Minimum Distance Estimation of Search Costs Using Price Distribution

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It has been shown that equilibrium restrictions in a search model can be used to identify quantiles of the search cost distribution from observedprices alone. These quantiles can be difficult to estimate in practice. This article uses a minimum distance approach to estimate them that is easy to compute. A version of our estimator is a solution to a nonlinear least-square problem that can be straightforwardly programmed on softwares such as STATA. We show our estimator is consistent and has an asymptotic normal distribution. Its distribution can be consistently estimated by a bootstrap. Our estimator can be used to estimate the cost distribution nonparametrically on a larger support when prices from heterogenous markets are available. We propose a two-step sieve estimator for that case. The first step estimates quantiles from each market. They are used in the second step as generated variables to perform nonparametric sieve estimation. We derive the uniform rate of convergence of the sieve estimator that can be used to quantify the errors incurred from interpolating data across markets. To illustrate we use online bookmaking odds for English football leagues' matches (as prices) and find evidence that suggests search costs for consumers have fallen following a change in the British law that allows gambling operators to advertise more widely. Supplementary materials for this article are available online.

KEY WORDS: Bootstrap; Generated variables; M-Estimation; Search cost; Sieve estimation.

1. INTRODUCTION

Heterogenous search cost is one of the classic factors that can be used to rationalize price dispersion of homogenous products. For example, see the seminal work of Stigler (1964). Various empirical models of search have been proposed and applied to numerous problems in economics depending on data availability. Hong and Shum (2006, hereafter HS) showed that search cost distributions can be identified from the price data alone. The innovation of HS is very useful since price data are often readily available, for instance in contrast to quantities of products supplied or demanded.

We consider an empirical search model with nonsequential search strategies. HS showed the quantiles of the search cost in such model can be estimated without specifying any parametric structure. Although there has been more recent empirical works that extend the original idea of HS to estimate more complicated models of search (for example, see Hortaçsu and Syverson 2004; De los Santos, Hortaçsu, and Wildenbeest 2012; Moraga-González, Sándor, and Wildenbeest 2012), there are still interests in the identification and estimation of the simpler search model nonparametrically. For example, Moraga-Gonzá lez, Sándor, and Wildenbeest (2013) showed how data from different markets can be used to identify the search cost distribution over a larger support and Blevins and Senney (2014) considered a dynamic version of the search model we consider here.

The main insight from HS is that the equilibrium condition can be summarized by an implicit equation relating the price and its distribution, parameterized by the proportions of consumers searching different number of sellers. The latter can be used to recover various quantiles of the search cost distribution. Two main features of the equilibrium condition that lead to an interesting econometric problem are: (i) it imposes a continuum of restrictions since the mixed strategy concept leads to a continuous distribution of price in equilibrium and (ii) the observed price distribution is only defined implicitly and cannot be solved out in terms of price and the parameters of interest.

In this article, we make two main methodological contributions that complement existing estimation procedures and make the empirical search model more accessible to empirical researchers.

First, when there are data from a single market, we provide an estimator for the quantiles on the cumulative distribution (cdf) of the search cost that is simple to construct and easy to perform inference on. Our estimator uses all information imposed

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