

TIES: Selected Doctoral Theses

“Essays on the Production of Ideas”

Author: Soomi Kim

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 contemptuous 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 non-founding joiners.

First, I study the effectiveness of high-tech startup acquisitions as a hiring strategy for incumbent firms – commonly known as “acqui-hiring”. Unlike conventional hires who choose to join a new firm on their own volition, most acquired employees do not have a voice in the decision to be acquired, much less by whom to be acquired. Using employee-employer matched data from the US Census, I show that this lack of choice leads acquired workers to exit at a much greater rate compared to regular hires. Moreover, I demonstrate that these departures can be largely predicted based on pre-acquisition employment patterns. Lastly, these departures suggest a deeper strategic cost of competitive spawning: Upon leaving, acquired workers are more likely to found their own companies, many of which appear to later compete against the buyer.

Second, my co-authors and I empirically assess the popular view that the most successful entrepreneurs tend to be young. Leveraging administrative data from the federal government, we find that the average age of US entrepreneurs at the time of founding is 42. Even when focusing on the most successful or technology-based entrepreneurs, founders tend to be middle-aged, not young. Prior industry experience appears to primarily explain the age advantage in entrepreneurship.

Third, 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. I tackle this question by leveraging MIT students who receive multiple job offers upon graduation, allowing for within-person comparison of wages. I find that startups pay competitive wages relative to established companies, and that the students who express preferences for risky and challenging work are much more likely to join startup employers.

“Essays on Economic Sociology of Innovation and Entrepreneurship”

Author: Hye Jun Kim (2019)

Committee: Ezra Zuckerman-Sivan (chair), Pierre Azoulay, Matt Marx

Abstract:

This dissertation considers how innovation and entrepreneurship are developed, encouraged, and evaluated with the theoretical lens of economic sociology. The first chapter investigates who becomes an entrepreneur among the pool of general consumers. The process by which individuals become entrepreneurs is often described as a decisive moment of transition, yet it necessarily involves a series of smaller steps. By collapsing the transition stages of knitting hobbyists’ transition to producers who sell their original design patterns, the study examines the distinctive characteristics that affect users’ decision to (a) create new products and (b) commercialize them. In particular, I show that more experienced, disobedient, and committed knitters tend to make the first transition and create new products, while knitters who make the second transition and sell their products tend to be less experienced, disobedient, and committed, compare to the sharing producers who do not commercialize their products.

The second chapter examines the role of social capital in revealing and encouraging avocational entrepreneurship. To the question of how social capital benefits innovation and entrepreneurship, existing literature has provided one dominant answer: the inflow of new information and knowledge recombination promote innovative ideas. In this study, I suggest a novel insight on the benefit of social capital on an individual’s transition to avocational entrepreneurs: social networks provide potential entrepreneurs self-confidence on the promise of their new ideas and encourages their entry into the market. Using a unique setting in a niche field of knitting, I first show that there are individuals with great potential to become innovators. Also, using a matched sample of potential innovators, I show that an individual’s participation in a closely connected local group encourages her transition to an entrepreneur, especially for those who already have the necessary skills for the transition. The empirical analysis resonates with qualitative evidence that knitting hobbyists make the transition to entrepreneurs when encouraged by their friends.

The third chapter (co-authored with Pierre Azoulay and Ezra Zuckerman) considers commitment-based typecasting among knit designers. We show that “commitment-based typecasting” has two characteristic features: asymmetry in audience valuation and retrospective reevaluation. When a novice performer

experiences an “identity shock” that suggests that she is more committed to the audience for one category than another, “betrayed” audience tends to regard her as having always been less committed to the rival audience/category. We test this theory in the domain of knitting, where there is a divide between avant-garde knitters and traditional knitters, and we show that when a novice knit designer is first published in the publication associated with one category, this elicits a retrospective devaluation of her prior work by the audience of the opposing category.

“Making the Cut: The Rate and Direction of CRISPR Innovation”

Author: Samantha Zyontz (2019)

Committee: Scott Stern (chair), Pierre Azoulay, Jeffrey Furman

Abstract:

This dissertation explores, in real time, key institutional factors contributing to the diffusion and impact of a breakthrough technology from its very first days. The set of studies provide a nuanced picture of the actors, institutions, technologies, and rules necessary for knowledge managers to make systematic comparisons among strategies to encourage innovation in emerging industries.

The first chapter examines whether the introduction of a breakthrough technology, the CRISPR DNA-editing system, affects the trajectory of a scientific field through project selection and new entry. Using proprietary data from the primary distributor of CRISPR to academic scientists, Addgene, the study shows that the relative proportion of scientists focusing on editing mammalian cells after the introduction of CRISPR increased over their counterparts working in bacteria and other eukaryotes. The shift towards mammalian research may result mostly from entry of new authors.

The second chapter (with Neil Thompson), explores whether characteristics of individual scientists who experiment with CRISPR differ from those who incorporate that experimentation into a new project. Using Addgene data we separately observe both groups by matching CRISPR orders to scientists’ publication histories. We find that some characteristics (e.g., proximity to the discoverers) do not impact experimentation but do influence the ability to publish, empirically showing that access to a complex new tool does not automatically translate into the ability to use the tool.

The third chapter builds on the previous two by noting that many new tools require specialized complementary know-how to be applied effectively and delving into how teams form to acquire that know-how. Teams in any research domain face the tradeoff of either acquiring this know-how themselves or working with scarce external tool specialists who also have a choice over domain teams. CRISPR enables identification of external tool specialists on research teams by exploiting natural difficulties of applying the tool across disease domains. External tool specialists appear more often in teams for difficult diseases, especially in subsequent innovations, suggesting that external tool specialists may be more attracted to complex but influential problems.