Parker Rogers
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October 9, 2019

NBER
1050 Massachusetts Avenue
Cambridge, MA 02138-5398

Dear Professor Ben Handel and other organizers,

With great enthusiasm I submit my application for the Health Economics Research Boot Camp. My research uses machine learning tools and best-practice statistical models to analyze medical innovation. This boot camp will broaden my knowledge of and connection to the research frontier, allowing me to accelerate my current research trajectory and foster meaningful relationships with participants.

My undergraduate training in computational mathematics gave me a strong foundation to produce meaningful data using machine learning tools. Professionally, I worked with a DC think tank, applying these tools to successfully develop a Neural Network-based microsimulation model that calculates the marginal tax rates of government benefit programs. In addition, I created a Random Forest Classifier model that imputes CPS and ACS data sets to match administrative data for seven different government programs.

At UCSD, I worked with Jeffrey Clemens on a project examining Civil War and WWI medical innovation. I read over 1,000 pages of patent documents to construct text data that trains machine learning algorithms. I then created a novel machine learning approach that identifies the economically relevant characteristics and patterns of a century of innovative activity. Using synthetic control groups with randomization inference, we disentangled the effects of various war-induced demand shocks on the direction of innovation. I am now starting my own research that examines knowledge spillovers in drug development at the firm level using text analysis.

This boot camp will provide invaluable direction and insight for continued research in this field. Thank you for your consideration.

Sincerely,

Parker Rogers

PARKER ROGERS

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EDUCATION

University of California, San Diego	Ph.D., Economics	Expected 2022
Brigham Young University	B.S., double major in Economics and Applied and Computational Mathematics	2017

Graduate coursework completed: Mathematics for Economists, Computation, first-year Microeconomics (A, B, C) and Macroeconomics (A, B, C), first- and second-year Econometrics (A, B, C, D, E, and F), Labor Economics, Economics of Natural Resources, Topics in Means-Tested Program Research, Public Economics: Social Insurance w/ Emphasis on Health, Public Economics: Redistribution and Social Insurance, The Economics of Pollution.

Current coursework: Pre-candidacy presentation, original research paper, workshop in applied economics.

REFERENCES

Jeffrey Clemens	UC San Diego	jeffclemens@ucsd.edu
Prashant Bharadwaj	UC San Diego	prbharadwaj@ucsd.edu
Richard Evans	University of Chicago	rwevans@uchicago.edu

FIELDS OF INTEREST

Health Economics, Public Finance, and Economics of Innovation.

RELEVANT POSITIONS HELD

Research Fellow	Center for Health Economics & Policy Studies	2019 -
Research Assistant	UCSD (Prof. Jeffrey Clemens)	2018 -
Policy Modeling Team	American Enterprise Institute, OSPC	2016 - 2017
Research Assistant	BYU (Profs. Richard Evans and Kerk Phillips)	2015 - 2016

HONORS, AWARDS, AND GRANTS

Research Fellowship, Center for Health Economics & Policy Studies, 2019 -.
Graduate Summer Research Scholarship, UCSD 2018, 2019.
Research Grant, Dissertation Development, UCSD 2018.
Regents Fellowship, UCSD 2017 - 2018.
Public Finance Fellowship, UCSD 2017 - 2018.
Research Grant (with Kerk Phillip), Office of Research and Creative Activities, BYU 2017.
Research Grant (with Richard Evans), Office of Research and Creative Activities, BYU 2016.

WORKING PAPERS

"Wartime Procurement and the Direction of Prosthetic Device Innovation" (with Jeffrey Clemens).

***Abstract**: We analyze how consumer demand and third-party procurement programs affect the volume and direction of medical innovation. We do this through an analysis of prosthetic device innovation during the U.S. Civil War and World War I. By analyzing patent texts, we develop new data describing the economic characteristics of prosthetic devices and other contemporaneous medical and mechanical inventions. We construct these data by manually coding a training data set of patent characteristics and extending these encodings to a broader set of patents using a modified supervised machine learning algorithm. We provide illustrations of key pitfalls that such analyses can encounter and recommend several components of best practice. Our analysis of the resulting data set generates four findings. First, there were sub- stantial increases in the volume of prosthetic device patents during both the Civil War and World War I. Second, relative to patents in other medical and mechanical categories, prosthetic device patents exhibited an increased emphasis on traits that facilitate low- cost mass production during both eras. Third, the Civil War generated effort to improve broad set of attributes aspects of the production process, while World War I did not. Fourth, the prosthetic device patents from the Civil War and World War I eras diverged with respect to their consumer-facing characteristics. Specifically, Civil War era pros- thetic device patents exhibit an increased emphasis on comfort, while World War I era prosthetic device patents de-emphasized comfort and exhibit an increased emphasis on appearance.*

"Machine Learning for Text Analysis: Pitfalls, Solutions, and Lessons Learned Analyzing Patent Documents" (with Jeffrey Clemens).

***Abstract**: We explore cutting-edge machine learning algorithms for text analysis. We evaluate their relative advantages and disadvantages when predicting variables contained in our newly constructed data set describing the economic attributes of medical and mechanical innovations. To this end, we first provide background regarding our particular application and highlight key issues faced when performing text analysis. We then compare predictive accuracy across a range of deep learning and non-neural network machine learning algorithms. Next, we provide a novel text analysis approach that uses what we term "selective contextualization" that achieves significant gains in predictive performance and computation time over our considered alternatives. We show several dimensions across which key issues in text analysis are more likely to induce large errors in generated data and we show how these errors affect potential economic estimates of interest. Given these pitfalls, we provide best practice approaches to ensure that the key issues are properly addressed.*

PROFESSIONAL ACTIVITIES

Conference Presentations

2016 "Marginal Tax Rate Calculator," American Enterprise Institute conference.
2015 "The Distribution of Inheritances," Macroeconomics and Computational Laboratory.

Teaching and Mentoring

2018-2019 Undergraduate Research Assistant Supervision (3 RAs).
2018-2019 Teaching Assistant, Principles of Microeconomics (×2) and Microeconomics B.
2015 Teaching Assistant, Economics Principles and Problems, BYU.

Other Relevant Activities

2014 Economic Analyst Intern, United States Senate.

Other Information

Fluent Languages:	English, Spanish
Computational Languages:	Python, MATLAB, STATA, SQL, Git
Github:	https://github.com/parkerrogers

Research Direction

Current Research

My current research broadly aims to ascertain the influence of public policy on medical innovation. One of my current projects seeks to analyze firm-level knowledge spillovers in drug development and the extent to which state noncompete clauses (NCCs, or noncompetes) affect these spillovers. The degree to which knowledge transfers across firms is important for determining the efficacy of public R&D subsidies for drug development. If R&D subsidies have a multiplicative effect, with multiple firms reaping the benefits of a single R&D subsidy, these funds may be more productive. NCCs, however, may limit this multiplicative effect by restricting a worker's ability to transfer their knowledge across firms. In the context of drug development, the extent to which medical knowledge transfers across firms is understudied. The empirical evidence of NCC's impacts on knowledge spillovers is also sparse.[1]

I will use variation in statewide enforcement of NCCs to assess how flows of medical knowledge related to drug development are restrained by NCCs. I am currently creating novel panel data that tracks individual scientists' innovative activity within and across firms. I use highly detailed text data on individual-level chemical innovations to quantify innovative activity. By analyzing the text similarity between drug innovations, I will compare how an innovator's knowledge evolves within a firm and how this knowledge transfers across firms. I plan to analyze how knowledge spills over differentially as individuals move from states that have stricter noncompetes to those that do not enforce noncompetes. Additionally, variation in drug type and sector (e.g., public vs. private) will allow me to measure how knowledge spills over differentially along these dimensions.

Another current project, joint with Jeffrey Clemens, aims to measure the influence of government procurement policy and consumer demand on the growth and attributes of medical device innovation. Notably, health policies and market size have been found to have large effects on the amount of technological change in drug markets (Finkelstein, 2004; Acemoglu and Linn, 2004).[2] This project differs by exploiting variation in Civil War and World War I demand environments to measure how the characteristics of prosthesis innovation respond to distinct financial incentives. It is important to understand the extent to which demand—as shaped by third-party procurers—

[1] Starr et al. (2015) provide meaningful survey evidence on NCC heterogeneity between states and industry, by surveying labor force participants to analyze the different aspects of current state-based noncompete environments.

[2] Finkelstein (2004) finds that health polices that affect public utilization of vaccines have large effects on technological change for drugs within their reach. Also, shifts in market size for pharmaceuticals can have significant and robust effects on pharmaceutical innovation (Acemoglu and Linn (2004)).

shifts innovators' emphases towards certain product attributes and away from others.

To this end, I initially read over 1,000 pages of patent documents from the years 1840-1940, to encode a data set tracking economically relevant attributes. I found a variety of distinguishing characteristics representing improvements in production processes and others that were aimed at improving the user's experience. I then created a novel text analysis approach to accurately classify our traits of interest to a much broader set of over 750,000 web-scraped patent texts that form the basis of our control groups. We find that inventors significantly streamlined the production process of prosthetic limbs during both wars, but that these efforts differed by the type of procurement regime. Specifically, the more "laissez-faire" nature of the CW procurement led to reduced extraneous components and an increased emphasis on comfort. During WWI, by contrast, procurement was centralized, leading inventors to streamline production, but to a lesser extent, while emphasizing appearance and de-emphasizing comfort.

Future Research

My future work will focus on the impacts of FDA policies and procedures on drug development. I plan to analyze, for example, the effects of the implementation of FDA surrogate endpoints on drug development and patient survival times. I will couple FDA policy changes with health outcomes data of individuals who participated in clinical trials to measure the subsequent effects of allowing surrogate endpoints.

This boot camp provides a terrific opportunity to refine my knowledge of these topics. In addition, I am excited for feedback, particularly from those who have complimentary research, and potential fruitful collaborative opportunities. I look forward to the possibility of interacting with some of the brightest minds in the field.

References

Acemoglu, Daron and Joshua Linn, "Market Size in Innovation: Theory and Evidence from the Pharmaceutical Industry," *Quarterly Journal of Economics*, August 2004.

Finkelstein, Amy, "Static and Dynamic Effects of Health Policy: Evidence from the Vaccine Industry," *Quarterly Journal of Economics*, May 2004.

Starr, Evan, J.J. Prescott, and Norman Bishara, "Noncompetes in the U.S. Labor Force," July 2015.

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October 9, 2019

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To the Program Organizers:

I am writing to enthusiastically recommend that you invite Parker Rogers to participate in the upcoming NBER Health Economics Research Bootcamp.

Parker is now in his third year as a graduate student at UC San Diego. I recommended Parker for last year's bootcamp and my enthusiasm for his potential to become a first-rate health economist has only grown! Advising and working with Parker over the last year has been a pleasure, and I look forward to more of the same.

Parker impressed me during the summer after his first year by showing a high level of maturity in his assessment of the potential success of his initial research ideas. What impressed me was the efficiency with which he assembled and digested the information required to assess the likelihood that he would be able to fill an important gap in the relevant literature. He quickly digested the relevant literature and familiarized himself with the data to which he would potentially have access. After concluding that the data to which he would have access would not enable him to contribute meaningfully beyond existing work, he wisely moved on to develop alternative project ideas.

Parker and I subsequently began working together on a project investigating the effects of wars on medical innovation, with an emphasis on the waves of prosthetic device innovation that occurred during the Civil War and World War I. Both wars were associated with large demand shocks due to large quantities of battlefield amputations. Both wars were also associated with substantial increases in flows of prosthetic arm and leg patents filed with the USPTO. In addition to quantifying these increases in patent flows, this project's primary goal is to provide insight into the key economic characteristics of the innovations that were developed in response to the government's programs for procuring artificial limbs. For example, to what extent did innovators emphasize improvements to aspects of the production process (e.g., simplification, cost reduction, and shifts from bespoke

artificial limbs to mass production) relative to consumer-facing attributes like comfort and appearance?

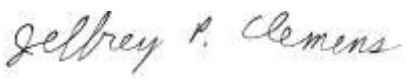
Our analysis of economic traits required generating new data through analysis of patent texts. The first step in this process was to closely read and code the traits of interest for a "training set" of 1200 patent documents. This training set spans both the Civil War and WWI as well as a combination of "treated" prosthetic device patents and "control" patents from other medical and mechanical patent classes. Parker has then used machine learning tools, which he has tailored to the needs of our particular text analysis task, to extend the training set to the full set of treatment and control patents of interest. Methodologically, an exciting aspect of this project is that we are developing several insights into best practice for the use of machine learning to develope new data from patent texts. This project has recently reached the stage at which we are circulating a draft for comments.

As we've drafted our joint paper, I've learned that Parker writes quite clearly and is capable of succinctly describing technically complicated material. This is not a skill I've come to take for granted among our graduate students, and it bodes well for his potential to write high-impact research papers.

As described in his proposal, Parker is beginning to make progress on an independent project investigating firm-level knowledge spillovers in drug development. He has taken a particular interest in the effects of non-compete agreements within this context. This project is in its early months and I'm excited to see where it goes.

Altogether, I'm very excited by Parker's potential. His skills, interests, and work ethic are such that I am confident he would benefit tremendously from the December Boot Camp. I hope you will give him this opportunity.

Sincerely,



Jeffrey Clemens