Productivity and Growth: Education, Agglomeration and Entrepreneurship

Edward L. Glaeser
Harvard University
Sources of Local Productivity

• Scale
  – Agglomeration matters and that is the potential challenge for New Zealand
  – I believe in spatial neutrality but the productivity differences within countries are quite large.

• Skill
  – Typically we measure this with years of schooling or test scores
  – Differentiate individual effects from human capital externalities
  – Built by the post-school environment as well

• Entrepreneurship
  – I view this as a specialized form of relatively general human capital
USA data is from the 2005 ACS. China data is from the 2005 Census. India data is from the 2005 IHDS (India Human Development Survey).
US data is from the 2000 IPUMS. India data is from the 2001 Census. Chinese data is from the Household Survey Income Project of 2002.
Class of 2009: Percentage of students at advanced level in math

Source: Hanushek, Peterson and Woessman
Figure 1. Overall annual rate of growth in student achievement in math, reading, and science in

Note: See Table B.1 for numerical values

Source is Hanushek, Peterson and Woessman--PEPG
49 countries, 1995-2009
Figure 7. Relationship between a country’s initial level of student achievement and its growth rate, 1995–2009
Figure 9. Relationship between increments in state expenditures per pupil and gains in student achievement, 1990–2008

*Change in expenditure per pupil adjusted for inflation; *Digest of Educational Statistics, 2011*
Figure 2: Geographic Variation in Math Reforms

(A) 1982 Math Requirement

(B) 1994 Math Requirement
Four Types of U.S. Findings

- Early Childhood Interventions (Heckman)
- Teacher Quality (Chetty, Friedman, Rockoff)
- Charter Schools (Angrist, Pathak, Walters)
- Science and Math (Joshua Goodman)
Area Growth and Establishment Size

Area Growth and Establishment Size

Entrepreneurship and Urban Growth: An Empirical Assessment with Historical Mines

Ed Glaeser, Sari Pekkala Kerr, and William Kerr
Worth All the Fuss?

- How robust is this relationship really?
  - Does it hold up to basic OLS scrutiny?
  - Exogeneity of initial entrepreneurship?
  - What form does this growth take?

- Important implications for cities
  - Models of spatial equilibria or growth
  - Policy initiatives for entrepreneurship
Basic Framework

- \( \ln(\text{EmpGr}_{82-02}) = \beta \cdot \ln(\text{Entr}_{82}) + \text{controls} \)
  - Controls = region fixed effects, initial empl. levels, and growth covariates
  - 291 city observations
  - Bootstrapped standard errors

- \( \text{EmpGr} + \text{PayrollGr}, \text{no WageGr} \)
<table>
<thead>
<tr>
<th>Model Term</th>
<th>Estimate 1</th>
<th>Estimate 2</th>
<th>Standard Error 1</th>
<th>Standard Error 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log average establishment size in city at start of period</td>
<td>-0.566</td>
<td>-0.693</td>
<td>0.078</td>
<td>0.082</td>
</tr>
<tr>
<td>Log start-up share of employment in city at start of period</td>
<td></td>
<td></td>
<td>0.200</td>
<td>0.161</td>
</tr>
<tr>
<td>Log bachelor's educated worker share, 1970</td>
<td>0.065</td>
<td>0.026</td>
<td>0.043</td>
<td>0.051</td>
</tr>
<tr>
<td>Log housing prices, 1970</td>
<td>-0.388</td>
<td>-0.078</td>
<td>0.183</td>
<td>0.276</td>
</tr>
<tr>
<td>Log population density, 1970</td>
<td>-0.054</td>
<td>-0.065</td>
<td>0.028</td>
<td>0.029</td>
</tr>
<tr>
<td>Log population, 1970</td>
<td>0.220</td>
<td>0.061</td>
<td>0.196</td>
<td>0.290</td>
</tr>
<tr>
<td>Log July temperature</td>
<td>0.451</td>
<td>0.482</td>
<td>0.616</td>
<td>0.719</td>
</tr>
<tr>
<td>Log January temperature</td>
<td>0.013</td>
<td>0.027</td>
<td>0.082</td>
<td>0.117</td>
</tr>
<tr>
<td>Initial employment controls</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Region fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: Entrepreneurship and growth estimations at city level, 1982-2002

<table>
<thead>
<tr>
<th></th>
<th>Log employment growth</th>
<th>Log payroll growth</th>
<th>Log wage growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Log average establishment size in city at start of period</td>
<td>-0.566 (0.094)</td>
<td>-0.598 (0.090)</td>
<td>-0.693 (0.087)</td>
</tr>
<tr>
<td></td>
<td>-0.435 (0.127)</td>
<td>-0.478 (0.132)</td>
<td>-0.640 (0.115)</td>
</tr>
<tr>
<td></td>
<td>0.073 (0.049)</td>
<td>0.018 (0.063)</td>
<td>-0.054 (0.039)</td>
</tr>
<tr>
<td>Initial employment controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Census division fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>City growth covariates</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

A. Measuring entrepreneurship through average establishment size

<table>
<thead>
<tr>
<th></th>
<th>Log start-up share of employment</th>
<th>Log start-up share of employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in city at start of period</td>
<td>in city at start of period</td>
</tr>
<tr>
<td>Log start-up share of employment in city at start of period</td>
<td>0.200 (0.081)</td>
<td>0.200 (0.055)</td>
</tr>
<tr>
<td></td>
<td>0.161 (0.040)</td>
<td>0.200 (0.096)</td>
</tr>
<tr>
<td></td>
<td>0.196 (0.058)</td>
<td>0.150 (0.047)</td>
</tr>
<tr>
<td></td>
<td>0.016 (0.027)</td>
<td>0.016 (0.018)</td>
</tr>
<tr>
<td></td>
<td>0.029 (0.018)</td>
<td>0.019 (0.020)</td>
</tr>
<tr>
<td>Initial employment controls</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Census division fixed effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>City growth covariates</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

B. Measuring entrepreneurship through start-up employment share

Notes: Estimations describe the OLS relationship between entrepreneurship and city growth. City growth is calculated as the log ratio of employments at the end of the period to the beginning of the period. Regressions are unweighted, report standard errors clustered by nine census divisions, and have 291 observations. Initial employment controls are log employment levels at start of period and their squared values. City growth covariates include log January temperature, log July temperature, log 1970 share of workers with bachelor's education or higher, log 1970 population density, log 1970 population, and log 1970 housing prices. Nine census divisions are used in the fixed effects. A 2% trim is employed on variables. Appendix Table 1 repeats these estimations by time period.
A: OLS with Warm/Cold City Split

- Total city employment
- Mining, constr. & manufacturing
- Trade, finance, & services
- Low agglomeration industries
- Medium agglomeration industries
- High agglomeration industries
- High agglom. trade, fin. & serv.
City-Industry Framework

- \( \ln(\text{EmpGr}_{82-02}) = \beta \cdot \ln(\text{Entr}_{82}) + \text{controls} \)
  - Controls: city + industry x region FEs
  - \( \text{Entr}_{82} \) specific to city-industry
  - Require 100 employees in city-industry
Table 4: Entrepreneurship and growth regressions at city-industry level

<table>
<thead>
<tr>
<th></th>
<th>Total employment</th>
<th>Total employment</th>
<th>Mining, construction, &amp; mfg.</th>
<th>Trade, finance, &amp; services</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td></td>
</tr>
</tbody>
</table>

A. Using average establishment size

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Log average establishment size</td>
<td>-0.192</td>
<td>-0.165</td>
<td>-0.291</td>
</tr>
<tr>
<td>in city-industry at start of period</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
</tbody>
</table>

B. Using start-up employment share

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Log start-up share of employment</td>
<td>0.054</td>
<td>0.042</td>
<td>0.055</td>
</tr>
<tr>
<td>in city-industry at start of period</td>
<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.011)</td>
</tr>
</tbody>
</table>

Initial employment controls            | Yes                  | Yes              | Yes                       |
Region x industry fixed effects         | Yes                  | Yes              | Yes                       |
City growth covariates                 | Yes                  |                  |                           |
City fixed effects                     | Yes                  | Yes              | Yes                       |

Notes: See Table 2. Estimations describe the OLS relationship between entrepreneurship and city-industry growth. Industries are defined at the two-digit level of the SIC system. Region x industry fixed effects use the nine census divisions. Initial employment controls are city-industry specific. City-industries must have 100 employees throughout the 1977-2002 period to be included in the full sample, for 12,178 observations.
Small Establishment Size: Interpretation and Causality

• First of all— we have currently decided to call these variables entrepreneurship— at other points they have been called competition and industry life cycle.

• These are interpretation issues that are separate from causality issues.

• Maybe omitted variables— like pro-business institutions— allow lots of little start-ups and plenty of employment growth.

• Other stories also abound.
Chinitz Effect

“My feeling is that you do not breed as many entrepreneurs per capita in families allied with steel as you do in families allied with apparel, using these two industries for illustrative purposes only. The son of a salaried executive is less likely to be sensitive to opportunities wholly unrelated to his father's field than the son of an independent entrepreneur...”
Chinitz Effect

• Aspirations of children
• “Aura of second-class citizenship”
• Reduced financing for start-ups
• Poor urban structure
• Poor input linkages
• Persistence in entrepreneurial supply
Coal and Iron Deposits in the United States, 1910
Ralph S. Tarr, B.S., F.G.S.A. and Frank M. McMurry, Ph.D., New Geographies 2nd ed
Downloaded from Maps ETC, on the web at http://etc.usf.edu/maps  [map #02085]
Historical Mines Data

- US Geological Survey database
  - USGS established in 1879
  - 304k known deposits at the mine level without production requirement
  - Latitude and longitude of location
  - Date of discovery (if known)
  - Types of minerals and ores
Historical Mines Data

• Distance ranges of 250-500 miles
  – Anthracite price listed: 250 mi
  – Log anthracite price: 250-500 mi
  – Bituminous price listed: Unclear
  – Log bituminous price: 500 mi
  – Coal is heavy...
### Table 6: Historical mining deposits and industrial structures

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Log mine counts within 500 miles of city, 1900</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log mines 500 miles of city, 1900</td>
<td>0.213</td>
<td>1.163</td>
<td>0.075</td>
<td>0.142</td>
</tr>
<tr>
<td></td>
<td>(0.045)</td>
<td>(0.054)</td>
<td>(0.011)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>B. Panel A including indicator variable for coal or iron ore being top</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log mines 500 miles of city, 1900</td>
<td>0.204</td>
<td>1.149</td>
<td>0.071</td>
<td>0.133</td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td>(0.049)</td>
<td>(0.009)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>(0,1) Coal or iron ore top state product, 1928</td>
<td>0.126</td>
<td>0.187</td>
<td>0.062</td>
<td>0.116</td>
</tr>
<tr>
<td></td>
<td>(0.069)</td>
<td>(0.058)</td>
<td>(0.017)</td>
<td>(0.041)</td>
</tr>
</tbody>
</table>

Notes: See Table 2. Regressions include Initial employment controls, Census division fixed effects, and City growth covariates. Appendix Tables 2a and 2b provide descriptive statistics regarding mining counts. Coal or iron ore is the top mineral product in 1928 for AL, CO, IL, IN, KY, MD, MI, MN, ND, PA, TN, VA, WA, and WV.
B: OLS and IV (250- and 500-Mile Bands)

- Total city employment
- Mining, constr. & manufacturing
- Trade, finance, & services
- Low agglomeration industries
- Medium agglomeration industries
- High agglomeration industries
- High agglom. trade, fin. & serv.

Legend:
- OLS
- IV 500
- IV 250
Parting Thoughts on New Zealand

• Agglomeration is the force that hurts the country—education and entrepreneurship must compensate.

• Schooling is strong and doing better than the U.S., but still far behind the Asian superstars.

• In entrepreneurship, the most important thing the government can do is to reduce permitting troubles and NZ ranks FIRST globally in starting a business according to the World Bank.