Inside or Outside the IP System?  
Business Creation in Academia

Scott Shane (CWRU)
Academic Entrepreneurship, Innovation, and Policy

- Academic research is a key engine of economic growth and competitive advantage
- But university research often distant from “real” economic needs
- Since academics respond to economic incentives
- Adopt policies to facilitate knowledge transfer and commercialization – the Bayh-Dole story
Trends in Academic Entrepreneurship

New U.S. Patent Applications Filed

Licenses/Options Executed

Start-ups established

Gross License Income Received

Source: AUTM (1996-2006)
### The Situation in 2006

<table>
<thead>
<tr>
<th>Activity</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(AUTM N=161)</td>
</tr>
<tr>
<td>Licenses and options executed</td>
<td>4,038</td>
</tr>
<tr>
<td>Startups</td>
<td>484</td>
</tr>
<tr>
<td>Invention disclosures</td>
<td>6,384</td>
</tr>
<tr>
<td>New US patent applications</td>
<td>10,183</td>
</tr>
<tr>
<td>License income ($’000)</td>
<td>1,249,082,798</td>
</tr>
</tbody>
</table>

*Source: AUTM (2006)*
Academic Entrepreneurship is a “hot” topic

Source: Google scholar
The venture creation process in academia

• Research → Invention → Disclosure to TTO → Patent → License or Start up based on Patent

• So polices are based on presence of formal IPRs, particularly patents

• But formal IPRs neither effective nor used in many sectors, leading lots of commercial, knowledge transfer activities by academics not to be patented

• Nevertheless, we study what we can measure – Academic research and public policy evaluation focuses on IP-based measures of entrepreneurship (patents, licensing, spinoffs)
What Previous Research Tells Us to Increase Academic Entrepreneurship

- **Individual**
  - Age
  - Being male
  - Higher academic rank
  - Being in biological sciences and engineering
  - Emphasize research; high publication rate

- **University**
  - Institution quality
  - Amount invested in R&D
  - Ties to industry
  - Located in a major city with venture capital activity
Questions

• Just how big is academic entrepreneurship outside the IP system?

• How does inside the IP-system entrepreneurship differ from outside the IP system entrepreneurship?

• Are “IP-based” policies appropriate for “non-IP-Based” forms of academic entrepreneurship?

• Is the extent of academic entrepreneurship systematically underestimated, and current analyses distorted?
Data and Research Design

- E-survey to 58,321 tenured or tenure track faculty members and post docs at all Carnegie I and II during second half of 2007
  - Voluntary participation
  - Four follow-up electronic messages sent to non-respondents
  - 11,572 responses (20%)
Data and Research Design

• Questions

  – Demographics: Gender; Age; Academic rank; Experience + Uni., Dept.

  – Academic activities in 2006-2007: Percentage of time in research, teaching; interaction with industry; research funding; cumulated publ. record

  – Commercial activities:
    • Invention disclosures, patents issued, licenses
    • Equity
    • New businesses started
      – Overall
      – On patent
      → And not based on patent
Data and Research Design

• Additional info on universities: Carnegie Foundation + AUTM + US News
  – Ownership, Age, Size, Research Expenditures, Localization, Tech-transfer support mechanisms, TT outputs, Ranks/Tiers

• Use this info to analyze peculiarities of IP and No-IP based business creation in academia

• Wealth of info at multiple levels, big sample size

• But...
  – ...Selection?
  – ...Cross-sectional data?
Data and Research Design

- Selection: Limited on school, tech area, gender, age

Sample representativeness

Resp. vs. 1,000 random non-resp.

$$\text{Prob}(\text{resp}) = f(\text{school, tech. area, sex, age})$$

Use inverse of est. prob. as IPW in regressions
Data and Research Design

- Cross sectional data
  - Descriptive study
  - But value in new info unveiled, for policy and research
Magnitude

- A lot of academics start businesses - 16 percent of the sample have done so
- Most do **not** start businesses based on a patented invention – two outside the IP-based system start-ups for every one inside the IP-based system start-up

**Researchers and policy makers are missing a lot of the academic entrepreneurship**
## Commercialization and the “underground entrepreneurs”

### Variable Tot Only activity Disclosure Patent License Equity New business on patent

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Disclosure</th>
<th>Patent</th>
<th>License</th>
<th>Equity</th>
<th>New business on patent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disclosure</td>
<td>2,950</td>
<td>793</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US Patent issued</td>
<td>2,166</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
<td>1,822</td>
</tr>
<tr>
<td>License (on US patent)</td>
<td>1,146</td>
<td>6</td>
<td>988</td>
<td>1,071</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity</td>
<td>957</td>
<td>45</td>
<td>691</td>
<td>611</td>
<td>409</td>
<td></td>
</tr>
<tr>
<td>New business on patent</td>
<td>682</td>
<td>12</td>
<td>560</td>
<td>560</td>
<td>358</td>
<td>493</td>
</tr>
<tr>
<td>New business not on patent</td>
<td>1,266</td>
<td>623</td>
<td>432</td>
<td>314</td>
<td>172</td>
<td>343 138</td>
</tr>
</tbody>
</table>

### Correlation table

<table>
<thead>
<tr>
<th></th>
<th>Disclosure</th>
<th>Patent</th>
<th>License</th>
<th>Equity</th>
<th>New business on patent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disclosure</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US Patent issued</td>
<td>0.67</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>License (on US patent)</td>
<td>0.46</td>
<td>0.64</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity</td>
<td>0.31</td>
<td>0.34</td>
<td>0.33</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>New business on patent</td>
<td>0.37</td>
<td>0.41</td>
<td>0.37</td>
<td>0.59</td>
<td>1</td>
</tr>
<tr>
<td>New business not on patent</td>
<td>0.07</td>
<td>0.05</td>
<td>0.04</td>
<td>0.24</td>
<td>0.06</td>
</tr>
</tbody>
</table>
Look at Differences

- Predict start-ups, start-ups based on patents, start-ups not based on patents, and start-ups based on patents versus start-ups not based on patents.
- Linear probability models with robust standard errors.
- Inverse probability weighting.
- Include variables about individuals’ age and gender, source of funding, publications, time allocation, academic field, university rank, location, university R&D, age and size of technology transfer office, and whether university is public or private.
So What’s Different?

Inside the IP-System Entrepreneurs are:
- More likely to be female
- Younger
- Publish more
- More likely to raise money from industry
- Spend more time on research
- Spend less time on teaching
- More likely to be located in the Northwest
- Less likely to be in a large town
- More likely to be from a higher ranked university
- More likely to be in a biomedical field
New businesses and Gender

Fraction of academics who have started a business, by gender

Fraction of academics who have started a business on patent, by gender

Fraction of academics who have started a business not on patent, by gender
New businesses and Age

Fraction of academics who have started a business, by age group

Fraction of academics who have started a business on patent, by age group

Fraction of academics who have started a business not on patent, by age group
New businesses and University rank

Fraction of academics who have started a business, by US news tier

Fraction of academics who have started a business on patent, by US news tier

Fraction of academics who have started a business not on patent, by US news tier
New businesses and Technological areas

Fraction of academics who have started a business on patent, by technological area

- Engineering: 0.3
- Bio, Med: 0.2
- Social Sc., Human.: 0.1
- Math, Phys, Stats.: 0.05

Fraction of academics who have started a business not on patent, by technological area

- Engineering: 0.3
- Bio, Med: 0.2
- Social Sc., Human.: 0.1
- Math, Phys, Stats.: 0.05
New businesses and Location

Fraction of academics who have started a business, by location

- Large city
- Large town
- Mid-size city
- Not assigned
- Rural
- Small town

Fraction of academics who have started a business on patent, by location

- Large city
- Large town
- Mid-size city
- Not assigned
- Rural
- Small town

Fraction of academics who have started a business not on patent, by location

- Large city
- Large town
- Mid-size city
- Not assigned
- Rural
- Small town
New businesses and Academic activities: research

Average % of time spent in research for respondents starting a business not on patent

Average % of time spent in research for respondents starting a business on patent
New businesses and Academic activities: teaching

Average % of time spent teaching for respondents starting a business

Average % of time spent teaching for respondents starting a business on patent

Average % of time spent teaching for respondents starting a business not on patent
Implications

• We are missing more than we are measuring: two thirds of academic entrepreneurship is “off the radar” of researchers and policy makers

• Outside the IP system academic entrepreneurship is different from within the IP system academic entrepreneurship across a number of dimensions
  – Individual characteristics
  – Technology/discipline
  – School rankings
  – School location
  – Approach to academic job

• We have a problem in both research and public policy that needs to be fixed
  – Understanding impact of academic entrepreneurs?
  – Revisiting what we think matters?
  – Adjusting Federal legislation?
  – Changing university technology transfer policies?