“Selection , Agglomeration and Firm Productivity in Taiwan: What Impact on the High-Tech Sector?”

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Research Question and Motivation

- **Efficiency of public incentives: NT$100 billion/annum spent on science parks by Taiwanese government (Lien *et al*., 2007)**
- **Evaluating performance of science parks complex – requires more rigorous approaches (Bigliardi *et al*. 2006)**
- **Empirical evidence on innovative capability, survival rate, profitability and job creation mixed (Monck, 2010)**
- **Consistent approach required for performance and impact assessment of science parks (Link and Siegel, 2009)**

Theoretical Background

- Positive relation between density of economic activity and firm productivity (Ciccone and Hall, 1996)
- Firms in large cities have high productivity (Rosenthal and Strange, 2004)
- Larger markets attract more firms, making competition tougher (Melitz and Ottaviano, 2008)
- Sorting of high productivity firms into cities, i.e., self-selection (Baldwin and Okubo 2006)

Methodology

- Taiwanese firm-level panel data for 2009-2011 period
- Define three regions: above median population density (large), below median population density (small), and counties housing science parks
- Estimate firms' total factor productivity (TFP) for each region
- Identify impact of agglomeration and selection on firms' productivity
- Also account for self-selection whereby most productive firms locate in large region(s) (Baldwin and Okubo, 2006)

Model

- Goods produced under monopolistic competition with sunk cost of entry, firms being indexed by unit labor requirement h
- h varies across firms based on productivity draw from known *cdf* $G(h) \epsilon [0,1]$, common to all regions
- Agglomeration economies introduced by assuming effective labor a increases with number of firms in region, $a(N)$, $a' > 0$, $a'' < 0$
- Selection modeled as proportion of firms that fail to survive product market competition in city i, $S_i \equiv 1 - G(h^d_i)$, where d is cut-off productivity for survival

Hypotheses

Hypothesis 1:

Increase in number of firms in region shifts log productivity distribution rightwards (agglomeration effect)

Hypothesis 2:

Increase in market size raises entry/survival cost, i.e., increases cut-off for unit labor requirement - greater left truncation of log productivity distribution (selection effect)

Results-TFP Estimates

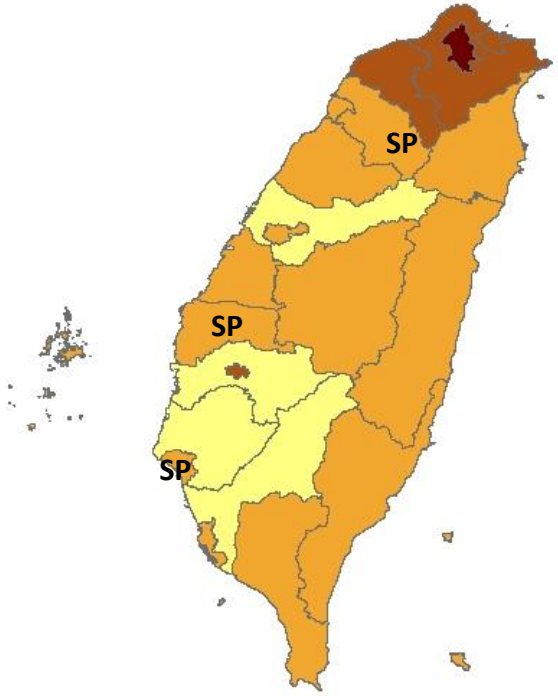
Data:
Firm-level, income statement and balance sheet; industry classification at 3-digit NAICS level

	OLS	IV	OP
β_k	0.37***	0.56***	0.29**
β_l	0.56***	0.21***	0.47**

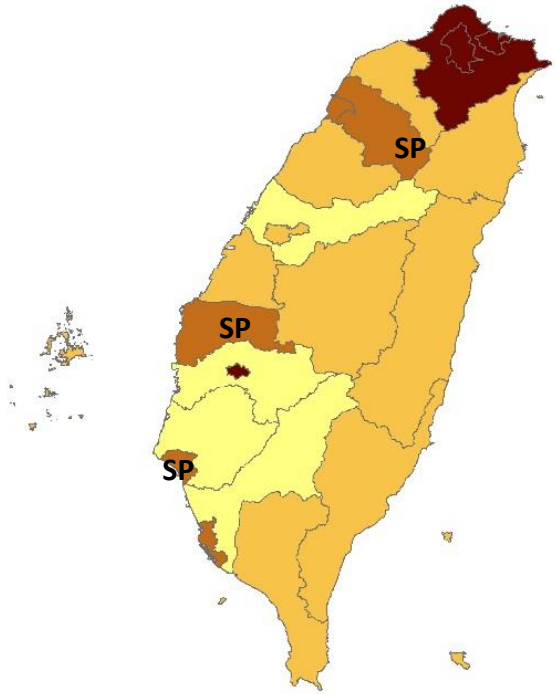
- Deflate sales
- Remove outliers
- Data limitations
  - Materials
  - Energy
  - Firm prices

Regional TFPs

POPULATION DENSITY

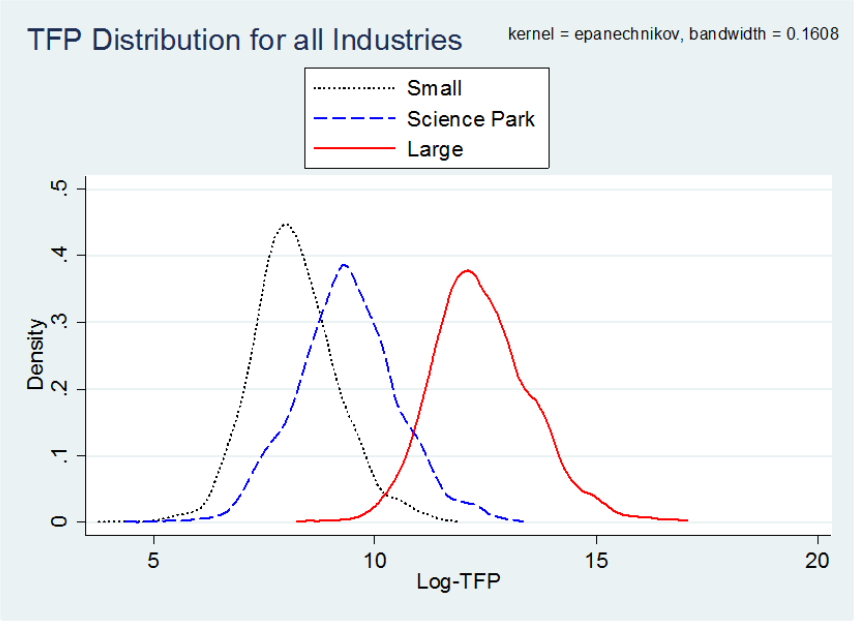


TFP-COUNTY MARKETS



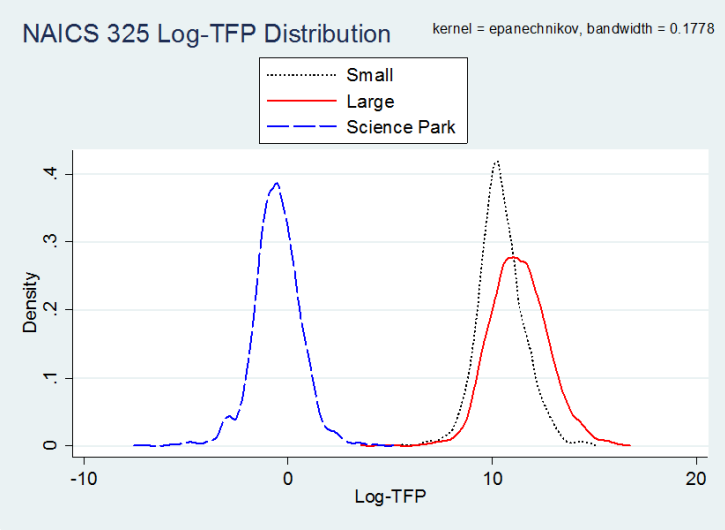
Summary Statistics-Log TFP

Statistic	Below median	Science park	Above median
N	840	1427	2388
mean	4.107	8.32	11.77
max	8.71	12.10	17.09
min	-2.43	1.00	4.61
IQR	1.23	1.35	1.42

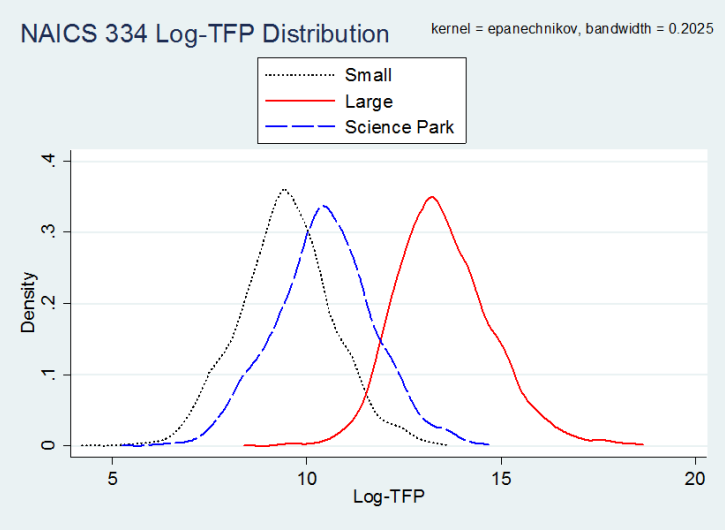


Inter-Industry Comparison: Technology-Intensive Occupation Levels

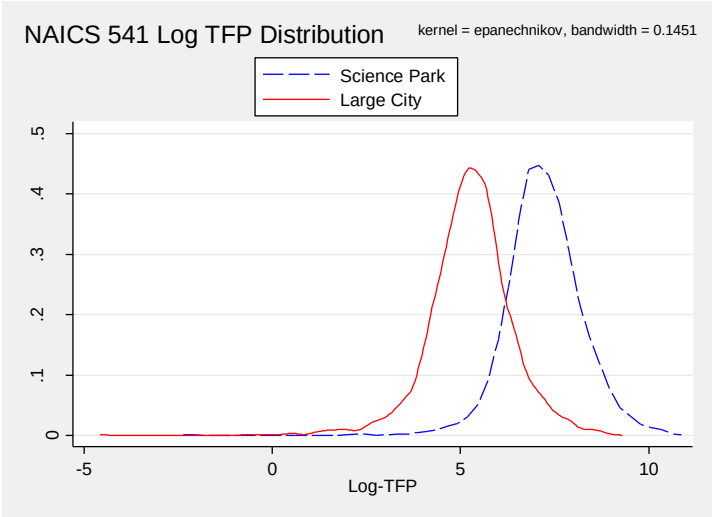
CHEMICAL MANUFACTURING



COMPUTERS AND ELECTRONICS



SCIENTIFIC AND TECHNICAL SERVICES



Agglomeration and Selection Variables

- **Localization: Henderson *et al*. (1995) - regional employment share of specific industry**
- **Urbanization: Herfindahl index computed as: $\sum_j s_{jrt}^2$**

  where *s* is employment share of two-digit manufacturing industry *j*, in region *r* at time *t*
- **Competition: population density - either diseconomies of scale or local demand**

Agglomeration vs. Selection

Agglomeration and Selection in Science Parks (NAICS 334)

IQR			MED			10-TILE		
LOC	URB	Lab Den	LOC	URB	Lab Den	LOC	URB	Lab Den
1.89***	-3.4***	-.07**	0.48***	-0.3***	0.31***	.70	1.84	.04***
(.10)	(0.16)	(.02)	(0.01)	(.06)	(.00)	(.63)	(1.9)	(.01)

Results

Aggregate:

- **Firms in large cities have highest level of productivity**
- **Firms located in science parks usually have intermediate productivity levels (in between large and small cities)**

Within science parks:

- **Firm productivity in science parks depends on technology-intensity of production process**
- **Agglomeration dominates selection**

Conclusion

- **Differentiate efficient (growth improving) and inefficient (life support) use of science parks**
- **Efficient use of science parks evident when used to support innovation – notably in an industry such as biotechnology**
- **Science park clusters may turn out to be protective shields against competition in some cases**