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Nonsequential search equilibrium with search cost
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ABSTRACT

We generalize the model of Burdett and Judd (1983) to the case where an arbitrary finite number of firms sells a homogeneous good to buyers who have heterogeneous search costs. We show that a price dispersed symmetric Nash equilibrium always exists. Numerical results show that the behavior of prices and consumer surplus with respect to the number of firms hinges upon the nature of search cost dispersion: when search costs are relatively concentrated, entry of firms leads to lower average prices and greater consumer surplus; however, for relatively dispersed search costs, the mean price goes up and consumer surplus may decrease with the number of firms.

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1. Introduction

The theory of search has become a toolkit for the understanding of the role of informational imperfections in generating observed market inefficiencies. [Burdett and Judd's \(1983\)](#) model of nonsequential search is one of the seminal contributions. Burdett and Judd show that price dispersion can arise as an equilibrium phenomenon in environments where firms and consumers are rational and identical. Burdett and Judd's model of nonsequential search has seen a number of important extensions, including [McAfee's \(1995\)](#) study of multiproduct firms, [Fershtman and Fishman's \(1992\)](#) study of price dynamics, [Acemoglu and Shimer's \(2000\)](#) study of a general equilibrium labour market, and [Janssen and Moraga-González's \(2004\)](#) study of oligopolistic pricing. In labor economics, [Burdett and Mortensen's \(1998\)](#) model has become a canonical framework for explaining wage dispersion and turnover.

This paper generalizes the nonsequential search model studied in [Burdett and Judd \(1983\)](#) to the case in which consumers have heterogeneous search costs. Even though the existence and characterization of price dispersed equilibria has not yet been shown, this extension has been used in the empirical literature as the workhorse model for structurally estimating search costs in homogenous product markets. By exploiting the equilibrium conditions of the search model, [Hong and Shum \(2006\)](#) were the first to show that search costs can be recovered from price data only. Subsequent empirical work extended the methodology by improving the estimation method ([Miessi Sanches et al., 2015](#); [Moraga-González and Wildenbeest, 2008](#)), and showed how vertical product differentiation ([Wildenbeest, 2011](#)), data from different markets ([Moraga-González et al., 2013](#)), forward looking consumers ([Blevins and Senney, 2016](#)), search data ([De los Santos, 2012](#)), and quantity data ([Zhang et al., 2015](#)) can be incorporated into the framework. Moreover, the methodology has been applied in many different settings, including grocery stores ([González and Miles, 2015](#); [Richards et al., 2016](#)) and gasoline markets ([Nishida and Remer, 2015](#)).

This paper contributes to this literature by demonstrating that optimal firm and consumer behavior can be integrated in such a way that the market equilibrium can be described by an N -dimensional nonlinear system of equations. This is useful for two reasons. First, it provides us with a simple way to simulate the market equilibrium and, second, it enables us to address the existence of equilibrium issue using a fixed point argument. Our main theorem shows that an equilibrium always exists for arbitrary search cost distributions with strictly increasing cumulative distribution function (CDF). Regarding the uniqueness of a symmetric Nash equilibrium in mixed strategies, in contrast to the models of [Burdett and Judd \(1983\)](#) and [Janssen and Moraga-González \(2004\)](#), we believe that consumer search cost heterogeneity results in a unique equilibrium when the search cost density is not too decreasing. In fact, we are able to show that there exists only one symmetric equilibrium when $N = 2$ and search costs follow a power distribution, no matter whether the density is increasing or decreasing. Though this result proves very difficult to extend to markets with an arbitrary number of firms, or with different search

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