



# **Spatial Differentiation in Retail Markets for Gasoline**

## **Dissertation Abstract**

**Aristoklis Avgousti**

University of Wisconsin – Madison

I study competition and product differentiation in the retail market for gasoline. Theory suggests that, conditional on the distribution of consumers, there are two opposing forces that determine firms' choices. Firms want to differentiate their product to gain market power, but at the same time there is an incentive to move their product closer to rivals in order to steal more customers. Even though the positive effect of higher demand on location choice is unambiguous and intuitive, the presence of these two opposing forces makes the effect of rivals' choices uncertain. Empirically this is hard to test since unobserved demand characteristics are correlated with location choice, making it difficult to identify any incentives to differentiate. Most of the empirical literature finds results in favor of clustering.

In the first chapter, I study the spatial differentiation of gasoline retailers along interstate highways. Gasoline stations compete for consumers traveling on the highways. The estimation depends on the observation that, conditional on demand characteristics, exits along interstate highways are exogenously determined. Therefore the distances between exits are exogenous. In other words, gasoline stations have to choose between locations that have a predetermined distance from the other locations in the market. This allows me to test how distance between highway exits affects the number of firms at an exit. I find that stations will tend to be established at exits that are physically more isolated. This effect is not identified unless I control for enough demand characteristics. Stations are attracted to isolated exits because potential competition is farther and the share of long-distance travelers seeking gas at these exits is higher. In addition, I show that, conditional on the location of exits and the size of the highway, spatial differentiation is higher in markets with more firms. This is supporting evidence that firms seek to gain market power through product differentiation.

In chapter two, I empirically test the effect of product differentiation on average prices and price dispersion. The effect on average price is intuitive; as product differentiation increases, I expect that average price will decrease. I actually find that average price is higher on interstate highways with more dispersed locations. In addition, as the number of firms increases the average price decreases. On the other hand price differences may depend on differences in the stations themselves. My results suggest that spatial differentiation is an important source of price dispersion.

In the third chapter, I estimate a model of entry with endogenous location choices. Location choices depend on local demand characteristics and firms' expectations about competitors' location choices. This analysis follows Seim (2006) by using a nested fixed-point algorithm solution. My results suggest that competitors have a negative effect on firms' profitability. Some of the estimates of the effects of competition are insignificant and I do not find that more adjacent competitors have larger effects on profits. I attribute this to two reasons: (1) in cases where demand comes mainly from commuters than residents, nearby stations are not necessarily immediate competitors; stations along a common commuting path are more direct competitors. (2) As I show in chapter one, without controlling for demand characteristics I cannot identify the incentives for product differentiation; here I do not observe traffic.



## **Dissertation Abstract**

**Emmanuele Bobbio**

University of Wisconsin-Madison

### **Replacement Hiring and Wages, Part I, Theory:**

I consider how search activity on the side of firms affects wages. In particular, I treat the search process as a symmetric one that allows firms to seek to replace the current worker, as well as workers to search while employed. The setup allows for meetings between multiple parties, e.g. a firm currently employing a worker contacts an employee at another firm. To address this issue I develop a solution concept which is parsimonious in terms of behavioral assumptions and allows disentangling these sorts of bargaining scenarios. Second, features of the data suggest that worker and firm heterogeneity are important to understand search behavior on the job. The model accounts for ex-ante heterogeneity across workers and across firms. Thus, this chapter contributes to the literature on sorting in the presence of frictions, as it allows agents within the model to react to the incentives arising from a misallocation.

### **Replacement Hiring and Wages, Part II, Empirics (in progress):**

I estimate the model developed in the previous chapter on Danish matched employer-employee data. I find that the data feature low returns to tenure ( $\sim 1\%$  a year), with a significant fraction of downward wage movements within jobs (the 10<sup>th</sup> percentile for the nominal data being  $-12\%$ ). 25% of job-to-job transitions are associated with a wage decline of  $-15\%$ , on average, and in these instances the wage is still below its level in the previous job after five years. However, when the wage increases between jobs, it increases enough that most wage growth occurs between jobs. Worker turnover is high, with 2 years being the median duration of a job. The theoretical framework is consistent with these facts. The upward pressure on wages induced by the competition between firms is somewhat balanced by the downward pressure resulting from the competition between workers; this results on relatively higher estimates of the workers' bargaining power parameter. Wage gains are realized when workers moves to better matches; replacement hiring helps explain wage cuts across jobs, as some workers trade lower wages for higher job security. Finally the estimates imply that heterogeneity is important and complementarities are strong. The model allows deriving estimates of the cost of mismatch, in a context where both workers and firms can respond to mismatch by continuing to search.

### **Transitions, reallocation and growth, the empirical content of the BHC decomposition:**

We extend the model developed by Lentz and Mortensen (2009) to allow for cycles and transitions. The model allows for a closed form characterization of the growth decomposition employed by Baily, Haltiwanger and Campbell (1992) to assess the contribution to growth of the reallocation of labor from less to more productive firms induced by competitive forces. We find that the 'within' component reflects productivity increases due to innovation, which constitute the long run component of growth; on the other hand, the 'between' component reflects temporary changes to the growth rate (i.e. once-and-for-all changes in the aggregate output level) due to variations in the "average" marginal cost which are induced by a shift in market share from less to more productive firms.



**NAME: Woo Hyun Chang**

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**Dissertation Title: "Essays in empirical study of online game industry"**

A new pricing strategy by which a firm keeps the majority of non-paying users in the game and generates revenue from a relatively small group of paying users who purchase special items became phenomenal in online game industry.

My first essay examines the impact of the introduction of a new pricing strategy. The demand estimation results by multi-stage budgeting using market level data from the Korean online game industry show that the effect of this new pricing strategy is dependent on the segment characteristics; even though the new pricing policy looks like a very aggressive pricing scheme and there should be substantial negative impacts on the shares of segments with normal pricing through a business stealing effect, most games in the segments with new pricing strategy show insignificant substitutability for the online games with normal pricing strategy. This implies that the games with new pricing policy rather create a new market in the online game industry by securing consumers from offline games or other leisure industries.

In the second essay I use a discrete choice model with a two-sided feature and estimate the demand system of the industry in conjunction with the firm's supply decision in order to recover the primitives lying under the new pricing strategy. Theoretically, this pricing strategy can be explained by two-sided network effects; when there is a two-sided network effect, it is possible for the service provider to charge only businesses or people who value the number of the other side more and let the people on the other side be subsidized by having the service they enjoy for lower price or even free. Though this price discrimination story shares the traditional idea of two-sided market example such as advertisement, it also has its unique features since the incentive to pay is not driven by profit, but rather by direct utility transfer among consumers from transactions via the game platform. I show that the estimation results are consistent with the assumption of the existence of two-sided network effects; payers value the number of non-payers while non-payers are indifferent to the number of payers, and in general it is optimal for firms not to charge non-payers under this condition.



# Essays on the Schooling Decisions and Risky Behaviors of Young Adults

Dissertation Abstract

**Benjamin Cowan**

University of Wisconsin—Madison

## **Chapter 1: Forward-Thinking Teens: The Effects of College Costs on Adolescent Risky Behavior**

This paper analyzes the effect of college costs on teenagers' engagement in risky behaviors before they are old enough to attend college. Individuals with brighter prospects for future schooling attainment may engage in less drug and alcohol use and risky sexual activity because they have more to lose if such behaviors have harmful effects in their lives. If teens correctly predict that higher college costs make future college enrollment less likely, then adolescents facing different expected college costs are likely to choose different levels of risky behavior. I find that lower college costs in NLSY97 teenagers' states of residence raise their subjective expectations regarding future college attendance. This in turn leads to a reduction in teenage substance use and sexual partnership. These findings suggest that the often-studied correlation between schooling and health habits emerges in adolescence because teenagers with brighter college prospects curb their risky behavior in accordance with their expectations. The results also imply that policies that improve teenagers' educational prospects may be effective tools for reducing youthful involvement in such behaviors.

## **Chapter 2: Young Adults' College Expectations and College Outcomes in the NLSY97**

Little is known regarding the process by which teenagers form expectations about future events. Combining NLSY97 data on respondents' subjective college expectations as teenagers with data on their eventual college outcomes, I show teenagers' expectations are not *rational* in that they are systematically positively biased. Moreover, youths' AFQT scores (a measure of scholastic aptitude) are highly negatively correlated with expectation bias, as youths with poorer scores fail to lower their expectations enough to match their objective chances of college enrollment/completion. Conditional on AFQT scores, family income and race/ethnicity have little or no additional effect on the precision of youths' expectations. Although teenagers' college expectations are biased, they are strongly positively correlated with youths' high school GPA's and college enrollment/completion rates, even after conditioning on other determinants of success. Since teenagers are capable of predicting future outcomes with some accuracy, policies that affect youths in the future may also have an effect on their current behavior.

## **Chapter 3: Does Smoking Reduce Wages? Evidence from Large Tax Increases**

In this essay, I examine whether smoking has a causal effect on wages. Large changes in cigarette excise taxes within many U.S. states over the past 10 years provide a plausibly exogenous source of variation in prices with which to identify this effect. I combine tax data with individual data from the CPS Tobacco Use Supplement (TUS) to examine whether smoking carries a penalty in the labor market, and whether that penalty differs by education level and job type. My paper builds on the existing literature in two ways. First, work in this field has previously been unable to identify the effect of smoking behavior on earnings using only changes in policy instruments such as excise taxes (due to a lack of longitudinal variation in those instruments until quite recently). Second, by utilizing the recent time-series variation in taxes, I am able to examine the effect of smoking cessation—apart from the effect of failing to take up smoking—on the wages of working-age adults.



# ESSAYS ON GAINS FROM TRADE

Dissertation Abstract

SWATI DHINGRA

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## **Trading Away Wide Brands for Cheap Brands.**

Recent plant-level studies find that large product and productivity changes take place *within* firms and trade liberalization affects products and productivity differently. I explain these findings with a model of multiproduct firms where intra-firm cannibalization from brand awareness provides a new distinction between product and process innovation. Trade affects innovation through this new channel of intra-firm cannibalization. Tougher import competition induces firms to ease cannibalization through lower product innovation. Greater foreign market access enables firms to increase process innovation. Examining Thai manufacturing firms, I provide direct evidence for intra-firm cannibalization and show that trade liberalization has the predicted effects on product and process innovation during Thai tariff changes of 2003-2006. Exporters increase process innovation with a relative rise in foreign market access. More export-oriented Thai firms increase product innovation while less export-oriented firms reduce product innovation. These results highlight the role of intra-firm demand linkages in unbundling the relationship between trade and innovation.

## **Reconciling Observed Tariffs and the Median Voter Model.**

Empirical studies show that factor ownership is associated with preferences over trade policy as predicted by the factor endowments model. Individuals with a relatively higher ownership of their country's abundant factor are more pro-trade and vice-versa. According to the median voter theory of trade policy, this implies positive tariffs in capital-abundant countries and negative tariffs in labor-abundant countries. I reconcile this empirically inconsistent prediction of the median voter theory with observed protectionism across countries. Considering a large country median voter model, I show the optimal tariff is a sum of the median voter component and a positive terms of trade component. Consequently, positive terms of trade effects can overcome the negative median voter component in labor-abundant countries, leading to positive tariffs across countries. Testing the tariff prediction with cross-sectional and panel data, I provide evidence for each component in the 1990s. Tariffs are higher on account of terms of trade considerations. In line with the median voter theory of trade policy, capital-abundant countries set higher tariffs while labor-abundant countries set lower tariffs on account of majority considerations.

## **Is Selection on Firm Productivity a Third Gain from Trade? (with John Morrow)**

This chapter addresses two questions: Do Selection Effects yield new Gains from Trade, distinct from Comparative Advantage and Scale Effects? If so, what is special about international trade in generating new welfare gains through Selection? Examining heterogeneous firm models, we find the answer to each question depends on the demand structure. The results highlight the role of demand in determining when Selection Effects are distinct, optimal and anti-variety.

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**Dissertation Title:** “Three Essays in International Macroeconomics”

**Abstract Summary:** The first essay presents evidence that supports the link between low (high) institutional quality (law and order, government stability, etc.), the pro-(counter-) cyclical policy, and the high (low) volatility of output and interest rate. It formulates a DSGE model in which the cyclical properties of monetary policies and the volatility of business fluctuations are the result of the interaction of institutional quality and the discretionary behavior of central banks. The second essay finds a U-shaped relationship between the US current account and its GDP cycle and proposes a DSGE model with asymmetric capital adjustment costs to explain it. By using a TAR model, the third essay explores the main determinants of the US current account and tests threshold dynamics related to the size and sign of the external imbalance.

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**Papers:** “Institutional Quality, the Cyclical Policy and Macroeconomic Volatility,” UW-Madison, 2009- Job Market Paper.  
“Is the Relationship between the US Current Account and Output Symmetric?” UW-Madison, 2008.  
“Threshold Adjustments of the US Current Account,” UW-Madison, 2007.  
“On the Implications of a Unilateral Currency Union on Macroeconomic Volatility”. In: Prospects for Monetary Unions after the Euro, edited by P. De Grauwe and J. Melitz. The MIT Press, 2005.

**Teaching Experience:** Lecturer: Statistics-Measurement in Economics (Spring 07); teaching assistant: Principles of Microeconomics, Principles of Macroeconomics (5 semesters); tutor for Macroeconomics Preliminary Examination (Summer 2006); UW-Madison.

**Research Experience:** Project Assistant (under Prof. Kenneth West), UW-Madison, August 2007-to date; Economist, (Research Unit, Central Bank of Chile, 2001-04).

**Fields of Interest:** International Finance, Macroeconomics, Applied Econometrics.

# Three Essays in International Macroeconomics

## Dissertation Abstract

**Roberto E. Duncan**

University of Wisconsin – Madison

### **Chapter 1. Institutional Quality, the Cyclical Quality of Monetary Policy and Macroeconomic Volatility**

In contrast to industrialized countries, emerging market economies are characterized by pro- or acyclical monetary policies and high output volatility. I argue that these facts can be related to a long-run feature of the economy - namely, its institutional quality (IQL). I present evidence that supports the link between an index of IQL (law and order, government stability, investment profile, etc.), the cyclical quality of monetary policy, and the volatility of output and nominal interest rate. I formulate a DSGE model with external shocks to demand for home goods and productivity shocks in which the central bank has as its objective to stabilize domestic inflation, output, and variations in the nominal exchange rate. In the model, a lower IQL tends to discourage foreign direct investment (FDI) and tilt the composition of exports away from foreign- to domestic-owned firms. When IQL is low, the share of exports from domestic-owned firms is higher and productivity shocks in that sector play a relatively more important role. In this context, a negative relationship between output and interest rate arises. As the economy improves its institutions, attracts more FDI and diversifies its exports, the channels through which exogenous shocks work tend to weaken and output volatility falls. A positive output-interest rate comovement arises because external shocks to demand for home goods become relatively more important. The cyclical properties of monetary policies and the volatility of business fluctuations are, thus, the result of the interaction of the IQL, the composition of exports, and the discretionary behavior of the central bank.

### **Chapter 2. Is the US Current Account Symmetric over the Business Cycle?**

Traditionally, the literature that attempts to explain the link between the current account and output finds and matches a linear negative relationship (Mendoza, 1991; Backus *et al.*, 1995). On the other hand, some researchers have argued that there exist nonlinearities in the dynamics of current accounts (Bergsten, 2002; Holman, 2001; Clarida *et al.*, 2005). By using a nonparametric regression, I find a U-shaped relationship between the US current account and the cyclical component of its real GDP. That is, when output is above (below) its long-run level, the current account and detrended output are positively (negatively) correlated. This fact is robust to different measures of external imbalances and econometric specifications. I propose a simple DSGE model with asymmetric adjustment costs of physical capital to account for this behavior. The model is capable not only of replicating this asymmetric link relatively well but also the main features of the cyclical behavior of the US economy.

### **Chapter 3. Threshold Adjustments of the US Current Account**

What are the main determinants of the US current account? Is there a linear relationship between the current account and those determinants? Is the behavior of the current account the same during deficits and surpluses? Does the size of the imbalance matter? In this paper we estimate a multivariate Threshold Autoregressive model to attempt to answer these questions for the 1975:1-2004:4 period. The main findings are: (1) statistically significant regressors are relative income, GDP growth, fiscal imbalance, and the real exchange rate; (2) there exist two regimes: a *surplus* and a *deficit* regime, therefore, the sign of the imbalances matters; (3) there is weak evidence on the importance of the size of the imbalances, in contrast to other studies; (4) relative income shocks deteriorate the current account significantly only under the deficit regime; and (5) there is evidence that supports the *twin-deficit* hypothesis in each regime.



**Name:** Danqing Hu

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**Dissertation Title:** "Two Essays on Dynamic Models of Binary Choices"

**Abstract:** The first essay studies the emergence of period two cycles in congestion games of binary choices. At each discrete time period, agents decide between two alternatives and they want to avoid congestion. With the existence of information lag, agents' decisions can only be based on the same outdated message that is the congestion status of the last period. We show that if agents' responses are sensitive to the message, the system dynamic becomes unstable and bifurcates to period two cycle. This happens because any deviation from an unstable rest point is met with overreaction from agents' sensitive responses. The restoring force comes in late as a consequence of the deviation, but it overshoots and starts the next phase of the cycle. Such excessive oscillation results a loss of efficiency. The conclusion of period two cycle is robust when the model extends to asymmetric binary choices and to populations with more general compositions of agents' responses. We also analyze the scenario in which agents are allowed to endogenously choose their response sensitivity.

In the second essay, we present a dynamic urban location choice model with binary choices, in which populations of firms and residents decide between locating in the city or outside the city. Firms' benefit of being in the city comes from the agglomeration economies. Residents want to reside in the city so as to avoid the commuting cost. The costs of locating in the city take the form of bid rent, which is an increasing function of the total number of firms and residents. The dynamic urban system is described with the aggregate best response dynamic. We first derive the stability condition of the system. Next we introduce the in-the-city wage differential and subject the model to changes in wage, population, congestion cost, and communication technology and obtain intuitive conclusions.



**Three Essays on Public Economics**  
Dissertation Abstract

**Shannon C. Mok**  
University of Wisconsin-Madison

My dissertation focuses on the effects of bequest intentions on the behavior of the elderly. In the first chapter, I examine whether individuals with bequest motives protect against the risk of a costly illness by buying more health insurance and spending less out-of-pocket. In the second chapter, I study how bequest motives affect nursing home utilization. In the third chapter, I examine how divorce rates are affected by changes in Medicaid eligibility rules.

In the first chapter, I examine whether bequest motives affect health spending. I exploit previously unused subjective bequest expectations data in the Health and Retirement Study to identify individuals with a bequest motive. I show that subjective expectations are valid measures of bequest preferences and are significant predictors for actual bequest realizations. In addition, I observe a detailed set of health conditions which allows me to better control for health shocks. This improves over previous works which fail to control for health or cannot directly identify individuals with bequest motives. I find that elderly singles who expect to leave a \$100,000 bequest are more likely to hold long term care and supplemental Medicare policies, and pay more for insurance premiums. In addition, individuals with bequest motives have lower out-of-pocket spending on health care compared to others with the same observed health. These results suggest that individuals with bequest motives insure against the risk of a costly illness.

In my second chapter, I show how bequest motives affect nursing home utilization. Nursing home care is typically not covered by health insurance other than Medicaid and nursing home expenses can be quite large. In addition, individuals may be able to substitute informal care by family and friends for paid caregivers. I use detailed information about caregivers and health limitations from the Health and Retirement Study to model the risk of nursing home entry and length of stay for individuals, and compare those with and without bequest motives.

In the third chapter, I examine the effect of changes in Medicaid's asset limits on the divorce rates of the elderly. The Medicare Catastrophic Coverage Act of 1988 loosened financial eligibility rules for couples in which one spouse needed nursing home care and the other spouse continued to live in the community. Previously, to qualify for Medicaid nursing home benefits almost all of the couple's assets had to be spent down. This created an incentive for a married couple to divorce and transfer joint assets to the spouse not entering the nursing home. Following the enactment of this law, Medicaid allows the spouse not entering the nursing home to keep his or her income and up to half of the value of the couple's estate (or the maximum set by the state). Using variations in asset limits across states and time, I estimate the effect of these assets and income limits on the probability of divorce among the elderly.

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**Dissertation Title:** Three Essays on Observational Learning

**Abstract Summary:** The dissertation studies learning from the behavior of others. In the first paper, we develop a flexible framework to study social learning when agents are uncertain about their positions in a technology adoption sequence. We show learning is robust to position uncertainty and characterize a lower bound for welfare that is valid for all information structures. In the second paper, I show that aggregate uncertainty can lead to agents herding on the inferior technology with positive probability. In the third paper, we study social learning with network externalities. We show that, via the observation of others, agents can simultaneously learn the state of the world and learn to coordinate.

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"Aggregate Uncertainty Can Lead to Herds," April 2008  
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**Fields of Interest:** Microeconomic Theory, Game Theory, Evolutionary Games

# Three Essays on Observational Learning

Dissertation Abstract

**Ignacio Monzón**

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## Chapter 1. Observational Learning with Position Uncertainty

In joint work with Michael Rapp, I present a model in which agents are uncertain about their positions in a technology adoption sequence. Agents choose between two competing technologies in an exogenous order. They sample the decisions of past individuals and receive a private signal about the state of the world. Sampling rules are stationary, with probabilities depending on agents' distances from one another in the sequence. Typically, observational learning is examined when agents have precise information about their position in the sequence of play. We provide a flexible framework to analyze learning under position uncertainty. Agents are allowed to have arbitrary ex-ante beliefs about their positions; they may observe their position perfectly, imperfectly, or not at all. We show learning is robust to position uncertainty. Under stationary sampling, learning is complete if the private signal strength is unbounded. If signal strength is bounded, agents achieve second-best learning: all individuals do as well as the most informed agents would do in isolation. We specify a minimum amount of information sufficient for social learning, allowing the agents to have more information and thus nesting several models previously studied.

## Chapter 2. Aggregate Uncertainty Can Lead to Herds

This paper presents a model in which homogeneous rational agents choose between two competing technologies. Agents observe a private signal and a sample of other agents' previous choices. The signal has both an idiosyncratic and an aggregate component of uncertainty. I derive the optimal decision rule when each agent observes the decision of exactly two agents. Due to aggregate uncertainty, aggregate behavior does not necessarily reflect the true state of nature. Nonetheless, agents still find others' choices a good source of information, and they base their decisions partly on the behavior of others. Consequently, bad choices can be perpetuated in this environment: I show that aggregate uncertainty can lead to agents herding on the inferior technology with positive probability. I also present examples in which herding occurs for arbitrarily large sample sizes.

## Chapter 3. Social Learning and Network Externalities

In joint work with Michael Rapp, I present a model in which agents must choose between two competing technologies. Payoffs depend *both* on an uncertain state of the world and on the proportion of agents choosing each technology. Agents are also uncertain about their positions in the technology adoption sequence. A useful example is that of an anti-coordination game: farmers are choosing to plant either corn or soybeans at the start of the season but are uncertain about what the relative demand will be at the end of the season. Farmers sample the decisions of other individuals and receive a private signal about the state of the world. Observational learning helps attain coordination since farmers can benefit from others' information. If signals are of unbounded strength, the proportion of crops planted correctly anticipates demand. If signal strength is bounded, observational learning still enhances coordination, augmenting the range of possible outcomes that can be correctly anticipated by agents.



# **Essays in Empirical Microeconomics**

## **Dissertation Abstract**

**David A. Rivers**  
University of Wisconsin-Madison

### **Chapter 1. Are Exporters More Productive than Non-Exporters?**

In the first chapter, I provide evidence that contrary to a common empirical finding in the international trade literature, exporting firms do not possess a productivity advantage relative to non-exporting firms. Productivity in this literature is typically measured by computing labor productivity, or by forming the residual from a regression of deflated value-added on input levels. The former method conflates differences in other inputs (in particular capital) with true differences in efficiency, while the latter suffers from endogeneity biases. I recover productivity through the estimation of a gross output production function. Using the methodology developed in the second chapter, I am able to control for endogeneity caused by the correlation between inputs and both unobserved productivity and unobserved differences between firm-level prices and the deflator. I argue that the relative productivity of exporters is overestimated for two reasons. The first is the use of value-added as opposed to gross output production functions. The second is the fact that the price received by exporting firms is a mixture of the domestic and foreign prices. With these corrections, I find that the estimated productivity gap between exporting and non-exporting firms goes to zero. This result is inconsistent with productivity being the main determinant of entry into export markets.

### **Chapter 2. Identifying Production Functions Using Restrictions from Economic Theory**

In the second chapter, I (along with Amit Gandhi and Salvador Navarro) develop a methodology for estimating production functions that, in addition to addressing some of the problems in the production function estimation literature, allows for a greater amount of firm-level heterogeneity. The key to the method lies in using the firm's static input decision as a source of identifying information. In particular, we use the first order condition as a second structural equation that allows us to separate out the endogenous part of the error term in the production function. Since we avoid proxy variables altogether, we can allow for richer patterns of firm heterogeneity, such as differences in prices and factor-specific productivity.

### **Chapter 3. Understanding Aggregate Crime Regressions**

In the third chapter, I (along with Steven N. Durlauf and Salvador Navarro) provide a general description of the relationship between individual decision problems and aggregate crime regressions. The analysis is designed to elucidate the behavioral and statistical assumptions that are implicit in the use of aggregate crime regressions for both the analysis of crime determinants as well as in counterfactual policy evaluation. We apply our general arguments to the question of the deterrent effect of capital punishment and show how alternative assumptions affect estimates of the deterrent effect.



# Three essays in wage formation and labor market

## Dissertation Abstract

**Seung-Gyu (Andrew) Sim**  
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### ***Chapter 1: Equilibrium Wage-Tenure Contracts with Unobservable Human Capital***

This paper presents an equilibrium job search model incorporating wage contracts that increase pay with tenure partly due to productivity increases and partly due to strategic considerations of the firm. Workers accumulate human capital through learning-by-doing on the job. They privately learn how to reduce their cost or disutility simply by repeating similar tasks on the job. If they are perfectly monitored by the firm, they should increase their output. Otherwise, they can enjoy private gains from leisure. In the mean time, employed workers as well as unemployed workers search for better paying jobs. The search outcome is not observed by the firm. In this environment, wage grows even within one employer due to two different factors. First, to induce truthful revelation, firms pay more when the worker becomes more productive (productive promotion). Second, to retain the worker longer or to extract more surplus from the early leavers, firms start with a low wage and raise it with job tenure (non-productive promotion). I estimate the model to examine the importance of human capital accumulation in individual wage growth. In the NLSY79 data, the average wage after 20 years market experience is 188% higher than the average initial wage. Counterfactual analysis using the estimated model shows that if a typical worker were not able to accumulate human capital, his wage could grow by just 41% only through non-productive promotion.

### ***Chapter 2: Directed Search on the Job with Multiple Job Applications***

This paper develops an equilibrium directed search model in which both employed and unemployed workers apply to multiple jobs. In contrast to 'undirected' search models, the directed search model with multiple job applications predicts a hump-shaped wage earnings density with a large wage differential even in a homogeneous environment. Although both 'directed search on the job with a single application' and 'directed search by unemployed workers with multiple job applications' fail to account for the stylized facts by themselves, the predictions of the model are significantly improved when they are combined. In particular, the trade-off between wage payment and job turnover probability under a directed search environment plays a key role in generating a realistic wage-earnings distribution rather than the trade-off between wage payment and offer turndown probability.

### ***Chapter 3: Incentive Contracts and Labor Market Fluctuations***

In reality, firms design complex wage schemes to provide a right incentive to work as well as to attract workers. However, the standard matching model focuses on only the second role of wage payment. This paper assumes that the match specific productivity in the standard matching model is the worker's private information, so that the firm must provide an incentive to induce truthful revelation. It shows that the incentive contract, by introducing rigidity in wage scheme, increases labor market volatility without violating qualitative implications, thus providing a partial solution to the puzzle first highlighted by Shimer(2005). But the large amount of volatility follows from the worker's disutility from working rather than the contracting environment itself as in Hagedorn and Manovskii (2005).



# Essays on Estimating Discrete Games

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## Chapter 1: Estimating A War of Attrition: The Case of the US Movie Theater Industry

This chapter estimates the impact of competition and exogenous demand decline on the exit process of movie theaters in the US from 1950-1965. I extend Fudenberg and Tirole (1986)'s model of exit in a duopoly with incomplete information to an oligopoly. Instead of using existing 2-step estimation methods, I fully solve the equilibrium in the estimation algorithm. This allows me to account for two important unobservable variables in the model: market-level heterogeneity and theaters' beliefs about competitors' opportunity costs. I estimate this model with panel data, using variations in TV diffusion across households and other market characteristics to identify the parameters in the theater's payoff function and the distribution of unobservable exit values. Using the estimated model, I show that theaters who are making negative profits may choose to remain in the market if they expect to outlast their competitors, because at that point their profits will increase. This creates a significant delay in the exit process. In addition, by decomposing the across-market variation in the exit process, I find that TV diffusion explains a substantial proportion of the variation in the exit process.

## Chapter 2: On the Initial Condition Problem in Estimation of Dynamic Games

Most papers estimating dynamic games ignore the correlation between initial conditions and unobservable variables. This chapter proposes a way to control for the endogeneity generated by the correlation between the initial number of players and unobservable market level heterogeneity (i.e., initial condition problem). For a given value of market heterogeneity and set of idiosyncratic shocks of all potential entrants, an entry game predicts the number of actual entrants as an equilibrium. Since the initial number of players is observed, I restrict the support of market heterogeneity and the shocks such that, in equilibrium, the entry game predicts the same number of entrants as is observed. Since it is hard to analytically characterize such a restriction, I propose an MCMC-like procedure to approximate the joint distribution of market heterogeneity and idiosyncratic shocks, conditional on the observed number of entrants. This simulated distribution can be used to simulate and solve the dynamic stage of the game.

## Chapter 3: A Semiparametric Test of Agent's Information Sets for Games of Incomplete Information (Joint with Salvador Navarro)

We develop a semiparametric test of misspecification of an agent's information in games of incomplete information. The test uses the intuition that, for any information structure, the opponent's choices should not predict a player's choice, conditional on the information available to the player. The test can check against some of the null hypotheses commonly used in the literature (independent private shocks in Bajari, Hong, Krainer, and Nekipelov (2006), and correlated private shocks in Aradillas-Lopez (2009)). We show that the tests we propose have satisfactory power properties against common alternatives, even in small samples. A simple empirical application to entry in the airline industry shows that the assumption of independent private shocks is not supported by the data.



# Three Essays on Crime and Police

Dissertation Abstract

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My dissertation covers three separate areas of crime economics. The first chapter examines the relationship between non-lethal weapons and police safety. It is the first paper to find a robust relationship between use of non-lethal weapons and police officer injuries over a large number of police agencies. The second chapter estimates the determinants of communication networks between police departments. The third chapter presents a model showing a causal mechanism by which crime can affect the growth rate of a locality.

The first chapter examines the relationship between use of non-lethal weapons and the numbers of attacks and injuries police officers suffer. I develop a use-of-force model and outline the conditions under which non-lethal weapons are expected to make injuries or attacks decrease. I then empirically estimate the relationship between non-lethal weapons and injuries using a large panel of U.S. police departments spanning 17 years. Using a specification that is robust to heterogeneity among police departments, I find that non-lethal chemical weapons decrease both injuries and attacks by a large and significant amount. I also find that non-lethal electrical weapons have no such effects. I contrast these results to earlier studies, which either fail to find any relationship or lack plausible external validity. I conclude the chapter by showing that my results are not due to biased selection by police departments and that there is evidence that the effects of non-lethal weapons increase the longer they are used.

The second chapter estimates the empirical model for network relationships between police departments. While information sharing among police departments is considered a crucial part of the model for police technology adoption, there has been very little work on determining the degree to which different factors cause departments to consult with one another. I fill this gap in the literature by developing a model of the conditions under which police departments find it optimal to maintain informal communication channels. To estimate the model, I use a survey on informal communications among several hundred large U.S. police departments. I then use methods from the social network literature to determine the importance of different factors in the creation of these network links. I conclude by showing how understanding these communication networks can guide future research on police technology.

The third chapter details a model of how crime shocks may affect local economic growth. Typically a high rate of return for a firm signals others to enter that sector. Rational criminals, however, will focus attention on these high-earning sectors and distort the price signals. This in turn deters entrepreneurs from entering the high-return sectors and distorts the mix of firms within the community. I consider which sectors are most affected by such distortions and show that the model produces testable implications when comparing crime shocks to other shocks of comparable size.