New Ways to Measure Innovation and Diffusion

Nathan Goldschlag[*], Ron Jarmin[*], Julia Lane[†], and Nikolas Zolas[*]

1. Introduction

This paper describes new data and new analyses that unpack two mechanisms for potentially measuring the diffusion of knowledge from research to the market. The first is the links of students and faculty working on university research projects to the startup, productivity and growth of businesses that they join (*1*). The second is the role of research purchases in transmitting research-based knowledge about cutting edge techniques to firms producing scientific machinery and services.

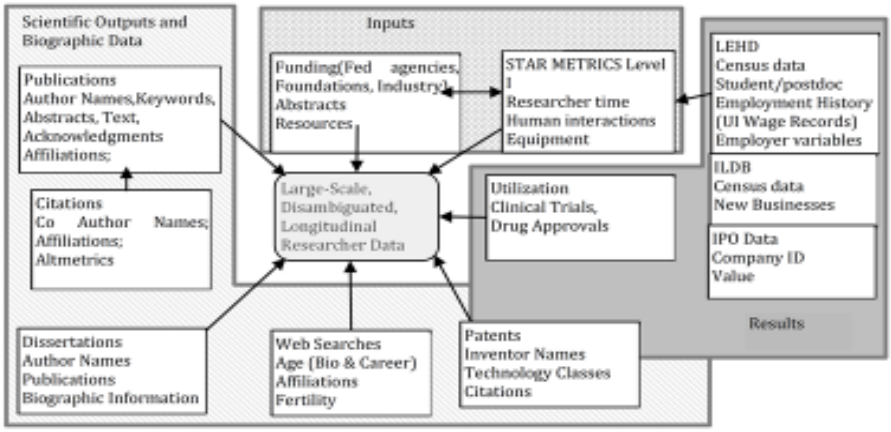
The conceptual framework for the person transmission is straightforward. Undergraduate students, graduate students, and postdoctoral fellows employed as part of scientific projects obtain valuable training while at the same time creating new knowledge that can be transmitted to their employers once their training is complete. The gains that result from their application of knowledge gained through research training accrue to both the employing firm and the workers. Researchers create new ideas that either directly generate new businesses or are transmitted through social and scientific networks to the private sector. Propinquity is a major driver of these effects (2).

The second transmission mechanism is the purchases of high tech research intensive equipment. Fifty years ago, Chris Freeman argued customers were key to firm innovation; von Hippel (3). University researchers are important customers of R&D performing firms. In life sciences, for example, about 8% of R&D funds are directly spent on equipment while core research expenditures are likely to be much more(4) – and universities are more likely to buy than to make their inputs (5). We also know that innovation depends not just on technical knowledge, but also on the knowledge of customers, market segments and potential applications(6). The literature suggests that physical closeness is an important source of this knowledge (2), particularly for small and young firms which are beginning to establish customer ties.

Much of the existing literature on the linkages examines data that aggregates research activity to the university level and business activity to the zip code or county level. The data we describe in this project allows for examination of the impacts of university research at a much more granular level. This project leverages university administrative records from the UMETRICS program, hosted at the Institute for Research on Innovation and Science (IRIS) at the University of Michigan. The UMETRICS data consist of employee and vendor transactions associated with research grants[1]. Shown in Figure 1, these data exist as part of data infrastructure on university led innovation that includes links to grant information, patent data, and bibliometric data.

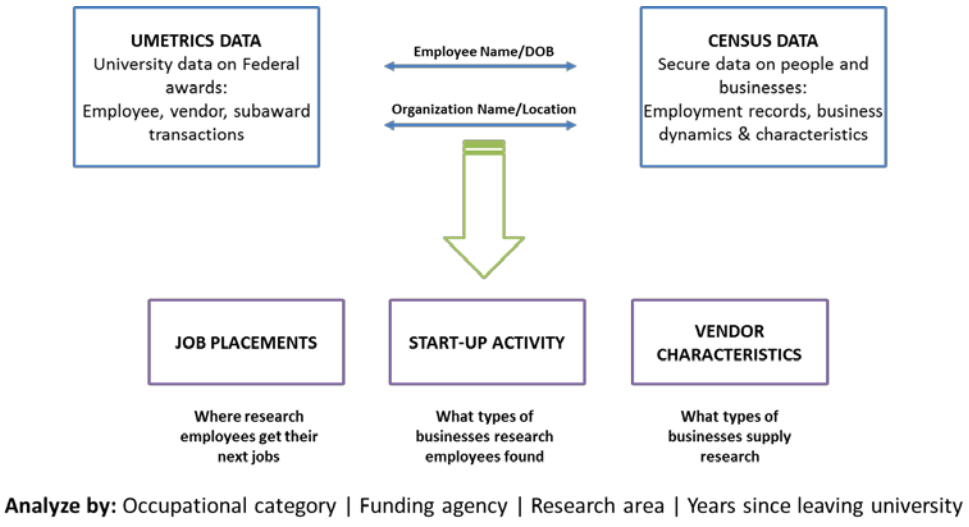
[*] Center for Economic Studies, U.S. Census Bureau
[†] New York University
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[1] For more information, see http://iris.isr.umich.edu

Figure 1: The overall data infrastructure of UMETRICS



Currently, IRIS counts 25 research universities in its membership, with a forecasted membership of 150 by the end of FY2017. The version of data used in this project contains 11 universities (Ohio State University, Penn State, Purdue, Michigan State, and the Universities of Arizona, Hawaii, Illinois (Urbana-Champaign), Iowa, Kansas, Michigan, and Missouri). These universities account for more than $6.5B in Federal R&D expenditures in 2012 and cover nearly 75,000 researchers and more than 67,000 vendors. The data are transferred, processed, and cleared at IRIS before being transferred to the Census Bureau. Once at Census, the UMETRICS data undergoes a series of processing steps at the individual and business level to allow micro-level linkage to Census data assets. The steps are summarized in Figure 2 below.

Figure 2: The Census matching approach



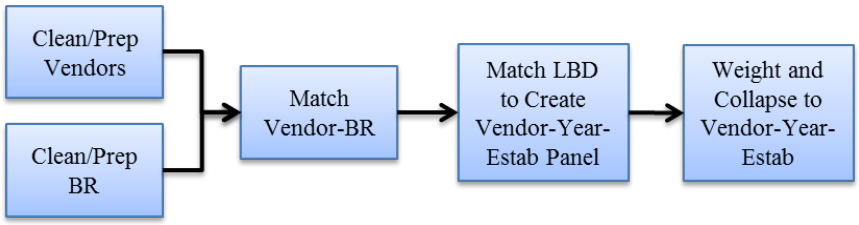
Once the data have been merged and linked, we are interested in the outcomes of the UMETRICS researchers after they exit the institution and the outcomes of the firms that hire these same researchers. Specifically, we target the employment and earnings outcomes of the individuals by identifying cross-sectional differences in industry, geography and firm characteristics (e.g. large versus small, old versus new, etc…) across these individuals. The patterns of diffusion reveal the sectors, locations and firm-types that hire these talented individuals with highly specialized

backgrounds and the key areas of the economy where knowledge diffusion takes place. We continue to track the movements of these individuals by assessing their earnings growth and transitions into other firms. In addition, we track the outcomes of the firms that make these hires. We look at their employment and sales growth, along with innovation in the form of R&D expenditures and patents.

Another key measure that we focus on looks at the start-up activity of these individuals. Combining the Integrated Longitudinal Business Database (iLBD), which consists of non-employer and self-employed businesses, and Longitudinal Business Database (LBD), we identify the new businesses that former university researchers begin as well as the start-up businesses that hire former researchers.

Finally, the UMETRICS data captures transaction level information on the supply of goods and services purchased with research funding. The business name and address associated with each transaction are provided in the data and are cleaned, matched to the BR in order to create an unbalanced vendor-year-establishment panel using the LBD (see Figure 3).

Figure 3: Vendor Match Flow



These data allow us to assess the impact to the firm before/after supplying goods and services for university research.

To summarize, our study combines unique administrative data collected by universities which are then linked to Census data to track the outcomes of the individuals and firms directly involved in academic research. Our paper highlights how knowledge and innovation diffuses from the university into the broader economy.

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