On the Location of Innovation: Implications for New Mexico

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Highly productive countries are highly innovative

Selected OECD Countries	GDP per worker ($1,000)	Research intensity (researchers as % of total employment)
U.S.	36.4	0.58
Canada	34.3	0.21
Australia	30.6	0.13
Belgium	30.2	0.20
Japan	21.4	0.36
Ireland	20.8	0.10
Greece	16.8	0.02
Portugal	13.3	0.01

More good things associated with innovation

- Highly innovative industries pay higher wages.
- Highly innovative cities experience

  - higher employment growth.

  - higher wage growth.

Overview

- Three observations about the innovative process
  - ✓Innovative activity is directed by the profit motive.
  - ✓Innovation requires specialized inputs.
  - ✓Innovation is a process of learning from others.
- Two features of a populous place that facilitate innovation
  - ✓thick markets
  - ✓knowledge spillovers

Overview

- Three observations about the innovative process
- Two features of a populous place that facilitate innovation
- Implications
  - ✓Innovation in emerging technologies is concentrated in large metropolitan areas.
  - ✓Less populous places may compete in mature technological fields.
  - ✓University locations will be disproportionately innovative.

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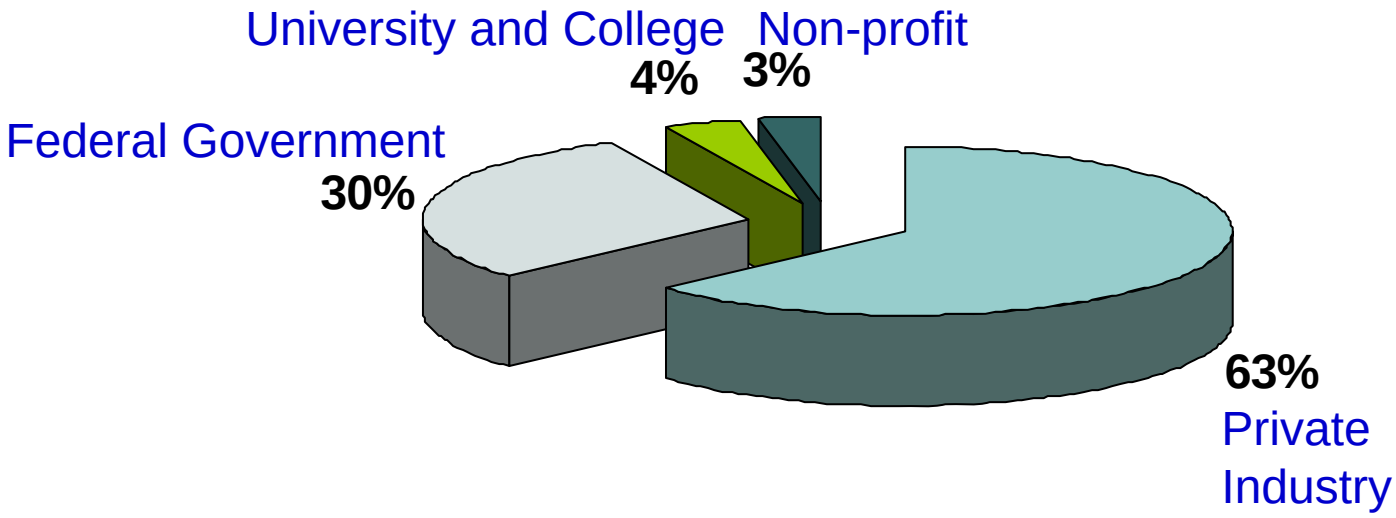
Three observations about the innovative process

- Much of innovative activity is directed by the profit motive.

Public and private funding of research and development activity



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Learning from others is a primary source of ideas

- Own R&D expenditures
- Technology licensing
- Reverse engineering
- Hiring employees of innovating firms
- Publications and technical meetings
- Patent disclosures
- Talking with employees of innovating firms

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Learning from others is facilitated by proximity

- Own R&D expenditures
- Technology licensing
- ***Local*** Knowledge Spillovers
  - ✓ Reverse engineering
  - ✓ ***Hiring employees of innovating firms***
  - ✓ Publications and ***technical meetings***
  - ✓ Patent disclosures
  - ✓ ***Talking with employees of innovating firms***

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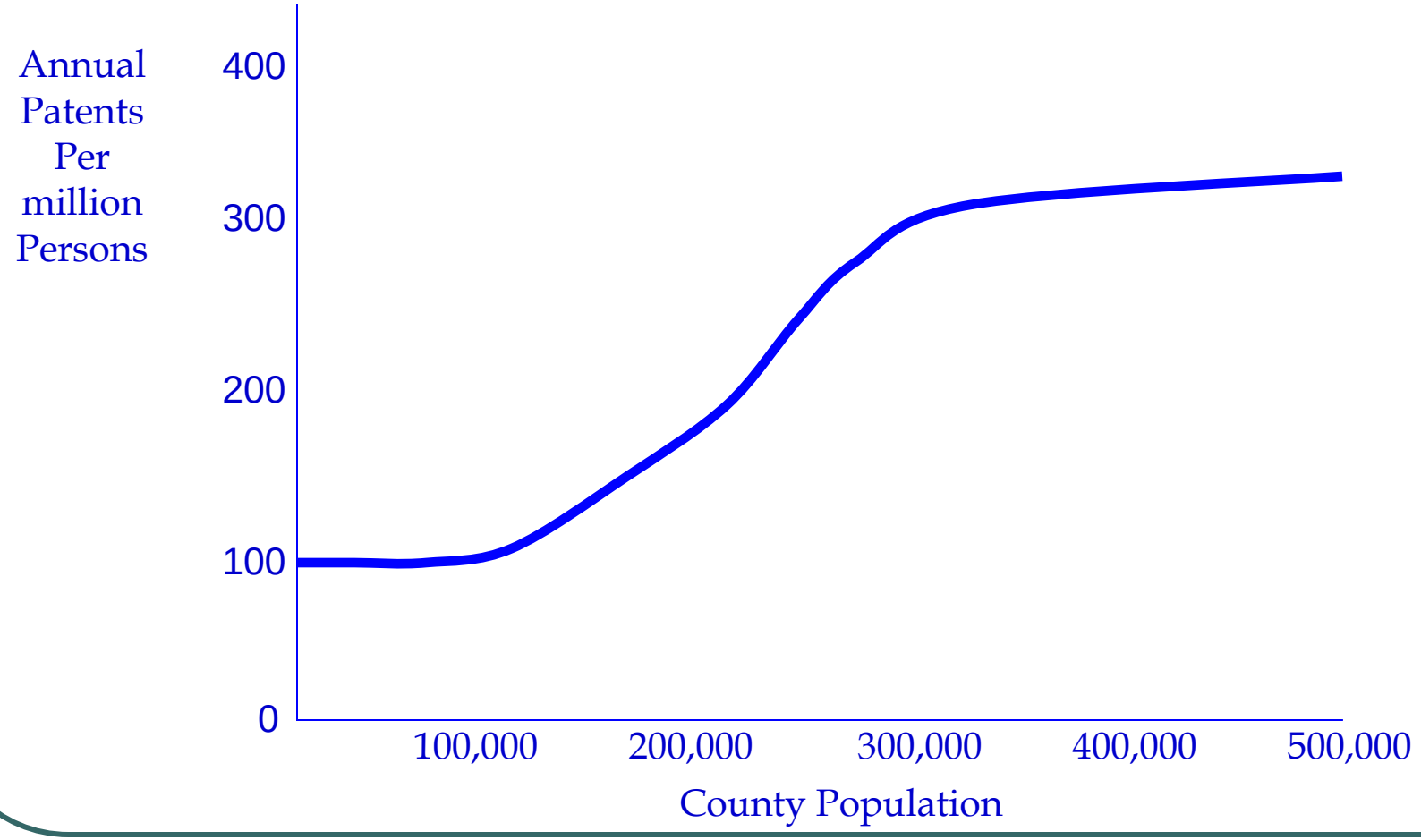
- More knowledge spillovers: more opportunities to learn from others.

Populous places are disproportionately more innovative



Overview

- Three observations about the innovative process
- Two features of a populous place that facilitate innovation
- Implications for the location of innovation

Technological maturity will determine the benefits of population

- Benefits of ***population*** are ***more important in emerging technological fields.***
  - ✓Innovators must be in close proximity to take advantage of thick markets and knowledge spillovers.

Technological maturity will determine the benefits of population

- Benefits of ***population*** are ***less important in mature technological fields***
  - ✓Learning-by-doing in operations and production.
  - ✓Incremental innovation is more predictable.
  - ✓Researchers may make more effective use of information and transportation technologies to acquire specialized inputs and learn from others.

Patent intensity in large MSAs

Relative to total U.S. patent activity (1990-1999)

High-intensity technologies	vs. U.S.
Electrophotography	2.4 times
Record receiver having plural interactive leaves	2.2
Photography	2.1
Incremental printing of symbolic information	1.9
Low-intensity technologies	
Chemistry of hydrocarbon compounds	0.27 times
Interrelated power delivery controls including engine control	0.27
Wells	0.27
Textiles: knitting	0.24

Patent intensity in micropolitan areas and town counties

Relative to total U.S. patent activity (1990-1999)

High-intensity technologies	vs. U.S.
Button making	16 times
Coopering	8.1
Type casting	8.1
Whips and whip apparatus	8.1
Low-intensity technologies	
Electrical computers and digital processing systems: memory	0.12 times
Active solid state devices	0.11
Semiconductor device manufacturing: process	0.11
Data processing: speech signal processing linguistics language translation and audio compression/decompression	0.08

Population is inversely correlated with technological maturity

	Large metropolitan areas	Micropolitan areas and town counties
Average year of patent class establishment:		
Ten highest-intensity classes	1982	1931
Ten lowest-intensity classes	1963	1992
All classes with no activity	1913	1936
Average year of peak patent activity:		
Ten highest-intensity classes	1998	1973
Ten lowest-intensity classes	1985	1996
All classes with no activity	1972	1980

Patent intensity in New Mexico micropolitan areas and town counties

Relative to total U.S. patent activity (1990-1999)

High-intensity technologies	vs. U.S.
Wheelwright Machines	38 times
Unearthing Plants or Buried Objects	28
Mining or In Situ Disintegration of Hard Material	18
Superconductor Technology: Apparatus Material Process	11
Low-intensity technologies	
Drug Bio-Affecting and Body Treating Compositions	0.20 times
Electrical connectors	0.18
Semiconductor device manufacturing: process	0.15
Surgery	0.14

Universities may mitigate the disadvantage of low population

- University towns have high education levels when compared to locations of similar population.

- Higher education levels in university towns may also support
  - thicker markets for innovative inputs.
  - greater knowledge spillovers between innovators.

Areas proximate to universities are disproportionately innovative

Location	Population	Patents per million capita
Albuquerque MSA	730,000	227
Las Cruces MSA	175,000	79
Santa Fe MSA	129,000	175
Los Alamos MicroSA	20,000	1,960
Farmington MSA	114,000	47
Denver-Aurora MSA	2,330,000	182
Median US county	26,000	53

Summary

- Thick market and knowledge spillover advantages of population are critical for innovation in emerging fields.
- Innovators in mature technological fields acquire specialized inputs and learn from others, even in the absence of large population.
- Innovators may be disproportionately productive in a university setting.

Implications for less-populous places

- Play to strengths
  - expect continued success in resource and natural amenity related industries.
- Minimize disadvantage of low population
  - expect continued success in mature technologies.
- Mitigate distance
  - expect benefits from investment that help to connect innovators - transportation? communication? education?

Questions?