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Education

Ph.D. in Marketing, University of Chicago, Graduate School of Business, 2008 (expected)

- *Area of Specialization*: Econometrics and Statistics
- *Dissertation (Essay 1)*: “Empirical Entry Games with Complementarities: An Application to the Shopping Center Industry”
- *Dissertation Committee*: Pradeep Chintagunta (Co-Chair), J.P. Dubé (Co-Chair), Matthew Gentzkow, Kenneth Judd, Peter Rossi

MSc in Statistics, London School of Economics, 2002

Licenciatura (B.A. equivalent) in Business Administration, Catholic University of Portugal, 2000

Honors, Awards and Scholarships

AMA-Sheth Doctoral Consortium Fellow, 2007

Kilts Center Fellow, Graduate School of Business, University of Chicago, 2007

Doctoral Scholarship, Calouste Gulbenkian Foundation, Portugal, 2006-

INFORMS Doctoral Consortium Fellow, 2005

TA-performance bonus for excellence in teaching assistance (Executive MBA), Graduate School of Business, University of Chicago, 2004 and 2005

Haring Symposium Fellow, 2004

Summer Research Grant, Graduate School of Business, University of Chicago, 2003

Doctoral Fellowship, Graduate School of Business, University of Chicago, 2002-2006

Master’s and Doctoral Scholarships, Ministry of Science and Higher Education, Portugal, 2001 and 2002-2006

Published and Working Papers

Dissertation Research

Essay 1: “Empirical Entry Games with Complementarities: An Application to the Shopping Center Industry”

Extended Abstract: I develop and estimate a model of firms’ entry decisions. The central contribution of this paper is twofold. First, I address the methodological problem of estimating an entry model without a priori restrictions on the sign of the strategic inter-firm effects. Second, I apply the method to a novel dataset containing information about the store configurations of all US regional shopping centers.

An increasingly common characteristic of US retail market structure is the notion of a shopping hub. A shopping hub consists of a large cluster of retail stores in close geographic proximity to one-another. A surprising aspect of these geographic clusters of stores is the frequent presence of several highly-substitutable competitors. For instance, antique and jewelry stores are often found in close proximity to one-another. The same phenomenon arises for automobile dealerships, often

collectively termed an “auto mall.” I study a specific type of retail cluster – the regional shopping center. Most regional malls have multiple anchor stores (traffic-generating stores) that are highly-substitutable competitors. Typically, these are competing department stores. A simple explanation for the coincidence of many highly competitive anchor stores might be that the profit-potential of the mall is sufficiently high to warrant head-to-head competition. However, interactions with mall planner practitioners indicates that another motive may arise from strategic complementarities. Namely, there are traffic spillovers from large competing stores. In addition, discussions with mall planners indicate that the process leading to the observed configuration of anchor stores in a mall has properties that are very similar to a simultaneous entry game. Hence, I study the observed configuration of anchor stores in a mall as the equilibrium outcome of a simultaneous moves entry game.

While there is already a well-established literature on empirical entry games, the extant work typically assumes away one of the types of spillovers I wish to study. The assumption that firms’ entry decisions are strategic substitutes is usually made for econometric identification purposes as games with strategic complementarities are more prone to generate multiple equilibria. Multiple equilibria bring difficulties to the estimation of strategic entry games. For full-information estimation methods, such as nested fixed-point approaches, it is difficult or infeasible to construct a likelihood function in the presence of multiple equilibria. Alternatively, researchers have used two-step methods that circumvent the need to solve the game. However, these approaches do not utilize all the information from the model. They also require a non-parametric first-stage which would be infeasible in most empirical contexts. For instance, the shopping center game I consider has over half a dozen market characteristics. The first stage would then require estimating a non-parametric entry strategy function for each firm in over half a dozen dimensions.

In this paper, I develop a model of entry that allows for positive and negative spillovers among firms. I study these effects in the shopping center industry where the composition of anchor stores in a regional mall is formalized as the outcome of a game of incomplete information in which each store’s entry decision affects the other stores’ entry decisions. The shopping center industry seems well suited for an analysis of spillovers in firms’ entry decisions because a regional mall is a self-contained shopping hub. For the purposes of analysis, I focus on the simultaneous entry decisions of anchor stores since these firms typically commit to a mall before smaller retailers. Based on my conversations with mall developers and on the “Shopping Center Development Handbook”, the anchor stores are considered critical for the generation of traffic to a mall. But how much traffic they generate depends on their particular identity and also on the interaction with the other anchors in the mall.

I address the estimation difficulties that arise due to the presence of multiple equilibria by making use of an insight from Judd and Su (“Constrained Optimization Approaches to Estimation of Structural Models,” Working Paper, 2006). I depart from the recent literature on the estimation of discrete choice static games and formulate the entry game as a Mathematical Problem with Equilibrium Constraints (MPEC). Specifically, I use a direct optimization approach that consists of maximizing the likelihood function subject to the constraint that the equilibrium conditions given by the economic model are satisfied. Using state-of-the-art constrained optimization programs, I obtain the true maximum likelihood estimates of the parameters of the model without having to restrict a priori the domain of the parameters while also allowing for the presence of multiple equilibria. The direct optimization approach used in this paper can be used in a wide range of structural estimation problems other than entry models but this paper constitutes the first attempt to use this approach to address a specific empirical problem.

In addition to resolving the computational problems associated with multiple equilibria, I also tackle some of the standard econometric identification problems from games. I explore several plausible exclusion restrictions that help in resolving identification for the shopping mall entry game studied.

Two main conclusions may be drawn from my preliminary results. First, the empirical evidence from the Shopping Center Industry strongly supports the agglomeration and clustering theories that predict firms may have incentives to locate together despite potential business stealing effects. This

result supports the notion that, in some empirical settings it is not realistic to assume that entry of additional firms always decreases the profits of the other firms in the market. Second, the empirical results demonstrate that demographic variables representing the influence of exogenous (with respect to firms' entry) demand factors help predict both how many firms can operate profitably in the market and the firm-types configurations. In some cases, the effect of the market demographics can be large enough to outweigh the negative or positive effects across firms. The relative magnitude of such effects varies across store-types. For example, I find that demographic market characteristics are the main determinant of long-run profits for discount department stores (e.g. Target). However, this is not true for more upscale department stores (e.g. Macy's) for which the competitive effects (from other anchors of the same type) and the positive spillovers from lower-scale department stores seem both to be the main determinants of long-run profits.

Essay 2: "Competition, Variety and the Geography of the Shopping Center Industry," Work in Progress

Brief Abstract: In this study, I model the entry strategy of shopping centers. The increased competition between shopping centers, arising from their proliferation and consumers greater mobility, has created pressures for differentiation between shopping centers. This differentiation can be achieved in many ways, from tenant-mix decisions (i.e. via more or less store variety) to the choice of the malls' physical characteristics. A major goal of this study is to document how the existence of neighborhood malls affects the composition of a new mall and to what extent is mall differentiation important in avoiding head-to-head competition between malls in the same geographical area.

Other Research

"Category Pricing with State Dependent Utility," with J.P. Dubé, Günter Hitsch and Peter Rossi, *Marketing Science* (forthcoming)

Abstract: There is a substantial literature that documents the presence of state dependent utility with packaged goods data. Typically, a form of brand loyalty is detected whereby there is a higher probability of purchasing the same brand as has been purchased in the recent past. The economic significance of the measured loyalty remains an open question. We consider the category pricing problem and demonstrate that the presence of loyalty materially affects optimal pricing. The prices of higher quality products decline relative to those of lower quality when loyalty is introduced into the model. Given the well-known problems with the confounding of state dependence and consumer heterogeneity, loyalty must be measured in a model which allows for an unknown and possibly highly non-normal distribution of heterogeneity. We implement a highly flexible model of heterogeneity using multivariate mixtures of normals in a hierarchical choice model. We use an Euler Equations approach to the solution of the dynamic pricing problem which allows us to consider a very large number of consumer types.

"Multiple Equilibria in Static Empirical Pricing Games," with J.P. Dubé and Che-Lin Su, Work in Progress

Brief Abstract: Some of the recent demand estimation literature has modelled the data-generation process as an equilibrium outcome from a static pricing game between firms facing discrete choice demands. There are several reasons for using this type of full-information maximum likelihood approach. By including structure about the density of prices in the likelihood function, researchers have been able to correct for potential endogeneity bias in demand parameters. Researchers have also used the likelihood of the prices to conduct tests. Finally, the supply-side information can improve the efficiency of the demand estimates.

In this paper, we show that many of the most commonly-used models, such as Bertrand oligopoly

with random coefficients logit demand, need not generate a unique price equilibrium for a given set of parameters. Hence, the likelihood function is not well-defined. One solution adopted by the literature has been to ignore the problem, which effectively imposes the very strong identification condition that the pricing game generates a unique equilibrium. Alternatively, less efficient estimators such as GMM have been used.

By formulating the problem as a Mathematical Problem with Equilibrium Constraints (MPEC) we are able to utilize all the information from the model efficiently without having to assume uniqueness in the pricing game. We contrast the performance from our proposed estimator with other estimators typically used in standard empirical pricing models. In addition to providing more efficient estimates, we also show that the MPEC approach is computationally faster as it does not require nesting the calculation of a fixed-point to the pricing game at each stage of the parameter search.

Presentations

Invited seminar speaker at the *Institute on Computational Economics*, University of Chicago and Argonne National Laboratory, Illinois, August 2007 (scheduled).

“Category Pricing with State Dependent Utility,” *Marketing Science Conference*, Emory University, Atlanta, June 2005.

“Estimation of Equilibrium Models Using a Likelihood Based Approach,” *34th Annual Haring Symposium*, Bloomington, Indiana, April 2004.

Teaching Experience

University of Chicago

- Teaching Assistant (Pricing Strategies - MBA), Professor J.P. Dubé, 2003-present
- Course Assistant (Statistical Theory and Methods I and II), Professor Stephen Stigler (Statistics Department), 2004-2005
- Course Assistant (Statistical Methods and Applications - Economics variant), Professor Kenneth Wilder (Statistics Department), 2003-2004, 2004-2005
- Teaching Assistant (Marketing Strategy - Executive MBA), Professor Pradeep Chintagunta (Summer 2003), Professor Günter Hitsch (Summer 2004)

Catholic University of Portugal (Department of Economics and Business)

- Assistant Lecturer (Statistics I and II, Marketing I and II), 1999-2001

Selected Ph.D. Level Coursework

Area	Course	Instructor
Econometrics	Empirical Analysis I	Michael Greenstone
	Empirical Analysis II	Timothy Conley
	Empirical Analysis III	Han Hong
	Applied Econometrics	Federico Bandi
	Structural Estimation and Applications (Economics Department, Northwestern University)	Raquel Bernal
Industrial Organization and other Economics	Price Theory I (Microeconomic Theory)	Gary Becker / Kevin Murphy
	Numerical Methods in Economics	Kenneth Judd
	Advanced Industrial Organization I	Dennis Carlton
	Advanced Industrial Organization II	Dennis Carlton
	Advanced Industrial Organization III	Chad Syverson
	Topics in Industrial Organization	Jeremy Fox
	Industrial Organization and Prices I	Robert Porter / Michael Whinston
	Industrial Organization and Prices II (Economics Department, Northwestern University)	
Statistics	Probability and Statistics	Nicholas Polson
	Statistical Inference	Nicholas Polson
	Generalized Linear Models (Statistics Department, University of Chicago)	Peter McCullagh
Marketing	Advanced Marketing Theory : Quantitative Perspective	Pradeep Chintagunta
	Advanced Marketing Theory : Behavioral Perspective	Chris Hsee
	Advanced Marketing Theory : Pro Seminar	All marketing group faculty
	Bayesian Statistics and Marketing	Peter Rossi

Service

Executive Committee, Portuguese American Post-Graduate Society, 2005-2006, 2006-2007

References

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