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Relevance of Blp Model for The Medical Markets Issues for Hahn, Hausman, Lustig Specification Test Application

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Abstract

This paper continues a research project on physicians' choice models, started in 2017 at MIT. Professor Huttin and Professor Hausman published a first experimental study to compare simulated data with an original dataset, extracted from the US National Ambulatory Care Survey, on Type II diabetes [1, 2]. This paper aims to discuss the specification issues of a second type of model, called the BLP model.Berry's approach is ideal for differentiated markets, such as pharmaceuticals, where oligopolies or duopolies are common. Empirical studies, often related to merger cases in markets like AIDS, already exist where misspecification tests can be empirically implemented. The medical markets have many cases of oligopolies, where competition authorities often use demand estimation in merger cases, to check ex ante and ex post cross price elasticities of market segments, impacted by the merger. Additional choice sets are then identified in major chronic conditions, or in procedures for genomic medicine (such as NGS) to compute misspecification tests at the individual level, as proposed by Hahn et ales (2020) and already tested in a simulated ML model on diabetic type II, in Huttin and Hausman (2021).

Keywords: Mixed Logit, Blp Models, Pharmaceuticals, Misspecification Tests, Medical Markets.

Introduction

After series of presentations on disease econometric modeling, using extraction of the National Ambulatory Care survey on office-based physicians in the USA, this working paper aims to provide a discussion on controversial issues concerning the relevance to add econometric specification tests on the models combining stated and revealed preference data. The most well-known was developed by the Nobel Prize Prof D McFadden, especially under the multinomial Logit model (also further developed under a popular form of the Mixed Logit model).

The first section of this paper discusses issues of major econometric specification tests, necessary to validate statistical estimates of choice models. These tests are usually implemented in vendors' statistical packages such as Stata, SAS/JMP, R or MATLAB. This type of model is very useful on health insurance and medical markets; so, a discussion of adding new econometric specification tests to run reliable choice economic models is of high relevance. This paper aims to move beyond the mixed logit model, with a second type of model, called the BLP model and a discussion on issues for computation of recent specification test at individual level for differentiated markets.

Background on the first-Choice experiment and the baseline study by Prof Huttin and Hausman (2021) using the Hahn, Hausman Lustig specification test.

The original experiment run by Prof Huttin and Hausman on an analytical data set, especially designed for the study, is also mentioned again in this paper as a baseline study, showing the interest of such an approach in the trend towards more individualization of clinical pathways and evolving treatments, especially in cancer care. The statistical analysis was run with a Mixed Logit (ML) model, with parameters for estimation of the demand model from previous disease econometric models, running logistic

or cumulative logistic regressions on the parameters. The mixed logit form required to reshape the dataset to run a choice model on qualitative dependent variables, instead of these series of logistic regression on numbers to describe patterns of utilization of medical services.

The generation of alternatives for such choice models resulted from complex interactions between medical investigators and the economist team, it is described in another paper [3] . The approach is to select choice sets of three alternatives and to check on each choice set, whether removing one of the three alternatives modifies or not the estimators. Different sequences are used and tested to verify correlations of parameters according to number of random draws. This original study is a first milestone for running this type of physician's choice model on critical drug areas or procedures.

The Mixed Logit (ML) model was the first one used for this type of demand estimation on a medical market. The study also includes the computation of the recent specification econometric test from [2] this test complements the generalized test proposed by [4], to improve the nested logit model and latent class models. These models are well specified only inside the branches of the tree. At this stage of the research, only Hahn Hausman and Lustig proposed to compute a specification test at an individual level, which then does not require any more to use classification in latent classes and ensures the specification of the mixed logit model at individual level [4-5] .

Why to use additional specification econometric tests for choice models? Summary of main tests already used on IIA

This section of this paper first provides a summary of major econometric choice models' specification tests, currently used to validate the statistical estimates of parameters in Choice models. These tests are especially computed in statistical packages such as Stata, SAS/JMP, R or MATLAB. Moreover, choice models are increasingly used to analyze supply but also more recently demand side of medical markets; they help a better understanding of the heterogeneity of demand for care and economic impacts of various benefit designs in health insurance. So, a discussion on existing tests, their limitations and the need to add or not additional econometric specification tests is of high relevance, to ensure the reliability of statistical results of economic choice models.

This section mainly addresses controversial issues concerning the relevance to add econometric specification tests on the main model combining stated and revealed preference data, developed by Prof D McFadden, initiated under the Multinomial logit model and further developed as the Mixed Logit Model (ML). This economic model was the one first use in the physician's choice experiment with the Hahn, Hausman Lustig specification test, on a diabetic dataset, using extraction of the National Ambulatory Care survey on office-based physicians in the USA.

The recent review of econometric choice models by [6] provides a landscape of economic discrete choice modelling research and a literature review on different types of choice modeling. In this paper, the main reference is the econometric models used with statistical procedures such as conjoint analysis. The unique application for the physician model developed by Prof Huttin and her team was called a reversed conjoint model.

Prof McFadden formalized the first main economic choice model called the multinomial logit model (1973). However, this model has a well-known limitation associated with the so-called Independence of Irrelevant Alternatives (IIA) assumption. IIA has been very discussed in the literature of the social choice theory (Arrow, 2014), in other theories (see Figure 1 below) In the context of this paper, which aims to discuss the relevance of a second type of model for a choice mode, developed for oligopolies, and called the BLP model; it is often used for demand estimations in competition analysis of mergers.

The Known limitations on specification tests in choice model and interest for health care choices:

There is a need for more research to understand the lack of efficiency towards positive outcomes in the health system. Statistical analysis on health care expenditures typically uses logit or probit based on discrete choice models. Discrete choice models are particularly appropriate to explore providers or patients' decision shifts under different economic conditions and capture large heterogeneity of demand, either from diversity of value judgement and preferences of providers of care (not only physicians) and large diversity of preferences among the population. However, for such choice models, to be used for national policies, they need reliable statistical models.

This type of economic research uses Random Utility Models, especially statistical models, such as the Multinomial logit models (McFadden, 1973,1984), which enforces the independence of Irrelevant Alternatives (IIA) assumption at the micro level. However, the IIA assumption, while simplifying the analysis, may well be inconsistent with choices, especially physicians 'choices. The widely used Hausman-McFadden (1984) test of the IIA properties has found that IIA fails in a wide variety of applications. The generalization of the Hausman-McFadden test [4], at individual level, is now implemented in codes on Mixed Logit model, but also BLP model it allows heterogenous preferences and helps to identify whether IIA failed in applications of such choice models.

The study performed by Huttin and Hausman in the medical field (2021) is the first-choice experiment on real data, on drug choice sets, using a Mixed Logit model and the approach proposed by Hahn, Hausman and Lustig [2] to ensure that the model is well specified; it shows especially the need to add a specification test on the Mixed Logit model; this recent specification test using Bayesian priors on the Burda , Harding and Hausman model or the Poisson-Mixture from the same authors (2012) allows to cover the specification issues not covered in Mixed Logit models or the limitations of the Nested Logit models to each branch of the decision tree (also limitations of latent class models).

The second model, BLP model at this point, has not been used and tested with the proposed specification tests for such application on medical markets.

[1]Originally the Mixed Logit model cited in this paper was developed by McFadden and Train (2000). Other extensions are also described in Fok and Paap paper (2025) or by Gu et ales (2022).

[2]See Fok et Paap (2025) on "misspecification not well captured in nested logit and mixed logit types of models".

This second model was developed by Berry, Levinsohn and Pakes (BLP), especially for application on the automobile market; its importance is mainly for analysis of pre and post-merger cases and calculation of cross price elasticities in main product segments impacted by the merger. Past controversies between competition lawyers exist, especially comparing estimations between BLP models and Mixed Logit or Nested Logit (see footnote 1).

Berry's approach is ideal for differentiated markets, such as pharmaceuticals, where oligopolies or duopolies are common. The medical markets have many cases of oligopolies, where competition authorities often use demand estimation in merger cases, to check ex ante and ex post cross elasticities of market segments, impacted by the merger. Empirical studies, often related to merger cases in pharmaceutical markets, already exist and misspecification tests can be empirically implemented.

The main specificity of Berry's approach is to use the mean utility and calculate it with the demand system, instead of using only the product sales. It is a model of discrete choice, especially for differentiated products (developed for oligopolistic markets). In medical markets, it would lead not to only examine Cost of Goods Sold (COGS) for instance according to market segments identified by marketing departments of pharmaceutical companies; but rather use other types of classifications with an analysis of medical claims or electronic medical records from public or private payers or health care organizations.

The discrete choice modeling from the demand system addresses the issue of unobserved product characteristics, which partially explained some consumers' choices. For instance, Berry mention the case in medical market of medical CT scanner market, studied by Tratjenberg (1989) in this market, in some cases the prices have a positive effect on demand; price increases in such case lead to increase consumer benefits , it refers to unobserved product quality In discrete choice models, prices and such unobserved product or service quality are in demand equation in a non linear way and cannot be represented by instrumental variables. Berry proposes to invert the function defining market share to uncover the mean utility level; his method is then called the Mean utility method; this approach is used for recovering the mean utility values in discrete choice models with oligopoly pricing [7- 14]. These medical markets have many cases of oligopolies, where competition authorities often examine merger cases, and need to check ex-ante and ex-post price cross elasticities of market segments, impacted by the merger.

(1) Interested readers can follow the controversies in the economic letters, especially between Berry et al and Wojcik (2000, 2001) concerning alternative models of demand for automobiles between nested logit, BLP models and Mixed logit models. However the applications in the car industry are different and so far, there is no empirical evidence yet with studies on the medical market and no application of the Hahn et ales (2020) specification test.

Demand discrete choice models have been used already in cases of mergers in pharmaceutical markets for price estimates. For instance, Farasat, Bokhari et Mariuzzo (2018) compared different types of choice models for a demand estimation of Attention Deficit Hyperactivity Disorder (ADHD) drugs: they identified choice sets among products by active ingredient (molecule), formulation (immediate release, extended release), substitutes versus complements, combination versus non combination products. However, there are no specification tests such as Hahn et ales, used in such studies. This work in progress may then be useful to provide a representation of a supply/demand economic model with better understanding of the demand side of oligopolies in medical markets. It will also discuss the controversies on empirical analysis of such markets and the issues around data sets used in existing studies.

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