A list of Working Papers on the last pages

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REGULATIONS IN SEARCH MARKETS

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Abstract

In a market with information costs, i.e., a search market, the equilibrium formation of prices and outputs will differ significantly from that of a purely competitive market. The equilibrium will be either a monopoly price or a price distribution. Hence, it is normally not a socially optimal situation. The problem discussed in this paper is what kinds of rules and regulations that can be introduced in a search market to improve the solution from a social welfare point of view.

[1]Paper prepared for the IUI–conference, November 15–17, 1989.

1.INTRODUCTION.

The theory of the allocation of resources in a market economy addresses the question of whether the actions of self–interested agents will lead to an allocation that is of a socially desirable kind.

The general equilibrium analysis of Arrow and Debreu shows that, under certain conditions, the equilibrium in a free market economy will be "the best", at least according to a Pareto norm.

However, there are many objections that may be raised against the Arrow–Debreu model. Some concern the fact that markets are open only at one instant of time, namely at the beginning (the Big Bang). All trade is contracted at that time, and the rest of the "economy's life" is a fulfilling of these original contracts.

A much more appealing model to work with would be an economy with a limited supply of future contract markets and, instead, overlapping generation markets, and the presence of incomplete information.

In fact, Lucas et al. have made extensive use of the overlapping generations model. Their assumption of market clearing prices (and no information costs), however, may run their analysis into a blind alley.

My own view is that a model with overlapping generations and information costs (i.e., search) will give rise to economic models of both high relevance and good explanatory power to observed phenomena. Let me argue this point in some detail.

2. THE ENDOGENEITY OF MARKETS

Any economy exhibits a large variety of market forms, i.e., sets of rules that control price formation, quantity decisions and, in general, the process of resource allocation.

The traditional textbook classification is; 1. Monopoly, 2. Oligopoly, 3. Monopolistic competition and 4. Perfect competition.

It is possible to go into further detail in the classification of market forms. In this paper we will study some of the "atomistic" market forms, namely, those atomistic markets that can be characterized as search markets.

By atomistic markets we usually mean markets with a large enough number of firms and consumers to prevent any one actor from affecting the market price. Each actor can be regarded as infinitely small compared to the total number. Still, it is

possible (and normal) to have a fairly large number of consumers per firm.

The atomistic markets can now be divided into more detailed subgroups, namely:

A. Auctions markets.

B. Broker markets.

C. Search markets.

Which in turn may be divided in further detail:

Auctions markets:

A1. English auctions.

A2. Dutch auctions.

A3. Sealed bid auctions.

Broker markets:

B1. Brokers take no positions.

B2. Brokers take positions.

Search markets:

C1. Sellers offer price and buyers accept or reject.

C2. Buyers offer price and sellers accept or reject.

C3. Sellers and buyers negotiate.

In an economy the "choice" of one or another of the above mentioned market forms is endogenous, i.e., the prevalent market form for a particular commodity is dependent of the whole economic system. In particular, it is dependent on what sort of information that must be transferred in the market process. This , of course, depends very much on the properties of the commodity in the specific market, but also on what the communication opportunities are (the communication technology). For example homogenous products such as stocks, raw material and foreign exchange are typically traded in (perfectly competitive) auction markets.

There is an infinite number of possible specifications of the "rules" in an atomistic market. In this paper we will limit the analysis to the search market where sellers make price offers and buyers accept or reject (i.e., to C1.).

3. THE GENERAL PROBLEM AND THE PROPOSITION.

Let us first formulate the general problem.

We claim the following:

1. If there is a pure market allocation of resources in a market with information costs, the outcome will be a situation with more waste of resources than necessary.

2. There may exist rules and regulations that will improve social welfare if known and properly used.

3. There is a significant risk that an extensive use of rules and regulations will decrease efficiency and welfare in the economy.

4. A SEARCH MARKET.

Now, first we describe a market with imperfect information (or with information cost) which we, henceforth, will refer to as a search market. We are particularly interested in its equilibrium solution, if it exists.

Let us introduce the following assumptions.

There is a large number of firms (k).

There is a large number of consumers (m).

Consumers know the distribution of price offers by firms.

However, they do not know which firm charges which price.

5. EQUILIBRIUM IN A MARKET WITH PRICE SETTING FIRMS AND IMPERFECT INFORMATION.

A central theorem in classical and neoclassical economic theory states that a commodity of given quality, supplied at a given instant of time and at a certain place could be sold in equilibrium only at one and the same price. There can not be any sort of "price dispersion" in an equilibrium with rational agents. This is the so called "Jevons law of one price". In this paper (and in Axell(76,77)) it is shown that this law is not valid in the presence of information costs.

When we look for an equilibrium in a market with price setting firms and imperfect information, we are, in particular, looking for the endogenously determined price distribution F(p) that will occur as the result of rationally behaving individuals and firms.

Assume that the market begins in a disorderly situation, which can be described

as one where many firms are offering different prices. The general picture of this is a price distribution. Let us note this with F(p), and the corresponding pdf with f(p).

We describe the bargaining behavior as follows. Firms choose an offering selling price. Consumers decide whether or not to accept this price. The decision is made on the basis of whether or not the consumer, with the search efforts that are required, will find another seller with a lower price with search efforts that are low enough to motivate further search.

If so, he will reject the offer. If not, he will accept the offer. This is the basic approach to a search theory of price formation under imperfect information.

Let us call the price distribution (the cumulative) F(p), and the density function (pdf) f(p).

A consumer who has found a firm offering p^* will consider whether or not he will, in another search step, find a firm offering a lower price. We denote the price that he will draw next time in case of further search p. The gain will be $p^* - p$, if p is less than p^*. The probability for that is f(p) (the density at p). The mathematically expected gain of further search is then;

$$\int_0^{p^*} (p^* - p) f(p) dp. \qquad (1)$$

Let us define: $F(p) = \int_0^p f(s)ds$, and $\tilde{F}(p) = \int_0^p F(s)ds$.

Integrating by parts, expression (1) becomes;

$$\int_0^{p^*} F(p)dp, \text{ or } \tilde{F}(p^*). \qquad (1B)$$

If the marginal cost of search for an individual is c (and constant through search), and if $\tilde{F}(p^*)$ is greater than c, then it is profitable to continue search, otherwise not.

Hence, if we regard p^* instead as an unknown, and the solution to the equation;

$$\tilde{F}(p^*) = c, \qquad (2)$$

we will find a price which we name the reservation price, which has the property that any price below it is acceptable and no price above it is acceptable.

Now what could be an equilibrium in a market with this kind of search behavior?

If consumers have different search costs, then firms will face a negatively sloped demand curve with a far from infinite elasticity.

Assume that consumers have different search costs according to a distribution function $\Gamma(c)$, with the probability density function $\gamma(c)$.

Then, firms may on average sell more if they offer a lower price, because, at a lower price, they will "undercut" more reservation prices than at a higher price.

Consumers that draw a particular firm will have a search cost somewhere in the distribution described by the pdf $\gamma(p)$.

The question for demand is then: Does the offered price undercut this consumer's reservation price?

It is easy to see that, out of the stream of consumers, only those with a reservation price above the offered price will accept the offer.

Let us first derive the demand function.

For a firm that announces price p, the consumers that contact this firm and accept it are those who have a search cost c greater than $\tilde{F}(p)$.

The fraction of the consumers that have search costs greater than $c = \tilde{F}(p)$ is described by the γ–function, and hence $\int_p^\infty \gamma(\tilde{F}(s))ds$.

If the number of consumers is k, and the number of firms is m, and each consumer buys exactly one unit when he has found an acceptable price, then the firms' demand curve is;

$$q(p) = \frac{k}{m}\int_p^\infty \gamma(\tilde{F}(s))ds \tag{3}$$

Now let us derive the profit function.

If the cost function is simply a constant marginal cost, mc, and no fixed costs, the profit function $\Pi(p)$ is;

$$\Pi(p) = (p - mc)\cdot\frac{k}{m}\cdot\int_p^\infty \gamma(\tilde{F}(s))ds \tag{4}$$

The equilibrium in such a market is either a distribution of prices or one single price (a degenerated distribution). In the case of a single price equilibrium, this price must be the monopoly price, which means that all firms charge the price that would have been charged by a single monopolist, controlling the whole market. In the present formulation of the model, the monopoly price is infinite (because individual consumers have zero elastic demand), but this is only an artifact of the desire to keep the model simple enough for the dispersion solution. We can introduce non–infinite individual demand elasticity (as in Axell(77)) or a limit price (as in Burdett, Judd(82)). But since the monopoly price solution is uninteresting in this paper compared to the price dispersion solution, we will not elaborate on this point.

Price dispersion equilibrium.

It is possible to show that if, for instance, all consumers are perfectly well informed about the actual distribution of the price offers in the market and they all have strictly positive search costs, the equilibrium must be the monopoly price.

However, we ask the question; is it possible to have another equilibrium, i.e., a price distribution?

The answer to this is given in Axell((76) and (77)), and we here give the necessary and sufficient conditions on $\gamma(c)$, without repeating the proof.

Necessary and sufficient conditions on the search cost pdf $\gamma(c)$ for the market to have a price dispersion solution:

If the market in equilibrium will be a price dispersion equilibrium, then $\gamma(c)$ must be such that profits in equation (4);

$$\Pi(p) = (p - mc) \cdot k/m \cdot \int_p^{\infty} \gamma(\tilde{F}(s))ds, \qquad (4)$$

is the same in an interval, e.g., from marginal cost to infinity (or from p_1 to p_2). $F(p)$ is what we endogenously solve from eq.(4) above, but the question is if there at all exists a density function $\gamma(c)$ such that, with a distribution function $F(p)$, the right hand side of eq.(4) above is constant in an interval of prices.

The necessary and sufficient conditions on $\gamma(c)$ for a price dispersion equilibrium in the price interval (mc, ∞) are the following:

1. γ is defined on $(0, \infty)$,

   $\gamma \in C^2$, i.e. twice differentiable,

   $\gamma' < 0$,

   $\gamma'' > 0$,

   $\gamma(c) \to 0$ when $c \to \infty$,

   $\gamma(c) \to \infty$ when $c \to 0+$.

2. $\dfrac{\gamma(c)^{3/2}}{\gamma'(c)}$ is decreasing.

3. $\lim\limits_{c \to \infty} \dfrac{\gamma(c)^{3/2}}{\gamma'(c)} = \dfrac{\sqrt{\Pi}}{2}$,

4. $\lim\limits_{c \to \infty} \dfrac{\gamma(c)^{3/2}}{\gamma'(c)} = 0.$

The proof is presented in Axell(76,77).

The conditions 3. and 4. are due specifically to the requirement of equal expected profit in the whole interval (mc, ∞). It is possible to have an equilibrium that covers only a more limited interval of prices, e.g. p_0 to p_1. This possibility is analyzed in Rob(82).

We will now restrict ourself to the price dispersion equilibrium.

If the above conditions are fulfilled, this market will show a (negatively sloping) price distribution, starting at marginal cost. (see fig.1)

The price–distribution, F(p) or f(p) as pdf, must then start at mc and then be negatively sloping, convex and approach both abscissa and ordinata. Hence, in particular, the search costs must not be bounded away from zero.

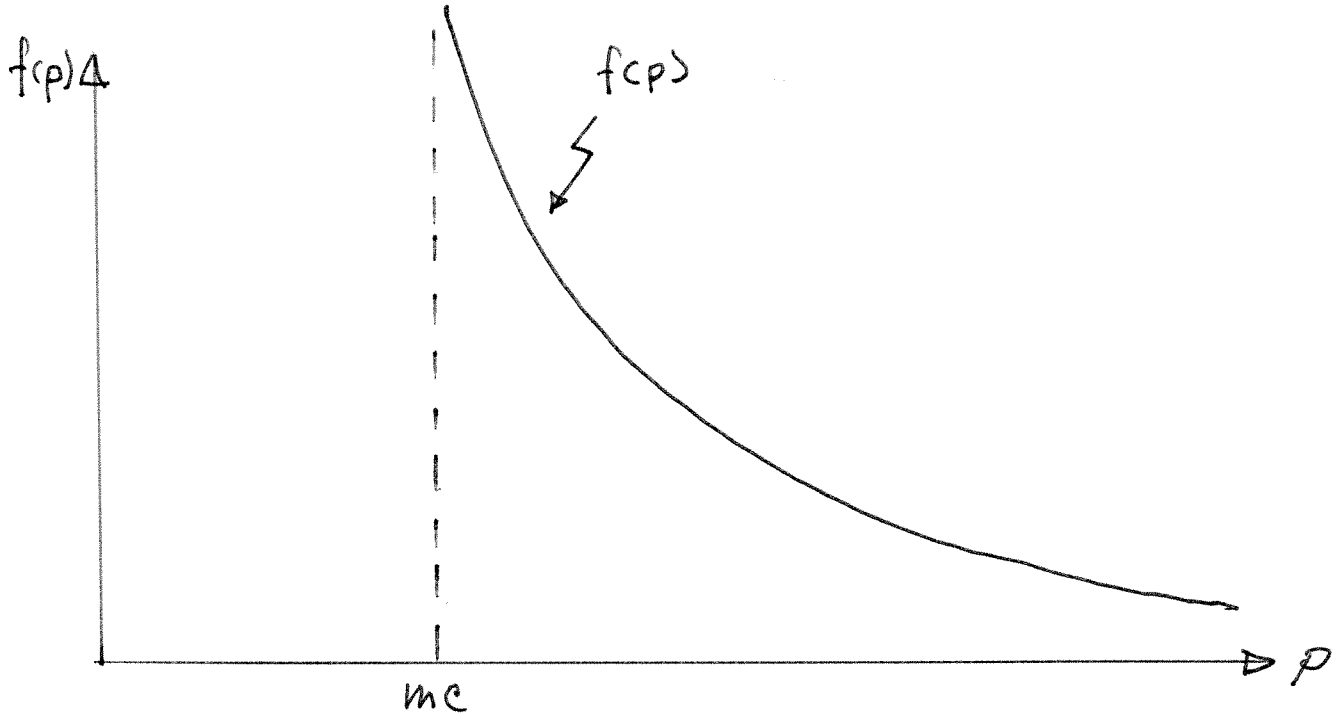

Figure 1
The price density in search equilibrium

6. REGULATION AND EFFICIENCY.

We conclude that a search market in equilibrium will use more resources in the price formation process than in a perfectly competitive market, because resources are required in the search process. On the other hand, in perfect markets we assume that the equilibrium solution has already somehow been found at no costs.

A question is whether or not it is possible to improve the situation by means of some kind of rules or regulations.

The inefficiencies of the equilibrium in a search market are of two kinds.

1. There will, because of the persistence of a price dispersion in equilibrium, be a certain amount of resources used in searching for low prices. These resources could otherwise have been used in the production of commodities. In a market with one single price, e.g., a perfectly competitive market, no resources are "wasted" in search activity.

2. If the equilibrium in the market is a price distribution, then prices will be above marginal cost. If other markets in the economy are competitive (which means that $p = mc$ in these markets), then there will be a difference between the marginal rate of transformation and the expected price ratio. This means that there will be a divergence between the marginal rate of transformation and the marginal rate of substitution, so

that the market solution will differ from a Pareto efficient equilibrium.

Improving efficiency by regulations.

Can efficiency be improved by regulations and, if so, how?

One possible candidate to an answer to that question is price controls: We concluded above that the reasons for the inefficiency is the fact that prices are above marginal cost (if the rest of the economy is competitive), and the fact that there is not a uniform price; it is instead a dispersion in price offers giving rise to a seeming waste of resources. It seems that it would be possible to get rid of both of these sources by means of price control. Then, the government could pass a regulation that all firms must charge the same price, namely the competitive price.

However, the question is; how does a government authority find out what the competitive price is? – And, if this would be possible, can it assert that production will be efficient at that price? Finally what are the economic costs associated with imposing the wrong price on the economy?

The problems with price regulations.

Even if it may appear to be possible to improve efficiency in a search market through price controls, several difficult information problems first have to be solved.

One is that it is difficult for the government to find out what the competitive prices (or what would be the otherwise most efficient price). The competitive price is equal to the minimum average cost for an individual firm. How can a price control authority find out what is the average cost minimum in an industry? The actual prices offered in a free search market equilibrium will be of almost no guide. Do they have to estimate "engineering production functions" or what?

We will have a very complicated and complex problem if the following process is the case. Consumers are searching for low prices from a disequilibrium distribution of price offers. At the same time a government regulatory authority is trying to estimate the "best" regulated price (or price distribution), and also try to enforce regulations based on empirical findings during their estimation process. If consumers and the government are simultanously behaving in the way described above, does the market converge to any equilibrium, and what does that equilibrium look like?

There is another problem, which is fundamental in economics. In perfect competition there cannot be any equilibrium if there are increasing returns to scale. There is a requirement that the ac–curves are U–shaped. Then, there exists a minimum

average cost at some production level. However, in a search market, there is no such requirement for the equilibrium to be atomistic. All firms can have production technology with increasing returns (economies of scale)) and still the endogenous market solution is atomistic (many firms). The reason for this is that a firm in order to sell more has to reduce its price. If the necessary price cut is larger than the decrease in costs, then it will stay at the old price. It is, of course, interesting to note that a search market can be in atomistic equilibrium even when there are "economies of scale". However, this creates a problem, if we try to see what the price that a price–controlling authority should stipulate would be. Even if the true production function were perfectly known, there is no guide to what price should be stipulated under regulation. Increasing returns suggests a regulated price so low that only one firm will remain. But this would give rise to an x–inefficiency (Leibenstein) problem.

A further problem with price regulations is: Even if the scale economy problem above is not present, it is difficult to find a price that makes demand equal supply. Hence, price controls will probably create a situation of excess demand or excess supply. In both cases the dynamic efficiency of the market will probably be lowered. This is the most traditional argument against price controls.

Another very important problem is whether or not the quality of the product can be controlled. If the price controlling authority regulates the price, then it must of course be based on a specified quantity and quality. Otherwise, one could avoid the price control by changing the quantity or quality. If a specific price is regulated per unit, a way to increase price is to decrease the quantity per unit. This would, however, be easy to check. A decrease in quality of the product would, however, be more difficult to control for.

This means that if the price of a particular product is regulated, price competition will turn into quality competition. And instead of a price distribution in equilibrium there may be a quality distribution at uniform price. However, that would make the search process more resource demanding, because it is more difficult to compare quality than to compare prices for items of equal quality. But, even if the basic sequential search model (C1) assumes homogenous products, it should be regarded as prices expressed per quantity and quality adjusted unit. Hence, in the non–regulated case, we in fact regard the case of a market where both prices and qualities differ. This may make us suspect that the search efforts are larger in the non–regulated case.

Our analytical problem, however, is to idenify and quantify the costs in a price control situation. These costs are of two kinds. First, the real costs associated with computing the "best" price (for instance the minimum average cost for a firm). Second, there are negative effects associated with a price that will not clear the market

(which,.in practice, will probably be the case with price controls). Third, there will probably be a difference in growth and x–inefficiency in the non–regulated and the price controlled case. However, it is not at all clear in what direction the difference will go.

Our discussion above concerned regulation of prices. Another set of rules and regulations to consider concerns the search and the bargaining processes. As mentioned above, the market form is endogenously determined in the economy. The market form is defined by the set of rules that determines the functioning of the market. These rules (or laws) concern two things. The contact process and the contract process.

The contact process is defined as the "natural laws" that govern the probabilities that buyers and seller come into contact with each other. (Is, e.g., the probability of finding a trading partner a concave or convex function of search efforts?)

By the contract process we mean the rules that govern the bargaining process and the limitations of the contract that could be signed.

The laws that govern the contacts are not easy to influence, since they are more lika natural laws and dependent on technical conditions. The rules that govern the contracts are, on the contrary, possible to influence. The rules are normally implicit but sometimes explicit. They depend on how much information that has to be transferred in a trade situation, and how it is transferred (the communication technology).

The question concerning the possibility to improve efficiency of markets by means of regulations is; are there other rules constraining the bargaining process that would make the market outcome more efficient?

One candidate for this is the regulation of "gross list prices". The question, at least in Sweden, has been: Should producers and whole–sale importers be allowed to set the price of its product in the retail trade? Such specifications have been regarded as limitation on competition. However, we could argue that regulations against such limitations on price setting will induce more search activity than otherwise. Hence it might diminish welfare in the economy.

The conclusion is that we see a conflict between the possible increase in welfare because of uniform prices and decrease in search activity, and the possibility of a decrease in welfare because of reduced competition.

7. SUMMARY AND CONCLUSIONS.

In this paper we have discussed the effects of regulations in markets that otherwise had been left to the market mechanism in the price formation. We conclude that, in the situation of "pure" (search market) competition, where a maximum of freedom is permitted, an equilibrium price distribution would be established. Although this equilibrium involves inefficiencies compared to the "nirvana" case, this might still be superior to an equilibrium with regulations, where either the "wrong" prices had been enforced, or the "right" prices but at too large a cost.

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