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Research Statement

In my research, I study topics in innovation and economic growth. My work has used natural language processing (NLP) to translate text records (such as patents, books, Wikipedia, earnings calls and job postings) to measure creation, implementation and adoption of technologies. I have combined these measures with traditional micro-data and macro computational methods to understand the factors which affect the creation of technologies, such as inventor demographics and firm-agency problems, and the macroeconomic effects when these technologies get adopted, such as on inequality.

Measuring creativity

In my job market paper "The Creativity Decline: Evidence from US Patents", I argue that the exponential increase in patents and slowdown in productivity growth over the last few decades is explained by a declining share of creative patents, partly driven by a lack of younger inventors. To separate creative from derivative patents, I develop a text-based measure of patent creativity: the share of two-word combinations that did not appear in previous patents.

Patent creativity captures a particularly important dimension of innovations for productivity and valuation. The paper documents that only creative and not derivative patents, not even citation weighted derivative patents, are predictive of improvements in productivity and market valuations at the firm level. Importantly, at every level, firm, industry or aggregate, only creative patents and not derivative patents are predictive of productivity growth.

Using the rich granularity of patent data, I investigate creativity patterns across inventors to understand reasons for the decline in creativity. I find that creativity is not evenly dispersed across innovators, and that composition of inventors is a key determinant of their creativity. In particular, I show that patents filed by new-entrants, and women and minority ethnicity authors are significantly more creative than others.

For the rest of paper, I bring all of these empirical insights together in a growth model, which puts a structure on spillovers of creative innovations and estimates aggregate productivity growth as a function of share of creative innovations. Through the lens of this model, I perform counterfactuals with changing population growth, and increasing inclusion of women and other minorities into patenting. I also investigate the role of government in boosting creativity and productivity growth.

In ongoing work, I build on my job market paper's focus on creativity by developing measures of creativity for academic papers to highlight the role of universities in the harboring creative process and subsequent commercialization of creative ideas in patents.

In related work, I also develop a methodology to identify the knowledge flows across innovators and academics using spread of creative two word combinations across countries and regions within the US. I am particularly interested in studying the role of immigration and foreign direct investment in knowledge flows.

Measuring technology diffusion

"The Diffusion of Disruptive Technologies" (with Nick Bloom, Tarek Hassan, Josh Lerner, and Ahmed Tahoun, solicited and submitted) measures the spread of disruptive technologies using textual analysis of patents, Wikipedia, job postings, and earnings calls. Our approach enables us to identify most disruptive technologies and document their diffusion across firms and labor markets in the U.S. Five stylized facts emerge from our data. First, the locations where technologies are developed that later disrupt businesses are geographically highly concentrated, even more so than overall patenting. Second, as the technologies mature and the number of new jobs related to them grows, they gradually spread geographically. While initial hiring is concentrated in high-skilled jobs, over time the mean skill level in new positions associated with the technologies declines, broadening the types of jobs that adopt a given technology. At the same time, the geographic diffusion of low-skilled positions is significantly faster than higher-skilled ones, so that the locations where initial discoveries were made retain their leading positions among high-paying positions for decades. Finally, these pioneer locations are more likely to arise in areas with universities and high skilled labor pools.

In this paper, we develop novel methodologies and results by intersecting large unstructured text datasets. One of the striking patterns seen in the analyses to date is the persistence of the original technology hubs, particularly when it comes to high-quality jobs. Behind this persistent advantage lie a complex set of interactions between firms, academia and the labor market. The success of the Boston area in biotechnology, and Silicon Valley in computers and information technology illustrates this point. The presence of academic institutions and younger firms has also attracted investments in major research facilities by established firms based elsewhere. In our follow-on work, we will explore the roles of firm and academia in these patterns by exploiting the rich corpus of academic research and the new firm-level datasets created by matching firms in patents with jobs and earnings calls.