

Misallocation: Recent advances and applications

Pete Klenow

STEG Macro Development Course

March 2021

- 1 Definition and simple model
- 2 Examples of misallocation
- 3 Five facts about misallocation
- 4 Datasets on firms and plants
- 5 Overview of the recent literature

My definition of misallocation

Misallocation exists if a social planner could implement budget-neutral targeted taxes and subsidies to induce the reallocation of inputs across activities (e.g., across products, firms or occupations) in a way that would increase the welfare of a representative agent.

Example: taxing polluting activities and subsidizing non-polluting activities.

This is just the efficiency of resource allocation — all of economics is about this! Well, at least the half of economics that is not about welfare across heterogeneous individuals. One might want to suffer some misallocation if it raises average welfare.

“could implement” rules out things like repealing gravity to eliminate transportation costs

“could implement” also requires that the government observes its targets

- $Y = \left(\sum_{i=1}^M Y_i^{1-\frac{1}{\sigma}} \right)^{\frac{1}{1-\frac{1}{\sigma}}}$, $P = \left(\sum_{i=1}^M P_i^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$
- $Y_i = A_i L_i$
- $\max (1 - \tau_i^Y) P_i Y_i - w L_i$
 - ▶ Monopolistic competitor takes w , Y , and P as given
- $L = \sum_{i=1}^M L_i$
- Exogenously fixed L and M

Simple model results

- $P_i = \left(\frac{\sigma}{\sigma - 1} \right) \times \left(\tau_i \cdot \frac{w}{A_i} \right)$, where $\tau_i \equiv \frac{1}{1 - \tau_i^Y}$
- $\text{TFPR}_i \equiv \frac{P_i Y_i}{L_i} \propto \tau_i \neq A_i \equiv \text{TFPQ}_i$
- $\text{TFP} \equiv \frac{Y}{L} = \left[\sum_{i=1}^M A_i^{\sigma-1} \left(\frac{\tau_i}{\tau} \right)^{1-\sigma} \right]^{\frac{1}{\sigma-1}}$
- $(A_i, \tau_i) \sim LN(\mu_A, \mu_\tau, \sigma_A^2, \sigma_\tau^2, \sigma_{\tau A}) \Rightarrow \log(\text{TFP}) = \mu_A + \frac{\sigma - 1}{2} \cdot \sigma_A^2 - \frac{\sigma}{2} \cdot \sigma_\tau^2$

Lessons from the simple model

- Wedges (τ 's) show up in TFPR
- TFPR \neq TFPQ (so do not use the former to proxy for the latter)
- Aggregate TFP is decreasing in the dispersion of wedges (more so with higher σ)
- Aggregate TFP is unrelated to the mean wedge (in this static model)
- Aggregate TFP is increasing in the dispersion of TFPQ because $\sigma > 1$

- Can infer Y from revenue by inverting the demand curve: $Y_i \propto (P_i Y_i)^{\frac{\sigma}{\sigma-1}}$
 - ▶ Captures quality as well as quantity
- Then $\text{TFPQ}_i = Y_i/L_i$
 - ▶ Composite of process efficiency and quality
- If also have data on physical quantities Q_i , can infer process efficiency from Q_i/L_i
- Can then estimate quality separately from process efficiency as TFPQ_i/Q_i

- Physical capital (e.g. Hsieh and Klenow, 2009)
- Intermediate inputs (e.g., Bils, Klenow and Ruane, 2020)
- Wedges on all inputs (HK 2009, BKR 2020)
- Overhead costs (Bartelsman, Haltiwanger and Scarpetta, 2013 AER)
- Entry costs (Dhingra and Morrow, 2019 JPE)

Harder (but still doable) generalizations

- Financial frictions
 - ▶ Buera, Kaboski and Shin (2011 AER), Moll (2014 AER), Midrigan and Xu (2014 AER)
- Adjustment costs
 - ▶ Asker, Collard-Wexler and De Loecker (2014 JPE), David and Venky (2019 AER)
- VES instead of CES (Dhingra and Morrow 2019; Edmond, Midrigan, and Xu 2019)
- Arbitrary input-output network and RTS (Baqae and Farhi, 2020 QJE)
- Endogenous TFPQ (HK 2014 QJE, Bento and Restuccia AEJ-Macro 2017)

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TFPR dispersion due to ...

- Measurement error in revenue or inputs
- Unavoidable adjustment costs and transportation costs
- Differential riskiness of investments in capital, R&D, etc.
- Compensating differentials for labor (amenities and disamenities)
- Misspecification of the production function
 - ▶ E.g., ignoring heterogeneity in production elasticities or overhead costs

TFPR dispersion due to ...

- Tax rate differences across firms (e.g., lower tax rates for oil and gas firms)
- Size-dependent regulations (e.g., firing restrictions on bigger firms)
- Price markup differences across products (e.g., Apple vs. Samsung smartphones)
- Wage markdown differences across firms (e.g., Apple and Google collusion)

Other potential sources of misallocation

- Discrimination
 - ▶ Labor market, lending, housing, school admissions/funding
- Financial frictions, state-owned banks, cronyism
- Efficiency wages in some firms or industries relative to others
- Licensing, entry, and land use restrictions
- Under- or over-investment in public R&D, infrastructure, etc.
- Externalities (positive or negative)

The Allocation of Talent in the U.S. 1/2

Share of each group in *high-skilled occupations*: lawyers, doctors, engineers, scientists (excluding social scientists), architects, mathematicians and executives/managers

	1960	2018
White men	18.8%	26.3%
White women	5.3%	21.2%
Black men	2.5%	15.5%
Black women	1.3%	15.8%

Source: U.S. Census data; Hsieh, Hurst, Jones and Klenow (2019 ECMA)

- Consistent with falling discrimination in the U.S. from 1960 to 2010
- Possible comparative advantage and human capital investment gains
- May have accounted for 40% of growth in GDP per capita
- And 25% of growth in GDP per worker (the difference due to rising participation)
- Repeatable? Maybe so, especially in research

Source: Hsieh, Hurst, Jones and Klenow (2019)

Decomposing TFPR with multiple inputs

- $\text{TFPR}_i \equiv \frac{P_i Y_i}{(K_i^\alpha L_i^{1-\alpha})^\gamma X_i^{1-\gamma}}$
 - ▶ PY here is gross output, K is physical capital, and X are intermediates
- Equivalently, $\text{TFPR}_i \equiv [\text{VAPK}_i^\alpha \text{VAPL}_i^{1-\alpha}]^\gamma \text{VAPX}_i^{1-\gamma}$
 - ▶ where $\text{VAPK} \equiv \frac{PY}{K}$, $\text{VAPL} \equiv \frac{PY}{L}$, and $\text{VAPX} \equiv \frac{PY}{X}$
- VAPK refers to the Value of the Average Product of Capital, and so on
- $\text{VAPK} \propto \text{VMPK} \propto \text{MRPK}$ *only if* Cobb-Douglas and equal markups

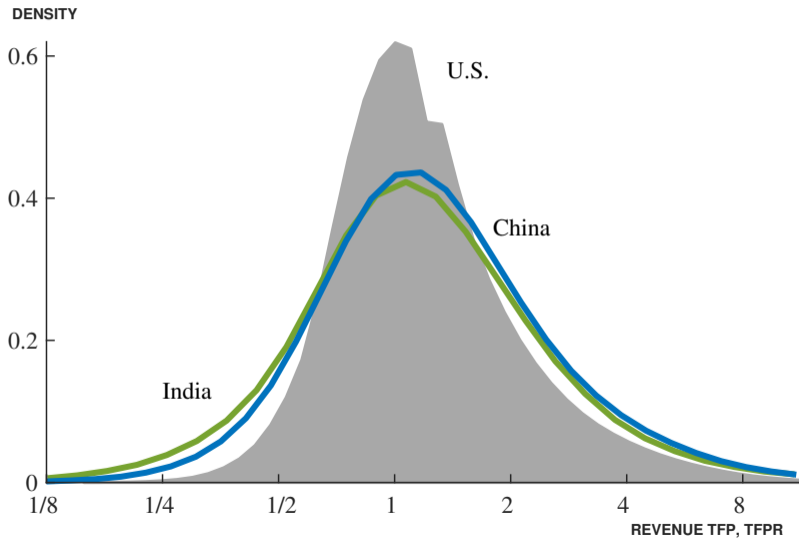
- TFPR dispersion is smaller with gross output than with value added
- But distortions are amplified through the input-output structure
 - ▶ Chad Jones (2011, 2013)
 - ▶ Ernest Liu (2019 QJE)
 - ▶ Baqaee and Farhi (2020)
 - ▶ Bils, Klenow and Ruane (2020)
- Intermediates are a multiplier (Jones) and double marginalization (Baqaee and Farhi)

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Five Facts about Misallocation

- 1 TFPR is more dispersed in developing economies than in advanced economies
- 2 TFPR is strongly increasing in TFPQ, especially in developing economies
- 3 Most dispersion is in TFPR rather than in relative VAPK, VAPL, VAPX
- 4 Much of the TFPR dispersion is persistent over time
- 5 Much of the VAPK dispersion is *within* firms

Fact 1: TFPR dispersion



Implications of TFPR dispersion for aggregate TFP

- Baqaee and Farhi (2020): ↓ aggregate TFP for U.S. Compustat firms by $\sim 20\%$
- HK 2009: ↓ manufacturing TFP by 30–60% in China and India vs. the U.S.
- IADB (2010): similar losses in manufacturing in various Latin American countries
- Same for Peters (2020) on Indonesian manufacturing
- Restuccia et al. (2017, 2019): even larger losses in agriculture in China and Malawi

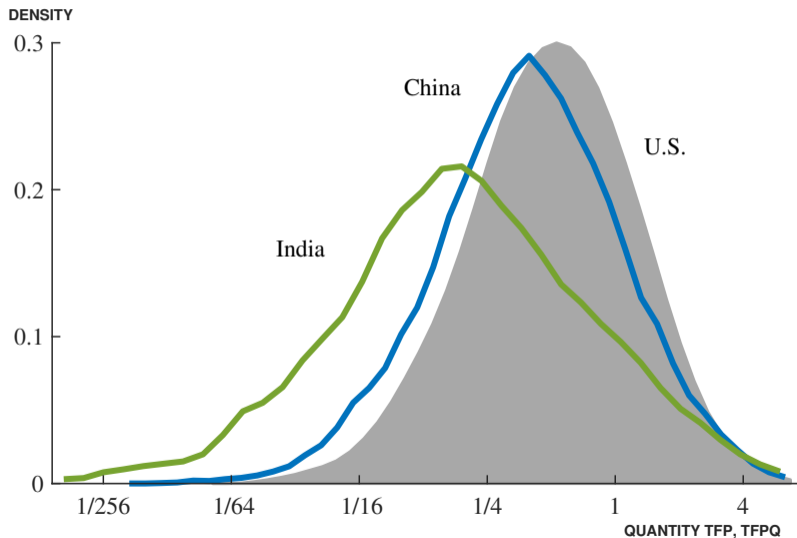
Harberger (1954): costs of monopoly \ll 1% of GDP

Baqae and Farhi (2020) found two orders of magnitude more damage and explain why:

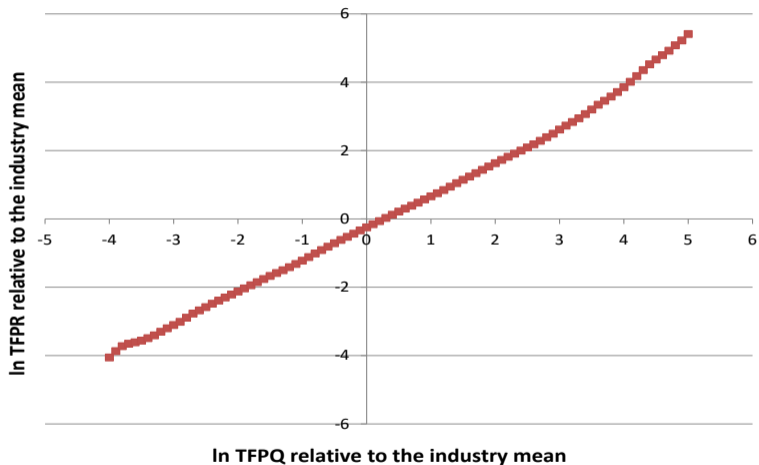
- Bigger wedges within than across industries
- More substitutability within than across industries
- Propagation from the input-output network

Also see Jim Schmitz's magisterial body of work!

Corollary: TFPQ dispersion is also greater in developing economies



Fact 2: TFPQ is increasing in TFPQ (data from India)

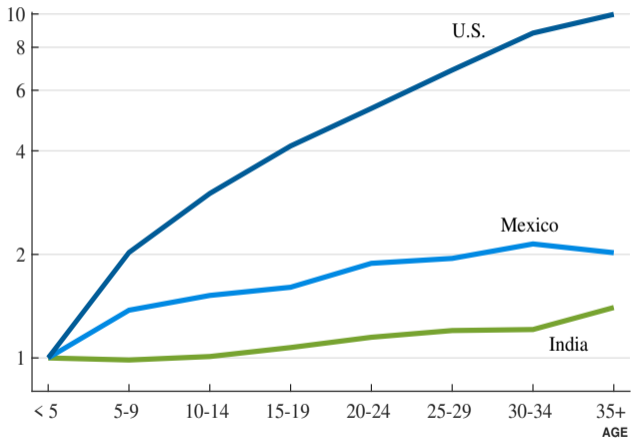


If barriers are increasing in productivity ...

- firms may invest less in productivity and quality before they enter
 - ▶ Bento and Restuccia (2017 AEJ-Macro)
- and innovate less after they enter
 - ▶ Hsieh and Klenow (2014 QJE), Akcigit, Alp and Peters (2021 AER)
- and enter in greater numbers
 - ▶ Atkeson and Burstein (2010 JPE), Fattal Jaef (2021 AEJ-Macro)

The Life Cycle of Plants

AVERAGE EMPLOYMENT (AGE<5 = 1, LOG SCALE)



Fact 3: Scale vs. Mix Distortions

- Scale: common component of VAPK, VAPL, and VAPX
- Mix: ratios of VAPK/VAPL, VAPK/VAPX, VAPL/VAPX
- David and Venky (2019) and BKR (2020) find mostly *scale* distortions
- Suggestive of markups, revenue taxes/subsidies, errors in revenue/(all inputs)
- Suggests not a dominant role for one of financial frictions, wage markdowns, etc.

Fact 4: Persistence of TFPR differences

- Most of the variance in TFPR is in the firm or plant fixed effect
- David and Venky (2019) for U.S. publicly listed firms and Chinese industrial firms
- BKR (2020) for Indian plants and U.S. plants, both in manufacturing
- Suggestive of persistent markups, measurement error, and taxes/subsidies
- Not consistent with a dominant role for financial frictions or adjustment costs

Fact 5: Lots of VAPK dispersion across plants *within* firms

- Kehrig and Vincent (2020) for U.S. manufacturing
- Most of the variance in VAPK is across plants within firms
- So cannot be financial frictions?
- They say it reflects the interaction of lumpy adjustment costs and financial frictions
- Also consistent with markup differences across plants within firms

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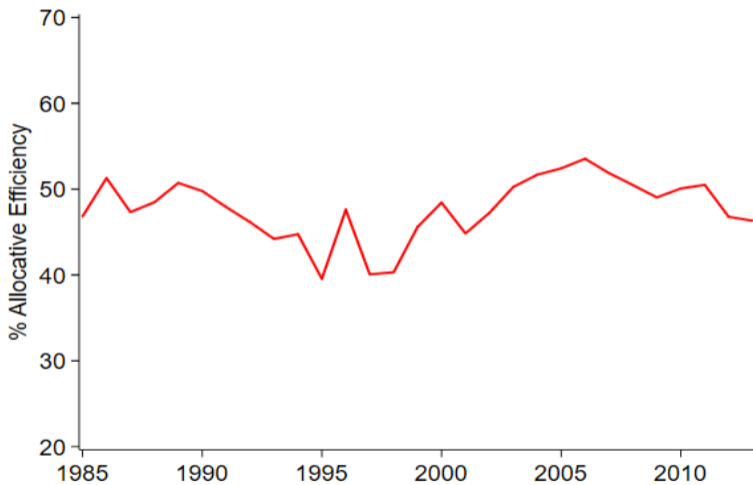
- Syverson (2011 JEL) – within U.S. manufacturing
- Hopenhayn (2014 Annual Reviews) – concepts
- Donaldson (2015 Annual Reviews) – trade within and across countries
- Restuccia and Rogerson (2017 JEP) – evidence for agriculture as well

Some publicly available datasets

- Indian Annual Survey of Industries (ASI) 1980–1981 through 2017–2018
- Chilean manufacturing plants, 1985–2014 (e.g., Asturias et al., 2019)
- Indonesian manufacturing firms, 1965–1999 (e.g., Peters, 2020 *Econometrica*)
- Colombian manufacturing plants, 1982–1998 (e.g., Midrigan and Xu, 2014)
- Compustat publicly-traded firms in the U.S. (e.g., David and Venky, 2019)

- Census of large plants (> 100 or 200 workers), 1/3 sample of smaller plants
- In some years, unit prices for output and detailed intermediate inputs
- Downloadable at `http://microdata.gov.in/nada43/index.php/catalog/ASI/about`
- BKR (2020) analyze 1984–1985 through 2012–2013
 - ▶ Code to calculate AE, TFPR, TFPQ, VAP's via Stanford's Big Data Initiative

Allocative Efficiency (AE) in India over time



Some harder to get datasets

- Chinese Industrial Firms, 1998–2013 (e.g. David and Venky, 2019)
- Korean manufacturing plants, 1985–2014 (e.g., Midrigan and Xu, 2014)
- Vietnamese firms, 2006–2010 (e.g., Bai et al., 2017 Economic Journal)
- Mexican establishments 1998, 2003 and 2008; (e.g., Hsieh and Klenow, 2014)
- Orbis — firms in many countries (e.g., Gopinath et al., 2017 QJE)

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Measuring Cross-Country Differences in Misallocation

There is a lot of imputation in the U.S. Census data (well beyond administrative records)

Understates TFPR dispersion in the U.S.

Not being done in Indian data (?)

So more misallocation in the U.S. than typically realized

Smaller gap in allocative efficiency between U.S. and India

Misallocation or Mismeasurement?

In U.S. manufacturing, allocative efficiency seemingly plummeted 55% since 1980

Regress Revenue growth on Input growth — coefficient is decreasing in TFPR

Increasingly negative relationship over the sample

Argue this reflects growing measurement error in revenue and inputs

Find a much more modest decline in allocative efficiency in the U.S.

And find U.S. has consistently higher allocative efficiency than India

Dynamic Inputs and Resource Mis(Allocation)

Costs of adjusting capital result in VAPK dispersion in the face of firm-specific productivity shocks

Find World Bank Enterprise Survey countries with bigger VAPK dispersion also exhibit higher time series volatility of firms-specific shocks

Upshot: adjustment costs reduce aggregate productivity, but perhaps this is constrained efficient rather than being misallocation

Caution: missing data, mysterious sampling frame in WBES

Source of Capital Misallocation

Data on Compustat firms in the U.S. and medium-to-large private firms China

Convex adjustment cost imply persistent investment rate differences across plants or firms

They document low persistence \Rightarrow a small role for convex adjustment costs

Non-convex adjustment costs? Not enough inaction or volatility of investment

Find a big role for the firm fixed effect in VAPK — markups?

Good Dispersion, Bad Dispersion

Most TFPR dispersion across plants within U.S. manufacturing is *within firms*

Argue this reflects nonconvex adjustment costs + financial frictions

Alternatives: Production elasticities vary across plants within firms
 Markups vary across plants within firms
 Misallocation within firms

Managing Resource (Mis)Allocation

Again, most TFPR dispersion across plants within U.S. manufacturing is *within firms*

Argue this is due to misallocation within firms

Document that within-firm dispersion in TFPR is negatively correlated with management quality and is positively correlated with the number of divisions and plants

Misallocation Measures: The Distortion that Ate the Residual

TFPR is a residual that only maps into a distortion in the special case of CES demand, monopolistic competition, and CRS production (with competitive input markets)

Entertain linear demand (VES) + monopolistic competition \rightarrow heterogeneous markups

And $RTS < 1$, though still isoelastic output with respect to inputs

Present evidence that TFPR is increasing in TFPQ across plants in 11 U.S. industries

Estimate $RTS \approx 1$ and linear demand parameters

Monopolistic Competition and Optimum Product Diversity Under Firm Heterogeneity

CES + monopolistic competition + free entry \rightarrow no static misallocation and optimal entry

VES + monopolistic competition + free entry \rightarrow static misallocation

SP wants to equate TFPR (VMP's) across firms

Can have too much or too little entry

How Costly are Markups?

Model with VES, monopolistic competition, intermediate inputs and free entry

Welfare cost = $\sim 7\%$ of permanent consumption

2/3 from average markup (distorts intermediates vs. labor)

1/3 from markup dispersion (misallocation)

~ 0 from entry (distorted little)

VES matters — shrinks misallocation relative to CES for given TFPR dispersion

Heterogeneous Markups, Growth and Endogenous Misallocation

Quality ladders + Bertrand competition

Endogenous growth model with creative destruction and incumbent innovation

Entry barriers \rightarrow less entry \rightarrow more incumbent innovation, more misallocation

Similar growth rate (less creative destruction, more incumbent innovation)

Tests mechanisms using data on manufacturing plants in Indonesia

*How Large Are the Gains from Economic Integration?
Theory and Evidence from U.S. Agriculture, 1880-1997*

Infer declining costs of agricultural trade between U.S. counties from 1880 to 1997

Leads to more suitable crops (wrt soil, climate) being grown on fields within counties

Estimate this *quadrupled* aggregate agricultural productivity

As important as rising yield per field for a given crop (hybrid seeds, tractors, fertilizer)

The Life Cycle of Plants and India and Mexico

In the U.S., plants grow or die. In India, they stagnate. Mexico is intermediate.

Why? If bigger plants face barriers, plants may invest less in technology.

Bento and Restuccia (2017 AEJ-Macro) go further and say these barriers make Indian plants invest less in quality before entry and start smaller as a result

Land Misallocation and Productivity

In Malawi, massive variation in farm TFPR (even controlling for land quality)

Argue better farmers do not use more land because most of it is untitled

May also be "wedges" in hiring non-family workers, financing, intermediate inputs

Says reallocating land across farms could more than triple aggregate farm TFP

*Misallocation, Selection and Productivity:
A Quantitative Analysis with Micro Data from China*

Frictions in land and capital markets constrain most productive farms from being larger

Also leads to misallocation of talent across sectors — too many marginally talented workers in agriculture who should be working in other sectors

Cuts TFP in half (2/3 of this misallocation is across villages, 1/3 within)

Heterogeneity, Measurement Error and Misallocation: Evidence from African Agriculture

Panel data on farms in Uganda and Tanzania

Key assumption:

no misallocation across plots within farms who sell homogeneous crops at given prices

Idiosyncratic shocks, heterogeneity, measurement error explain 2/3 of TFPR dispersion

Find misallocation is vastly oversaturated in both countries

Some of the many papers:

- Buera, Kaboski and Shin (2011 AER)
- Gilchrist, Sim and Zakrajsek (2013 RED)
- Midrigan and Xu (2014 AER)
- Moll (2014 AER)
- Cole, Greenwood and Sanchez (2016 ECMA)
- Gopinath, Karabarbounis, Kalemli-Ozcan, and Villegas-Sanchez (2017 QJE)
- Bau and Matray (2020 working paper, R&R at ECMA)

Explaining Cross-Country Productivity Differences in Retail Trade

Small stores used to dominate retail employment in Argentina, Brazil, El Salvador, Mexico, the Philippines and Thailand

Supermarkets have long dominated retail employment in the U.S.

Retail VA per worker used to be much higher in the U.S., but not so much for supermarkets

Why the difference? Cars, according to Lagakos

Tariffs on imports, and cars are indivisible so amplify income differences

Required:

- David and Venkateswaran (2019 AER) ▶ David and Venky
- Hsieh, Hurst, Jones and Klenow (2019 ECMA) ▶ HHJK

Supplemental papers (in order of appearance in slides):

- Hsieh and Klenow (2009 QJE)
- Bils, Klenow and Ruane (2020 working paper)
- Bartelsman, Haltiwanger and Scarpetta (2013 AER)
- Dhingra and Morrow (2019 JPE)
- Buera, Kaboski and Shin (2011 AER)

Readings for “Misallocation: Recent advances and applications” (2/4)

- Moll (2014 AER)
- Midrigan and Xu (2014 AER)
- Asker, Collard-Wexler and De Loecker (2014 JPE)
- Edmond, Midrigan and Xu (2019 working paper)
- Baqaee and Farhi (2020 QJE)
- Hsieh and Klenow (2014 QJE)
- Bento and Restuccia (2017 AEJ-Macro)
- Cole, Greenwood and Sanchez (2016 ECMA)
- Gopinath, Karabarbounis, Kalemli-Ozcan, and Villegas-Sanchez (2017 QJE)
- Akcigit, Alp and Peters (AER 2021)
- Atkeson and Burstein (2010 JPE)
- Kehrig and Vincent (2020 working paper)

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- Syverson (2011 JEL)
- Hopenhayn (2014 Annual Reviews)
- Donaldson (2015 Annual Reviews)
- Restuccia and Rogerson (2017 JEP)
- Asturias, Hur, Kehoe and Ruhl (2019 working paper)
- Peters (2020 ECMA)
- Bai, Jayachandran, Malesky and Olken (2017 Economic Journal)
- Parente and Prescott (1994 JPE)
- Howitt (2000 AER)
- Banerjee and Duflo (2005 Handbook of Economic Growth)
- Restuccia and Rogerson (2009 RED)
- Melitz and Ottaviano (2008 REStud) paper)

Readings for “Misallocation: Recent advances and applications” (4/4)

- Atkeson and Burstein (2008 AER)
- Rotemberg and White (2017 working paper)
- Giroud, Matvos, Seru and Silva (2018 working paper)
- Haltiwanger, Kulick and Syverson (2018 working paper)
- Costinot and Donaldson (2016 working paper)
- Restuccia and Santaaulalia-Llopis (2017 working paper)
- Adamopoulos, Brandt, Leight, and Restuccia (2019 working paper)
- Gollin and Udry (2019 working paper)
- Gilchrist, Sim and Zakrajsek (2013 RED)
- Bau and Matray (2020 working paper)
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