Resource Allocation and Aggregate Productivity

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Motivation of Research Agenda

- Why are some countries rich and others poor?

GDP per capita across countries rel. to USA			
Decile	1960	1990	2014
1	3.4	2.3	2.0
2	5.5	3.2	3.3
5	12.7	10.2	18.5
9	49.9	65.1	79.5
10	80.1	79.3	105.0
R 10/1	23.4	34.0	51.3

- There is also substantial mobility in relative income performance of countries over time across the entire income distribution, suggesting policies/institutions are important

GDP per capita across Countries and Time

Country	1960	1980	2000	2014
Botswana	2.3	7.5	21.5	29.1
Ethiopia	2.5	2.5	1.2	2.6
Malawi	4.7	4.3	2.1	1.9
Indonesia	5.3	7.1	9.0	19.8
China	5.6	5.7	9.5	24.6
India	5.9	4.0	4.4	10.5
Korea	6.2	18.3	50.5	68.2
Zimbabwe	11.3	10.0	6.1	3.1
Singapore	14.3	41.7	83.3	149.7
Japan	30.8	63.2	73.9	68.2
Mexico	32.0	38.1	25.4	31.1
Austria	53.4	62.9	77.8	92.7
France	59.4	75.4	68.3	76.5
United Kingdom	68.0	64.7	74.9	75.3
New Zealand	81.2	60.2	59.4	66.0

Overview

(1) Differences in income per capita across countries mostly accounted for by total factor productivity (TFP)

- What accounts for these productivity differences?

(2) Simple framework with production heterogeneity to discuss/assess potential channels:

- misallocation
- selection
- technology

(3) Evidence of misallocation, causes, and aggregate effects

(4) Broader consequences of misallocation via effects on selection and technology

(1) TFP and Income Differences

- Cross-country income differences mostly accounted for by TFP (e.g. Klenow and Rodriguez-Clare 1997; Jones 2016)
- Similar conclusion when accounting for human capital quality differences (e.g. Erosa, Koreshkova, and Restuccia 2010; Manuelli and Seshadri 2014)

Basic Development Accounting 2010

	Y/E	$(K/Y)^{\frac{\alpha}{(1-\alpha)}}$	h	TFP	Contrib. (%)
United States	1.00	1.00	1.00	1.00	—
Hong Kong	0.85	1.09	0.83	0.94	48.8
Germany	0.74	1.08	0.92	0.75	57.0
Japan	0.68	1.22	0.90	0.62	63.9
South Korea	0.60	1.15	0.93	0.56	65.3
Argentina	0.38	1.11	0.78	0.44	66.5
Mexico	0.34	0.93	0.76	0.48	59.7
China	0.14	1.14	0.71	0.17	82.9
India	0.10	0.82	0.53	0.22	67.0
Malawi	0.02	1.11	0.51	0.04	93.6
Average	0.21	0.98	0.71	0.31	63.8

Source: Jones (2016)

Key Question

- What accounts for productivity differences across countries?
- One explanation is that poor countries are slow in adopting advanced technologies and best practices
- Another distinct but complementary explanation is that resources are not allocated to best uses among heterogeneous producers in poor countries causing misallocation
- Evidence points to a substantial role of reallocation (expanding/contracting, entry/exit) in accounting for productivity growth in advanced economies

- Remark: Explanations may be linked via same underlined policies and institutions

(2) Simple Framework of TFP Differences

- Draws from Restuccia and Rogerson (2017)
- In each period, a single good produced by M potential heterogeneous production units indexed by i
- Output y_i is produced according to

$$y_i = A_i \cdot h_i^{\gamma}, \qquad \gamma \in (0,1)$$

where A_i reflects productivity differences across producers, h_i is labor input, and γ measures the extent of decreasing returns to scale at the establishment level

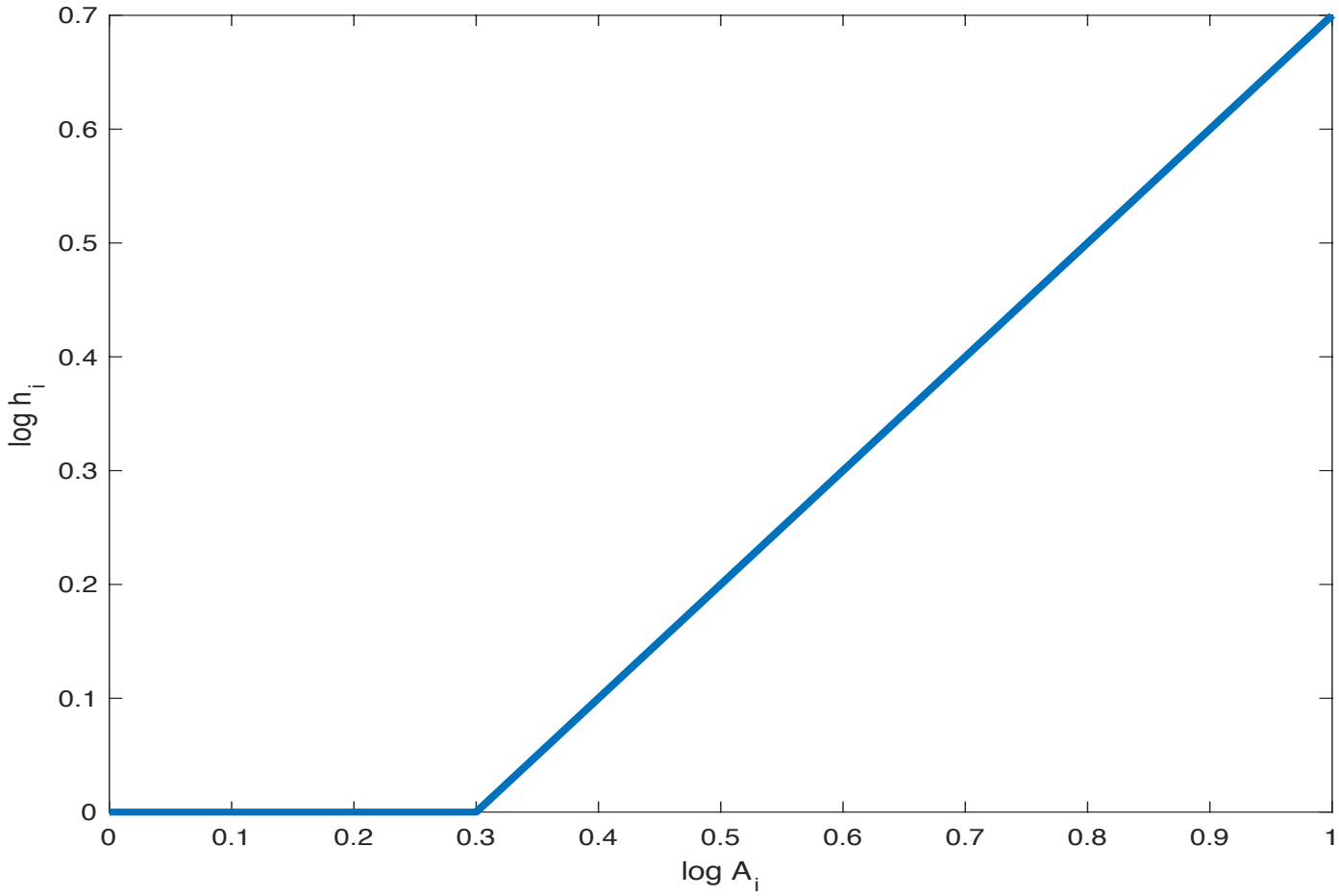
- Fixed cost of operation c in units of output

(2) Simple Framework of TFP Differences

Efficient allocation:

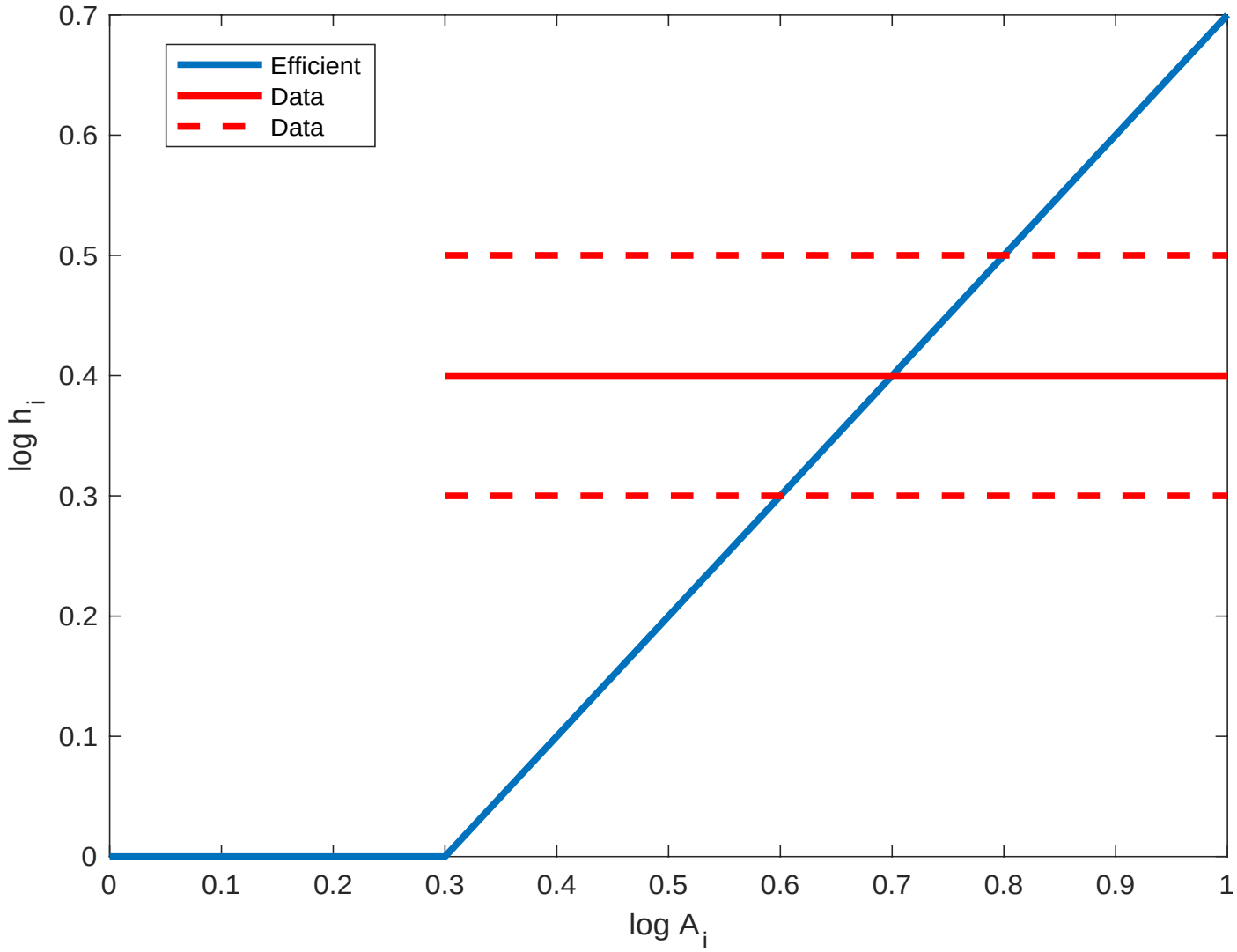
- Consider the efficient allocation of labor across producers that maximizes aggregate output net of operation costs
- Given aggregate labor H, there is unique threshold $\bar{A}$ such that producers with $A_i \geq \bar{A}$ operate, producers with $A_i < \bar{A}$ do not operate
- Among operating producers, those with higher A_i are allocated greater amount of labor, producers with the same productivity operate at the same scale

Stylized Efficient Allocation

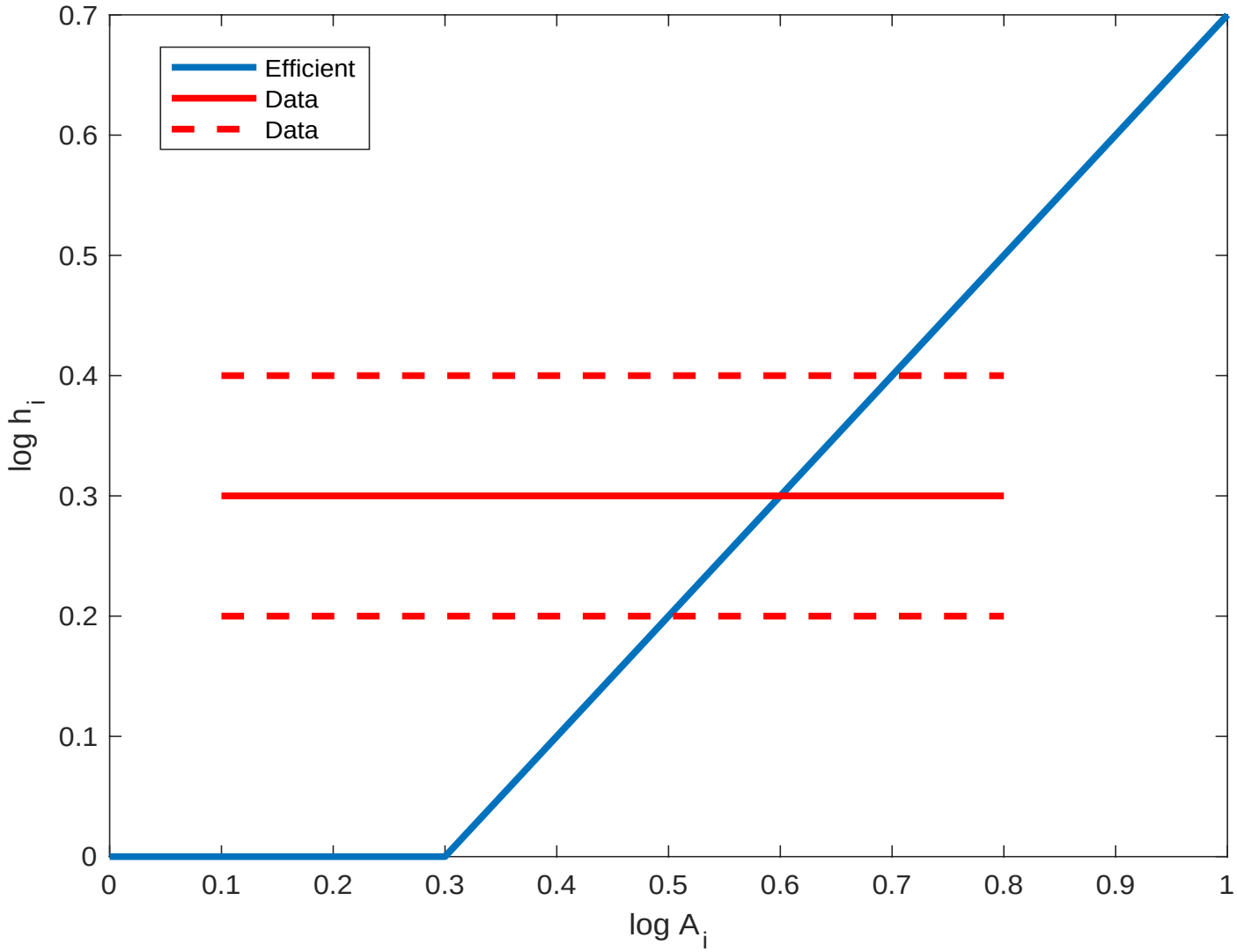


- Any deviation from this allocation would lower aggregate output and hence aggregate TFP

Stylized Misallocation



Misallocation and Selection/Technology



(2) Simple Framework of TFP Differences

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

- Remark: specific policies/institutions generating misallocation can have larger effects on TFP by affecting technology/selection channels

The Cost of Misallocation

- Focus on misallocation: no selection with fixed cost set to zero, no technology differences (Restuccia and Rogerson 2008)
- 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)

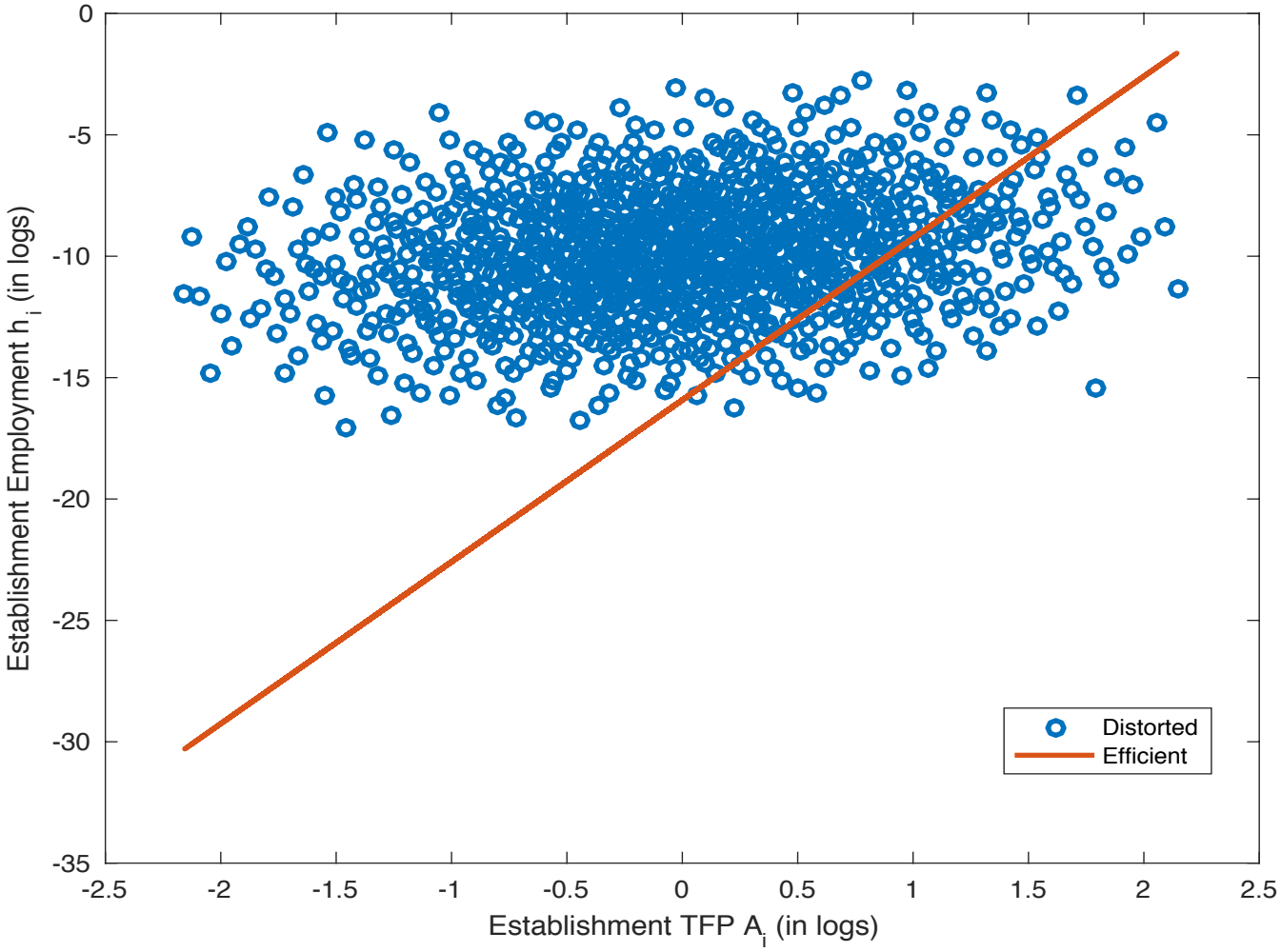
- Assume ϵ_i log normally distributed with mean zero and standard deviation σ_ϵ

The Cost of Misallocation

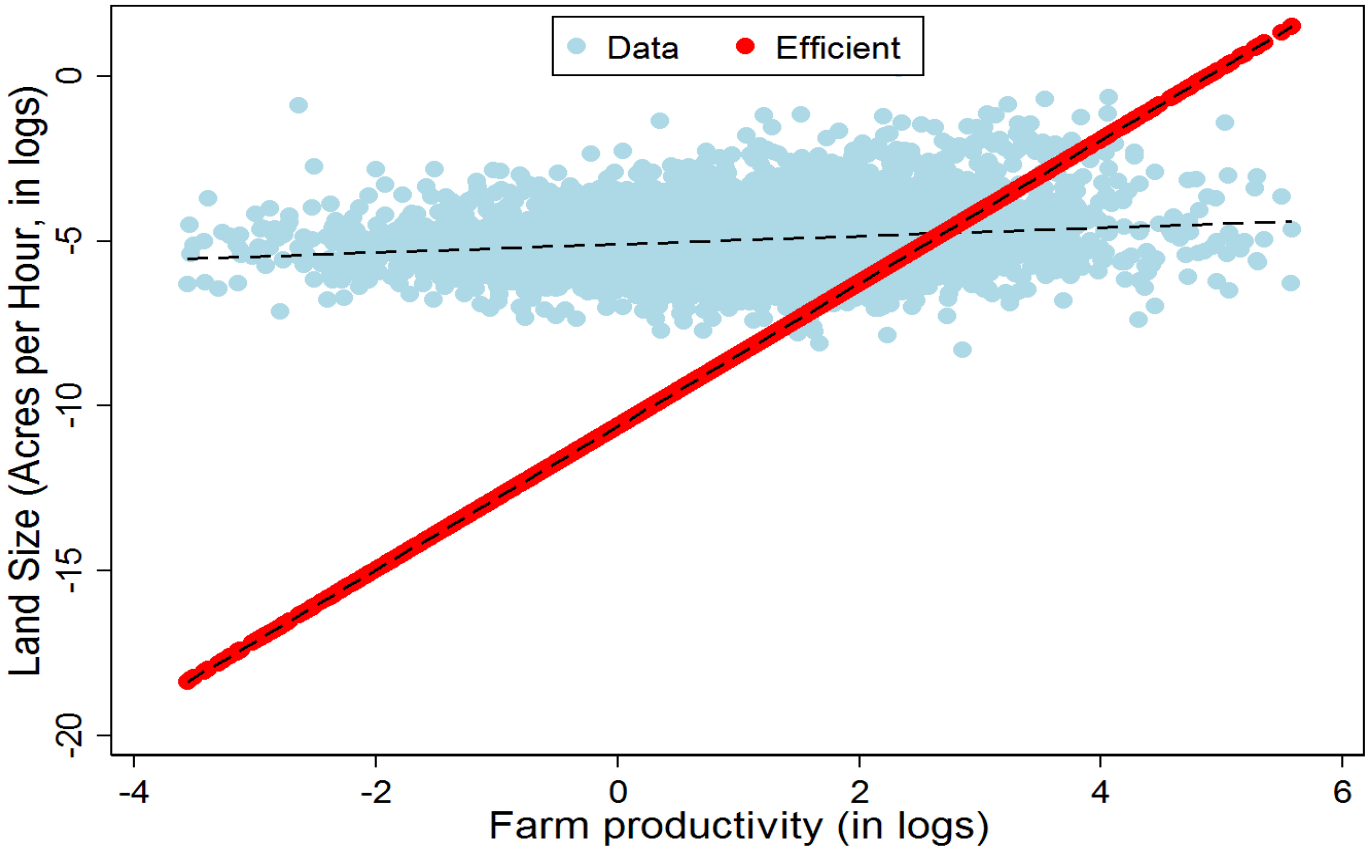
- Calibrate benchmark economy with no distortions ($\theta = 0, \sigma_\epsilon = 0$) to US data: key are moments of productivity distribution A_i (to match employment-size distribution or direct moments of establishment-level TFP distribution)
- For each economy $(\theta, \sigma_\epsilon)$, report the 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 ($\theta = 0.9, \sigma_\epsilon = 0.4$)



Land Misallocation in Malawi



- Restuccia and Santaeulalia-Llopis (2017): Efficient factor reallocation increases aggregate agricultural TFP by a factor of around 2-fold

Virtue of Production Heterogeneity

- Aggregate production function:

$$Y = \sum_{i=1}^{O} y_i = AO^{1-\gamma}H^{\gamma} = \text{TFP} \times F(\text{factors})$$

- Limited scope for policies/institutions that drive TFP differences across countries (aggregate institutions)
- Recognizing production heterogeneity opens the door for many policies/institutions to drive idiosyncratic effects across producers that are potentially measurable

(3) Evidence of Misallocation

- Key insight: to maximize aggregate output, the marginal (or average) product of factors should equalize across producers

$$\underbrace{(1-\tau_i)\gamma\frac{y_i}{h_i}}_{\text{Value of marginal output}} = w \quad \Rightarrow \quad \text{TFPR}_i \equiv \frac{y_i}{h_i} \propto \frac{1}{(1-\tau_i)}$$

- Suggests two broad approaches to assess the empirical relevance of misallocation:
  - 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

Indirect Approach

- Assess extent of misallocation without identifying underlying source (Hsieh and Klenow 2009)
- Evidence points to substantial misallocation, large TFP loses

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

- Evidence from many other contexts/countries
- Approach useful in identifying relevant patterns, but silent about specific sources, key for policy analysis
- Relevant limitations related to measurement and specification (Bils, Klenow, and Ruane 2017; David and Venkateswaran 2019)

Direct Approach

- Quantifies role of specific policies/institutions creating misallocation through quasi-natural experiments or structural models
- 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

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

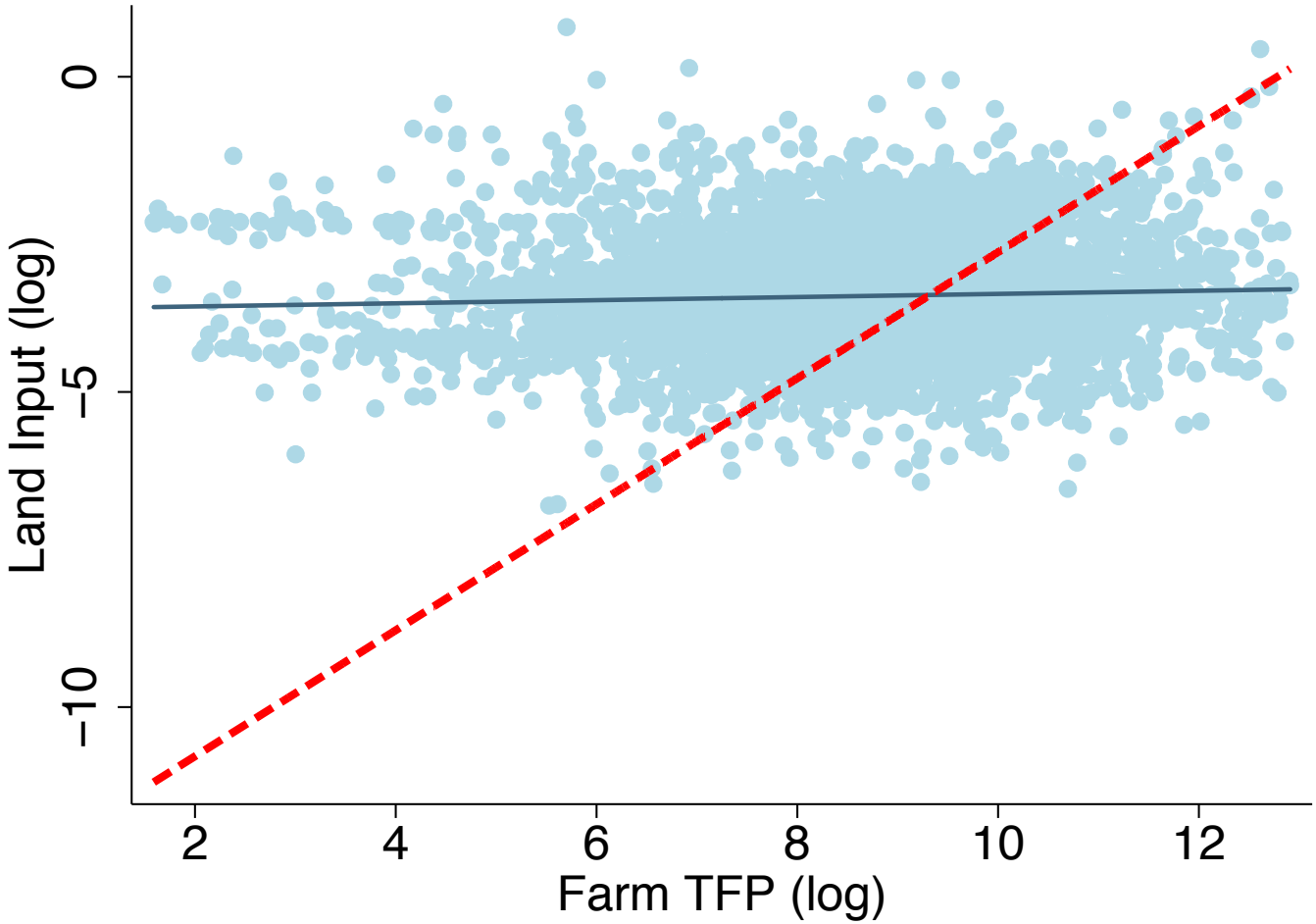
Causes of Misallocation

- 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

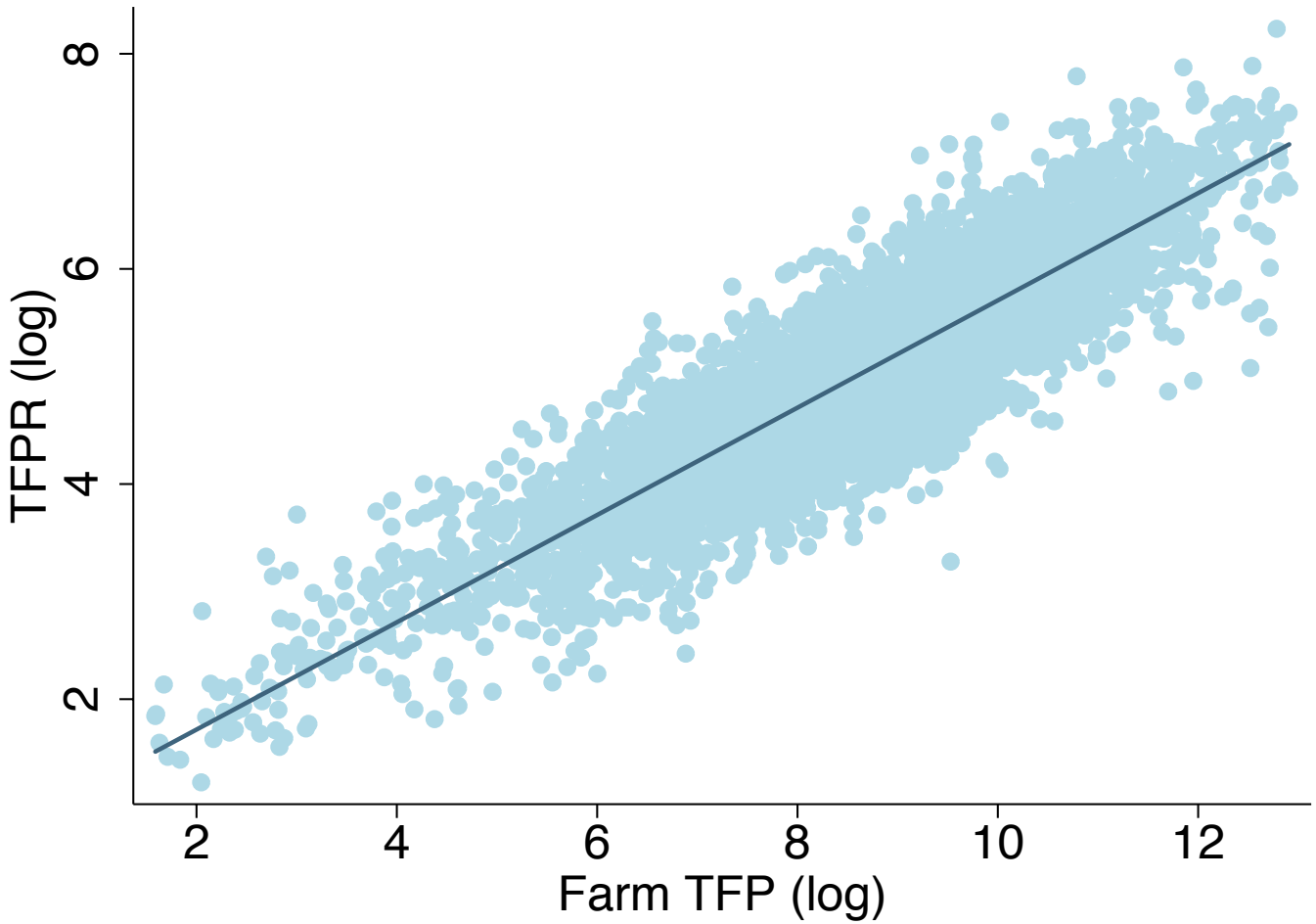
- Land institutions in poor countries characterized by:
  - Lack of well-defined property rights over land
  - Land use-rights are distributed in a fairly egalitarian basis...
  - ...coupled with difficulty of adjusting operational scales
- As a result, land not allocated to best uses, leading to small 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

Land Misallocation in China



- Adamopoulos et al (2017): Efficient reallocation of operated land can increase agricultural productivity by 57%

Implicit Agricultural Distortions in China



- Large implied correlated distortions in the agricultural sector σ(logTFPR)=0.78, ρ(logTFPR,logTFP)=0.86

Changes in Policy in Specific Contexts

(1) Land reform in Philippines (Adamopoulos and Restuccia 2019)

- 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

(2) 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 the 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

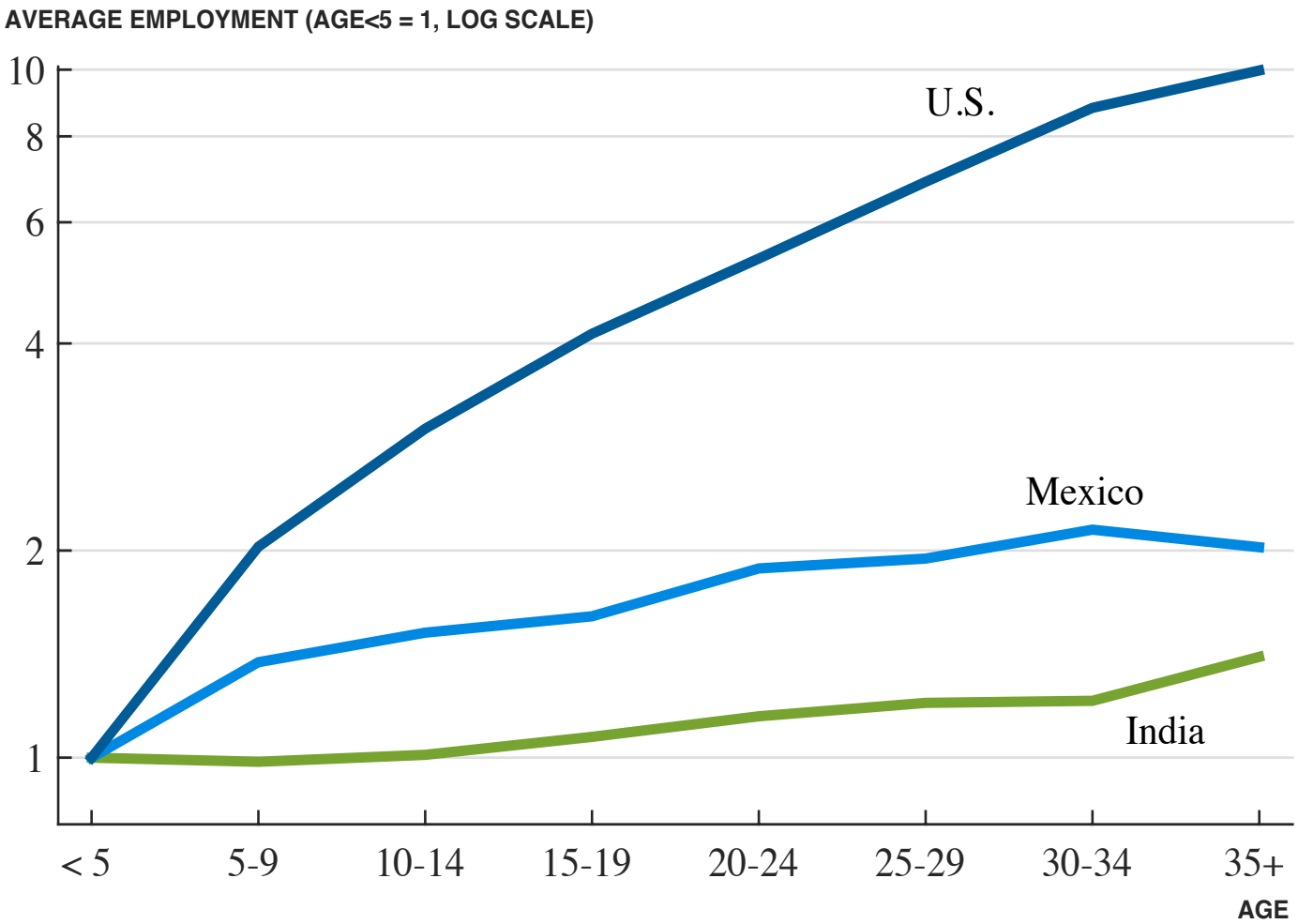
Key Characteristics of Distortions

- 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

(4) Broader Consequences of Misallocation

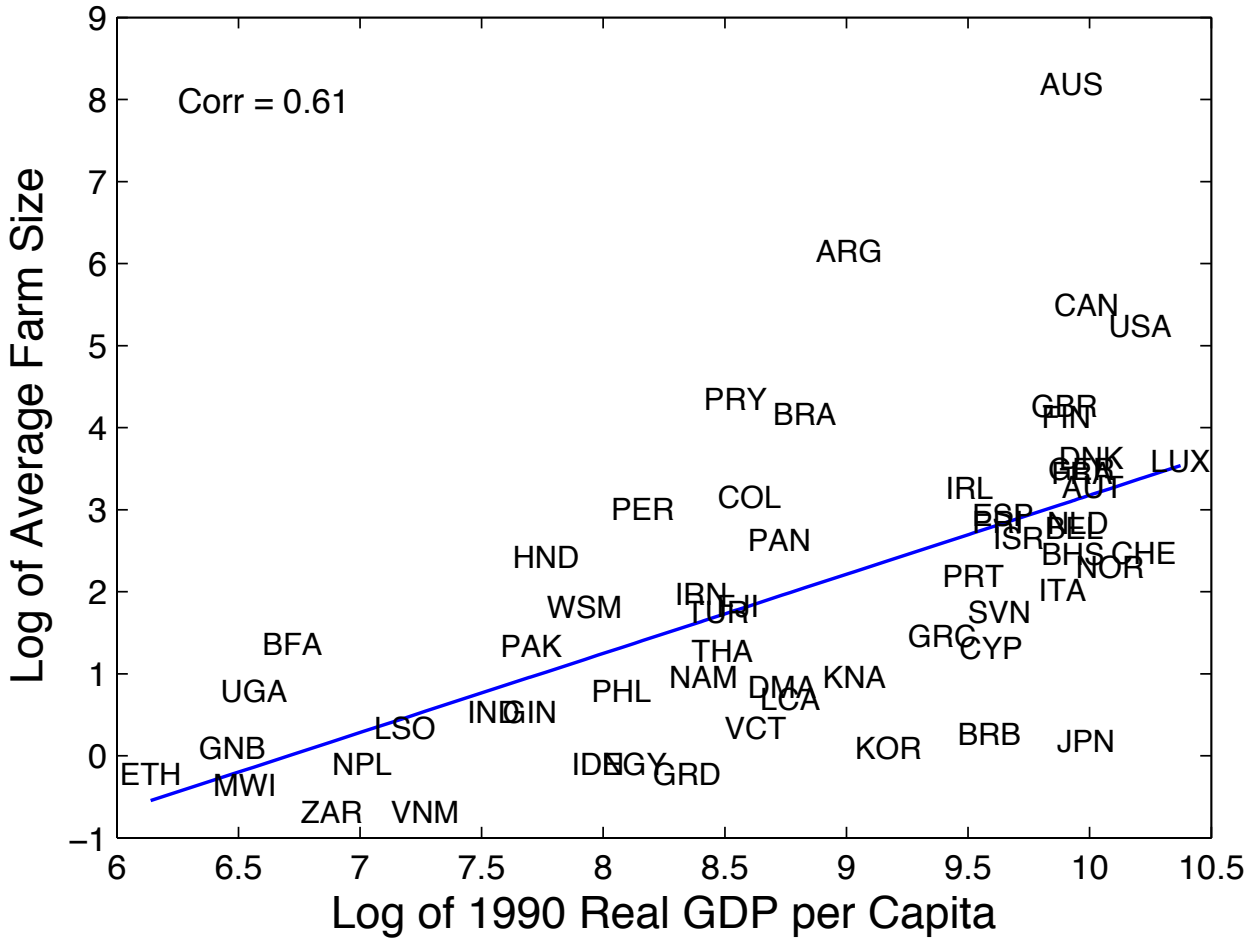
- Early misallocation analysis: given a fixed productivity distribution common across countries, assess quantitative impact of factor misallocation
- Recent research considers dynamic implications of misallocation
- A prevalent property of policies/institutions that create misallocation in developing countries: disproportionally affect more productive producers (correlated distortions)
- In models of firm dynamics these 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



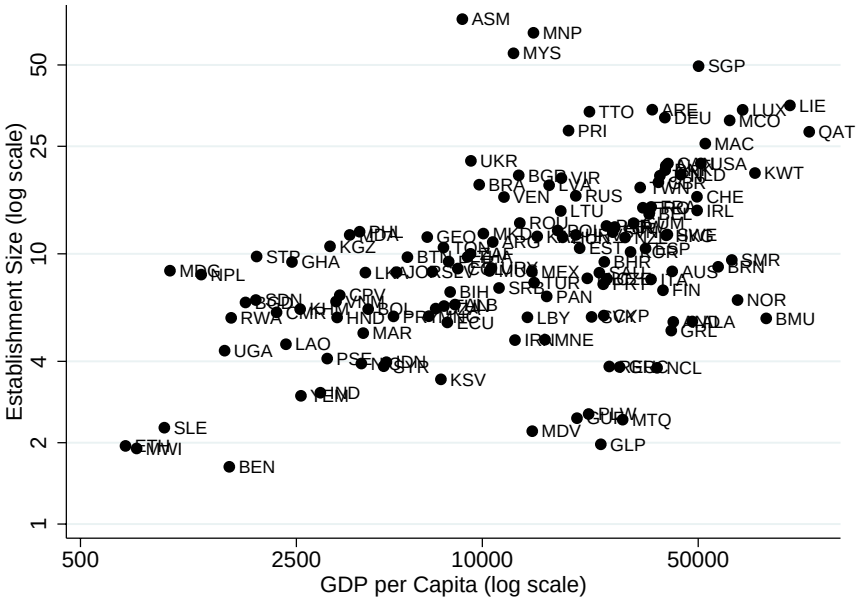
- Source: Hsieh and Klenow (2014)

Average Farm Size across Countries

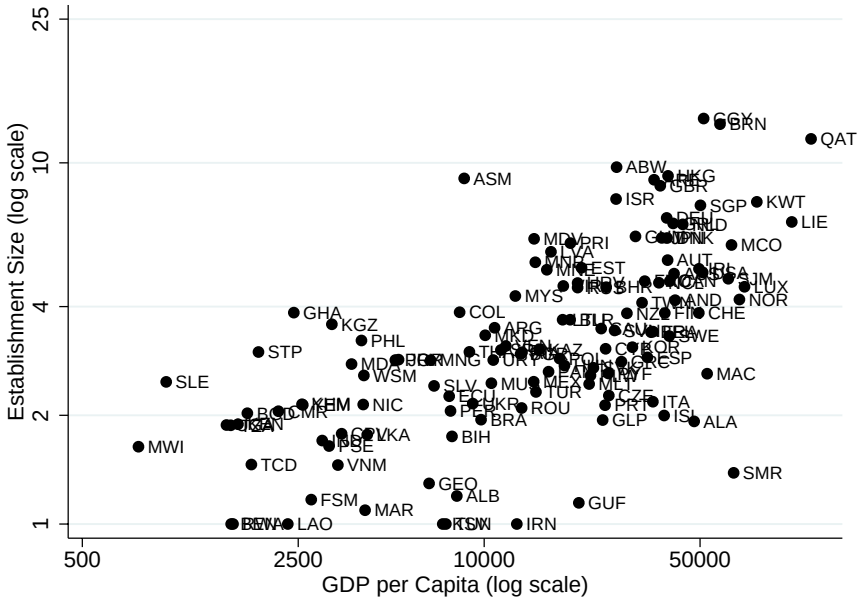


- Source: Adamopoulos and Restuccia (2014)

Average Establishment Size



(a) Manufacturing



(b) Services

- Source: Bento and Restuccia (2017, 2018)

(4) 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

(4) 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)

(4) Broader Consequences of Misallocation

Some examples (misallocation + selection):

- Imperfect land markets (Adamopoulos et al. 2017)
  - Pattern of implicit distortions affect sector choice of highly productive farmers in addition to misallocation
  - In China a 1.5-fold TFP gain in agriculture from eliminating misallocation translates into a 3-fold gain when accounting for selection

(4) Broader Consequences of Misallocation

Some examples (misallocation + technology):

- Trade liberalization and technology upgrading (Bustos 2011)
- Technology adoption and diffusion (Ayerst 2016)
- 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

Conclusions

- 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 research shows important link between misallocation and technology/selection channels in accounting for productivity differences
- More work is needed in quantifying the dynamic implications of misallocation