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Consumer's response to price distribution and σ-overload under time allocation

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ABSTRACT

It has been recently suggested that both the number of options considered by consumers and their satisfaction when shopping respond to changes in the mean and spread of market prices. A structured analysis of those responses is provided in this paper. A new adverse effect related with consumer's welfare is presented here, namely a consumer that searches exhaustively among all market options – called maximizer – experiences welfare loss when the dispersion of prices is too high. In fact, her welfare exhibits an inverted-U shape with respect to the standard deviation σ of prices so that an increase in price spread produces more welfare for small values of σ but it has a negative effect for larger values of σ. This new phenomenon is termed σ-overload. It is also shown that a consumer that is content with shopping from a reduced sample of options – a satisficer – avoids σ-overload by adapting her search behavior to the increase in spread. A quantitative assessment of consumer's behavior and welfare with respect to changes in the mean and dispersion of prices under different scenarios is also provided.

1. Introduction

A classical problem in economic theory consists of determining a consumer's demand for a product whose price is given, according to a rational assessment of welfare which in turn is produced from consumption of the product. An alternative viewpoint focuses on a rational assessment of the welfare produced by different uses of time, so that a consumer's decision when shopping for a product – whose distribution of prices is given – is obtained as a by-product of her rational allocation of time among alternative uses.

Specifically, a consumer is considered in this paper who goes shopping for some consumption good. There are a number of shops or sites offering the good and each one sets the price for its own version of the product. When shopping, the consumer faces a cost in terms of time, namely visiting each shop to inspect price and quality of the product version. Shopping cost is exogenously given. Shopping time has an opportunity cost, since time can be spent in other alternative and desirable uses. Two alternative uses of time are considered in this paper, leisure time and working time. The consumer searches the cheapest price among the valid versions of the product, so that there is a trade-off between visiting an additional shop – so

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that a better deal may be found – and spending some more time in other rewarding uses. Market prices of the product are assumed to follow a given probability distribution. Thus, visiting a number of n shops can be understood as taking a sample of n prices from the underlying price distribution. The main goal of the paper is to analyze the consumer's shopping behavior and welfare in response to a change in the basic characteristics of the price distribution, namely its mean and dispersion.

Following Álvarez et al. [1], a consumer who visits all available shops is called a maximizer, whereas a consumer who visits only an optimal number of the existing shops is called a satisficer. These two types of consumers are possible avatars of the maximizer and satisficer decision makers considered by social psychologists (see [2]). Within the framework of this paper, given a price distribution and a market of size N, i.e. a sample of N prices/shops, a maximizer visits all the N shops to make her decision whereas a satisficer visits a subsample of size n, $n < N$, which is further selected optimally in terms of her welfare.

It was suggested in [1] that, for any number of shops, both a maximizer and a satisficer with constant unit shopping cost typically lose welfare when the average price increases whereas they gain welfare as price dispersion increases. Also, the number of shops visited by a satisficer should decrease when the price mean increases whereas it should increase when price dispersion increases. Assuming a more general structure for shopping costs, a systematic numerical study of these qualitative responses is addressed in this paper. In particular, it is shown that the number of shops visited by a satisficer can be consistently estimated from the mean and dispersion of prices. This quantitative analysis may produce useful information, say for a shop manager that should take into account the reaction of potential shoppers when setting the price for its product.

The celebrated paradox of choice is a striking phenomenon originally described by social psychologists. It implies that a large number of shopping options will have a negative impact on consumer's welfare assuming that he is a maximizer. The choice overload effect has been reported empirically in a number of studies triggered by Iyengar and Lepper [3] and Schwartz [4]. Its general validity remains controversial [5], however, and current research revolves around finding preconditions for choice overload. The paradox of choice has been numerically explained within the time allocation framework in this paper in [6]. Specifically, for a typical class of maximizers, when the number N of shops in the market becomes too large their welfare decreases.

As explained above, the analysis in this paper concerns the effect on welfare which is due to variations in the mean and dispersion of prices/shops rather than provoked by an increase in the number of shops N—considered fixed here. A main result of the paper unveils a new adverse effect on consumer's welfare which we call σ-overload. Under the natural assumption that the shopping cost correlates positively with the standard deviation σ of prices, it is shown that a maximizer's welfare has an inverted-U shape with respect to σ. Thus, a mean-preserving spread of a sample of N prices produces a decrease in her welfare if the spread is too large. Even though some dispersion may be beneficial, too much dispersion hurts. However, under the same conditions, the welfare response of a satisficer does not exhibit σ-overload. Rather, a satisficer is capable to adapt her shopping behavior to any price spread in a way that she never suffers a loss of welfare.

The paper is organized as follows. In Section 2 the general features of the time allocation model are introduced together with the description of the two consumer profiles considered in the paper. In Section 3 specifics are explained about model parameters, shopping cost, consumer's preferences on time use, and the role of price distribution. In Section 4, the results obtained for the maximizer and satisficer problems are discussed in a benchmark case (namely, non-constant unit cost and prices normally distributed). Secondary variations of the benchmark case (i.e. constant unit cost, prices uniformly distributed) as well as further estimation results are presented in an Appendix. It is shown therein how the effect of σ-overload remains when the price distribution changes but not when unit costs are constant.

2. Theory: consumer's time allocation and price distribution

A consumer decides how to spend her total available time (T) in three different rival uses of time: shopping time to visit each shop and check its version of a wanted product, working time to get additional income, and free time devoted to leisure, consumption of goods or some activity other than shopping or working. The consumer must then fulfill the time constraints

$$T_s + T_f + T_w = T, \quad T_s, T_f, T_w \geq 0, \tag{1}$$

where T_s is shopping time, T_w is working time, and T_f is free time.

Each shop in the market sets one price for its version of the product sought by the consumer. Market prices are obtained as a random sample of size N from a given price distribution $\mathcal{F}$, so that N gives the total number of shops in the market or just the market size. The mean and standard deviation of $\mathcal{F}$ are denoted by μ and σ, respectively.

Given the shape of the price distribution $\mathcal{F}$ and a random sample of n prices, consumer's total expenditure G is bounded from below by the best expected deal, in turn determined by n and the distributional parameters μ and σ, $G = G(n, \mu, \sigma)$. Thus, when n shops are visited, the consumer's decision is subject to the budget constraint

$$G(n, \mu, \sigma) \leq wT_w + V, \tag{2}$$

where w is the wage rate per unit of working time (T_w), and V is non-working income or savings. In words, the consumer's expenditure cannot exceed her income (right hand side in (2)), the latter being implicitly determined by her allocation of time. In this paper μ and σ will vary to evaluate the consumer's response accordingly.