Technology Transfer from Spark to Fire

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Contents

• Why be concerned with technology transfer?
• Some ‘basics’ in U-I technology transfer
• The ‘best’ in U-I technology transfer
• What does it take?
• The Inland Northwest
• Start-up companies
• Conclusions
Why do we want to know the link between university research and the local economy?
Importance of university research

  – 11% of new products & 9% of new processes could not have been developed without university research
  – additional 8% of new products & 6% of new processes could have been developed but would have been much more expensive
  – Time lag from academic research and first commercial introduction of new product/process: 7 years
Importance of university research

- Silicon Valley, US
- Route 128, US
- Research Triangle Park, US
- Cambridge, UK
- Göthenborg, Sweden

➔ The ultimate questions:
Can this be duplicated? And if so, how?
And, what about our region?
University-industry technology transfer
University-industry technology transfer

Innovation

Technology transfer

Economic geography

University-industry technology transfer and impact on regional economy

Technology Transfer from Spark to Fire
Effects on the (local) economy

University effect on local economy

Expenditure effect

Knowledge effect

Indirect effect

Impact on location choice of high technology companies

Impact on spatial distribution of high technology production

Impact on spatial pattern of industrial R&D

Direct effect

Impact on local process of innovation
The ‘funnel’

Research expenditures

Invention disclosure

Patent applications

Technology licenses executed

Technology licenses yielding income

Start-up companies

Technology royalties

Jobs

Wealth
The ‘cost’

AUTM (2000): included 190 institutes

- $29.5 billion in research expenditures ($155 million/institute)
- 13,032 invention disclosures (1 per $2.3 million)
- 6,375 new patent applications (1 per $4.6 million)
- 3,764 patents issued (1 per $7.8 million)
- 4,362 licenses/options executed (1 per $6.8 million)
- 454 start-ups formed (1 per $65 million)
- License income $1.26 billion ($140K per license)
<table>
<thead>
<tr>
<th>University</th>
<th>FY 2000 R&amp;D (rank out of 589)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EWU</td>
<td>$ 2.1 million (356)</td>
</tr>
<tr>
<td>UI</td>
<td>$ 61.3 million (126)</td>
</tr>
<tr>
<td>WSU</td>
<td>$ 104.8 million (93)</td>
</tr>
<tr>
<td>PNNL</td>
<td>$ 520.5 million</td>
</tr>
<tr>
<td>U WI-Madison</td>
<td>$ 554.4 million (1)</td>
</tr>
<tr>
<td>U of Washington</td>
<td>$ 529.3 million (4)</td>
</tr>
<tr>
<td>Average top-100</td>
<td>$ 243.1 million</td>
</tr>
</tbody>
</table>
The ‘best’ in tech transfer: Silicon Valley - Stanford

- Patents filed for appr. 50% of cases. 30% leads to a license
- However of 385 inventions that produced income in ‘02
  - only 42 (11%) produced income over $100,000
  - only 7 (1.8%) produced income over $1 million
- Since 1969, only 31 cases have generated $1 million + in cumulative royalties
- Only 1 in 4850 (0.02%) was a big winner
Great performance:
- In 1997: appr. 4,000 MIT related companies employed 1.1 million people
- Annual world sales of $232 billion
- Appr. 150 new MIT-related companies founded each year

However:
- Only 17 (0.4%) had employment of 10,000 or more together employing 732,000 workers and sales of $159 billion
- 106 (2.5%) largest companies (> 1,000) represent nearly 90% of total sales and employment.
- 0.6% of active licenses generated more than $1 million in revenue in FY2000
What does it take to have a local effect?
Local impact

- Varga (1998) on innovation elasticity (the cost to produce one extra local innovation)
  - Tier 1 city: $ 5.1 million
  - Tier 2 city: $ 11.5 million
  - Tier 3 city: $ 49.2 million
  - Tier 4 city: $ 889 million
Local impact

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  ➔ Spokane is identified as “tier 4”
  ➔ Seattle is identified as “tier 1”
Local impact

• Varga (1998): intensity of university technology transfers depends on certain agglomeration factors
  – concentration of high technology production
  – presence of business services
  – relative importance of small firms in the area’s economy
• “critical mass”: to put university research expenditures to work for the regional economy a typical city needs:
  – size of city: around 1 million
  – local university enrollment: about 32,000
  – employment in R&D laboratories: appr. 2,100
  – employment in production facilities: appr. 43,000
  – employment in business service firms: appr. 22,000
The Inland Northwest
STC benchmarks

• **Input**
  – U.S. patent applications for a given year
  – U.S. patents awarded for a given year

• **Output**
  – The total number of licenses/options in effect
  – The license revenue for a given year

• **Economic impact**
  – Total number of licenses in effect **in-state**
  – Total number of licenses in effect to **start-ups**
  – License revenue from **in-state** companies
  – **Start-up** companies formed in a particular year
Note: this is ‘statistics’

Statistics are like a bikini. What they reveal is suggestive but what they conceal is vital.

Aaron Levenstein
Research expenditures

NSF ’00: $243
NSF ’02: $292
(avg. top-100)

NSF ’00: $75
NSF ’02: $90
(avg. top-400)

AUTM ’00: $155
AUTM ’03: $205
(average)

UW ’00: $529
Research expenditures

Figure 22: Industry Sponsored R&D as Percentage of Total R&D

Percentage

EWU
UI
WSU
PNNL

Year

1998 1999 2000 2001 2002

AUTM ’00: 9.1%
AUTM ’03: 7.4%
(UW ’00: 6.5% average)
Figure 13. Input Benchmark 1a:
Ratio of U.S. Patent Applications Filed per Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Patent applications per $10 million R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>5.0</td>
</tr>
<tr>
<td>1999</td>
<td>2.0</td>
</tr>
<tr>
<td>2000</td>
<td>3.5</td>
</tr>
<tr>
<td>2001</td>
<td>4.5</td>
</tr>
<tr>
<td>2002</td>
<td>2.5</td>
</tr>
<tr>
<td>2003</td>
<td>2.0</td>
</tr>
</tbody>
</table>

STC '98: 1.9
AUTM '98: 2.6 (medians)
AUTM '00: 2.16 (average)
AUTM '03: 2.06
UW '00: 1.67

“Producing” patents (input)
“Producing” patents (input)

Figure 14. Input Benchmark 2a: Ratio of U.S. Patents Awarded per Year

STC ’98: 0.9
AUTM ’98: 2.6
(medians)
AUTM ’00: 1.28
AUTM ’03: 1.02
(average)
UW ’00: 0.90
“Producing” licenses (output)

Figure 15. Output Benchmark 1a:
Ratio of Active Licenses per Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Active licenses per $10 million R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>6.6</td>
</tr>
<tr>
<td>1999</td>
<td>5.8</td>
</tr>
<tr>
<td>2000</td>
<td>5.2</td>
</tr>
<tr>
<td>2001</td>
<td>5.6</td>
</tr>
<tr>
<td>2002</td>
<td>6.7</td>
</tr>
<tr>
<td>2003</td>
<td>6.7</td>
</tr>
</tbody>
</table>

STC ’98: 3.0
AUTM ’98: 5.5
(Averages)
AUTM ’00: 7.1
AUTM ’03: 6.7
(UW ’00: 7.7)
Figure 16. Output Benchmark 2a: Ratio of License Income per Year

License income as percentage of R&D expenditure

Year

1998 1999 2000 2001 2002 2003

EWU UI WSU PNNL

STC ’98: 0.4%
AUTM ’98: 0.8% (medians)
AUTM ’00: 4.3%
AUTM ’03: 3.4% (average)
UW ’00: 4.65%
In-state licensing (impact)

Figure 17. Economic Impact Benchmark 1a: Ratio of In-state Licenses in Effect

- STC ’98: 13.5%
- AUTM ’98: N.A. (medians)
- AUTM ’00: N.A.
- AUTM ’03: N.A. (average)
- UW ’00: N.A.
Start-up licensing (impact)

Figure 18. Economic Impact Benchmark 2a: Ratio of Start-up Licenses in Effect

- STC '98: 4.2%
- AUTM '98: N.A. (medians)
- AUTM '00: N.A.
- AUTM '03: N.A. (average)
- UW '00: N.A.
In-state license income (impact)

Figure 19. Economic Impact Benchmark 3a: Ratio of License Income from In-state Licensees

In-state license income as percentage of all license income

EWU  
UI  
WSU  
PNNL

Year

1998 1999 2000 2001 2002 2003

STC ’98: 0%
AUTM ’98: N.A. (medians)
AUTM ’00: N.A.
AUTM ’03: N.A. (average)
UW ’00: N.A.
“Assisting” start-ups (impact)

Figure 20. Economic Impact Benchmark 4a: Ratio of Start-up Companies Formed per Year

STC ’98: 0.01
AUTM ’98: 0.28 (medians)
AUTM ’00: 0.15
AUTM ’03: 0.10 (average)
UW ’00: 0.09

Start-up companies per $10 million R&D expenditures

EWU
UI
WSU
PNNL

Year
Emphasis on start-ups (impact)

Figure 21: Percentage of New Licenses Awarded per Year to Start-up and Small Companies

Year

EWU
UI
WSU
PNNL

Percentage of companies that are start-ups or small companies

0%
10%
20%
30%
40%
50%
60%

1998 1999 2000 2001 2002 2003

STC ’98: N.A.
AUTM ’98: N.A.
(medians)
AUTM ’00: 66%
AUTM ’03: 66%
(average)
UW ’00: 79%
Local start-up companies
Local start-up companies

- GenPrime (EWU)
- Quantum Northwest (EWU)
- Advanced Hardware Architecture (UI)
- Blue Water Technologies (UI)
- Pacific Northwest Biotechnologies (WSU)
- Fruitgard (WSU)
- Innovatek (PNNL)
- SafeView (PNNL)
Conclusions
Conclusions

• INW universities have below average R&D expenditure
• INW universities have below average industry supported R&D
• Input benchmarks; on average
  – INW institutes have below average patent application ratio
  – INW institutes have below average patent awarded ratio (except WSU)
Conclusions

• Output benchmarks; on average
  – INW institutes have below average (AUTM) active licenses ratio
  – INW institutes are considerably below average license income ratio

• Economic impact benchmarks (limited data)
  – UI and WSU are considerably above average for in-state licensing in effect ratio
  – UI and PNNL do well on ratio of start-up licenses in effect
  – UI and PNNL do well on license income ratio from in-state
  – UI does reasonably well on ratio of start-up companies formed per year
Conclusions

- So generally:
  - Not enough money invested in R&D
  - The money that is invested is turned into too few patents
  - The money that is invested is turned into too few licenses with too little income
- For specific regional effects:
  - EWU, in line with its emphasis, plays hardly a role
  - UI is generally performing ‘the best’
  - WSU produces in-state licenses but not much in-state license income and does not emphasize start-up companies
  - PNNL has “good” ratio of start-up licenses in effect, licensing to small companies and in-state license income
Conclusions

• Problems:
  – We don’t have a ‘critical mass’
  – Distribution of universities in state
  – Resources in technology transfer offices
  – Awareness (companies and faculty)
  – Absorptive capacity of local industry

• In general, it requires three parties that need to be aligned
Conclusions

Generation of knowledge

Technology transfer

Application of knowledge
Where to go from here?
Where to go from here?

- This study is limited in its scope and its measuring instrument
- Now we need to find out “what is behind the bikini?”
  ➔ Move to the WHY and HOW
- Focus on other types of technology transfer
  ➔ there are many, e.g. cooperative research centers, incubators
- Focus on other measures of technology transfer
- Focus on EWU peers
- Look at start-up companies ➔ 2nd part of the study
- Potential use of patent donations
Questions & comments?

Full report available at:
http://www.cbpa.ewu.edu/IPPEA/Monograph_8.pdf