MACROECONOMIC IMPLICATIONS OF COVID-19: CAN NEGATIVE SUPPLY SHOCKS CAUSE DEMAND SHORTAGES?

GUERRIERI + LORENZONI + STRAUB + WERNING

(BOOTH) (NWU) (HARVARD) (MIT)
COVID-19 pandemic: deep impact on the macroeconomy

Governments and Central Banks: bold policies to help economy

**Active debate:** should policy “stimulate” spending?

**Textbook approach:**

Is the pandemic a supply or a demand shock?
• COVID-19 pandemic: deep impact on the macroeconomy

• Governments and Central Banks: bold policies to help economy

• **Active debate:** should policy “stimulate” spending?

• **Textbook approach:**
  Is the pandemic a supply or a demand shock?

Our Approach:
Demand is Endogenous to Supply Shock
Examine this relationship and policy
COVID shock...

- **Asymmetric Shock**: only in contact-intensive sectors
- **Gains from Trade**: health risk inhibits trading between buyers & sellers

call this a supply shock = reduces efficient production/consumption
COVID shock...

- **Asymmetric Shock**: only in contact-intensive sectors
- **Gains from Trade**: health risk inhibits trading between buyers & sellers
  
  call this a supply shock = reduces efficient production/consumption

- **Our focus**: Demand deficiencies
COVID shock...

- **Asymmetric Shock**: only in contact-intensive sectors

- **Gains from Trade**: health risk inhibits trading between buyers & sellers

  call this a supply shock = reduces efficient production/consumption

- **Our focus**: Demand deficiencies

- “Keynesian Supply Shock”
COVID shock...

- **Asymmetric Shock**: only in contact-intensive sectors
- **Gains from Trade**: health risk inhibits trading between buyers & sellers
  
  call this a supply shock = reduces efficient production/consumption

- **Our focus**: Demand deficiencies
- **“Keynesian Supply Shock”**
  
  A negative supply shock that causes demand shortages
## RESULTS: DEMAND SHORTAGE FROM SUPPLY SHOCK?

<table>
<thead>
<tr>
<th></th>
<th>Complete Markets</th>
<th>Incomplete Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One Sector</strong></td>
<td><strong>NO (Standard)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Multiple Sectors</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## RESULTS: DEMAND SHORTAGE FROM SUPPLY SHOCK?

<table>
<thead>
<tr>
<th></th>
<th>Complete Markets</th>
<th>Incomplete Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One Sector</strong></td>
<td>NO (Standard)</td>
<td>NO! (New)</td>
</tr>
<tr>
<td><strong>Multiple Sectors</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### RESULTS: DEMAND SHORTAGE FROM SUPPLY SHOCK?

<table>
<thead>
<tr>
<th></th>
<th>Complete Markets</th>
<th>Incomplete Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>One Sector</strong></td>
<td>NO (Standard)</td>
<td>NO! (New)</td>
</tr>
<tr>
<td><strong>Multiple Sectors</strong></td>
<td>POSSIBLE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complete Markets</td>
<td>Incomplete Markets</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>One Sector</td>
<td>NO (Standard)</td>
<td>NO! (New)</td>
</tr>
<tr>
<td>Multiple Sectors</td>
<td>POSSIBLE</td>
<td>EVEN MORE POSSIBLE</td>
</tr>
</tbody>
</table>
BEFORE THE SHOCK

SECTOR A: HIGH CONTACT INTENSIVE

SECTOR B: LOW CONTACT INTENSIVE

INCOME

SPENDING

TRANSFERS

SECTOR A WORKERS

SECTOR B WORKERS

INCOME
SECTORAL SHOCK: COMPLETE MARKETS

SECTOR A: HIGH CONTACT INTENSIVE

SECTOR B: LOW CONTACT INTENSIVE

SECTOR A WORKERS

SECTOR B WORKERS

INCOME

SPENDING

TRANSFERS
SECTORAL SHOCK: INCOMPLETE MARKETS

SECTOR A: HIGH CONTACT INTENSIVE

SECTOR B: LOW CONTACT INTENSIVE

INCOME

SPENDING

SECTOR A WORKERS

SECTOR B WORKERS
Model
PREFERENCES AND TECHNOLOGY

Preferences

\[
\sum_{t=0}^{\infty} \beta^t U(c_{At}, c_{Bt})
\]

\[
U(c_{At}, c_{Bt}) = \frac{\sigma}{\sigma - 1} \left( \phi^{\frac{1}{e}} c_{A_t}^{\frac{e-1}{e}} + (1 - \phi)^{\frac{1}{e}} c_{B_t}^{\frac{e-1}{e}} \right)^{\frac{e}{e-1} \frac{\sigma - 1}{\sigma}}
\]

Technology

\[
Y_{jt} = N_{jt}
\]

Each worker with labor endowment \( n_{it} = \bar{n} \)

Specialized labor, with fraction

- \( \phi \) in sector \( A \)
- \( 1 - \phi \) in sector \( B \)
Agents have access to zero-net-supply one-period bonds

Budget constraint

\[ p_{A_t}c_{iA_t} + p_{B_t}c_{iB_t} + a_{it} \leq w_t n_{it} + (1 + i_{t-1})a_{1t-1} \]

Fraction \( \mu \) face borrowing constraint

\[ a_{it} \geq 0 \]

Limit cases...

- \( \epsilon \to \infty \) one sector model
- \( \mu \to 0 \) complete markets in aggregate (Gorman)
PANDEMIC SHOCK

MIT shock...

- Time 0: shutdown of sector A
  (fraction $\phi$ of workers get $n_{i0} = 0$)

- Time 1,2,3,...: back to normal (flexible price allocation)

Assume...

1. Downward rigid nominal wages
2. Central Bank keeps interest rate unchanged

Question: at time 0, is there excess demand or insufficient demand?
Proposition: One sector ($\epsilon \to \infty$)

- Negative Supply Shock
- Higher natural rate + Excess demand
Why?

- temporary negative supply shock = good news shock
- agents want to borrow (not save!), but they might not be able to...

Limit case: $\mu \rightarrow 1$ and no excess demand
CONSUMPTION FUNCTIONS: ONE SECTOR, COMPLETE MARKETS

\[ (1 - \phi)\bar{n} \]

\[ \bar{n} \]

EXCESS DEMAND
Proposition. Multiple Sectors + Complete Markets

Negative Supply Shock ➔ Lower natural rate + Deficient demand

$\sigma > \epsilon$
CONSUMPTION FUNCTIONS: MULTI SECTOR, COMPLETE MARKETS

\[ (1 - \phi)\bar{n} \]

\[ (1 - \phi)\bar{n} \]

\[ \bar{n} \]

TOTAL DEMAND

Steady State

DEMAND GOOD B

INCOME

CONSUMPTION

\[ (1 - \phi)\bar{n} \]
CONSUMPTION FUNCTIONS: MULTI SECTOR, COMPLETE MARKETS

\[
\text{CONSUMPTION} = (1 - \phi)\bar{n} \\
\text{INCOME} = \bar{n} \\
\]

DEMAND GOOD B

After Shock

\[\sigma < \epsilon\]
CONSUMPTION FUNCTIONS: MULTI SECTOR, COMPLETE MARKETS

\[
\text{CONSUMPTION} = (1 - \phi) \bar{n}
\]

\[
\text{DEMAND GOOD B}
\]

After Shock

\[
\sigma > \epsilon
\]

INSUFFICIENT DEMAND
Proposition: Multiple Sectors + Incomplete Markets

Negative Supply Shock

Lower natural rate + Deficient demand

\[ \sigma > (1 - \omega)\epsilon + \omega \]

Complete markets

Incomplete markets (CES)
Proposition. Multiple Sectors + Incomplete Markets

Negative Supply Shock

Lower natural rate + Deficient demand

\[ \sigma > (1 - \omega)\epsilon + \omega \]
CONSUMPTION FUNCTIONS: MULTI SECTOR, INCOMPLETE MARKETS

\[
\bar{C} = (1 - \phi) \bar{n} + \bar{n} \sigma < \epsilon
\]
CONSUMPTION FUNCTIONS: MULTI SECTOR, INCOMPLETE MARKETS

CONSUMPTION

\[(1 - \phi)\bar{n}\]

DEMAND GOOD B

After Shock

\[\sigma < \epsilon\]
CONSUMPTION FUNCTIONS: MULTI SECTOR, INCOMPLETE MARKETS

\[
\bar{c} = (1 - \phi) \bar{n}
\]

DEMAND GOOD B

After Shock

\[
\sigma < \epsilon
\]

INSUFFICIENT DEMAND!
DEMAND CHAINS

- Input-output...
  - usual story: make supply shock greater
  - here: demand effect...

\[
Y_A = F(X, N_A) \\
Y_B = C_B + X
\]

- Result: Keynesian Supply Shock more likely
- Intuition: similar to higher hand-to-mouth consumption
- Demand shocks: from downstream to upstream!
MOBILITY

- Allow fraction of workers to move

  - Result...
    - natural output falls by less
    - actual output also falls by less (income)
    - gap grows!

- Mobility...
  - good for economy
  - but increases demand deficiency
FISCAL POLICY
\[ G_t + \phi T_{At} + (1 - \phi) T_{Bt} + (1 + r_{t-1}) D_{t-1} = D_t \]
FISCAL POLICY: MULTIPLIERS

\[ G_t + \phi T_{At} + (1 - \phi) T_{Bt} + (1 + r_{t-1}) D_{t-1} = D_t \]

Proposition. Fiscal Policy

\[ Y_{B0} = G_0 + \mu \phi T_{A0} + \text{constant} \]
FISCAL POLICY: MULTIPLIERS

\[ G_t + \phi T_{At} + (1 - \phi) T_{Bt} + (1 + r_{t-1}) D_{t-1} = D_t \]

**Proposition.** Fiscal Policy

\[ Y_{B0} = G_0 + \mu \phi T_{A0} + \text{constant} \]

- Spending multiplier = 1
- Transfer multiplier = \( \mu < 1 \)
- No 2nd round Keynesian Cross operating!
  Multipliers not \( 1/ (1 - mpc) \)
FISCAL POLICY: MULTIPLIERS

\[ G_t + \phi T_{At} + (1 - \phi) T_{Bt} + (1 + r_{t-1}) D_{t-1} = D_t \]

Proposition. Fiscal Policy

\[ Y_{B0} = G_0 + \mu \phi T_{A0} + \text{constant} \]

- Spending multiplier = 1
- Transfer multiplier = \( \mu < 1 \)
- No 2nd round Keynesian Cross operating!
  Multipliers not \( 1/(1 - \text{mpc}) \)
Social Insurance: low multipliers, yet optimal!

Transfer to A, with equal taxes on A and B in future $t=1,2,...$

$$T_{A0} = \rho \bar{n} \geq 0$$

(replacement rate $\rho$)
FISCAL POLICY: SOCIAL INSURANCE

- Social Insurance: low multipliers, yet optimal!
- Transfer to A, with equal taxes on A and B in future $t=1,2,...$

$$T_{A0} = \rho \bar{n} \geq 0$$
(replacement rate $\rho$)

**Proposition.** Exists cutoff $\hat{\rho} < 1$

- $\rho \in (0, \hat{\rho})$ → output increasing
- $\rho \in [\hat{\rho}, \infty)$ → output constant

Full insurance $\rho^* = 1$ optimal for Utilitarian
FISCAL POLICY: SOCIAL INSURANCE

- Social Insurance: low multipliers, yet optimal!
- Transfer to A, with equal taxes on A and B in future $t=1,2,...$

$$T_{A0} = \rho \bar{n} \geq 0$$

(replacement rate $\rho$)

replacement less than 100% maximizes stimulus
but 100% optimal for insurance

**Proposition.** Exists cutoff $\hat{\rho} < 1$

- $\rho \in (0, \hat{\rho})$ → output increasing
- $\rho \in [\hat{\rho}, \infty)$ → output constant

Full insurance $\rho^* = 1$ optimal for Utilitarian
EXTENSIONS
$V_0 = \max\{-w + \frac{1}{R} V_1, 0\}$
LABOR HOARDING TO PRESERVE JOB MATCHES

\[ V_0 = \max \{-w + \frac{1}{R} V_1, 0\} \]

\[-w + \frac{1}{R} V_1 < 0\]
LABOR HOARDING TO PRESERVE JOB MATCHES

\[ V_0 = \max\{-w + \frac{1}{R} V_1, 0\} \]

\[-w + \frac{1}{R} V_1 < 0 \quad \text{Destroy Matches} \]
LABOR HOARDING TO PRESERVE JOB MATCHES

\[ V_0 = \max \{-w + \frac{1}{R} V_1, 0\} \]

\[-w + \frac{1}{R} V_1 < 0 \quad \text{Destroy Matches} \]

\[-w + \frac{1}{R} V_1 \geq 0 \]
LABOR HOARDING TO PRESERVE JOB MATCHES

\[ V_0 = \max\{-w + \frac{1}{R} V_1, 0\} \]

\(-w + \frac{1}{R} V_1 < 0\)  \(\rightarrow\)  Destroy Matches

\(-w + \frac{1}{R} V_1 \geq 0\)  \(\rightarrow\)  Labor Hoarding
$V_0 = \max\{-w + \frac{1}{R} V_1, 0\}$

$-w + \frac{1}{R} V_1 < 0 \quad \rightarrow \quad \text{Destroy Matches}$

$-w + \frac{1}{R} V_1 \geq 0 \quad \rightarrow \quad \text{Labor Hoarding}$

\[\text{Perfect Insurance!}\]
LABOR HOARDING TO PRESERVE JOB MATCHES

\[ V_0 = \max\{-w + \frac{1}{R} V_1, 0\} \]

\[ -w + \frac{1}{R} V_1 < 0 \quad \rightarrow \quad \text{Destroy Matches} \]

\[ -w + \frac{1}{R} V_1 \geq 0 \quad \rightarrow \quad \text{Labor Hoarding} \quad \rightarrow \quad \text{Perfect Insurance!} \]
LABOR HOARDING TO PRESERVE JOB MATCHES

\[ V_0 = \max \{ -w + \frac{1}{R} V_1, 0 \} \]

\(-w + \frac{1}{R} V_1 < 0 \quad \rightarrow \quad \text{Destroy Matches}\)

\(-w + \frac{1}{R} V_1 \geq 0 \quad \rightarrow \quad \text{Labor Hoarding}\)

\[ \frac{1}{\beta} \]

Perfect Insurance!
JOB DESTRUCTION AND SLOW RECOVERIES

- If job losses not temporary: persistence and amplification
- Suppose vacancies
  - do not come back at $t=1$
  - come back at $t=2$ for free
- Result...
  - Affect $t=1$ productivity...
  - ... affects $t=1$ income...
  - ... which feeds back into demand at $t=1$ and $t=0$
BUSINESS EXIT CASCADES

- Lack of demand can cause some non-affected businesses to shut down (if they can’t cover fixed costs)
- Set of goods falls beyond initial shock
- Complementarities + incomplete markets: amplification!
DISCUSSION & EVIDENCE
EVIDENCE FOR KSS FORCES AT WORK

- Consumption drop

From Cox, Farrell, Ganong, Grieg, Noel, Vavra, Wong (2020)
Evidence suggesting complementarities main force:

From Cox, Farrell, Ganong, Grieg, Noel, Vavra, Wong (2020)
EVIDENCE FOR KSS FORCES AT WORK

- Broad contraction in most sectors

From Brinca, Duarte, Faria e Castro (2020)
Spillover to low income spending

Chetty, Friedman, Hendren, Stepner, Opportunity Insights Team (2000)
A. Seasonally Adjusted Spending Changes by Income Quartile

Chetty, Friedman, Hendren, Stepner, Opportunity Insights Team (2000)
• CPI down
ASIDE ON INFLATION

- Two different ways to look at inflation:
  1. **measure of slack**: prices go down for traded goods reflecting lack of demand
  2. **cost of living**: welfare-based CPI goes up (Jaravel-O’Connell)

- Alternative intuition for result: expected deflation and intertemporal substitution drive spending down
A condition for KSS in terms of measurable objects

\[
(1 - \mu) \cdot MPC^{S,U} + \mu \cdot MPC^{S,C} > \left[ \frac{\Delta c_B}{\Delta c_A} \right]^{\text{shutdown}}
\]

Quantity on RHS also a type of cross-goods MPC: if you save x on hotels because hotels are closed, how much do you spend on other stuff?
Stronger complementarities if we consider **input-output linkages** across sectors.

Incentivizing **labor hoarding** achieves two objectives:

1. Provide social insurance
2. Preserves job match value

Endogenous **business exit** generates cascade effects.

![Diagram showing low demand leading to exit with arrows indicating direction of movement](image-url)
CONCLUSIONS

- KSS = asymmetric supply shocks that generate demand shortages in the rest of the economy

- KSS are more plausible when sectors are more complementary (through preferences or input-output linkages) and when markets are more incomplete

- Policy recommendation: targeted transfers!

- Tentative reading of real time evidence: CARES Act has been successful and we need caution in reducing social insurance going forward
<table>
<thead>
<tr>
<th></th>
<th>Complete Markets</th>
<th>Incomplete Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Sector</td>
<td>NO (Standard)</td>
<td>NO! (New)</td>
</tr>
<tr>
<td>Multiple Sectors</td>
<td>POSSIBLE</td>
<td>EVEN MORE POSSIBLE</td>
</tr>
</tbody>
</table>