Selection and Agglomeration Impact on Firm Productivity: A Study of Taiwan's Manufacturing Sector

SYED HASAN, ALLEN KLAIBER AND IAN SHELDON
OHIO STATE UNIVERSITY
Significance of TFP Estimation

- Importance of Technology vs Capital in economic growth
- Abramovitz (1956)-Measure of our ignorance
- Solow (1957)
- Melitz (2003)-Survival and scope of the firm in the market- heterogeneous firms (and heterogeneity is thought of in terms of productivity)
Regional Productivity

- Rosenthal and Strange (2003) - Firms in large cities have high productivity
- Ciccone and Hall (1996) - Positive relation between density of economic activity and firm’s productivity
- Large City - Above median employment density
- Clusters/Science Park - Public-private partnership that fosters knowledge flows among firms and contributes to regional economic growth
- Market failure - Innovations
Research Motivation

- To compare the relative productivity distributions of firms located in clusters to those located in large cities and small cities
- To compare industry level productivity distribution within the cluster
- What drives the productivity-Agglomeration or Selection
- Policy Implications- Do they deliver
Research Methodology

- TFP Estimation
- Methods
  - OLS
  - Fixed effects
  - IV
- Sources of Bias
  - Simultaneity
  - Selectivity

Production Function

\[ y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \varepsilon_{it} \]
\[ y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + v_{it} + u_{it} \]
\[ \omega_{it} = \beta_0 + v_{it} \]

\[ E(x_{it} \omega_{it}) = 0 \]
Semi-Parametric Estimation

Olley and Pakes (1996) -

semi-parametric method,

based on proxy variables -

i) the identification of a proxy variable, which is function of TFP, and

ii) the definition of the conditions under which this function can be inverted in order to express TFP as a function of the proxy variable itself
Why Taiwan?

Taiwan is now the home of many of the world's largest makers of computers and associated hardware. Its firms produce more than 50% of all chips, nearly 70% of computer displays and more than 90% of all portable computers (Economist, 2010).
Results-TFP Estimates

Data:
Emerging Markets Information Services, firm level, income statement and balance sheet. Industry classification at 3-digit NAICS level.

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>IV</th>
<th>OP</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta_k )</td>
<td>0.37***</td>
<td>0.56***</td>
<td>0.29**</td>
</tr>
<tr>
<td>( \beta_l )</td>
<td>0.56***</td>
<td>0.21***</td>
<td>0.47**</td>
</tr>
</tbody>
</table>

- Deflate sales
- Remove outliers
- Data limitations
  - Materials
  - Energy
  - Firm prices

Multi-Product Bias
When products have bigger technological -give up some product lines. Moreover, multi-product plants are shown to exit markets where production technologies are farthest away from their primary products.
Regional TFPs

POPULATION DENSITY

TFP-COUNTY MARKET
## Summary Stats-Log TFP

<table>
<thead>
<tr>
<th>Stats</th>
<th>BM</th>
<th>SP</th>
<th>AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>840</td>
<td>1427</td>
<td>2388</td>
</tr>
<tr>
<td>mean</td>
<td>4.10692</td>
<td>8.32283</td>
<td>11.7669</td>
</tr>
<tr>
<td>max</td>
<td>8.70842</td>
<td>12.1029</td>
<td>17.0863</td>
</tr>
<tr>
<td>min</td>
<td>-2.4334</td>
<td>1.00501</td>
<td>4.60511</td>
</tr>
<tr>
<td>IQR</td>
<td>1.23055</td>
<td>1.3496</td>
<td>1.41828</td>
</tr>
</tbody>
</table>

The graph on the right shows the TFP distribution for all industries, with different bandwidth settings for each category.
Inter-Industry comparison-Technology intensive levels

COMPUTER AND ELECTRONICS

CHEMICAL MANUFACTURING
Agglomeration and Selection

Localization- Henderson et al (1995)- Regional employment share of the specific industry

Urbanization- Herfindahl-Hirschman Index which is computed as \( \sum_j s_{jrt}^2 \) where \( s \) is the employment share of two digit manufacturing industry \( j \)

Competition- Population density; diseconomies of scale or local demand
Self Selection

Baldwin and Okubo (2006) show that high productivity firms self-select into large markets.

Heckman two-step estimator for selection models (Heckman, 1976; 1979)

**Robustness Checks**

Dummy variable for location

Instrument the endogenous variable

\[ z_{it}^* = \alpha_0 + \alpha C_{it} + \epsilon_{it} \quad z_{it}^* \quad z_{it} = 1 \]

\[ S_{prt} = \beta_0 + \beta_a A_{rt} + \beta_c X_{rt} + \nu_{prt} \]

where \( S_{prt} \) is the \( p \)-th percentile of region \( r \) at time \( t \), \( A_r \) are industry specific agglomeration variables for region \( r \) at time \( t \), \( X_r \) are the region-time specific control variables and \( \nu_{prt} \) is the error term.
Agglomeration OR Selection


i. Mean (median)-to check for relative shift

ii. IQR -for dispersion

iii. 10th percentile - for truncation/cut-off
Simulations-To be done

Simulations to suppress noise in TFP estimation

TFP Distribution of empirical data

Combes(2012) and Melitz & Ottaviano (2008)

Normal – Quantile Plots

ML estimates
Results

Firms in large cities have the highest level of productivity.

Firms located in Science parks usually have intermediate productivity levels—in between large and small cities.

Firms productivity in Science parks may depend on the technology intensity of the production process.
Conclusion

- Policy Implications
- Creating clusters may enhance productivity of technology intensive industry
- Clusters may turn out to be protective shields against competition in some cases
Comments: hasan.47@osu.edu