RUBY (RUISHAN) ZHANG

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Recommender:
Richard Freeman
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Dear Professors Bryan, Ganguli, and Myers:

My name is Ruby Zhang and I am a third-year Ph.D. student in the Economics department at Harvard University. Please find my application materials for the NBER Innovation Research Boot Camp below, where I list my CV, completed courses, and research statement. I am interested in understanding (1) how innovations diffuse (in the context of consumer electronics and basic research) and (2) the subsequent market effects and welfare impacts. The boot camp would be an invaluable experience to learn the frontier of innovation research and meet scholars with similar interests.

Thank you for taking the time to consider my application, I look forward to hearing back from you.

Regards,
Ruby (Ruishan) Zhang

RUBY (RUISHAN) ZHANG

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Phone: (312) 843 2679
Citizenship: Canada

EDUCATION

2021 – 2027	Harvard University Ph.D. Economics
2015 – 2019	University of Chicago B.S. Mathematics, B.S. Statistics, and B.A. Economics (honors) GPA: 3.94/4.0. Phi Beta Kappa. Student Marshal. David S. Hu Award.

INDEPENDENT RESEARCH

2023 – Present	Building Up Research Capacity at Minority Institutions (supervised by Richard Freeman)
2023 – Present	Who Benefits from Secrecy in Commercialization? (joint with Shane Greenstein)
2018 – 2019	Manufacturer Merger Effects on Retail Prices and Product Variety (B.A. Thesis) Advised by Professor Thomas Wollmann, Chicago Booth School of Business

PAPERS

Chetty, R., Jackson, M.O., Kuchler, T. *et al.* Social capital I: measurement and associations with economic mobility. *Nature* **608**, 108–121 (2022). https://doi.org/10.1038/s41586-022-04996-4

Chetty, R., Jackson, M.O., Kuchler, T. *et al.* Social capital II: determinants of economic connectedness. *Nature* **608**, 122–134 (2022). https://doi.org/10.1038/s41586-022-04997-3

TEACHING

Summer 2024	Computing for Economists (developed with Toren Fronsdal & Jesse Shapiro) *Topics Include:* optimization (continuous and combinatorial), dynamic programming, big data & parallelization, application of ML, bandit problems & reinforcement learning
Fall 2023	Personal Finance (Teaching Fellow for John Campbell)

HONORS & AWARDS

2019	Becker-Friedman Institute Microeconomics Academic Award
2019	David S. Hu Award (for economics B.A. thesis)
2018	Student Marshal
2018	Phi Beta Kappa
2016	Chicago Booth Dougan Scholar Certificate Program

NON-ACADEMIC POSITIONS

Summer 2018	Lazard Financial Advisory Investment Banking Summer Analyst in M&A	Chicago, IL

PHD COURSES

Spring 2023	Economics of Science	R. Freeman
Spring 2023	Industrial Organization II	R. Lee, M. Kalouptsidi, A. Pakes
Spring 2023	Contract Theory	O. Hart
Spring 2023	Unleashing Novel Data at Scale	M. Dell
Spring 2023	Topics in Econometrics	A. de Paula
Fall 2022	Industrial Organization I	R. Lee, M. Kalouptsidi, A. Pakes
Fall 2022	Corporate Finance and Banking	S. Hansen, A. Sunderam
Fall 2022	Time Series Analysis	A. Mikusheva
Fall 2022	China Economy Reading Group	D. Yang
Spring 2022	Theoretical and Empirical Perspectives on Entrepreneurship	J. Lerner, S. Bernstein
Spring 2022	Econometric Methods II	W. Gao
Spring 2022	Microeconomic Theory II	J. Hatfield
Spring 2022	Macroeconomic Theory II	A. Bilal, X. Gabaix, L. Straub
Fall 2021	Econometric Methods I	E. Tamer
Fall 2021	Microeconomic Theory I	E. Glaeser, E. Maskin
Fall 2021	Macroeconomic Theory I	D. Laibson, R. Barro

There are two strands of research topics I am currently engaged in: (1) how basic research accumulate and diffuse; and (2) the technological evolution of consumer electronics based on competitor strategy. On the methodology side, I am also interested in using computational methods from industrial organization and ML, such as applying structural frameworks to evaluate the dynamics of innovation processes or using text analysis to identify novel research. For each topic, I will first describe my current research then the follow-on research I plan to undertake in the future.

How do institutions build up research capacity? This is a difficult task given that the Matthew effect plays out along the dimensions of funding and attracting faculty & students, perpetuating research inequality. I am investigating how to build up research capacity for minority institutions (Historically Black Colleges & Universities, Hispanic Serving Institutions, and Tribal Colleges & Universities) under the supervision of Professor Richard Freeman in a joint project with the National Academy of Sciences. Using NSF data on institutional R&D spending as well as facility cost & space across fields over time, I identify the dispersion in R&D infrastructure across institution types (e.g. R1s) by field. To examine the progression of outcomes, I plan to link NSF personnel data (i.e. faculty and student counts) and publication statistics from Scopus. I will use the rich cross-sectional and historical data on capital and labor to investigate the dynamic evolution of research. While there is a literature on the labor force in science, there is less focus on the capital side (e.g. infrastructure). Apart from dynamics, I am also interested in how the spatial proximity facilitates cooperation versus competition. For the research gap, what are the general equilibrium effects of having strong research institutions nearby? If there is synergy, where does it come from – do capital-intensive fields benefit more from equipment sharing or is it from researcher cooperation? Are there competitive effects and "brain drain"? I plan to investigate the dynamics and geographic components of research capacity at universities.

One of my current projects with Professor Shane Greenstein investigates the role of secrecy in the commercialization process and its impact on entry speed and innovation direction. All short-range radio frequency devices (i.e. consumer electronics using WiFi or Bluetooth) require certification and approval from the FCC. The FCC then publishes all application exhibits publicly at time of grant. This includes information useful to competitors: user manuals, internal and external photos, etc. In 2007, under industry complaints, the FCC introduced a new policy: firms can pay to withhold exhibits after the grant date for up to six months or until the product hits the market. Unlike IP, firms pay a price to preserve secrecy **only** during the commercialization process. Instead of full take-up as we expected, only 40% of new products use the policy. We web-scrapped the public data on every registered product from 1990 to 2021 to study the effects of the policy. The question is two-fold: (1) Who are the firms or devices that decide to use the policy? How important are product segment competition and product complexity? (2) What are the changes to the product market before and after the policy? Is there an increase in more complex products? What happens to the entry speed of generic vs. novel products? One thing missing from the public data is the downstream price and quantity. I am currently collecting historical data on all phone model sales in the US, which will allow us to factor in the dynamic responses to competitor outcomes for the mobile market. Finally, we can ask the question: what is the "price" of commercialization?

Innovation is a multi-faceted topic and can be approached from many different directions depending on the field. I wish to get a holistic sense of how to think about innovation and learn about the research frontier, including about topics and methodologies different from my own. Furthermore, I am excited about building and meeting a community of scholars with similar research interests. Thank you so much for considering my application.

HARVARD UNIVERSITY
DEPARTMENT OF ECONOMICS

Richard B. Freeman
Herbert Ascherman Professor of Economics

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Cambridge, MA 02138

31 January 2024

NBER Innovation Research Boot Camp
Brett Maranjian <maranjian@nber.org>

Dear Selection Committee:

I have been working with Ruby Zhang who is PhD student at Harvard for 2 years and recommend her strongly for the NBER Innovation boot camp. Ruby has a unique take on innovation and science that puts much greater stress on the instruments and physical equipment than most analyses that are human capital focused. The last several months she has been in a unique position for a grad student of having received support for her research from the NAS focused on a federal govt effort to improve the ability of colleges and universities with primarily minority students to the frontier of science. Ruby has been a star in this activity and her work will undoubtedly be cited in the NAS report. She is great with data and ideas. She has begun to think of a thesis chapter on the impact of being a smaller less prestigious college or university near a top R1 institution on the small institutions' science and technology – a spillover analysis.

She is also a very pleasant and forthcoming person, who will contribute to the Innovation boot camp as well as learn a lot from it. She jumped on the NAS opportunity and has been a great success. She will do the same here.

I recommend Ruby to you with great enthusiasm and am happy to provide more information by email or phone call.

Sincerely,

Richard B. Freeman
Ascherman Professor of Economics, Harvard University
National Bureau of Economic Research