

## Application for NBER Economics of Digitization Tutorial

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### **Course of Study**

As a graduate student in Economics at Stanford University, I have focused my coursework to support my research interests on the organizational economics of innovation and technology. Through a course taught by Petra Moser, I began investigating how open source and creative commons licensing had transformed the design of incentives for innovative work. The study of licensing for novel technologies built on the tools that I had developed through more traditional classes on incentive design, such as Contracts. Since the progenitors of innovation are employees of firms and institutions, I completed classes in Labor Economics and Personnel Economics in an effort to understand how employment configurations create environments conducive to innovative activity.

Much of my research proceeds by developing structural models that can be estimated or tested empirically. Because this often requires careful consideration of the methods of inference, I supplemented the standard empirical econometrics courses by taking an Advance Econometrics class on nonparametric and semi-parametric analysis and inference. Additionally, a course on Economic Network Analysis provided me with tools for thinking about the social and economic networks that are prevalent in many online and mediated markets.

I have also participated in courses related to my interests at Stanford's Graduate School of Business as well as the Department of Management Science & Engineering. This past quarter, I served as a grader for Susan Athey's course, Management Economics 513: Platform Competition in Digital Markets.

### **Research Interests**

My research interest focuses on how organizations design incentives for producing innovative activity. For example, this summer I published an NBER book chapter with co-authors Richard B. Freeman and Ina Ganguli on the formation and configuration of international collaborations on research in three prominent scientific fields. Despite the advent of Internet based telecommunication technologies, such as Skype, that enable easier collaboration across geographies, the formation of innovative research teams predominantly occurred through in-person meetings. Through extensive surveying of 3,925 researchers in the fields of Particle Physics, Nanotechnology, and Biotechnology, we found that the vast majority of collaborative research efforts began when the researchers were collocated.

In addition to my work on the organization of scientific and technological innovation, I have served as a research assistant for Jon Levin and Liran Einav on a project calculating the welfare impacts of entry into digital markets. We use transaction level credit card data from Visa to categorize the relative "affluence" of consumer shopping patterns online and offline. One of the striking facts that we uncovered is that while those who live in more affluent locations purchase from higher-end stores online, those who live in less affluent neighborhoods also purchase from online stores that are relatively higher-end

than the brick-and-mortar retailers they visit. In fact, the gap between the “affluence” of shoppers online retailers and brick-and-mortar retailers is much higher for consumers who physically reside in less affluent neighborhoods than those in more affluent areas. This work is related to articles by Avi Goldfarb and his coauthors. We hope that it will bring new insights into the welfare implications of online entry by firms and broadband adoption in different geographies.

### **Proposed Dissertation**

My dissertation topic and current research examines how open source software contributions have affected labor market flows for highly skilled engineers. In particular, I explore how centralized open source repositories provide a means for currently employed software developers to signal their skills and abilities to other potential employers. In turn, firms who hire software developers face a tradeoff between encouraging their employees to contribute to open source projects and the potential impact on the retention of their workers. A firm that encourages open source contributions may have an easier time hiring workers initially, but might also make risk losing those employees faster to outside raid offers.

Through a structural model of the labor market equilibrium created by the advent of open source platforms, such as GitHub, I find a series of empirically testable implications. First, firms that sponsor or encourage open source contributions can pay lower wages when hiring workers since they are committed to providing a means of allowing their workers to signal their abilities. Indeed, vacancies for positions with open source software contributions fill faster than those for proprietary projects. Second, engineers who are able to contribute to open source get promotions faster than non-contributing colleagues as they are more likely to receive outside offers from raiding firms. Third, the employment spells of open source contributors at firms are shorter relative to their non-contributing peers. Finally, open source contributing favors younger workers with thinner resumes whose abilities are more noisily imputed, and thus, who benefit the most from a transparent signaling mechanism.

In order to test for these implications of the model, I utilize a novel dataset from an online hiring and recruiting platform utilized by 300 companies. This platform enables companies to search the resumes and profiles of millions of software engineers and developers around the world in order to select workers to raid or recruit. These profiles, which include information on past open source contributions, enable me to see the durations of employment spells and how that correlates with open source contributing behavior. In addition, once candidates apply for a job vacancy, company human resource managers use the platform to organize and process the applications of those who apply, noting the candidates performance in interviews and collaborating with other hiring managers in selecting the person to make an offer. Therefore, I can observe who applies to job vacancies in software engineer, how long their vacancies remain open depending on whether or not the position allows for open source contributing, which candidates are made offers.

My dissertation committee is led by Jon Levin and Tim Bresnahan. As a fourth year graduate student, I am currently working to test for the implications of my model in this data. My goal is to complete the research for my dissertation within the coming year.