Institute for Research on Innovation & Science (IRIS)

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In 2014, our society invested $214 on academic research for every man, woman, and child in the country

- We make those investments to develop human knowledge and to improve quality of life and well being.
- How do we understand, explain and improve those effects?
"I think you should be more explicit here in step two."

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2.03 - 6.24
\[ \frac{2 \times 5}{56} \]

Then a miracle occurs...
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\frac{0.0651}{\text{ms}} \times \frac{4.0 \times 345}{17}
```

Framework

Science Investments → Universities → Discovery Learning Dissemination → Knowledge, People, Skills → Hiring, Spending → Jobs Stimulus → Innovation Entrepreneurship Economic Growth Public Health Food Safety Security (More) Rational Policy ...

Framework
Background

- Recession & Stimulus
- Federal STAR METRICS (Level 1) Program
- CIC/UMETRICS Pilot Project
- Institute for Research on Innovation and Science (IRIS)
  - Founded 01/01/2015
  - Core facility at University of Michigan
  - Seed funding for infrastructure from Sloan & Kauffman
  - Significant research funding from NSF, NIH, USDA, SBA
  - 56 member institutions committed now
  - 3 year goal = 150 (~93% of federal R&D spending, ~85% of doctorate grants)

PI Team: Julia Lane (NYU), Jason Owen-Smith (Michigan), Bruce Weinberg (Ohio State), Ron Jarmin (U.S. Census)
MEMBERS: Universities contribute data, support infrastructure and receive campus-specific and aggregate reports

NODES: Approved nodes materially improve data, develop products, and expand user communities

USERS: Approved users securely access de-identified aggregate datasets

PARTNERS: Approved partners receive data from IRIS which they improve and make accessible through their own secure systems
“Wrapping it up in a person: Tracing flows from funded research into the economy using linked administrative records.” *Science*. 350:1367-1371


# Placements by Sector & Location

Table 1. Postgraduation employment of UMETRICS doctoral recipients who were paid by research grants and left the university between 2009 and 2011. The national workforce distribution is calculated from all employment in all establishments covered by the Census’s LBD between 2010 and 2012.

<table>
<thead>
<tr>
<th>Locale and small</th>
<th>Industry</th>
<th>R&amp;D firms</th>
<th>Non-R&amp;D firms</th>
<th>Academia</th>
<th>Government</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placed within sector</td>
<td></td>
<td>17.0</td>
<td>21.7</td>
<td>57.1</td>
<td>4.1</td>
<td>100.0</td>
</tr>
<tr>
<td>National sample (M)</td>
<td></td>
<td>10.8</td>
<td>75.0</td>
<td>10.7</td>
<td>3.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Of those in sector, percent placed:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within 50 miles</td>
<td></td>
<td>10.1</td>
<td>23.5</td>
<td>8.9</td>
<td>18.2</td>
<td>12.7</td>
</tr>
<tr>
<td>Within state</td>
<td></td>
<td>16.6</td>
<td>36.0</td>
<td>18.0</td>
<td>25.8</td>
<td>22.0</td>
</tr>
</tbody>
</table>
Figure 1. UMETRICS Doctoral Recipients are placed at establishments that are larger and have higher payrolls per worker.
### Most overrepresented industries

<table>
<thead>
<tr>
<th>Industry Description (4 digit NAICS codes)</th>
<th>All U.S. Employers</th>
<th>Doctoral Recipients</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical and Electronic Goods Merchant Wholesalers</td>
<td>0.44%</td>
<td>6.67%</td>
<td>6.22%</td>
</tr>
<tr>
<td>Computer Systems Design and Related Services</td>
<td>1.32%</td>
<td>6.19%</td>
<td>4.87%</td>
</tr>
<tr>
<td>Architectural, Engineering, and Related Services</td>
<td>1.16%</td>
<td>5.95%</td>
<td>4.79%</td>
</tr>
<tr>
<td>Semiconductor and Other Electronic Component Manufacturing</td>
<td>0.26%</td>
<td>4.05%</td>
<td>3.79%</td>
</tr>
<tr>
<td>Pharmaceutical and Medicine Manufacturing</td>
<td>0.21%</td>
<td>3.33%</td>
<td>3.12%</td>
</tr>
<tr>
<td>Navigational, Measuring, Electromedical, and Control Instruments Manufacturing</td>
<td>0.36%</td>
<td>3.33%</td>
<td>2.98%</td>
</tr>
<tr>
<td>Management of Companies and Enterprises</td>
<td>2.71%</td>
<td>5.00%</td>
<td>2.29%</td>
</tr>
<tr>
<td>Basic Chemical Manufacturing</td>
<td>0.14%</td>
<td>2.38%</td>
<td>2.24%</td>
</tr>
<tr>
<td>Aerospace Product and Parts Manufacturing</td>
<td>0.32%</td>
<td>2.38%</td>
<td>2.06%</td>
</tr>
<tr>
<td>Other Information Services</td>
<td>0.16%</td>
<td>2.02%</td>
<td>1.86%</td>
</tr>
</tbody>
</table>

Earnings Distributions

(a) All Sectors
(b) Government & Academia
(c) Other Sectors

Source: UMETRICS linked to 2010 Census, ProQuest, LEHD, W2, LBD, BR, and iLBD. 
Note: Sample includes STEM students in the 2007–2010 graduating cohort. Wages are in 2012 dollars and are from one year following graduation or leaving the university payroll, whichever was later. The tails of the k-density plots and the bandwidth size are not displayed to satisfy confidentiality requirements.
High Level Findings

• Women make 31 cents less per dollar at first job than men
• The effect disappears when controlling for the presence of dependent children in the house

Significant implications for how universities might support graduate students and post-docs.
“The Link Between R&D and Entrepreneurship”

Working paper.

N. Goldschlag, R. Jarmin, J. Lane, N. Zolas

NSF grant 1535399 (EHR Core Research DGE) “STEM Training, employment in industry, and entrepreneurship”
• Preliminary findings from work in progress
• Introduce new measures of human capital – research training, extended with machine learning
• Investigate human capital composition of startups
• Findings: doubling research trained workforce
  – 8.7% increase in survival
  – 24.6% increase in high growth
• Next steps
  – Additional robustness, linking to productivity, explore mechanisms
IRIS data allow observational experiments that can directly . . . [track] how scientific training affects career trajectories and returns to industry.
IRIS Data Release

• 19 universities
  – $11B in 2014 federal R&D (16% of total)
• Transaction level data
  – 162,694 federal and non-federal sponsored projects
  – 333,565 individuals
    • 28,641 Post-Docs
    • 76,295 Grad Students
    • 87,195 Undergrads
  – $18.1B in vendor spending to 441,796 establishments
  – $6B in subcontracts to other performers
• Links to abstracts etc for federal awards (NIH, NSF, USDA)
• Individual level links to patent and dissertation information
• Title 13 crosswalks to LEHD, LBD, ACS, Decennial Census
  (available only through the FSRDC system)
As IRIS expands

- More campuses mean more fine grained reporting & better research
- First research data release February 15, 2017
- Longer time frame, trustworthy trend data
- Detailed information on research outcomes
- Pilot work underway with undergraduate data
- Pilot study in collaboration with MICHR (Michigan CTSA)
- An administrative data facility to examine scientific training, career and workforce outcomes
Future Directions

• Undergraduate data pilot
  – University of Michigan, University of California System, University of Texas System
  – ~1.5 million enrolled students across 27 campuses
  – Linking to Census Data
  – Availability of highly detailed course and educational data
  – Marrying Learning Analytics with IRIS
Probing Impact of Research Experiences on Retention and Persistence at University of Michigan

Student Record Data
- Transcript
  - Research for credit
- Major
- Admission portfolio
- Demographic information

F2002-2014: 93,350 students
Data assembled: 12,006 students enrolled in research course

Federally Funded Research Records
- Payroll
- Grant account
- Job title
- Proportion of earnings

2002-2014: 49,487 personnel
Data assembled: 9,130 students paid on grant

Data consolidated:
- 18,720 students had “research experience”
- 2,416 students had both “research experiences”
93,350 enrolled students

12,006 (12.9%) took a research class

9,130 (9.8%) paid on a grant

2416 (2.6%) did both

87.2% (2105) of students who did both took the class FIRST

Source: University of Michigan administrative data

All undergraduates enrolled from fall 2001 to winter 2014 who were employed on a federal grant.
<table>
<thead>
<tr>
<th><strong>Undergraduates (Fall 2001- Winter 2014)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered for classes</td>
</tr>
<tr>
<td>Coded as Freshmen</td>
</tr>
<tr>
<td>Taking classes</td>
</tr>
<tr>
<td>Classes before Winter 2010</td>
</tr>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Black</td>
</tr>
<tr>
<td>Hispanic</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>Other race race</td>
</tr>
<tr>
<td>International student</td>
</tr>
<tr>
<td>Low income</td>
</tr>
<tr>
<td>In state</td>
</tr>
<tr>
<td>ACT composite score</td>
</tr>
<tr>
<td>GPA</td>
</tr>
</tbody>
</table>
Start school at UM

87% Male: 90%, Female 83%

Take STEM first year

31% Male: 43%, Female 19%

Declare STEM major

97% Male: 97%, Female 96%

Graduate in STEM