Misallocation

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Motivation

- Development and growth accounting suggest that aggregate differences in TFP are an important source of differences in relative living standards.
- We need to understand the forces that shape TFP.
- Two distinct channels:
  1) Differences in the adoption of best practice methods and technologies
  2) Differences in the extent to which resources are allocated efficiently
- Models that start with an aggregate production functions can't distinguish between the two.

What is Misallocation?

- If markets are perfect then resource flow to their most productive use:
  - Land flows to the most productive farmer
  - Capital flows to the most productive factor
  - Education flows to the person who will benefit most
  - Health spending will be put to its most productive use
- Misallocation arises if factors of production are allocated inefficiently.

What is Misallocation?

- Misallocation could be:
  - Across firms within (or across) sectors;
  - Across sectors
  - Across space
- The misallocated factor could be:
  - Human capital;
  - Physical capital;
  - Resources;
  - Talent.
- Usually models of misallocation feature a distribution of productivities:

$$Y_i = A_i f(\cdot)$$

What is Not Misallocation?

- Measurement error in revenue or inputs
- Unavoidable adjustment costs or transportation costs
- Differential riskiness of investments
- Compensating differentials for labor (amenities and disamenities)
- Misspecification in the production function

What Can Generate Misallocation?

- TFRP dispersion due to...
  - Tax rate differences between firms
  - Size-dependent regulations (e.g., firing restrictions)
  - Price markup differences across products
  - Wage markdown differences across firms
  - Discrimination — labor market, lending, housing, school admissions, etc.
  - Financial frictions, state-owned banks, cronyism
  - Efficiency wages in some firms or industries relative to others
  - Licensing, entry restrictions, land-use restrictions
  - Under- or over-investment in public goods (e.g. R&D, infrastructure)
  - Externalities (positive or negative)

Misallocation Affects TFP (Jones, 2011)

- An economy produces a single output Y, from two inputs: Steel and Lattes.
- Production is very simple
$$X_s = AK_s, X_l = AK_l$$
- Resource constraints in the economy are:
$$K_s + K_l = \bar{K}$$
- Steel and Lattes are combined by a single firm to form output according to:
$$Y = X_s^{0.5} X_l^{0.5}$$

Lattes and Steel

- Suppose that the firm must allocate capital to steel and lattes to produce maximum output.
- Let's suppose that it does so by giving $K_s = x\bar{K}$ and $K_l = (1-x)\bar{K}$.
- Substituting back into the production function we have,

$$Y = A\sqrt{x(1-x)\bar{K}}$$

- TFP has two parts:
  - A measure of efficiency in production, A; and
  - $\sqrt{x(1-x)}$: A geometric average of the allocations.
  - It is straightforward to see that TFP is maximized when x = 0.5.

Type of Studies

- Restuccia and Rogerson (2017) divide studies into two types:
  - Direct: Specifies a potential source of misallocation, measures it, and uses a model to assess its consequences.
  - Indirect: tries to quantify the overall amount of misallocation without identifying the underlying source.
- Studies are also:
  - Micro
  - Macro
- This is probably the most active area on the intersection of micro and macroeconomics

The Indirect Approach

Indirect Approach

- Seeks to assess the extent of misallocation without identifying the underlying cause
  - Useful for identifying relevant patterns, but silent about the source
  - Efficiency dictates equalization of marginal products:

$$\alpha z_i k_i^{\alpha-1} = \alpha z_j k_j^{\alpha-1}$$

  - It follows that violations of this condition imply misallocation.
  - The bigger the violation, the bigger the misallocation.

The Allocation of Talent in the U.S.

	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%

The share of each group in *high-skilled occupations*: lawyers, doctors, engineers, scientists, architects, mathematicians, and executives/managers

The Allocation of Talent in the U.S.

- These facts are consistent with falling discrimination in the U.S. over time.
- Generates gains from comparative advantage and human capital investments
- May have accounted for:
  - 40% of growth in GDP per capita over this period.
  - 25% of growth in GDP per worker (difference due to rising participation)

Identifying Misallocation

- How do we identify violations?
- Given our functional form, the previous conditions becomes:

$$\frac{y_i}{k_i} = \frac{y_j}{k_j}$$

- Given data on y_i and k_i we can identify whether misallocation exists.
- We also want to understand the effects of misallocation.

Inferring the Effect of Misallocation on TFP

- Suppose $y_i = z_i k_i^{\alpha}$ with α known and you have data on y and k.
- Define $Y = \sum_i y_i$, $K = \sum_i k_i$, and TFP as Y/K
- If we know z_i then we can solve for the level of output if capital were allocated efficiently. Denote this as Y*
- Can solve for z_i as: $z_i = y_i/k_i^{\alpha}$ from data.
- $Y/Y*$ is the effect of misallocation on aggregate TFP.
- Implicitly if y_i/k_i is not constant, $Y* > Y$

Conceptual Issues

- If we write down a model and it does not fit some part of the data, how do we interpret this?
- Important issues relating to measurement and specification
  - Demand structure
  - Production structure
  - Inputs and outputs may be measured with error (Bills, Klenow, and Ruane, 2017)
  - Adjustment costs vs. distortions (David and Venkateswaran, 2017)

Practical Issues

- Microdata typically reports $p_i y_i$ not y_i
- Hopenhayn and Lucas model assumes homogenous output so not an issue as $p_i = p$
- We can identify z_i up to a scaling factor.
- But if output is not homogenous and prices vary, we can't identify z_i.
- We need a framework that permits price heterogeneity.

Misallocation in a One Factor Melitz Model

- N heterogeneous producers (varieties), where N is taken as given,
- Labor supply is exogenous and also fixed, L.
  - Firm i's technology: $y_i = z_i \ell_i$
  - Final good (CES over varieties): $Y = [\sum_i y_i^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}$
- Idiosyncratic taxes on revenue: τ_i
- Competitive labor market, competitive final goods producer, monopolistic competition among producers of varieties.

Identifying Misallocation in a One Factor Melitz Model

- If $\tau_i = 0 \rightarrow$ equilibrium allocation is efficient.
- Firm i chooses labor to maximize profits,

$$\max_{\ell_i} p_i z_i \ell_i - w\ell_i \text{ s.t. } p_i = B(A_i \ell_i)^{\frac{-1}{\sigma}}$$

  where B is a demand constant implied by the CES structure.

- F.O.Cs imply,

$$z_i^{\frac{\sigma-1}{\sigma}} \ell_i^{-\frac{1}{\sigma}} = z_j^{\frac{\sigma-1}{\sigma}} \ell_j^{-\frac{1}{\sigma}} \qquad \forall i, j$$

- Using the demand system, this is equivalent to,

$$TFPR_i \equiv \frac{p_i y_i}{\ell_i} = \frac{p_j y_j}{\ell_j} \equiv TFPR_j$$

- efficiency $\rightarrow$ equalized average revenue products (TFPR) across firms.
- Provides a simple condition for identifying misallocation.

Recovering Productivity in a One-Factor Melitz Model

- We need to uncover z_i given data on $p_i y_i$ and ℓ_i
- Trick: CES demand system lets us do this up to a scaling factor.
- Demand system implies that for variety i,

$$p_i = B\, y_i^{-\frac{1}{\sigma}} \quad \Rightarrow \quad p_i y_i = B\, y_i^{\frac{\sigma-1}{\sigma}} = B\left(z_i \ell_i\right)^{\frac{\sigma-1}{\sigma}}$$

- Rearranging,

$$z_i = B^{\frac{\sigma}{1-\sigma}} \frac{\left(p_i y_i\right)^{\frac{\sigma}{\sigma-1}}}{\ell_i}$$

- Given $p_i y_i$ and ℓ_i, we can recover z_i up to the common constant $B^{\frac{\sigma}{1-\sigma}}$.

Computing the Effect of Misallocation in a One Factor Melitz Model

- Need to compute the output gain from moving to the efficient allocation, $Y/Y*$.
- Key point: efficient labor allocation depends only on relative $z's$:

$$\frac{\ell_i}{\ell_j} = \left[\frac{z_i}{z_j}\right]^{1-\sigma}, \quad \sum_i \ell_i^* = L \quad \Rightarrow \quad \ell_i^* = \frac{z_i^{1-\sigma}}{\sum_j z_j^{1-\sigma}} L$$

- Let ℓ_i denote observed allocation and ℓ^* denote the efficient allocation.

$$\begin{aligned} Y &= \frac{1}{B^{\frac{\sigma}{1-\sigma}}} \left[\sum \left(B^{\frac{\sigma}{1-\sigma}} z_i \ell_i\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} = \left[\sum \left(z_i \ell_i\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \\ Y^* &= \frac{1}{B^{\frac{\sigma}{1-\sigma}}} \left[\sum \left(B^{\frac{\sigma}{1-\sigma}} z_i \ell_i^*\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} = \left[\sum \left(z_i \ell_i^*\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \end{aligned}$$

- The common factor $B^{\frac{\sigma}{1-\sigma}}$ cancels in the ratio Y^*/Y, so we do not need to know B to measure the output loss from misallocation.

Recovering the Wedges

- Without taxes:

$$z_i^{\frac{\sigma-1}{\sigma}} \ell_i^{-\frac{1}{\sigma}} = z_j^{\frac{\sigma-1}{\sigma}} \ell_j^{-\frac{1}{\sigma}} \rightarrow \frac{p_i y_i}{\ell_i} = \frac{p_j y_j}{\ell_j}$$

- With idiosyncratic taxes on revenue we have:

$$(1-\tau_i)\, z_i^{\frac{\sigma-1}{\sigma}} \ell_i^{-\frac{1}{\sigma}} = (1-\tau_j)\, z_j^{\frac{\sigma-1}{\sigma}} \ell_j^{-\frac{1}{\sigma}} \rightarrow \frac{(1-\tau_i)\, p_i y_i}{\ell_i} = \frac{(1-\tau_j)\, p_j y_j}{\ell_j}$$

- This implies:

$$\frac{(1-\tau_i)}{(1-\tau_j)} = \frac{p_j y_j / \ell_j}{p_i y_i / \ell_i}$$

- We can identify τ_i up to a scaling factor – a uniform tax on all producers does not create misallocation.

Summary

- Given the model structure (one-factor Melitz, CES demand, chosen σ) and firm-level data on $p_i y_i$ and ℓ_i, we can:

1) Recover firm productivities z_i (up to a common scale) and compute the efficient allocation $\{\ell_i^*\}$.

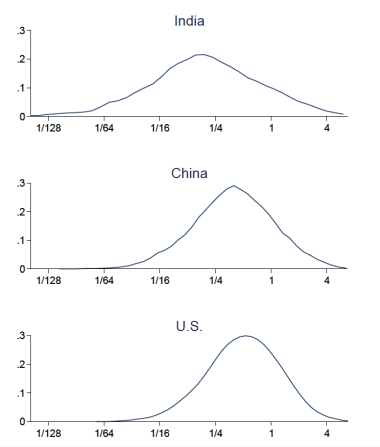
2) Quantify the TFP/output loss from misallocation, e.g. via the ratio Y^*/Y.

3) Back out the pattern of wedges $\{\tau_i\}$ that rationalizes the observed allocation as a distorted equilibrium.

Hsieh and Klenow (2009)

- HK generalize previous analysis to multiple factors.
- Consider distortion to output and distortion to k/ℓ
- Research question:
  - Is there more capital misallocation in China and India than the US?
  - Is this difference quantitatively important?
- Rough idea:
  - Firms may differ in productivity
  - But, they should all make the same revenue from the same input.
    - Dispersion in revenue productivity measures misallocation.
    - $TFPR_i \propto MRPK_i$
    - So if allocation is efficient $\rightarrow$ TFPR must be equal across firms.

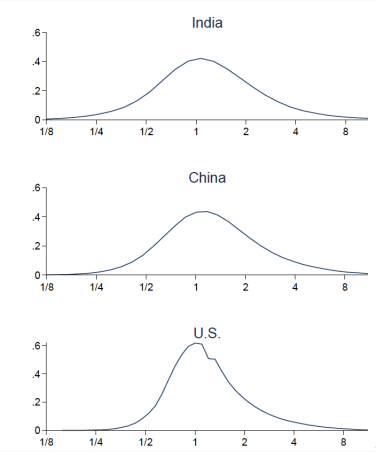
Results: $TFPQ_i \equiv A_i$



Interpretation: $TFPQ_i \equiv A_i$

- All countries have highly productive firms
    - Some firms everywhere are really good at turning inputs into physical output (technical efficiency)
- India and China have bigger left tails
- But, this could be because of many things:
    - Different talent distribution
    - Different tastes
    - Different qualities
- But, we know that *TFPR* should not differ.

Results: $TFPR_i \equiv \frac{P_i Y_i}{K_i}$



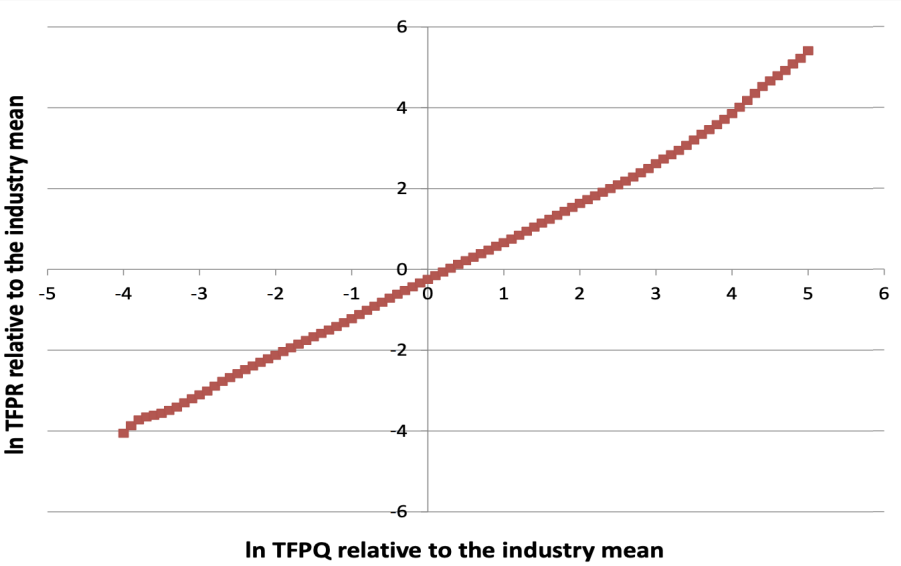
Results

- With no distortions TFP would increase by:
  - China: 86-115%
  - India: 100-120%
  - US: 30-43%
- Developing countries are more distorted.

Gains to Becoming US

- Estimates suggest that reallocation would lead to
  - 49% of the TFP gap between the US and China
  - 35% of the TFP gap between the US and India
- Substantial (but remember the nature of the exercise).
- Needed: better understanding about sources of misallocation.

TFPR is increasing in TFPQ



Decomposing TFPR with Multiple Inputs

- $TFPR_i = \frac{P_i Y_i}{(K_i^{\alpha} L_i^{1-\alpha})^{\gamma} X_i^{1-\gamma}}$
    - PY is gross output, K is physical capital, L is labor, and X are intermediates.
- $TFPR_i \equiv [VAPK_i^{\alpha} VAPL_i^{1-\alpha}]^{\gamma} APX_i^{1-\gamma}$
- VAPK refers to the "Value of the Average Product of Capital", ...
- $VAPK \propto VMPK \propto VRPK$ *only* if Cobb-Douglas and equal markups.

Scale vs. Mix Distortions

- Scale: common component of VAPK, VAPL, and VAPX
- Mix: ratios of VAPK/VAPL, VAPK/VAPX, VAPL/VAPX
- David and Venkateswaran (2019) and Bils, Klenow, Ruane (2021) find mostly *scale* distortions
- Suggests markpus, revenue taxes/subsidies, errors in revenue/(all inputs)
- Suggests financial frictions, wage markdowns, etc. aren't dominant.

Persistence

- Most of the variance in TFPR is in the firm or plant fixed effect.
- Again points to persistent markups, measurement error, and revenue taxes/subsidies.
- Not consistent with a dominant role for financial frictions or adjustment costs.
  - More likely to affect firms in a dynamic way.
  - E.g. financial frictions might affect firms differently over the business cycle or as the firm ages, leading to fluctuations in TFPR over time.

Dynamic Effects of Static Misallocation

- If barriers are increasing in productivity...
  - firms may invest less in productivity and quality before they enter (Bento and Restuccia, 2017)
  - innovate less after they enter (Hsieh and Klenow, 2014; Akcigit et al., 2021)
  - and enter in greater numbers (Atkeson and Burstein, 2010; Jaef, 2021).

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

Dispersion in VAPK across plants within firms

- Kehrig and Vincent (2020) show that in U.S. Manufacturing, most of the variance in VAPK is across plants within firms.
- So cannot be financial frictions?
- They argue that it reflects the interaction of lumpy adjustment costs and financial frictions
- Also consistent with plant-specific markups or production elasticities within firms.

Summary: Five Facts

1) TFPR is more dispersed in LMIC countries.

2) TFPR is strongly increasing in TFPQ, especially in LMICs.

3) Most dispersion in in TFPR, rather than in one of VAPK, VAPL, or VAPX.

4) Much of the TFPR dispersion is persistent over time.

5) Much of the VAPK dispersion is *within* firms (at least in the U.S.)

Farms

- Land misallocation and productivity:
  - Massive variation in farm TFPR (even controlling for land quality)
  - 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
  - Restuccia et al. (2017) say reallocating land could more than triple aggregate farm TFP.
- Gollin and Udry (2019) argue that there should be no misallocation across plots within farms that sell homogenous crops at given prices.
  - Idiosyncratic shocks, measurement error, and heterogeneity explain 2/3 of TFPR dispersion.

The Direct Approach

Direct Approach

- Quantifies the role of specific policies/institutions that create misallocation, either through natural experiments or structural models
- Some examples:
  - Regulation and discretionary provisions
  - Selective industrial policy
  - Financial frictions
  - Trade restrictions
- Challenges:
  - Many specific policies/institutions are not amenable to direct measurement
  - The bulk of misallocation does not come from a single source

De Mel, McKenzie, and Woodruff (2006)

- In general, it is hard to measure the returns to capital (i.e., the MPK). Why?
- If we compare two firms, one that has more capital than another, we have to ask ourselves "Why does that firm have more capital?"
- DMW circumvent this problem by giving a sample of small firms in Sri Lanka a cash grant of $100-200.
- They then measure the returns to capital, using this grant as an instrument for capital holdings.

Results

- On average the returns to capital are staggering: 55-63% per year.
- Question: If these are the returns to giving $100 to small firms in Sri Lanka, why don't we all do that right now?
- The results, mask a lot of heterogeneity:
  - Returns for female entrepreneurs are on average zero.
  - Firms with wealthy families have a much lower return to capital
  - More well educated individuals had a much higher return to capital
  - Those with a larger digit span had a much higher return to capital
- Under what assumptions does this imply an initial misallocation?

Bloom, Genakos, Sadun and Van Reenen (2009)

- Bloom and Van Reenen produced a survey of management practices, in consultation with consulting companies.
- They conducted double blind surveys:
  - The managers did not know they were being scored.
  - The surveyor did not know which firm they were surveying.
- Questions focus on a set of key variables such as performance reviews, J-I-T, etc.
- Turned these answers into a 5-point scale from bad to good.

Key Findings

1) Firms with better management practices tend to have better performance on a wide range of indicators $\Rightarrow$ larger, more productive, grow faster, and have higher survival rates.

2) Management practices vary tremendously across firms and countries

3) Countries specialize in different styles of management $\Rightarrow$ e.g., US firms focus on incentives, Swedish firms focus on monitoring.

4) Stronger product market competition appears to boost management practices by eliminating the left tail of badly managed firms and by pushing incumbents to improve their practices.

Key Findings

5) Multinational firms are generally well managed in every country

6) Firms that export (but do not produce) overseas are better managed that domestic non-exporters but are worse managed than multinationals.

7) Inherited family-owned firms who appoint a family member as CEO are very badly managed on average.

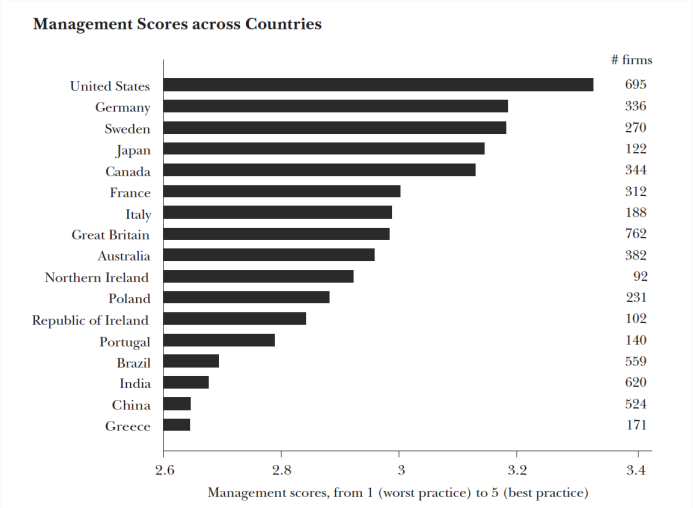
8) Government owned firms are typically managed extremely badly.

9) Firms that intensively use human capital, as measured by more educated workers, tend to have much better management practices

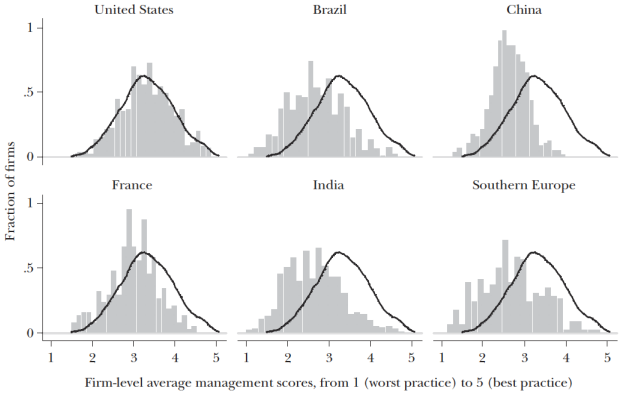
10) At the country level, a relatively light touch in labor market regulation is associated with better use of incentives by managers.

Three Key Areas

- Monitoring
  - Do firms know what is going on
  - Do they use this information
- Targets
  - Set targets, track outcomes, take action
- Incentives
  - Rewarding people for performance
  - Hiring and keeping good people



Random sample of firms with 100-5000 employees


United States
Brazil
China
France
India
Southern Europe
Fraction of firms
0
.5
1
1
2
3
4
5
Firm-level average management scores, from 1 (worst practice) to 5 (best practice)

Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable	**Ln (Sales)**	**Ln (Sales)**	**Ln (Sales)**	**Ln (Sales)**	**Ln (Employees)**	**Profitability (ROCE, %)**	**5 year Sales growth (%)**	**Ln (Tobin Q)**	**Death (%)**
Management	0.330***	0.150***	0.142***	0.033**	0.338***	1.202***	0.039***	0.082**	-0.006***
(z-score)	(0.018)	(0.016)	(0.019)	(0.013)	(0.015)	(0.264)	(0.013)	(0.031)	(0.002)
Ln(Employees)	0.905***	0.645***	0.632***	0.374***					
	(0.018)	(0.024)	(0.030)	(0.096)					
Ln(Capital)		0.307***	0.305***	0.237***					
		(0.019)	(0.024)	(0.078)					
Competition									
Management ×Competition									
General controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Firm fixed effects	No	No	No	Yes	No	No	No	No	No
Firms	4,265	3,493	1,543	1,543	7,519	3,917	3,606	657	7,532
Observations	9,352	8,314	6,364	6,364	15,608	9,163	8,365	1,743	7,532

Three Possible Explanations

- Developing countries need to get better management
    - Can we do development accounting?
- Developing countries need to allocate managers better.
- Correlation is not causation

Conclusions

- There is a great deal of dispersion in management practices, even in the US.
- This is a constant finding in IO: some firms are good and some are not.
- However, there is much more dispersion in developing countries.
- And, it seems that dispersion comes in terms of a large left tail – bad firms are not driven out.
- But, good firms exist in all countries (evidence that the country has the same tech as the US, but that it is not used by all firms).

Causal Estimates

- We want causal estimates of management practices on outcomes.
- Can we interpret the above as causal?
- What is the easiest approach to generate causal estimates?

Does Management Matter: Bloom et al. (2013)

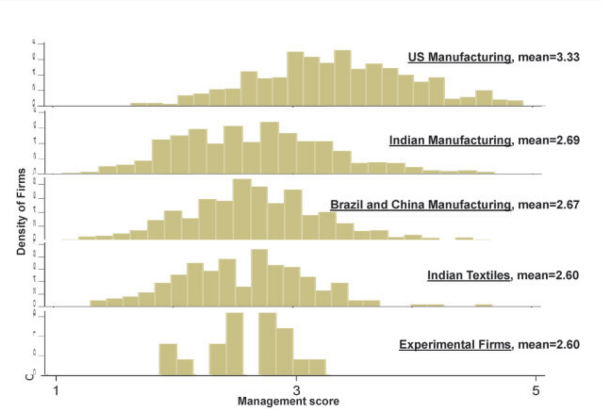
- Offer high quality consulting to a randomly selected set of Indian textile firms.
- 100-1000 employees
- Total 66 in sample
  - 34 interested
  - 17 Agreed to commit time
  - 6 control and 11 treatment . . . wow, sample size!

Facts About Firms

	All				Treatment	Control	Diff
	Mean	Median	Min	Max	Mean	Mean	p-value
Number of plants	28	n/a	n/a	n/a	19	9	n/a
Number of experimental plants	20	n/a	n/a	n/a	14	6	n/a
Number of firms	17	n/a	n/a	n/a	11	6	n/a
Plants per firm	1.65	2	1	4	1.73	1.5	0.393
Employees per firm	273	250	70	500	291	236	0.454
Employees, experimental plants	134	132	60	250	144	114	0.161
Hierarchical levels	4.4	4	3	7	4.4	4.4	0.935
Annual sales ($m) per firm	7.45	6	1.4	15.6	7.06	8.37	0.598
Current assets ($m) per firm	8.50	5.21	1.89	29.33	8.83	7.96	0.837
Daily mtrs, experimental plants	5,560	5,130	2,260	13,000	5,757	5,091	0.602
BVR management score	2.60	2.61	1.89	3.28	2.50	2.75	0.203
Management adoption rates	0.262	0.257	0.079	0.553	0.255	0.288	0.575
Age, experimental plant (years)	19.4	16.5	2	46	20.5	16.8	0.662
Quality defects index	5.24	3.89	0.61	16.4	4.47	7.02	0.395
Inventory (1,000 kilograms)	61.1	72.8	7.4	117.0	61.4	60.2	0.945
Output (picks, million)	23.3	25.4	6.9	32.1	22.1	25.8	0.271
Productivity (in logs)	2.90	2.90	2.12	3.59	2.91	2.86	0.869

Top 1% in India by employment and sales

Facts About Firms



Facts About Firms

Garbage outside a factory

Garbage inside a factory

Garbage inside a factory

Shelves overfilled and disorganized

Facts About Firms

An old warp beam, threading equipment, chairs and a desk obstructing the factory floor and blocking the movement of people and materials

Tools left on the floor

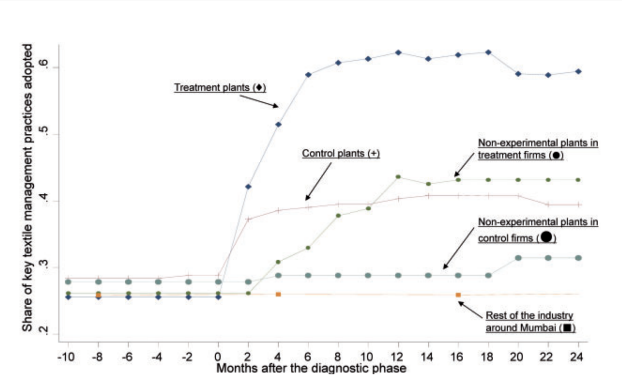
Dirty and poorly maintained machines

Facts About Firms

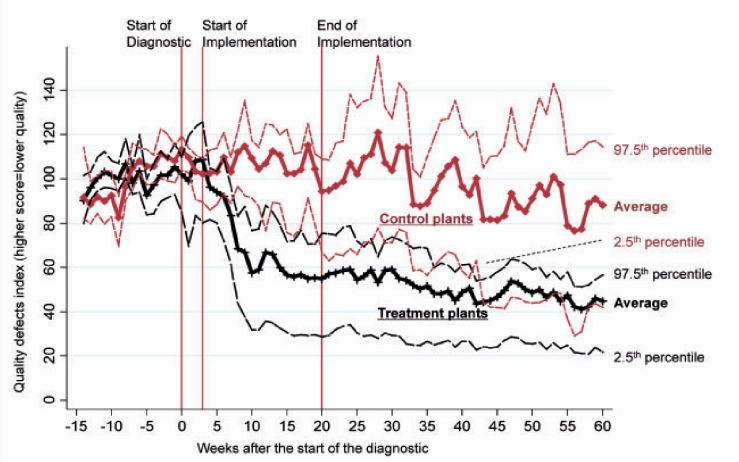
The Intervention

- Concentrate on:
  - Factory operations (e.g. maintenance, organization)
  - Continuous quality control
  - Inventory management
  - Human resources management
  - Sales and order management
- Market cost: about $250,000
- All firms given enough consulting to allow measurement.
- Treatment firms given 4 months consulting on implementation.

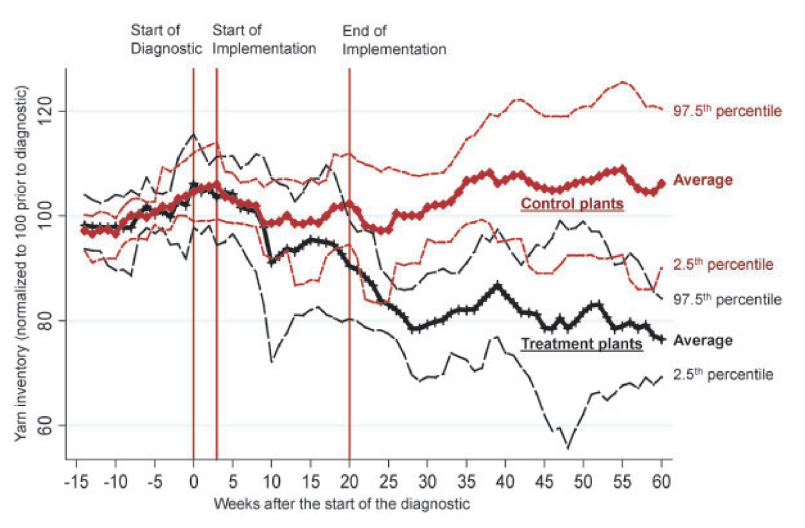
Impacts: Management Practices



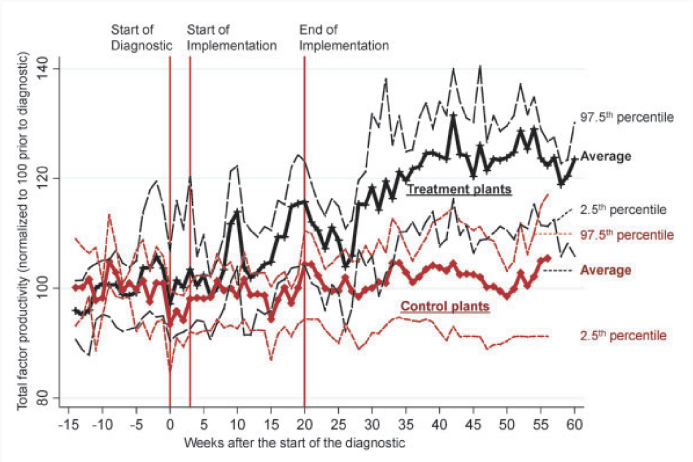
Impacts: Defects



Impacts: Inventory



Impacts: TFPR



Overall

- At a cost of $250,000 profits increase by about $350,000 – could be profitable
- No evidence of management spillovers.
- We have our usual questions:
  - Where did the increase in profit come from?
  - It seems that we have a real increase in productivity.

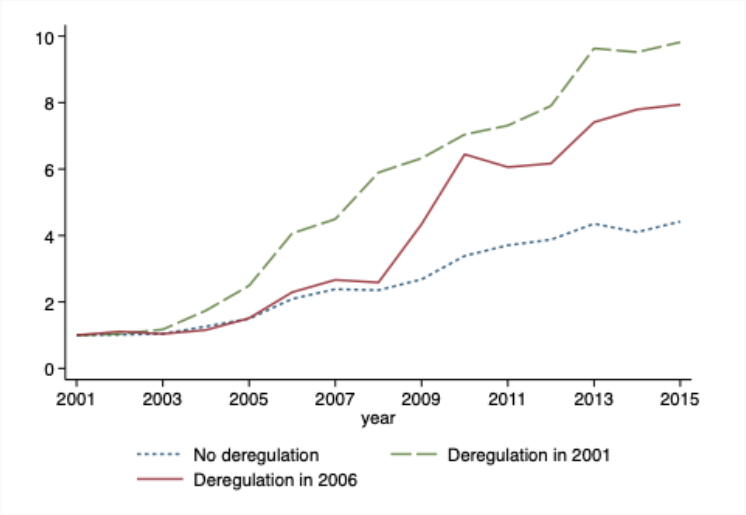
Do Management Interventions Last? – Bloom et al. (2018)

- Revisiting the plants in 2017 the authors found:
  - About half the management practices adopted had been dropped, but a significant gap remains
  - Performance gap still exists, suggesting lasting impact of effective management practices.
  - Management practices had spread within firms, but not across firms.
  - Managerial turnover and lack of Director time were two of the most cited reasons for the drop in management practices.

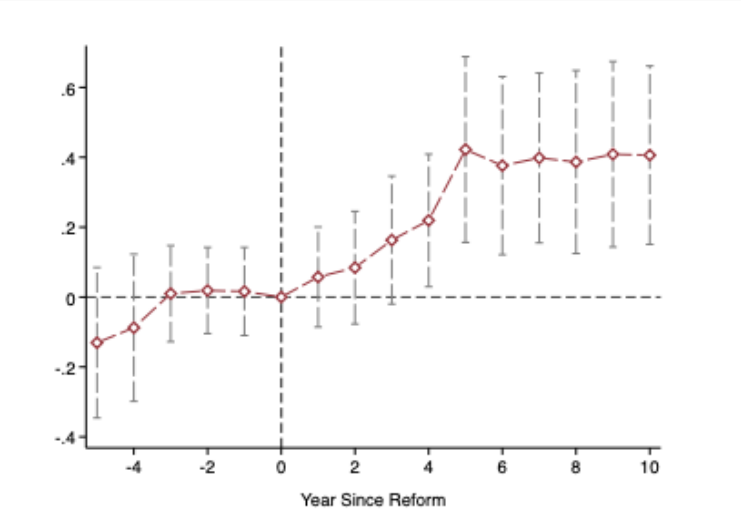
Bau and Matray (2023)

- An interesting paper that tries to tie together direct and indirect approaches.
- "Direct Intervention": India introduced the automatic approval of FDI up to 51% of a domestic firm's equity, increasing access to capital.
  - Increases the overall amount of capital, allowing the *average* firm to grow
  - Can change the *distribution* of capital across firms, affecting capital misallocation
- Exploiting the staggered introduction of the policy across industries, the authors us a diff-in-diff approach.
- Natural experiment helps to isolate changes in inputs and MRPK due to the policy (avoiding measurement error and other contaminants).

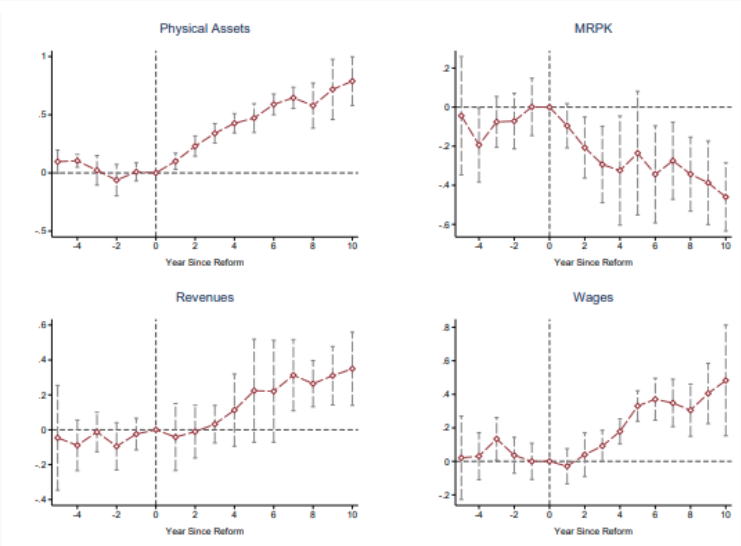
Flow of Foreign Equities



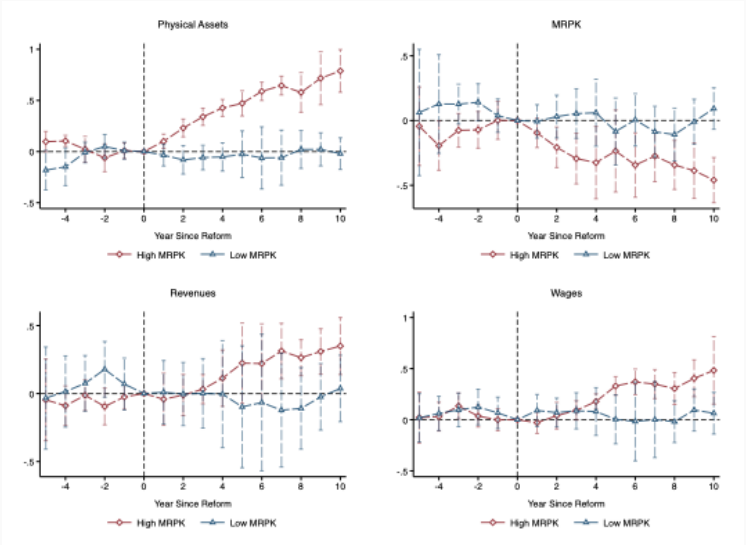
Average Effect of FDI Liberalization on Physical Capital



Effect of FDI Liberalization on High MRPK firms



Effect of FDI Liberalization on High and Low MRPK firms



Aggregate Effects

- Results suggest that misallocation fell within treated industries but not whether this had economically meaningful effects on output growth.

- To get at aggregate effects BM use a theoretical framework to estimate the policies effect on the treated industries' Solow residual, a proxy for aggregate productivity,

$$\Delta Solow_{I,t} \approx \sum_{i \in I} \lambda_i \Delta logA_i + \sum_{i \in I} \sum_{x \in \{K,L,M\}} \lambda_i \alpha_i^x \frac{\tau_i^x}{1+\tau_i^x} \Delta logx_i$$

where λ_i is the ratio of firm i's sales to treated industry I's net output, $\Delta logA_i$ is the change in TFPQ, α_i^x is the output elasticity w.r.t x, τ_i^x is the level of the firm-specific wedge prior to the policy change, and $\Delta logx_i$ is the change in the log input x consumed by firm i.

Aggregate Effects

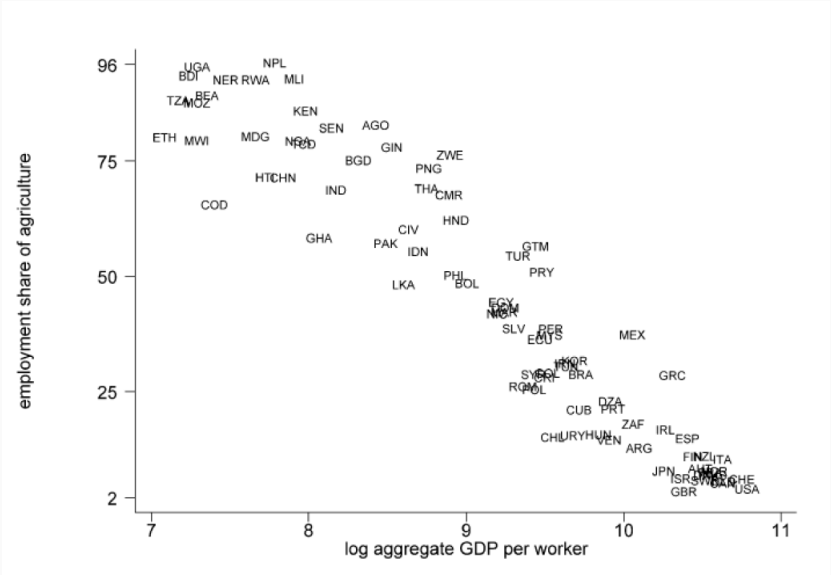
	Increase in Solow Residual
Lower Bound	3.4%
Conventional Approach	16.3%
Lower Bound Allowing for Cumulative Effects	6.2%
Non-Linear Approximation	6.0%

Misallocation Across Space?

Rural-Urban Wage Gaps

- The shift out of agriculture into more "modern" sectors has long been viewed as central to economic development.
- The share of labor in the agricultural sector correlates strongly with levels of per capita income,
    - Most workers in the poorest countries work in agriculture while few do in wealthy countries.
- On average there are substantial wage gaps between agriculture/rural and non-agriculture/urban areas.

Poor Countries Work in Agriculture

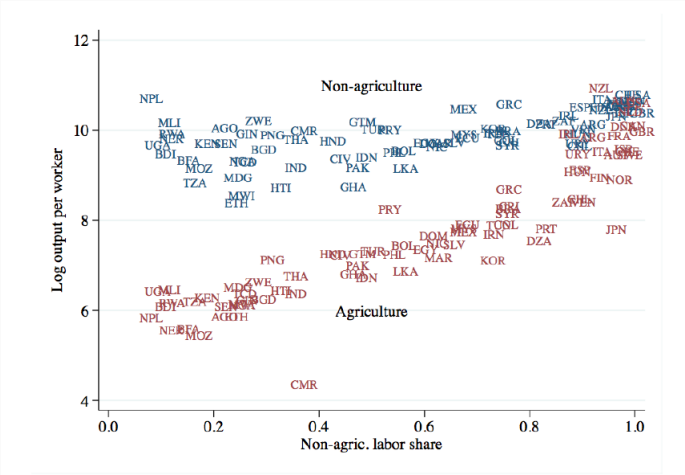


Rural-Urban Wage Gaps

- Why are there so many people in developing countries working in a sector where they appear to be relatively so unproductive?

- Ricardian comparative advantage suggests that countries should specialize in sectors that are relatively most productive, compared to the rest of the world.

Agriculture vs. Non-Agricultural Productivity



Rural-Urban Wage Gaps

- Are these wage gaps *causal*, i.e., workers employed in non-agricultural industries are more productive than the same worker employed in agriculture.
- Or do they reflect *worker selection*, i.e., differences reflect the fact that workers of varying ability and skill are concentrated in certain sectors.
- If differences are causal then a rural-urban wage gaps reflect a misallocation of labor across sectors.
- Policy debate: Should we encourage movement out of agriculture, or target the agricultural sector for investments?
    - How amenable are frictions to policy?

Gollin, Lagakos, and Waugh (2014)

- GLW examine labor productivity gaps in non-ag employment vs. ag using a combination of national accounts and repeated cross-sections from micro-data.

- They define the agricultural productivity gap (APG) to be:

$$APG \equiv \frac{VA_n/L_n}{VA_a/L_a}$$

- Under some moderately restrictive assumptions, APG should be close to 1

- A typical developing country has an APG of 4. Some have an APG of 8 or more!

- Can we trust these highly aggregate numbers?

Measurement Error?

- Sector differences in hours worked per worker?
  - Construct measures of hours worked by sector for 51 countries
- Sector differences in human capital per worker?
  - Construct measures of human capital for 98 countries
- Shortcomings of national accounts data?
  - Use household income/expenditure surveys for 10 countries

Main Results

- After adjustments, the average APG in developing countries falls from 4 to 2.
- Gaps are present in micro data and macro data.
- Needed: better understanding of why residual gaps so large + what are the productivity and welfare gains from moving workers out of subsistence agriculture?

Why are Residual Gaps So Large?

- Yet more measurement error – Herrendorf and Schoellman (2018)
- Selection of more productive workers out of agriculture – Lagakos and Waugh (2013), Young (2013), Hamory et al., (2020); Alvarez, (2020)
- Risk of Migrating – Lewis, 1954; Harris and Todaro (1970), Bryan et al. (2014)
- Rural amenities – Munshi and Rosenzweig, 2016; Meghir et al., 2017)
- Urban disamenities (social alienation? crime? pollution? decline in relative social status?) – Dercon et al. (2012); Bryan and Morten (2018); Lagakos et al., 2017
- General point: the more important sorting is, the less room there is for "misallocation". It's hard to nail the quantitative importance of sorting (Heckman and Honore, 1990)

Open Questions

- Spatial price differences
  - APG > 1 could reflect lower cost of living (Chen et al., 2009)
  - In the U.S. more goods are available in U.S. cities – not simply the case that the same basket costs more (Hanbury and Weinstein, 2014)
  - Is this true in developing countries?

Open Questions

- Seasonal migration
  - Bryan et al., (2014) – migration RCT
    - 30% consumption gains to migration in the "lean season"
    - Most households don't send migrant in subsequent year
  - Lagakos et al., (2020) – structural model of experiment
    - Seasonal migration acts as an insurance mechanism (Morten, 2018)
    - If no opportunities available in the village and assets low, migration is valuable
    - Not about workers being "stuck" in rural areas due to credit constraints
  - Is temporary migration a gateway to more permanent moves? Are there negative effects on urban wages/areas? What's the role for policy? What is the role of imperfect information?

Open Questions

- Household decision-making
  - Most models of migration have unitary households.
    - In practice, household may send a migrant and keep remaining members of the household in the village
    - Migration decisions are linked to lifecycle choices like education, marriage, and fertility
    - Women much less likely to move than man; could be gender-specific frictions to migration
    - Big picture: what is the role of within-household economics in understanding why gaps persist.

Conclusions

- In sum,
  - There are large APGs in most developing countries
  - There's been a lot of work on understanding what determines these gaps in both macro and micro
  - Lots of open questions, but the big picture is "what are the frictions that keep people in low-productivity agriculture work?" and "What (if anything) should policymakers do to get households out of subsistence farming?"

An Overview of the Spatial Equilibrium Model

- There are large differences in income and living standards across space within a country.
- Is this an equilibrium, or are we out of equilibrium?
  - If it is an equilibrium, what's driving the difference?
  - If we're out of equilibrium, what are the frictions and what policies may help to reduce differences.
- Again: Are gaps *causal* or do gaps reflect *selection*? If causal, how amenable are these gaps to policy intervention?
- Moretti (2011) "Local Labor Markets", *Handbook of Labor Economics* is a useful start.
- Moretti and Kline (2014), Greenstone (2017), Redding and Rossi-Hansberg (2017), Diamond and Gaubert (2023) are other very useful references.

An Overview of the Spatial Equilibrium Model

- Types of research question:
  - What explains differences in income (other outcomes) across locations?
  - What happens to welfare/the distribution of welfare when a location gets a productivity shock?
  - What happens to welfare productivity when we connect places?
- Workhorse model: Rosen-Roback
  - We'll work through n $=$ 2 case
  - Extendable to n ¿ 2 locations and can be applied to other settings e.g., trade, commuting, etc.

Why Isn't Income Equalized Across Space?

- People maximize utility, not income
- Places may have different amenities
- Places may have different costs of living
- Places may require different skills
- People usually differ in the individual preferences for locations (informal risk-sharing, preferences for being close to family, etc.)
- There may be frictions:
  - migration costs
  - trade costs
  - housing frictions (zoning, geography)
  - information

Rosen-Roback Model: Exogenous Prices, 2 Locations

- Assume wages, rents, amenities are exogenous
- Person i's indirect utility of being in A:

$$V_A^i = \underbrace{wage_A - rent_A + Amenities_A}_{\text{common to A } (V_A)} + \epsilon_A^i$$

- Person i's indirect utility of being in B:

$$V_B^i = \underbrace{wage_B - rent_B + Amenities_B}_{\text{common to B } (V_B)} + \epsilon_B^i$$

- Common piece + idiosyncratic piece

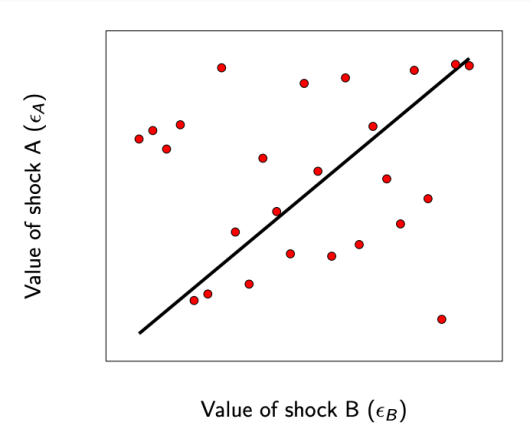
Quick check: If people can freely move, what is equalized across space?

- Wages?
- Rents?
- Observed Utility (i.e., V_A, V_B)?
- Average Welfare (i.e., $V_A + \epsilon_A$, $V_B + \epsilon_B$)?

Quick check: If people can freely move, what is equalized across space?

- Wages?
- Rents?
- Observed Utility (i.e., V_A, V_B)?
- Average Welfare (i.e., $V_A + \epsilon_A$, $V_B + \epsilon_B$)?
- Can we be in a spatial equilibrium, even if none of these equalized?

Migration decision: choose location that maximizes utility



Live in A if: $V_A + \epsilon_A > V_B + \epsilon_B$

$\epsilon_A > \epsilon_B + (V_B - V_A)$

Migration choice – Uniform Distribution Assumption

- Assume that the difference in shocks is uniform: $\epsilon_B - \epsilon_A \sim U(-S, S)$:
  - Live in A if:
    $$V_B - V_A > \epsilon_B - \epsilon_A$$
  - Note the role of S:
    - People are less responsive to differences in indirect utility
    - Changes labor supply elasticity
    - Could be thought of as a migration cost.
  - If S is really dispersed then even if you could earn 10 $\times$ more in location A people may choose B.
  - It could look like people are leaving lots of money on the table.

Spatial Equilibrium: What share of people live in each location?

- Person i will choose to live in A if:

$$V_A + \epsilon_A^i > V_B + \epsilon_B^i$$

- Using uniform distribution: $F(X) = \frac{x-a}{b-a}$

$$\begin{aligned} P(\epsilon_B - \epsilon_A < V_A - V_B) &= F_{\epsilon_B - \epsilon_A (V_A - V_B)} \\ &= \frac{V_A - V_B + S}{2S} \\ &= \frac{1}{2} + \frac{V_A - V_B}{2S} \end{aligned}$$

Is this a Spatial Equilibrium?

- If $V_A > V_B$, more people will live in A than B
- Despite the different Vs, we have a spatial equilibrium.
  - The marginal migrant (not the average one) is indifferent between A and B.
  - No one wants to live elsewhere.
- Note: usually observe equivalent of V_A and V_B, but that's not welfare
  - Need to account for the idiosyncratic shock, i.e, $E(V_A + \epsilon_A | \text{choose A}) vs. E(V_B + \epsilon_B | \text{choose B})$
  - In the simple case this is hard to check since it's defined by the difference in the shock.
  - Can get this though (e.g., with Frechet), in which case average welfare is equalized across two locations, despite differences in V

Extending to more than 2 locations

- Model generalizes easily by assuming extreme value shocks:

1) Gumbel (Type 1): used in many IO and labor models – additively separable, often used for preference shocks,

$$F(x) = e^{-e^{-x+\alpha}}$$

$$\max_i v_i + \epsilon_i \quad \epsilon_i \sim EV1$$

2) Frechet (Type 2): used in many trade and migration models; often used for productivity shocks (Eaton and Kortum, 2002)

$$F(x) = e^{-x^{-\theta}}$$

$$\max_i v_i \epsilon_i \quad \epsilon_i \sim EV2$$

Extreme Value Magic

- Extreme value shocks are commonly used because they have closed form solutions

$$\begin{aligned} \textit{Gumbel} : P(\text{choose } i) &= \frac{e^{v_i}}{\sum_i e^{v_i}} \\ \textit{Frechet} : P(\text{choose } i) &= \frac{v_i^{\theta}}{\sum_i v_i^{\theta}} \end{aligned}$$

- Can derive these expressions, as well as expected values conditional on choosing i

- General intuition of the simple model goes through.

Rosen-Roback Model (1979; 1982): Endogenous Prices

- Baseline assumptions:
  - Labor is homogenous; each person supplies one unit of labor
  - Each city produces homogenous good that is freely traded (consumption cost is the same across locations)
  - Land is the only immobile factor; quantity is fixed
  - Labor is perfectly mobile
  - Capital perfectly mobile (or no capital). Gives CRS.
- Original RR model didn't have individual heterogeneity. Added by Bayer et al., (2007). See Moretti (2011) and Redding and Rossi-Hansberg (2017) for overviews).

RR Model

- Migration driven by 4 factors:

    1. Wages
    2. Cost of living (rents)
    3. Amenities
    4. Individual preferences

Definition of a Spatial Equilibrium

- Given the economic environment (exogenous productivities and amenities), a spatial equilibrium (number of workers, rent, wages) solves the following equations:
  - Labor supply: individuals choose location to maximize utility,

$$\max_d w_d - r_d + A_d + \epsilon_d^i$$

  - Labor demand: firms pay workers their marginal product (here: assume only labor. Equivalent to assuming CRS in capital and labor, with international price of capital)

$$\begin{aligned} Y_d &= X_d N_d \\ w_d &= X_d \end{aligned}$$

  - Housing demand: each worker demands one unit of housing
  - Housing supply: allow housing elasticity k_b

$$r_b = z + k_b N_b$$

Consider a Productivity Increase in Location d

- Wages increase in d
- Holding prices constant, more people want to live there
- If more people move, rents increase
    - Could easily add other spillovers, e.g., congestion, agglomeration
- So, not all people move (general eq. change ¡ partial eq. change)
- End up with a new equilibrium where nobody wants to change location
- With more than 2 locations you have to simulate out the model (no closed forms).

The Spatial Model in Other Settings

- Trade: interpret idiosyncratic shock as distribution of productivity for producing different types of goods (Eaton and Kortum 2002)
  - Under autarky, need to produce everything, even stuff with low productivity draws
  - Trade allows you to import things you aren't good at: increases average productivity in the economy
- Sorting on productivity:
  - Idiosyncratic draw can be your productivity in a location (e.g., Lagakos and Waugh, 2013; Bryan and Morten, 2019)
  - Delivers Roy model of sorting
- Include frictions (e.g., goods/people)
  - Only differences is one more term in the indirect utility function
  - No migration costs: $V_d = w_d - r_d + A_d$
  - Migration costs between o, d: $V_{od} = w_d - r_d + A_d - c_{od}$