Estimation of durable goods models for differentiated products

Professor Gautam Gowrisankaran
University of Arizona and National Bureau of Economic Research
gautamg2@gmail.com
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Lecture 1: Static and dynamic models for estimating preferences for differentiated products

Lecture Topics:

1) Background on static models of demand for differentiated products: logit models, nested logit models, Berry (1994) and Berry, Levinsohn, Pakes (1995) [BLP] models

   a) The multinomial logit model:
      • computation of shares in model
      • likelihood for model
      • independence of irrelevant alternatives and relation to IIA assumption on unobservables

   b) Discussion of main advances in Berry/BLP model relative to multinomial logit model:
      • random coefficients
      • unobserved product characteristics
      • integration of supply and demand side with equilibrium conditions

   c) Estimation and identification of the Berry/BLP model:
      • BLP contraction mapping to back out $\xi$
      • Identification of random coefficients and endogenous regressors, notably price
      • Role of micro-moments
      • Implementing a BLP estimator: two-stage GMM process; construction of instruments; non-linear search over some parameters and linear search over others
      • Individual welfare and choice probabilities in BLP model
      • Interpreting a BLP model: what are the revealed parameters

2) Dynamic models of demand: the Gowrisankaran and Rysman (2010) model

   a) Features of the base model relative to BLP:
      • Consumer heterogeneity like BLP but need assumption on persistence over time
      • Assumptions on durability of products
      • Assumptions on purchases of new products

   b) Understanding repeat purchases
      • Bellman equations with and without repeat purchases
c) The role of expectations
   - Expectations about future logit error terms
   - Consumers care about current and future logit inclusive values (Proposition 1)
   - Expectations of future product qualities: Inclusive Value Sufficiency (IVS) Assumption

d) Supply side of model

e) Identification of model
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Professor Gautam Gowrisankaran
University of Arizona and National Bureau of Economic Research
gautamg2@gmail.com
Sep. 24, 2010
Lecture 2: Toolkit: Estimation of simple dynamic models

Lecture Topics:

1) Estimating dynamic durable goods models with no random coefficients and no repeat purchases
   a) Melnikov (2000) model with perfect foresight: exposition and estimation of characteristics
      • Exposition of model
      • Transformation of model into optimal stopping model
      • Estimation of preferences for characteristics without solving dynamic model
   b) Melnikov (2000) model with perfect foresight: estimation of constant term
      • Exposition of general Bellman equation: state space and maximization
      • Properties of logit inclusive value $\delta_i$
      • Inclusive value sufficiency assumption about future
      • Simplification of Bellman equation with logit inclusive value formulation and inclusive value sufficiency assumption
      • Estimation of constant term by Rust (1987)-style nested fixed point
   c) Estimation with rational expectations but distribution over future outcomes
      • Specifying expectations with rational expectations but not perfect foresight
      • Computation of Bellman equation for this model
      • Computational details: grid approximations, tolerance levels, AR(1) approximations, grid minima and maxima, and other computational details
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Professor Gautam Gowrisankaran
University of Arizona and National Bureau of Economic Research
gautamg2@gmail.com
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Lecture 3: Toolkit: A user’s guide to the Gowrisankaran-Rysman method; results from the model

Lecture Topics:

1) Adding random coefficients to the Melnikov model
   a) Solving the individual optimization problem: generalization of inclusive value sufficiency assumption to have $\delta_n$ instead of $\delta_i$ and $\gamma_{i0}, \gamma_{i1}$ instead of $\gamma_0, \gamma_1$
   b) Computing shares: reason why we can no longer solve for most parameters in first stage
   c) Idea of nesting Bellman equation solution within BLP contraction mapping

2) Adding repeat purchases to the model
   a) Solving the individual optimization problem
      • Definition of flow utility $\delta^{f}_{jt}$
      • New state space
      • Bellman equation
      • Generalization of inclusive value sufficiency assumption
   b) Computing shares: three equations that must hold simultaneously
      • Bellman equation
      • $\delta_n$ equation
      • Regression coefficients
   c) Use of micro-moments in a dynamic model

3) Results and applications of Gowrisankaran and Rysman durable goods models
   d) Comparison of results for camcorder data
      • Static BLP model with random coefficients
      • Dynamic model without random coefficients or repeat purchases
      • Dynamic model with random coefficients
• Dynamic model with random coefficients and repeat purchases
• Dynamic model with random coefficients, repeat purchases and micromoments

b) Application: price indices
• Some issues with price indices: new buyer problem, new goods problem, problem with expectations
• Our welfare index: the set of state-contingent taxes that keep welfare constant

c) Other applications
• Switching costs in cable and satellite television industry
• Network effects in video game market
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Professor Gautam Gowrisankaran
University of Arizona and National Bureau of Economic Research
gautamg2@gmail.com
Oct. 8, 2010
Lecture 4: Broader context and future directions of the Gowrisankaran-Rysman approach

Lecture Topics:

1) Relation of different dynamic estimation approaches in literature
   a) Similar models to Gowrisankaran and Rysman
      • Melnikov (2000)
      • Carranza (2006)
   b) Models of storable goods
      • Hendel and Nevo (2006)
   c) The relation between models for aggregate data (such as BLP) and models for individual data
      • Why and when should we use aggregate data?
      • Necessity of unobserved product characteristics with aggregate data
      • Use of micro-moments to supplement aggregate data
   d) Relation to dynamic oligopoly models
      • Hotz and Miller (1993); Aguirregabiria and Mira (2002)
      • Aguirregabiria and Mira (2007); Bajari, Benkard and Levin (2007); Pakes, Ostrovsky and Berry (2007); etc.

2) Future directions
   a) Other estimation methods for this algorithm
      • Dube, Fox and Su (2010)
      • Conlon (2010)
   b) Simpler estimation of storable goods models
      • Hendel and Nevo (2010)
   c) Future research questions
      • Complementary goods and network effects: Lee (2010), Gowrisankaran, Rysman and Park (2010)
• Switching costs: Shcherbakov (2010)
• Models with resale markets: Schiraldi (2010)