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May 2006 (Oral) Industrial Organization and Econometrics (*both with distinction*)
May 2005 (Written) Microeconomic Theory, Macroeconomic Theory

Dissertation Title: *Estimating Multiple-Equilibria Models of Product Variety*

Committee:

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Expected Completion Date: May 2009

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Ph.D., Economics, Yale University, (expected May 2009)
M.Phil., Economics, Yale University, December 2007
M.A., Economics, Yale University, December 2007
M.A., Economics (*Summa Cum Laude*), Tel Aviv University, June 2005. Thesis:
“Technological Interdependence and its Impact: Evidence from Patent Citation
Data” (advisor: Professor Manuel Trajtenberg)
B.A., Economics (*Magna Cum Laude*) and Management (*Summa Cum Laude*), Tel

Aviv University, June 2003

Fellowships, Honors and Awards:

Carl Arvid Anderson Prize Fellowship, Cowles Foundation, Yale University, 2008-09
Dissertation Fellowship, Yale University, 2009
Economics Department Fellowship, Yale University, 2004-2008
Yale University Doctoral Fellowship, 2004-2008
Yale University Summer Fellowship, 2005, 2007, 2008
Honor Program, Eitan Berglas School of Economics, Tel Aviv University, 2001-2004
The Special Program for Outstanding Students, Tel Aviv University, 2000-2003
Honors scholarship, Faculty of Social Sciences, Tel Aviv University, 2003, 2004
Dean's lists, both Faculty of Social Sciences and Faculty of Management, Tel Aviv University, 2000, 2001
Honors scholarship from the Wolf Foundation, Tel Aviv University, 2001

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Graduate Econometrics III, Professor Yuichi Kitamura, Yale University, Spring 2008
Graduate Econometrics III, Professor Donald Andrews and Professor Azeem Shaikh, Yale University, Spring 2007
Introductory Microeconomics, Professor Justine Hastings, Yale University, Fall 2006
Graduate Macroeconomics, Professor Zvi Hercowitz, Tel Aviv University, Spring 2004

Research Experience:

Research Assistant to Professor Steven Berry, Yale University, 2005-2006
Research Assistant to Professor Manuel Trajtenberg, Tel Aviv University, 2001-2004

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Part-time analyst, P.O.C. (management consulting), 2000-2001
Military service in the Israeli Defense Forces, 1995-1999

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Papers:

“Upstream Innovation and Product Variety in the United States Home PC Market” [Job Market Paper]
“Does Competition Bolster or Restrict Product Variety? Evidence from the Home PC Industry” [in progress]
“Optimal Product Variety in Radio Markets”, with Steven Berry and Joel Waldfogel

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Dissertation Abstract

My dissertation studies the determinants of product variety in the United States Home Personal Computer (PC) and the Radio industries. In particular, I ask how are product choices in these markets affected by features of the economic environment such as innovation, mergers, and regulation of market entry. These research questions are motivated by a vast theoretical literature that demonstrated the potential for inefficient product provision in oligopoly equilibrium. To address these questions, I estimate models in which firms locate their products in discrete spaces, such that both the number, and the types of products offered are endogenously determined. Strong assumptions which guarantee a unique equilibrium outcome are relaxed, creating several challenges to the estimation and analysis of these models.

Innovation in consumer electronics markets is typically accompanied by a rapid elimination of existing technologies, which could hurt consumers who seek basic product configurations. Chapter I of my dissertation (my job market paper) asks whether innovation in Central Processing Units (CPU) leads to an inefficient elimination of basic PC products. Preliminary results suggest that consumer welfare gains from a particular innovation were partially offset by product elimination. Chapter II (in progress) examines the effect of mergers on the variety of PC configurations offered to consumers. Chapter III, joint with Steven Berry and Joel Waldfogel, analyzes entry into local radio markets while allowing for station differentiation. This analysis finds a smaller degree of excessive station entry than that reported in previous work.

I. Upstream Innovation and Product Variety in the US Home PC Market (job market paper)

A salient feature of the PC industry is the fast pace with which innovative products crowd existing products out of the market. While PC innovation fosters growth in many economic sectors, I ask whether it also leads to *inefficient product elimination*. Motivating this question is

the anecdotal evidence that some consumers have very basic computing needs, and, as a consequence, may be hurt when basic products exit the market.

Empirical work is required to determine whether basic products are inefficiently eliminated, since the potential for such a market failure depends on specific market features, such as the size of the market segment of basic PC users. My estimation results suggest that the demand for PCs is highly segmented. Preliminary results from a counterfactual analysis imply that the welfare gains from a particular innovation were partially offset by product elimination, and were primarily enjoyed by consumers who were the least price sensitive.

I analyze the impact of upstream innovation in the CPU, which serves as the PC's "calculating engine". I model a two-stage game played by PC makers: in the first stage, they face a discrete menu of vertically differentiated CPUs, and simultaneously choose which CPU options to offer with their PC products. While consumer heterogeneity provides incentives to offer vertically differentiated PC configurations, offering each such configuration results in fixed costs. In the second stage, the chosen configurations are sold to consumers in a simultaneous price-setting game. CPU innovation expands the menu of available CPU options, and I use the model to predict the impact of this expansion on both product choices and prices in the PC market.

I use data on product characteristics, prices, and sales to estimate PC demand. This allows me to quantify the benefits to PC producers from offering product configurations. Set estimates of fixed cost parameters are obtained by exploiting variation in observed product choices: for example, an observed decision to offer a certain PC configuration implies an upper bound on the fixed costs associated with it. With these estimates of the benefits and costs associated with each PC configuration, I simulate counterfactual equilibria of the two-stage game.

The paper offers three methodological contributions. First, in contrast to previous work with vertical product differentiation, my framework allows for multiple equilibria, resulting in partial identification of fixed costs. Following recent literature, I estimate upper and lower bounds on these costs using necessary equilibrium conditions. Second, I allow for a large, discrete product space, which provides a detailed picture of PC product variety. This exacerbates the computational burden associated with simulating sets of counterfactual equilibria, and I develop techniques which alleviate this burden. Finally, I consider two alternative approaches to deal with a sample selection bias, which arises because firms select the set of products observed in the data.

The estimated model implies a strong degree of consumer heterogeneity in price sensitivity, as well as in the degree to which consumer utility from a given PC product falls over time. I also find that the average consumer displays a considerable willingness to pay for PC brands, suggesting that product choices by some PC makers can have an important impact on the map from upstream CPU innovation to consumer welfare.

I use the model to study the impact of Intel's introduction of its Pentium M chip, which is considered a landmark in mobile computing. I quantify the welfare gains from this innovation using both the full model, and a restricted model, in which product choices are fixed. Preliminary results from both models imply that the benefits to consumers were primarily accrued to consumers who are the least price sensitive. The full model offers some preliminary evidence that total consumer benefits were partially offset by product elimination.

An important issue is that innovation in software transforms basic users into advanced users over time. While my analysis captures this effect, the important role of CPU innovation in fostering such complementary innovation is not quantified, motivating future research of this process.

II. Does Competition Bolster or Restrict Product Variety? Evidence from the Home PC Industry (in progress)

The relationship between mergers and product variety is characterized by conflicting forces that lead to inconclusive theoretical predictions. While joint ownership of products creates incentives to differentiate them in the product characteristics space, it could also motivate the elimination of products, which would decrease product variety. Chapter II of my dissertation studies the impact of the 2001 HP-Compaq merger on product variety in the PC market. Treating the portfolio of PC configurations offered to consumers as endogenous, I compare post-merger product choices to the choices made under a counterfactual scenario, in which the merger did not occur. To account for possible efficiency gains, I allow for economies of scope, which may allow merging firms to reduce their per-product fixed costs.

III. Optimal Product Variety in Radio Markets (with Steven Berry and Joel Waldfogel)

Free entry can result in excessive entry if entrants fail to induce new demand, and instead split the market with incumbents while consuming fixed costs. Berry and Waldfogel [1999] quantified the extent of excessive entry in local radio markets, relying on an assumption of symmetry among stations. Chapter III extends this work by relaxing the symmetry assumption, and instead allowing stations to differentiate their broadcasting along both horizontal and vertical dimensions. Discrete station differentiation results in multiple equilibria. The results, however, indicate that allowing for horizontal differentiation is important: the degree of excessive entry is found to be markedly smaller than that reported in previous work.