Xiaoxi (Joyce) Wang
Office 8029
105 St. George Street
Toronto, Ontario, M5S 3E6

February 5, 2026

Review Panel
NBER Innovation Research Boot Camp
National Bureau of Economic Research

Dear NBER Innovation Research Boot Camp Review Panel,

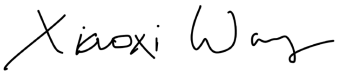
I am writing to express my interest in attending the NBER Innovation Research Boot Camp. I am currently a fourth-year PhD student in Economic Analysis and Policy at the Rotman School, University of Toronto, with a focus on industrial organization and economics of innovation. Having completed over two years of rigorous coursework in economics, I am eager to deepen my understanding of innovation research and engage with fellow scholars in this dynamic field.

For your reference, Professor Mitsuru Igami, who has been closely supervising my thesis, will be submitting a recommendation letter on my behalf.

Thank you for considering my application. I look forward to the opportunity to contribute to and learn from this esteemed program.

Please find enclosed: my CV, research statement, and a list of completed PhD courses.

Sincerely,



Xiaoxi (Joyce) Wang

Xiaoxi (Joyce) Wang

PhD Candidate • Economic Analysis and Policy • Rotman School of Management

xiaoxiw.wang@rotman.utoronto.ca — joycelafee — xiaoxiwangreen

Research Interests

Economics of Innovation, Industrial Organization, Applied Microeconomics, Organizational Economics

Education

Ph.D. in Economic Analysis and Policy, Rotman School of Management, University of Toronto 2022 – Now
Honors M.A. in Public Policy, Harris School of Public Policy, University of Chicago 2019 – 2021
B.Eng. in Bioresource Engineering, McGill University 2011 – 2016

PhD Coursework

IO: Industrial Organization I/II, Advanced Topics in the Theory of Industrial Organization
Macroeconomics: Macroeconomic Theory I/II, Quantitative Macroeconomics, Topics in Growth and Development, Firm Dynamics and Economic Growth
Other: Advanced Microeconomic Theory I, International Trade Theory

Working Papers

Artificial Intelligence and New Drug Development. *[with Fang Jie, Ruiqi Sun, and Dan Trefler]*

How does AI shift the direction of innovation in drug development? This paper addresses this question from two perspectives. First, using a difference-in-differences design with the release of AlphaFold2 as a quasi-exogenous shock, we find that protein targets previously lacking experimental structural coverage experienced a significant increase in assay activity (a 23% increase over the baseline). Furthermore, drugs targeting these proteins saw a 6.9% relative increase in the adoption of novel modalities, suggesting that structural knowledge enables more sophisticated drug design over time. Second, we utilize LinkedIn data matched with drug pipeline data to analyze firm-level AI scientist hiring. By instrumenting this hiring with regional university AI talent, we assess the resulting effects on innovation novelty at the firm level.

How does Contractual Terms affect Drug Development Success. *[Second Year Paper]*

While licensing allows firms to leverage external innovation, royalty obligations may increase marginal costs and deter investment. We investigate this by examining the effect of royalty rates on biopharmaceutical project attrition. To address endogeneity, we use an instrumental variable approach incorporating benchmark rates, market competitiveness, and historical technology reliance. Our baseline estimates show wide variance; however, a one standard deviation increase in royalty rates significantly reduces success rates by 30% to 32% for high-capacity licensees (those with 3+ prior drugs). These results suggest that high royalty burdens can stifle development incentives, particularly for experienced firms, underscoring the need for better-aligned contractual structures in external innovation.

Teaching Experience

Teaching Assistant, Managerial Economics (Professor William Strange) 2023-2025
Instructor, Math Camp (Harris School of Public Policy) 2020
Three-week review course in mathematical concepts for first-year public policy students
Teaching Assistant, Advanced Microeconomics (Professor Steven Durlauf) 2020

Awards and Scholarships

Institute for Gender and the Economy (GATE) Research Grant	2025
TD-MDAL Research Grants	2025–2026
TD-MDAL Research Grants	2024–2025
Merit-based Scholarship for Public Policy Student, University of Chicago	2019

Other Experience

Research Assistant, Professor Richard Hornbeck	2020 – 2022
Research Apprenticeship, Professor Steven Durlauf	2021 – 2021
Science and Technology and Innovation Assistant, Embassy Canada	2019 – 2019
Commercial Business Analyst, Humanitas Inc. (Drone Startup Firm)	2018 – 2019
Membership Manager, The Canadian Chamber of Commerce in Shanghai	2017 – 2018
Co-Founder, Green Innovation Engine (GREIEN)	2016 – 2017
Intern, Climate Change Environment Management, UN Environment Programme (DEWA)	2014 – 2015

List of Completed PhD Courses

University of Toronto

Winter 2024:

ECO3200H – Advanced Microeconomic Theory I

ECO3901H – Industrial Organization II

RSM3011H – Advanced Topics in the Theory of Industrial Organization

Fall 2023:

ECO2104H – Quantitative Macroeconomics

Eco2120H – Topics in Growth and Development

ECO3300H – International Trade Theory

ECO3900H – Industrial Organization I

Fall 2022 / Winter 2023:

ECO2200H/ECO2201H – Microeconomic Theory I&II

ECO2100H/ECO2101H – Macroeconomic Theory I&II

ECO2400H/ECO2401H – Econometrics I&II

University of Chicago:

Winter 2021

ECON 33530 – Firm Dynamics and Economic Growth

Research Agenda
NBER Innovation Research Boot Camp 2026

Xiaoxi (Joyce) Wang

February 05, 2026

My research examines how firms innovate beyond their boundaries.

Current Research

My dissertation explores three interconnected questions about external innovation in biopharmaceuticals. First, I analyze how contract structure affects innovation incentives. While licensing enables firms to access external technologies, royalty obligations may increase marginal costs and deter subsequent investment. Using comprehensive industry data, I examine how royalty rates influence biopharmaceutical project attrition, revealing the delicate balance between incentivizing innovators and maintaining downstream development.

Second, I investigate the substitution between licensing and acquisition under antitrust constraints. When regulators block acquisitions, firms turn to licensing as an alternative. I build a dynamic structural model to quantify the long-run effects of antitrust policy on drug innovation and market structure. This reveals a fundamental competition-efficiency trade-off: while licensing creates inefficiencies through incomplete contracts and potential holdup problems when market power concentrates in marketers' hands, it also enables continuous firm growth through royalty income that recycles into new projects, fostering a healthier biopharmaceutical ecosystem.

Third, I examine how artificial intelligence - adopted in biopharmaceuticals since the early 1980s—affects innovation patterns. Using LinkedIn employment data, I find that AI-enabled firms not only develop more drugs and pursue more novel therapies, but also form significantly more partnerships, suggesting AI lowers entry costs and reshapes collaborative networks in drug development.

Future Research Direction

Building on this foundation, I aim to develop a network model of common ownership in venture capital and drug development. The bargaining between innovative upstream firms and established downstream companies essentially represents negotiation between venture capital and big pharma. However, when large, branded firms establish corporate venture entities, they gain competitive advantages in identifying nascent technologies and acquiring promising innovations early.

Beyond biopharmaceuticals, I aim to extend this research to other innovation markets, including creative industries and consumer-branded sectors, as across different industries, large firms increasingly subcontract innovation to entrepreneurs.

Why This Boot Camp

I am eager to attend this boot camp to learn about the forefront of innovation research, and engage with leading scholars studying innovation from a wide range of backgrounds. I believe it will be an enriching experience.

UNIVERSITY OF TORONTO
Department of Economics
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Toronto, ON M5S 3G7, Canada
Email: mitsuru.igami@utoronto.ca

February 10, 2026

Dear Review Committee,

I am writing to offer my strongest recommendation for Xiaoxi (Joyce) Wang to attend the NBER Innovation Research Boot Camp. As her **PhD advisor** at the University of Toronto (together with **Matt Mitchell**, who is currently on leave), I have worked closely with Joyce and can attest that she is exactly the type of promising young scholar this program is designed to support.

Joyce's dissertation research focuses on the **competition and cooperation in the biopharmaceutical industry**, specifically examining the trade-offs between licensing and acquisition under antitrust constraints. She is building a dynamic structural model to quantify how regulatory interventions (e.g., blocking acquisitions) ripple through the market to affect long-run innovation incentives and contract structures, which is a truly important policy question.

There is a profound alignment between her research agenda and my own work in empirical IO and innovation. However, what sets Joyce apart is her **deep industry knowledge**, as well as the **ambition and execution** of her job market paper. To be candid, hers is the **only student project I have encountered that made me feel genuinely "jealous."** The way she identifies and quantifies the competition-efficiency trade-off is an insight I wish I had arrived at myself.

Joyce is a technically gifted and creative economist who will contribute significantly to the next generation of innovation research. The NBER Boot Camp would be the ideal environment for her to refine this high-potential work.

Sincerely,



Mitsuru Igami
Associate Professor of Economics
University of Toronto
mitsuru.igami@utoronto.ca