Markups, Labor Market Inequality and the Nature of Work

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Overview

- Goal: Develop a framework to understand how changes in markups affect income distribution:

    1. Profits versus labor

    2. Different types of workers

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  1. Profits versus labor
  2. Different types of workers

- Why? Markups central to trends and fluctuations in macroeconomic models
  - Long run: Trends in competition and technology
  - Short run: Monetary or demand shocks in New Keynesian models

Uses of Labor in a Modern Economy

- Two ways that workers contribute to generating revenue for firms
  1. Y-type labor: Marginal production of existing goods for sale in existing markets
  2. N-type labor: Facilitate expansion or replication into new goods or new markets

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  1. Moving along demand curves

     vs

  2. Shifting out demand curves

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  Markups shift input demand between factors

Outline

1. Theory: importance of N-type labor in Representative Agent model
   - Effect of markups on overall labor share versus profit share
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2. Measurement: extent and identity of N-type labor in US economy
   - Extent: co-movement of labor share and markup
   - Identity: co-movement of occupational income shares and aggregate labor share

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2. Measurement: extent and identity of N-type labor in US economy
    - Extent: co-movement of labor share and markup
    - Identity: co-movement of occupational income shares and aggregate labor share
3. Quantitative: quantify forces in Heterogeneous Agent model (NOT TODAY)
    - Short-run: distributional effects of monetary / demand shocks in HANK
    - Long-run: distributional effects of changes in market power and technology

Outline

1. Theory: Representative Agent Model

2. Measurement
   - Estimation Stage 1: Aggregate Parameters
   - Estimation Stage 2: Occupation-Specific Parameters

3. Conclusion

Upstream Sector

- Representative upstream producer hires production labor in a competitive market
- Produce a homogenous intermediate good Y that is sold in a competitive market

$$
\begin{aligned}
\Pi_U &= \max_{L_Y, Y} P_U Y - W_Y L_Y \\
&\quad \text{subject to} \\
Y &= Z_Y L_Y^{\theta_Y}
\end{aligned}
$$

- P_U: upstream price of intermediate goods
- Π_U: profits of upstream sector

Downstream Sector: Product Lines

- Measure 1 of downstream firms hire expansionary labor to manage product lines.
- Decide measure of product lines N to operate

$$
\begin{aligned}
\Pi_D &= \max_{L_N, N} \int_0^N \Pi_j dj - W_N L_N \\
&\text{subject to} \\
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$$

- Π_j: gross profits per product line j
- Π_D: net profits of downstream sector

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- Π_j: gross profits per product line j
- Π_D: net profits of downstream sector

Downstream Sector: Pricing

- Produce differentiated goods y_j using homogenous goods as only input
- Sell to consumers at price p_j, markup μ over marginal cost P_U
- Gross profits in each product line:

$$\begin{aligned}\Pi_j &= y_j(p_j)(p_j - P_U) \\ &= y_j(p_j)\, p_j \left(1 - \frac{1}{\mu}\right)\end{aligned}$$

- Results that follow apply to wide array of micro-foundations for μ

→ microfoundations for markups

Equilibrium Factor Shares

- Symmetric equilibrium: $p_j = p \; \forall j$, $y_j = y \; \forall j$
- Market clearing: $y N = Y \quad \Rightarrow \quad$ nominal GDP = pY

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Labor Share S_L	Production	$S_Y := \frac{W_Y L_Y}{pY}$	$\frac{1}{\mu}\theta_Y$
	Expansionary	$S_N := \frac{W_N L_N}{pY}$	$\left(1 - \frac{1}{\mu}\right)\theta_N$
Profit Share S_Π	Downstream	$S_D := \frac{\Pi_D}{pY}$	$\left(1 - \frac{1}{\mu}\right)(1 - \theta_N)$
	Upstream	$S_U := \frac{\Pi_U}{pY}$	$\frac{1}{\mu}(1 - \theta_Y)$

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  1. $\theta_N = 0 \quad \Rightarrow$ standard one-sector model

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  2. $\theta_Y = 1 \quad \Rightarrow$ only downstream profits, reflect rents from monopoly power

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- Special cases:
  1. $\theta_N = 0 \quad \Rightarrow$ standard one-sector model
  2. $\theta_Y = 1 \quad \Rightarrow$ only downstream profits, reflect rents from monopoly power
  3. $\theta_N = 1 \quad \Rightarrow$ only upstream profits, reflect rents from fixed factor

Observations About Markups

Q1: How do markups redistribute labor income between production vs expansionary labor ?

- $\mu \uparrow \Rightarrow S_Y \downarrow$: production labor is negatively exposed to markups
- $\mu \uparrow \Rightarrow S_N \uparrow$: expansionary labor is positively exposed to markups

- Implication for workers:
  - $\theta_N = 0$: Only production labor, all workers negatively exposed to markups
  - $\theta_N > 0$: Some expansionary labor, some workers positively exposed to markups

Observations About Markups

Q2: How do markups redistribute total income between profits and labor?

- Ambiguous effect on labor share S_L relative to profit share S_Π:

$$\frac{\partial S_L}{\partial \mu} \lesseqgtr 0 \text{ if and only if } \theta_N \lesseqgtr \theta_Y$$

- Co-movement of labor share S_L and markups μ informative about $\theta_N \lessgtr \theta_Y$

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- Co-movement of labor share S_L and markups μ informative about $\theta_N \lessgtr \theta_Y$
- One-sector NK models ($\theta_N = 0$):
  - Always negative co-movement between S_L and μ
  - Conversely always positive co-movement between S_Π and μ
- Result hinges on whether profits reflect rents from monopoly power or fixed factor

Taking Stock

- Questions:
  - Relative size of θ_N vs θ_Y: How much N-type labor?
  - Who performs N-type activities? Occupations, wages, etc
- Challenges: notion of N is abstract
  - Reflects activities that shift demand curves, most workers do some of each activity

Outline

Overview of Estimation

Estimation Stage 1: Aggregate Parameters: (θ_Y, θ_N)

- Co-movement of labor share and markups reveals relative size of (θ_Y, θ_N)
- Identify overall share of N-type labor from data on labor share and markup

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Estimation Stage 2: Occupation-specific Parameters

- Introduce notion of an occupation into framework
- Labor income shifts towards N-intensive occupations in response to a markup-induced increase in overall labor share
- Identify N-intensity of occupation from data on occupational income shares

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Identification of θ_Y, θ_N

- Introduce capital:

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\begin{aligned}
Y &= Z_Y \left(K_Y^{\alpha_Y} L_Y^{1-\alpha_Y}\right)^{\theta_Y} \\
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- Factor shares:

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- Assume all capital used in Y sector ($\alpha_N = 0$):

$$\boxed{S_L = \theta_N + \left[\theta_Y(1-\alpha_Y) - \theta_N\right]\frac{1}{\mu}}$$

- Intuition: Recover $\theta_N, (1-\alpha_Y)\theta_Y$ from levels of (μ, S_L) and sensitivity of S_L to μ
- Assumption on S_Π need to to recover α_Y

→ moment conditions

Labor Share Data

- Quarterly data from National Economic Accounts from BEA from 1947:Q1 - 2019:Q2
- Follow Gomme-Rupert (2004) to adjust for ambiguous components
- Mean $S_L = 65\%$. Of remaining 35%, assume $S_\Pi = 10\%$

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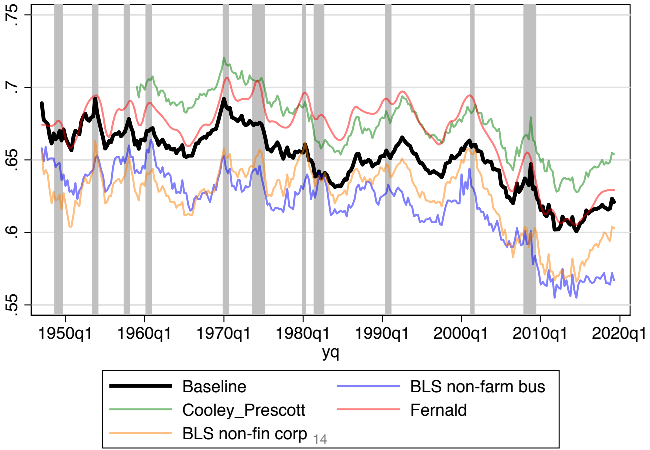

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Kaplan and Zoch (2020)

Markup Data

- Existing approaches inappropriate in our context
    1. Inverse labor share e.g. Bills(1987), Nekarda-Ramey(2019)
    2. Ratio estimator e.g. De Loecker-Warzynski(2012), De Loecker-Eeckhout-Unger(2019))

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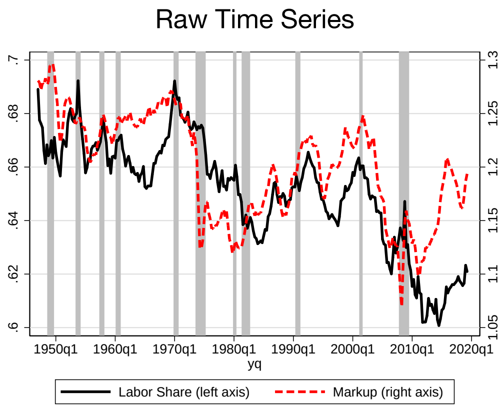
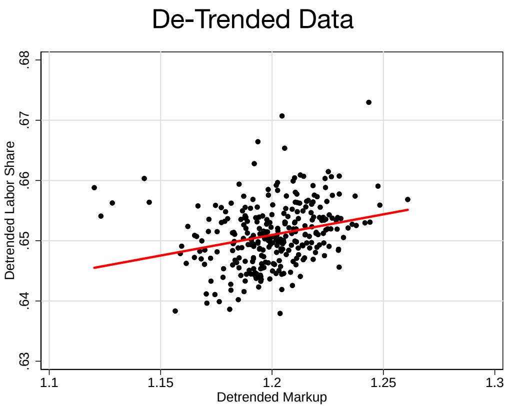
- Markup in model is ratio:
  - Downstream price: price of differentiated goods paid by consumers, over
  - Upstream price: price of undifferentiated goods produced by raw materials, capital and labor

- Ratio of PPI series produced by BLS similarly to Barro-Tenreyo(2006)
  - WPSFD49207: finished demand
  - WPSID61: processed goods for intermediate demand

- Assumption required about mean level of markup: baseline $E\left[\mu_t\right] = 1.2$

Labor Share and Markup Data





Estimates of Overall N-type Share

	(1) Baseline	(2) Low Profit Share	(3) High Profit Share	(4) Low Markup	(5) High Markup
θ_Y	0.934	0.994	0.874	0.908	0.963
	(0.005)	(0.005)	(0.005)	(0.001)	(0.008)
θ_N	0.730	0.730	0.730	0.741	0.721
	(0.024)	(0.024)	(0.024)	(0.027)	(0.021)
Implied value of $\frac{S_{N,L}}{S_L}$	19%	19%	19%	5%	29%
Assumed mean markup, μ	1.20	1.20	1.20	1.05	1.35
Assumed profit share, S_Π	10%	5%	15%	10%	10%
Capital share parameter, α_Y	0.32	0.36	0.27	0.29	0.35

Table: First stage estimation results

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Occupational Framework

- Fixed set of occupations, $j = 1 \ldots J$, each used in both sectors

$$L_Y = \prod_{j=1}^{J} L_{jY}^{\eta_{jY}}, \qquad L_N = \prod_{j=1}^{J} L_{jN}^{\eta_{jN}}, \qquad \sum_{j=1}^{J} \eta_{jY} = \sum_{j=1}^{J} \eta_{jN} = 1$$

- Labor market clearing in each occupation j: $L_j = L_{jY} + L_{jN} \quad \forall j$
  where L_j is labor supplied by workers in occupation j

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- Labor market clearing in each occupation j: $L_j = L_{jY} + L_{jN} \quad \forall j$
  where L_j is labor supplied by workers in occupation j

- Income share of labor in occupation j is a weighted sum of sectoral labor share

$$S_j = \eta_{jY} S_{Y,L} + \eta_{jN} S_{N,L}$$

- Define occupational labor income share of occupation j as $s_j = \frac{S_j}{S_L}$

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Kaplan and Zoch (2020)

Identification of $\{\eta_{jY}, \eta_{jN}\}_{j=1}^{J}$

- Occupations differ in terms of exposure to movements in overall labor share:

$$\boxed{s_j = \eta_{jY} + \left(\eta_{jN} - \eta_{jY}\right)\left(1 - \frac{\theta_Y\left(1-\alpha_Y\right)}{\theta_N}\right)^{-1}\left(1 - \theta_Y\left(1-\alpha_Y\right)\frac{1}{S_L}\right)\forall j}$$

- Recover $\{\eta_{jY}, \eta_{jN}\}_{j=1}^{J}$ from level of s_j and sensitivity of s_j to labor share S_L

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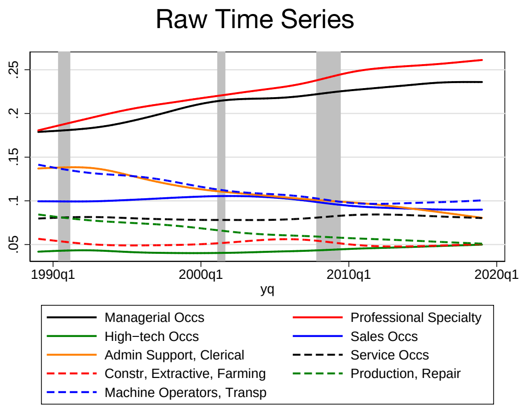
- Recover $\{\eta_{jY}, \eta_{jN}\}_{j=1}^{J}$ from level of s_j and sensitivity of s_j to labor share S_L

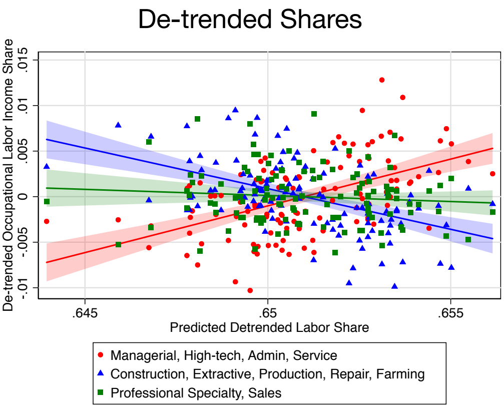
- Three possible sources of variation:

  1. De-trended Markup $\Rightarrow$ IV with de-trended markup as instrument for inverse labor share
  2. De-trended Labor Share: $\Rightarrow$ OLS with de-trended inverse labor share
  3. Lagged Monetary Policy Shocks $\Rightarrow$ IV with identified monetary policy shocks as instrument for inverse labor share → SVAR IRF

→ further details, moment conditions

Occupational Labor Shares





- Intuition for identification: right panel plots de-trended occupational income shares for three-broad groups against predicted de-trended overall labor share → CPS-ORG data

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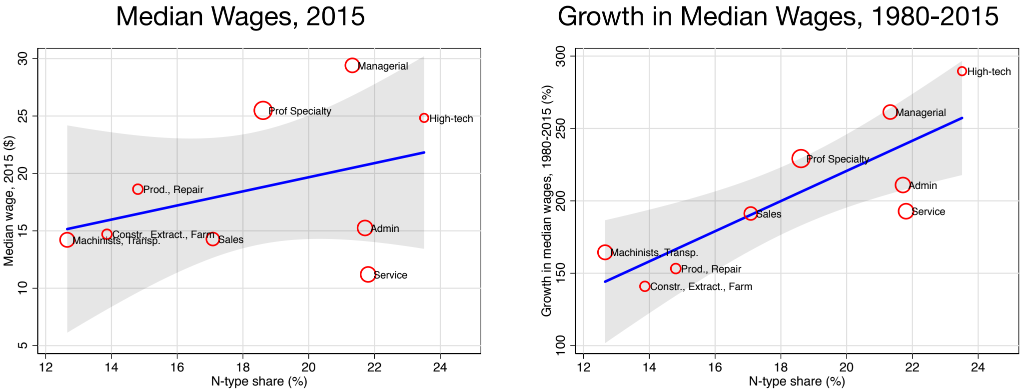
Baseline Estimates of Occupation N-intensity

		η_Y	η_N	P-val $\eta_Y = \eta_N$	Elasticity ε_{S_j, S_L}	Share $\frac{S_{jN}}{S_j}$
Panel A: Instrument: De-trended Markup (IV)						
High-tech Occs		0.041	0.055	0.027	3.38	24%
Service Occs		0.078	0.094	0.050	2.54	22%
Admin, Clerical		0.105	0.127	0.014	2.49	22%
Managerial Occs		0.206	0.243	0.007	2.30	21%
Prof. Specialty		0.227	0.226	0.909	0.96	19%
Sales Occs		0.100	0.090	0.083	0.21	17%
Production, Repair		0.068	0.051	0.022	-0.92	15%
Constr., Extract., Farm		0.054	0.038	0.014	-1.38	14%
Machinists, Transp.		0.121	0.076	0.002	-1.98	13%
First stage: R2	0.16					
First stage F	11.2					

Table: Stage 2 estimates of occupational factor share parameters

→ OLS: de-trended labor share
→ IV: monetary policy shocks

Characteristics of N-intensive Occupations



- Both high and low wages among N-intensive occupations
- N-intensive occupations experienced fastest wage growth
- Wage data from 1980 Census and 2015 ACS

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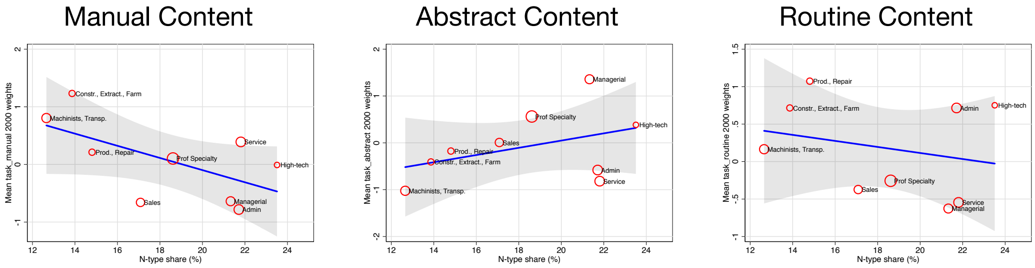
Kaplan and Zoch (2020)

Characteristics of *N*-intensive Occupations



- Broad task measures from Autor-Katz-Kearney (2006)

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Summary

- Differentiate between two uses of labor in a modern economy:
  - N-type expansionary activities
  - Y-type traditional production activities
- Co-movement of labor share with markup: $\sim 20\%$ of US labor income compensates N-type activities
- Co-movement of occupational shares with overall labor share: heterogeneity in N-intensity:
  - N-intensive occupations are those associated with white-collar jobs
  - Y-intensive occupations are those associated with blue-collar jobs
- N-intensive occupations experienced fasted wage and employment growth in last 35 years
- Recognizing labor's expansionary role:
  - Study distributional consequences of monetary policy, demand shocks and competition

THANK YOU !

Micro-foundations for the Markup

1. Monopolistic competition:
   - CES Dixit-Stiglitz: exogenous shifts in demand elasticity
   - Translog demand Feenstra, Bilbie-Melitz-Ghironi: changes in Z_N, Z_Y
   - Linear demand Melitz-Ottaviano: changes in Z_N, Z_Y
   - Sticky prices Blanchard-Kiyotaki: Calvo or Rotemberg
2. Oligopoly: Atkeson-Burstein, Jaimovich-Floettotto, Mongey
   - Bertrand or Cournot: changes in number of sellers of each variety
3. Limit Pricing: Milgrom-Roberts, Barro-Tenreyo
   - Change in fringe production cost
4. Product market search: Burdett-Judd, Alessandria, Kaplan-Menzio
   - Exogenous or endogenous changes in consumer search effort

→ back

Identification of θ_Y, θ_N

- Introduce deterministic trends in θ_Y, θ_N, μ, measurement error and shocks to S_L, μ

$$
\begin{aligned}
S_{L,t} &= \theta_{N,t} + \left[\theta_{Y,t}\left(1-\alpha_Y\right) - \theta_{N,t}\right]\frac{1}{\mu_t} + \epsilon_{L,t} \\
\theta_{N,t} &= g_{\theta_N}\left(\beta_{\theta_N}, t\right) \\
\theta_{Y,t} &= g_{\theta_Y}\left(\beta_{\theta_Y}, t\right) \\
\frac{1}{\mu_t} &= g_{\mu}\left(\beta_{\mu}, t\right) + \epsilon_{\mu,t}
\end{aligned}
$$

- Moment conditions for estimation

$$
\begin{aligned}
E\left[\epsilon_{L,t}\right] &= 0 \;\forall t \\
E\left[\epsilon_{L,\tau} | \epsilon_{\mu,t}\right] &= 0 \;\forall \left(t, \tau\right)
\end{aligned}
$$

→ back

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Identification of $\{\eta_{jY}, \eta_{jN}\}_{j=1}^{J}$

- Occupations differ in terms of exposure to movements in overall labor share:

$$\boxed{s_j = \eta_{jY} + (\eta_{jN} - \eta_{jY}) \left(1 - \frac{\theta_Y (1 - \alpha_Y)}{\theta_N}\right)^{-1} \left(1 - \theta_Y (1 - \alpha_Y) \frac{1}{S_L}\right) \forall j}$$

- Recover $\{\eta_{jY}, \eta_{jN}\}_{j=1}^{J}$ from level of s_j and sensitivity of s_j to labor share S_L

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Kaplan and Zoch (2020)

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- Recover $\{\eta_{jY}, \eta_{jN}\}_{j=1}^{J}$ from level of s_j and sensitivity of s_j to labor share S_L
- Empirical specification with trends and shocks:

$$\begin{aligned} s_{j,t} &= \eta_{jYt} + (\eta_{jNt} - \eta_{jYt}) \left(1 - \frac{\theta_Y (1 - \alpha_Y)}{\theta_N}\right)^{-1} \left(1 - \theta_Y (1 - \alpha_Y) \frac{1}{S_{Lt}}\right) + \epsilon_{s_j,t} \forall j \\ \eta_{jY,t} &= g_{\eta_{jY}}\left(\beta_{\eta_{jY}}, t\right) + \epsilon_{jY,t} \\ \eta_{jN,t} &= g_{\eta_{jN}}\left(\beta_{\eta_{jN}}, t\right) + \epsilon_{jN,t} \end{aligned}$$

Define $\epsilon_{j,t} := \left(\epsilon_{jY,t}, \epsilon_{jN,t}, \epsilon_{s_j,t}\right)$

Three Sources of Variation

1. De-trended Markup

$$E\left[\epsilon_{j,\tau} \,|\, \epsilon_{\mu,t}\right] = 0 \;\forall\,(t,\tau)\,,\;\forall j$$

$\Rightarrow$ IV with de-trended markup as instrument for inverse labor share

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1. De-trended Markup

$$E\left[\epsilon_{j,\tau} \mid \epsilon_{\mu,t}\right] = 0 \; \forall \left(t, \tau\right), \; \forall j$$

$\Rightarrow$ IV with de-trended markup as instrument for inverse labor share

2. De-trended Labor Share:

$$S_{L,t} = g_{S_L}\left(\beta_{S_L}, t\right) + \epsilon_{S_L,t}$$

$$E\left[\epsilon_{j,\tau} \mid \epsilon_{S_L,t}\right] = 0 \; \forall \left(t, \tau\right), \; \forall j$$

$\Rightarrow$ OLS with de-trended inverse labor share

$\rightarrow$ back

Three Sources of Variation

3. Lagged Monetary Policy Shocks

   Instrument Z_t that moves the markup

$$\frac{1}{\mu_t} = g_\mu\left(\beta_\mu, t\right) + \gamma Z_t + \epsilon_{\mu,t}$$

   with $\gamma \neq 0$, $E\left[Z_t\right] = 0$ and

$$E\left[\epsilon_{j,\tau} \middle| Z_t\right] = 0 \; \forall \left(t, \tau\right), \; \forall j$$

   $\Rightarrow$ IV with identified monetary policy shocks as instrument for inverse labor share

- Cantore-Ferroni-Leon-Ledesma (2020): counter-cyclical IRF of labor share to monetary policy shocks, peak response after 1-2 years, robust to identification schemes, country …
- Combine three series: Romer-Romer(2004), Miranda-Agrippino-Ricco(2018), Gertler-Karadi(2015)

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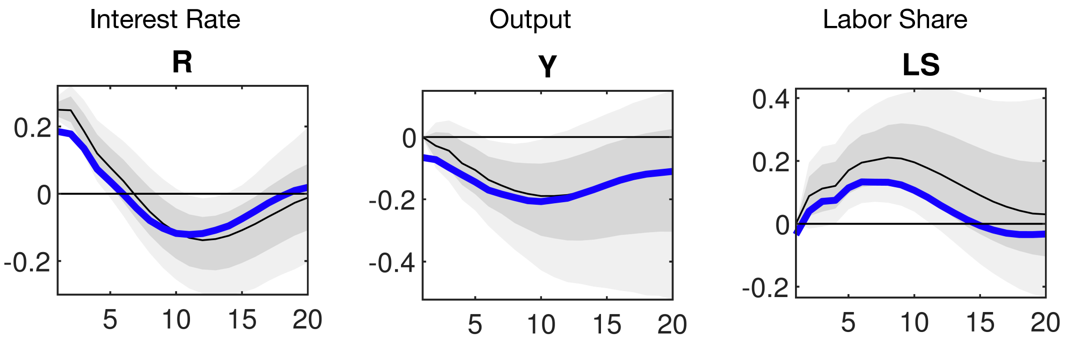
Impulse Response to Contractionary Monetary Policy Shock



- Impulse response from Cantore-Ferroni-Leon-Ledesma (2020)
- Blue line uses recursive identification scheme. Black line uses instruments from Romer and Romer (2004), Gertler and Karadi (2015) and Miranda-Agrippino (2016)

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Baseline Estimates of Occupation N-intensity

	η_Y	η_N	P-val $\eta_Y = \eta_N$	Elasticity ε_{S_j, S_L}	Share $\frac{S_{jN}}{S_j}$	P-val overid
Panel B: Instrument: De-trended Labor Share (OLS)						
High-tech Occs	0.043	0.046	0.194	1.60	20%	
Service Occs	0.080	0.082	0.398	1.19	19%	
Admin, Clerical	0.108	0.117	0.025	1.65	20%	
Managerial Occs	0.211	0.220	0.068	1.30	19%	
Prof. Specialty	0.227	0.228	0.731	1.05	19%	
Sales Occs	0.099	0.096	0.374	0.79	18%	
Production, Repair	0.065	0.062	0.122	0.58	18%	
Constr., Extract., Farm	0.052	0.047	0.021	0.17	17%	
Machinists, Transp.	0.115	0.102	0.000	0.13	17%	

Table: Stage 2 estimates of occupational factor share parameters

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Baseline Estimates of Occupation N-intensity

		η_Y	η_N	P-val $\eta_Y = \eta_N$	Elasticity ε_{S_j, S_L}	Share $\frac{S_{jN}}{S_j}$	P-val overid
Panel C: Instrument: Lagged Monetary Shocks (GMM)							
High-tech Occs		0.043	0.047	0.287	1.68	20%	0.214
Service Occs		0.079	0.088	0.022	1.80	20%	0.556
Admin, Clerical		0.105	0.126	0.000	2.39	22%	0.287
Managerial Occs		0.210	0.224	0.060	1.48	20%	0.650
Prof. Specialty		0.224	0.239	0.067	1.51	20%	0.341
Sales Occs		0.101	0.088	0.006	0.04	17%	0.222
Production, Repair		0.066	0.061	0.096	0.43	18%	0.670
Constr., Extract., Farm		0.054	0.039	0.001	-1.19	14%	0.437
Machinists, Transp.		0.117	0.092	0.000	-0.68	15%	0.244
First stage: R2	0.16						
First stage F	3.14						

Table: Stage 2 estimates of occupational factor share parameters

Estimates from a New Keynesian DSGE Model

- Modify Smets-Wouters (2007) to include N-type labor
- Re-estimate model using de-trended quarterly data on output, wages, consumption, investment, nominal interest rate and labor share from 1955-2007
- Posterior mode estimates:
  - $\alpha_Y = 0.36$
  - $\theta_Y = 0.88$
  - $\theta_N = 0.83$
  - $\mu = 1.30$
  - N-type share $= 25\%$
- Model generates counter-cyclical labor share in response to monetary policy shocks

→ DSGE IRF

Occupational Labor Share Data

Quarterly $s_{j,t}$

- Current Population Survey Outgoing Rotation Group data.
- January 1989 to December 2018. Monthly data aggregated to quarterly.
- Age > 15, employed.
- 389 OCC1990 occupation codes aggregated to 9 broad categories
- Seasonally adjusted.

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