

ECON-L1300 - Empirical Industrial Organization, PhD

I: Static models

Lecture 1

Tanja Saxell, Ari Hyytinen, Otto Toivanen & Iivo Vehviläinen

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Objectives of these lectures

By the end of these lectures, you

- understand what structural econometrics means,
- know how to model demand in differentiated goods markets using both market- and individual level data,
- know how to model supply in an imperfectly competitive market, and
- know how to conduct a merger analysis.

Schedule

- Week 1
 - Logit and nested logit, (welfare, interpretation of parameters, market & individual level data), Otto Toivanen
 - Exercise 1 (logit, nested logit)
- Week 2
 - The BLP demand model, Tanja Saxell
 - Exercise 2
- Week 3
 - Identification, optimal instruments (Berry & Haile, market & individual level data), Ari Hyytinen
 - No exercise

Schedule

- Week 4
 - Supply side, Otto Toivanen
 - Exercise 3
- Week 5
 - Market power, merger analysis, Iivo Vehviläinen
 - Exercise 4
- Week 6
 - demand side applications, Tanja Saxell and Otto Toivanen
 - No exercise

About the course

- This is a PhD level course. That means the following things:
 - We take the prerequisites as given.
 - The work load of the course is substantially higher than in MSc courses.
 - The exercises will be more difficult than in the MSc courses.
 - You are expected to prepare for the lectures by reading the compulsory material in advance.
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 - 2 hours of paying attention during the lecture
 - 3 hours of post-lecture work trying to understand what it all really was about.

Materials for the course

- Lectures and lecture notes.
 - We build, with permission, on the lectures of [Phil Haile \(Yale\)](#) and [Chris Conlon \(NYU\)](#) + others.
- Reading list.
- Exercises.
- Videos: [Chris Conlon \(NYU\)](#), [AEA](#) / [Phil Haile](#).

What this course is not about

- Compared to many other IO PhD courses, we do not start by
 - ① talking about the development of the field (SCP, NEIO, ...).
 - ② covering homogenous goods demand and supply.
- For these, see Chris Conlon's lecture materials and videos and/or refer back to Jiekai Zhang's MSc IO course at Helsinki GSE.

About today's lecture

- Today's lecture is a warm-up lecture. We discuss
 - ① Definition of econometrics.
 - ② What is structural econometrics.
 - ③ What is a reduced form model.
 - ④ Marshak's Maxim.
 - ⑤ Different approaches to modeling demand.

1. Definition of Econometrics

Econometrics: *A branch of economics in which **economic theory** and statistical methods are fused in the analysis of numerical and institutional data*", Hood, W. & Koopmans, T. (1953). Studies in econometric method. *Cowles Commission Monograph no. 14, Wiley.*

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2. Ingredients of a structural model

- A **structural (econometric) model** combines a theoretical with a statistical structure and delivers (combinations of) **structural parameters** what have an interpretation within the model.
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- **Structure = economics & statistics.**

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- Generally:
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 - ③ Adequacy of the model as a description of the data.

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- 4 The decision variables, time horizons, objective fcn's.
- 5 An equilibrium concept.

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 - ② Is the stochastic specification consistent with what is observed?
 - ③ Is the stochastic specification consistent with the model? (who observes what when).

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- ① What the researcher does not know.
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- ③ Optimization errors.

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- ① What the researcher does not know.
 - ② What the agents do not know.
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- The stochastic model must be able to rationalize all possible realizations of the endogenous variables.

2. The stochastic model & estimation & testing

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- 1 Functional form assumptions.
- 2 Distributional assumptions.
- 3 Estimation technique.
- 4 Specification / out-of-sample tests.

3. Definition of a reduced form model

- **Definition.** A **reduced form** is a functional or stochastic mapping for which the inputs are
 - 1 **exogenous** variables and
 - 2 unobservables ("structural errors"),
- The outputs of a reduced form model are **endogenous** variables. e.g.,
 $Y = f(X, Z, U)$.

3. Definition of a reduced form model

- What does **exogenous** mean here?
- It can mean different things:
 - ① For a theorist, all those things not determined within the model
 - ② For an econometrician, exogenous variables need to satisfy some **independence** condition.
- These can be different!

3. Definition of a reduced form model

- A reduced form model implies that a structural model exists.
- This may or may not have implications on the functional forms used for the reduced form model (e.g. semiparametric).
- A reduced form model can be used for counterfactuals.
- **Requirement:** The mapping from exogenous variables (incl. error terms) to endogenous variables is invariant to the counterfactual.

3. Definition of a reduced form model

- Demand and supply example.

3. Definition of a reduced form model

- Lesson from the example: It is hard to think of what the unobservables in your regression equation are (what economic role, what statistical role they play) if you do not have a model in mind.
- From this point of view, it is unfortunate we call them "errors"; this does not give license not to think about their content!
- Note, model does not have to mean a mathematical model, but often that would be helpful (can be deceiving, too).

4. Marschak's Maxim (Marschak 1953, Heckman and Vytlacil, 2007)

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- This may (greatly) reduce the number of assumptions needed.
- Marschak's Maxim helps bridge the gap between different approaches.

5. Different approaches to modeling differentiated goods demand)

- Taxonomy of demand systems.
 - ① Representative consumer vs. heterogenous agents.
 - ② Discrete choice vs. continuous choice.
 - ③ Single vs. many products.
 - ④ Product space vs. characteristics space.

5. Different approaches to modeling differentiated goods demand)

- Data.
 - ① Individual level data. Who bought what, where and when.
 - ② Aggregate data: market shares and prices for each good in a given market in a given period.
 - ③ Sometimes a combination of both, e.g., aggregate data + survey data.

5. Different approaches to modeling differentiated goods demand)

- Starting point: consumers value different goods available to them differently.
- How to model?
- First, let's label the goods $j = 1, \dots, J$.
- **Note:** we will start with approaches using market level data, then go to individual level data, only to go back to market level data.

5.1 The product space approach

- **The product space (goods) approach:** We write down a model for each of the goods.
- Let's take the simplest model, i.e., constant elasticity of demand.
- Now the demand for good j , q_j , is a function of

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- Now the demand for good j , q_j , is a function of
 - 1 income y ;
 - 2 possible demand shifters x ;
 - 3 its own price p_j ; and
 - 4 the prices of all the substitutes' prices.

5.1 The goods approach

$$\begin{aligned}\ln q_1 &= \alpha_{10} + \alpha_{11} \ln y + \alpha_{12} \ln p_1 + \dots + \alpha_{1J} \ln p_J + \mathbf{x}'\beta_1 + \epsilon_1 \\ &\cdot \\ &\cdot \\ \ln q_J &= \alpha_{J0} + \alpha_{J1} \ln y + \alpha_{J2} \ln p_1 \dots + \alpha_{JJ} \ln p_J + \mathbf{x}'\beta_J + \epsilon_J\end{aligned}\tag{1}$$

5.1 The goods approach

- What about those consumers that choose none of the products? (substitution in and out of the market).
- Number of parameters: $J(J + 2 + M)$, where $M =$ number of demand shifters.
- Very large number of price elasticity parameters (J^2).
- Need J instruments (collinearity of them an issue...).
- Question: What if you want to study the effect of introducing a new good?
- Finally: This may be a very suitable approach, depending on the data and the research question.

5.1 The goods approach

- Ways to deal with the problems:
 - ① Hicks composite commodity theorem. Not useful here as it assumes away differential price movements.
 - ② Multilevel budgeting, Gorman polar forms = representative consumer, Dixit-Stiglitz (CES) preferences, Almost Ideal Demand System.
 - ③ See Chris Conlon's slides + video, [lecture 2](#).

5.2 The characteristics approach

- Goods are treated as bundles of **observed** and **unobserved** characteristics.
- Note, price is a characteristic (which is potentially endogenous in a way to be specified).
- Consumers have preferences over these bundles.
- Then we apply consumer theory, i.e., discrete choice models.