ACADEMIC ENTREPRENEURSHIP

Bayh-Dole

versus

The Professor’s Privilege

Thomas Åstebro, HEC Paris, KULeuven
Serguey Braguinsky, U Maryland
Pontus Braunerhjelm, KTH Royal Institute of Technology
Anders Broström, KTH Royal Institute of Technology
What is the current thinking on university spin-offs?

Faculty should do more spin-offs
Universities should spin off more start-ups

Policies have been created to accomplish these goals:

– Changes to laws to allow universities to take ownership and control rights of academics’ IP
  • Bayh-Dole in U.S., copied by Denmark, Norway, Finland, Germany, Japan, China, and Belgium
– Creation of TLOs to manage IP and stimulate spin-offs
– University funding of start-ups
– Academics (particularly in STEM fields) encouraged to create more spin-offs
– Spin-off counts suggested to join bibliometric measures and external funding as criteria for evaluations of university performance

Still, university spin-offs are rather few and far between
Swedish Political Context

• Professor’s Privilege in place since 1949
  – Professor own 100% of I.P.
  – Professor retain all control rights

• Politicians
  – Are concerned about the so called Swedish/European paradox
  – Have enviously observed “enormous success” of the post-BDA commercialization of research in the U.S.
  – Have twice debated in parliament whether to scrap the P.P. in favour of BDA legislation
  – Are aware that neighbours Denmark, Norway, Finland and Germany have converted to BDA
  – Fear that University Chancellors and Rectors, because universities by default have no stake in IPR, do not sufficiently strong promote academic entrepreneurship
  – Again consider repealing the P.P.
Recent time-series evidence

Changing from Professor’s Privilege to Bayh-Dole legislation has

- decreased academic patenting
- decreased start-ups
- decreased university-industry collaboration significantly in Denmark, Norway and Germany

• Czarnitzki et al., 2015; 2016; Hvide and Jones, 2015; Valentin and Lund-Jensen, 2007
Do we have sufficient evidence?

- Are these studies assessing particular BDA implementations or providing fundamental evidence on the effect of switching IPR regimes?
- Are these studies capturing initial problems of institutional immaturity, while positive effects take more time to materialize?

quality of coaching and support * university/TTO greed * inertia in achieving cultural shifts in academia
How can we further improve our understanding of BDA vs PP?

- We could wait for a switch in a country maintaining the PP ...
  
  ... but few remain, and even if one occurs we would have to wait several years to get our hands on appropriate data

- We could wait for longer time series which allow BDE institutions to mature...
  
  ... but in the meantime, parallel development obscures our before-after comparison

- We could also find a mature PP environment and compare it to a mature BDA environment
Objective

• To compare U.S. vs Sweden on
  – The rate of STEM academic entrepreneurship
  – The earnings from commercialization
• One of the main differences: IPR regime. Cash-flow rights and control right are very different.
  
  **Bayh-Dole (42%) vs Professor’s Privilege (100%)**

  – Expect higher absolute rate of academic entrepreneurship in the U.S. driven by difference in the general institutions of entrepreneurship
  – Expect higher relative rate of academic entrepreneurship in Sweden driven by PP / BDA differences
  – No strong prior expectation on U.S./Sweden differences in returns to entrepreneurship
    
    **BDA expected to trim the tail of entrepreneurship quality, but may also – depending on TTO incentives and quality – stimulate over-entry**
Why study the private returns to entrepreneurship?

• Making money is an important motivator for employment choices
• A relevant proxy for venture performance
  – allows us to pick up signs of over-entry
  – has bearing on a discussion of the magnitude of social returns
• If the private returns to entrepreneurship are negative
  – we need theory going beyond income maximisation to explain their behavior
  – one might ask for policies to discourage such wasteful activities
  – but if social returns are clearly positive there is an argument for subsidizing the expected losses of the agents (see Mansfield et al., 1977)
• If the returns are positive they need no subsidies
# U.S. – Sweden Institutions

<table>
<thead>
<tr>
<th>Measure</th>
<th>U.S.</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP regime</td>
<td>Bayh-Dole 30% ownership of IP</td>
<td>Professor’s Privilege 100% ownership of IP</td>
</tr>
<tr>
<td>Taxes/GDP (effective)</td>
<td>25%</td>
<td>45%</td>
</tr>
<tr>
<td>University-industry collaboration</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>University System</td>
<td>Large, public &amp; private, large variety</td>
<td>Small, public, little variety</td>
</tr>
<tr>
<td>Labor Market</td>
<td>Deregulated</td>
<td>Coming down from heavy regulation</td>
</tr>
<tr>
<td>Labor turnover</td>
<td>35%-40%</td>
<td>10%-15%</td>
</tr>
<tr>
<td>Academic Earnings</td>
<td>Highest in world, skew</td>
<td>Modest, with wage compression</td>
</tr>
<tr>
<td>Patenting / academic</td>
<td>6 %</td>
<td>5-7%</td>
</tr>
</tbody>
</table>
General Methodology

• Lots of things vary between Sweden and the U.S.
• We try to difference those out
• Entrepreneurship rates: Difference-in-Difference
  – Rate of entrepreneurship by academics (a)
  – Rate of entrepreneurship by non-academics with similar Ph.D.’s (b)
  – Difference between (a/b) between U.S. and Sweden
• Earnings: Triple Difference-in-difference
  – Earnings by academics (a)
  – Earnings by same academics after becoming entrepreneurs (b)
  – Earnings by non-academics with similar Ph.D.’s (c)
  – Earnings by same non-academics after becoming entrepreneurs (d)
  – Difference between (a/b) – (c/d) between U.S. and Sweden
Data

• **Statistics Sweden Register data**
  • *All individuals* with a Ph.D. in STEM (Medicine, Natural Science or Engineering) who during 1999-2008 were employed at a Swedish university. Removed all above 60 years of age.
    – 278 individuals *leaving* a Swedish university to become *full-time* entrepreneurs.
  • Add those who left academia to work full-time for a new small company (<10 employees) founded in the year they left academia
    – Add 200 individuals
    – 25% of these were verified owners of the firms they worked in
• 2,720 year-observations

• **U.S. SESTAT survey data**
  • 322 similarly defined STEM individuals making the transition
  • **Differences across countries have to be done with t-tests**
Variables

• Annual income from the Swedish tax register. Survey self-reported income from U.S. SESTAT
  – Wages, business earnings
• Employed at university, or employed by themselves / own a business and work full-time there
• Socio-demographic background; field of Ph.D., foreign born, gender, marital status, years since Ph.D., years at last employer, tenure-track position
• University quality: [R&D intensity (R&D/employee) or NRC score]
### RESULTS: Entry into Entrepreneurship

<table>
<thead>
<tr>
<th>Measure</th>
<th>U.S.</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-annual non-academic entrepreneurship rate</td>
<td>4.0%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Bi-annual academic entrepreneurship rate</td>
<td>0.9%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Relative entry rate</td>
<td>25%</td>
<td>44%</td>
</tr>
</tbody>
</table>
### Linear Probability of Entrepreneurship

<table>
<thead>
<tr>
<th>Panel logit</th>
<th>USA</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicine</td>
<td>.008** (.004)</td>
<td>-.006** (.002)</td>
</tr>
<tr>
<td>Engineering</td>
<td>.009*** (.003)</td>
<td>-.009** (.002)</td>
</tr>
<tr>
<td>Foreign born</td>
<td>-.004** (.002)</td>
<td>-.004** (.002)</td>
</tr>
<tr>
<td>Male</td>
<td>-.004* (.002)</td>
<td>.000 (.002)</td>
</tr>
<tr>
<td>Married</td>
<td>.001 (.002)</td>
<td>.003** (.001)</td>
</tr>
<tr>
<td>Years Experience</td>
<td>.002*** (.000)</td>
<td>.003** (.002)</td>
</tr>
<tr>
<td>Years last employer</td>
<td>-.002*** (.000)</td>
<td>-.005** (.002)</td>
</tr>
<tr>
<td>Tenure track=1</td>
<td>-.021*** (.003)</td>
<td>N/A</td>
</tr>
<tr>
<td>Log(wage)t-1</td>
<td>-.002 (.001)</td>
<td>-.008** (.002)</td>
</tr>
<tr>
<td>University quality</td>
<td>-.003*** (.001)</td>
<td>.003** (.001)</td>
</tr>
<tr>
<td>No observations</td>
<td>29,652</td>
<td>68,746</td>
</tr>
</tbody>
</table>

**significant at 1% level, * significant at 5% level.
PRELIMINARY RESULTS

Private Returns Estimation

• Difference individual-fixed estimator on sample who become entrepreneurs

\[ y_{it} = \alpha + E_{it}(\beta + \delta X_{it}) + \theta_i + \tau_t + \varepsilon_{it} \]

- \( E = 1 \) for years when entrepreneur, =0 else
- \( \gamma \) log(earnings)
- \( X \) covariates
- \( \theta \) individual-fixed effects
- \( \tau \) time-fixed effects

• Estimate the effect of covariates on the *difference in income* between entrepreneurship and employment *for a given individual*

• Since we cannot put both samples together, we compare estimates of \( \beta \) across the two samples, and \( \beta \) for academic entrepreneurs with \( \beta \) for Ph.D.’s *not* originating from university employment
Log(Earnings) Density

Negative earnings comparison
Log(Earnings) Density

prior to moving for those who move versus those who stay

Stayers are on average better paid
Log(Earnings) Density before and after moving only for those moving
## Returns to Academic Entrepreneurship

<table>
<thead>
<tr>
<th>Fixed effects panel data OLS</th>
<th>USA</th>
<th>USA</th>
<th>Sweden</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneur</td>
<td>-0.151** (0.077)</td>
<td>-0.333 (0.574)</td>
<td>-0.097* (0.026)</td>
<td>-0.031 (0.131)</td>
</tr>
<tr>
<td>Ent*Medicine</td>
<td>0.381 (0.274)</td>
<td>-0.110 (0.123)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Engineering</td>
<td>0.260 (0.269)</td>
<td>-0.102 (0.090)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Foreign born</td>
<td>0.493*** (0.207)</td>
<td>-0.343** (0.160)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Male</td>
<td>0.071 (0.247)</td>
<td>-0.092 (0.097)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Married</td>
<td>0.149 (0.206)</td>
<td>-0.009 (0.097)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Years Experience</td>
<td>-0.040*** (0.012)</td>
<td>-0.006 (0.006)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Years at last employer</td>
<td>0.018 (0.019)</td>
<td>0.0022 (0.023)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Tenure Track</td>
<td>0.048 (0.235)</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*University Quality</td>
<td>0.101 (0.162)</td>
<td>0.068 (0.064)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number observations 1,016 605 2,578 2,578

**significant at 1% level, * significant at 5% level.
Next step

• Use coarsened exact matching to reduce potential imbalance in covariates between entrepreneurs and the control group

• Estimate $y_{it} = \alpha + E_{it}(\beta + \delta X_{it}) + A(\gamma + lE_{it}) + \theta_i + \tau_t + \varepsilon_{it}$

• Test against omitted variable bias
# Main Results

<table>
<thead>
<tr>
<th>Measure</th>
<th>U.S.</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bi-annual academic entrepreneurship rate</td>
<td>0.9%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Bi-annual non-acad. entrepreneurship rate</td>
<td>4.0%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Relative entry rate</td>
<td>25%</td>
<td>44%</td>
</tr>
<tr>
<td>Earnings difference academics to entr</td>
<td>-15.1%</td>
<td>-9.7%</td>
</tr>
<tr>
<td>Earnings difference non-academics to entrepreneurs</td>
<td>-16.0%</td>
<td>-12.1%</td>
</tr>
<tr>
<td>Two-year failure rate</td>
<td>40%</td>
<td>46%</td>
</tr>
<tr>
<td>Non-academic failure rate</td>
<td>n.a.</td>
<td>32%</td>
</tr>
<tr>
<td>Percent returning to academia</td>
<td>33%</td>
<td>61%</td>
</tr>
</tbody>
</table>
Summary of Findings

• There is a higher relative rate of entry into entrepreneurship by academics in Sweden than in the U.S.

• For academics, entrepreneurship does not pay well
  – Returns between 10% to 15% lower than staying employed
  – Income risk is three times higher

• Academics in less attractive employment positions are more likely than others to become entrepreneurs...
  – with lower wage, and not on tenure track position

• ...but fare equally well in entrepreneurship

• Entrepreneurship spells are very short
  – over 40% exit within two years
  – many – in particular in Sweden – return to academia
Inferences

• The market for academic entrepreneurship seems privately risky, but liquid and highly mobile
• Professors respond to economic incentives
• Signs of over-entry in both the U.S. and Sweden?
  – Financial encouragement of academic entrepreneurship beyond existing efforts needs to make plausible substantial social returns
• In both countries there is selection from the bottom of the ability distribution
  – Stimulating younger, tenure-track academics should produce greater marginal benefits for society than general incentives for all academics
• Consulting and advisory roles may be more efficient than full-time efforts
Policy Advice

• Abolishing the Professor’s Privilege in Sweden would likely lead to less – not more – academic entrepreneurship

• Consider improving the screening process to support fewer academic entrepreneurs but with higher quality projects, or more loose affiliations (not full-time) to business

• Do not expect great economic outcomes from academic entrepreneurs
EXTRA
Returns to non-Academic Entrepreneurship

<table>
<thead>
<tr>
<th>Fixed effects panel data OLS</th>
<th>USA</th>
<th>USA</th>
<th>Sweden</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrepreneur</td>
<td>-0.160**</td>
<td>(0.027)</td>
<td>-0.121***</td>
<td>(.026)</td>
</tr>
<tr>
<td>Ent*Medicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Foreign born</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Married</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Years Experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Years at last employer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*Tenure Track</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ent*University Quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number observations</td>
<td>1,650</td>
<td></td>
<td>1,943</td>
<td></td>
</tr>
</tbody>
</table>

Legend: **significant at 1% level, * significant at 5% level.
What are the private benefits?

• The private returns to entrepreneurship turn out to be negative, between -5% to -15% per year (e.g. Hamilton, 2000; Woodward and Hall, 2013)
  – People would be better off remaining employed