World Bank & STEG "Knowledge for Jobs"

Misallocation and Aggregate Productivity

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Misallocation and aggregate productivity

- Aggregate productivity at the core of international differences in income per capita (Klenow-Rodriguez-Clare 1997, Prescott 1998, Jones 2016).
- What can explain productivity differences across countries?
- In standard model, CRS production function, only aggregate factors such as aggregate barriers to capital accumulation and technology adoption.
- In practice, non-trivial portion of productivity growth occurs via reallocation of factors across heterogeneous production units such as firms or establishments.
- Ongoing expansion of successful firms, and contraction of failing firms, including new entry and exit.
- What if this process is disrupted in less developed countries?

Overview: misallocation and aggregate productivity

- Basic framework.
- Evidence of misallocation (application: size-dependent policies).
- Broader impact of misallocation.
- Quantifying broader impact of misallocation.

Misallocation and aggregate productivity

Survey articles:

- Restuccia and Rogerson (RED 2013)
  http://dx.doi.org/10.1016/j.red.2012.11.003
- Hopenhayn (2014)
  http://dx.doi.org/10.1146/annurev-economics-082912-110223
- Restuccia and Rogerson (2017)
  http://doi.org/10.1257/jep.31.3.151
- Restuccia (2019)
  https://doi.org/10.1111/caje.12364

Basic Framework

Basic framework

- Based on simplified version of Restuccia and Rogerson (2008) “Policy Distortions and Aggregate Productivity with Heterogeneous Establishments" http://dx.doi.org/10.1016/j.red.2008.05.002.
- M heterogeneous producers of a single good indexed by i with production function

$$y_i = A_i n_i^{\gamma} = z_i^{1-\gamma} n_i^{\gamma}, \quad \gamma < 1, \quad A_i = z_i^{1-\gamma},$$

  where z_i is establishment productivity (A_i is total factor productivity) and n_i is the labor input.
- Assume the amount of labor in the economy is equal to N.

Basic framework

- To start, characterize the best this economy can do given resources.
- An efficient allocation maximizes aggregate output subject to aggregate resources,

$$\max_{\{n_i \geq 0\}} Y^e = \sum_i y_i = z_i^{1-\gamma} n_i^{\gamma} \quad \text{s.t.} \quad \sum_i n_i = N.$$

- FOC wrt n_i implies: $n_i = (\frac{\gamma}{\lambda})^{1/(1-\gamma)} z_i$, where λ is Lagrange multiplier on resource constraint (shadow value of labor).
- Substitute n_i on resource constraint to find λ and back into n_i to solve for the efficient allocation n_i^e.

Basic framework

- The efficient allocation is given by

$$n_i^e = \frac{z_i}{\sum_i z_i} N,$$

  which implies efficient establishment output

$$y_i^e = \left(\frac{N}{\sum_i z_i} \right)^{\gamma} z_i.$$

- Note the employment and output shares highly non-linear on TFP (A_i), e.g.,

$$\frac{n_i^e}{N} \propto A_i^{1/(1-\gamma)}.$$

Basic framework

Key features of efficient allocation:

- More productive establishments allocated more resources, strong association between establishment productivity and size. Share of resources highly non-linear on establishment TFP.
- Equally productive establishments allocated the same amount of resources, hence of same size.
- The marginal (and average) product of labor is equalized across establishments in the efficient allocation,

$$MPn_i = \gamma A_i n_i^{\gamma-1} = \gamma \frac{y_i}{n_i} = \text{constant}.$$

Basic framework

- Aggregate production function in the efficient allocation,

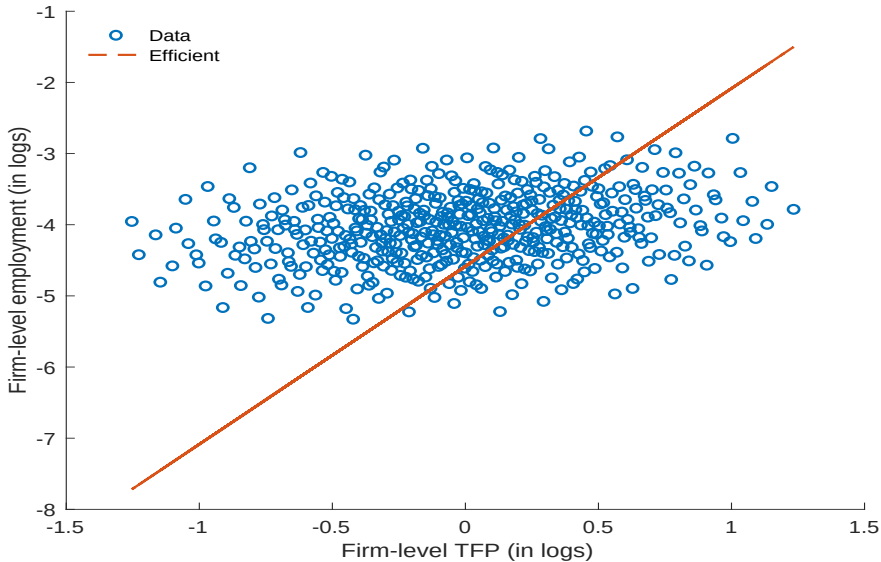
$$Y^e = AN^{\gamma}M^{1-\gamma},$$

where

$$A = \left(\frac{\sum_i z_i}{M}\right)^{1-\gamma} = \bar{z}^{1-\gamma}.$$

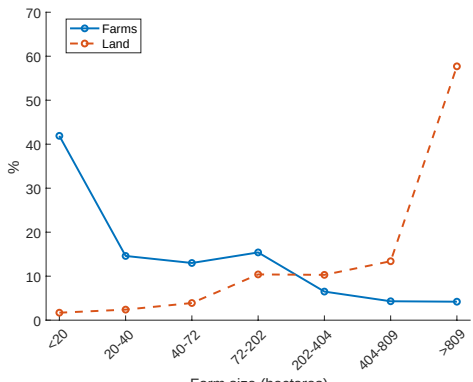
- Any allocation that deviates from the efficient allocation reduces output (even allocating more resources to more productive producers), show up as lower A.
- Aggregate production function is CRS despite DRS at the establishment level.

Stylized misallocation

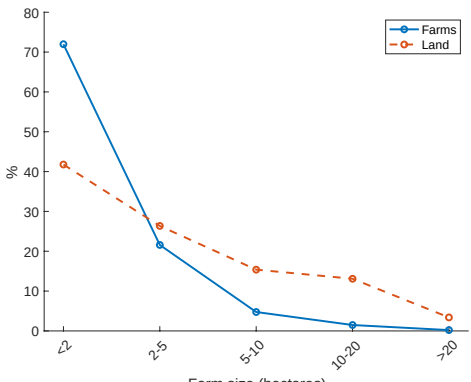


Size distribution of farms and land

(a) United States



(b) Poorest income quintile



- Land distribution skewed towards small farms in poor countries, suggesting misallocation (Adamopoulos and Restuccia, 2014).

Competitive equilibrium framework

- What can generate misallocation?
- Focus on competitive market economies that may be distorted by policies or institutions.
- Start with competitive equilibrium solution without distortions, then consider distorted economies.

Competitive equilibrium framework

- Assume establishments operate in competitive markets for output and labor.
- Normalize price of output to one and denote the wage rate as w.
- Consumers are silent in this framework: supply inelastically their productive time to firms for a competitive wage, and consume all income from labor and firms profits.

Competitive equilibrium framework

A *competitive equilibrium* is a set of prices w and allocations n_i such that:

(i) given prices, establishment's allocation n_i maximizes profits

$$\max_{n_i>0} z_i^{1-\gamma} n_i^{\gamma} - w n_i, \quad \forall i$$

(ii) the labor market clears,

$$\sum_i n_i = N.$$

Characterizing competitive equilibrium

- FOCs for establishments:

$$\gamma z_i^{1-\gamma} n_i^{\gamma-1} = w,$$

  which implies a demand for labor:

$$n_i = \left(\frac{\gamma}{w}\right)^{1/(1-\gamma)} z_i.$$

- Use this demand and market clearing equation to solve for w

$$w = \gamma \left(\frac{\sum z_i}{N}\right)^{1-\gamma}.$$

Characterizing competitive equilibrium

- Note at competitive equilibrium price, competitive equilibrium allocation coincides with efficient allocation (planner's solution),

$$n_i = \left(\frac{\gamma}{w}\right)^{1/(1-\gamma)} z_i = \left(\frac{N}{\sum z_i}\right)^{\frac{1-\gamma}{1-\gamma}} z_i = n_i^e.$$

Competitive equilibrium with distortions

- Assume establishments face an idiosyncratic tax τ_i on revenues.
- Easy to show that in this context a common tax across firms ($\tau_i = \tau$) does not generate misallocation.
- Tax revenues are rebated back to consumers as a lump sum transfer T (not that relevant here).
- Establishment's revenues change to: $(1 - \tau_i)y_i$.

Competitive equilibrium with distortions

A *competitive equilibrium* is a set of prices w, transfer T, and allocations n_i such that:

(i) given prices, establishment's allocation n_i maximizes profits

$$\max_{n_i>0}(1-\tau_i)z_i^{1-\gamma}n_i^{\gamma}-wn_i, \quad \forall i$$

(ii) the labor market clears,

$$\sum_i n_i = N.$$

(ii) the government budget balances,

$$T=\sum_i \tau_i z_i^{1-\gamma}n_i^{\gamma}.$$

Competitive equilibrium with distortions

- FOCs for establishments:

$$\gamma(1-\tau_i)z_i^{1-\gamma}n_i^{\gamma-1}=w,$$

  which implies a demand for labor:

$$n_i=\left(\frac{\gamma(1-\tau_i)}{w}\right)^{1/(1-\gamma)}z_i.$$

- Use this demand and market clearing equation to solve for distorted wage w

$$w=\gamma\left(\frac{\sum_i(1-\tau_i)^{\frac{1}{1-\gamma}}z_i}{N}\right)^{1-\gamma}.$$

Competitive equilibrium with distortions

- Note that distorted allocation does not coincide with efficient allocation,

$$n_i = \frac{(1-\tau_i)^{\frac{1}{1-\gamma}} z_i}{\sum_i (1-\tau_i)^{\frac{1}{1-\gamma}} z_i} N.$$

The cost of misallocation

- Consider idiosyncratic policy distortions in the form of effective output taxes/subsidies τ_i

$$(1 - \tau_i) = \frac{1}{A_i^{\theta} \epsilon_i},$$

  where θ controls the elasticity of distortions with respect to productivity (correlated distortions) and ϵ_i reflects random idiosyncratic distortions (uncorrelated distortions).

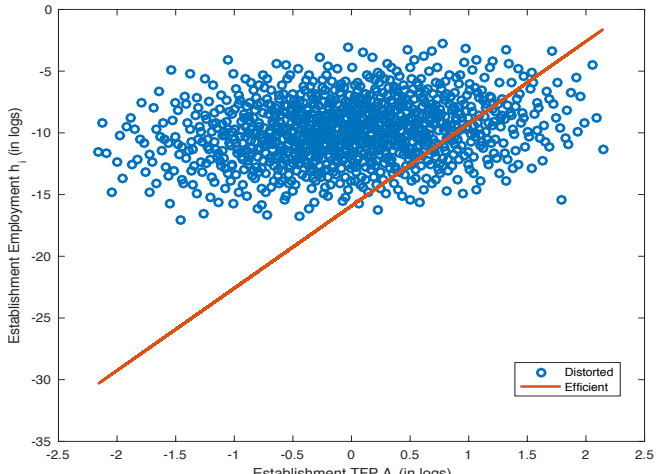
- Assume ϵ_i log normally distributed with mean zero and standard deviation σ_ϵ.
- Discuss what θ and σ_ϵ mean for the allocation of labor across firm productivity.

The cost of misallocation

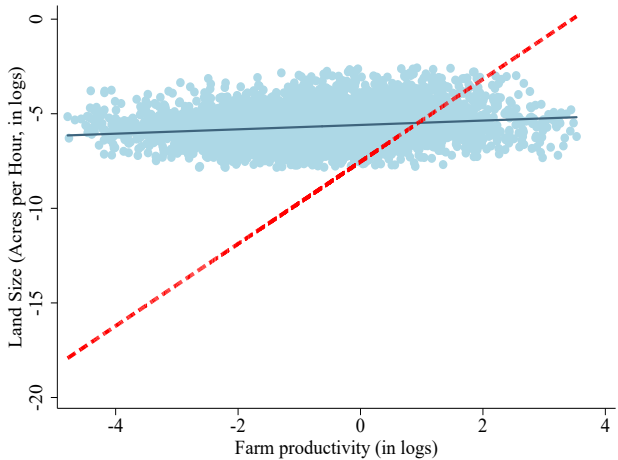
- Calibrate benchmark economy with no distortions $(\theta = 0, \sigma_\epsilon = 0)$ to US data.
- Key are moments of productivity distribution A_i (to match employment-size distribution or direct moments of establishment-level TFP distribution).
- For each economy $(\theta, \sigma_\epsilon)$, report the ratio of aggregate TFP in the efficient allocation (benchmark economy) to the distorted economy:

	θ		
σ_ϵ	0	0.5	0.9
0	1.00	1.10	2.02
0.1	1.03	1.12	2.07
0.4	1.23	1.43	2.72

Distorted allocation ($\theta = 0.9$,$\sigma_\epsilon = 0.4$)



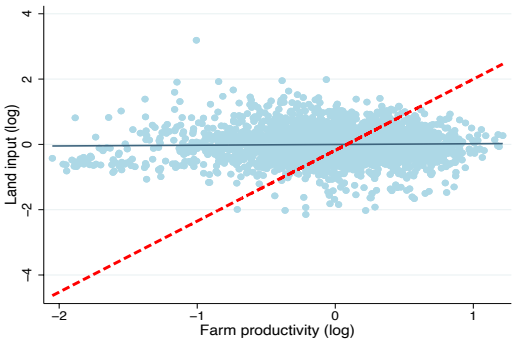
Evidence of misallocation—Malawi



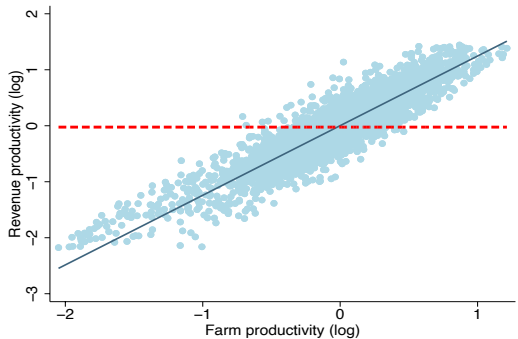
- Chen, Restuccia and Santaeulalia-Llopis (2023): Efficient reallocation increases agricultural productivity by a factor around 2-fold.

Evidence of misallocation—China

(a) Operated land



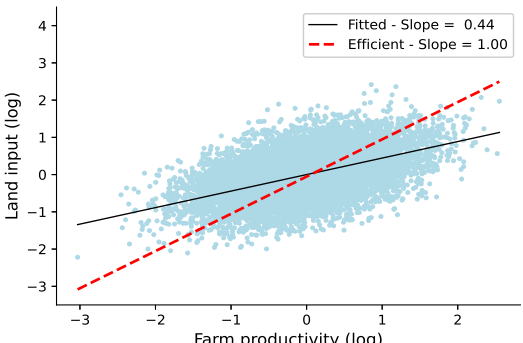
(b) Measured distortions



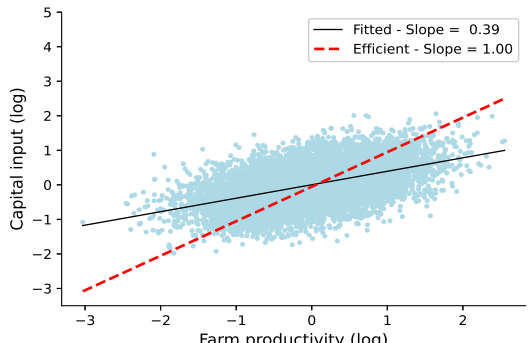
- Efficiency gains: China 53.2% (Adamopoulos, Brandt, Leight, and Restuccia 2022); Uganda 107% (Aragon, Restuccia, and Rud 2024).

Evidence of misallocation—Canada

(a) Operated land



(b) Operated capital



- Efficiency gain: 5% (Nguyen & Restuccia 2025).

Taking stock

- Idiosyncratic distortions can lead to substantial reallocation of resources across heterogeneous production units.
- The impact of this reallocation on aggregate TFP and output per capita can be large.
- Given the pervasiveness of institutions, policies, and regulations that induce resource reallocation across productive units, this channel may prove useful in accounting for some of the patterns in output, capital accumulation, and TFP across countries.
- Is there more systematic evidence of misallocation?

Evidence of Misallocation

Evidence of misallocation

- An important insight of basic framework (e.g. $y_i = A_i n_i^{\gamma}$) is that to maximize output, the marginal (or average) product of factors should equalize across producers of the same good

$$\underbrace{(1-\tau_i)\gamma\frac{y_i}{n_i}}_{\text{Value of marginal output}} = w.$$

- In this context we can define Revenue Productivity as

$$\text{TFPR}_i \equiv \frac{y_i}{n_i} \propto \frac{1}{(1-\tau_i)}.$$

- TFPR_i equalizes across producers in the efficient allocation (more productive establishments are larger).

Evidence of misallocation

$$\text{TFPR}_i \equiv \frac{y_i}{n_i} \propto \frac{1}{(1-\tau_i)}$$

- Suggests two broad approaches to assess the empirical relevance of misallocation: indirect and direct
- Indirect: measure deviations in TFPR_i across producers using data on output and inputs.
- Direct: Measure specific policies and institutions that generate $(1-\tau_i)$ differences.
- Policies/institutions can have aggregate productivity effects (low TFP) even if no impact on aggregate prices or aggregate resources.
- Remark: The aggregate productivity cost of misallocation depends not only on dispersion in TFPR_i but also on dispersion of A_i (generally joint distribution).

Indirect approach

- Assess extent of misallocation without identifying underlying cause: Hsieh and Klenow (2009).
- Evidence points to substantial misallocation and large TFP loses from misallocation.

	SD (log TFPR_i)	TFP gains
China (1998)	0.74	115%
India (1991)	0.67	102%
India (1994)	0.67	128%
United States (1997)	0.49	43%

Indirect approach

- Evidence of misallocation from many other contexts/countries.
- Recent World Bank study using census data for manufacturing in poor African countries (Cirera, Fattal-Jaef, and Maemir 2017).

	SD (log TFPR$_i$)	θ	TFP gains
Cote d'Ivoire	0.65	0.42	31%
Kenya	1.52	0.52	67%
Ghana	0.95	0.44	76%
Ethiopia	0.78	0.53	163%

Indirect approach

- Approach useful in identifying relevant patterns as an accounting devise (within industry, across industry, across time and space, across occupations, etc.).
- But is silent about the specific sources of misallocation.
- Identifying causes of misallocation key for policy analysis.
- Important limitations related to measurement and specification:
  - Demand structure to separate price and output from revenue data.
  - Specification of production structure.
  - Measurement and specification errors (Bils, Klenow, and Ruane 2021, David and Venkateswaran 2019).

Direct approach

- Quantifies role of specific policies/institutions creating misallocation either through quasi-natural experiments or via a structural model.
- Examples:
  - Regulation and discretionary provisions such as firing costs, size-dependent policies.
    For instance, a regulation that applies to all producers in a market but...in practice is enforced more strictly among larger (more productive) producers, connects to informality.
  - Selective industrial policy.
  - Land institutions.
  - Financial frictions.
  - Trade restrictions.

Regulations

- Firing costs (Hopenhayn and Rogerson 1993).
  - Adjustment costs created by policy generating misallocation.
  - Firing cost equivalent to 1 year's wages (prevalent in some OECD and developing countries) implies a TFP loss of 2%.
  - Firing cost equivalent to 5 year's wages implies dispersion in TFPR of 0.19, correlation log TFPR and TFPQ of 0.76, and TFP loss of 8% (Hopenhayn 2014).
- Size-dependent policies (Guner, Ventura, and Xu 2008).
  - Distortions related to the size of the establishment (e.g. number of employees).
  - Large effects on number of establishments and average size.
  - Relatively small effects on TFP.

Application: size-dependent policies

- Simpler version of “Macroeconomic Implications of Size-Dependent Policies," Nezih Guner, Gustavo Ventura, and Xu Yi, Review of Economic Dynamics 2008 https://doi.org/10.1016/j.red.2008.01.005.
- Many government policies depend on establishment size.
- Size-dependent policies take a variety of forms, ranging from subsidies to small units to regulations and restrictions on the size and operation of large units.
- Examples:
  - Labor regulations in OECD such as France or Italy.
  - Regulation of the size of retail shops in Japan.
  - National policy of protection to small enterprises in India, including reservation policy: set of manufacturing goods reserved for small firms, currently covers 13% of total manufacturing output.

Application: size-dependent policies—model

- Economy inhabited by a single representative household with a continuum of members of size 1.
- Standard preferences over consumption.
- Each household member endowed with one unit of productive time and z units of managerial skill, support in $[0, \bar{z}]$, cdf $F(z)$.
- Household members can operate a firm or work for a firm.
- Technology for manager z:

$$y = z^{1-\gamma} n^{\gamma}, \quad \gamma \in (0, 1),$$

  where n is hired labor.
- Competitive markets.

Application: size-dependent policies—model

- A manager z that operates a firm maximizes profits given w:

$$\pi(z;w) = \max_{n>0}\{z^{1-\gamma}n^{\gamma} - wn\},$$

  implies decision rule $n(z;w)$.
- A worker with one unit of labor simply earns a wage w.
- Occupational choice: household chooses occupations that deliver higher income,

$$\max\{w, \pi(z;w)\}.$$

- Solution is a threshold rule $\hat{z}$ such that if $z \leq \hat{z}$ worker, and manager otherwise.

Household problem

- Choose $\{C_t, \hat{z}_t\}$ to maximize

$$\sum_{t=0}^{\infty} \beta^t \log(C_t),$$

subject to

$$C_t = w_t F(\hat{z}_t) + \int_{\hat{z}_t}^{\bar{z}} \pi(z; w_t) dF(z).$$

- Optimal occupational choice implies

$$w_t = \pi(\hat{z}_t, w_t).$$

Competitive equilibrium

A competitive equilibrium is a sequence of prices $\{w_t\}$, allocation of employment and profits for managers $n(z; w_t)$, $\pi(z; w_t)$ and allocations for consumers C_t, $\hat{z}_t$ such that:

- Given $\{w_t\}$, household chooses $\{C_t, \hat{z}_t\}$ to solve HH problem.
- Given $\{w_t\}$, $n(z; w_t)$ and $\pi(z; w_t)$ solve the manager's problem.
- Markets clear

$$F(\hat{z}_t) = \int_{\hat{z}_t}^{\bar{z}} n(z; w_t) dF(z),$$

$$C_t = \int_{\hat{z}_t}^{\bar{z}} z^{1-\gamma} n(z; w_t)^{\gamma} dF(z).$$

Size distortions

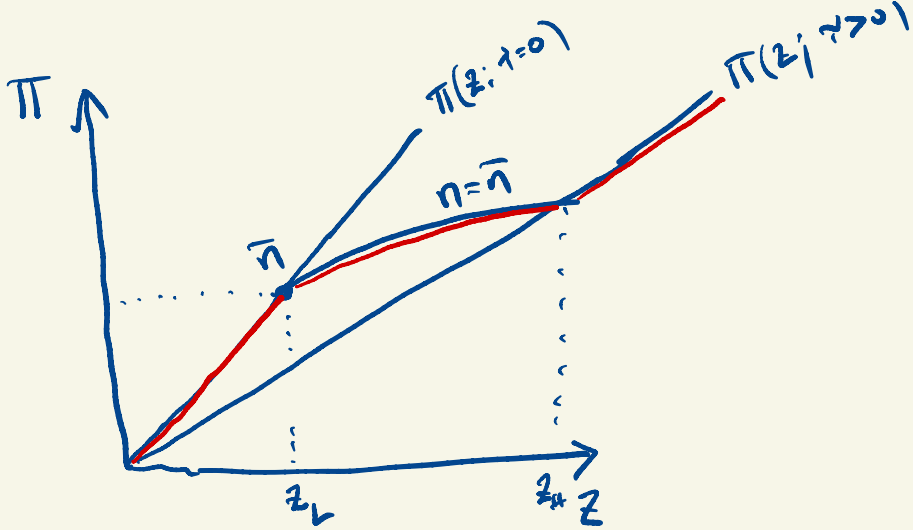
- Model distortions as implicit taxes on the use of labor beyond size $\bar{n}$.
- Cost of labor for the establishment is then:

$$wn \quad \text{if} \quad n \leq \bar{n},$$

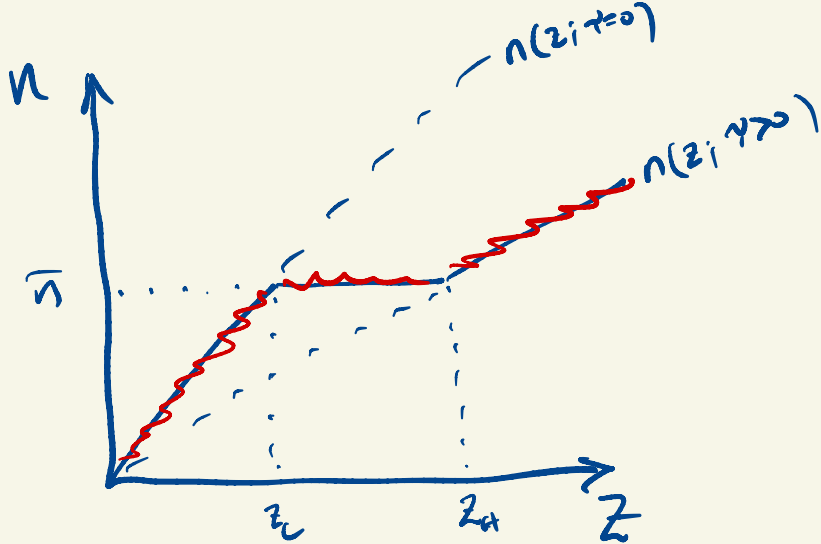
$$w\bar{n} + w(1+\tau)(n-\bar{n}) \quad \text{if} \quad n > \bar{n}.$$

- Distorted allocation characterized by three types of establishments: unconstrained (small), sitting on $\bar{n}$ (zone of inaction), and large (taxed) establishments.
- Figure with profits, labor demand, and thresholds.

Profits



Labor demand



Quantitative experiment

- Calibrate an undistorted economy to US data (model economy has capital and labor).
- Consider experiment that increases τ for a given size threshold $\bar{k}$.
- Size threshold $\bar{k}$ calibrated to the average size in undistorted economy, tax τ to achieve a 20% drop in average establishment size.

Quantitative experiment—results

- Capital and labor demand decline, and output declines by almost 10%.
- Decline in wages.
- Entry of small establishments (number of establishment increases by 23%)
- Decline in measures of aggregate productivity (between 8 to 12%).

- Main takeaway: size-dependent policies can contribute to our understanding of productivity differences across countries.

Financial frictions

- Large literature, survey in Buera, Kaboski, and Shin (2015).
  - Credit constraints generate dispersion in the marginal product of capital across producers.
  - Country-level institution, idiosyncratic effects: credit constraints disproportionally affect productive producers that should operate al larger scale.
  - TFP loss from this type of misallocation can be large.
- Interaction with rule of law (Ranasinghe and Restuccia 2018).
  - Uses establishment-level evidence on crime and access to credit.

Causes of misallocation

- Challenges of direct approach:
  - Many specific policies/institutions not easily amenable to direct measurement.
  - Not a single source generating the bulk of misallocation and productivity differences across countries.
  - Role of misallocation from specific policies quantitatively limited.
  - Many different policies/institutions needed to account for the data.
- Some notable exceptions:
  - Land market institutions in agriculture (Adamopoulos and Restuccia 2014).
  - Changes in policy over time in specific contexts.

Land-market institutions

- Land institutions in poor countries characterized by:
  - Lack of well-defined property rights over land
  - Land use-rights are distributed in a fairly egalitarian basis...
  - ...coupled with difficulty of adjusting operational scales
- As a result, land not allocated to best uses, leading to small operational scales, preventing the adoption of best practices and investment in farm operations
- Evidence points to substantial land (and factor) misallocation in agriculture in poor and developing countries

Changes in policy in specific contexts

- Land reform in Philippines (Adamopoulos and Restuccia 2020).
  - Cap in farm size + gov. intervention in the land market (direct excess land to landless/smallholders, restrict reallocation).
  - Reform reduces farm size (34%) and aggregate productivity (17%), gov intervention key as market reallocation of excess land generates only 1/3 of the negative effects.
- Trade reform in Chile (Pavnick 2002).
  - Liberalized trade reform on productivity using plant-level data, exploiting differential exposure to external competitive pressure.
  - Plants in import competing sectors grew 3-10% more than plants in non-traded sector.
  - Reallocation of resources from less to more efficient plants and through plant exit contributed substantially to aggregate productivity growth during the period.

Key characteristics of distortions

- Idiosyncratic effects from policies/institutions: dispersion in effective prices (wedges) across producers.
  - Generate misallocation.
  - Note that a tax/wedge common to all producers has no effect on aggregate productivity (given factors).
- Systematic idiosyncratic effects: policies/institutions that effectively penalize more productive producers (correlated distortions).
  - Affecting aggregate productivity via selection and technology channels.
  - Altering occupational/production choices.
  - Effectively lowering the return to technology adoption/productive investments.
  - Systematic idiosyncratic effects common, most often implicit/effective, not designed.

Broader Impact of Misallocation

Broader impact of misallocation

- Other dimensions of misallocation:
  - Misallocation of talent (Hurst, Hsieh, Jones, and Klenow 2019).
  - Misallocation of innovation (Aghion, Bergeaud, and Van Reenen 2023) and R&D (Ayerst 2020).
  - Misallocation across broad sectors (Gollin, Lagakos, and Waugh 2014) and sectors and space (Adamopoulos, Brandt, Chen, Restuccia, and Wei 2024).
- Misallocation and structural transformation:
  - Land institutions, misallocation in agriculture, and structural transformation (Adamopoulos, Brandt, Leight, and Restuccia 2022).
  - Land markets, structural transformation, and poverty (Restuccia 2021 STEG special lecture).

Back to simple framework

- What accounts for productivity differences across countries?
- Restuccia and Rogerson (2017): Single good produced by N potential heterogeneous production units indexed by i according to

$$y_i = A_i \cdot f(k_i, n_i),$$

  where A_i reflects differences in productivity across producers.
- Fixed cost of operation c in units of output.
- Efficient allocation: Given aggregate capital K and labor N, there is unique threshold $\bar{A}$ such that producers with $A_i > \bar{A}$ operate; and producers with higher A_i are allocated greater amounts of capital and labor.

Simple framework of TFP differences

- Holding the amount of aggregate resources constant, three channels can account for aggregate TFP differences across countries:
  - Distribution of A_i's differs across countries (technology).
  - Countries choose different set of producers to operate (selection).
  - Countries allocate inputs differently across producers (misallocation).
- All channels seem relevant.

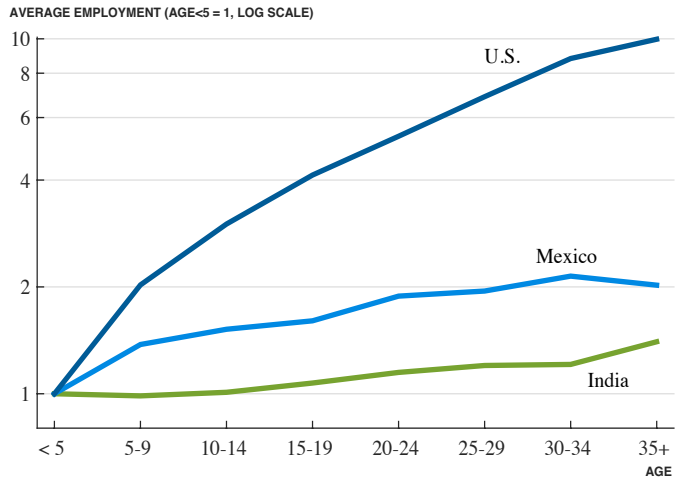
Broader consequences of misallocation

- Early misallocation analysis: given a fixed productivity distribution common across countries, assess quantitative impact of factor misallocation (e.g. Restuccia and Rogerson, 2008).
- A prevalent property of policies/institutions that create misallocation in developing countries: disproportionally affect more productive producers (correlated distortions).
- Policies/institutions causing misallocation can generate larger effects on aggregate productivity by altering the productivity distribution via technology and selection channels.

Broader consequences of misallocation

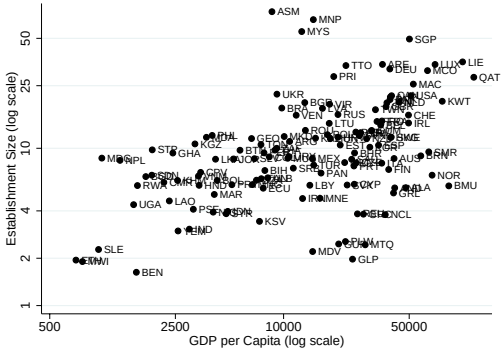
- In models of firm dynamics correlated distortions effectively lower the return to productivity growth.
  - Connection between misallocation and technology/selection channels.
  - Establish a connection to the average size of establishments.

Plant life-cycle employment growth

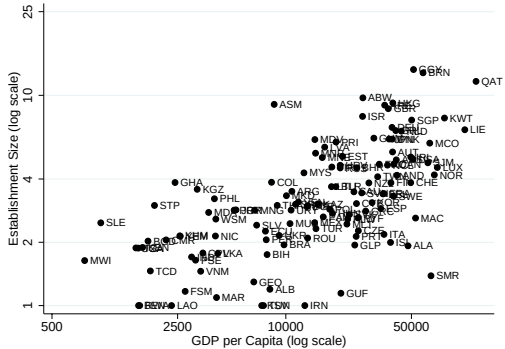


- Source: Hsieh and Klenow (2014)

Average establishment size



(a) Manufacturing



(b) Services

- Source: Bento and Restuccia (2017) and Bento and Restuccia (2021).

Broader consequences of misallocation

Some examples (misallocation + selection):

- Financial frictions (Buera, Kaboski, and Shin 2011; Midrigan and Xu 2014).
  - Distorts entrepreneur-worker choices in addition to misallocation.
  - Generates large negative effects on productivity.
  - Can account for 40% of non-agricultural productivity differences across countries.

Broader consequences of misallocation

Some examples (misallocation + selection):

- Trade liberalizations:
  - Selection effects important in all the empirical studies of trade liberalizations (also important productivity effects of incumbents).
    - Pavcnik (2002) for Chile.
    - Trefler (2004) for the Canada-US Free Trade Agreement.
    - Eslava, Haltiwanger, Kugler, and Kugler (2013) for Colombia.
  - Khandelwal, Schott, and Wei (2013): elimination of export quotas on Chinese textile and clothing by US, EU, and Canada in 2005, particularly government allocation of quotas to less productive state-owned enterprises; large TFP gain, 70% due to quota misallocation (selection).

Broader consequences of misallocation

Some examples (misallocation + technology):

- Trade liberalization and technology upgrading (Bustos 2011)
- Technology adoption and diffusion (Ayerst 2025).
- Productivity investment and firm dynamics (Hsieh and Klenow (2014); Bento and Restuccia 2017).

The pitfalls of well-intended policies

- A key insight of the misallocation literature is that size is deeply confounded by distortions, making policy implementation challenging.
- Even if policy makers can identify productivity at the micro level, difficult to assess “optimal" size.
- Insights on policy in developing countries:
  - Focus on better rather than more policy: review policy framework to minimize systematic idiosyncratic effects.
  - Foster the development and efficiency of markets for the allocation of productive resources.
  - Delink resource allocation from redistribution: for instance, operational scales achieved via efficient rental markets.

Taking stock

- Productivity at the core of cross-country differences in aggregate economic outcomes.
- Misallocation quantitatively important in accounting for productivity differences but...
- ...there is not a single source of misallocation that can account for the bulk of differences.
- Current work shows important link between misallocation and technology/selection channels in accounting for productivity differences.
- More work is needed in quantifying the broader (dynamic) implications of misallocation...

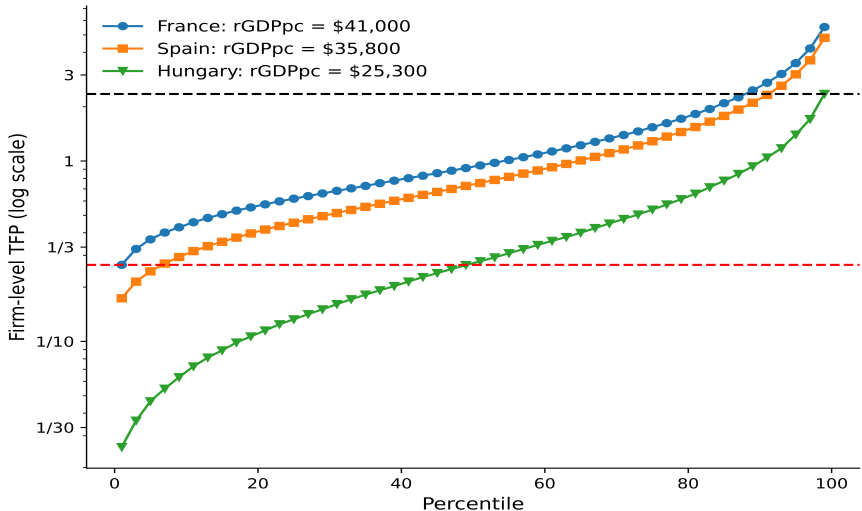
Quantifying Broader Impact of Misallocation

Quantifying broader impact of misallocation

- Based on "The micro and macro productivity of nations," with Stephen Ayerst (IMF) and Duc Nguyen (Amherst College), https://www.nber.org/papers/w32750.

- Micro data reveals differences in the firm-level productivity distribution (Hsieh & Klenow 2009; Gal 2013) suggesting potential role of selection and technology differences.

Firm-level productivity distribution 2005



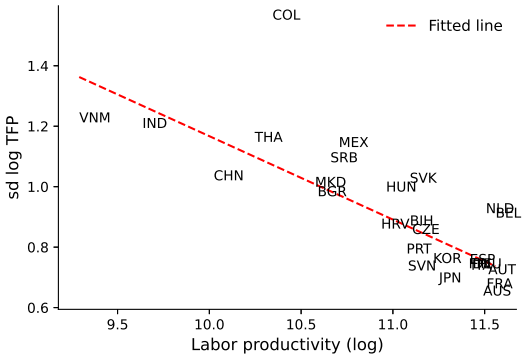
Research questions and approach

- Evidence of higher dispersion in firm-level productivity in less developed countries motivates two questions:
  - How important are differences in firm-level productivity in accounting for international income differences?
  - What accounts for differences in firm-level productivity?
- Our approach systematically links observed firm-level TFP distributions to policies and institutions that misallocate resources across firms.
- This approach motivated by empirical evidence from policy reforms that find substantial effects on selection and technology upgrading from reductions in misallocation (e.g., Pavcnik 02, Bustos 11, Khandelwal et al. 13)

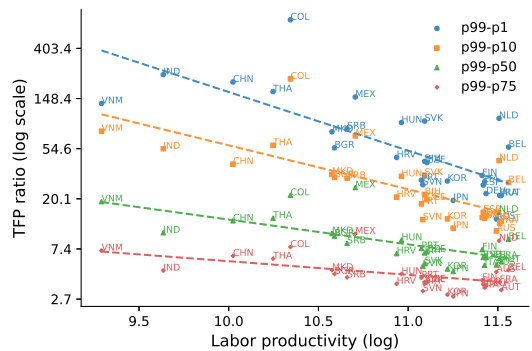
What we do

- Construct comparable firm-level data to document cross-country facts on productivity and measured distortions.
- Develop a model of heterogeneous firms with distortions where firms make entry, operation, and productivity-enhancing investment decisions.
- Use model to quantify the effects of measured distortions on micro and macro productivity differences across countries.

Cross-country productivity distribution

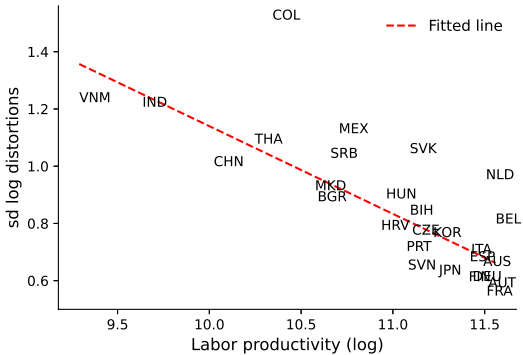


(a) Standard deviation

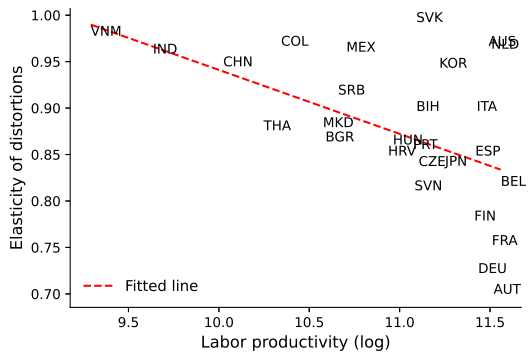


(b) Fanning out of productivity

Cross-country distortion distribution



(a) Standard deviation of distortions



(b) Elasticity of distortions

Model

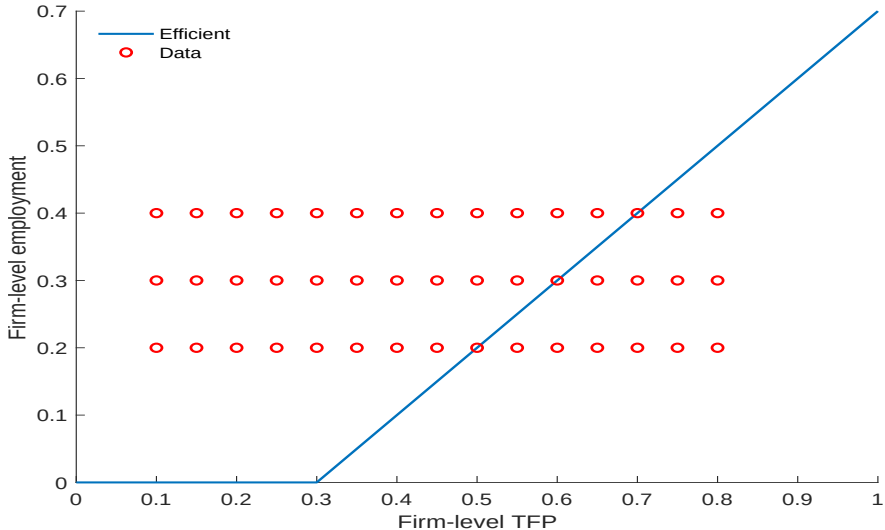
- Standard model of production heterogeneity with distortions (Hopenhayn 1992, Restuccia & Rogerson 2008).
- Framework allows for productivity enhancing investment (technology) and operation decisions by firms (selection).
- Each firm i employs labor (n_i) to produce output (y_i):

$$y_i = v_i {z_i}^{1-\gamma} {n_i}^{\gamma}, \qquad \gamma \in (0,1).$$

- To attain productivity z_i, a firm incurs a productivity investment cost of $\psi \frac{z^{\phi}}{\chi_i}$ in units of output where χ_i is an innovation ability drawn from iid cdf $G(\chi)$.
- Fixed cost of operation every in units of labor.
- Firms face idiosyncratic distortions:

$$(1-\tau_i) = \left(z_i^{-\rho}\epsilon_i\right)^{1-\gamma}.$$

Stylized misallocation with selection/technology



Model insights

- Measured TFP and wedges for firm i are given by

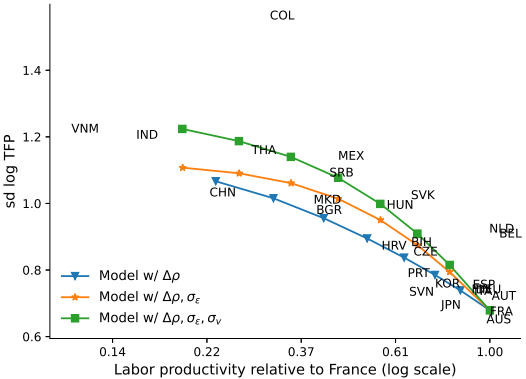
$$\text{TFP}_i = \frac{y_i}{n_i^{\gamma}} = z(\chi_i, \epsilon_i; \rho)^{1-\gamma} v_i; \qquad \text{wedge}_i = \frac{y_i}{n_i} = \left(\frac{w}{\gamma}\right) \frac{v_i}{1 - \tau_i(z_i, \epsilon_i; \rho)}.$$

- Technology and selection affect dispersion of TFP, so does mismeasurement.
- Technology: ρ compresses productivity distribution given χ.
- Selection: increase dispersion of TFP since lees productive firms may operate given distortions, needed but a quantitative issue.

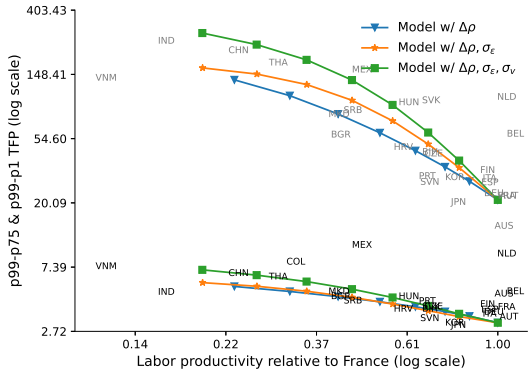
Calibration

- Strategy: calibrate distorted benchmark economy (BE) to firm-level and aggregate data for France.
- There are 11 parameters to be calibrated.
- 6 parameters normalized or assigned values from outside evidence: $\gamma = 0.8$ (misallocation literature), exit rate $\lambda = 0.1$, real interest rate $r = 0.04$, curvature investment cost function $\phi = 2$, productivity investment cost $\psi = 1$ and entry cost $c_e = 1$.
- Remaining 5 parameters ($\rho, \sigma_\epsilon, \sigma_v, \sigma_\chi, c_f$) jointly calibrated to match 5 moments from French data: (1) TFP elasticity of distortions, (2) sd log distortions, (3) sd log TFP, (4) sd log employment, and (5) average firm size.

Firm-level TFP (facts 1 & 2)



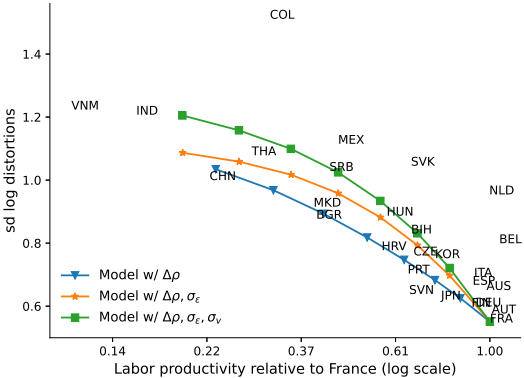
sd log TFP



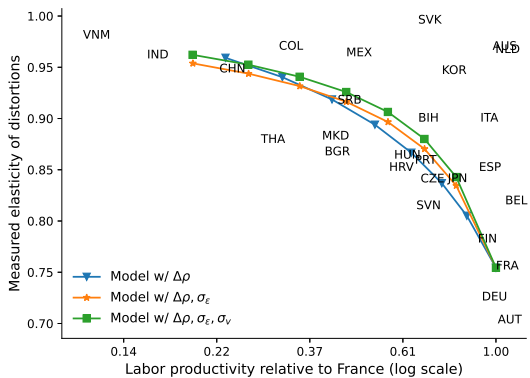
p99-p75 & p99-p1 log TFP

- Model fits cross-country data well, bulk of effects from distortions elasticity ρ.
- Aggregate productivity in model represents 2/3 variation cross-country data.

Firm-level distortions (facts 3 & 4)



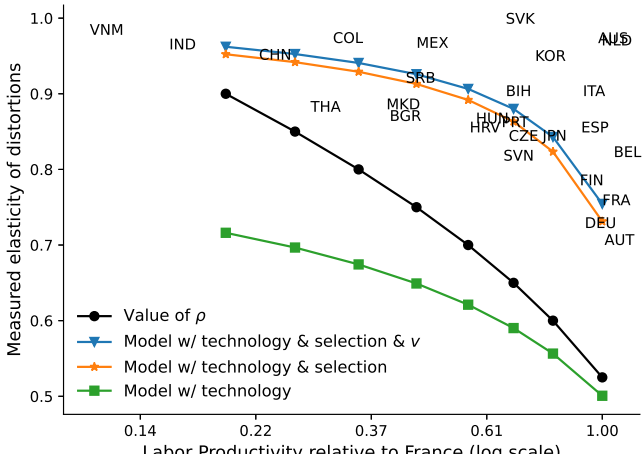
sd log wedges



Elasticity of distortions

- Bulk of distortions dispersion from distortions elasticity ρ.

Estimation bias in measured elasticity of distortions



- Measured bias due to ex-post v, selection, and technology choice.
- Overall positive bias and more severe in higher income countries.

Decomposing productivity losses

	Value of ρ	
	0.525	0.90
Aggregate output	1.00	0.23
Static misallocation contribution (%)	–	*41*
Firm-level productivity contribution (%)	–	*40*
Firm productivity with distortions contribution (%)	–	*19*
Allocative efficiency contribution (%)	–	*60*

- Static misallocation: change distortions with same producers and technologies.
- Changes in firm-level productivity account for 60% of aggregate productivity loss.

Conclusions

- Substantial differences in firm productivity distributions across countries.
- Policy and institutional distortions can account for differences in firm distributions through selection and technology decisions.
- Productivity cost of misallocation extends beyond static misallocation: changes in firm-level productivity distribution account for 60% of output differences.
- Future work:
  - Link technology and selection with distortions (eg., within-country institutional differences Ayerst et. al. 2023 or reform periods Bustos 2011).
  - Understanding how distortions impact specific firm investments (e.g., management practices, technology adoption, multi-national FDI).