Misallocation and Markups: Evidence from Indian Manufacturing

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Introduction

- Misallocation of resources can significantly reduce aggregate productivity

  "When capital and labor are hypothetically reallocated to equalize marginal products to the extent observed in the United States, we calculate manufacturing TFP gains of 30%–50% in China and 40%–60% in India." (Hsieh and Klenow 2009)

- Markups are a source of endogenous misallocation
- How important are markups for misallocation relative to capital and labor wedges?
- How much productivity gains can be achieved by removing exogenous wedges in the presence of endogenous markups?

Main Findings

- Markups account for a small fraction (<4%) of dispersion in revenue productivity
- However, the interactions between markups and wedges matter
- Models with variable markups generate a smaller total factor productivity gain (nearly 20% lower) than the canonical model with constant markups

Related Literature

- Misallocation, its impact, and sources: productivity effect (Restuccia and Rogerson 2008; Heish and Klenow 2009), financial frictions (Buera, Kaboski, and Shin 2011; Midrigan and Xu 2014; Moll 2014), adjustment costs (Asker, Collard-Wexler, and De Loecker 2014; Gopinath et al. 2017), managerial practices (Akcigit, Alp, and Peters 2016; Caselli and Gennaioli 2013), legal institutions (Boehm and Oberfield 2020), and variable markups (Baqaee and Farhi 2020; Edmond, Midrigan, and Xu 2021; Peters 2020).
- Welfare costs of markups: Dixit and Stiglitz (1977), Zhelobodko et al. (2012), Nocco, Ottaviano, and Salto (2014), Dhingra and Morrow (2019), Bilbiie, Ghironi, and Melitz (2019), Arkolakis et al. (2019), and Edmond, Midrigan, and Xu (2021).

Setup

- Preferences

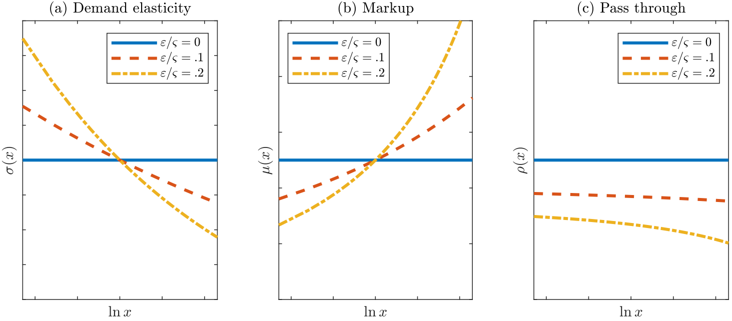
$$Y = \prod_{s=1}^{S} Y_s^{\eta_s} \quad \text{and} \quad \int_0^{n_s} \Upsilon\left(\frac{y_{si}}{Y_s}\right) di = 1, \tag{1}$$

- Klenow and Willis (2016) specification for the Kimball aggregator

$$\Upsilon(x) = 1 + (\varsigma - 1)\exp\left(\frac{1}{\varepsilon}\right)\varepsilon^{(\varsigma/\varepsilon)-1}\left(\Gamma\left(\frac{\varsigma}{\varepsilon}, \frac{1}{\varepsilon}\right) - \Gamma\left(\frac{\varsigma}{\varepsilon}, \frac{x^{\varepsilon/\varsigma}}{\varepsilon}\right)\right),$$

- Demand elasticity $\sigma(x) \equiv \frac{\Upsilon'(x)}{-\Upsilon''(x)x} = \varsigma x^{-\varepsilon/\varsigma}$
- Superelasticity $-\frac{d \ln \sigma(x)}{d \ln x} = \varepsilon/\varsigma$

Kimball Aggregator



- Markup $\mu(x) = \frac{\sigma(x)}{\sigma(x)-1}$
- Pass through $\rho(x) = \frac{1}{1+\frac{\mu'(x)x}{\mu(x)}\sigma(x)}$

Production

- A firm with productivity A_{si} uses capital k_{si} and labor l_{si} to produce output

$$y_{si} = A_{si} \left(\frac{k_{si}}{\alpha_s} \right)^{\alpha_s} \left(\frac{l_{si}}{1 - \alpha_s} \right)^{1-\alpha_s}$$

- Given the wage rate w, rental rate r, output distortion τ_{Ysi}, and capital distortion τ_{Ksi}, the firm maximizes profit:

$$\pi_{si} = \frac{1}{\tau_{Ysi}} p_{si} y_{si} - w l_{si} - \tau_{Ksi} r k_{si},$$

- subject to the individual demand

Aggregate Output

- The final output is a function of sectoral TFP A_s, capital K_s, and labor L_s:

$$Y = \prod_{s=1}^{S} \left(A_s K_s^{\alpha_s} L_s^{1-\alpha_s} \right)^{\eta_s},$$

where:

$$A_s = \left(\int_0^{n_s} \frac{y_{si}}{Y_s A_{si}} di \right)^{-1} \Delta_s \quad \text{and} \quad \Delta_s = \left(\int_0^{n_s} \lambda_{si} \frac{TFPR_s}{TFPR_{si}} di \right).$$

Data and Measurements

- India's Annual Survey of Industries (ASI) 2001-2008
- The basic survey unit is a plant, corresponding to a firm in the theory
- Key variables: each plant's industry (4-digit National Industry Classification), labor compensation, value added, and the book value of the fixed capital stock

Calibration

- Set the rental rate to $r = 10\%$, wage rate to $w = 1$, and obtain capital's share α_s from NBER Productivity Database (Hsieh and Klenow 2009)
- Estimate superelasticity ε using the relation between Lerner markups and market shares (Edmond, Midrigan, and Xu 2021)
- Calibrate ς to match the aggregate profit margin (Blaum, Lelarge, and Peters 2018)

Estimation

- Recover theory-consistent markups from the relation between markups and market shares ‣ Markup

$$\lambda_{si} = D_s \left(\frac{\varsigma}{e}\right)^{\varsigma/\varepsilon} \left[\left(1 - \frac{1}{\mu_{si}}\right) \exp\left(\frac{1}{\mu_{si}}\right)\right]^{\varsigma/\varepsilon}. \tag{2}$$

- Recover capital and output distortions using first-order conditions

$$\tau_{Ksi} = \frac{\alpha_s}{1-\alpha_s} \frac{wl_{si}}{rk_{si}},$$

$$\tau_{Ysi} = \frac{1}{\mu_{si}} \frac{(1-\alpha_s)\, p_{si} y_{si}}{wl_{si}}.$$

- Recover productivity by normalizing cutoff productivity to one

$$A_{si} = \frac{P_s}{c_{si}} \tau_{Ysi} \left(\tau_{Ksi}\right)^{\alpha_s}.$$

- Estimate the joint distribution of productivity and distortions using truncated lognormal maximum likelihood estimators ‣ Model fit

Counterfactuals

- Consider a liberalization that collapses idiosyncratic distortions at the firm level to their industry averages
- Calculate potential gains from reallocation using theory and simulation

TFPR Dispersions

Table: Revenue-based total factor productivity dispersion

		2001	2004	2008
Preliberalization	Total	42.2	40.8	40.1
	Markup	1.6	1.5	1.6
	The rest	40.6	39.4	38.5
Postliberalization	Total	2.0	1.9	2.0
	Markup	2.0	1.9	2.0
	The rest	0.0	0.0	0.0
Remaining (%)		4.7	4.7	5.0

- Dispersion in revenue productivity across firms is commonly used to measure misallocation
- Markups account for a small fraction ($<4\%$) of dispersion in revenue productivity

TFP Gains

Table: Total factor productivity gains

Preference	2001	2004	2008
Kimball	121.1	114.2	108.4
Constant elasticity of substitution	156.5	138.6	132.4

- The baseline model with variable markups predicts substantial gains from liberalization (114% in 2004)
- However, the TFP gains predicted by the canonical model with constant markups are even higher (139% vs 114%)
- The presence of variable markups lowers TFP gains by nearly (114/139-1=) 20 percent

Further Analysis

- Illustration of incomplete pass-throughs
- Incomplete pass-through versus diminishing returns
- Sensitivity: demand elasticity, superelasticity
- Robustness: free entry, Dotsey-King specification, translog preferences, quadratic preferences, oligopoly competition

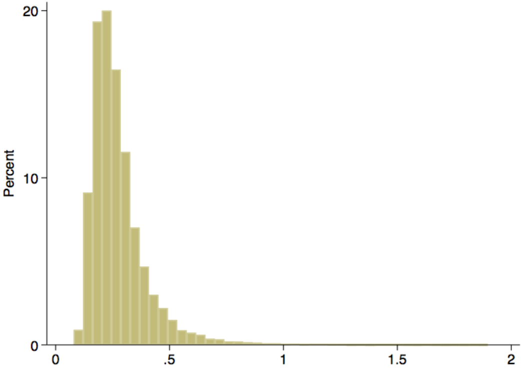
Conclusion

- Markups account for a small fraction of dispersion in revenue productivity
- But they shave a large fraction of TFP gains from those predicted by canonical models
- Information about the cross-sectional variations in revenue productivity alone is unlikely to be sufficient for inferring TFP gains from reallocation

Appendix

Markup

Figure: Distribution of markups



Notes: This figure shows the distribution of markups (in log terms) at the firm level in 2004. Markup is estimated from the data using equation (2).

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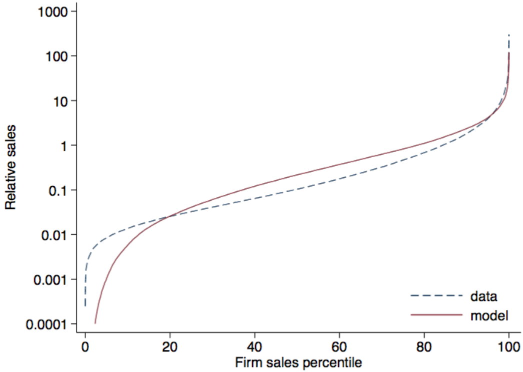
Model Fit

Figure: Distribution of firm sales



Notes: The dashed blue line depicts the distribution of firm sales relative to the average sales of firms in the industry across different percentiles for manufacturing firms in India in 2004. The solid red line shows the model's predictions for the distribution of relative firm sales across different percentiles.

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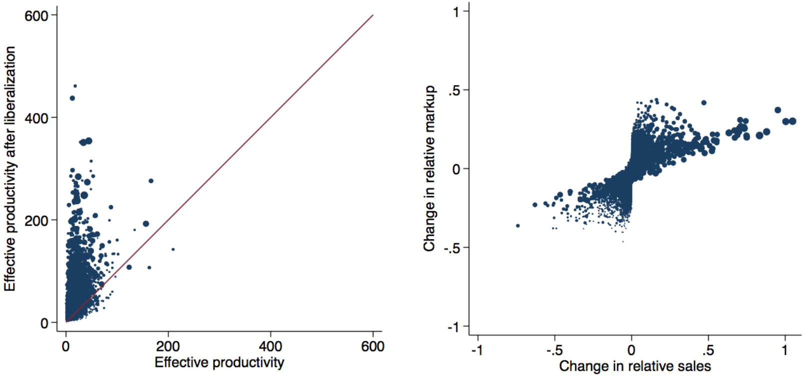
Incomplete Pass-throughs

Figure: Productivity and markup response to liberalization



(a) productivity (b) markup

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Diminishing Returns

- With complete pass-throughs, the first-order effect of productivity on allocation is $d \ln (y_\theta / Y) = \sigma_\theta d \ln A_\theta$.
- If more productive firms have lower demand elasticities, their relative outputs will be lower than those under CES preferences.
- Thus, social planners are unable to reallocate as many resources to firms with high productivity and relative quantity as they could if consumer preferences were CES.

Incomplete Pass-through versus Diminishing Returns

Table: Baseline total factor productivity gains

Preference		2001	2004	2008
Kimball	Market allocation	121.1	114.2	108.4
	Planner allocation	137.2	129.1	127.0
CES	Market/planner allocation	156.5	138.6	132.4

- Incomplete pass-throughs lower aggregate productivity by 15 percent
- Diminishing returns reduce aggregate productivity by 10 percent
- Markup-led misallocation is about 1.5 times larger than the effect of diminishing returns

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Sensitivity: Demand Elasticity

Preference		2001	2004	2008
Panel A: Baseline calibration				
Kimball	Market allocation	121.1	114.2	108.4
	Planner allocation	137.2	129.1	127.0
CES	Market/planner allocation	156.5	138.6	132.4
Panel B: Matching structural parameter				
Kimball	Market allocation	93.5	91.6	79.6
	Planner allocation	111.3	105.1	102.5
CES	Market/planner allocation	159.1	138.7	138.3
Panel C: Matching aggregate markup				
Kimball	Market allocation	132.5	122.5	123.0
	Planner allocation	149.6	138.0	146.1
CES	Market/planner allocation	152.2	137.8	139.6

Notes: Panel A $\varsigma = 3.43$. Panel B $\varsigma = 2.92$. Panel C $\varsigma = 3.62$.

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Sensitivity: Superelasticity

Preference		2001	2004	2008
Panel A: Baseline calibration				
Kimball	Market allocation	121.1	114.2	108.4
	Planner allocation	137.2	129.1	127.0
CES	Market/planner allocation	156.5	138.6	132.4
Panel B: High superelasticity				
Kimball	Market allocation	82.1	104.4	97.2
	Planner allocation	135.0	139.7	143.7
CES	Market/planner allocation	171.4	145.9	154.8
Panel C: Low superelasticity				
Kimball	Market allocation	128.5	119.7	117.3
	Planner allocation	133.7	128.9	127.5
CES	Market/planner allocation	148.9	136.4	134.2

Notes: Panel A $\varepsilon/\varsigma = 0.14$. Panel B $\varepsilon/\varsigma = 0.2$. Panel C $\varepsilon/\varsigma = 0.1$.

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Robustness: Free Entry

Preference		2001	2004	2008
Kimball w/ free entry	Market allocation	120.9	113.1	106.5
	Planner allocation	126.2	118.8	113.3
CES	Market/planner allocation	156.5	138.6	132.4

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Robustness: Dotsey-King Specification

Preference		2001	2004	2008
Dotsey–King	Market allocation	134.5	123.0	116.9
	Planner allocation	137.7	126.0	121.0
CES	Market/planner allocation	156.5	138.6	132.4

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Robustness: Translog Preferences

Preference		2001	2004	2008
Translog	Market allocation	115.7	108.2	102.3
	Planner allocation	117.1	110.1	106.2
CES	Market/planner allocation	156.5	138.6	132.4

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Robustness: Quadratic Preferences

Preference		2001	2004	2008
Quadratic	Market allocation	64.5	62.6	58.1
	Planner allocation	88.6	86.7	86.9
CES	Market/planner allocation	156.5	138.6	132.4

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Robustness: Oligopoly Competition

Competition		2001	2004	2008
Oligopoly w/ CES	Market allocation	119.1	113.7	104.8
	Planner allocation	139.6	133.6	129.2
Monopolistic w/ CES	Market/planner allocation	156.5	138.6	132.4

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