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Price beliefs and experience: Do consumers' beliefs converge to empirical distributions with repeated purchases?☆

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ABSTRACT

We use data on consumers' subjective beliefs about the distribution of prices in an online marketplace to investigate two questions of interest. First, when consumers face price uncertainty, to what extent do their beliefs about the distribution of prices reflect the actual empirical price distribution? Second, do consumers learn about features of the empirical distribution through experience? Using reported expectations for online textbook prices from a survey of 1224 college students, we find that consumers with no prior experience in purchasing textbooks online tend to expect online prices to be higher than what is observed empirically. However, consumers with more experience in the marketplace generally have more accurate beliefs about the price distribution, which is consistent with learning.

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1. Introduction

Price dispersion is a feature of many markets and even occurs in markets for homogeneous goods or services (Stigler, 1961). One possible reason for the persistence of price dispersion is that consumers have limited information over prices and acquiring information may be costly. In markets with limited information and costly search, an individual may not purchase from the seller with the lowest price if she is unaware of that price. Theoretical models of consumer search incorporate the search decision into a model of consumer demand by assuming that individuals have beliefs about the empirical distribution of prices in the market and must incur a cost to reveal price information from one or more retailers before deciding whether to purchase the good or service (e.g., Reinganum, 1979; Burdett and Judd, 1983). The decision to search depends upon the magnitude of the search costs as well as the individual's subjective beliefs about the distribution of prices. When estimating models of consumer search, researchers may impose assumptions on individuals' beliefs in order to estimate search costs. In this paper, we test the validity of these assumptions using data on the observed distribution of prices for the online textbook market and data on individuals' subjective beliefs about this distribution.

There is a growing literature focusing on the development and estimation of structural models of consumer search. These models have been used to explain observed price dispersion for homogeneous goods (Hortaçsu and Syverson, 2004; Hong and Shum, 2006), test competing models of consumer search (De los Santos et al., 2012; Honka and Chintagunta, 2015), separately identify search costs from other market frictions such as switching costs or learning (Dube et al., 2010; Honka,

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2014), and investigate firm pricing behavior and recover demand estimates in markets where price uncertainty and search frictions are important (Giulietti et al., 2014; Koulayev, 2014; Moraga-González et al., 2015; Pires, 2015; Seiler, 2013). A critical assumption used in these studies is that consumers have rational expectations (i.e., the price of a product is a random variable, but consumers know the parameters that govern the distribution of prices). However, if consumers have biased beliefs about the parameters of the empirical distribution of prices, this will lead to biased estimates of search costs. In particular, if consumers' beliefs about prices are biased upward, the rational expectations assumption will bias search cost estimates upwards and bias price elasticity estimates towards zero (low levels of search can be explained by either high search costs or low expected benefits from search). By comparing subjective beliefs to actual observed price distributions, we are able to test the validity of this assumption.

In addition to testing the validity of the rational expectations assumption, we also investigate the degree to which experienced consumers have more accurate beliefs than their less experienced counterparts. Recent research has supported this idea by incorporating learning into consumer search models.¹ In these models, consumers learn about characteristics of the products offered within a single purchasing decision through a sequential search process (De los Santos et al., 2016; Koulayev, 2009, 2013). We focus instead on learning across purchasing decisions; in particular we examine the hypothesis that more experienced consumers have acquired information about the empirical price distribution through repeated participation in the market.²

We collect data on the empirical distribution of textbook prices from online retailers and consumers' subjective beliefs about this distribution. In order to obtain data on individuals' subjective beliefs, we provide an online questionnaire to 1224 undergraduate students with multiple textbook purchasing scenarios in order to elicit their beliefs about prices. For each hypothetical textbook purchasing scenario, students are given the price of a textbook from the campus bookstore and are asked about their expectations of the lowest price available from an online retailer. Additional questions are asked to elicit consumers' beliefs about the variability of the lowest price. For example, if a consumer reports an expected online price of \$100, she is then asked about the likelihood that the actual price is below \$95.

Our results show that inexperienced consumers have price expectations that are significantly greater than the mean of the empirical price distribution. Therefore, we can reject the hypothesis that inexperienced consumers know the parameters of the price distribution for the online textbook market. Individuals with higher levels of experience, measured by the number of prior online textbook purchases, typically have price expectations that are closer to the empirical mean. Beliefs about the variation of the price distribution improve modestly with experience. Overall, the evidence is consistent with learning, at least for learning about the mean of the price distribution. These results support a greater focus on the role of information and subjective beliefs when estimating models of consumer behavior.

The following section provides theoretical motivation for this project and expands on our goals. Section 3 describes the data and Section 4 presents results. Section 5 discusses the issue of selection, and Section 6 concludes.

2. Theoretical motivation

In order to understand how consumers' beliefs about prices affect the search decision and to motivate the empirical section of this paper, consider the following simple model of consumer search. Individuals can purchase a given product from two locations. Assume for simplicity that the search cost is zero for one of the locations, so the individual knows the price of the product at this location. The price of the product at the other location is unknown by the individual, and there is a cost associated with determining this price.³ Denote the price at the zero search cost location as p^* and the price at the location with a positive search cost as p , which is a random variable with cumulative density function, $F(p)$. The individual can either purchase the product from the first location or pay some cost, c , to search and discover the price at the other location. If the individual decides to search, he does not incur an additional search cost should he choose to purchase the product from the first location (i.e., search with recall).

The decision rule for the search problem is given by Eq. (1). An individual chooses to search if,

$$\int_0^{p^*} (p^* - p) d\tilde{F}_i(p) > c_i \quad (1)$$

where \tilde{F}_i denotes an individual's beliefs about the empirical price distribution. The LHS of Eq. (1) is the expected benefit of search. A individual integrates over the difference between the known (p^*) and unknown price (p), given his beliefs about

¹ Earlier studies examined learning and search through experimental designs (e.g., Sonnemans, 1998; Einav, 2005).

² The research questions we address in this paper are further supported by research in the labor literature, which uses subjective beliefs about future earnings to explain college major choice (Arcidiacono et al., 2012; Stinebrickner and Stinebrickner, 2011; Wiswall and Zafar, 2015). These studies show that incorporating students' subjective beliefs leads to significantly different estimates than those obtained under the assumption of rational expectations. In addition to this, Wiswall and Zafar (2015) show that college students' beliefs about future earnings become more consistent with the actual earnings distribution as they proceed through school (i.e., become more familiar with their field).

³ This model abstracts from the decision to engage in sequential search or fixed-sample search as there is only one firm to search over. For both types of search behavior, beliefs about the mean that are biased upward or beliefs about the variance that are biased downward lead to suboptimal levels of search.

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