Xizhao Wang

Kellogg School of Management, Northwestern University

(773)595-8453 xizhao.wang@kellogg.northwestern.edu

Dear Innovation Research Boot Camp Admission Committee Members,

I am writing to express my strong interest in participating in the NBER Innovation Research Boot Camp 2024. As a fourth-year Ph.D. student in the Managerial Economics and Strategy program at Kellogg School of Management, Northwestern University, I am enthusiastic about the opportunity to engage in this program and further enhance my expertise in the field of economics of innovation research.

My academic journey has equipped me with a solid foundation in the economics research. I hold an M.A. (Honor) in Public Policy from the University of Chicago, where I gained valuable research experience as a research assistant to Professor Steven Durlauf and Professor Richard Hornbeck. These experiences not only honed my technical skills in economics research but also ignited my passion for exploring and answering complex economic questions independently.

During my Ph.D. at Kellogg School of Management, I pursued rigorous Ph.D.-level coursework in economics and selected Technology & Innovation courses as part of my Ph.D. field course sequences. Under the guidance of my advisor, Professor Benjamin Jones, I am conducting research on the economics of innovation. One project examines how human capital influences a firm's innovation direction, while another project investigates the relationship between innovation commercialization and patent disclosure, utilizing textual analysis to assess the readability of patent documents.

I believe that my educational background, research experience, and dedication to the economics of innovation make me a well-suited candidate for the NBER Innovation Research Boot Camp. I have included my curriculum vitae, a comprehensive list of my completed Ph.D. courses, and a one-page application essay outlining my motivation to attend the boot camp. Please contact me with any questions or requests for additional materials.

I am genuinely excited about participating in the NBER Innovation Research Boot Camp and look forward to the opportunity to collaborate with researchers in this field. Thank you for considering my application.

Sincerely,

Xizhao Wang

Reference

Professor Benjamin F. Jones
Gordon and Llura Gund Family Professor of Entrepreneurship
Professor of Strategy
Kellogg School of Management
bjones@kellogg.northwestern.edu
847-491-3177

Xizhao Wang

(she/her/hers)

Kellogg School of Management, Northwestern University

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Education

Northwestern University - Kellogg School of Management **2020-present**
Ph.D., Managerial Economics and Strategy, Advisor: Prof. Benjamin F. Jones

The University of Chicago - Harris School of Public Policy **2018-2020**
M.A., Public Policy (Honors), GPA Rank: 1/25

Southwestern University of Finance and Economics **2014-2018**
BEcon., Economics (Honors), GPA Rank: 1/122

ISCTE - Instituto Universitrio de Lisboa **2016**
Exchange Student

Research Interests

Economics of Innovation, Entrepreneurship, Technology, Science of Science, Applied Microeconomics

Working Papers

"Human Capital and Firm's Innovation Direction"

Present: Applied Micro Lunch (Northwestern Econ, 2023), Strategy Brown Bag (Kellogg Strategy, 2023), Eastern Economic Association Annual Meeting (2024, scheduled)

This paper studies how the sudden loss of personnel affects the direction of innovation in firms. This paper introduces three different measures (cosine distance, total variation distance, and Wasserstein distance) to systematically quantify changes in firm's innovation direction. I exploit a difference-in-difference approach to assess the change in innovation direction within U.S. public firms following sudden deaths of personnel. I find that the loss of upper-tail inventors significantly alters a firm's innovation trajectory, whereas losses of lower-tail inventors and losses at the management level do not. Further analysis underscores the organization's innovation direction is the aggregation of innovation direction from inventor's own expertise plus the innovation direction from team collaboration. The findings on technology distance between different groups of inventors highlight the hard-to-replace nature and the role of inventive human capital, exploring the dynamic capabilities of firms.

"Innovation Commercialization and Patent Disclosure"

Present: Applied Micro Lunch (Northwestern Econ, 2023), International Conference Science of Science and Innovation (2023, Best Poster Award), AI in Management Conference (2024, Scheduled)

This paper studies how the commercialization of innovation affects patent disclosure. I measure the innovation disclosure by using textual analysis methods to construct the readability scores of each patent's detailed description, background, and summary texts. To identify the causal impact of innovation commercialization on innovation disclosure, this paper uses the difference-in-difference approach. First, this paper uses the 1980 Bayh-Dole Act, which gave universities potential realization of the economic benefits of the inventions as an exogenous shock and leverages the readability change of university patents and non-university patents. Second, this paper considers the technology transfer offices (TTOs) establishment as another exogenous shock of innovation commercialization to patent inventors. This paper finds a decrease in readability in patent detailed description by

inventors affiliated with universities after the 1980 Bayh-Dole Act and the TTO's establishment. Such decrease in readability did not apply to patent background and summary text. This paper points out a possible strategic innovation disclosure behavior, a finding that when inventors foresee innovation commercialization, they would strategically decrease the readability of patent detailed descriptions and lower openness in sharing how to make and use the invention.

"Knowledge as Output and as Input: Artificial Intelligence and Quantum Computing" with Daniel Spulber

Present: AI@NU(Northwestern, 2023), International Industrial Organization Conference (2023), Economics of QIT Conference (2023)

This paper explores the contributions of Artificial Intelligence (AI) and Quantum Computing (QC) knowledge capital to the production of knowledge and the production of output within firms. Using the Artificial Intelligence Patent Dataset from the USPTO, the study matches AI and QC patents with firm characteristics data from the CRSP/Compustat Merged database to quantify the AI and QC knowledge adoption and the impact of these forms of knowledge capital on firms. We present five stylized facts about knowledge as an input and as an output. Our regression findings indicate that both AI and QC knowledge stocks are positively associated with their own knowledge production, with AI knowledge stocks positively associated with QC innovation but not vice versa. The impact of the two forms of knowledge capital on firm productivity and growth differs, with AI potentially positively correlating with firm output while QC is more of an investment not impacting output immediately. Our study implies that knowledge capital has heterogeneous effects on both knowledge and output production. Rather than treating all types of knowledge capital as homogeneous, it is important to consider their potential differences.

Research Experience

Research Assistant to Prof. Daniel Spulber, Northwestern University **2022-2023**

Research Assistant to Prof. Richard Hornbeck, The University of Chicago **2019-2020**

Research Assistant to Prof. Steven Durlauf, The University of Chicago **2019-2020**

Teaching Experience

Teaching Assistant, Northwestern University

Analytical Approach to Uncertainty (EMBA, Miami Campus), Prof. Alireza Tahbaz-Salehi **2023**

Business Analytics (MBA), Prof. Alireza Tahbaz-Salehi **2021-2022**

Teaching Assistant, The University of Chicago

Microeconomics (MBA), Prof. Richard Hornbeck **2019-2020**

Business in Historical Perspective (MBA), Prof. Richard Hornbeck **2019-2020**

Principles of Microeconomics and Public Policy II (MPP), Prof. Konstantin Sonin **2020**

Awards and Honors

Best Poster Prize (ICSSI Conference) **2023**

Kellogg Graduate Fellowship (Northwestern University) **2020-present**

Merit Scholarship (University of Chicago) **2018-2020**

Outstanding Graduate (Sichuan Province, China, 1/122) **2018**

National Scholarship (Undergraduate, 2/122) **2015-2016, 2017-2018**

Top 10 Students in the Class of 2018 (Undergraduate, 10/3751) **2015**

Seminars and Conferences (including scheduled)

Presenter

2024 (Scheduled): Strategy Brown Bag Seminar(Northwestern Kellogg), Eastern Economic Association Annual Meeting(Boston), AI in Management Conference(USC)

2023: Applied Micro Lunch × 2 (Northwestern Econ), International Industrial Organization Conference(Washington DC), Economics of QIT Conference(USC), Strategy Brownbag Seminar(Northwestern Kellogg)

Discussant

2023: International Industrial Organization Conference

Participant

2023: NBER Economics of Artificial Intelligence Conference(Toronto), NBER Digital Economics and AI Tutorial(Toronto)

Skills

Softwares: Stata, Python, R, LaTeX

Languages: Chinese (Native), English

Reference

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Course Information

Completed PhD courses **Northwestern University**

Mathematical Methods for Economic Theory
Economics 410-1&2&3, Microeconomics I, II, III
Economics 480-1&2&3, Econometrics I, II, III
MECS-560-1, Static Optimization in Economics
MECS-560-2, Dynamic Optimization in Economics
MECS-560-3, Research in Economics
MECS-570-1&2, Economics of Organizations I, II
MECS-549-1&2, Technology & Innovation I, II
ECON 425-1, Development Economics
FINC-586-2&3, Corporate Finance II, III
KPHD-540-0, Computational Social Science: Methods and Applications
MECS-499-0, Independent Research

Completed PhD courses **The University of Chicago**

Political Economy I, II
Advanced Microeconomics for Policy Analysis I, II
Applied Econometrics I, II
Social Interactions and Inequality

Application Essay

As a fourth-year Ph.D. student in Managerial Economics and Strategy Program at Kellogg School, Northwestern University, I have been very fascinated by research on the economics of innovation. To better prepare for my further research, I am applying to the Innovation Research Boot Camp 2024, which I believe is an extremely suitable and beneficial program for me.

I am interested in researching the economics of innovation with a combination of knowledge from applied microeconomics, strategy, and public policy. My current research interest is to provide empirical evidence for questions in the economics of innovation that broadly fall into three sub-categories: human capital and innovation, innovation commercialization and patent disclosure, and new technology within the firm. I am also open to exploring various research topics, and I firmly believe that my horizons will expand significantly through the boot camp training.

One of my current research projects are on human capital and firm's innovation direction. This project studies how the sudden loss of personnel affects the direction of innovation in firms. This paper introduces three different measures (cosine distance, total variation distance, and Wasserstein distance) to systematically quantify changes in firm's innovation direction. I exploit a difference-in-difference approach to assess the change in innovation direction within U.S. public firms following sudden deaths of personnel. I find that the loss of upper-tail inventors significantly alters a firm's innovation trajectory, whereas losses of lower-tail inventors and losses at the management level do not. Further analysis underscores the organization's innovation direction is the aggregation of innovation direction from inventor's own expertise plus the innovation direction from team collaboration. The findings on technology distance between different groups of inventors highlight the hard-to-replace nature and the role of inventive human capital, exploring the dynamic capabilities of firms.

Another research project I am working on is how the commercialization of innovation affects patent disclosure. I measure the innovation disclosure by using textual analysis methods to construct the readability scores of each patent's detailed description, background, and summary texts. To identify the causal impact of innovation commercialization on innovation disclosure, this paper uses the difference-in-difference approach. First, this paper uses the 1980 Bayh-Dole Act, which gave universities potential realization of the economic benefits of the inventions as an exogenous shock and leverages the readability change of university patents and non-university patents. Second, this paper considers the technology transfer offices (TTOs) establishment as another exogenous shock of innovation commercialization to patent inventors. I find a decrease in readability in patent detailed description by inventors affiliated with universities after the 1980 Bayh-Dole Act and the TTO's establishment. Such decrease in readability did not apply to patent background and summary text. This paper points out a possible strategic innovation disclosure behavior, a finding that when inventors foresee innovation commercialization, they would strategically decrease the readability of patent detailed descriptions and lower openness in sharing how to make and use the invention.

I believe this competitive research boot camp taught by outstanding researchers will greatly help me in furthering research in the economics of innovation. I will have the opportunity to learn cutting-edge innovation research, improve my ability to formulate research questions, develop innovative research ideas, and make significant contributions to the field in the future. I believe that the research skills that I have acquired in my research projects can be used to address questions in innovation study.

I am very eager and enthusiastic to join the NBER Innovation Research Boot Camp. I strongly believe this is an essential opportunity for a young scholar like me to get intensive academic training, build an academic connection with fascinating scholars, and advance my research in the economics of innovation. I sincerely hope to be considered for admission to this competitive boot camp.

NORTHWESTERN UNIVERSITY
Kellogg
School of Management

Strategy Department

1 February 2024

Recommendation Letter for Xizhao Wang

Dear IRBC Committee:

While I know we randomize admission, I'm very hopeful Xizhao Wang can make it into the program. Xizhao has emerged as one of the very best Ph.D. students I have had the chance to advise over the last two decades. She has a number of super interesting projects in the innovation space, all creative ideas – both conceptually and empirically – that are all her own. She is technically adept, hard-working, and always interesting to talk to. I think she has an extremely bright future and will likely place in a top department.

One of her projects examines how replaceable inventive human capital is within firms. Using inventor deaths, and some novel measurement approaches, she shows that the inventive direction of firms changes when they lose top inventors. Interestingly, the deaths of top inventors affect the technological trajectory of the firm, while the deaths of top managers do not, suggesting that the specialized nature of inventive human capital is hard to replace (and influential). Another of her projects examines how patents are written, and whether assignees can have a strategic incentive to obfuscate the invention in the disclosure. She uses comparisons between university patenting and corporate patenting, with Bayh-Dole as a quasi-experiment, to show that the language in university patents (even from the same inventor) becomes more obfuscated after TTOs are established, and converges to corporate behavior.

Xizhao is currently in her fourth year in the Ph.D. program at Kellogg, and I expect that she will go on the market soon, quite possibly this fall. The boot camp will be a great opportunity for her to learn and to meet people. She would also be a strong contributor to the group – in addition to her research strengths, she is extremely pleasant, curious, and engaging, and she may well develop new potential collaborators through the boot camp opportunity. She has my highest recommendation.

Sincerely,



Benjamin F. Jones, Gund Family Professor of Entrepreneurship
Kellogg School of Management
bjones@kellogg.northwestern.edu