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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- In reality, policy propagates through complex supply chains, regional trade, employment, consumption linkages.

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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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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).
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

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

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

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 and spending shocks dG^1

Define shock's PE effect as Δ final demand before incomes adjust: $\mathrm{B}Y^1 \quad dG^1 \quad {}_n \frac{dc^1}{d \; {}_n} d \; {}_n$

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Sufficient statistics

- $r\mathcal{X}^1 s_{ij}$ j's unit exp. on good i.
- $r\mathcal{L}^1 s_{ij}$ $1_{i \quad j}$ j's unit exp. on labor.
- $r R_L s_{n;i}$ marg. rationing of i's LD to HH n
- $r m s_{n;n^1}$ $1_{n \quad n^1}$ n's MPC.
- $r\mathcal{C}^1 s_{in}$ share of n's marg. exp. on good i

Proposition (Network Keynesian Multiplier)

The general equilibrium change in rst-period nal output dY^1 following a scal shock with partial equilibrium impact on rst-period nal output BY^1 is

$$dY^1 \qquad I \qquad \mathcal{C}\ m\ R_{L^1}\ \mathcal{L}^1 \quad I \quad \mathcal{X}^1 \quad {}^1 \quad {}^1 BY^1$$

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Intuition: Shock Ñ production Ñ labor rationed Ñ marg. consumption Ñ 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 Bh_n^1 onto rst-period HH incomes and total incidence $\sum_n Bh_n^1 = 1$,

$$1^T dY^1 = 1^T dG^1 \frac{1}{1 - \mathbb{E}_{\iota}[m_n]} \Big(\underbrace{\mathbb{E}_{\iota}[m_n]}_{\text{RA Keynesian effect}} + \underbrace{\mathbb{E}_{Bh^1}[m_n] - \mathbb{E}_{\iota}[m_n]}_{\text{Incidence effect}}$$

$$+ \underbrace{\mathbb{E}_{Bh^1}[m_n] \left(\mathbb{E}_{Bh^1}[m_n^{next}] - \mathbb{E}_{\iota}[m_n] \right)}_{\text{Biased spending direction effect}} + \underbrace{Cov_{Bh^1}[m_n, m_n^{next}]}_{\text{Homophily effect}} \Big) + O^3(|m|)$$

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

Network E ects: An Example

Two-household economy

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

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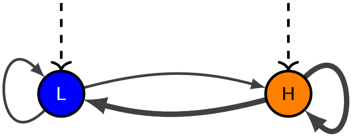
Case 1: Uniform incidence, neutral network



- *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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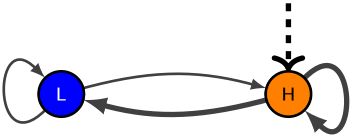
Case 2: Heterogeneous incidence, neutral network

- Initial transfer directed entirely to m_H



- Initial and higher "rounds" of multiplier are different

$$M \quad 1 \quad \frac{m_H}{1 \quad \overline{m}} \quad 1.71$$

Two-household economy

- High-MPC HH with $m_H \quad 0.5$. Low-MPC HH with $m_L \quad 0.1$
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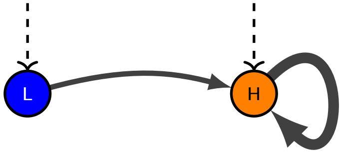
Case 3: Uniform incidence, biased network

- All marginal spending directed to sector employing m_H



- Higher "rounds" of multiplier propagates at m_H

$$M \quad 1 \quad \frac{\overline{m}}{1 \quad m_H} \quad 1.60$$

Two-household economy

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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

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

Data and Calibration

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Mapping model to data

"Sectors" = 51 states   55 industries (3-digit NAICS).

"Households" = state   income quintile   age quartile   gender   race + capitalists + foreigners

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Strategy to calibrate multiplier $I \quad \mathcal{C}^{1} m \, R_{L_1} \mathcal{L}^{1} \, p I \quad \mathcal{X}^{1} q \; ^{1} \; ^{1}$

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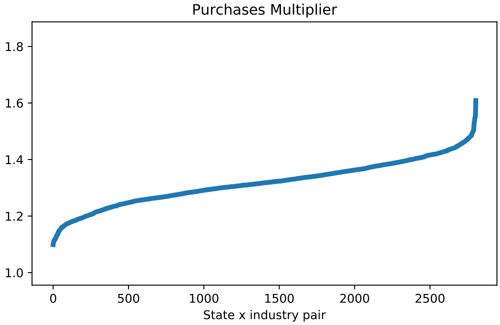
3. Directed MPC matrix ($\mathcal{C}^{1} m$) ▸ Details
   - Data: PSID + CEX for MPC estimation. ▸ Details CEX cons. basket by demog. CFS interstate trade.
   - Assumptions: Marg. cons. basket = avg. cons. basket. ▸ Validation Same interstate sourcing as firms.

Empirical Results

Large dispersion in government purchases, transfer multipliers



Aggregate government purchases multiplier: Response of GDP to GDP-proportional shock is 1.3

Amplification beyond original purchase varies by a factor of 6 depending on sector/state targeted

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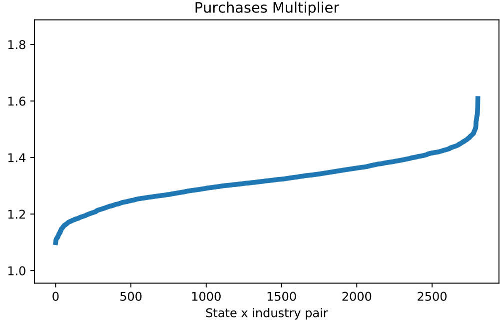

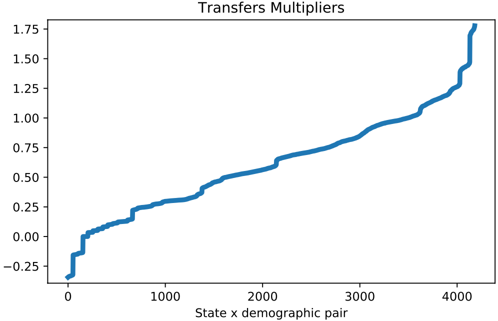

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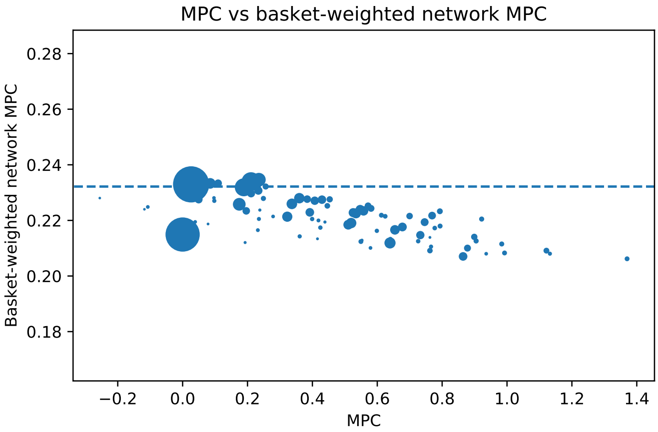
Uniform transfer multiplier: Transferring $1 to average HH increases GDP by 77 cents

▸ Sources of heterogeneity ▸ Counterfactuals

Incidence drives variation in multipliers



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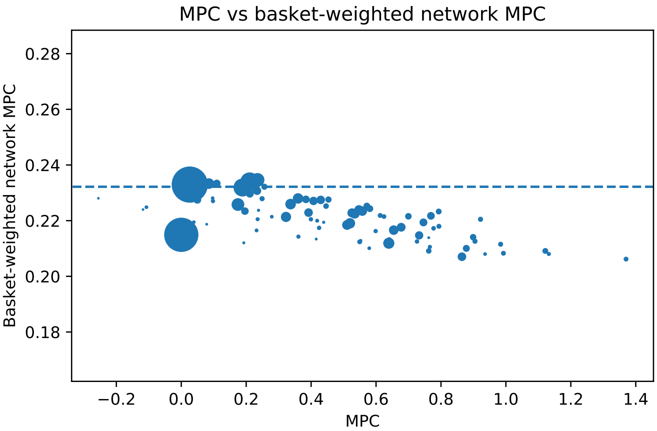

Observation 1: Basket-weighted network MPCs are very similar across population

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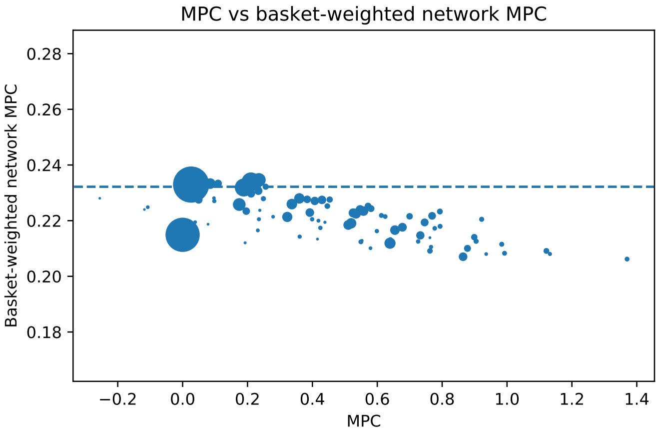

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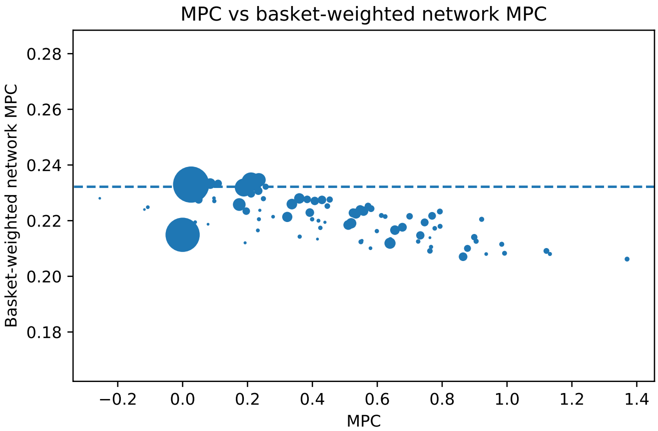

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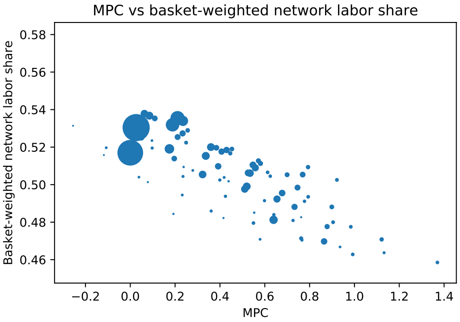
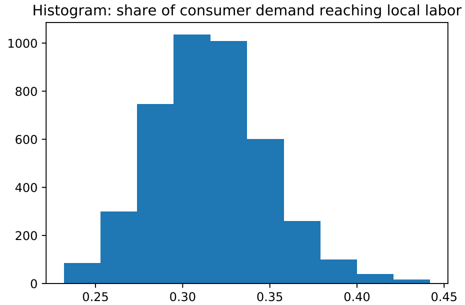
Ñ Bias and homophily terms are both close to 0 ▸ Robustness of empirical result

Understanding Bias and Homophily Terms: Two O setting E ects



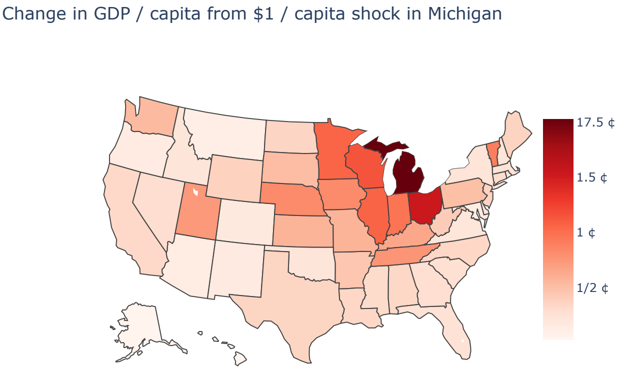


Empirical Fact 1: High MPC households consume from low labor share industries, creating negative homophily (Hubmer 2019)

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

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Theory + data

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

Takeaway

- Targeting scal 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 di ering MPCs

Historical and Counterfactual Exercis ▸ 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 multiplier Figure
2. The decline of the labor share: The fall in the labor share from 2000 to 2012 lead to smaller purchas multipliers Figure
3. Rising labor income inequality: Can change multipliers if it changes MPCs or shu es workers across industries/regions

Characterizing how targeting scal policy a ects welf Back

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Setting: Some amount of funds are available for scal spending, nancing for such spending is

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Question facing planner: how should they allocate funds across the economy?

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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 $_n$ on household n and chooses government spending (G) (and taxes ( ) to maximize total welfare

Proposition 1

The change in welfare dW due to a small change in taxes and government purchases in the rst peri can be expressed a

Formal Statement of Problem Optimal Policy

dW ¸ $\sum_{n \in N}$ $_n r_n$ looomooon d`1 looomoon d 1

Address under-emp. Make transfers

Where r_n = social value of transfers to n, $_n$ = labor wedge of household n.

Maximizing aggregate income through simple MPC targeting

Back

In the case where:

1. All labor is rationing to un(der)employed households, who have no marginal disutility of labor
2. Social value of transfers are equal across households
3. Bias and homophily e ects are 0

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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 ampli cation

Model Extensions: Multiple Time Perio Back

Allow set of periods $\mathcal{T} \subseteq \{1, \ldots, T\}$ in which labor is rationed

Proposition 2

For any small shock to fiscal policy inducing a partial equilibrium effect $BY^{\mathcal{T}}$ 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 $dY^{\mathcal{T}}$ is given by:

$$dY^{\mathcal{T}} \quad I \quad C^{\mathcal{T}} m^{\mathcal{T}} R_L^{\mathcal{T}} \, \mathcal{L}^{\mathcal{T}}_{\mathcal{T}} \, \left(I \quad X^{\mathcal{T}}\right)^{-1} \quad ^{-1} BY^{\mathcal{T}}$$

Shocks in each rationing period can influence output in other rationing periods

Need to consider intertemporal MPCs (Auclert et al 2018)

- Allow for xed rm-level markups on marginal cost $\frac{p_i^t}{1 \; p_i^t}$
- Now need to also ration dividends back to households
- Very similar result holds in this setting

Proposition 3

For any shock inducing a rst-period partial equilibrium e ect BQ, the general equilibrium response in production satis es:

$$dQ \quad X\!\!\!/ dQ \quad C_{`1} R^1_{L1} L^1 dQ^1 \quad C \; D \; p \, dQ \quad B \; Q$$

where C is the matrix of household directed MPCs out of pro t income, where D is the block diagonal matrix composed of $D^1{}_1$ and $D^2{}_2$ { which are each N I matrices with entries $D^t{}_i \, p^t q_n$ { and where p is the block diagonal matrix composed of p^1 and p^2 { themselves each diagonal matrices with entries p_i^t . All quantities are evaluated at the initial equilibrium.

Heterogeneous multipliers: Amplifying and dampening fo[Back]s

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

Heterogeneous multipliers: Amplifying and dampening forces

▸ Back

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- Covariance between worker MPCs and elasticity of income to changes in output

What dampens the heterogeneity in multipliers?

- IO links dilute the MPC of workers receiving marginal dollars

Full equilibrium conditions

Firm optimization

$$pX_i^t ; L_i^t q \;\; P \; \text{argmax}_{X;L} \; p_i^t F_i^t pX ; Lq \quad p^t \quad X \quad L$$

HH optimization

$$pc_n^1 ; c_n^2 ; \grave{}_n^2 q \;\; P \; \text{argmax}_{c^1;c^2;\grave{}^2} \; ¸_t \; {}^t u_n^t pc^t ; \grave{}^t q$$

$$\text{s.t.} \; ¸_t \frac{p^t \quad c^t \qquad {}_n^t \qquad \grave{}^t}{p1 \quad r q^t} \; ¤ \; 0 \qquad \text{and} \qquad \grave{}^1 \quad p^1 \quad c^1 \qquad {}_n^1 \; ¤ \; \underline{s}_n$$

Labor rationing

$$\grave{}_n^1 \qquad R_n ptL_i^1 uq$$

Market clearing

$$F_i^t pX_i^t ; L_i^t q \qquad ¸_n c_{n;i}^t \qquad ¸_j X_{j;i}^t \qquad G_i^t \qquad \text{and} \qquad ¸_i L_i^t \qquad ¸_n \grave{}_n^t$$

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Define:

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

Proposition 4

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

$$\mathbf{1}^T dY^1 = \underbrace{\frac{1}{1-E_{By^1}[m_n]}}_{\text{Incidence multiplier}} \underbrace{\left(E_{By^1}[m_n]\, E_{By^1}[b_n^{next}] + \frac{1}{1-E_{By^1}[m_n]} \underbrace{Cov_{By^1}(m_n, b_n^{next})}_{\text{Homophily effect}} \right)}_{\text{Biased spending direction effect}}$$

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Household Problem:

$$(\ell^2_n, c^1_n, c^2_n) \in \arg\max_{\ell^2, c^1, c^2} u^t_n(c^1, \ell^1_n) \quad {}_n u^t_n(c^2, \ell^2)$$
$$\text{s.t } p^1 c^1 \quad \frac{p^2 c^2}{1 \quad r} \quad {}^1_n \quad \frac{{}^2_n}{1 \quad r} \quad \ell^1_n \quad \frac{\ell^2}{1 \quad r}$$
$$\ell^1_n \quad p^1 c^1 \quad {}^1_n \geq \underline{s}_n$$

Social welfare for fiscal policy $(G, \quad)$:

$$W(G, \quad) \quad \sum_{n \in N} {}_n \; {}_n W_n(l^1_n(G, \quad), {}_n)$$

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

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Quantifying gains from targeting transfers: CARES Act ▸ Back

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Back

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

Quantifying gains from targeting transfers: CARES Act

Back

- Direct payments in CARES Act: $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

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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

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

In our model, increased GDP by 79 cents per dollar spent

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 househol lox^1on : sector i in state s uses $p x^{1}_{si;kj} q$ units of output from sector j in state k

pS Iq p S Iq

Use 2012 BEA make and use tables to construct national IO matrix

Use 2012 CFS microdata on to compute gross trade ows between all state pairs for tradable commodities

For nontradable sectors, we assume all production is within state

Estimating the Rationing Matrix

Back

$$R^{L}_{rn;si} = \underbrace{1_{r=s}}_{\text{Within State}} \; \underbrace{\alpha_{ir}}_{\text{Labor Share of Output}} \; \underbrace{\frac{y_{inr}}{y_{ir}}}_{\text{Income Shares}} \; \underbrace{\frac{1 - MPC_{n}}{1 - \overline{MPC}_{ir}}}_{\text{Rationing on MPCs}}$$

1. Assume all labor income earned within state where production takes place ($1_{r=s}$)
2. Compute labor shares of output from BEA for each sector and state (α_{ir})
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 (Patterson 2019)

   Figure

Estimating the Directed MPC Matrix

$\omega^{d}_{ri;sn}$: demographic n in state s's MPC for good i in state r

pS Iq p S Nq

$$MPC_{ri;sn} = \underbrace{\omega^{MPC}_{n}}_{\text{PSID/CEX MPC}} \; \underbrace{\omega_{ni}}_{\text{CEX Basket Share}} \; \underbrace{\omega_{irs}}_{\text{CFS Flow}}$$

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

Exploring constant consumption shares assumption

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

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Substantial MPC Heterogeneity Across Demographics

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

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Details of MPC Estimation

Following Gruber (1997) use panel structure of PSID:

$$C_{it} \quad \sum_{x} \beta \left(x \; E_{it} \quad x_{it} \quad x \quad x_{it} \right) \quad s(i)t \quad \varepsilon_{it}$$

- 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-dur consumption, demographic variables and CPI prices
- Assuming monotonicity, invert to predict total consumption in the PSID using demographics and food expenditure

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Relationship between MPC and Exposure to the Business Cycle

Figure: Earnings Elasticity and MPCs (Patterson 2019)

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Empirical irrelevance of the bias and homophily e ects is a robust fea
economy

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Regional Demand Linkages: Per Capita Spending

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IO linkages dampen the distribution of multipliers

IO linkages *narrow* the heterogeneity across sectors/states

Inputs dilutes the MPC of workers receiving marginal dollars

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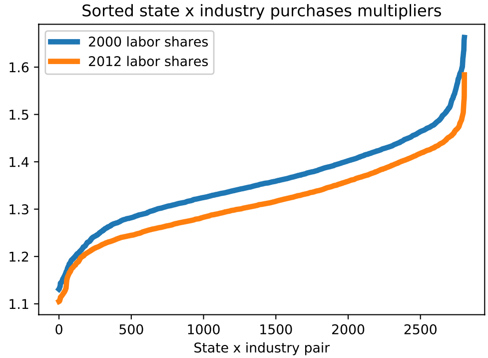
Multipliers and the decline of the labor share

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 E ect: 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 Ñ income-weighted average of marginal consumption is proportional to output.
- Households with different consumption bundles Ñ some households experience a greater change in income
- Those households have different MPCs from the average Ñ homophily possible.

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Special Case with No Network E ects

When does this collapse to classical Keynesian multiplier?

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

$$\mathbb{1}^T dY^1 = \frac{1}{1 - \mathbb{E}_y[m_n]} = \frac{1}{1 - m}$$

No matter where the shock hits, the aggregate consumption response is the same

Special case of this: single good and single household

Back

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_t^1; τ_t^2 and purchases G_t^1; G_t^2 solve the planner's problem. Now consider a change in policy $\tau_t(\varepsilon)$; $G_t(\varepsilon)$, indexed by ε. The following first-order condition holds:

$$0 = \underbrace{\lambda^T \mu WTP^1 (\gamma 1)^T \lambda^T \Delta \Gamma^1 (G_\varepsilon^1)}_{\text{Opportunistic government purchases}} + \underbrace{\frac{\lambda^T \mu (I - \phi) WTP^2 \quad \gamma 1^T \quad G_\varepsilon^2}{1 + r}}_{\text{Short-termist government purchases}}$$

$$+ \underbrace{(\lambda - \gamma 1)^T \mu \left(\tau_\varepsilon^1 + \frac{\tau_\varepsilon^2}{1+r}\right)}_{\text{Pure redistribution}} + \underbrace{\lambda^T \frac{\phi \mu \tau_\varepsilon^2}{1+r}}_{\text{Relaxation of borrowing constraints}}$$

$$+ \underbrace{\lambda^T \Delta \Gamma^1 \left(I \quad C_{\ell 1}^1 \Gamma^1 \right)^{-1} C_{\ell 1}^1 \quad \Gamma^1 G_\varepsilon^1 \quad \mu \tau_\varepsilon^1 \quad \frac{(1-\phi)(\ldots) \mu \tau_\varepsilon^2}{1+r}}_{\text{Keynesian stimulus (alleviation of involuntary unemployment)}}$$

where γ is the marginal value of public funds, $\Gamma^1 = (R_{L1}^1 (I - \ldots)^{-1})$, 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:

$$M \quad C^{1}_{`1} R_{L^{1}} L p^{1} \quad I \quad X p^{1} \quad ^{1}$$

Proposition 6

Consider a change in the economy such that M is replaced with $M^1 \quad M \quad "E$. The e ect on dY^1 of this change is given to rst order in " by:

$$\frac{d}{d''} dY^1 |_{'' \; 0} \quad pI \quad Mq^{\;1} EpI \quad Mq^{\;1} BQ^1$$

where BQ^1 generalizes BY^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