Fiscal Policy in a Networked Economy

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Policymakers Choose from Array of Fiscal Policies: How to Target?

Many fiscal stimulus instruments

- Undirected Transfers (e.g. stimulus checks)
- Targeted Transfers (e.g. extended UI benefits)
- Targeted Spending (e.g. auto industry bailout, infrastructure spending)

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Research question: How does network structure shape impact and optimal design of fiscal policy?

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1. **Theory:** Develop model of how heterogeneity affects propagation of fiscal shocks
    - Simple model of recessions: prices fixed, labor rationed in short run
    - Rich model of heterogeneity: Many HHs, sectors, regions, linked via IO, emp., & cons. networks.
    - Provide a novel decomposition describing how heterogeneity affects the fiscal multiplier(s).

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   - Provide a novel decomposition describing how heterogeneity affects the fiscal multiplier(s).

2. **Empirics:** Bring decomposition to data and explore implications for fiscal policy design
   - Estimate components of multiplier using several public-use datasets
   - Find that many dimensions of heterogeneity are irrelevant for aggregate multipliers
   - Key policy implication: targeting fiscal policy to high-MPC households is maximally expansionary
   - Estimate of fiscal spillovers across states, distributional impacts

Related Literature

- Literature has proposed many channels by which network structures and heterogeneity might matter. Our paper brings together and quantifies what matters for which questions:
  - *Aggregate GDP responses*: **loading of shocks onto high MPC households** (Werning, 2015; Kaplan, Moll, and Violante, 2018; Auclert, 2019; Patterson, 2019; Bilbiie, 2019), **input-output linkages** (Long and Plosser, 1987; Acemoglu, Carvalho, Ozdaglar, and Tahbaz-Salehi, 2012; Baqaee and Farhi, 2019; Rubbo, 2019; Bigio and La'O, 2020)
  - *Distributional and spatial impacts*: **regional trade and within-region consumption bias** (Farhi and Werning, 2017; Caliendo, Parro, Rossi-Hansberg, and Sarte, 2018; Dupor, Karabarbounis, Kudlyak, and Mehkari, 2018)

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- Sufficient statistics approach: Miyazawa (1976); Auclert, Rognlie, and Straub (2018); Wolf (2019)
- Network propagation of demand shocks: Baqaee (2015); Baqaee and Farhi (2018, 2020); Woodford (2020); Guerrieri, Lorenzoni, Straub, and Werning (2020); Andersen, Huber, Johannesen, Straub, Vestergaard (2023)
- Semi-structural approach consistent with and complements reduced-form estimation of fiscal multipliers: Ramey (2011); Nakamura and Steinsson (2014); Chodorow-Reich (2019); Corbi, Papaioannou, and Surico (2019)

This Talk

1. Model
2. Networks, Heterogeneity, and the Multiplier
3. Data and Calibration
4. Empirical Results
5. Implications for Design of Fiscal Policy
6. Conclusion

Model

A Rationing Model of Recessions

Setup: Two time periods t. Many sectors i and HHs n. One labor factor. ▸ More time periods

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Labor rationing: Pd. 1 labor supply determined by rationing. Model w/ flexible rationing function

$$R : \{L_i^1\} \mapsto \{\ell_n^1\}$$

that satisfies labor market clearing: $\sum_n R_n(\{L_i^1\}) = \sum_i L_i^1$. ▸ Full equilibrium conditions

Networks, Heterogeneity, and the Multiplier

The Output Multiplier: From PE to GE

- We consider two policy shocks: tax and transfer shocks $d\tau$ and spending shocks dG^1
- Define shock's PE effect as Δ final demand before incomes adjust: $\partial Y^1 = dG^1 + \sum_n \frac{dc^1}{d\tau_n} d\tau_n$

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Sufficient statistics

- $[\widehat{X}^1]_{ij}$ = j's unit exp. on good i.
- $[\widehat{L}^1]_{ij} = \mathbb{1}_{i=j} \times j$'s unit exp. on labor.
- $[R_L]_{n,i}$ = marg. rationing of i's LD to HH n
- $[m]_{n,n'} = \mathbb{1}_{n=n'} \times n$'s MPC.
- $[\widehat{C}^1]_{in}$ = share of n's marg. exp. on good i

Proposition (Network Keynesian Multiplier)

The general equilibrium change in first-period final output dY^1 following a fiscal shock with partial equilibrium impact on first-period final output ∂Y^1 is

$$dY^1 = \left(I - \widehat{C}\, m\, R_{L^1}\, \widehat{L}^1 \left(I - \widehat{X}^1\right)^{-1}\right)^{-1} \partial Y^1$$

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Intuition: Shock $\rightarrow$ production $\rightarrow$ labor rationed $\rightarrow$ marg. consumption $\rightarrow$ directed consumption

Comparative Statics

The Output Multiplier: Network Effects

▸ Exact Decomposition ▸ Neutral Case ▸ Homotheticity

- The many dimensions of heterogeneity can amplify shocks through three network effects:
  1. **Incidence Effect:** The shock disproportionately hits households with higher MPCs
  2. **Bias Effect:** shocked HHs direct marginal spending towards HHs with higher-than-average MPCs
  3. **Homophily Effect:** Correlation between HH's own MPC and MPCs of the HHs they spend on

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Proposition (Network Decomposition)

For any shock with PE incidence ∂h_n^1 onto first-period HH incomes and total incidence $\sum_n \partial h_n^1 = 1$,

$$\mathbb{1}^T dY^1 = \mathbb{1}^T dG^1 + \frac{1}{1-\mathbb{E}_{\ell^1}[m_n]}\Bigg(\underbrace{\mathbb{E}_{\ell^1}[m_n]}_{\text{RA Keynesian effect}} + \underbrace{\mathbb{E}_{\partial h^1}[m_n] - \mathbb{E}_{\ell^1}[m_n]}_{\text{Incidence effect}}$$

$$+ \underbrace{\mathbb{E}_{\partial h^1}[m_n]\left(\mathbb{E}_{\partial h^1}[m_n^{next}] - \mathbb{E}_{\ell^1}[m_n]\right)}_{\text{Biased spending direction effect}} + \underbrace{\mathbb{C}ov_{\partial h^1}[m_n, m_n^{next}]}_{\text{Homophily effect}}\Bigg) + O^3(|m|)$$

where m_n^{next} is the average MPC of HHs who receive as income i's marginal dollar of spending.

Network Effects: An Example

Two-household economy

- High-MPC HH with $m_H = 0.5$. Low-MPC HH with $m_L = 0.1$
- Consider 4 different cases for shock incidence and spending-to-income network

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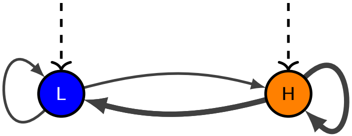
Case 1: Uniform incidence, neutral network



- *As if* economy had a single household with $\overline{m} = \frac{m_L + m_H}{2}$
- Multiplier (M) given by

$$M = \frac{1}{1 - \overline{m}} = 1.43$$

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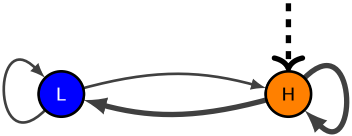
Case 2: Heterogeneous incidence, neutral network

- Initial transfer directed entirely to m_H



- Initial and higher "rounds" of multiplier are different

$$M = 1 + \frac{m_H}{1 - \overline{m}} = 1.71$$

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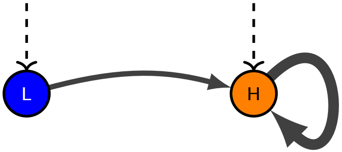
Case 3: Uniform incidence, biased network

- All marginal spending directed to sector employing m_H



- Higher "rounds" of multiplier propagates at m_H

$$M = 1 + \frac{\overline{m}}{1 - m_H} = 1.60$$

Network Effects: An Example

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- Consider 4 different cases for shock incidence and spending-to-income network

Case 4: Uniform incidence, homophilic network

- All marginal spending directed to own sector

- Each shock propagates separately

$$M = \frac{1}{2}\Big(\frac{1}{1-m_L} + \frac{1}{1-m_H}\Big) = 1.56$$

Data and Calibration

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Mapping model to data

- "Sectors" $=$ 51 states $\times$ 55 industries ($\approx$ 3-digit NAICS).
- "Households" $=$ state $\times$ income quintile $\times$ age quartile $\times$ gender $\times$ race $+$ capitalists $+$ foreigners

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Strategy to calibrate multiplier $= \left(I - \widehat{C}^1 m\, R_{L_1} \widehat{L}^1 \, (I - \widehat{X}^1)^{-1}\right)^{-1}$

1. Regional input-output matrix ($\widehat{X}^1$) ▸ Details
   - Data: BEA make and use tables. CFS interstate trade.
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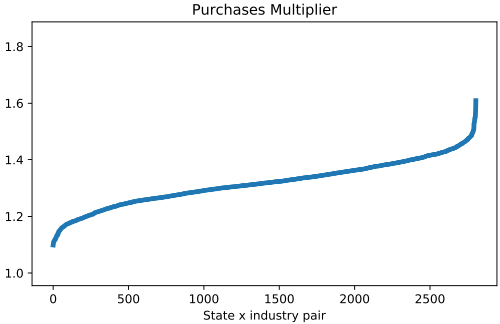
3. Directed MPC matrix ($\hat{C}^1 m$) Details
   - Data: PSID $+$ CEX for MPC estimation. Details CEX cons. basket by demog. CFS interstate trade.
   - Assumptions: Marg. cons. basket $=$ avg. cons. basket. Validation Same interstate sourcing as firms.

Empirical Results

Large dispersion in government purchases, transfer multipliers



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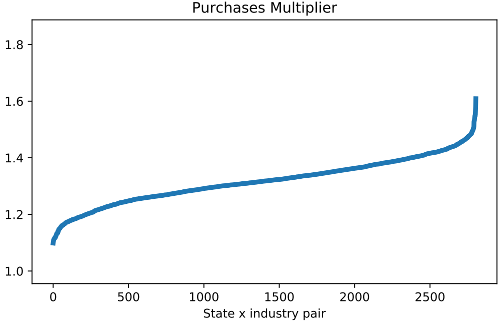

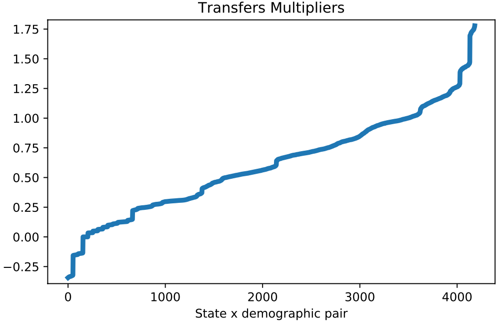

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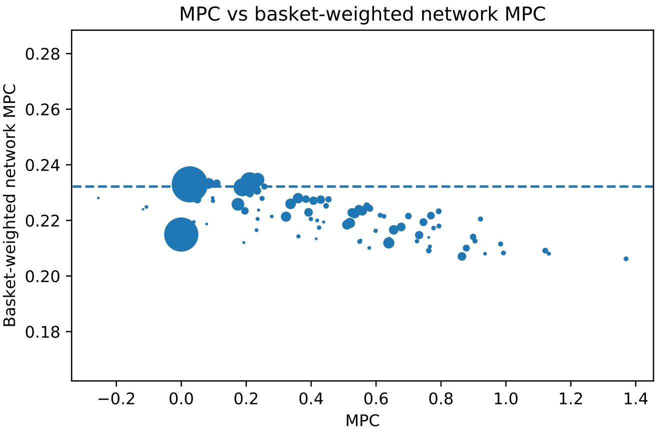
- *Uniform transfer multiplier*: Transferring \$1 to average HH increases GDP by 77 cents

▸ Sources of heterogeneity ▸ Counterfactuals

Incidence drives variation in multipliers



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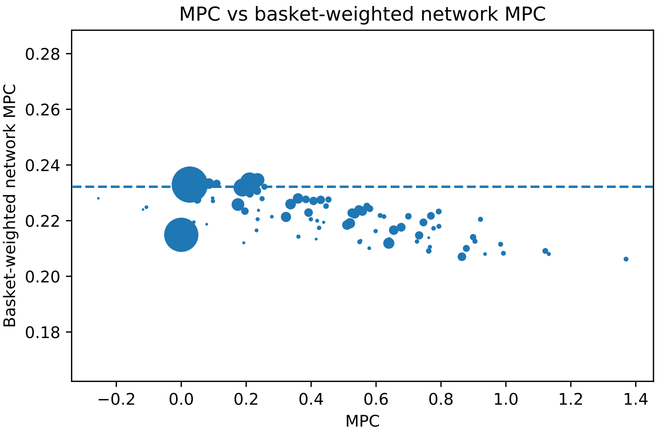

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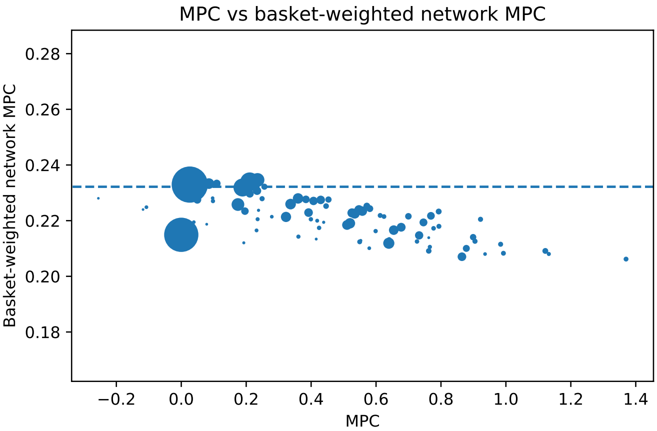

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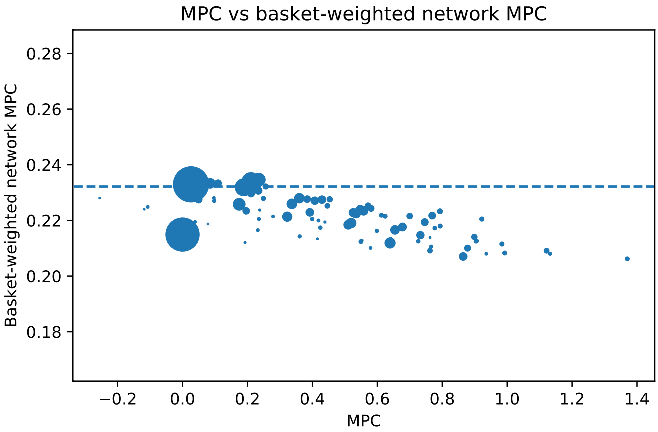
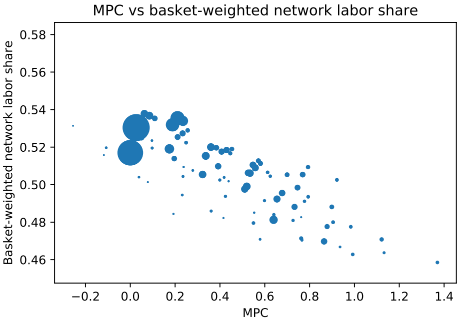
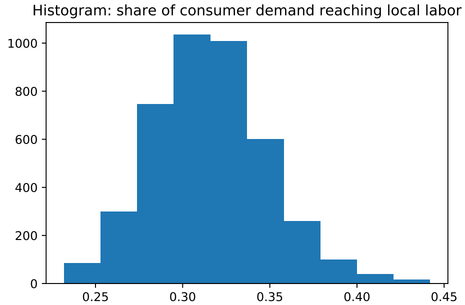


- *Observation 1:* Basket-weighted network MPCs are very similar across population
- *Observation 2:* Basket-weighted network MPCs are similar to benchmark average MPC
- → Bias and homophily terms are both close to 0 ▸ Robustness of empirical result

Understanding Bias and Homophily Terms: Two Offsetting Effects

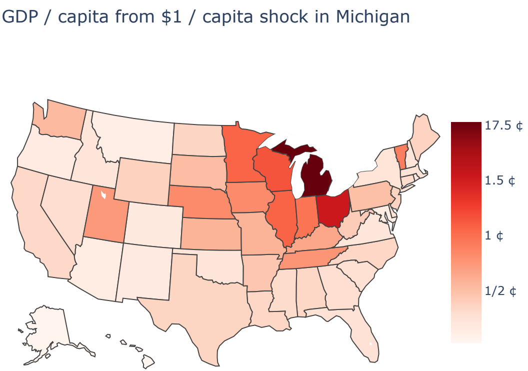




- *Empirical Fact 1:* High MPC households consume from low labor share industries, creating negative homophily (Hubmer 2019)
- *Empirical Fact 2:* Substantial fraction of demand remains local, creating positive homophily

Regional Policy Spillovers

- Of national multiplier, out-of-state spillovers account for 47% of amplification



▸ Non per-capita version

Implications for Design of Fiscal Policy

MPC-targeting for transfers vs. government purchases

Back to motivating question: If planner wants to max agg. income, how to target policy? Microfoundation

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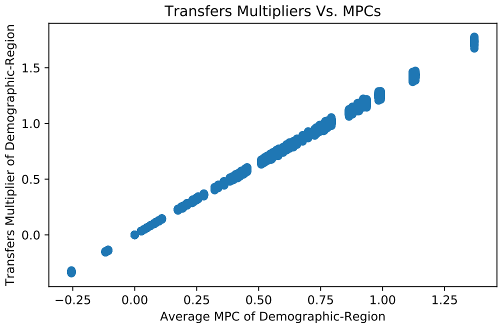

Transfers: A group's MPC is *very* highly correlated with multiplier for transfers to it Application: CARES Act

MPC-targeting for transfers vs. government purchases

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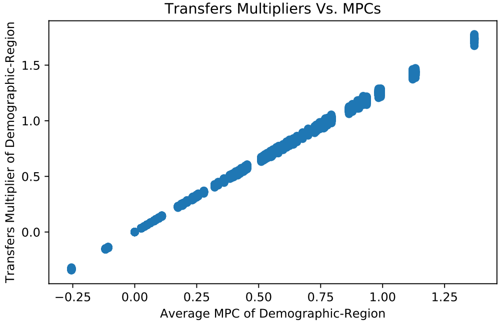

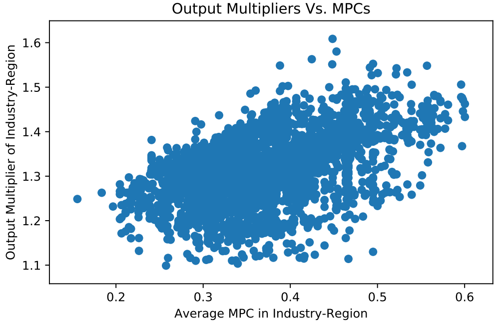

Transfers: A group's MPC is *very* highly correlated with multiplier for transfers to it Application: CARES Act

Gov't purchases: Avg. MPC w/in sector × state less correlated w/ multiplier. IO shapes incidence.

Conclusion

Conclusion

Theory + data

- Simple, rich model. Analytical decomp. of multiplier into deviations from Keynesian benchmark.
- Calibration in terms of estimable sufficient statistics.

Takeaway

- Targeting fiscal policy is (a) important and (b) simple.
  - Fiscal multipliers vary substantially depending on where the shock is targeted
  - All heterogeneity stems from heterogeneous initial incidence across households with differing MPCs

Historical and Counterfactual Exercises Back

- Multiplier changes over time as fundamentals of economy change

    1. The role of IO linkages: An economy with no intermediate inputs has the same aggregate multipliers but more heterogeneity in spending multipliers Figure
    2. The decline of the labor share: The fall in the labor share from 2000 to 2012 lead to smaller purchases multipliers Figure
    3. Rising labor income inequality: Can change multipliers if it changes MPCs or shuffles workers across industries/regions

Characterizing how targeting fiscal policy affects welfare ▸ Back

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- Question facing planner: how should they allocate funds across the economy?
  - Additively-separable utility functions over consumption and labor
  - In $t = 1$, no labor supply decision and households face borrowing constraints
  - In $t = 2$, households are unconstrained
  - Utilitarian social planner puts weight λ_n on household n and chooses government spending (G) and taxes (τ) to maximize total welfare

Proposition 1

The change in welfare dW due to a small change in taxes and government purchases in the first period can be expressed as: ▸ Formal Statement of Problem ▸ Optimal Policy

$$dW = \sum_{n \in N} \mu_n \widetilde{\lambda}_n \left[\underbrace{-\Delta_n d\ell_n^1}_{\text{Address under-emp.}} - \underbrace{d\tau_n^1}_{\text{Make transfers}} \right]$$

Where $\widetilde{\lambda}_n$ = social value of transfers to n, Δ_n = labor wedge of household n.

Maximizing aggregate income through simple MPC targeting

Back

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  1. All labor is rationing to un(der)employed households, who have no marginal disutility of labor
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$$dW \propto \sum_{n \in N} m_n \partial h_n^1$$

- ∂h_n^1: partial equilibrium change in total household incomes induced by policy
- Intuition: Without bias/homophily, all households direct consumption in same way for purposes of amplification

Model Extensions: Multiple Time Periods

Back

- Allow set of periods $\mathcal{T}(\omega) \subseteq \mathbb{T}$ in which labor is rationed

Proposition 2

For any small shock to fiscal policy inducing a partial equilibrium effect ∂Y^{-T} in periods $1, \ldots, T-1$, there exists a selection from the equilibrium set such that the general equilibrium response of $1, \ldots, T-1$ period values added dY^{-T} is given by:

$$dY^{-T} = \left(I \; - \; \hat{C}^{-T} \; m^{-T} \; R_{L^{-T}}^{-T} \; \hat{L}^{-T} \; \left(I - \hat{X}^{-T} \right)^{-1} \right)^{-1} \partial Y^{-T}$$

- Shocks in each rationing period can influence output in other rationing periods
- Need to consider intertemporal MPCs (Auclert et al 2018)

Model Extensions: Imperfect Competition ▸ Back

- Allow for fixed firm-level markups on marginal cost $\frac{\hat{\Pi}_i^t}{1-\hat{\Pi}_i^t}$
- Now need to also ration dividends back to households
- Very similar result holds in this setting

Proposition 3

For any shock inducing a first-period partial equilibrium effect ∂Q, the general equilibrium response in production satisfies:

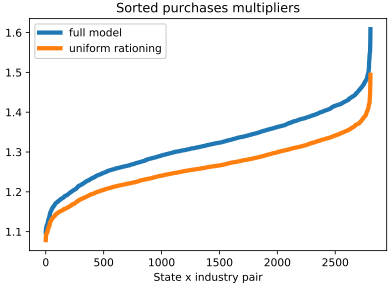
$$dQ = \hat{X} dQ + C_{\ell^1} R^1_{L^1} \hat{L}^1 dQ^1 + C_\pi D_\Pi \hat{\Pi} dQ + \partial Q$$

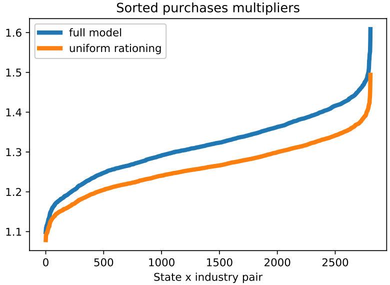
where C_π is the matrix of household directed MPCs out of profit income, where D_Π is the block diagonal matrix composed of $D^1_{\Pi^1}$ and $D^2_{\Pi^2}$ – which are each $N \times I$ matrices with entries $D^t_{\Pi^t_i}(\Pi^t)_n$ – and where $\hat{\Pi}$ is the block diagonal matrix composed of $\hat{\Pi}^1$ and $\hat{\Pi}^2$ – themselves each diagonal matrices with entries $\hat{\Pi}^t_i$. All quantities are evaluated at the initial equilibrium.

Heterogeneous multipliers: Amplifying and dampening forces

What widens the heterogeneity in multipliers?

- Heterogeneous demographic composition of states and sectors
- Covariance between worker MPCs and elasticity of income to changes in output





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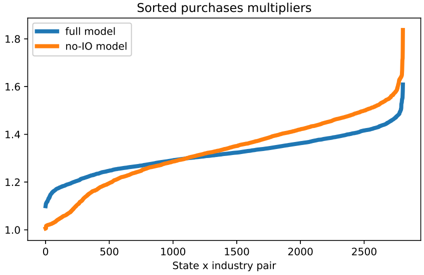


What dampens the heterogeneity in multipliers?

- IO links dilute the MPC of workers receiving marginal dollars

Full equilibrium conditions

Firm optimization

$$(X_i^t, L_i^t) \;\in\; \text{argmax}_{X,L} \; p_i^t F_i^t(X,L) - p^t \cdot X - L$$

HH optimization

$$(c_n^1, c_n^2, \ell_n^2) \;\in\; \text{argmax}_{c^1,c^2,\ell^2} \; \sum_t \beta^t u_n^t(c^t, \ell^t)$$

$$\text{s.t.} \quad \sum_t \frac{p^t \cdot c^t + \tau_n^t - \ell^t}{(1+r)^t} \leqslant 0 \qquad \text{and} \qquad \ell^1 - p^1 \cdot c^1 - \tau_n^1 \leqslant \underline{s}_n$$

Labor rationing

$$\ell_n^1 \;=\; R_n(\{L_i^1\})$$

Market clearing

$$F_i^t(X_i^t, L_i^t) \;=\; \sum_n c_{n,i}^t + \sum_j X_{j,i}^t + G_i^t \qquad \text{and} \qquad \sum_i L_i^t = \sum_n \ell_n^t$$

Back

Network Effects: Exact Decomposition in Terms of Bonacich Centralities

- Define:
  1. $\hat{m}$ – diagonal matrix of MPCs
  2. $\widehat{C}^1$ – normalized spending direction matrix
  3. $\mathcal{G} \equiv R_{L^1} \widehat{L}^1 \left(I - \widehat{X}^1 \right)^{-1} \widehat{C}^1$ map from household spending to others' income
  4. $b \equiv \vec{1}^T (I - \mathcal{G}\hat{m})^{-1}$ – Vector of Bonacich centralities in spending network
  5. $(b^{next})^T = b^T \mathcal{G}$ – Average Bonacich centrality of households on whom I consume

Proposition 4

For any shock inducing a unit-magnitude labor incidence shock ∂y^1:

$$\vec{1}^T dY^1 = \underbrace{\frac{1}{1 - \mathbb{E}_{\partial y^1}[m_n]}}_{\text{Incidence multiplier}} + \underbrace{\mathbb{E}_{\partial y^1}[m_n] \left(\mathbb{E}_{\partial y^1}[b_n^{next}] - \frac{1}{1 - \mathbb{E}_{\partial y^1}[m_n]} \right)}_{\text{Biased spending direction effect}} + \underbrace{\mathbb{C}ov_{\partial y^1}[m_n, b_n^{next}]}_{\text{Homophily effect}}$$

Back

Full Statement of Planner's Problem

- Household Problem:

$$(\ell_n^2, c_n^1, c_n^2) \in \text{argmax}_{\ell^2, c^1, c^2} \; u_n^t(c^1, \ell_n^1) + \beta_n u_n^t(c^2, \ell^2)$$

$$\text{s.t } p^1 c^1 + \frac{p^2 c^2}{1+r} + \tau_n^1 + \frac{\tau_n^2}{1+r} = \ell_n^1 + \frac{\ell^2}{1+r}$$

$$\ell_n^1 - p^1 c^1 - \tau_n^1 \geqslant \underline{s}_n$$

- Social welfare for fiscal policy (G, τ):

$$W(G, \tau) \equiv \sum_{n \in N} \lambda_n \mu_n W_n(l_n^1(G, \tau), \tau_n)$$

  - $l^1(G, \tau)$: household labor income consistent with rationing equilibrium with fiscal policy given by (G, τ).

Back

Quantifying gains from targeting transfers: CARES Act

Back

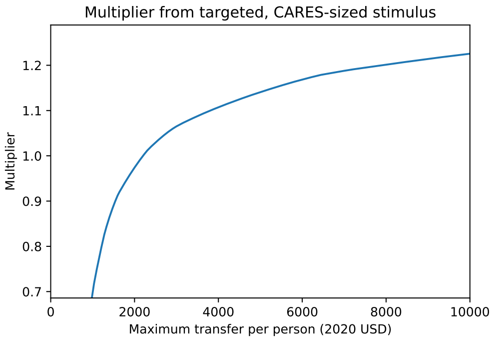
Quantifying gains from targeting transfers: CARES Act ▸ Back

- Direct payments in CARES Act: $\approx \$1,200$ to those making less than \$75,000

Quantifying gains from targeting transfers: CARES Act

Back

- Direct payments in CARES Act: $\approx \$1,200$ to those making less than \$75,000
- In our model, increased GDP by 79 cents per dollar spent



Quantifying gains from targeting transfers: CARES Act ▸ Back

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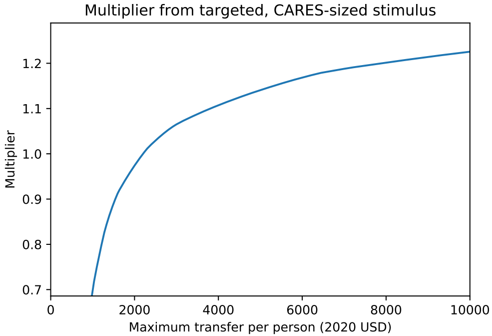

- Takeaway 1: With maximum transfer of $1,200, income-targeting was very effective (0.79 vs. 0.8)

Quantifying gains from targeting transfers: CARES Act

Back

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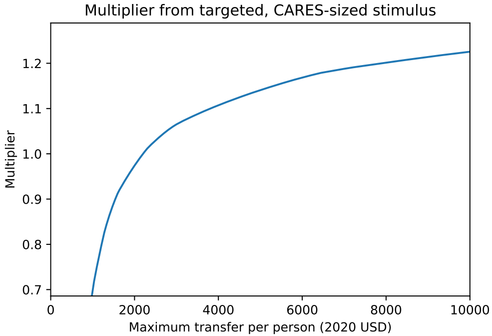


- Takeaway 1: With maximum transfer of $1,200, income-targeting was very effective (0.79 vs. 0.8)
- Takeaway 2: Could have generated more stimulus with larger transfer to higher-MPC households

Estimating the Regional IO Matrix ▸ Back

$$\underbrace{\hat{X}^1}_{(S\times I)\times(S\times I)} : \text{ sector } i \text{ in state } s \text{ uses } (\hat{x}^1_{si,kj}) \text{ units of output from sector } j \text{ in state } k$$

- Use 2012 BEA make and use tables to construct national IO matrix
- Use 2012 CFS microdata on to compute gross trade flows between all state pairs for tradable commodities
- For nontradable sectors, we assume all production is within state

Estimating the Rationing Matrix

Back

$$\left(R^1_{L^1}\widehat{L}^1\right)_{rn,si} = \underbrace{\mathbb{I}[r=s]}_{\substack{\text{Within}\\ \text{State}}} \underbrace{\alpha_{ir}\beta_i}_{\substack{\text{Labor Share}\\ \text{of Output}}} \underbrace{\frac{y_{inr}}{\sum_n y_{inr}}}_{\substack{\text{Income}\\ \text{Shares}}} \underbrace{\left(1+\xi\left(MPC_n - \overline{MPC}_{ir}\right)\right)}_{\text{Rationing on MPCs}}$$

1. Assume all labor income earned within state where production takes place ($\mathbb{I}[r=s]$)
2. Compute labor shares of output from BEA for each sector and state ($\alpha_{ri}\beta_i$)
3. Use ACS to compute income shares of demographics in sectors and states (y_{inr})
4. Use LEHD to estimate exposure to business cycle shocks by worker demographic (ξ) (Patterson 2019)

Figure

Estimating the Directed MPC Matrix ▸ Back

$$\underbrace{\hat{C}m}_{(S\times I)\times(S\times N)} : \text{demographic } n \text{ in state } s\text{'s MPC for good } i \text{ in state } r$$

$$MPC_{ri,sn} = \underbrace{MPC_n}_{\substack{\text{PSID/CEX} \\ \text{MPC}}} \times \underbrace{\alpha_{ni}}_{\substack{\text{CEX Basket} \\ \text{Share}}} \times \underbrace{\lambda_{irs}}_{\substack{\text{CFS} \\ \text{Flow}}}$$

1. Use PSID and CEX to estimate MPC_n using methodology of Blundell, Pistaferri and Prestion (2008), Guvenen and Smith (2014) and Patterson (2019) ▸ Figure ▸ Details
   - MPC for capitalists of 0.028 (Chodorow-Reich, Nenov, and Simsek 2019)
2. Use CEX to compute consumption basket shares for each demographic α_{ni} ▸ Figure
   - Linear Engel curves for each demographic group
3. Use CFS to compute consumption trade flows across states λ_{irs}
   - Assume all non tradables consumed within state

Exploring constant consumption shares assumption

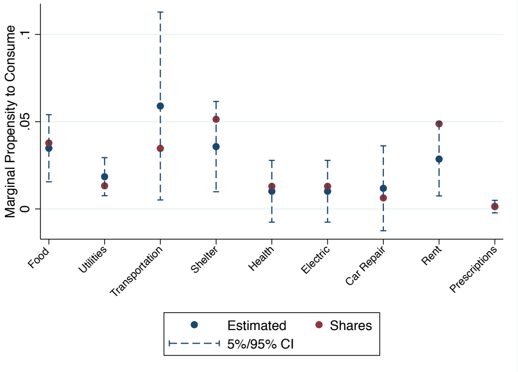


Figure: Estimated Directed MPCs Vs. CEX basket-weighted MPCs

Back

Substantial MPC Heterogeneity Across Demographics

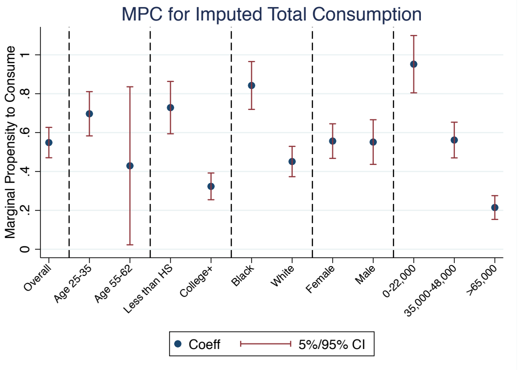


Figure: Heterogeneity in MPCs by Demographic Group (Patterson 2019)

Back

Details of MPC Estimation

- Following Gruber (1997) use panel structure of PSID:

$$\Delta C_{it} = \sum_x \left(\beta_x \Delta E_{it} \times x_{it} + \alpha_x \times x_{it}\right) + \delta_{s(i)t} + \varepsilon_{it}$$

  C_{it} = consumption expenditure, E_{it} = labor earnings, x = demographics, state-by-time FEs
- Instrument for income changes using unemployment shocks
- Using CEX: estimate demand for food expenditure as function of durable consumption, non-durable consumption, demographic variables and CPI prices
- Assuming monotonicity, invert to predict total consumption in the PSID using demographics and food expenditure

▸ Back

Relationship between MPC and Exposure to the Business Cycle

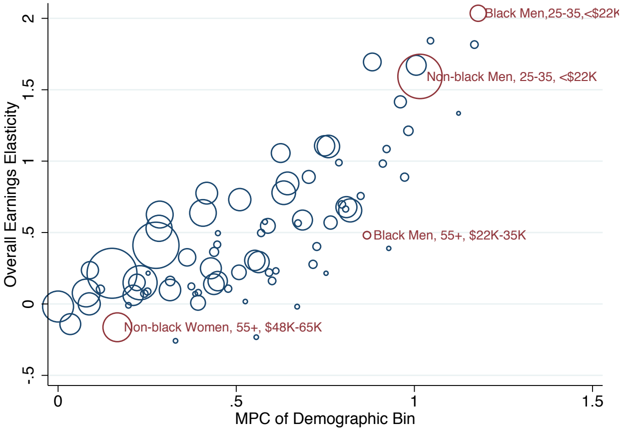
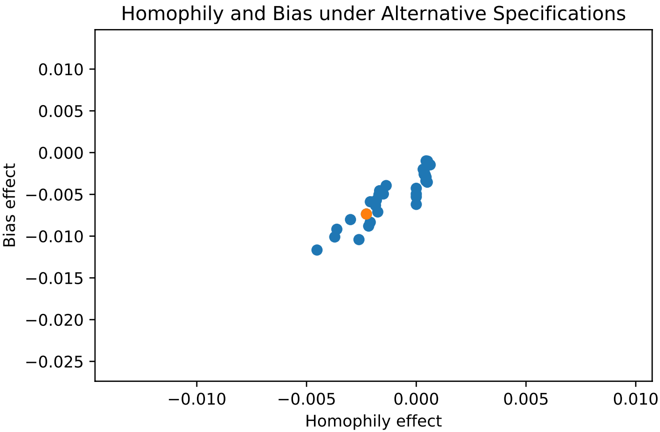


Figure: Earnings Elasticity and MPCs (Patterson 2019)

Back

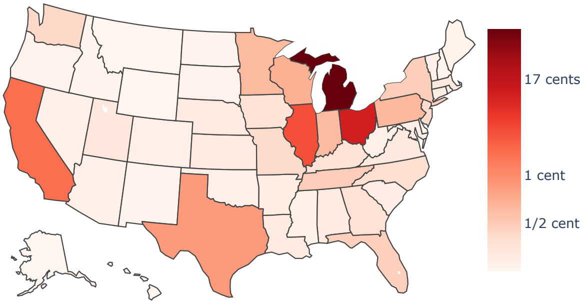
Empirical irrelevance of the bias and homophily effects is a robust feature economy



Back

Regional Demand Linkages: Per Capita Spending

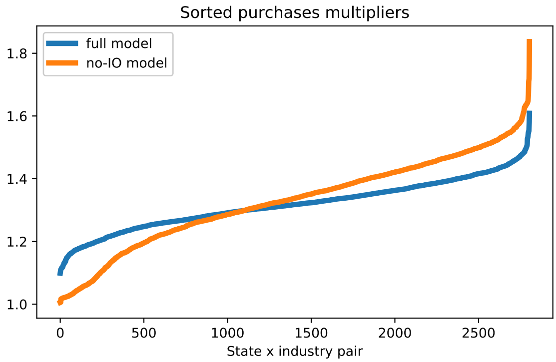
Change in GDP from $1 shock in Michigan



Back

IO linkages dampen the distribution of multipliers

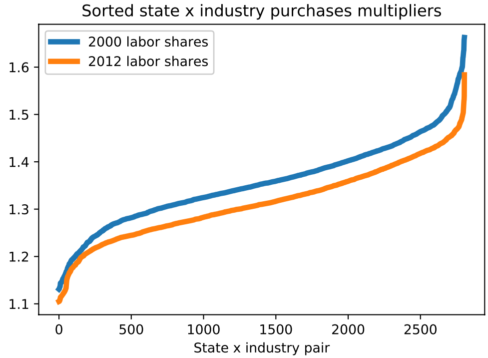
- IO linkages *narrow* the heterogeneity across sectors/states
  - Inputs dilutes the MPC of workers receiving marginal dollars



Back

Multipliers and the decline of the labor share

- Consider the decline in the labor share by industry from 2000-2012, keeping all else equal
- Assume the difference in labor income accures to a factor with $MPC = 0$



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Special Case with No Incidence of Bias Effect: Homotheticity

- Assume the following conditions:
  - Consumption preference and labor rationing are homothetic (i.e. marginal change is the same as the average)
  - No households are net borrowers in period 1
  - No government spending
- Then, for a final-output-proportional demand shock, the incidence and bias effects are 0
  - Each household's marginal consumption is proportional to its initial consumption → income-weighted average of marginal consumption is proportional to output.
  - Households with different consumption bundles → some households experience a greater change in income
  - Those households have different MPCs from the average → homophily possible.

Back

Special Case with No Network Effects

When does this collapse to classical Keynesian multiplier?

- If all industries have a common rationing-weighted average MPC, m, then

$$\vec{1}^T dY^1 = \frac{1}{1 - \mathbb{E}_{y*}[m_n]} = \frac{1}{1-m}$$

- *No matter where the shock hits, the aggregate consumption response is the same*
- Special case of this: single good and single household

Back

Optimal Fiscal Policy Back

- In the paper we provide a number of results on the optimality of fiscal policy, not merely the welfare effects of potentially suboptimal fiscal policy

Proposition 5

Suppose taxes τ^{1*}, τ^{2*} and purchases G^{1*}, G^{2*} solve the planner's problem. Now consider a change in policy $\tau^t = \tau^{t*} + \varepsilon \tau^t_\varepsilon$, $G^t = G^{t*} + \varepsilon G^t_\varepsilon$, indexed by ε. The following first-order condition holds:

$$
\begin{aligned}
0 = & \underbrace{\left(\tilde{\lambda}^T \mu WTP^1 - \left(\gamma \mathbb{1}^T + \tilde{\lambda}^T \Delta \Gamma^1\right)\right) G^1_\varepsilon}_{\textit{Opportunistic government purchases}} + \underbrace{\frac{\left(\tilde{\lambda}^T \mu (I - \phi) WTP^2 - \gamma \mathbb{1}^T\right) G^2_\varepsilon}{1 + r}}_{\textit{Short-termist government purchases}} \\
& \underbrace{- \left(\tilde{\lambda} - \gamma \mathbb{1}\right)^T \mu \left(\tau^1_\varepsilon + \frac{\tau^2_\varepsilon}{1 + r}\right)}_{\textit{Pure redistribution}} \quad \underbrace{+ \tilde{\lambda}^T \frac{\phi \mu \tau^2_\varepsilon}{1 + r}}_{\textit{Relaxation of borrowing constraints}} \\
& \underbrace{- \tilde{\lambda}^T \Delta \Gamma^1 \left(I - C^1_{\ell 1} \Gamma^1\right)^{-1} C^1_{\ell 1} \left(\Gamma^1 G^1_\varepsilon - \mu \tau^1_\varepsilon - \frac{\mathbb{1}_{\phi_n = 0} \mu \tau^2_\varepsilon}{1 + r}\right)}_{\textit{Keynesian stimulus (alleviation of involuntary unemployment)}}
\end{aligned}
$$

where γ is the marginal value of public funds, $\Gamma^1 \equiv R^1_{L^1} \hat{L}^1 \left(I - \hat{X}^1\right)^{-1}$, μ, ϕ, and Δ are the diagonal matrices of type weights, borrowing wedges, and labor wedges, respectively.

Comparative Statics ▸ Back

- In the paper we derive a number of comparative statics results which explore how changes in the network structure affect the distribution of fiscal multipliers
- Define the matrix:

$$\mathcal{M} = C^1_{\ell^1} R_{L^1} \widehat{L}^1 \left(I - \widehat{X}^1 \right)^{-1}$$

Proposition 6

Consider a change in the economy such that $\mathcal{M}$ is replaced with $\mathcal{M}' = \mathcal{M} + \varepsilon \mathcal{E}$. The effect on dY^1 of this change is given to first order in ε by:

$$\frac{d}{d\varepsilon} dY^1|_{\varepsilon=0} = (I - \mathcal{M})^{-1} \mathcal{E} (I - \mathcal{M})^{-1} \partial Q^1$$

where ∂Q^1 generalizes ∂Y^1 to the case with supply shocks.

- Corollaries include:
  1. Higher multipliers with higher MPCs / labor shares
  2. More dispersed multipliers with less connected IO matrix