Background on Demand Systems.

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• There had been two ways of empirically analyzing the impact of environmental and/or policy changes on market demand.

1. "Outcome focused" analysis. Goal was to measure outcomes from observed changes (usually policy changes) without a model of the relationship of the outcome to a utility function which directed choices. Today's analogue is the literature on "causal models".
2. Demand systems based on underlying utility theory where the utilities are defined on products. Initially this was largely based on representative agent models, but there was no conceptual problem with turning it into a micro model of individual choice and then aggregating up to market demand and with modern computers it is easy to do that.

• Dates at least to T. Haavelmo, in his 120 page Nobel Prize winning treatise, "The Probability Approach to Econometrics", *Econometrica*, 1944.

"The method of econometric research aims, essentially, at a conjunction of economic theory and actual measurements."

The outcome focused alternatives.

- They had the advantage of providing a single number that policy makers and politicians found easy to access.
- The disadvantage of the outcome focused approach is that they could not credibly predict the outcomes from different policies or from the same policy in alternative environments.
  - To evaluate different policies we needed an ability to do counterfactuals.
  - Our data often came from different market, or the same market over time, so we needed to allow the distribution of consumer attributes to change with different observations.
- The strength of the "Haavelmo's" approach is that once we condition on the theory and have estimates of the primitives, in the demand case the distribution of utilities for the goods marketed, we can construct outcomes from counterfactual policies and/or counterfactual characteristic distributions, that is from policies or characteristics that are being evaluated but not yet observed.

Product Space.

• The demand for each product was estimated as a function of the prices of all products, and perhaps characteristics of the distribution of population attributes in the market being studied.

• This had two problems when analyzing demand in markets.

1. the "too many parameter problem",
   - Even in a linear system and a market of twenty products, this would require estimates of ≈ 400 parameters. Too many to estimate with any precision with almost any known data set, and many data sets had many more than ten products[1].
2. it was unable to predict demand for new goods.
   - A basic question in the study of a market is what would happen were we to introduce a new good (or for that matter just about any other new policy).

[1] Prior attempts to solve this problems go back at least to Terrence Gorman's polar forms in 1953, and the literature on Almost Ideal Demand systems by Deaton and Muelbauer 1980.

Characteristic Space.

- Products are defined as bundles of characteristics.
- Individual preferences determined by the interaction of product characteristics with the individual attributes[2].

- This generated the potential to solve the two problems above:
  - All we need to know is the distribution of preferences over characteristics: I.e. number of parameters are now independent of the number of products.
  - We could estimate the demand for new goods if we knew those goods characteristics (at least if those characteristics were within the span of the observed characteristics).

[2]Major articles: Mcfadden (1974) for analysis of individual choices, Berry, Levinsohn and Pakes (1995,2004); or BLP and fellow travellers for the analysis of markets.

Moving to characteristic space generated two new problems.

1. Aggregation. To obtain aggregate demand we had to sum the demands of individuals with different attributes as those attributes enter their utility from purchasing different goods.
2. At least for retail products we need to allow for characteristics we could not condition on (either they were not in the data, or they were but there were too man of them). This is the analogue of the disturbance term in product level demand systems and it generates a similar simultaneous equation problem. But now the error is inside a highly non-linear function so the standard solution of applying instruments is not available.

1. Aggregation: solved by the introductions of simulation estimators[3].
2. The unobserved characteristic: BLP provides a contraction mapping which enables the researcher to obtain the unobserved characteristic as a linear function of characteristics (including price), This enables the use of instruments, as in the earlier demand literature. [4].

[3] Literature in economics. Simulation for prediction: McFadden and Travilte,1979; & for estimation: Pakes, 1986. Formal econometric theory; McFadden (1989) and Pakes and Pollard (1989).

[4] Literature: Berry (1994) showed that in a logit model with no interactions between product characteristics and consumer attributes, there was a simple linear transform of shares that did this. BLP(1995) provided the contraction mapping which allowed for those interactions, and Jeff will show you why those interactions are needed.

Where are we now?

- The framework has spread to:
  - The many fields who need estimates of market demand (health care, environment, public finance, finance, ...).
  - Consultancies and some other private firms.
  - Government agencies that require demand systems to evaluate policy (e.g.s, FTC, DOJ, EPA, ...).

- Though the demand system that will be discussed is in many instance the best tool available (and that is how we evaluate applied tools as the world is too complicated to get everything exactly right), there are still aspects of demand that need attention and generate new research.

Problems that we are just starting to grapple with.

• **Consumer dynamics** needed to analyze choices (or prices) in any market where either

- past choices or
- perceptions of future choices,

are important.

• The increased availability of panel data on discrete choices has added to the importance of this.

• Distinguish between two situations.

1. One where the decisions made are closely tied to the perceptions of future outcomes (requires explicit dynamic reasoning).
2. Decisions which are deferred, either because
   - the implications of a bad choice can easily be reversed if needed,
   - &/or the cognitive costs of repeated evaluations rival perceived utility gains.

• Models of "inattention" &/or "switching costs" are relevant for the second case. They lead to *a direct dependence on past choices.*

• So inattention implies choice models need the impact of a policy *conditional* on *both*; (i) preferences and (ii) past choices.

• Some of the determinants of preferences are not observed and are relatively stable over time making them correlated with past choices.

• So if we put past choices into the model with no correction for unobserved preferences, its coefficient will pick up their impact.

• Other coefficients will also be biased. E.g. for pricing responses is the fact that people stay with their last choice when prices change

- because they like their last choice, or because of inattention.

• Moment inequalities have generated progress here[5].

[5] Pakes A, Porter J, Shepard M, Calder-Wang S. Unobserved Heterogeneity, State Dependence, and Health Plan Choices. 2025, see my web site.

• Similar issues in distinguishing the reasons acquaintances chose similar things. This could be due to

- network effects (either direct or indirect) or
- because you and your friends and have similar (unobserved) tastes.

• Finally there are questions related to which choices are the individuals aware of (their "consideration sets"), and what do they know about those choices? Again there is a budding literature here both to

- determine what agents know when making their choices
- how to use that knowledge when estimating demand.

Enjoy Jeff's course, and thanks for coming.