Misallocation, Establishment Size, and Productivity

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Motivation

Large Income Differences Across Countries

- consensus: mostly explained by productivity differences
- evidence of resource misallocation across establishments in poor countries (Hsieh & Klenow 2009)
  - explains significant portion (but not most) of variation in aggregate productivity
- establishment-level productivity also varies across countries (Hsieh & Klenow 2009, Pagés-Serra 2010, Gal 2013)
  - not explored much in misallocation literature
in our model, establishments take misallocation into account when investing in productivity

- Bhattacharya, Guner, & Ventura (2013) and Hsieh & Klenow (2014) include similar mechanism, combined with (several) other extensions
- simplify, isolate effect of misallocation on investment and entry
- separated from static effect through distorted output decisions
What We Find

- if distortions are random;
  - no effect of misallocation on investment or establishment size
  - model collapses to Hsieh and Klenow (2009)
- if distortions are correlated with productivity;
  - less investment in productivity
  - larger impact of misallocation on aggregate productivity
  - smaller establishments
Evidence: Establishment Size

Are establishments smaller in poor countries?
- previous evidence inconclusive
  - no standardized data for large number of countries
Evidence: Establishment Size

Are establishments smaller in poor countries?

- previous evidence inconclusive
  - no standardized data for large number of countries
- we construct new dataset
- hundreds of sources: census, business registries, ...
- standardized data for 134 economies
- persons engaged per establishment
- representative of all manufacturing establishments
Evidence: Establishment Size (134 economies)

- **Motivation**
- **Establishment Size**
- **Model**
- **Quantitative Analysis**
- **Correlated Distortions**
- **Conclusion**

**Graph Description:**
- **Y-axis:** Establishment Size (log scale)
- **X-axis:** GDP per Capita (log scale)
- **Data Points:** Representing 134 economies
- **Trend Line:** Elasticity: 0.27 (0.04)

**States Represented:**
- ALB
- ARG
- BEN
- BGD
- BGR
- BIH
- BOL
- BRA
- BTN
- CMR
- COL
- CPV
- CZE
- DZA
- ECU
- ESP
- EST
- ETH
- GEO
- GHA
- HND
- HRV
- HUN
- IDN
- IND
- IRL
- JOR
- KAZ
- KGZ
- KHM
- LAO
- LKA
- LTU
- LVA
- MAR
- MDA
- MDG
- MEX
- MKD
- MNE
- MNG
- MUS
- MWI
- NIC
- NPL
- PAN
- PER
- PHL
- POL
- PRY
- PSE
- ROU
- RUS
- RWA
- SLE
- SLV
- SRB
- SVK
- SVN
- SYR
- THA
- TTO
- TUR
- UGA
- UKR
- URU
- UVK
- VNM
- YEM
- ZAF
- ABW
- ALA
- AND
- ARE
- ASM
- AUS
- AUT
- BEL
- BHR
- BMU
- BRN
- CAN
- CHE
- CYP
- DEU
- DNK
- DOM
- ECU
- EGY
- ESP
- EST
- ETH
- FIN
- FRO
- GBR
- GLP
- GRC
- GRL
- GUF
- GUM
- HKG
- HND
- HRV
- HUN
- IDN
- IND
- IRL
- JPN
- KOR
- KWT
- LBN
- LBY
- LIE
- LUX
- MAC
- MCO
- MDV
- MLT
- MNP
- MTQ
- MYS
- NCL
- NOR
- NZL
- PLW
- PRI
- PRT
- PYF
- QAT
- REU
- SAU
- SEN
- SDN
- SGP
- SMR
- STP
- SWE
- TUN
- TWN
- USA
- VIR

**Graph Notes:**
- **Y-axis Scale:** 1, 2, 4, 10, 25, 50
- **X-axis Scale:** 500, 2500, 10000, 50000
- **Label:** Elasticity: 0.27 (0.04)
Evidence: Establishment Size (107 large economies)

- Elasticity: 0.33 (0.04), population > 0.5 million
Model: Environment

- standard model of monopolistic competition, but;
  - endogenous entry
  - entrants invest to determine productivity
  - abstract from heterogeneity, establishments identical ex ante
Model: Environment

Final-Good Firm: \[ Y = \left( \int_{0}^{N} y_i^\frac{\sigma-1}{\sigma} di \right)^\frac{\sigma}{\sigma-1} \]

- \( N \): number of intermediate-good firms
- \( y_i \): demand for input \( i \)
- \( \sigma \): the constant elasticity of substitution between varieties.

Intermediate Firm: \[ y_i = s_i \ell_i \]

- \( s_i \): productivity, \( \ell_i \): labor demanded
- upon entry, choose \( s_i \) by investing \( c_s Ys_i^\theta \)
- owner forgoes market wage \( w \) while running firm
- exogenous probability of firm death \( \lambda \)
Model: Environment

- each firm $i$ faces ‘tax’ $\tau_i$ on output
- assume $\tau_i$ depends on productivity $s_i$

$$(1 - \tau_i) = \left( \frac{s_i}{\bar{s}} \right)^{-\gamma}$$

- $\bar{s}$: average productivity
- $\gamma$: elasticity of distortion w.r.t. productivity
Steady-State Decentralized EQ: prices and allocations constant

- given prices $P_i$, final-good firm maximizes profits
  \[ P_i = Y^{\frac{1}{\sigma}} y_i^{\frac{-1}{\sigma}} \]

- given $w$, $R$, $Y$, $\ell_i$ maximizes per-period profits
  \[ \ell_i = \frac{(1 - \tau_i)^{\sigma} s_i^{\sigma-1}}{w^{\sigma}} \left( \frac{\sigma - 1}{\sigma} \right)^{\sigma} Y, \quad \pi_i = \frac{w \ell_i}{\sigma - 1} \]

- given $w$, $R$, $Y$, $s_i$ maximizes life-time profits
- free-entry: investment = life-time profits – forgone wages
- labor-market clears: $1 = N \left( \mathbb{E} [\ell_i] + 1 \right)$
Model: Equilibrium

labor-market clearing + optimal \( \ell_i \);

\[
Y = N^{\frac{1}{\sigma-1}} (1 - N) \frac{\mathbb{E} \left[ s^{\sigma-1} (1 - \tau)^{\sigma-1} \right]^{\frac{\sigma}{\sigma-1}}}{\mathbb{E} \left[ s^{\sigma-1} (1 - \tau)^{\sigma} \right]}
\]

or

\[
Y = N^{\frac{1}{\sigma-1}} (1 - N) \mathbb{E} \left[ s^{\sigma-1} \left( \frac{\text{MRPL}}{\text{MRPL}_i} \right)^{\sigma-1} \right]^{\frac{1}{\sigma-1}}
\]

- \( \text{MRPL}_i = \frac{P_i y_i}{\ell_i} = \left( \frac{\sigma}{\sigma-1} \right) \frac{w}{(1 - \tau_i)} \)
- if no investment, same as Hsieh & Klenow (2009)
- if distortions random, same as Hsieh & Klenow (2009)
Model: Equilibrium

- now use \((1 - \tau_i) = \left(\frac{s_i}{\bar{s}}\right)^{-\gamma}\)

- value of entry:
  \[
  \frac{Y(\sigma - 1)^{\sigma - 1}}{(1 - \rho)w^{\sigma - 1}\sigma^\sigma} \cdot \frac{s_i^{\sigma(1 - \gamma) - 1}}{\bar{s}^{-\sigma\gamma}} - \frac{w}{1 - \rho} - c_S YS_i^\theta
  \]
  \(\rho(\lambda, R):\) discount factor

- optimal investment:
  \[
  c_S YS_i^\theta = \frac{\mathbb{E}[\pi]}{(1 - \rho)} \cdot \frac{\sigma(1 - \gamma) - 1}{\theta}
  \]

- free-entry:
  \[
  \frac{\mathbb{E}[\pi][\theta + 1 - \sigma(1 - \gamma)]}{\theta} = w
  \]
Model: Results

\[ N = \frac{[\theta + 1 - \sigma(1 - \gamma)]}{\theta \sigma + 1 - \sigma(1 - \gamma)} \]

\[ s = \left( \frac{\sigma(1 - \gamma) - 1}{N} \right)^{\frac{1}{\theta}} \left( \frac{1}{\theta(1 - \rho)\sigma c_s} \right)^{\frac{1}{\theta}} \]

aggregate investment share: \[ \frac{\lambda[\sigma(1 - \gamma) - 1]}{\sigma \theta (1 - \rho)} \]
- correlated distortions ($\gamma$) discourage productivity investment
- entrants invest lower fraction of profits on productivity
- this *increases* value of entry, so free entry implies number of establishments must increase to lower value of entry to zero
Model: Results

When distortions more correlated with productivity (higher $\gamma$):

- higher number of establishments
- lower employment per establishment
- lower establishment-level productivity
- aggregate productivity increasing in both establishment-level productivity and number of establishments
  - could be higher or lower
Calibration

- quantify impact of correlated distortions on average employment and productivity
- calibrate model economy to U.S. manufacturing
- benchmark: $\gamma_{US} = 0.13$ from Hsieh & Klenow (2014)
## Quantitative Exercise

**Table:** Model Results across Hypothetical Correlated Distortions $\gamma$

<table>
<thead>
<tr>
<th>$\gamma$</th>
<th>Size</th>
<th>Productivity</th>
<th>Investment</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.13$ ($\gamma_{US}$)</td>
<td>22</td>
<td>1</td>
<td>21%</td>
<td>1</td>
</tr>
<tr>
<td>0.2</td>
<td>10</td>
<td>0.61</td>
<td>18%</td>
<td>0.84</td>
</tr>
<tr>
<td>0.3</td>
<td>6.2</td>
<td>0.40</td>
<td>14%</td>
<td>0.66</td>
</tr>
<tr>
<td>0.4</td>
<td>4.6</td>
<td>0.28</td>
<td>10%</td>
<td>0.50</td>
</tr>
<tr>
<td>0.5</td>
<td>3.8</td>
<td>0.19</td>
<td>7%</td>
<td>0.36</td>
</tr>
<tr>
<td>$0.56$ ($\gamma_{India}$)</td>
<td>3.4</td>
<td>0.14</td>
<td>4%</td>
<td>0.27 (0.17)</td>
</tr>
</tbody>
</table>
Evidence: Correlated Distortions

Do poor countries have higher $\gamma$’s?

- Hsieh & Klenow (2014): India, Mexico higher $\gamma$’s than U.S.

- World Bank’s Enterprise Surveys: establishment-level data for low- and middle-income countries
  - Hsieh & Klenow (2009) method to back out within-industry distributions of distortions and productivity
  - use regressions to estimate $\gamma$’s for 62 countries
  - result: $\gamma$ higher in poorer countries
Evidence: Correlated Distortions and GDP per Capita

- elasticity: -3.04 (0.86)
Evidence: Correlated Distortions and Average Employment

- elasticity: -1.98 (0.50)
Evidence: Correlated Distortions and R&D Intensity

\[ \text{elasticity: } -4.32 (1.04) \]
systematic evidence that poor countries have:
- smaller establishments
- less investment in productivity
- more strongly correlated idiosyncratic distortions

if establishments take misallocation into account when investing in productivity;
- model can account for above facts
- large impact on aggregate productivity

combined with Hsieh & Klenow (2009), misallocation can explain 6-fold difference in size, establishment-level productivity, and aggregate TFP between U.S. and India.