

## Junying ZHAO

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- EDUCATION**
- Ph.D.** in Social Science, with concentration in Mathematical Behavioral Sciences, University of California, Irvine, USA (expected) 2019  
Dissertation: *Hippocratic Paradox — A Mathematical Model of Medical Ethics, its Application to Medical Artificial Intelligence, and its Economic Consequences.*  
Committee: Donald Saari (Chair), Stergios Skaperdas, Igor Kopylov
- Ph.D.** in Health Policy, with specialty in Economics, McMaster University, Canada 2015  
Dissertation: *Three Essays in Welfare and Health Economics: Social Choice, Health Capital, and Health Expenditure.*  
Committee: Jeremiah Hurley (Chair), Deirdre Haskell, William Scarth
- B.Sc.** in Honours Mathematics and Statistics, McMaster University, Canada 2015  
**M.P.H.** in Global Health and Population, Harvard University, USA 2009  
**B.Med.** in Clinical Medicine, Hebei Medical University, China 2005
- RESEARCH INTERESTS** Applications of Mathematics and Economics to Medicine:  
**Medical Artificial Intelligence, Medical Decision-Making, Mathematical Medicine Health Technology Innovation, Health Economics**
- PEER-REVIEWED PUBLICATIONS**
- Zhao, J.**, Scarth, W., and Hurley, J. 2018 “Investing in Health: A Macroeconomics Exploration of Short-Run and Long-Run Trade-Offs”, *Atlantic Economic Journal*, Accepted. Forthcoming.
- Haskell, D., Hurley, J., and **Zhao, J.** 2017 “The Possibility of Anonymous Social Orderings Using Curvature of Indifference Hypersurfaces”, *Mathematics of Operations Research*, Revise & Resubmit.
- Zhao, J.** 2008 “Purification and Identification of Recombinant Human Interferon- $\lambda_1$ ,” *Journal of Clinical Rehabilitative and Tissue Engineering Research*, 12(50): 9932-9936.
- WORKING PAPERS**
- Zhao, J.**, Scarth, W., and Hurley, J. 2015 “Investing in Health: A Macroeconomics Exploration of Short-Run and Long-Run Trade-Offs” McMaster University Department of Economics Working Paper No. 2015-15. <https://www.economics.mcmaster.ca/research/department-working-papers>
- Zhao, J.** 2015 “Forecasting Health Expenditure: Methods and Applications to International Databases.” McMaster University Centre for Health Economics and Policy Analysis Working Paper No. 15-05. <http://www.chepa.org/research-papers/working-papers>
- NEWSLETTERS**
- Zhao, J.** and Zuo, G. 2013 “A Critique of Welfarism and Extra-welfarism,” *Health Economy News*, January 25.
- FUNDED RESEARCH**
- “Hippocratic Paradox and Irrational Consensus: A Mathematical Analysis of Medical Decision-Making” (with Don Saari, UC Humanities Research Institute, \$20,000)

WORK IN  
PROGRESS

“Political Economy of Health Care” (with Stergios Skaperdas)

“Subjective States and Incomplete Preferences Over Menus” (with Igor Kopylov)

“Temptation, Commitment, and Weak Resolve Preferences Over Menus: A Lab Experiment ” (with John Duffy and Igor Kopylov)

GRANTS AND  
AWARDS

The Andrew and Florence White Fellowship, UC Humanities Research Institute (\$20,000) 2016–2017

Summer Research Award, IMBS, UC Irvine (\$2,750) 2016

Teaching Assistant Award, UC Irvine (\$48,900 annual) 2015–2018

EDEEM Fellowship, European Union (€27,040 annual, declined) 2015–2018

Canadian Economics Association Travel Grant 2013, 2015

International Institute of Forecasters Travel Grant (\$2,000) 2013

Canadian Institutes of Health Research Travel Award (\$1,500) 2012

Yates Scholarship, McMaster University 2012

Graduate Student Association Travel Award, McMaster University 2012

Graduate and Research Scholarships, McMaster University (\$28,000 annual) 2010–2015

Presidential Scholars Fund, Harvard University (\$35,403) 2008–2009

RESEARCH  
EXPERIENCE

2011, **Short Term Consultant**, Health, Nutrition, and Population Unit, World Bank, September – December.

“The Assessment of Total and Public Health Expenditures Data Discrepancy for World Bank Member Countries”. Assessed data quality and consistency, systematically documented discrepancies between data sources from WHO-National Health Account, IMF-World Economic Outlook, OECD Health Account.

2011, **Research Intern**, Dept of Health Systems Financing, World Health Organization, June – September.

“Macroeconomic Forecasting of Health Expenditure and its Components for WHO Member Countries”. Evaluated forecasting methods for health spending using National Health Account database.

2010, **Research Fellow**, Dana-Farber Cancer Institute, Harvard Medical School, January – June.

“Medicaid Services and Outcomes Research”. Examined the cancer stage distribution, delivery and survival outcomes of standard chemotherapy and radiation associated with Medicaid enrollment in New York and California.

2009, **Research Fellow**, National Institute of Injury Prevention, Ministry of Health, Mexico, July – December.

“The Impacts of Influenza A/H1N1 on Health Care Expenditure in Mexico”. Conducted panel data analysis, drafted and disseminated research report.

TEACHING  
INTERESTS

**Mathematics for Economics, Health Economics** (graduate)

**Economics, Mathematics** (undergraduate)

TEACHING  
EXPERIENCE

2015 – present, **Teaching Assistant**, Economics Department, UC Irvine

Taught discussion sessions two hours each week; reviewed course contents; wrote extra credit problems; discussed and graded assignments, midterms and finals; held office hours at Economics Learning Center; answered students’ questions about course materials; mentored students on their choices of major and career.

Econ 15B: Probability and Statistics for Economics II (1 quarter, 90 students)

Econ 20A: Basic Economics I/Microeconomics (2 quarters, 100 students each quarter)  
Econ 100A: Intermediate Economics I/Microeconomics (1 quarter, 90 students)  
Econ 100C: Intermediate Economics III/Macroeconomics (1 quarter, 85 students)  
Econ 122A: Applied Econometrics I (1 quarter, 40 students)

INTERNATIONAL CONFERENCE PRESENTATIONS 2018, "*Hippocratic Paradox*"  
the American Economics Association Annual Conference, Philadelphia, PA, United States, January 5.

2015, "*Anonymous Social Orderings*"  
the Royal Economic Society annual conference, Manchester, United Kingdom, March 30.  
the 49th Annual Conference, Canadian Economics Association, Toronto, Canada, May 30.

2013, "*Forecasting Health Expenditure*"  
the 33rd International Symposium on Forecasting, Seoul, South Korea, June 24.  
the 47th Annual Conference, Canadian Economics Association, Montreal, Canada, June 1.  
the 12th Annual Meeting, Canadian Health Economist's Study Group, Winnipeg, Canada, May 22.

2012, "*Forecasting Health Expenditure*"  
the 9th European Conference on Health Economics, Zurich, Switzerland, July 20.  
the 2nd Global Symposium on Health Services Research, Beijing, China, November 2.  
the Annual Canadian Association for Health Services and Policy Research Conference, Montreal, Canada, May 30.

2011, "*Evaluating Forecasting Methods for Health Spending*", Department of Health Systems Financing, World Health Organization, Geneva, Switzerland, August 30.  
"*Impacts of Influenza A/H1N1 on Health Care Expenditure in Mexico*", the 8th World Congress on Health Economics, Toronto, Canada, July 12.

CAMPUS TALKS 2016, "*Hippocratic Paradox*", IMBS Luce Graduate Student Conference, May 27.  
2015, "*The Possibility of Anonymous Social Orderings Using Curvature of Indifference Hypersurfaces*", IMBS Friday Lunch Seminar, October 9.

PROFESSIONAL DEVELOPMENT Preparing for the Faculty Career Certificate Program: completed workshop series on faculty career preparation offered by the Graduate Resource Center at University of California, Irvine, Spring 2016.

Certificate of Completion of Neural Networks in System Identification and Forecasting: completed the workshop on neural networks offered by the International Institute of Forecasters, 2013.

Certificates of Completion of Medical Terminology I & II: completed workshop series on basic and advanced medical terminology offered by Dana-Farber Cancer Institute, Harvard Medical School, 2010.

SERVICE TO PROFESSION Chair: Annual Conference of the Royal Economic Society, session of collective decision-making, Manchester, United Kingdom, 2015.

Discussant:  
Annual Conference of Canadian Economics Association, Toronto, Canada, 2015.  
Annual Conference of Canadian Economics Association, Montreal, Canada, 2013.  
Annual Meeting of Canadian Health Economist's Study Group, Winnipeg, Canada, 2013.

UNIVERSITY SERVICE	Vice President: Chinese Students and Scholars Association, Harvard School of Public Health, 2009–2010.	
MEMBERSHIP	Society for Industrial and Applied Mathematics, Association for Women in Mathematics American Association for Artificial Intelligence, Canadian Artificial Intelligence Association American Economics Association, Canadian Economics Association American Society of Health Economists, International Health Economics Association, The Society for Medical Decision Making	
SKILLS	Python, Maple, Mathematica, GeoGebra, STATA, L <sup>A</sup> T <sub>E</sub> X	
LANGUAGES	English (fluent), Mandarin (native)	
REFERENCES	<u>Donald Saari</u> Distinguished Professor of Mathematics and Economics Director, IMBS University of California, Irvine Irvine, CA USA +1 949 824 8651 dsaari@uci.edu	<u>Jeremiah Hurley</u> Dean of Social Sciences Professor of Economics McMaster University Hamilton, ON Canada +1 905 525 9140 x26156 hurley@mcmaster.ca
	<u>Igor Kopylov</u> Professor of Economics University of California, Irvine Irvine, CA USA +1 949 824 6182 ikopylov@uci.edu	<u>Deirdre Haskell</u> Professor of Mathematics McMaster University Hamilton, ON Canada +1 905 525 9140 x27244 haskell@math.mcmaster.ca
ABSTRACTS	<b>“Hippocratic Paradox: A Mathematical Analysis of Medical Decision-Making”</b> (with Saari)	
	<p>The Hippocratic Oath and its derived four principles — nonmaleficence, beneficence, respect for patient’s autonomy, and justice — are the moral foundations of medical decision-making. However, they are found self-contradictory in both theory and practice, which leads to hard cases confronted by the U.S. Supreme Court. This paper aims to resolve such paradoxes. It offers a geometric approach to identify all possible contradictions in the form of cyclic rankings. This approach has achieved success in other areas in social sciences such as decision theory and voting theory (e.g., impossibility theorems by Arrow, Sen, and Saari) and can provide new interpretations in medicine and partial resolutions. This study is the first mathematical analysis of the Hippocratic Paradox. It identifies the cause and source of conflicts in medical decision-making, which are commonly concerned across disciplines including medicine, ethics/moral philosophy, law, and economics. By tracing where all such possible conflicts come from, we predict all paradoxical situations. And then by modifying the relative positions of problematic regions, that is, by remedying the extent of some principles, this study helps health professionals escape from fatal self-contradictions while making important decisions.</p>	
	<b>“The Possibility of Anonymous Social Orderings Using Curvature of Indifference Hypersurfaces”</b> (with Haskell and Hurley)	
	<p>This paper concerns the aggregation of individual preferences into a social ordering. Working in a higher-dimensional economic environment where an indifference hypersurface is</p>	

the level set of a utility function representing a preference relation, we give axiomatic conditions under which a function on the indifference hypersurfaces can be used to define a rational anonymous social ordering function. We show that the curvature of the indifference hypersurfaces can potentially be used as such a function, and discuss a possible economic interpretation of the curvature. The minmax-like definition of our social ordering function coincides with the Rawlsian difference principle under certain circumstances.

*JEL classification:* D63; D70; D71

*Keywords:* Preference aggregation; Social ordering function; Independence of irrelevant alternatives; Indifference hypersurface; Curvature; Information

**“Investing in Health: A Macroeconomic Exploration of Short-Run and Long-Run Trade-Offs”** (with Scarth and Hurley)

This paper aims to unravel the competing effects of the health investment. It explores, both analytically and numerically, the equilibrium shift and transitional dynamics after a one-time policy of health investment. We find that such a policy improves health status in the long run, but harms economic growth in both short and long term. The relative sizes of these competing effects depend on the specific health parameters. Within the plausible range for the value of health relative to consumption, households gain welfare in the long run as long as the effectiveness of labor in health production is large. The expanded health sector policy makes households worse off only if labor is rather unproductive in producing health and households value health relatively little. The findings challenge the policy recommendations of the World Bank (1993) and World Health Organization (2001) in that good health increases neither the productivity of workers nor the economic growth rate. It is hoped that the relative simplicity of our model, compared to the existing theoretical literature, can help close the gap between formal academic work on this topic and actual debates among policy makers in both developed and developing countries.

*JEL classification:* E2; E6; O4; I1

*Keywords:* Health capital; Health investment; Endogenous growth; Dynamic system; Transitional dynamics