Brett Maranjian
NBER Conference Department
National Bureau of Economic Research
1050 Massachusetts Avenue
Cambridge, MA 02138-5398

Dear application reviewers,

March 28, 2016

My name is Xiaolu Wang; I am a second-year Ph.D. student in Economics at Cornell University. My research areas are applied microeconomics (Industrial Organization, Healthcare, and Innovation), and applied econometrics. I have been interested in the interdisciplinary area of innovation and entrepreneurship since last fall, and am excited to apply for the 2016 NBER Entrepreneurship Boot Camp. My recommender is Prof. Sean Nicholson, an expert of financing and innovation in the pharmaceutical and biotechnology industries, and the co-editor of the *The Oxford Handbook of the Economics of the Biopharmaceutical Industry* (2012).

I am writing to apply for the 2016 NBER Summer Entrepreneurship Research Boot Camp. In this package, I have enclosed all the requested application materials: a Statement of Purpose (SOP), a Curriculum Vitae, a list with Ph.D. level courses taken. I have illustrated my current research projects and ideas which are related to innovation and entrepreneurship in the SOP, and listed some of my previous research projects and interests in the Vitae. Prof. Nicholson will send out his recommendation letter separately in the incoming few days.

Please let me know if there is any other information that you require. I am currently working on a second year research paper on biopharmaceutical innovation, and I am getting excited while diving into the "economics of innovation" literature. I am more than eager to gain a systematic understanding of this area by reading through the papers to be assigned, attending the intensive summer Boot Camp, and communicating research ideas with scholars working in this area. I would deeply appreciate the potential chance to get enrolled, and would try my best to make you proud as a future alumna.

Sincerely,

Xiaolu Wang

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Cornell University
Ithaca, NY 14850

1. Why I want to study innovation & entrepreneurship

I want my research in economics to make an impact. Through my eight-year part-time research in both China and the U.S., I have gained first-hand experience of social welfare problems that can be resolved by innovation and entrepreneurship. To give specific examples, I saw how social entrepreneurs in both China and U.S. tried to provide innovative microfinance services to help the long-ignored needs of small-size enterprises and poor individuals; as an undergraduate I surveyed thousands of old persons in Beijing and Shanghai, and was surprised by the deficiencies of the outdated financial system in an aging demographic; and perhaps the most searing experience of all: I heard the desperate voices of residents in the "AIDS Villages" in Henan Province, who were deeply trapped in the fortune-driven vicious cycle of disastrous lives, regardless of the billions of dollars investment in anti-HIV drugs by "Big Pharma" or bio-tech companies in the past decade. In short, I have seen first-hand how important it is to have innovative financial, technological and policy support to develop, test, and deploy high-impact solution to society's toughest challenges. I would love to deepen my understanding of the role played by entrepreneurs, their dynamic interaction with the market, and innovation-friendly incentive schemes (especially in bio-pharmaceutical industry).

2. How I prepared and want to study in innovation & entrepreneurship

As a second year PhD student in Economics at Cornell, I am interested in applied microeconomics (industrial organization, healthcare, innovation) and applied econometrics. While accumulating my own human capital, I am working on several projects/ideas related to innovation and entrepreneurship, where I encountered various difficulties that I hope to solve through the boot camp.

The first project (my second year paper) is on biopharmaceutical companies' research and development (R&D) decisions under different contractual designs and integration status (full ownership, acquired, co-licensing). Well-known as a costly process, biopharmaceutical firms invested an estimated $51.2 billion in R&D in the U.S. in 2014, an amount representing 23.4% of their domestic sales. Research-intensive small biotech firms are by and large financially constrained, and internal funding often fails to cover R&D cost, due to asymmetric information in the drug quality and potential agency problem in firms with separation between owners and managers. Entrepreneurial biotech companies may manipulate their R&D decisions to send positive signals to venture capitalist and then attract investors, which may lead to short run inefficiency if that drug cannot successfully launch to the market. I am working on project-level data from PharmaProjects, with merged financial information on public companies from Compustat during 1985-2004. Endogenous product choices are documented for both big pharma and small biotech, in terms of new products' degree of innovation *vs.* lucrativeness. I am constructing innovation index based on drugs' world development status, relative difficulties across therapeutic categories, and within-category bio-similarity; and lucrativeness is based on sales data and market shares. I want to characterize the agency problem in an applied theory model, test predictions with reduced-form evidence, and hoping for consistent results via a simplified structural model of dynamic optimization, but I am having difficulty modeling the drug development process realistically without suffering from curse of dimensionality. I am also working on getting more recent and broader data, for future research incorporating demand-side information and meaningful counterfactuals.

The second project is to analyze the impact of government intervention on firms' R&D behavior. In particular, I would like to look at an innovation-promoting incentive policy, the priority review voucher (PRV), on biopharmaceutical companies' R&D investment behavior. The PRV is an expedited review granted by the FDA to the developer of a treatment for neglected diseases, and with a bonus voucher that can be sold in the secondary market (via auction) to other firms for usage of potential profitable drugs. Beside market-based incentives provided for the development of new medicines in

the direct market for neglected diseases (such as malaria, tuberculosis and dengue), I am particularly interested in the policy impact in the secondary market where the voucher is being purchased for the fast review of profitable drugs. May the auction winner invest more aggressively with the potential monopoly-power (if successfully got approved)? Or might the temporary monopoly power lead to distortion in the secondary market via signaling to competitors? Given the limited amount of voucher in the market, I am working on developing a theoretical structural model to capture the policy impact on biopharmaceutical companies' investment behavior, and will try to compare reality with simulated counterfactuals (e.g., alternative mechanism). Meanwhile, I am scraping the publicly available clinical trials data, for a directly policy analysis on the voucher's impact on drug R&D across therapeutics.

The third idea is on the relative role of China in the global innovation dynamics. China leads the world in patent applications for the past few years (WIPO 2015), has spent more than $200 billion on research (second only to the U.S.), produced close to 30,000 Ph.D.s in STEM major, and has become a strong STEM-major producer and big innovator in consumer electronics and construction equipment. However, the overall picture is blurry, as the innovation in science-intensive areas is still scant. For example, no radical innovation in new drugs since artemisinin for malaria in the 1970s — a breakthrough for which chemist Youyou Tu was awarded a Nobel Prize last year — and even that was not adopted widely until its commercialization by Novartis in the 1990s. This means China has been taking advantage of the global price differentials in drugs for decades, without contributing enough as a global citizen. Meanwhile, the share of high-tech industry export is growing much fast than other categories within manufacturing export, indicating a potential transition in innovation dynamics. I am clearing the data in *China Statistical Yearbook on High Technology Industry* (1995-2015), and hope to combine Chinese high technology firms' innovation evolution in the global "co-opetition." More resourceful firm-level data is preferred, and I want to dive deeper into the literature for the research.

In additional, I would like to explore some restricted-use microdata at the Census Bureau, such as the Longitudinal Employer-Household Dynamics data, as linked employer-employee data provides the richest resources by combining information from business, workforce and individuals. I am looking forward to working in the restricted data center upon approval at Cornell, thanks to Prof. John Abowd, who helped construct the linked employer-employee data. Besides, affiliation with the Institute of Social Sciences' "Creativity, Innovation and Entrepreneurship" project exposed me to various scholars.

3. Why I am applying to the NBER Entrepreneurship Boot Camp

Given my general research interest in applied microeconomics (IO-health), with proper training and strong enthusiasm in the interdisciplinary of entrepreneurship, I am particularly attracted to the NBER entrepreneurship research boot camp. After diving deeper into relevant literature and institutional details, and communicating with former Boot Camp attendants such as Prof. Sean Nicholson and Allan Kwan, I affirmed my aspiration to participate in the program. First, the extensive topics covered by experts in entrepreneurship will be vital in building a comprehensive system in this area, which can help me achieve my research goals. Second, the boot camp provides a unique environment to pool researchers sharing similar interest together, which is a special incubator for new sparking ideas and collaboration. Third, having attended the Healthcare and Aging session in NBER summer institute last year, I deeply appreciate the unique institutional structures, intellectually intensive sessions, and highly diversified scholars, all of which make the journey of research extremely enjoyable and fruitful. Since my research interests overlap those of the Boot-Camp's Professors in multiple dimensions, I get thrilled for the (potential) opportunity to learn from and communicate with these amazing scholars. At the same time, with my rich research experience, intensive training and great enthusiasm in the field of innovation and entrepreneurship, I believe I will make you proud as a future alumna.

XIAOLU WANG

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EDUCATION

CORNELL UNIVERSITY **Ithaca, NY, U.S.**
Ph.D. Student in Economics ***Aug. 2014 – Jun. 2019 (expected)***

- In Progress. Passed all three qualifiers, with high passes in Macroeconomics and Econometrics.
- Research Interests: Industrial Organization, Health Economics, Applied Econometrics.

DUKE UNIVERSITY **Durham, NC, U.S.**
Master of Arts in Economics (Graduate with Distinction) ***Aug. 2012-May 2014***

- GPA: 3.9/4.0; Specialization: Economic Analysis (PhD preparation); Economics Master's Scholarship
- Award: Duke Economics Master's Program Award for Leadership and Academic Excellence, Class of 2014

CENTRAL UNIVERSITY OF FINANCE AND ECONOMICS (CUFE) **Beijing, China**
Bachelor of Economics, Major: Insurance (Graduated with Highest Honors) ***Aug. 2008-Jun. 2012***

- GPA: 91/100; Full tuition and stipends covered by various academic scholarships
- "Outstanding Student" of Beijing Municipality (<0.1%) & that of Anhui Province (Top 10) 2011 & 2005
- "Outstanding Undergraduate" of Beijing Municipality (top 0.5% selected in CUFE) 2012

RESEARCH EXPERIENCES

Research Assistant, for Prof. Michael Lovenheim and Maria Fitzpatrick **Ithaca, NY**
- Work on data-driven, policy-oriented empirical projects. **Jun. 2015 – Jun. 2016**

"Auto-loan Default Analysis & Demand Estimation for SelfHelp Credit Union" **Durham, NC**
Principal Investigator, for Profs: Charles Becker & Martin Zelder ***Sept. 2012-May 2014***

- Merged and cleaned first-hand confidential datasets for SelfHelp; built data-driving model specifications.
- Combined data mining with casual inference in loan default risk analysis, constructed risk measures on all economic agents (credit union, clients, and car dealers), allowed Bayesian hierarchical information sharing.
- Constructed discrete choice models for auto load demand estimations, characterized and predicted branch-specific default risks. Accomplished three reports for policy advice, and presented with Prof. Becker.

"Should Manufacturing Be Subsidized?" **Durham, NC**
Research Independent Study & Research Assistant for Prof. Edward Tower ***Aug. 2013 –Jan. 2014***

- Constructed a comprehensive dataset based on five mainstream datasets; data-driven sample corrections.
- Conducted cross-sectional and panel analyses to the determinants of manufacturing share of GDP and economic growth; discussed the role of governance (using 6-dimensional indicators) and regional effects.
- Analyzed the impact of trade restriction (using various measures) on manufacturing share and economic growth; in particular, focused on heterogeneous regional effects and government performance.
- Submitted a chapter (with Prof. Edward Tower and Alecia Waite) for the book *The Region and Trade (2015).*

"Chinese CFOs Think China should Triple Gold Holdings" **Durham, NC**
Research Assistant for Prof. Campbell Harvey (Fuqua Business School) ***Jan.2013-Feb.2013***

- Worked as a "cultural bridge" in Duke Global CFO survey; analyzed the attitude to gold of Chinese CFOs.
- Discussed and modified an essay of the professor, and translated it into accurate streamlined Chinese.

"Innovative Research on Old Age Security System under Longevity Risk in China" **Beijing & Shanghai**
National Innovative Research Project, Project Creator & Chief Modeler ***May 2010-Nov.2012***

- Won grant from National Ministry of Education (China) in Oct. 2010, and completed in May 2012.
- Stood out as Top 5 completed undergraduate National Innovative Project in Beijing (Top 20 in China), and exhibited in "National Undergraduate Innovation and Entrepreneurship Conference" (Nov 2012 Beijing).

✧ Vast sampling questionnaire survey twice in various regions in Beijing and Shanghai: (1) in 2010: collected 1635 valid questionnaires (1255 from people aged 40-65, 380 from people aged 65+); (2) in 2012: collected 1046 valid questionnaires (507 middle-aged, 539 elderly) to fellow-up study the influence of longevity risk on middle class in Chinese metropolises.

✧ Project Summary: Apply empirical analysis and innovative actuarial models to do in-depth and fellow-up analyses on China's social security system under increased longevity, summarize major problems and underlying reasons and provide policy recommendation.

✧ Project-related papers and conferences: resulted in two main project papers, published in international conference and books, along with prize-winning reports in "Challenge Cup" Academic Contests.

PROJECT EXPERIENCES

"Fledgling Eagle Project" for Most-Promising Migrant Children in Rural Beijing **Beijing, China**

Founder, Principal investigator & Team leader ***June 2010- June 2012***

✧ Founded and self-sponsored the "Fledgling Eagle Scholarship" for migrant children at *Tongxin Primary School* (Jul.2010). Initial funding: My academic awards -winning scholarships; later, won long-run external funding.

✧ Raised awareness for young migrant children and "fledgling eagles" (the most promising migrant students) through award-winning investigations, promotion in universities in Beijing and media exposure during the "Afternoon Tea of Finance" (4-5.Aug.2010) on CCTV 2, the top Finance and Economics Channel in China.

"Plan – Migrant Children Development Project" **Beijing, China**

Voluntary teacher & Volunteer Coordinator ***Mar. 2009-Jul. 2010***

✧ Selected as a top 5% applicant and team leader for "Migrant Children Project", funded by Plan Foundation. Worked as a part-time art teacher for immigrant children (whose parents are immigrant laborers) in rural Beijing.

✧ Investigated social security system in rural Beijing and collected 541 valid questionnaires to analyze the status of medical coverage for immigrant children, published the research paper and presented it in *China Social Security Symposium* (*Highest level in its kind;* Jul. 2010 Great Hall of the People, Beijing).

✧ Coordinated with 6 volunteers in teaching, and led a team of 3 people in the academic investigation.

SOCIAL ENTREPRENEURSHIP EXPERIENCES

A Better Community (ABC) Consulting Group **Beijing, China**

Project Consultant and Volunteer on "Teach Future China" (TFC) Project ***Mar. -Jul. 2012***

✧Standout as top 4% applicant, trained by Accenture and ABC as a project consultant for "Teach future China"

✧Conduct benchmarking on "Teach for America" and other 5 NGOs; renovate the structure for "TFC".

✧Design and analyze in-depth survey of 30 TFC members, work out effective ways to build regional teams.

Microfinance Entrepreneurship Awards (CMA) -Citi-Bank funded **Beijing & Guizhou, China**

Financial investigator & Team leader* for *China Banking Association* (CBA)** ***Jul. -Sept. 2010

✧ Selected as a representative of "China Student Alliance for Microfinance", wrote English assessments of applicants for awards, and cooperated with Sina.com in web-building and project promotion.

✧ Audited financial conditions of 3 individual applicants and 2 NGOs in two counties of Guizhou Province**.**

DISCUSSANT

Asia-Pacific Risk and Insurance Annual Conference (Jul 2012, Seoul Korea), Session: Actuarial pricing

Pre-Doctorial PUBLICATIONS & PRESENTATIONS

Edward Tower, Alecia Waite and **Xiaolu Wang,** "Manufacturing Fetishism: The Neo-Mercantilist Preoccupation with Protecting Manufacturing." Chapter 11 in *The Region and Trade: New Analytical Directions*, 2015. (World Scientific)

Xiaolu Wang, "Bayesian Hierarchical Regression (Generalized Linear Model) Analysis of US State-Specific Non-Violent Crime." *International Journal of Business and Management Invention* (06/2013), Page 33-40.

Xiaolu Wang, "Challenge of Longevity Risk to China's Emerging Life-Insurance Industry: Game Analysis on China's Commercial Pension Market." *Asia-Pacific Risk and Insurance Association (APRIA) 16th Conference*

(Concurrent Session 3, 7.21~7.25, 2012 Seoul Korea)

Xiaolu Wang, Zhijun Deng, Meichen Jiang, "An Innovative Research of Old Age Security System in Emerging Market under Longevity Risk Environment: Based on Investigations in Beijing and Shanghai, P.R.China." *Asia-Pacific Risk and Insurance Association (APRIA) 15th Annual Conference (Tokyo 7.31~8.3, 2011)*; original Chinese draft won the 2nd prize of "*Challenge Cup" National Academic Science & Technology Competition* (Beijing Jun. 2011)

AWARDS & HONORS

- ✧ "Top Ten Outstanding Individuals/Teams in Academic and Research", CUFE (<0.1%) 2010 - 2012
- ✧ 1st prize of "Challenge Cup" Academic Dissertation Contest, Economic Group, CUFE (3%) 2010 & 2011
- ✧ 1st prize of China Ping An National Academic Dissertation Contest, Insurance Group, 1st author 2010
- ✧ Honorable Mention, Interdisciplinary Contest in Modeling (ICM), U.S. based 2011
- ✧ 2nd place, China National Undergraduate Mathematical Contest in Modeling (CUMCM) 2010

SKILLS & HOBBIES

Computer Skills: Proficient in Stata, Matlab, R, Github; Basic in Parallel Programming, Python, GAMS, SQL

Language Skills: Native Speaker of Chinese; Fluent in English

Music: Electronic Piano (Level 8/9); Basic command of "Xiao" (a Chinese bamboo instrument)

Painting: Sketch Level 7/10, Gouache Level 5/10, Making handicrafts (e.g. Chinese paper-cuttings)

Running: 400 meters and 1500 meters champions in Middle, High School and University Sports Competitions

Others: Cooking (& eating), sky watching, reading, traveling.

List of Current and Completed Ph.D. Courses

1. Ph.D. courses in Cornell University, NY (2014 – 2016)

- Advanced PhD courses (in progress):

  Semi/Non-parametric Econometrics, Francesca Molinari

  Empirical Methods in Public Economics, Claire S.H. Lim

  Empirical Public Finance and Taxation, Mike Lovenheim

  Empirical Strategy for Policy Analysis I (audit), Jordan Matsudaira

- Advanced PhD courses (completed):

  Industrial Organization & Regulation II, Panle Jia Barwick

  Seminar in Labor Economics I, Richard Mansfield & Victoria Prowse

  Empirical Strategy for Policy Analysis II, Zhuan Pei

  Graduate Independent Study, Sean Nicholson

- Standard 1st year PhD courses:

  Microeconomics I - II, David Easley, Larry Blume

  Econometrics I - II, Yongmiao Hong, Jörg Stoye

  Macroeconomics I - II, Julieta Caunedo, Karl Shell, Karel Mertens, Francesco Bianchi

  Mathematical Economics I, Tapan Mitra

- Throughout all 4 semesters: Industrial Organization Workshops, Labor Economics Workshops

2. Ph.D. courses completed in Duke University, NC (2012-2014)

- Advanced PhD courses:

  Human Capital, by Joseph Hotz

  Health Economics I – Supply Side, by Frank Sloan & Charles Becker

  Demand Models, Andrew Sweeting

  Bayesian and Modern Statistics, David Dunson

  Special Topics in Economics: Stata, Joe Mazur

  Special Topics in Economics: Matlab, Joe Mazur

  Real Analysis, Aaron Kolb

- 1st year PhD courses:

  Microeconomic Analysis I – The Economic Agent, Philipp Sadowski

  Microeconomic Analysis II – Game Theory, Curtis Taylor

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March 27, 2016

To Whom It May Concern:

This letter is in support of Xiaolu Wang's application to the NBER Entrepreneurship Boot Camp in July 2016. I am a professor in the Department of Policy Analysis and Management at Cornell University and a Research Associate at the NBER in the health care group. Xiaolu is a second-year economics PhD student at Cornell. I have gotten to know her quite well this year while she has been working with me on an independent study project. Under my direction, Xiaolu has been reading and summarizing important articles in the health economics literature and discussing them with me at biweekly meetings. We have also been discussing her evolving second-year paper. I believe Xiaolu would be a great addition to the Entrepreneurship Boot Camp. She is smart, has a strong grounding and interest in theory, has plenty of interesting ideas, and is quickly developing her empirical and econometric skills. I am confident that Xiaolu would learn a great deal at the Boot Camp and would invest these skills into her future research.

Xiaolu has taken a rigorous set of economics PhD courses in her first two years at Cornell and passed her qualifying exams after her first year, two with high honors. She is developing an interesting paper that may eventually become her job market paper. She is interested in the intersection of health economics, industrial organization, and finance. Specifically, Xiaolu is exploring how the size and financial condition of biotech and pharmaceutical firms affect their research and development and product development decisions. Due to asymmetric information and agency problems, managers of smaller biotech firms may pursue sub-optimal projects and develop them in inefficient organizational forms. In order to test her hypotheses, she has assembled detailed pipeline information from PharmaProjects from 1991 to 2004, and is integrating that with the clinical trials data base available on-line (and workable after a great deal of data cleaning). Although it is early, this research area is promising. R&D in the biotech and pharmaceutical industries is a major driver of health improvement and increased spending in the health care sector, and is a hotbed of entrepreneurial activity.

Xiaolu would benefit greatly from and contribute to the NBER entrepreneurship boot camp. Please contact me (607-254-6498) if you require additional information and/or if you would like me to elaborate on my comments.

Sincerely,

Sean Nicholson, Ph.D.