

Statement on Research and Teaching
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December, 2019

Research:

My research has been guided by a quest to answer important, policy-relevant questions with a focus on applied microeconomics. My main fields of research are industrial organization, healthcare economics, and energy/environmental economics, and most of my papers combine insights from these fields. These are all fields with complex regulatory environments and rapid technological change, implying a high value of frontier economic analysis. Accounting for 17.8% of U.S. GDP and growing, healthcare and its increasing costs are major concerns in the United States and around the world. Healthcare is also a sector where government regulation is complex and pervasive, implying a need to evaluate how government policies impact firm and consumer behavior and outcomes. As climate change and other environmental pressures build, the policy implications in the energy sector—and of environmental policies more generally—are crucial as well. Besides these sectors, much of my research has focused on the market for new high-technology goods. High-technology goods have been a huge force in the economy in recent decades, and understanding phenomena such as network externalities and consumer preferences for these goods is necessary to evaluate their impact and formulate policies.

My research within these areas has been influential because it has successfully developed frontier methods to answer key policy-relevant questions. A common method of analysis in my papers has been to specify and estimate models of individual and firm decision-making and use these estimated models to ex-ante evaluate the market outcomes that could result from alternative policies.

I now highlight some of my main research contributions.

Bargaining in healthcare:

One of my main research themes that straddles industrial organization and healthcare economics has been to develop methods to better estimate the price impact of hospital mergers. Antitrust policy regulating hospital mergers can have benefits in terms of decreasing costs, but also reduces the competition hospitals face, which may lead to higher prices. Prices for hospitals, as in many other industries with a small number of buyers and sellers, are determined by negotiation. In my 2015 *American Economic Review* paper “Mergers When Prices Are Negotiated: Evidence from the Hospital Industry,” my co-authors and I developed methods to study market interactions in settings with negotiated prices and used these methods to understand the implications of mergers and policy interventions in hospital markets. Because of the importance of hospital mergers and antitrust policies and the fact that this paper developed a tractable equilibrium framework to study the hospital sector, this paper is widely cited by courts and government agencies in their analysis of hospital mergers.

Microfoundations of bargaining:

In a related paper, “‘Nash-in-Nash’ Bargaining: A Microfoundation for Applied Work,” published in the *Journal of Political Economy* in 2019, my co-authors and I developed a theoretical foundation for the bargaining model that is used in my *AER* paper above, which we called “Nash-in-Nash” bargaining. The Nash-in-Nash model has become the workhorse model with which to explain counterfactual prices in sectors where prices are negotiated. Our theoretical foundation derives the set of fundamentals for which the Nash-in-Nash model can be credibly used. We find that Nash-in-Nash bargaining is a useful tool in cases where a downstream firm (e.g., a cable company or an insurance company) desires a fixed set of suppliers (e.g., a fixed set of television stations or hospitals) and where the different suppliers are either substitutes for one another or, if they are complements, the complementarities are relatively weak.

Though just recently published, this paper has become widely used and cited in academic papers and policy settings that analyze vertical relations between firms. This overall topic of negotiated prices has become very important as prices are negotiated in most sectors with business-to-business transactions and several high profile antitrust cases concern such sectors, such as the recent proposed Time-Warner / AT&T merger. The paper has also led to prominent follow-on papers that develop concepts that build on Nash-in-Nash, for instance for the case where the desired set of suppliers is not fixed.¹

Estimation of hospital quality:

Another research theme of mine in healthcare economics has been the estimation of hospital quality. Properly estimating hospital quality is crucial to making markets for healthcare work better. One of the most unambiguous measures of quality is patient mortality. Yet, patient mortality reflects at two least two components: the quality of the hospital that is providing the treatment and the severity of illness of the patient that is receiving the treatment. If patients based their choice of hospital in part on their severity of illness and the econometrician does not perfectly observe patient severity of illness, then this can lead to inconsistent estimates of hospital quality. In a series of papers, including my 2003 *Econometrica* paper “Bayesian Inference for Hospital Quality in a Selection Model,” my co-authors and I developed methods to control for selection of patients based on unobserved quality and to understand the economic determinants of hospital quality. These models relied on an assumption that the location of patients may provide variation that is plausibly not related to the unobserved component of their severity of illness and developed frontier methods to efficiently use this variation to identify hospital quality. The methods that I developed here are widely cited and are leading to further work on estimation of quality for hospitals and other institutions where selection into different options based on unobservables is potentially important.²

¹ For instance, Ho, K. and R. Lee (2019), “Equilibrium Provider Networks: Bargaining and Exclusion in Health Care Markets,” *American Economic Review* 109: 473-522, develop a follow-on concept called Nash-in-Nash with threat of replacement.

² For instance, a recent working paper, Hull P. (2019), Estimating Hospital Quality with Quasi-Experimental Data,” that is currently in the revise and resubmit stage at *Econometrica*, builds on

Computation and estimation of dynamic models:

Methodologically, a central theme of my research has been to develop models and estimation techniques to better evaluate the dynamics of consumer and firm preferences. My dissertation work, published in “A Dynamic Model of Endogenous Horizontal Mergers,” in the *RAND Journal of Economics* in 1999, developed a theoretical model of mergers, entry, exit, and investment, that was used to understand when entry was a mitigating factor to mergers. This paper has led to much future work by prominent authors, including recent work on optimal antitrust policy with endogenous mergers.³ My 1999 *Journal of Economics & Management Strategy* paper, “Dynamic Equilibrium in the Hospital Industry,” was widely credited with being the first structural, dynamic estimation of an oligopoly market. It has also led to much future research that builds on the estimation approach, as this area of inquiry has developed hugely over the past two decades.

Dynamics of durable goods:

More recently, my 2012 *Journal of Political Economy* paper, “Dynamics of Demand for New Consumer Durable Goods” develops a framework to estimate consumer preferences for durable goods sectors for new high-technology products where technology is advancing rapidly. The framework takes into account the fact that consumers may purchase a high-tech product when the segment is new, or wait a few months, knowing that prices are sure to drop and features to improve. This paper develops methods to account for this future value and to incorporate it in a model with existing state-of-the-art techniques adapted from the static (non-dynamic) estimation literature. A main finding is that incorporating dynamics and heterogeneous preferences across consumers yielded much more realistic estimates of the value of innovation than in the existing literature. Valuing new durable goods is very important for understanding innovation in the economy. This paper is widely taught in Ph.D. industrial organization classes as it represents the current frontier of estimation for durable goods sectors with differentiated products, combining approaches from durable goods with those from static demand estimation. It has also led to prominent follow up papers.⁴

Dynamics and behavioral preferences:

My forthcoming *Review of Economic Studies* paper, “Salience, Myopia, and Complex Dynamic Incentives” evaluates how insurance enrollees respond to complex price schedules, such as insurance incentives that fall or rise depending on the amount spent over the year. In the

this paper.

³ Mermelstein, B., V. Nocke, M. Satterthwaite, and M. Whinston (2019), “Internal Versus External Growth in Industries with Scale Economics: A Computational Model of Optimal Merger Policy,” forthcoming, *Journal of Political Economy*, describe my paper as the “closest work” to theirs.

⁴ See, for instance, R. Lee (2013), “Vertical Integration and Exclusivity in Platform and Two-Sided Markets,” *American Economic Review* 103: 2960-3000, which builds on this model by adding platform competition and network effects.

presence of such non-linear price schedules, enrollees' dynamic optimization is important to enrollees maximizing their value. This paper provides evidence that enrollees do not dynamically optimize, based on the fact that enrollees reduce drug spending when their initial insurance runs out, even for those individuals who would have known that their insurance was going to run out. The paper then tests different behavioral models that can explain the lack of dynamic optimization, finding that a model where individuals do not perceive future prices as salient fits the data better than other models, such as quasi-hyperbolic discounting. This paper contributes to a fast-growing literature on behavioral economics and industrial organization and is the first paper to model the concept of salience in a dynamic optimization framework. Our tests for deviations from dynamic optimization and dynamic models of consumers faced with non-linear price incentives are currently being adapted in a number of working papers by other authors.

Renewable energy:

Similar to my work on healthcare economics, my research on energy/environmental economics has modeled firm incentives and then evaluated how policies affect these incentives and through them, market outcomes. In my 2016 *Journal of Political Economy* paper, "Intermittency and the Value of Renewable Energy," my co-authors and I develop a framework to estimate the social cost of renewable energy such as solar power. The main policies that we consider are renewable portfolio standards that mandate large-scale renewable energy generation. Our framework incorporates the fact that solar energy is intermittent, producing when the sun is shining rather than when the operators chooses to burn fuel and that the system operator cannot perfectly forecast when the sun is shining. It allows the system operator to hedge against the intermittency by building more backup fossil fuel generators, by using these generators in costly reserve operations (e.g., when the sun goes behind clouds), and ultimately by allowing more system failures in the presence of renewable energy. The paper solves for the system operator's optimal policies, under different levels of renewable energy penetration, and the accompanying social welfare from different levels of renewable energy. We find that the unforecastable intermittency component of renewable energy adds only a very small amount to the social costs of renewable energy.

This paper has been used in regulatory cases on valuing renewable energy and has impacted research in this area. Besides its research and policy contributions, it is taught in a number of undergraduate energy/environmental economics classes because it lays out the economics of renewable energy in a coherent model and empirical framework that is accessible to undergraduate students.

Environmental regulation:

A current working paper, "Escalation of Scrutiny: The Gains from Dynamic Enforcement of Environmental Regulations," (currently in the third round at the *American Economic Review*), estimates the value that is created by the fact that environmental regulations in the U.S. are enforced with an escalation mechanism, where repeat offenders are inspected more often and fined more severely than one-time offenders. We develop and estimate a dynamic model of plant investment when faced with dynamic enforcement. The model allows us to evaluate how costly plants find investments in environmental mitigation relative to inspections, fines, and the public

stigma from being designated a repeat offender. We then use the model to evaluate how much dynamic enforcement helps regulators by lowering the assessed fines necessary to keep pollution constant and how the current dynamic enforcement system compares to benchmark policies such as Pigouvian taxes, which are taxes for pollution based on the harm that they cause. We find that though current regulation is far from benchmark policies such as Pigouvian taxes, the theorized value of dynamic enforcement in reducing both fines and pollution is large in practice.

Dynamic enforcement is used in a variety of contexts, from three strikes laws for crimes to penalties for sports. This paper is the first to empirically model optimal decision-making in the presence of dynamic enforcement. As such, I expect that it will lead to significant follow-on work and policy interest.

Ongoing and future research:

I am performing ongoing research on a number of areas related to these papers, including three that I briefly outline here. In one project, my co-authors and I are evaluating insurance design, using detailed claims and enrollment data from one of the largest insurers in the U.S. This work is being supported by a grant from the Agency for Healthcare Research and Quality. This work also has led to the development of modeling framework of health insurance choices that is influencing models using in policy settings through my work on the Congressional Budget Office's Health Insurance Simulation Advisory Panel, whose goal is to predict the impact of policy reform on health insurance coverage. In a second project, which is supported by a grant from the National Science Foundation, I am evaluating the impact of pollution fees in China on pollution and productivity. A third ongoing project estimates the value of battery storage and the importance of market policy design for batteries in electricity markets with substantial renewable energy. Though very different in topic, these projects all have important policy implications and use state-of-the-art data that have not been widely available in the past.

Given the range of topics on which I have researched, a natural question is the direction that my research will take in the future. I believe that applied microeconomics can add value when it brings data, theory, and empirical methods to bear to evaluate the impact of different policies and ultimately to help design policies that increase social welfare. For these reasons, I am motivated to answer research questions where policymakers might ultimately care about the answers and where I feel that I can contribute to the knowledge of these answers. While some of my research is directly relevant to policies, even my more abstract research aims to develop methods and insights that might be useful inputs for policy decisions of the future. Thus, the research questions that I will consider are ones where I believe that I can contribute insight on important policy questions, through frontier modeling and state-of-the-art data.

Evidence of impact of research:

As overall measures of the impact of my research, I have given 46 invited seminars over the past five years at institutions such as Cornell, Princeton, Duke, Hong Kong University, and University of Technology Sydney. I have served on the Board of Editors of five prominent journals, including the American Economic Review. Over my career, I have served as the PI for 9 investigator-initiated federal and private foundation grants worth a combined total of over \$2.5

million. I have offered expert testimony on a number of legal cases related to my fields of research. I have over 3,400 cites on Google scholar. I was awarded an honorary degree from the University of Oulu. I frequently serve on government panels where research and policy expertise is required, including the National Science Foundation Economics Program Review Panel and the Congressional Budget Office Health Insurance Simulation Advisory Panel. And, I am frequently invited to give keynote speeches at research conferences.

Teaching:

As a faculty member at research universities for the past 24 years, I believe strongly in the model of a research-driven university where teaching is also central. I believe that our substantial research expertise helps us teach rigorous and challenging skills that will allow our students to develop a long-term competitive edge.

Consistent with my broad research interests, I have taught many subjects and at every level during my teaching career. Specifically, I have taught courses in Competitive Strategy, Econometrics, Healthcare Economics, Industrial Organization, and Microeconomic Theory. I have taught courses to undergraduates, MBA students, Ph.D. students, and non-degree executive education students. Currently, I teach an elective Ph.D. course called Econometrics of Dynamic Industrial Organization and a required EMBA course called Business Strategy.

My primary teaching skills in a classroom setting are my ability to listen, to engage the class, to explain difficult concepts and to create an atmosphere that allows people to contribute and learn. I try to foster an inclusive environment, where people with different backgrounds and skills feel comfortable contributing. Towards this goal, I engage students who have not talked much. If they do not have a thoughtful response, I encourage them to be more prepared the next time, but also make it clear that engaging them in classroom discussion is not meant to humiliate them or make them feel bad. In general, when people give answers that are logically inconsistent, I think that it is important to help them understand what part of their thought process is inconsistent but also to stress that wrong answers are a necessary part of learning. I believe that intellectually rigorous teaching is part of our mission. Yet, I think that humor can play an important role in creating an environment where people feel welcome to participate and make mistakes. My goal is a class where students are required to think on their feet but are not afraid to make mistakes

For my MBA teaching of business strategy, I believe that economic methods, including game theory and data analysis, yield insights that can help transform business decision-making. The overall format of this teaching has been to help students analyze business cases, economic theories and research papers and through that to develop skills that better allow them to analyze important business decisions. My technique in teaching difficult concepts is to use relevant cases to help students realize the ways in which businesses can make better decisions using the concepts of economics and strategy, by putting these concepts in contexts with which they are familiar.

My experience teaching undergraduate students is similar. However, I believe that for undergraduates, we must also offer a liberal arts education at its core; an education that helps develop and foster the ability to continue learning skills that will help in future career and other

aspects of life. This idea of developing the general skills of learning heavily influences my teaching for undergraduates. Personally, I also benefitted tremendously from my undergraduate liberal arts education at Swarthmore College, which allowed me to explore broad interests across a variety of disciplines and ultimately helped me learn of my love for economics. I am also honored to have delivered the 2019 Bernie Saffran Lecture at Swarthmore, in honor of my undergraduate mentor.

Besides my classroom teaching, a substantial portion of my teaching responsibilities, and one I enjoy greatly, has been the mentoring of Ph.D. students. I am gratified of the recognition that I received in this dimension as the recipient of the 2009 Kalt Prize for best doctoral student mentorship in the Eller College at the University of Arizona as well as the placements of my advisees at tenure-track positions at institutions such as Washington University in St. Louis, the University of Colorado, Boulder, and the University of Leuven. I have succeeded in helping my Ph.D. students develop interesting dissertation ideas, follow through on those ideas and communicate them to the rest of the world, such that they have obtained successful placements. Teaching Ph.D. students is also a crucial component in helping me develop as a scholar. For example, my 2016 *Journal of Political Economy* paper on renewable energy started because of my advising of Joseph Cullen. I have co-authored many papers with former Ph.D. students (including the above paper, which was co-written with my current colleague Stan Reynolds and former student Mario Samano).

I have found that success for Ph.D. students depends on a high level of economic theory, econometric, and computational skills, knowledge about industries, a knack for finding good research questions, and probably most importantly, on a strong work ethic. Maintaining a work ethic is particularly difficult in the context of a long, independent research project with uncertain outcomes such as dissertation research. I believe in setting high, but realistic, expectations for Ph.D. students and then working closely with them to make sure that they have all the help that I can offer towards meeting those expectations.

Finally, in my teaching, I am deeply committed to providing an open and equitable learning environment in which all students can thrive, independent of gender, race, ethnicity, or sexual orientation. In the classroom, I strive to foster an environment where students can challenge themselves to achieve excellence, all while respecting differences in viewpoints, backgrounds, and styles of learning. More generally, I have mentored and advised students from across the world. As Director of Graduate Studies for 11 years at the University of Arizona, I have recruited diverse and excellent cohorts of Ph.D. students and have developed a parental leave policy for Ph.D. students. I have also served or serve as the primary or co-primary Ph.D. advisor for eight women (who are underrepresented in Economics). I have offered NSF- or AHRQ-funded research assistantships to a number of members of groups that are underrepresented in Economics, including four women. I similarly seek to mentor young faculty, no matter their background.