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EDUCATION

My name is Ruby Zhang and I am a rising third-year Ph.D. student in the Economics department at Harvard University. I completed all economics core and field course requirements as of May 2023. To understand how firms behave both within and outside of the firm boundary, I have taken the full industrial organization sequence as well as contract theory and corporate finance. To understand the economics of innovation, I have taken "Theoretical and Empirical Perspectives on Entrepreneurship" with Josh Lerner and Shai Bernstein, "Economics of Science" with Richard Freeman, and an online innovation course by the Institute for Progress.

RESEARCH INTERESTS

My research interests are in innovation and industrial organization, with a focus on understanding how firms respond to technological innovation from competitors or deregulation. I'm also interested in how capital and technological improvements extend the production frontier of scientific research. AI is a significant technological advancement with the potential to change both the dynamics of firm competition and the process of knowledge production. For example, AI's reliance on big data may raise barriers of entry for small entrants with returns accruing to large incumbents. However, the deployment of AI may vastly expedite and automate firm processes that lead to gains in efficiency. In the domain of scientific research, AI has already made strides in protein folding with the use of AlphaFold. On the other hand, the emphasis on existing data can bias the direction of subsequent discoveries. At the NBER tutorial, I am looking forward to enriching my own understanding of digitization and AI and its implications for the economy through rigorous and careful analyses.

RESEARCH PROJECTS

I will now describe in-process and nascent research projects.

One of my current projects with Professor Shane Greenstein aims to characterize how the market for unlicensed spectrum products led to new innovations after a regulatory change which decreased barriers to entry. In 1998, the FCC opened up testing and certification of unlicensed spectrum products (e.g. wifi, Bluetooth) to third-party testing labs and certification bodies (that are periodically audited by the FCC). This greatly decreased the time between application and grant, and an explosion of new products and firms entered the market. Using web-scrapped public data released by the FCC on every registered product from 1980 to 2021, we can study the effects of market structure and regulatory relationships on product innovation. Who are the firms that enter the market, and how quickly do we see new innovations? Do they follow a quality ladder model? Do firms with close, contractual relationships to testing and certification firms produce more products, or firms with arms-length relationships? The unlicensed spectrum market provides a unique framework to study questions of product improvements within an industry after deregulation.

Relatedly, a product category that has experienced rapid technological change during this time frame is mobile phones. I am planning to use detailed mobile phone data collected by Professor Juan Alcacer on characteristics, price, and quantity from the first mobile device until 2012. The data allows me to estimate a dynamic structural model on how quickly firms learn to innovate from competitors, and whether demand or production improvements drive the direction of innovation. To this end, I will merge external data on firm R&D and marketing costs. The mobile phone market is very dynamic and has been driven by technological progress in both creating new product characteristics and simplifying the production process.

However, while capital has been thoroughly incorporated into firm production, its relation to science production is less examined. Every two years starting in 1986, the National Science Foundation conducts the "Survey of Science and Engineering (S&E) Research Facilities" for U.S. research-performing post-secondary institutions. The survey collects data on space, cost of construction & repair, and funding sources of S&E facilities for the next two fiscal years. I plan to investigate the returns to capital on facility investment by S&E field for universities by linking the institutional data to faculty and publications data. Most of the emphasis in the economics of science has been on the labor supply of scientists and/or monetary incentives, with very little examination of capital investment. Now with AI as a major tool, there is an increasing importance of data or "knowledge capital" in the production of research. This is also a topic I hope to investigate in the future.