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Price Dispersion and Social Welfare

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Introduction

At the beginning of a microeconomic course everybody starts with the Marshallian demand

and supply function and ends with the perfect competition. All these theorems are about the

law of one price, which shows us that only one equilibrium price exists on the market in case

of homogeneous goods and lots of firms because of the clearing mechanism. The law of one

price is sourced from Jevons[1]. But by looking around in a real market we can notice that the

same products are sold at several prices at different places even if it is a homogeneous good

with numerous sellers. So "the law of one price is not a law at all", as Varian (1980)[2] wrote.

Price dispersion is an explanation of what we experience on markets: the same products are

sold at several prices. The model of Salop and Stiglitz (1977)[3] shows the existence of price

dispersion in case of differently informed consumers.

In this study I search for some observations about social welfare for dispersed prices.

In the case of the law of one price when the equilibrium price is the competitive, there is no

dead weight loss and the social welfare is maximal. With informational asymmetry not only

the search costs diminish the social welfare but the technological inefficiency as well. I examine the social welfare for all the four equilibriums appearing in the model of Salop and Stiglitz (1977). They analysis focused on the evolution of prices but I perform thereinafter the effect of dispersed prices on social welfare and on technological efficiency.

Price Dispersion

Price dispersion is described in the New Palgrave Dictionary of Economics as: "Price dispersion occurs when different sellers offer different prices for the same good in a given market. Thus, it differs from price discrimination under which a single seller offers different prices to different groups of buyers or in different geographical locations."[4] Price dispersion is a Nash equilibrium not only a position from which a price shifts to another state. We know a few explanations for this phenomenon - e.g. cost heterogeneity, location models - and nowadays one of the most recognized theorems is informational asymmetry.

There is diversity in the degree of information between sellers and buyers which we call informational asymmetry and here consumers have less information about prices: they know only the distribution of available prices. Furtherwise, another difference exists in between the consumers: in their capabilities and in their searching costs. Because of asymmetric information and the searching costs, price dispersion appears in lots of markets.

Several models explain price dispersion but nowadays authors use preceding theorems and apply them as an empirical verification of the existence of price dispersion. The first of the three most often used basic models comes from Salop and Stiglitz (1977), the second one from Varian (1980) and the third from Burdett and Judd (1983)[5]. They use nearly the same assumptions about the market: lots of firms sell a homogeneous good, the demand is inelastic and there could exists perfect competition but because of informational asymmetry it could appear only in very special cases.

Asymmetrical Information

Probably the first article dealing with restraint information about prices was written by Scitovsky (1950)[6]. He thought that the power of an oligopoly is based on the ignorance of consumers. The expert buyers are exceptions and due to the lack of information sellers differentiate their products and its prices. The significance of Scitovsky's (1950) model is to establish the definition of uninformed consumer.

While Scitovsky (1950) introduced the notion of ignorant consumer with restraint information, Stigler (1979)[7] concentrated on the searching costs. Due to informational asymmetry consumers have to search to purchase at the lowest price. Each consumer behaves in the same way: when they enter the market they have no experience about prices. They have to decide if they invest in search, or not. If the expected benefits from search are greater then the marginal cost of the search then consumers choose the searching method. In the long run each consumer have their experience about all prices, hence their search costs disappear. However, with every new entry of a buyer or a seller prices modify and search still exists. The model of Stigler is not an equilibrium model, it deals with the searching method and firm behavior but the later mentioned ones are equilibrium models.

The Model of Salop and Stiglitz (1977)

The model of Salop and Stiglitz (1977) is based on asymmetric information and explains the price dispersion with heterogeneous searching costs. They assume that two kinds of consumers exist on a market, and they differ in their capabilities so in their search costs. The first type with low search cost could become an informed consumer who recognizes all prices in the market so that he can purchase at the lowest available price. The other type of consumer with higher search costs is called an uninformed consumer. For him the expected benefits of search are less than the marginal cost of it, so uninformed consumers purchase randomly. From all consumers L proportion α has low search cost (c_1) and $1-\alpha$ has higher (c_2).

Consumers have inelastic demand curves for only one unit of commodity where the reservation prices are denoted by u, hence it is equal to the monopoly price.

The model assumes that consumers know only the distribution of prices but they do not know the location – price pairs. Contrarily the sellers know the exact prices of other sellers and the searching costs of consumers as well, so their strategy in this case is some kind of Stackelberg strategy. Their pricing strategy is based on that they know the consumers' behavior and search decision. However, it considers that the firms price decisions induces the searching method of consumers. Such that firms can choose from sell at the same price as the others or deviate from them. All the n firms have the same U-shaped average cost (AC) curve and we assume zero profit equilibrium because of the free entry and the long term run.

At several initial-value parameters of the model (like α, L, cost curve etc.) three kinds of Nash equilibriums and one non-equilibrium could occur in this model:

(1) Firstly, the equilibrium price is at the competitive price if there are no search costs ($c_1, c_2 = 0$), which equals to the perfect information situation, or the low cost consumers have no search costs and it is worth searching for the consumers with higher search costs as well, so their benefits from search (b) are higher than their searching cost ($c_2 \leq b$).

There are two inverse effects in this situation rising the price: the benefit of a store is to earn more on high cost consumers and the loss on the informed consumers who purchase at another shop at competitive price. To reach the competitive price equilibrium the loss has to be more than the benefit from selling at the higher price.

(2) Secondly, Single-Price Equilibrium occurs at the monopoly price if the searching costs are higher than the benefits from search ($c_2 \geq c_1 > b$).

This phenomenon is similar to the Diamond paradox (1971)[8]. According to Diamond (1971), if the search costs differ from zero the only equilibrium is the monopoly price. He assumes that every consumer knows the distribution of prices, and regarding that they have a cutoff

price so that the consumer purchases at any time less than or equal to that cutoff price. This price depends on the model assumptions but it is the same for all consumers. Because each producer sell the product at that cutoff price, the distribution of prices disappear and only one price remains on the market. Therefore the consumers do not search, they purchase at the first store. The model implies that the sellers request the highest affordable price, which is the monopoly price.

Salop and Stiglitz (1977) get the same result demonstrated by the behaviour of a deviant firm.

(3) The next situation when there is no Nash equilibrium is when the price oscillates. Salop (1976)[9] observed that if firms seek for a Single-Price Equilibrium, there exists a p^L limit price, and at higher prices other firms use a cutoff strategy. Hence, if model conditions are not suitable for the Nash equilibrium the prices oscillate between the competitive and the p^L limit price (Figure 1).
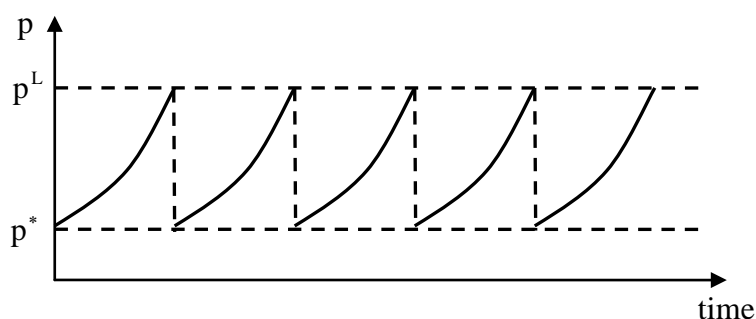

Figure 1 Oscillation of prices from Salop (1976)

(4) The most important and exciting Nash equilibrium is the Two-Price Equilibrium when for some companies it is worth for offering lower prices to obtain the informed consumers, while others sell at higher prices to uninformed consumers only. To examine it Salop and Stiglitz (1977) introduce β into the model, which shows the percentage of the companies offering their products at the lower price from the two existing prices.

For the Two-Price Equilibrium it is crucial that only the low-cost consumers possess information, because otherwise if both of them or neither of them become informed about prices only one price develops on the market, as I showed above.

The low-price shops not only satisfy their share of the informed consumers ($(1-\alpha)L/n$), but in addition, they "split" the uninformed consumers among all the sellers (which means $\alpha L/\beta n$ consumers).

So the equilibrium is a Two-Price Equilibrium when the informed consumers purchase at the lowest price which equals to the competitive price and the others offer at the monopoly price (Figure 2). The higher price stores sell only to uninformed consumers.
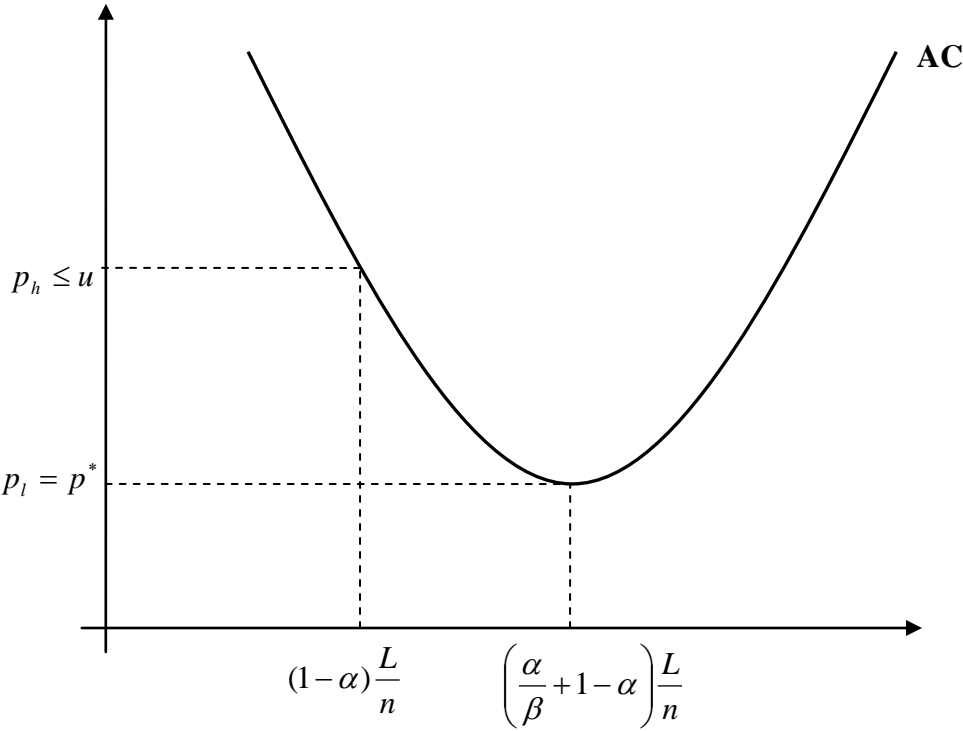

Figure 2 The Two-Price Equilibrium from Salop and Stiglitz (1977)

Lots of empirical research are based on this theorem and examine the price dispersion in different markets, for example retail food shops, gasoline market etc., as I mentioned in the first chapter in Table 1. My thesis work and PhD research deal with this as well. I studied the

food prices in the neighborhood of my university and now I concentrate on the Hungarian gasoline market from the point of view of distance. I assume that more uninformed consumers exist in centrums which lead to higher prices at central places than rural or suburban ones. There could be other reason for price dispersion but my researches on the spatial distribution of consumers confirm the correlation between price dispersion and the distance. In case of retail food prices the econometrical analisis is significant for price dispersion regarding to the distance while unfortunately in gasoline market I get only weak significance level.

Social Welfare and Price Dispersion

Several equilibriums could have different level of social welfare. Up to this point this paper deals with equilibriums with different prices. Now I analyze social welfare in case of different price situations. With sort the four equilibrium of the price dispersion the regulator could choose the optimal state and maybe control it to reach the social optimum.

We could simplify the social welfare in case of asymmetric information as summing up consumer surplus (CS) and economic profit and deduct the aggregate consumer search costs. The difference compared to perfect competition and perfect price discrimination is in the searching costs and the equilibrium price which influences consumer surplus.

An important question is whether it is price dispersion or informational asymmetry will cause a decrease of the purchased quantity. If the quantity diminishes dead weight loss exists, otherwise only the distribution of consumer surplus and profit change.

The assumption of the model of Salop and Stiglitz (1977) is the inelastic demand curve, so each consumer purchases one product independently from the price of the product if it is less than the reservation price.

In case of price dispersion the profit of the sellers is zero on the long term so only the consumer surplus and searching costs could change compared with perfect competition.

When we talk about efficiency, we can think of Pareto efficiency regarding to social welfare and the efficiency of production[10]. At dispersed prices the high-price firms produce at the descending part of the average cost curve which is showed by the picture of the Two-Price Equilibrium and at monopoly price as well (Figure 2). The technical optimum is at the minimum of the curve so there is technological inefficiency. The same problem appears when in short term profit exists so firm or firms enter the market, which increase all the fix costs which also lead to technological inefficiency.

Next we compare the welfare and the technological efficiency to the above-mentioned results of the model of Salop and Stiglitz (1977).

(1) The first case is when there is no price dispersion, the Single-Price Equilibrium is at the competitive price. Because of the model assumptions there are no search costs or only the high cost consumers are faced with them (c_2). In this case the social welfare is equal to the consumer surplus ($CS_1 = (u - p^*)L$). We should not deduct this by the sum of the high search cost (c_2) if it exists because in case of a Single-Price Equilibrium the prices are the same so it is not worth searching. The low or no search costs are only the necessary assumptions of the equilibrium: if a store rises its price no one buys there because than it is worth searching for another shop with a more competitive price.

At competitive price there is no dead weight loss and from the viewpoint of efficiency it is the social optimum. At the minimum of the average cost curve the technical efficiency is the highest and - because a firm produces much more than at monopoly price – less firm exist at the long term equilibrium which minimize the inefficiency coming from the barriers of entry.

 (2) In case of a Single-Price Equilibrium at monopoly price searching costs exist but nobody spends on searching because each shop offers the product at the same price. The consumer surplus is zero if the monopoly price is equal with the reservation price or less than the consumer surplus at competitive price ($CS_2 = (u - p_h)L$, and $CS_1 \geq CS_2$ because $p^* \leq p_h$).

The other part is the dead weight loss. Because of the inelastic demand curve at the monopoly price the purchased quantity does not change so the lack of the dead weight loss is inherent to the inelasticity of the demand curve.

From the aspect of technical efficiency the monopoly price is the worst: the technological inefficiency and the sunk fix cost are the highest in this case[11].

(3) If the assumptions of the model does not result an equilibrium the price is oscillating between the competitive price and limit price at which the stores use a cutoff strategy. In this case the consumer surplus changes over time: the lowest degree of the consumer surplus is at the highest price so at the limit price ($CS_3 = (u - p^L)L$) and the highest degree is at the competitive price (CS_1).

At oscillating prices there have to be search costs in order to be worth applying the cutoff strategy. So the social welfare will be reduced by the sum of the searching costs.

This situation lies between the social welfare of the monopoly price and the competitive price. The degree of the social welfare depends on the model conditions. For example it could be close to the competitive level if the limit price is low enough.

With the change of the prices, the efficiency level is changing as well, over time.

(4) In case of the dispersed prices the Two-Price Equilibrium assumes two different prices and two differently informed types of consumers. To examine the consumer surplus we should divide consumers into three groups.

Group A contains the informed consumers purchased at the low price. Their consumer surplus likes as the competitive Single-Price Equilibrium's consumer surplus: $CS_A = \alpha L(u - p^*)$.

Group B involves the uninformed consumers purchasing at the higher price. The monopoly price is equal to the reservation price so CS_B is zero.

In Group C the uninformed consumers consume randomly in a low-price shop at competitive price. Their consumer surplus is equal with $CS_C = (1 - \alpha)L(u - p^*)\beta$.

Therefore the consumer surplus at Two-Price Equilibrium depends on the model conditions but it should be in between the two kinds of Single-Price Equilibrium.

Here the searching and the searching costs have great importance. The informed consumers have to search to become informed. Their searching costs are $\alpha L c_1$. We should decrease the welfare with this amount.

Similarly to the level of welfare the efficiency level of this equilibrium is in between the Single-Price Equilibriums. The low-price-type firms are technically efficient while the others are not, because average cost is higher than the minimum level.

<u>Conclusion</u>

When analyzing social welfare in the context of the model of Salop and Stiglitz (1977) I found several interesting results. There are some simplifying conditions for counting social welfare: the inelastic-demand curve prevents the appearance of the dead weight loss (because everybody is served) and companies product at long-term equilibrium so the profit is zero.

The three equilibriums and the price-oscillation eventuate different values of social welfare and technological efficiency. Searching appear only at Two-Price Equilibrium and at the non-equilibrium situation. In these cases the sum of searching costs diminishes the welfare.

The highest level of the consumer surplus is at the competitive Single-Price Equilibrium while the lowest is at the monopoly Single-Price Equilibrium where it could be zero. At the two other instances the consumer surplus is in between the two previous situations.

The efficiency level is the same as the consumer surplus. At competitive price the efficiency is the highest and at monopoly price it is the lowest.

The social optimum would be the perfect competition but if search costs exist the price dispersion is a better situation than the Single-Price Equilibrium at monopoly price. So the price dispersion is more Pareto efficient than the second one. Hence it is worth for the

regulatory to facilitate the flow of information at least to a part of consumer. With getting information easier the searching costs of this proportion decrease, therefore price dispersion or perfect competition could appear.

It could be difficult to establish numerical connection between social welfare and asymmetric information or price dispersion because it depends on lots of components of model assumptions, for example the ratio of low search-cost consumer or the number of firms. This is a less examined part of economy so I will try to measure somehow the search costs and dead weight loss in order to get a full econometric model of this topic.

[1] The law of one price is comes from Jevons' book, "*The Theory of Political Economy*" (1871).

[2] Hal R. Varian (1980), "*A Model of Sales*". American Economic Review, 1980. No. 70, 651-659)

[3] Steven Salop and Joseph Stiglitz (1977), "*Bargains and Ripoffs: A Model of Monopolistically Competitive Price Dispersion*" (Review of Economic Studies, 1977. No. 44, 493-510)

[4] Ed Hopkins (2006), "*Price Dispersion*" (Journal of Economic Literature, 2006), 1.

[5] Kenneth Burdett and Kenneth L. Judd (1983), "*Equilibrium Price Dispersion*" (Econometrica, 1983. Vol. 51, No. 4, 955-969)

[6] Tibor Scitovsky (1950), "*Ignorance as a Source of Oligopoly Power*" (The American Economic Review, Vol. 40, No. 2, 48-53)

[7] Joseph Stiglitz (1979): "*Equilibrium in Product Markets with Inperfect Information*" (The American Economic Review, 1979, No. 69, 339-345.)

[8] Peter A. Diamond (1971), "*A Model of Price Adjustment*" (Journal of Economic Theory, 1971, Vol. 3, Issue 2, 156-168)

[9] Steven Salop (1976), "*Information and Monopolistic Competition*" (The American Economic Review, 1976. No. 66. 240-245)

[10] On the one hand Pareto efficiency measures the value of welfare (e.g. the perfect competition is more Pareto efficient than the monopoly because of the dead weight loss) and on the other hand technological efficiency measures of the efficiency of production (the most efficient point is at the minimum of the average cost curve).

[11] The worst situation is the monopoly price because (1) Salop and Stiglitz (1977) assume zero profit at long term situation but because the firms produce at the descending part of the average cost curve, the average cost so the price is higher than the marginal cost so the fix costs have to be the reason of the zero profit and (2) at monopoly price there is no consumer surplus.