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# *Market equilibrium with FSS search*

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It is acknowledged that in the trading of homogeneous goods there is persistent price dispersion. However, it is theoretically derived that if buyers are optimizers there is no price dispersion. This negative result motivates the emergence of alternative paths in the literature that studies price dispersion. In Burdett and Judd's seminal work, buyers follow the sub-optimal fixed sample size search strategy, FSS. These authors claim that under this sub-optimal strategy there are, *ex ante*, three points of Nash equilibrium, two of them associated with price dispersion and search. This article shows that these two points of equilibrium with price dispersion are not empirically relevant because they will not be *ex post* enforced, being unproductive for explaining equilibrium price dispersion using the FSS sub-optimal search strategy.

## 1. INTRODUCTION

Assuming the existence of both market price dispersion and search costs, the buyers' optimal strategy is a sequential search with a reservation price, the sequential search rule (SSR) of McCall (1965). However, if buyers follow this optimal strategy then, in market equilibrium, all sellers set the same monopoly price and buyers do not search (Diamond, 1971, p. 164). This result motivates the appearance of alternative paths in the literature that studies the market price dispersion. One of them is the seminal paper of Burdett and Judd (1983) (B&J), where firms and buyers are identical and buyers use Stigler's (1961) sub-optimal fixed sample size (FSS) strategy.

In the one-shot non-cooperative $(N+\mu N) \times (N+\mu N)$ game that B&J (1983) consider, theorem 2 predicts *ex ante* that, if unitary search cost belongs to $]0; c^*[$ set, there are three possible Nash equilibrium points which may be *ex post* enforced, two of them associated with price dispersion and search (B&J, p. 962).

However, regardless of the number of algebraic solutions of the game, a buyer must implement only one action, claiming that it is possible to predict which equilibrium will be implemented *ex post*.

## 2. SELLERS' EQUILIBRIUM WHEN BUYERS ARE HETEROGENEOUS AND FOLLOW FSS

Salop and Stiglitz (1977), Wilde and Schwartz (1979), Varian (1980) and Guimarães (1996), among others, study the sellers' side market equilibrium ("a partial partial equilibrium": Rothschild, 1973, p. 1288) as the solution of a one-shot noncooperative $n \cdot n$ game, assuming that buyers use the sub-optimal FSS search strategy.

This assumes, as in Guimarães (1996), that, on the buyers' side, (i) there are a percentage $\mu_i$ of buyers of type $i$ that know the price set by $i$ sellers, (ii) each observed price is an independent extraction of the market prices distribution function, $G(p)$, and (iii) that it is common knowledge, and that, on the sellers' side, (iv) sellers are price distribution takers, (v) they have the same cost structure and, (vi) if a monopolist, a seller would set price $M$, and there exists a sellers' Nash equilibrium if all of them have the same expected profit.

In the determination of the expected demand function, instead of using the combinatory calculation used by Salop and Stiglitz (1977) and Guimarães (1996), this article uses, as in Axell (1977), the price distribution function of

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acquisition of the good. In this vein, in a situation of stationary equilibrium, the price of goods acquired by a particular buyer is the minimum in the set of prices that he knows. In statistical terms, the probability that this minimum price is less than or equal to $p$ is:

$$W(p,i) = \text{Prob(acq. price} \leqslant p|i) = 1 - [1 - G(p)]^i. \quad (1)$$

Expanding this distribution function to all types of buyers, we obtain, in aggregated terms, the distribution function of the price at which the buyers acquire the good:

$$W(p) = \sum_i [W(p,i)\mu_i] = \sum_{i=1}^{\infty} \{1 - [1 - G(p)]^i\}\mu_i. \quad (2)$$

Assuming, without loss, that the number of buyers and sellers is normalized to one, then the expected profit function of a seller is the derivative of expression (2) divided by the quantity of sellers that set price $p$ and multiplied by $p$ (equivalent to B&J, 1983, p. 959):

$$E[\pi(p)] = \frac{w(p)}{f(p)}p = E[q(p)]p = \sum_{i=1}^{\infty} \{i[1 - G(p)]^{i-1}\mu_i\}p. \quad (3)$$

The main property of the model is that the sellers' equilibrium is the 'perfect competition price equilibrium' if $\mu_1 = 0$, the 'monopoly price equilibrium' if $\mu_1 = 1$ or a 'dispersed price equilibrium' if $0 < \mu_1 < 1$ (Guimarães, 1996, p. 418).

## 3. ENDOGENIZATION OF BUYERS' TYPE

Assuming, as in B&J (1983), that all buyers have the same positive search cost $c$, there will be a Nash equilibrium between the $m$ buyers only if all of them have the same expected expenditure, $E[V(i)]$:

$$E[V(i)] = \int_0^M [1 - G(x)]^i \, dx + i\,c = K, \ \forall i \quad (4)$$

In this situation, all buyers will ask just one price, or they will be indifferent between asking one or two prices (B&J, 1983, p. 962). In the first case, we have the monopoly price equilibrium while, in the second case, we have a dispersed price equilibrium (B&J, 1983, p. 962). If, instead, all buyers had zero search cost, they would all ask more than one price and we would have the perfect price equilibrium.

## 4. THE *EX POST* ENFORCED EQUILIBRIUM

In the one-shot noncooperative $(m+n)\cdot(m+n)$ game that B&J (1983) consider, theorem 1 is unable to predict *ex ante* which market equilibrium will be enforced *ex post* among three possible ones (two dispersion price equilibria plus the monopoly price equilibrium). Given this lack of information, we must investigate which of such equilibrium points will be, *ex ante*, implemented.

This lack of information implies that a particular buyer cannot attribute *ex ante* a null probability to any of the three possible Nash equilibria, which implies the following result.

*Theorem*

Assuming that all buyers follow FSS with the same positive cost of search and that all sellers are identical, then, in equilibrium, each buyer asks the price to just one seller and all sellers set the monopoly price.

*Proof*

Each buyer knows that *ex post* one of the three Nash equilibria points identified in B&J (1983) will be enforced. If, *ex post*, the monopoly equilibrium is enforced, a buyer is better off if he asks the price to only one seller. On the other hand, if, *ex post*, an equilibrium with price dispersion is enforced, a buyer has equal expected expenditure if he asks the price to one or two sellers. Because of the *ex ante* lack of information, a buyer cannot *ex ante* attribute a null probability of any of those three Nash equilibria points being enforced *ex post*. Being so, the action that minimizes the expected expenditure is to ask the price to only one seller.

By symmetry, all buyers will ask the price to only one seller and all sellers will charge the monopolistic price.

If now a buyer assumes *ex ante* that it is certain that the monopoly equilibrium will be *ex post* enforced, he is better off if he asks the price to only one seller as he anticipated.

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