Competition, Markups, and Inflation: Evidence from Australian Firm-Level Data

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- *How much of recent inflation is due to market power?*
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- Against background trends of increased sales concentration, etc.

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- This paper: quantifies extent to which rising profit margins amplify inflationary shocks in a New Keynesian model with variable markups.
- Supplement results from model with reduced-form evidence including firm- and industry-level passthrough regressions.

This Paper: Two Contributions

(1) *Model* parameterized to match key features of Australian micro data

- heterogeneous firms with endogenously variable markups, sticky prices
  (as in Baqaee, Farhi and Sangani 2023 JPE)
- key parameters estimated using model-implied cross-sectional relationship between firm-level sales shares and markups
  (as in Edmond, Midrigan and Xu 2023 JPE)
- estimated markups using production function techniques
  (as in De Loecker and Warzynski 2012 AER; Hambur 2023 Econ Record)

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(2) *Reduced-form evidence* from Australian firm- and industry-level data

- firm-level passthrough in retail
- industry-level passthrough for broader set of industries
  (as in Bräuning, Fillar and Joaquim 2023wp)
- industry-level changes in prices vs. changes in markups
  (as in Conlon, Miller, Otgon and Yao 2023 AEA P&P)

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  - but for substantial inflation amplification, need passthrough > 1, especially for high markup firms

- Reduced-form evidence reinforces this finding

  - firm- and industry-level passthrough typically < 1, no statistically significant increase in passthrough during covid period

  - negative correlation between industry-level price changes and markup changes in covid period

Model

Overview

- New Keynesian model
  - heterogenous firms, endogenously variable markups [Kimball demand]
  - sticky prices [Calvo friction]

- **Key new parameter**
  - *superelasticity of demand*, governs variable markups mechanism
  - if superelasticity > 0, markups are higher for firms with high sales shares, and passthrough < 1 and lower for high markup firms

Firms: Final Good

- Final good produced by competitive firms using bundle of intermediates.

- *Kimball aggregator*

$$\int_0^1 \Upsilon\left(\frac{y_i}{Y}\right) di = 1$$

where $\Upsilon' > 0$, $\Upsilon'' < 0$. CES is special case Υ a power function.

- Final good producers choose y_i for $i \in [0,1]$ to max

$$PY - \int_0^1 p_i y_i \, di$$

subject to the Kimball aggregator above.

Kimball Demand

- Inverse demand curve facing intermediate $i \in [0,1]$ given by

$$\frac{p_i}{P} = \Upsilon'(q_i)\, D, \qquad q_i := \frac{y_i}{Y}$$

- Price index, usual weighted average of prices

$$P = \int_0^1 p_i\, q_i\, di$$

- Demand index, inverse weighted average of marginal utilities

$$D = \left(\int_0^1 \Upsilon'(q_i)\, q_i\, di \right)^{-1}$$

Firms: Intermediate Producers

- Monopolistically competitive intermediate producers $i \in [0, 1]$.

- *Heterogenous in productivity*, $z_i \sim G(z_i)$, production technology

$$y_i = z_i \, x_i^{\alpha} \, l_i^{1-\alpha}, \qquad 0 < \alpha < 1$$

- Maximize profits

$$\pi_i = p_i y_i - R x_i - W l_i$$

subject to technology, demand curve, and pricing frictions.

- Absent pricing frictions, prices a markup μ_i over marginal cost

$$p_i = \mu_i \, \frac{\Psi}{z_i}, \qquad \Psi := \left(\frac{R}{\alpha}\right)^{\alpha} \left(\frac{W}{1-\alpha}\right)^{1-\alpha}$$

Flex-Price Markups and Passthrough

- Demand elasticity and sales share

$$\sigma(q_i) := -\frac{\Upsilon'(q_i)}{\Upsilon''(q_i)q_i}, \qquad \omega(q_i) := \frac{p_i y_i}{PY} \sim \Upsilon'(q_i)q_i$$

- *Markup* is then

$$\mu(q_i) = \frac{\sigma(q_i)}{\sigma(q_i) - 1}$$

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$$\mu(q_i) = \frac{\sigma(q_i)}{\sigma(q_i) - 1}$$

- *Passthrough coefficient* then works out to be

$$\rho(q_i) := -\frac{\partial \log p_i}{\partial \log z_i} = \frac{1}{1 + \sigma(q_i)\frac{\mu'(q_i)q_i}{\mu(q_i)}} = \frac{1}{1 - \mu(q_i)\frac{\sigma'(q_i)q_i}{\sigma(q_i)}}$$

Sticky Prices

- Log-linear model with Calvo friction, reset price for firm of size q_i

$$\ln p_{it}^* = (1-\theta\beta)\left[\bar{\rho}_i \ln \Psi_t + (1-\bar{\rho}_i)(\ln P_t + \ln D_t)\right] + \theta\beta\mathbb{E}_t\left[\ln p_{it+1}^*\right]$$

where $\bar{\rho}_i$ denotes steady-state passthrough for firm of size q_i.

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where $\bar{\rho}_i$ denotes steady-state passthrough for firm of size q_i.

- As in Baqaee, Farhi and Sangani (2023 JPE), implies inflation dynamics

$$\Delta \ln P_t = \beta \mathbb{E}_t\left[\Delta \ln P_{t+1}\right] + \lambda\left(\mathbb{E}_\omega[\bar{\rho}_i](\underbrace{\ln \Psi_t - \ln P_t}_{\text{real marginal cost}}) + \left(1 - \mathbb{E}_\omega[\bar{\rho}_i]\right)\ln D_t\right)$$

where $\mathbb{E}_\omega[\bar{\rho}_i]$ denotes the sales-weighted average

$$\mathbb{E}_\omega[\bar{\rho}_i] := \int_0^1 \bar{\rho}_i\, \bar{\omega}_i\, di, \qquad \text{and} \qquad \lambda := \frac{(1-\theta)(1-\theta\beta)}{\theta}$$

- Collapses to usual inflation dynamics if complete passthrough.

Aggregate TFP Dynamics

- With variable markups, relative price dispersion has first-order effects on aggregate TFP even local to zero inflation steady state.
- Reflects the cross-sectional dispersion in markups, i.e., *misallocation*

$$\ln Z_t = \ln \mathcal{M}_t - \mathbb{E}_\omega \big[\ln \mu_{it} \big]$$

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- Baqaee, Farhi and Sangani (2023 JPE) show that, for this setup, aggregate TFP dynamics are given by

$$\Delta \ln Z_t = \beta \mathbb{E}_t \big[\Delta \ln Z_{t+1} \big] - \lambda \ln Z_t + \lambda \bar{\mathcal{M}} \frac{\mathrm{Cov}_\omega [\bar{\sigma}_i, \bar{\rho}_i]}{\mathbb{E}_\omega [\bar{\sigma}_i]} \big(\ln \Psi_t - \ln P_t - \ln D_t \big)$$

- Collapses to zero TFP dynamics if constant passthrough.

Benchmark Parameterization

Kimball-Klenow-Willis Specification

- We use the Klenow-Willis (2016) version of the Kimball aggregator

$$\Upsilon'(q_i) = \frac{\bar{\sigma} - 1}{\bar{\sigma}} \exp\left(\frac{1 - q_i^{\varepsilon/\bar{\sigma}}}{\varepsilon}\right), \qquad \bar{\sigma} > 1$$

- Implies demand elasticity and passthrough coefficients

$$\sigma(q_i) = \bar{\sigma}\, q_i^{-\varepsilon/\bar{\sigma}}, \qquad \qquad \rho(q_i) = \frac{1}{1 + \frac{\varepsilon}{\bar{\sigma}}\mu(q_i)}$$

- *Superelasticity* $\varepsilon/\bar{\sigma}$ governs strength of variable markups mechanism.

- If $\varepsilon > 0$ larger firms face less elastic demand, set higher markups, and have passthrough < 1 that is lower the larger they are.

Key Cross-Sectional Moments

- Coefficients of log-linear model depends on *key cross-sectional moments*

$$\mathbb{E}_\omega[\,\bar{\sigma}_i\,], \qquad \mathbb{E}_\omega[\,\bar{\rho}_i\,], \qquad \mathrm{Cov}_\omega[\,\bar{\sigma}_i\,,\,\bar{\rho}_i\,]$$

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- Edmond, Midrigan and Xu (JPE 2023) show that we can write

$$f(\mu_i) = a + b\,\ln\omega_i, \qquad b = \frac{\varepsilon}{\bar{\sigma}}, \qquad f(\mu) := \frac{1}{\mu_i} + \ln\left(1 - \frac{1}{\mu_i}\right)$$

- Estimate $\varepsilon/\bar{\sigma} = \hat{b}$ using cross-sectional relationship between observed sales share ω_i and Hambur (2023) estimated markups $\hat{\mu}_i$.

Key Moments from BLADE

	$\varepsilon/\bar{\sigma}$	$\mathbb{E}_\omega[\hat{\rho}_i]$	$\mathbb{E}_\omega[\hat{\sigma}_i]$	$\mathrm{Cov}_\omega[\hat{\sigma}_i, \hat{\rho}_i]$
preferred production function $\hat{\mu}_i$ estimates (Hambur 2023)				
weighted mean	0.11	0.87	2.56	0.010
weighted percentiles				
25	−0.01	0.75	2.14	−0.001
50	0.13	0.85	2.47	0.001
75	0.26	1.01	2.90	0.016
simple cost-share $\hat{\mu}_i$ estimates				
weighted mean	0.10	0.80	5.16	0.270

How Much Amplification?

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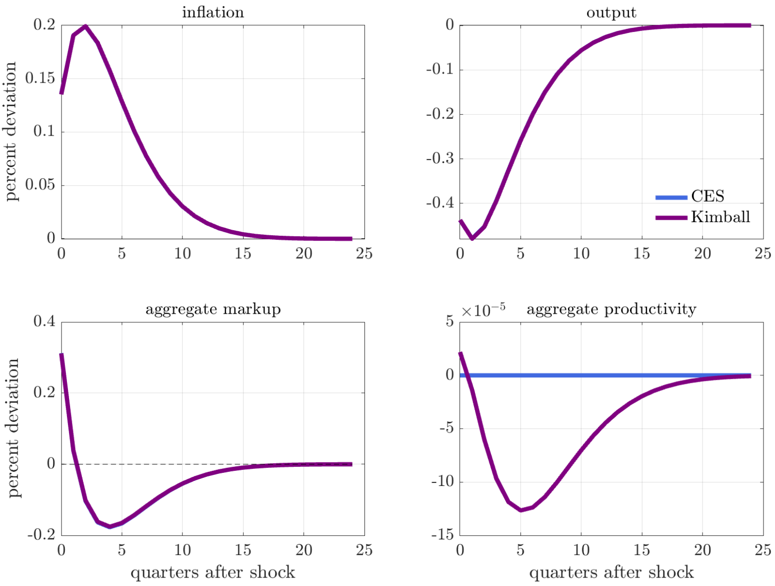
- *How much amplification does this mechanism generate?*

- Compare results to same model but with CES demand.

- Model lacks features needed to generate realistic impulse responses.

- Goal is to assess whether variable markups, when calibrated to Australian firm-level data, are a basic source of amplification of inflation dynamics.

Response to Cost Shock: Median BLADE



How Much Amplification?

- Measure inflation amplification by long run difference in log price levels

$$\lim_{t\to\infty} \ln \frac{P_t}{P_{t,ces}}$$

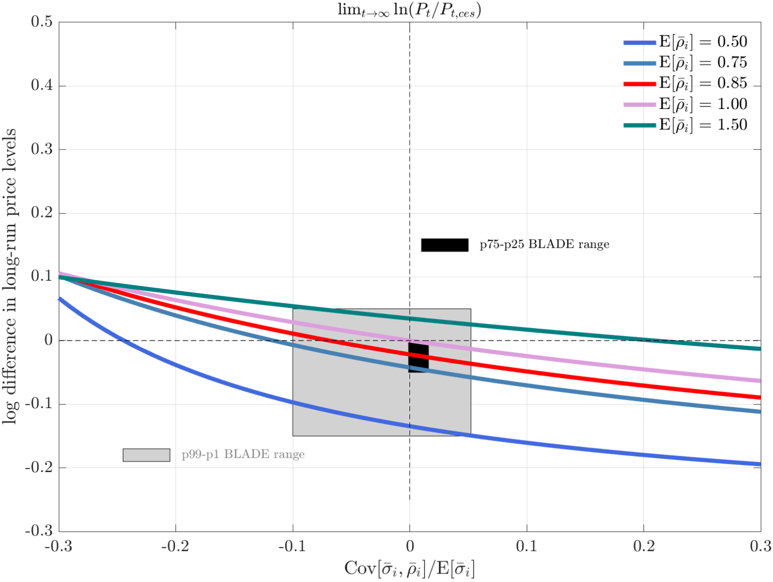
relative to same model but with CES demand.

- Benchmark parameterization: negligible amplification of cost shock.

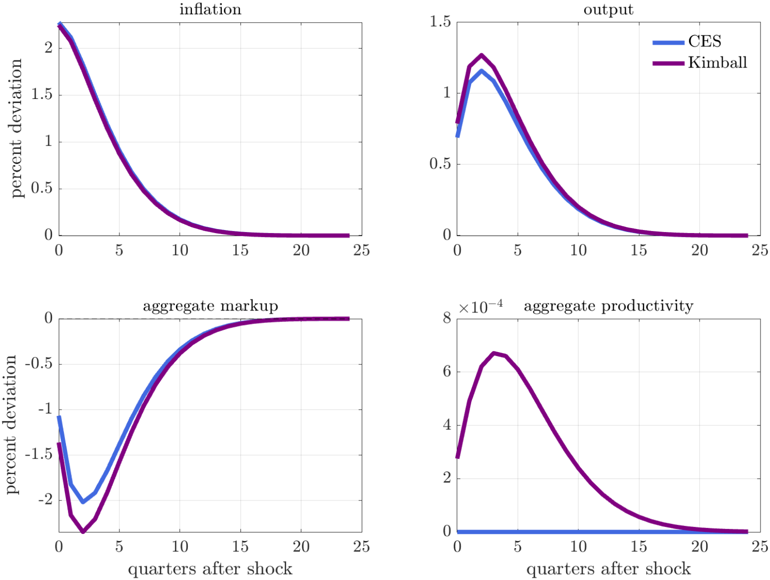
- Assess sensitivity by calculating amplification as function of key moments

$$\frac{\mathrm{Cov}_\omega[\bar{\sigma}_i, \bar{\rho}_i]}{\mathbb{E}_\omega[\bar{\sigma}_i]} \qquad \text{and} \qquad \mathbb{E}_\omega[\bar{\rho}_i]$$

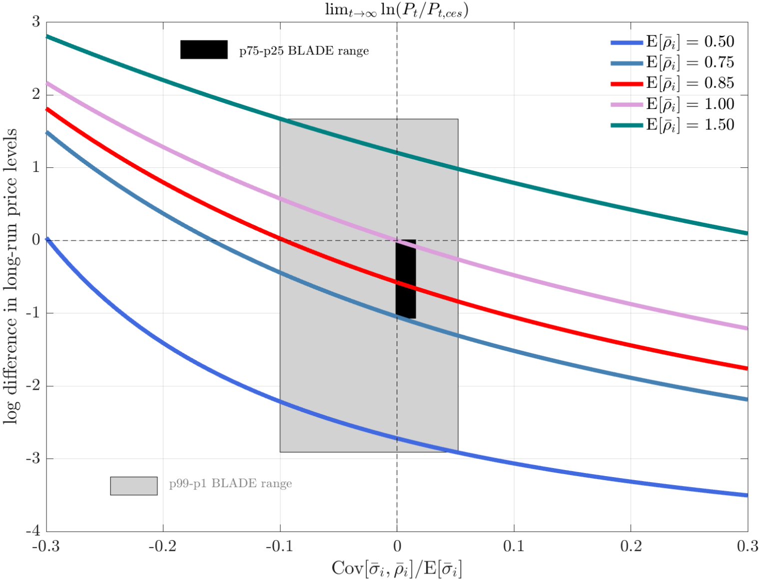
Inflation Amplification: Cost Shock



Response to Demand Shock: Median BLADE



Inflation Amplification: Demand Shock



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- When calibrated to median BLADE estimates, variable markups mechanism *is not a plausible source of inflation amplification.*

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- Can generate inflation amplification, but only for configurations where

$$\frac{\mathrm{Cov}_\omega[\bar{\sigma}_i, \bar{\rho}_i]}{\mathbb{E}_\omega[\bar{\sigma}_i]} < 0 \qquad \Leftrightarrow \qquad \frac{\varepsilon}{\bar{\sigma}} < 0 \qquad \Leftrightarrow \qquad \mathbb{E}_\omega[\bar{\rho}_i] > 1$$

- Superelasticity $\varepsilon/\bar{\sigma} < 0$ would mean that firms with low demand elasticity also have high passthrough [failure of '*Marshall's 2nd Law of Demand*'].

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- Median 4-digit estimate $\varepsilon/\bar{\sigma} = 0.13$. Large firms with low demand elasticity have *lower passthrough*, not higher, prevents amplification.

- Lower 25% 4-digit estimates are $\varepsilon/\bar{\sigma} < 0$, but it takes lowest 1% estimates to get quantitatively substantial amplification.

Passthrough Across 1-Digit Industries

	passthrough	*superelasticity*
agriculture	0.63	0.21
mining	0.82	0.08
manufacturing	0.87	0.08
utilities	0.83	0.09
construction	0.70	0.16
wholesale trade	0.77	0.12
retail trade	0.87	0.08
accommodation	0.96	0.02
transport	0.82	0.08
rental hire and real estate	0.74	0.09
professional services	0.76	0.12
administrative services	0.76	0.08
arts and recreation	0.76	0.13
other services	0.83	0.07

Reduced-Form Evidence

Firm-Level Prices and Profits

- Are increasing prices associated with increasing profits at the firm level?
- Webscraped product-level prices matched to BLADE tax data
  (Fink, Hambur and Majeed 2023wp)
- Sample of 60 retail firms, quarterly 2016-2022.
- Regress change in gross profit margins $\Delta \ln \pi_{it}$ on average change in prices

$$\Delta \ln \pi_{it} = \alpha_t + \beta \Delta \ln p_{it} + \varepsilon_{it}$$

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	full sample β	*split sample*
price change	−0.147***	−0.137
	(0.044)	(0.225)
price change×2019		0.0235
		(0.261)
price change×2020		0.056
		(0.245)
price change×2021		−0.178
		(0.241)
price change×2022		0.102
		(0.234)
R-squared	0.011	0.047
observations	742	742

Industry-Level Passthrough

- *Is passthrough higher in less competitive industries?*

- Industry-level passthrough regressions, GIV cost shocks (Bräuning, Fillar and Joaquim 2023wp)
  - residualize firm-level variable costs on extensive set of controls
  - aggregate to industry-level using lagged sales shares

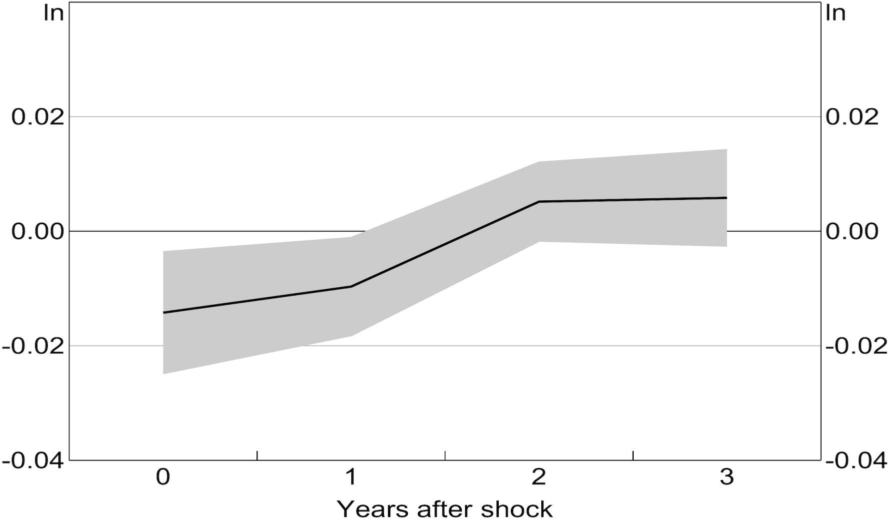
- Regress industry PPI on industry GIV cost shock and industry controls

$$\ln \mathrm{PPI}_{j,t+h} = \alpha_j^h + \alpha_t^h + \beta^h \, \mathrm{GIV}_{j,t} + \beta_\mu^h \, \mathrm{GIV}_{j,t} \times \mu_{j,t} + \boldsymbol{\gamma} \cdot \boldsymbol{x}_{j,t} + \varepsilon_{j,t}$$

- Passthrough is higher in less competitive industries *if interaction $\beta_\mu^h > 0$*.

Lower Passthrough in Less Competitive Industries

interaction coefficient β_{μ}^{h} *at horizons* $h = 0, 1, 2, 3$ *years*



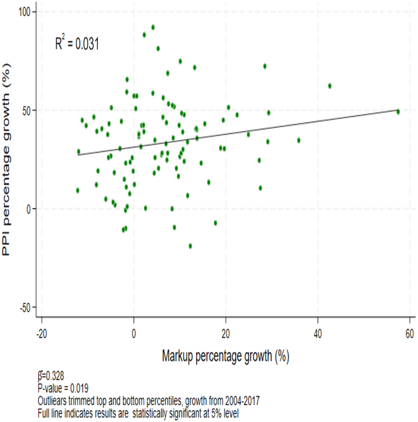
Industry-Level Markups and Price Changes

- *Do prices increase in industries where markups increase?*
- Conlon, Miller, Otgon and Yao (2023) regressions.
- Regress growth in industry-level markups on growth in PPI

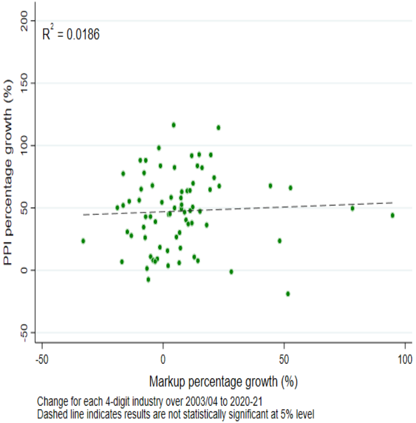
$$\Delta \ln \mu_j = \alpha + \beta \Delta \ln \text{PPI}_j + \varepsilon_j$$

for each 4-digit industry j for which we have PPI data.

Industry-Level Markups and Price Changes



2004–2017



2004–2021

Negative Correlation Since Covid

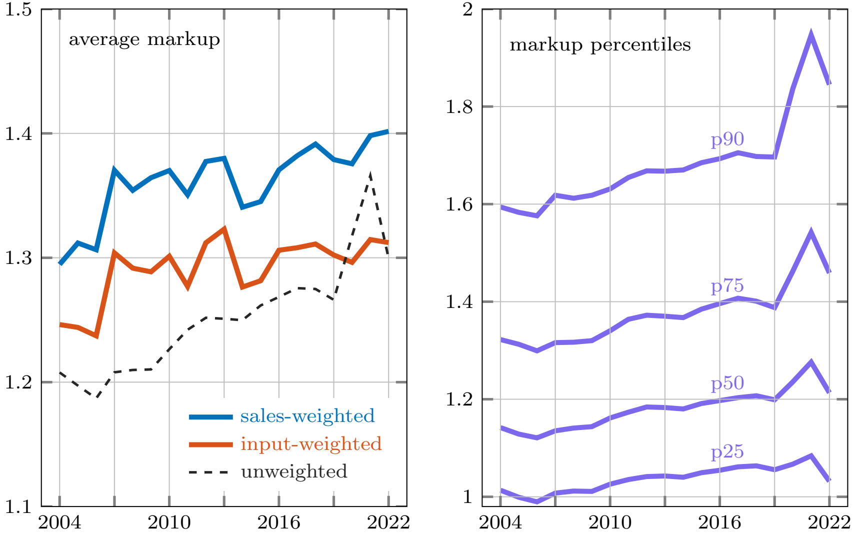
	unweighted	firm-weighted
benchmark sample 2004–2017		
coefficient	0.332**	0.367*
t-stat	(1.98)	(1.71)
R-squared	0.024	0.062
observations	104	104
covid sample 2019–2022		
coefficient	−0.214*	−0.522**
t-stat	(−1.69)	(−2.19)
R-squared	0.020	0.070
observations	90	90

Summary and Conclusions

- New Keynesian model parameterized to match firm-level relationship between markups and sales concentration in Australian micro data
  - estimated superelasticity of demand > 0, markups are higher for firms with high sales share
  - passthrough typically < 1, lower for high markup firms
  - implies that variable markups *dampen inflationary shocks*
- Reduced-form evidence reinforces this finding
  - passthrough typically < 1, no statistically significant increase in passthrough during covid period
  - negative correlation between industry-level price changes and markup changes in covid period
- *Rising profit margins are not a plausible source of inflation amplification.*

Spares

Markup Levels



Aggregate Markup and Aggregate Profits

- As in Edmond, Midrigan and Xu (2015 AER), can show aggregate markup is a *sales-weighted harmonic average* of firm-level markups

$$\mathcal{M} = \left(\int_0^1 \frac{\omega_i}{\mu_i} \, di \right)^{-1}, \qquad \omega_i := \frac{p_i y_i}{PY}$$

- Aggregate profits are then

$$\Pi = \int_0^1 \left(p_i - \frac{\Psi}{z_i} \right) y_i \, di = \left(1 - \frac{1}{\mathcal{M}} \right) PY$$

- Aggregate profit share moves one-for-one with aggregate markup.

Rest of the Model is Standard

- Aggregate production function

$$\ln Y_t = \ln Z_t + \alpha \ln X_t + (1-\alpha) \ln L_t$$

- Representative household labor supply, given goods market clearing

$$\ln W_t - \ln P_t = \gamma \ln Y_t + \varphi \ln L_t$$

- Representative household Euler equation, given goods market clearing

$$\mathbb{E}_t\left[\Delta \ln Y_{t+1}\right] = \frac{1}{\gamma}\left(i_t - \mathbb{E}_t\left[\Delta \ln P_{t+1}\right]\right)$$

- Interest rate rule

$$i_t = \phi_\pi \, \Delta \ln P_t + \phi_y \, \ln Y_t$$

Recover Passthrough Coefficients

- Given markup estimates, demand elasticities are

$$\hat{\sigma}_i = \frac{\hat{\mu}_i}{\hat{\mu}_i - 1}$$

- Given markup estimates and superelasticity estimate $\hat{b} = \varepsilon/\bar{\sigma}$, estimated passthrough coefficients are

$$\hat{\rho}_i = \frac{1}{1 + \hat{b}\hat{\mu}_i}$$

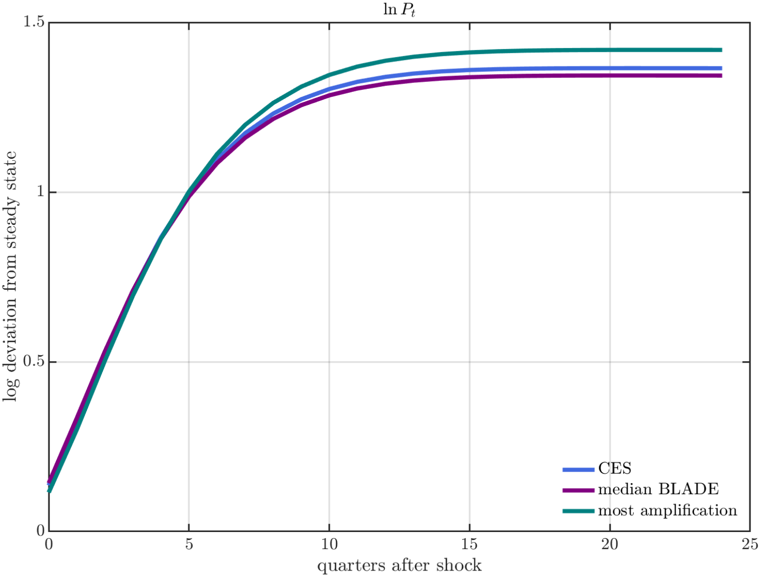
- Calculate the key cross-sectional moments that enter log-linear model

$$\mathbb{E}_\omega[\hat{\sigma}_i], \qquad \mathbb{E}_\omega[\hat{\rho}_i], \qquad \mathrm{Cov}_\omega[\hat{\sigma}_i, \hat{\rho}_i]$$

Benchmark Parameterization: Median BLADE

superelasticity	$\varepsilon/\bar{\sigma}$	0.13
average passthrough	$\mathbb{E}_\omega[\bar{\rho}_i]$	0.85
average demand elasticity	$\mathbb{E}_\omega[\bar{\sigma}_i]$	2.47
covariance	$\mathrm{Cov}_\omega[\bar{\sigma}_i, \bar{\rho}_i]$	0.001
aggregate markup	$\bar{\mathcal{M}}$	1.15
elasticity of output wrt nonlabor input	α	1/3
discount factor	β	0.99
intertemporal elasticity of substitution	$1/\gamma$	1
Frisch elasticity	$1/\varphi$	1
Calvo probability no price change	θ	2/3
interest rate rule coefficient inflation	ϕ_π	1.5
interest rate rule coefficient output	ϕ_y	0.5/4

Amplification Cost Shock



Amplification Demand Shock