Misallocation and Firms

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Ec 721 Lecture 7

Meaning of Misallocation (Restuccia-Rogerson (JEP 2017))

- *Misallocation* refers to deviations from (first-best) allocation of labor and capital across heterogenous producers
- Firm i production function $y_i = A_i f(h_i, k_i)$, where A_i is TFP, h_i : labor, land etc; k_i : capital inputs, f is strictly concave
- Firm fixed cost c, so whether firms enters or not is endogenous
- Given aggregate supplies of factor inputs H, K, first-best allocation is unique, specifying:
  - *Selection:* which firms should enter
  - *Allocation:* of inputs across active firms
- Deviation from this results in inefficiency, measured by loss of aggregate output given aggregate factor inputs

Notes on the Concept

- Takes productivity (TFP) distribution as given; ignores issues relating to endogenous technology acquisition or diffusion, or firm management practices
- Does not include effects of regulations or taxes that apply evenly to all firms (e.g., corporate or personal income taxes)
- What it does include:
  - variations in taxes or regulations across different categories of firms (varying by sector, region, size, age, ownership)
  - variations in enforcement of taxes/regulations/property rights, eg owing to weak state capacity, political economy/corruption
  - market imperfections (credit, monopoly power) varying across firms

Related Notion of Labor Mis-Allocation

- Focuses on labor market frictions that result in suboptimal location of workers
- Migration frictions: huge area of research (rural-urban, inter-state, international)
- Will be covered in Ec722 next semester

Quantitative Estimation Approaches

- **Direct Approach:** identify a specific source of misallocation (e.g., differential taxes) and use standard public finance methods to estimate deadweight losses
- Problems: difficult with complex difficult-to-measure regulations (such as non-tariff barriers); need to estimate a structural model
- **Indirect Approach:** examine *outcomes* rather than sources (e.g., how factor marginal products vary across firms)
- Problems: difficult to identify roles of specific sources, but can try with suitable identification assumptions (diff of diff approach to estimating effects of regulations)

Hsieh-Klenow (QJE 2009)

- Estimates misallocation in manufacturing sector in China and India, compares with US
- Bottom-line result: moving to 'US efficiency' would raise aggregate productivity by 30-50% in China and 40-60% in India; output gains would double if response of investment rates are incorporated
- Suggests misallocation explains substantial fraction of per capita income differences between DCs and LDCs
- Has sparked large literature thereafter, both for and against; different interpretations of the evidence

Hsieh-Klenow 2009 Method

- Aggregate output produced by combining outputs of different sectors $s = 1, \ldots, S$ using CD technology: $Y = \Pi_s Y_s^{\theta_s}$
- Sector s output produced from intermediate goods $si, i = 1, \ldots, M_s$ with CES technology: $Y_s = [\sum_i Y_{si}^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{1-\sigma}}$
- Firm i in sector s produces according to CD technology: $Y_{\sigma_i} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s}$
- Distortions arise from *wedges:* τ_{ysi}: product tax, τ_{ksi}: capital tax on firm si; (labor: numeraire)
- Use the model to derive resulting loss of aggregate output owing to these wedges, which can be estimated from firm level data

Hsieh-Klenow 2009 Method, contd.

- *Key idea:* misallocation manifested by divergence of marginal revenue products (MRP) of labor and capital across firms in the same sector
- Given technology assumptions, firm MRPs and their dispersion can be estimated; the model then generates resulting aggregate output loss
- Firms have market power on output markets, price takers in input markets (factor prices w, R exclusive of wedges)
- $MRPL_{si} = (1-\alpha_s)\frac{\sigma-1}{\sigma}\frac{P_s Y_{si}}{L_{si}} = \frac{w}{1-\tau_{ysi}}$
- $MRPK_{si} = \alpha_s \frac{\sigma-1}{\sigma}\frac{P_s Y_{si}}{K_{si}} = R\frac{1+\tau_{ksi}}{1-\tau_{ysi}}$

Hsieh-Klenow 2009 Method, contd.

- Define $TFPR_{si} \equiv P_{si}A_{si} = \frac{P_{si}Y_{si}}{K_{si}^{\alpha_s}L_{si}^{1-\alpha_s}}$, can be calculated from firm data
- Equals $\left(\frac{P_{si}Y_{si}}{K_{si}}\right)^{\alpha_s}\left(\frac{P_{si}Y_{si}}{L_{si}}\right)^{1-\alpha_s} \propto (MRPK_{si})^{\alpha_s}(MRPL_{si})^{1-\alpha_s}$
- Hence $TFPR_{si} = \frac{(1+\tau_{ksi})^{\alpha_s}}{1-\tau_{ysi}}$
- $TFPR_{si}$ high relative to other firms in the sector, indicates high wedges for firm si, i.e., this firm is 'too small'

Hsieh-Klenow 2009 Method, contd.

- Sector s geometric average $MRPK_s$, $MRPL_s$, and $TFPR_s \propto (MRPK_s)^{\alpha_s}(MRPL_s)^{1-\alpha_s}$
- Sector s aggregate

$$TFP_s = \left[\sum_{i=1}^{M_s}\left(A_{si}\frac{TFPR_s}{TFPR_{si}}\right)^{\sigma-1}\right]^{\frac{1}{\sigma-1}}$$

- **Proposition:** *If A_{si} and $TFPR_{si}$ are jointly log-normally distributed:*

$$\log TFP_s = \frac{1}{\sigma-1}\log\left(\sum_{i=1}^{M_s} A_{si}^{\sigma-1}\right) - \frac{\sigma}{2}\text{Var}\left(\log TFPR_{si}\right)$$

- First term on RHS is efficient TFP benchmark; second term is *measure of misallocation*, ignoring firm selection (entry/exit)

HK 2009 misallocation estimation procedure for China, India, US

- Use four-digit level manufacturing firm/plant level data for each country (missing small firm data in China (NBS) and India (ASI))
- Calibrate technology parameters (α_s) from labor share estimates in US firm data
- Set others somewhat arbitrarily ($R = 0.10$), or on the basis of trade-industry literature ($\sigma = 3$); check robustness to these

Key HK 2009 Results

- TFPR dispersion in 1998: 0.74 in China, 0.69 in India, 0.45 in US, which corresponds to 100% loss in aggregate output in China and India, compared with 30% in US
- Break down into sources of dispersion: firm size (8, 4%), region (10,5%), ownership (5, .5%), age (6,1%) for China, India resp.
- Too few large and small firms, too many medium sized firms in all three countries (opposite of 'missing middle' hypothesis)
- Misallocation fell in China between 1998-2005, contributed 2% TFP growth per year, no improvement in India between 1987-94

Extension to Firm Dynamics: Hsieh-Klenow QJE 2014

- This follow up paper examines variations in firm growth rates and entry of new firms
- Compares Mexico, India and US (includes data on small firms in informal sector)
- Key facts:
  - firm growth rates substantially higher in the US
  - Too many young firms, too few old firms in India and Mexico (suggesting excessive entry), compared with US

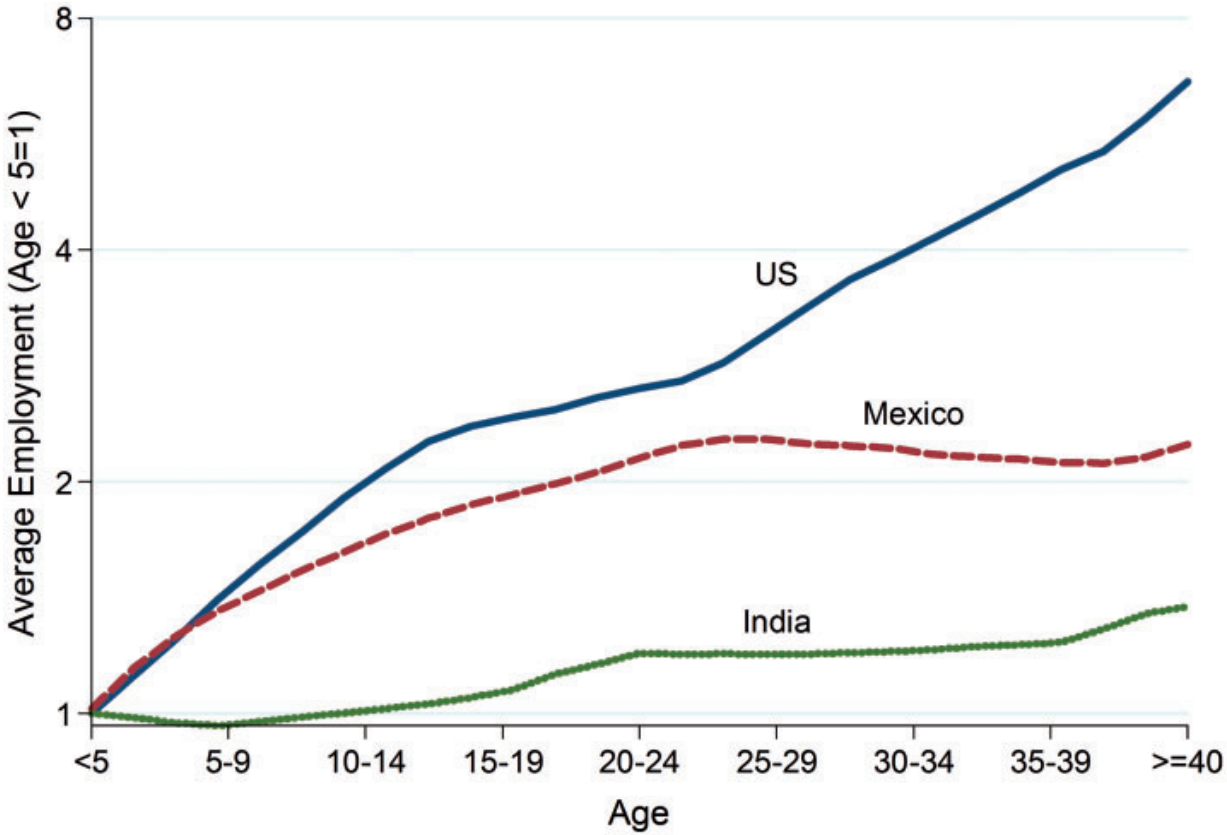
8
4
2
1
Average Employment (Age < 5=1)
US
Mexico
India
<5
5-9
10-14
15-19
20-24
25-29
30-34
35-39
>=40
Age

FIGURE I

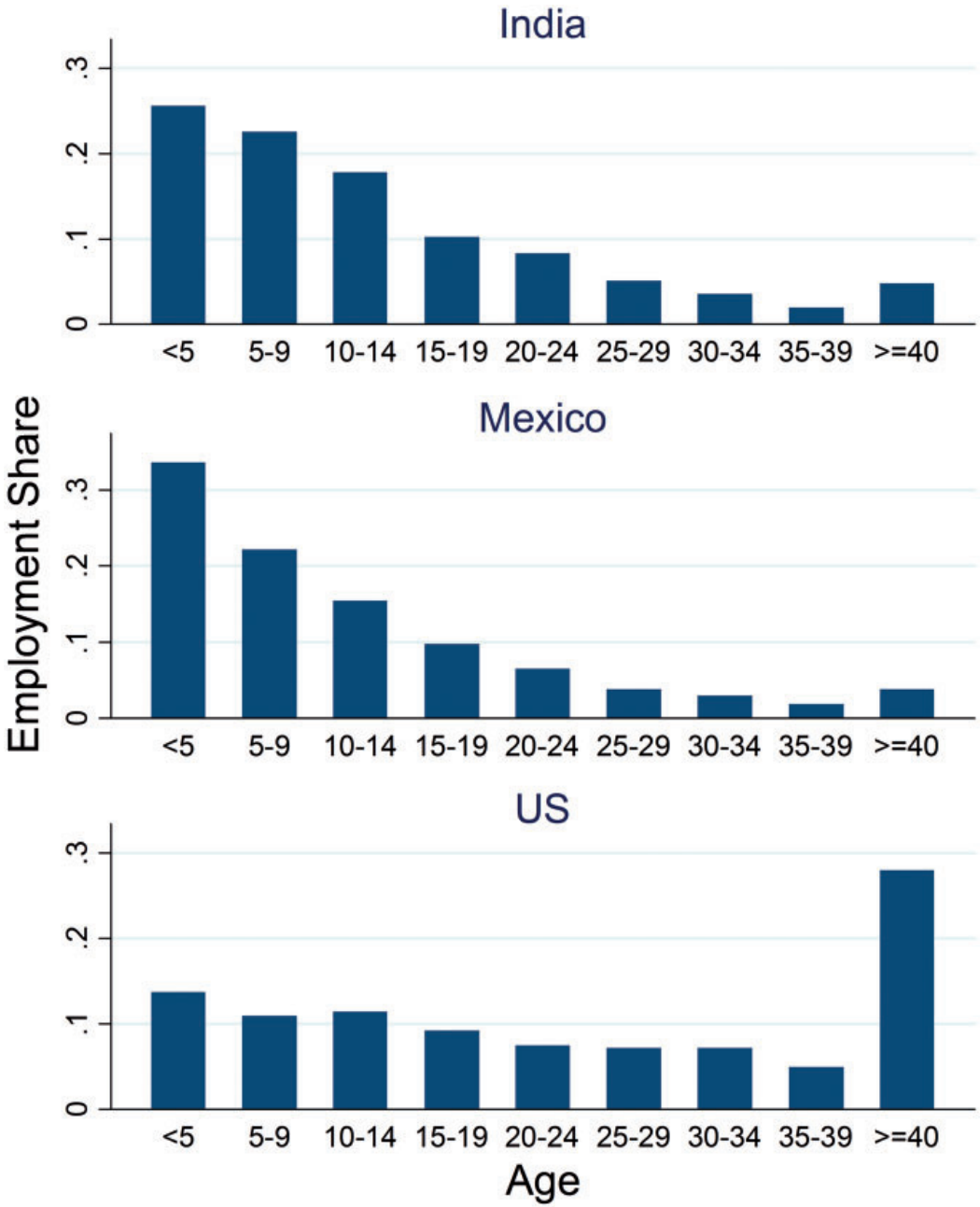
India
Mexico
US
Employment Share
0
.1
.2
.3
<5
5-9
10-14
15-19
20-24
25-29
30-34
35-39
>=40
Age

FIGURE III

HK 2014 Approach

- Model distinguishes firms by age (rather than sector):
$$Y = \left(\sum_a \sum_{i=1}^{N_a} Y_{ai}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$
- 'wedge dynamics': τ_{ai} vary with a (besides i)
- measure productivity by age in the three countries, follows roughly the same pattern as employment
- 'wedge dynamics' affects firm investment decisions with consequences for productivity growth and entry (similar to Atkeson-Burstein (2010))
- fit this model to country data: estimate that differences in 'wedge dynamics' account for 25% difference in aggregate TFP across these three countries

Qualifications, Concerns

- **Measurement error:** could be larger in China and India owing to poorer data quality
- HK argue this may play some role (eg effects of trimming tails), but argue that measured TFPR varies with ownership (eg state owned versus private) and exit rates, and IV estimates based on lagged variables
- Rotemberg and White (2017), NYU working paper, argue that US Census authorities use data cleaning methods (missing values, reporting errors) are not used in China and India, which account for the differences in estimated TFPR dispersion
- Boundaries of the Firm? US firms more vertically integrated; clusters of small firms play bigger role in Chinese and Indian industry (comparable to divisions within US firms; inter-divisional dispersion does not appear in US data)

What is the Source?

- Difficult to answer using the same method
- Can make progress looking at variations across time and types of firms
- HK 2009: not much variation in India with deregulation (across years, or states); some variation across SOEs and other firms in China
- HK 2014: larger, older firms in India face more regulations, pay more taxes relative to small, new firms

Interpretation, Underlying Assumptions

- Underlying benchmark: perfect markets without any frictions and exogenous TFP
- Such models have difficulty explaining aggregate growth rates or spatial agglomeration patterns: need learning spillovers and externalities
- Capital adjustment costs: delayed reactions to firm specific productivity shocks can account for substantial part of misallocation (Asker, Collard-Wexler and DeLoeker (2017))
- Benchmark does not incorporate credit market frictions, infrastructure or corruption as possible causes of misallocation, which are not so easy to remove by policy makers
- Emerging literature modeling and testing such mechanisms, eg Akcigit-Alp-Peters (2017), Dai et al (2018)