Do Firms in Developing Countries Grow as they Age?

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Motivation

• A long-standing academic and policy debate on convergence between rich and poor countries points to ubiquitous differences in productivity.
  – Hall and Jones (1999), Klenow and Rodríguez-Clare (1997)

• So why is plant productivity so much lower in less developed countries?
  – Need microdata to answer this macro question.

• Economists have only recently started to address this question by looking at the growth of plants over their life-cycle.
Motivation

- Correlation between firm size and age matters for the allocation of resources towards more productive firms, and reflects differences in investments to boost post-entry growth.

- Important policy implications
  - small vs. large, young vs. mature firms
What do we know so far about plant life-cycle?

• We know a lot about life-cycles in the U.S.
  – New businesses start small and, if they survive, grow fast as they age.

• But firm lifecycle in developing countries is largely a black-box.
  – It is unclear whether firms in developing countries face a similar size-age profile as in the US given that they face entirely different business environments and operating conditions.
What do we know so far about plant life-cycle?

- Recent evidence does suggest that developing countries are different. E.g. Hsieh and Klenow (2012)

![Figure 4: Employment Growth over the Life-Cycle](image-url)
Unanswered questions and what we do?

• What is the relationship between plant size, age, and growth in developing economies?
  – Are older plants much larger than young plants or are they the same size?
  – Are there differences in the size-age relationship across country income groups and industries?
  – Our focus is on the formal sector

• How are institutions, especially financial development, associated with the size-age gap?

• Can we predict which plants are going to be successful?
  – New paper “What predicts entrepreneurial success? Size at birth and Institutions?”
What we find?

1. The average plant that is 40+ years is 4.65 times the size of the average plant under the age of 5 years in developing countries

2. The upward sloping age-size profile is pervasive in the vast majority of countries

3. The average 40+ plant in the formal sector in India is 2 to 4 times the size of plants less than five years of age
   - Contrasts with evidence in Hsieh and Klenow (2012)
What we find?

3. Technological differences across industries shape establishment life cycle in India.

4. Stark differences in firm lifecycle in the formal and informal sectors
   - Older firms in the unorganized manufacturing sector in India employ fewer people than firms younger than 5 years old.

7. Despite considerable differences in financial depth across Indian states we find the role of state-level financial development to be marginal in explaining firm lifecycle
Contributions to existing literature

• **Firm Size and age**

• **State-ownership of banking systems**

• **Formal Vs. Informal Sectors**
  – La Porta and Shleifer (2008), Harris and Todaro (1970)
Data

• **Data from World Bank Enterprise Survey database (ES)**
  – Universe of registered businesses in each country using standardized survey instruments
  – Stratified random sampling methodology.
  – Sampling weights help make assertions about the whole population.
  – 69000+ formal sector firms from 120 countries
  – All the surveys in our sample were administered during 2006-2012.
  – Covers most of the developing countries in the world (Highest GDP/capita in our sample is Slovenia)
  – Data Caveats: Survey data, No data on exits, Establishments (not firms)

• **Indian census data as a case study**
Why India as a case study?

If Uttar Pradesh were to declare independence, it would be the world's fifth most populous country. (Brazil)

Yet its economy would only be the size of Qatar, a tiny oil-rich state of fewer than 2m people.

That makes it poor on a per person basis. Equivalent to Kenya on a per capita basis.
Indian Data

• **Annual Survey of Industries (ASI)**
  – **Formal manufacturing** sector
  – All registered factories employing 10 or more workers
  – Consists of the “Census” sector (surveyed each year) and the “Sample” sector (sampled randomly)
  – Repeated cross-sections – 1983/84; 1989/90; 1994/95; 2000/01; and 2004/05

• **National Sample Survey (NSS)**
  – **Informal manufacturing** sector
  – Data for 1994/95
  – (Indian data choices consistent with Hsieh and Klenow (2012))
Specific Questions

1. What is the relationship between size and age in the formal sector in developing countries?

2. What is the relationship between size and age in India?

3. What role do technological differences across industries play?

4. How does this relationship vary across different types of institutions?

5. How does this relationship differ in the informal sector?
Plant that is 40+ years old employs nearly 5 times as many people as the plant that is less than 5 years old.
<table>
<thead>
<tr>
<th></th>
<th>Establishment Size Manufacturing</th>
<th>Establishment Size Non-Manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9</td>
<td>13.424***</td>
<td>12.382***</td>
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<tr>
<td></td>
<td>(1.388)</td>
<td>(2.361)</td>
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<tr>
<td>10-14</td>
<td>30.411***</td>
<td>28.663***</td>
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<tr>
<td></td>
<td>(1.618)</td>
<td>(2.682)</td>
</tr>
<tr>
<td>15-19</td>
<td>36.483***</td>
<td>29.525***</td>
</tr>
<tr>
<td></td>
<td>(1.916)</td>
<td>(3.067)</td>
</tr>
<tr>
<td>20-24</td>
<td>41.206***</td>
<td>35.970***</td>
</tr>
<tr>
<td></td>
<td>(2.634)</td>
<td>(3.700)</td>
</tr>
<tr>
<td>25-29</td>
<td>44.286***</td>
<td>39.902***</td>
</tr>
<tr>
<td></td>
<td>(2.947)</td>
<td>(4.175)</td>
</tr>
<tr>
<td>30-34</td>
<td>58.577***</td>
<td>51.136***</td>
</tr>
<tr>
<td></td>
<td>(3.863)</td>
<td>(5.263)</td>
</tr>
<tr>
<td>35-39</td>
<td>69.747***</td>
<td>70.089***</td>
</tr>
<tr>
<td></td>
<td>(4.851)</td>
<td>(6.674)</td>
</tr>
<tr>
<td>40+</td>
<td>135.520***</td>
<td>142.259***</td>
</tr>
<tr>
<td></td>
<td>(3.754)</td>
<td>(5.131)</td>
</tr>
</tbody>
</table>

**Ratio:**
Size of 40+ age group to size of <5 age group
Firm Lifecycle in Developing Countries

Robustness

• Upward sloping age-size profile is pervasive
  – In 90% of the countries, the average 40+ plant is much larger than the plant younger than five years old

• Similar results using Sampling weights to derive Population Estimates

• Exclude countries with former Socialist legal tradition

• Robust to normalizing by size at birth
  – Firms report the number of employees at the time they began operations.

• Across countries
  – The size-age gap ranges from 4.75 times in the case of high income countries to 5.3 times in the case of low income countries.
  – Across regions, the size-age gap ranges from 3.32 in East Asia Pacific to 6.03 in Africa.
**Specific Questions**

1. What is the relationship between size and age in the formal sector in developing countries?

2. **What is the relationship between size and age in India?**

3. What role do technological differences across industries play?

4. How does this relationship vary across different types of institutions?

5. How does this relationship differ in the informal sector?
Robust to using sampling weights, just the Census sector, using value-added weighted average across all industries.

### Firm Lifecycle in India

<table>
<thead>
<tr>
<th>Establishment Age</th>
<th>Size (Normalizing by mean size of &lt;5 firms)</th>
<th>Size Ratio (Normalizing by mean size of birth cohort)</th>
<th>Size (State, Industry, Year FE)</th>
<th>Size Ratio (State, Industry, Year FE)</th>
</tr>
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<tbody>
<tr>
<td>No FE</td>
<td>11.531***</td>
<td>0.377***</td>
<td>12.777***</td>
<td>0.421***</td>
</tr>
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<td>State, Industry,</td>
<td>(1.026)</td>
<td>(0.016)</td>
<td>(1.026)</td>
<td>(0.016)</td>
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<tr>
<td>Year FE</td>
<td>[1.149]</td>
<td></td>
<td>[1.1258]</td>
<td></td>
</tr>
<tr>
<td>5-9</td>
<td>21.942***</td>
<td>0.636***</td>
<td>24.367***</td>
<td>0.833***</td>
</tr>
<tr>
<td>(1.189)</td>
<td>(1.195)</td>
<td>(0.023)</td>
<td>(1.195)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>[1.284]</td>
<td>[1.493]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-14</td>
<td>34.544***</td>
<td>0.884***</td>
<td>37.649***</td>
<td>1.200***</td>
</tr>
<tr>
<td>(1.452)</td>
<td>(1.465)</td>
<td>(0.040)</td>
<td>(1.465)</td>
<td>(0.042)</td>
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<tr>
<td>[1.447]</td>
<td>[1.762]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-19</td>
<td>48.060***</td>
<td>1.419***</td>
<td>53.217***</td>
<td>1.862***</td>
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<tr>
<td>(1.816)</td>
<td>(1.814)</td>
<td>(0.075)</td>
<td>(1.814)</td>
<td>(0.076)</td>
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<tr>
<td>[1.622]</td>
<td>[2.076]</td>
<td></td>
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<td>20-24</td>
<td>66.018***</td>
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<td>(2.370)</td>
<td>(2.351)</td>
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<td>[1.855]</td>
<td>[2.420]</td>
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<td></td>
</tr>
<tr>
<td>25-29</td>
<td>89.781***</td>
<td></td>
<td></td>
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<tr>
<td>(3.142)</td>
<td>(3.101)</td>
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<td></td>
</tr>
<tr>
<td>[2.163]</td>
<td>[2.894]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>30-34</td>
<td>110.703***</td>
<td></td>
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<td></td>
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<tr>
<td>(4.068)</td>
<td>(3.985)</td>
<td></td>
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<tr>
<td>[2.434]</td>
<td>[3.320]</td>
<td></td>
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<td>35-39</td>
<td>214.261***</td>
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<tr>
<td>(3.335)</td>
<td>(3.349)</td>
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</tr>
<tr>
<td>[3.775]</td>
<td>[5.200]</td>
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</tbody>
</table>

Establishments that are 20-24 years old are **1.419 times** the size of average firms in their birth cohort.

The average 40+ year establishment is **3.775 times** the size of average firm that is younger than 5 years old.
Firm Lifecycle in India

Age coefficients from regression in previous slide.
Specific Questions

1. What is the relationship between size and age in the formal sector in developing countries?
2. What is the relationship between size and age in India?
3. **What role do technological differences across industries play?**
4. How does this relationship vary across different types of institutions?
5. How does this relationship differ in the informal sector?
Firm Lifecycle in India

Industry Heterogeneity

• Pooled OLS regressions with *Age x Industry Characteristic*
  – Labor Intensive Vs. Capital Intensive (Hasan and Jandoc, 2012)
  – Dependence on external finance (Rajan and Zingales, 1998)
  – Small vs. large firm dominated industry (Index of Small firm domination from Beck, Demirguc-Kunt, Laeven, and Levine, 2008)

• For ease of interpretation, instead of regressions, let us see
  – **Margin plots** of the interaction coefficients
  – **Ratio of the predicted margin** of each age group with that of youngest firms to give an estimate of growth rates.
Firm Lifecycle in India

Industry Heterogeneity

Predictive Margins of Interaction Coefficients

- Capital Intensive, Large Firm Dominated
- Capital Intensive, Small Firm Dominated
- Labor Intensive, Large Firm Dominated
- Labor Intensive, Small Firm Dominated

Predictive Margins of Interaction Coefficients

- Low Dep. on Extfin
- High Dep. on Extfin
Firm Lifecycle in India

*Industry Heterogeneity*

<table>
<thead>
<tr>
<th>Age</th>
<th>Large-Firm, Capital Intensive</th>
<th>Small-Firm, Capital Intensive</th>
<th>Large-Firm, Labor Intensive</th>
<th>Small-Firm, Labor Intensive</th>
<th>Low Dependence on External Finance</th>
<th>High Dependence on External Finance</th>
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<tbody>
<tr>
<td>&lt;5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5-9</td>
<td>1.22</td>
<td>1.13</td>
<td>1.00</td>
<td>1.08</td>
<td>1.09</td>
<td>1.17</td>
</tr>
<tr>
<td>10-14</td>
<td>1.40</td>
<td>1.23</td>
<td>1.33</td>
<td>1.09</td>
<td>1.18</td>
<td>1.34</td>
</tr>
<tr>
<td>15-19</td>
<td>1.63</td>
<td>1.36</td>
<td>1.44</td>
<td>1.14</td>
<td>1.29</td>
<td>1.53</td>
</tr>
<tr>
<td>20-24</td>
<td>1.89</td>
<td>1.56</td>
<td>1.41</td>
<td>1.19</td>
<td>1.43</td>
<td>1.76</td>
</tr>
<tr>
<td>25-29</td>
<td>2.18</td>
<td>1.75</td>
<td>1.73</td>
<td>1.25</td>
<td>1.58</td>
<td>2.04</td>
</tr>
<tr>
<td>30-34</td>
<td>2.44</td>
<td>2.15</td>
<td>1.75</td>
<td>1.33</td>
<td>1.84</td>
<td>2.36</td>
</tr>
<tr>
<td>35-39</td>
<td>2.97</td>
<td>2.28</td>
<td>1.93</td>
<td>1.67</td>
<td>2.14</td>
<td>2.66</td>
</tr>
<tr>
<td>40+</td>
<td><strong>5.69</strong></td>
<td>3.02</td>
<td><strong>2.71</strong></td>
<td><strong>2.12</strong></td>
<td><strong>2.93</strong></td>
<td><strong>4.89</strong></td>
</tr>
</tbody>
</table>

*Firms grow faster over their lifecycles in large-firm dominated, capital intensive industries, and industries more dependent on external finance*
Specific Questions

1. What is the relationship between size and age in the formal sector in developing countries?
2. What is the relationship between size and age in India?
3. What role do technological differences across industries play?
4. How does this relationship vary across different types of institutions?
5. How does this relationship differ in the informal sector?
Financial Institutions in India

• Our measure of financial development is the ratio of total Commercial Bank Credit outstanding to the Net State Domestic Product (SDP) in each census year
  – Sourced from Reserve Bank of India and Burgess and Pande (2005)

• Largely state-owned
  – State controlled banks still account for three-quarters of all loans in India
Firm Lifecycle in India
Role of Financial Development

Financial Development does not seem to make a material difference to plant lifecycles in India
Firm Lifecycle in India
Role of Financial Development – Robustness Checks

• Robust to alternate measures – Commercial Bank Deposits/SDP and Total number of branches/capita

• No material difference in lifecycle of firms born after industry de-licensing in financially developed vs. under-developed states

• No material difference in lifecycle of firms born after financial liberalization in financially developed vs. under-developed states

• Exceptions:
  – Firms in large-firm dominated labor intensive industries are larger in financially developed states versus underdeveloped states
  – Some evidence that financial development matters in states with rigid labor laws
Firm Lifecycle in India

Role of Financial Development –

- Do financial institutions have a differential effect on the extensive margin (Number of Plants) versus intensive margin (Avg Employment/Plant)?

![Graph showing the comparison of employees and establishments in different segments of the firm lifecycle.]
Firms in the unorganized manufacturing sector have a downward sloping age size profile.
Reconciling our results with Hsieh and Klenow (2012)

• Difference in the “total employment” measure?
Conclusion

• The average 40 year old plant in developing countries (120 countries and India) is about 5 times larger than the average plant less than 5 years of age.

• The differences in financial development across Indian states, while substantial, only modestly affect the life-cycles of established firms in most industries.
  – Firms in large-firm dominated labor intensive industries are larger in financially developed states versus underdeveloped states.
  – Plants in financially developed states that have rigid labor market regulations are larger than plants in financially under-developed states with rigid labor market regulations.
Takeaway

• On average, across the world, formal new establishments start small and grow as they age.

• No evidence of declining life-cycles in the formal sector.

• However, we also find that the size-age ratio may not be as large as that in developed countries such as the United States, suggesting that other factors may play a role in establishment life-cycle.

Our new paper...
What determines entrepreneurial success?
Ayyagari, Demirguc-Kunt, and Maksimovic (2014)

Size at birth is a key determinant of success over early life cycle
What determines entrepreneurial success?
Ayyagari, Demirguc-Kunt, and Maksimovic (2014)

• Large entrants have higher labor productivity, more complex production structures, and are more responsive to financing shocks

• Role of financial development more important since 2000
  – Financial development allows greater entry and also allows entry at a smaller size.
  – Larger entrants benefit more from financial development later on in their lifecycle.
Extra slides
Why India as a case study?

Uttar Pradesh’s GDP per head is close to that of Kenya.
ES

• **Establishment Size:** # of permanent, full-time employees in the establishment

• **Establishment Size Ratio:** Ratio of current establishment size to the size of the establishment when it first started operations.

• **Establishment Age** is defined as the number of years since the establishment began operations in the country.

ASI

• **Establishment Size:** total number of workers

• **Establishment Size Ratio** which is the ratio of each firm’s establishment size scaled by the average establishment size of all firms in its birth cohort.

• **Establishment Age** is defined as the year of the census - year of initial production reported by the firms.
## ASI Data – Employment Module

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Item</th>
<th>Average number of persons worked</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Workers Employed directly</td>
<td>Men</td>
</tr>
<tr>
<td>2</td>
<td>Workers Employed directly</td>
<td>Women</td>
</tr>
<tr>
<td>3</td>
<td>Workers Employed directly</td>
<td>Children</td>
</tr>
<tr>
<td>4</td>
<td>Sub-total (1+2+3)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Employed through contractors</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Total Workers (4+5)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Supervisory &amp; managerial staff</td>
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</tr>
<tr>
<td>8</td>
<td>Other employees</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Total (6 to 8)</td>
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</tr>
<tr>
<td>10</td>
<td>Working proprietors</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Unpaid family members</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>If cooperative factory unpaid working members</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Total (9 to 12)</td>
<td></td>
</tr>
</tbody>
</table>
Credit to SDP in India over time