></th>
<th>Δ Real GDP</th>
<th>Δ % Demand Constrained (pp)</th>
<th>Δ Keynesian Unemp. (pp)</th>
<th>Δ Prices %</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID w/o stimulus</td>
<td>-8.90</td>
<td>39.22</td>
<td>2.36</td>
<td>-0.77</td>
</tr>
<tr>
<td>COVID w/ stimulus</td>
<td>-8.44</td>
<td>32.04</td>
<td>1.53</td>
<td>2.50</td>
</tr>
<tr>
<td>Effect of Stimulus (Δ)</td>
<td>0.50</td>
<td>-7.18</td>
<td>-0.83</td>
<td>3.27</td>
</tr>
</tbody>
</table>
Fiscal Multiplier and Activity Reallocation: Low Multiplier

<table>
<thead>
<tr>
<th></th>
<th>Δ Real GDP</th>
<th>Δ Share Demand Constrained (pp)</th>
<th>Δ Keynesian Unemp (pp)</th>
<th>Δ Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID w/o stimulus</td>
<td>-8.90</td>
<td>39.22</td>
<td>2.36</td>
<td>-0.77</td>
</tr>
<tr>
<td>COVID w/ stimulus</td>
<td>-8.44</td>
<td>32.04</td>
<td>1.53</td>
<td>2.50</td>
</tr>
<tr>
<td>Effect of Stimulus (Δ)</td>
<td>0.50</td>
<td>-7.18</td>
<td>-0.83</td>
<td>3.27</td>
</tr>
</tbody>
</table>

- **Fiscal Multiplier = 0.04**: Impulse of 11.3% of GDP raises output by 0.50%.

**Channels:**

<table>
<thead>
<tr>
<th>Transfers work through MPC (avg. = 0.29)</th>
<th>Multiplier: 0.40</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Bottlenecks in 2/3 of sectors (w/o I-O)</td>
<td>Multiplier: 0.11</td>
</tr>
<tr>
<td>+ I-O structure matters</td>
<td>Multiplier: 0.06</td>
</tr>
<tr>
<td>+ Global Policy Rate Rises</td>
<td>Multiplier: 0.04</td>
</tr>
</tbody>
</table>
### Fiscal Multiplier and Activity Reallocation: Employment

<table>
<thead>
<tr>
<th></th>
<th>Δ Real GDP</th>
<th>Δ Share Demand Constrained (pp)</th>
<th>Δ Keynesian Unemp. (pp)</th>
<th>Δ Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>COVID w/o stimulus</td>
<td>-8.90</td>
<td>39.22</td>
<td>2.36</td>
<td>-0.77</td>
</tr>
<tr>
<td>COVID w/ stimulus</td>
<td>-8.44</td>
<td>32.04</td>
<td>1.53</td>
<td>2.50</td>
</tr>
<tr>
<td>Difference (Δ)</td>
<td>0.50</td>
<td>-7.18</td>
<td>-0.83</td>
<td>3.27</td>
</tr>
</tbody>
</table>

Fiscal Policy dissipated through higher prices—**but, stimulus supported employment:**

- Policy increased activity in demand-constrained sectors.
- 7% of GDP no longer demand constrained.
- ‘Keynesian Unemployment’ decreases from 2.36% to 1.53% of labor force.
Cross-border Spillovers: US-only Fiscal policy Scenario

- **Spillovers are small!**
  - 20% of US NGDP stimulus $\rightarrow$ 1% rise in US RGDP $\rightarrow$ 0.1% of GDP rise in Canada!
  - Supply shocks matter. If the whole world were demand constrained:
    20% of US NGDP stimulus $\rightarrow$ 2.7% rise in US RGDP $\rightarrow$ 0.4% of GDP rise in Canada!
  - Home bias also important in explaining low fiscal spillovers.
Cross-border Spillovers: Role of International I-O

(a) RGDP – Advanced Economies

- Only Domestic I-O Connections (Lighter bars)
- Full International I-O (darker bars)

(b) RGDP – Emerging Economies

- International I-O shapes the distribution of spillovers:
  - On top of previous graph: Δ RGDP if I-O connections are domestic only
  - International I-O connections matter for the distribution of spillovers
Cross-border Spillovers: Explaining GNI Decline in ROW

- **Standard: Final Demand ToT (1/2)**
  - US goods prices rise
  - ROW pays more for US goods

- **New: Intermediates ToT (1/2)**
  - US GDP and final goods ↑
  - US intermediate demand ↑
  - $P_m \uparrow$, ROW intermediates ↓
  - ROW Final Goods Production ↓

- RGDP vs. RGNI $\leftrightarrow P_{GDP} vs. P_{CPI}$

(a) USA

(b) Avg. ROW

Only Domestic I-O Connections

(lighter bars)

Full International I-O

(darker bars)
Fiscal Policy and COVID

- The multiplier from fiscal transfers is very small.
  - *This is to be expected: transfers + bottlenecks + I-O linkages.*

- Nonetheless, fiscal policy increase demand to sectors with slack
  - *Fiscal policy in COVID reduced ‘Keynesian’ unemployment by 1/3*

- Cross border spillovers are small & RGNI falls for two reasons:
  - *Standard terms of trade mechanisms (1/2) & competition for constrained intermediates (1/2)*
Thank You
Intensity of Sectoral Supply & Demand Shocks

(a) Supply Shock Intensity: Emerging

(b) Demand Shock Intensity: Emerging
Cross-border Spillovers – No Supply Shocks

Counterfactual: US fiscal policy only (relative to no fiscal policy)

(a) Advanced

(b) Emerging
Cross-border Spillovers

Counterfactual: US fiscal policy only (relative to no fiscal policy)

(a) Advanced
- Only Domestic I-O Connections
- Full International I-O

(b) Emerging
Cross-border Spillovers – Final Output Decomposition

(a) Final Output – Advanced Economies

Only Domestic I-O Connections

(b) Final Output – Emerging Economies

- Need supply shocks and international I-O for non-US final output to fall
- (Competition for global intermediates needs both)
Cross-border Spillovers – Final Output w/o. supply shocks Decomposition

(a) Final Output – Advanced Economies
Only Domestic I-O Connections

(b) Final Output – Emerging Economies

- Need supply shocks and international I-O for non-US final output to fall
- (Competition for global intermediates needs both)