

TIES: Selected Doctoral Theses

“Essays on the Economics of Algorithms, Markets, and Organizations”

Author: Lindsey Raymond (2024)

Committee: Danielle Li (co-chair), Sendhil Mullainathan (co-chair), Erik Brynjolfsson, Scott Stern

Abstract:

This dissertation contains three chapters that study how digitization and increasingly reliance on algorithms shapes workers, organizations, and markets. In the first chapter, I show how the digitization of public housing records leads to the entry of investors using algorithms. Digitization and entry lead to changes in equilibrium prices and allocation in the US residential real estate market. Consistent with a theoretical model of comparative advantage, I observe shifts in investment patterns for both humans and algorithmic investors and changing house prices, particularly for minority homeowners. In the second chapter, I study how hiring algorithm design shapes the effects of algorithms in the labor market. Using data from a professional services firm, I show that incorporating exploration can improve the quality of the interview screening process (as measured by eventual hiring rates), while also increasing demographic diversity, relative to the firm's existing practices. While the adoption of automated approaches to hiring is often associated with decreasing access to opportunity, we show the impact on efficiency and equity depends on algorithm design choices. In the third chapter, joint with Danielle Li and Erik Brynjolfsson, we study the staggered introduction of a generative AI-based conversational assistant using data from 5,000 customer support agents. Access to the tool increases productivity, as measured by issues resolved per hour, by 14% on average, including a 34% improvement for novice and low-skilled workers but with minimal impact on experienced and highly skilled workers. We provide suggestive evidence that the AI model disseminates the best practices of more able workers, helps newer workers move down the experience curve, and improves worker learning. Our results suggest that access to generative AI can increase productivity, with large heterogeneity in effects across workers. Together, these chapters highlight how the increasing prevalence of algorithmic decision making impacts workers, firms, and markets.

“Essays on the Production of Ideas”

Author: Soomi Kim (2023)

Committee: Danielle Li (chair), Pierre Azoulay, Scott Stern

Abstract:

Old ideas serve as critical inputs in the production of new ideas. In order to generate knowledge, innovators “stand on the shoulders of giants,” the great thinkers who came before, whose ideas serve as the foundation to build on. In this dissertation, I rely on rich empirical data in biomedical settings to identify factors that drive or hinder this cumulative process of knowledge production. The first essay focuses on how knowledge workers innovate in new domains without giants, where there are only few existing ideas to build on. Using the setting of structural biology, I explore how a new technological tool—the automation of analogical reasoning—allowed innovators to import knowledge from an adjacent domain, bypassing the need to build knowledge from the ground up. In the second essay, I turn to how institutions can shape innovative outcomes, particularly when the shoulders of giants rest on a weak foundation. I document that poor communication among different institutional parties of the patent system likely led to the prevalence of biomedical patents based on erroneous or fraudulent science, reducing incentives for innovation. Finally, in the third essay, I highlight the role of private sector polices—specifically, insurance design—in steering the direction of firms’ R&D efforts in drug development.

“Essays on the Role of Metrics in Innovation”

Author: Jane Wu (2022)

Committee: Scott Stern (chair), Pierre Azoulay, Fiona Murray

Abstract:

This dissertation consists of three essays studying the role of metrics in the process of innovation. Scientific and technical metrics are trusted as objective and consistent arbiters of knowledge, and as a result, are

typically taken as given without much question. Yet at the same time, these metrics are chosen at a given point in time under imperfect information. The motivation of this work is to understand how such metrics influence the ideas production process, and ultimately, who benefits from innovative effort. In the first essay, I define and delineate the role of metrics in innovation from other forms of quantification in organizations. I synthesize prior work to develop a typology of mechanisms that metrics can involve, highlighting how metrics are used at different junctures in the innovation process. The second essay explores the impact of introducing a new metric on the rate and direction of innovation. I study the setting of US automotive safety, finding that the introduction of the side impact dummy as a metric reduced overall fatalities but also led to disproportionate benefits for occupants similar to the metric itself. Moreover, firms responded heterogeneously, suggesting that metrics can profoundly affect the innovation trajectories of firms. In the third essay, I analyze whether it is possible to move firms away from a metric that has become a key focusing device for R&D within an industry. I use a policy shock to estimate the effects of the “removal” of watts as a metric within the domestic vacuum cleaner industry. I find that rather than investing in new metrics, firms reduced their R&D in the focal area and shifted efforts to adjacent, unregulated product areas.

“Essays on the Very Invisible College: Global Science and African Participation”

Author: Caroline Viola Fry (2020)

Committee: Scott Stern (chair), Pierre Azoulay, Ezra Zuckerman-Sivan

Abstract:

Despite globalization, innovative activities remain concentrated in a handful of high-income countries. Leveraging knowledge and resources in these locations through ties in the global network presents opportunities for emerging economies. This dissertation consists of three essays studying the role of international ties in the development of scientific capacity in sub-Saharan Africa. Each chapter helps to uncover a different feature of the way in which, and the scope by which, international ties impact African science, and ultimately facilitate technological catch-up and economic growth. Chapter 1 is an introductory chapter, and chapters 2-4 are specific research applications. Chapter 2 explores the value of international relationships to African scientists leveraging a unique opportunity afforded to some scientists to develop these relationships: the 2014 Ebola epidemic. Chapter 3 studies the spillover impact of the return home of American trained scientists to African institutions. Chapter 4 explores a macro-association between foreign knowledge stocks and African scientific productivity.

“Essays on Innovation and Uncertainty”

Author: Ankur Chavda (2019)

Committee: Scott Stern (chair), Pierre Azoulay, Shane Greenstein

Abstract:

In Chapter 1 I study how innovative firms often try out new ideas before fully investing in them as a kind of experimentation on those ideas. This experimentation generates an early signal of final outcomes, allowing potentially bad ideas to be terminated before those outcomes are realized. But not committing to ideas by retaining right to terminate can also be detrimental to outcomes, by for example attracting lower quality workers or shifting worker effort away from final outcomes towards passing the experimentation phase. In this paper I explore this tension, asking when does experimentation improve final outcomes. I test a theoretical model of experimentation against a dataset of television shows that both enables an estimate of the treatment effect of experimentation and allows a test for selection bias. I find evidence that experimentation may both handicap worker recruitment and adversely shift effort. This results in experimentation only improving final outcomes when it terminates enough bad ideas, otherwise experimentation is detrimental as its benefits are unable to overcome its downside: the lack of commitment.

In Chapter 2 I consider how entrepreneurs in high growth industries face a unique form of uncertainty in their search for strategies to execute their ideas: the underlying distribution of potential outcomes is unknown. This uncertainty creates an opportunity for venture capitalists to extract value in certain cases by resolving that uncertainty and improving the search prospects for entrepreneurs. This paper models the optimal search

problem faced by entrepreneurs and finds the value generated by venture capitalists is non-monotonic in the best strategy discovered so far by an entrepreneur. Our results suggest the rents captured by venture capital may be driven by selection of a specific kind of entrepreneur: one with a great idea but poor strategy for executing that idea.

In Chapter 3 I investigate the decision to vertically integrate; an important optimization decision made by firms. However, this decision not only affects the firm itself, it also influences the firm's industry as the relationships between firms is changed. This paper is an empirical study of how vertical integration impacts an industry, specifically the set of new products developed each year: the direction of innovation. Television shows can either be financed independently of the show's broadcast network or partially funded by the show's broadcast network; this variation in funding changes the owner of the television show and is therefore a form of vertical integration. Using a regulatory shock that restricted the networks' incentives to fund television shows, I find a drop in vertical integration contemporaneous with a shift away from dramas and an overall decrease in the introduction of new show genre combinations. My results demonstrate how organizational form affects an industry's rate and direction of innovation.

“Entrepreneurial Organizations and Human Capital”

Author: J. Daniel Kim (2019)

Committee: Pierre Azoulay (chair), Fiona Murray, Scott Stern

Abstract:

This dissertation investigates how human capital shapes both the creation and performance of entrepreneurial organizations. In three essays, I study the intricate linkage between startups and the individuals that embody them - which include not only the founders, but also the nonfounding joiners. In the first essay, my co-authors and I empirically assess the popular view that the most successful entrepreneurs tend to be young. Second, I investigate the types of individuals that choose to work for startups rather than established firms, and the resulting wage differential between the two employer types. Third, I study the effectiveness of high-tech startup acquisitions as a hiring strategy for incumbent firms - commonly known as "acqui-hiring."