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Fields of Concentration:
Microeconomic Theory
Game Theory
Political Economy

Desired Teaching:
Microeconomics
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Political Economy

Comprehensive Examinations Completed:
2004 (Oral): Microeconomic Theory (*with distinction*), Political Economy (*with distinction*)
2003 (Written): Microeconomic Theory (*with distinction*), Macroeconomic Theory

Dissertation Title: *Coordination in Dynamic Environments*

Committee:
Professor Stephen Morris (chair)
Professor Benjamin Polak
Professor Dirk Bergemann

Expected Completion Date: May 2007

Education:
Ph.D. (Economics), Yale University, expected May 2007
Exchange Scholar, Stanford University, 2005-2006
M.Phil. (Economics), Yale University, 2005
M.A. (Economics), Yale University, 2003
Non-Degree Student in Economics, University of Toronto, 2001-2002
M.Sc. (Mathematics), McGill University (Montreal, Canada), 2001
B.Sc.H. (Mathematics), Queen's University (Kingston, Canada), 1998

Fellowships, Honors and Awards:

2006 Yale University Dissertation Fellowship
2004 and 2005 Annual Cowles Foundation Prize
2002-2006 Yale University Graduate Fellowship
2002-2006 Cowles Foundation Fellowship
2001 Dean's Honour List, McGill University
1998-2000 National Science and Engineering Research Council of Canada Postgraduate Scholarship
1998 Queen's University Medal in Mathematics and Statistics
1996-98 Dean's Honour List, Queen's University
1994-98 Canada Science Scholarship

Teaching Experience:

At Yale University:

- Teaching Assistant, Game Theory (Undergraduate), Fall 2004
- Teaching Assistant, Microeconomics (Graduate), Spring 2005

Prior to Yale:

- Teaching Assistant, Math for Management II, McGill University, Spring 2001
- Teaching Assistant, Calculus B, McGill University, Spring 2001
- Teaching Assistant, Calculus A, McGill University, Fall 2000
- Teaching Assistant, Calculus I, McGill University, Spring 2000
- Teaching Assistant, Algebra I, McGill University, Fall 1999
- Teaching Assistant, Calculus II, McGill University, Spring 1999
- Teaching Assistant, Calculus, Queen's University, Summer 1997

Research Experience:

Research Assistant for Professor Dirk Bergemann, 2003
Research Assistant for Professor John Roemer, 2004

Papers:

"Learning by Similarity in Coordination Problems" (Job Market Paper, with Jakub Steiner), 2006

"Robust Conventions and the Structure of Social Networks," 2006

"The Truth is Gradually Revealed: Efficient Coordination with Information Dynamics," work in progress (with Jakub Steiner)

"Testing Multiple Forecasters," work in progress (with Yossi Feinberg)

Publications in Mathematics:

"Universal Deformations, Rigidity, and Ihara's Cocycle," *Communications in Algebra*, Vol. 31(2), 2003, pp. 901-943

"Goldbach's Conjecture for Z[x]" (with Amarpreet Rattan), *Mathematical Reports of the Academy of Science,* Vol. 20(3), 1998, pp. 83-85

Conference and Workshop Presentations:

North American Summer Meeting of the Econometric Society, Minneapolis, MN, June 2006
Stanford University, Department of Economics Theory Lunch, March 2006
Sixth Trento Summer School in Adaptive Economic Dynamics, June 2005
Quebec-Vermont Number Theory Seminar, McGill University, May 2001

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References:

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Dissertation Abstract:

Coordination games have been used to model a wide variety of strategic interactions, such as speculative attacks, job search, and political revolutions. Static coordination problems are characterized by multiple equilibria, limiting the predictive power of these models. My dissertation considers how various dynamic processes might select among these equilibria. In the three chapters, the dynamics are generated by learning, evolution, and the exogenous flow of information, respectively. We contrast the outcomes to those of Carlsson and van Damme (Econometrica, 1993), who obtain equilibrium uniqueness in a static framework by introducing small noise in players' observations of payoffs.

"Learning by Similarity in Coordination Problems" (Job Market Paper, joint with Jakub Steiner) considers learning how to play games when players do not know their own payoffs or the strategies of others. Standard models of learning suppose that a fixed game is played repeatedly and that players learn from history. In reality, however, strategic situations vary, and players typically have no past experience with the exact situation they face today. Thus, for learning to occur, players must extrapolate from similar situations in the past.

For example, a venture capitalist might face a new investment proposal each period. No two proposals are exactly alike. The quality of each proposal depends on inherent characteristics (such as the share of capital provided by the entrepreneur), and its success may also depend on the number of investors who buy in. We suppose that investors estimate returns based on past returns from proposals similar to the current one, weighted by the degree of similarity. For example, if the entrepreneur provides ten percent of the capital, investors may place the greatest weight on past proposals with entrepreneurial capital between eight and twelve percent. This approach is related to Gilboa & Schmeidler's case-based decision theory (QJE, 1995), or alternatively, players may be viewed as using kernel estimators of payoffs as a function of perceived quality.

When applied to coordination problems, this learning process has an important strategic consequence: actions may spread contagiously across situations, leading to a unique long-run outcome even when the game has a large multiplicity of Bayesian Nash equilibria. Contagion occurs even if the similarity weight is concentrated only on situations with payoffs very close to the current one.

We establish a formal connection between similarity-based learning and a modification of the underlying game in which each player treats her own information as less precise than it actually is, while holding correct beliefs about the precision of her opponents' information. Specifically, we show that players learn not to play strategies that *would be* iteratively dominated in this modified game; players eventually behave *as if* they held these incorrect priors. This result provides a tool for understanding the learning process: extending techniques developed for global games to this subjective-prior modified game allows us to identify precisely the long-run outcomes of learning.

If investors observe identical information about proposals, then the original game has a continuum of equilibria, but a unique learning outcome when similarity is concentrated. With private information, modeled as a global game, there is a unique equilibrium if errors in payoff observations are small. In this case, there is also a unique learning outcome when similarity is concentrated, but this outcome depends on the relative size of the noise compared to the concentration of the similarity. In particular, the learning outcome does not generally agree with the global game prediction. At the concentrated similarity extreme, we recover the usual global game equilibrium; at the opposite extreme of small noise, the outcome is identical to that of the complete information model. While the quantitative predictions of the learning and the global game models generally differ, the qualitative comparative statics agree.

"Robust Conventions and the Structure of Social Networks" examines equilibrium selection in binary-action coordination games where each agent interacts only with a fixed subset of the population, her neighbors in a social network. For example, consider choosing between LaTeX and Word when there are benefits from using the same technology as one's coauthors.

A common evolutionary approach has been to consider strategy profiles that arise in the long-run when players play myopic best responses in each period except with a small probability of mutation. Such profiles are called stochastically stable. Coordination on the risk-dominant action is known to be stochastically stable when mutation probabilities are constant across players and states. However, this prediction is not always robust if different mutations occur at different rates; the robustness depends on the structure of the social network.

This paper identifies conditions under which the risk-dominance prediction is robust to large differences in mutation rates, first for fixed finite networks, and then for large population asymptotics. In each case, robustness fails if there exists a small, highly cohesive clique of agents in the network – a group who coauthor primarily with each other. For finite networks, robustness occurs if no such clique exists and each agent has approximately the same number of neighbors. With large populations, for a very large class of mutation rates, robustness occurs if no such clique exists and the risk-dominant action spreads contagiously through best responses from a finite set of agents to the entire population. One might guess that networks in which convergence to the stable state is fast also exhibit robustness. Examples demonstrate, however, that this conjecture is false.

"The Truth is Gradually Revealed: Efficient Coordination with Information Dynamics" (work in progress, joint with Jakub Steiner) studies a fixed investment project played over many periods, the success of which depends on the current number of investors. In the usual static global game model, where each player receives a noisy signal of the payoffs, there is inefficient underinvestment when the noise is small. We consider a dynamic framework in which players choose in each period whether to invest or to wait for more precise information about payoffs. Investment is irreversible, and unobservable to the other players.

There are two possible sources of inefficiency in our model: *long-run inefficiency* and *dynamic inefficiency*. Long-run inefficiency occurs if there exist states of the world at which players fail to coordinate on the efficient outcome. Dynamic inefficiency depends on the timing of investment, and may occur as a result of either delay or premature investment.

We show that, if players have an incentive to invest at least one period prior to success of the project, then full investment occurs in the long-run whenever it is efficient. Moreover, in the limit as the initial noise in payoff signals becomes small, delays in investment disappear, and the efficient outcome is realized immediately. The early investment motive is essential: without it, long-run inefficiency may occur.

A project separate from my dissertation, **"Testing Multiple Forecasters"** (work in progress, joint with Yossi Feinberg), studies the problem of testing the knowledge that potential experts have of a stochastic process. In each period, every potential expert predicts the probability with which a particular event will occur. The classic example is of weather forecasters, who predict each day the probability that it will rain the following day. With only one forecaster, a natural approach is to test whether the forecasts are *calibrated*, that is, whether the empirical distribution conditional on each prediction converges to that prediction. Thus, for instance, rain should occur 40% of the time after predictions of 40% if the forecasts are to be calibrated. While a forecaster who knows the true distribution almost surely passes this test, Foster and Vohra (*Biometrika*, 1998) showed that there exists a forecasting strategy that passes this test for *any* distribution over outcomes. By using this strategy, a strategic weather forecaster can almost surely pass the calibration test without knowing anything about the true probabilities with which rain will occur.

With multiple forecasters, a simple extension of the calibration test, which we call the *cross-calibration test*, effectively distinguishes true experts from charlatans. A potential expert passes this test if the empirical frequency of events converges to her prediction conditional on every *profile* of predictions by the forecasters. For instance, in order for the first of two weather forecasters to pass the cross-calibration test, rain must occur 40% of the time in days for which her prediction was 40% and the second forecaster's prediction was 20%. We show that true experts who know the distribution of outcomes almost surely pass this test regardless of the strategies used by the other forecasters. False experts, however, fail the test on a large set of distributions if a true expert is present. If there is no true expert, two or more experts cannot simultaneously pass the test except on a small set of realized outcomes.