

# A Note on Spatial Competition

by

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## I

Sellers' tendency to become gregarious is due to imperfect information involved in making a purchase; it is qualitatively measured by how easily a seller is found and to what degree a buyer thinks the commodity or service he is going to buy has standardized quality and a uniform price. When a buyer does not know the exact locations of individual sellers whose products he is going to buy, he will go to a place where the sellers are most easily to be found. When a buyer is not certain about the price and quality differences of a commodity or service sold by several sellers, he thinks he will be effectively prevented from making the worst bargain, if they seem to be competing. Hence sellers pretend competition to attract buyers; the outcome is sellers' becoming gregarious. Hotelling's extended logic holds only when the exact locations of sellers are known and the price and quality of a commodity or service are standardized and uniform.

The purpose of this paper is to modify the concept of spatial competition developed by Professor Harold Hotelling<sup>1)</sup> in terms of transportation cost on the basis of the implications of Professor George J. Stigler's "The Economics of Information."<sup>2)</sup>

Hotelling begins his argument with two sellers and ends up with the conclusion that the two sellers will be exactly adjacent. But when Hotelling's logic is extended to the case of more than three sellers, it necessarily follows that they will be separated from each other,<sup>3)</sup> and yet it is well observed that sellers of some commodities or services are separated while sellers of other commodities or services are gregarious. The latter cases are too numerous to be considered simply exceptions to Hotelling's

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1) Hotelling (1929), Only a few further contributions have been made to the concept such as Lerner and Singer (1937), Smithies (1941), Ackley (1941), and Chamberlain (1956).

2) Stigler (1961)

3) The point was already made in Chamberlin, *op. cit.*, but he did not discuss stability.

model, and hence this fact suggests the need to regard the matter from a different angle. At the moment, the most handy and valuable tools to tackle this problem can be found in "The Economics of Information".

The basic idea of the present paper runs as follows.

Sellers' tendency to become gregarious is due to imperfect information involved in making a purchase; it is qualitatively measured by how easily a seller is found and to what degree a buyer thinks the commodity or service he is going to buy has standardized quality and a uniform price. When a buyer does not know the exact locations of individual sellers whose products he is going to buy, he will go to a place where the sellers are most easily to be found. When a buyer is not certain about the price and quality differences of a commodity or service sold by several sellers, he thinks he will be effectively prevented from making the worst bargain, if they seem to him to be competing. Hence sellers pretend competition to attract buyers; the outcome is seller' becoming gregarious.<sup>4)</sup> Hotelling's extended logic holds only when the exact locations of sellers are known and the price and quality of a commodity or service are standardized and uniform.

To develop the idea, the present argument will proceed according to the following steps: the extension of Hotelling's logic to the case of three sellers, and the derivation of the conclusion that they will be separated; the application of Stigler's logic to spatial competition; and the citation of empirical evidence taken from Korean experience to substantiate the idea.

## II

The essence of Hotelling's version of spatial competition may be summarized as follows.

Suppose that at any point on a road between Point A and Point B demand for a certain commodity is equally intense and absolutely inelastic, and there are two suppliers, X and Y, of the commodity. For instance, X and Y may be hamburger and Coca cola stands. Then, if the transportation cost is a crucial factor for the buyer in deciding from which of the two sellers to buy, X and Y may locate themselves at the points away from A by one-fourth and three-fourths of  $\overline{AB}$ , respectively, in order to divide the market equally between them. But this is a state of unstable equilibrium; if X moves rightward he will not lose to Y any of his customers on the left-hand but attract some of Y's customers, and vice versa for Y if he moves leftward. So, stable equilibrium will be reached if X and Y are exactly adjacent at

4) The idea was already mentioned in Seitzinger (1951).

the middle point of  $\overline{AB}$ . The market is equally divided between X and Y, and neither of them has any incentive to move away from the point.

The above argument leaves two things to be clarified.

1. Will the argument continue to hold if the transportation cost is positive for a measurable distance but zero for an infinitesimal distance? That is, if a buyer does not prefer one seller to the other when they are exactly adjacent, will the argument be modified?

2. How will the argument be revised if more than three suppliers compete on the road?

For the first question. Unstable equilibrium can be attained if the two suppliers are exactly adjacent at any point on the road. But stable equilibrium is reached, as before, only when the two suppliers are exactly adjacent at the middle of the road, and hence this case is of no particular interest. This is readily seen in Figure 1.

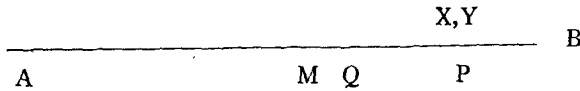


Figure 1

Let M be the middle point of  $\overline{AB}$ , P be a point between M and B, and Q between M and P. Suppose X and Y are exactly adjacent at P; then the market will be equally divided between X and Y, and there will be an equilibrium. But if one of them moves to Q while the other remains at P, the former can attain more than half of the market since  $\overline{QP}$  is not infinitesimal. Stable equilibrium can be reached only at M.

For the second question. Suppose there are  $n$  ( $n \geq 3$ ) suppliers competing on the road. If they are adjacent in a row around the middle of the road, most buyers prefer suppliers located at one of the ends to those at the middle of the row and hence those at the middle will continuously strive to move to one of the ends. No equilibrium will be reached if the suppliers are to be adjacent; however, an equilibrium is possible if the suppliers are located at the points away from A by  $\frac{1}{2n}$ ,  $\frac{3}{2n}$ ,  $\frac{5}{2n}$ , ... of  $\overline{AB}$ , since at these points the market is equally divided between the suppliers. This equilibrium can also be stable, which is illustrated for  $n=3$  in Figure 2.

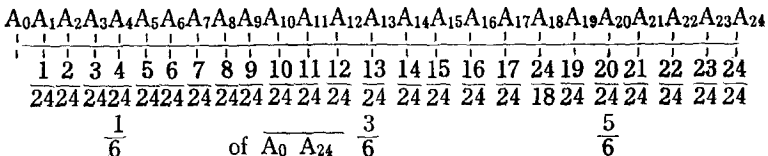


Figure 2

Suppose there are three suppliers, X, Y and Z locating at  $A_4$ ,<sup>5</sup>  $A_{12}$ , and  $A_{20}$ , respectively. Now X moves rightward to invade Y's market. If X moves beyond  $A_8$ , Y can move to the immediate left of X, and recover his market, so X will not move beyond  $A_8$  but to, for example,  $A_6$ ; if Y remains at  $A_{12}$ , his market will shrink from  $\frac{8}{24}$  to  $\frac{7}{24}$  of  $\overline{A_0 A_{24}}$ . What can Y do to recover his market or at least to "punish" the aggressive X? If Y can assume that X will not move rightward beyond  $A_6$  and Z will remain at  $A_{20}$  whatever action he takes, then at any point between  $A_6$  and  $A_{20}$  Y's market share will be  $\frac{7}{24}$  of  $\overline{A_0 A_{24}}$ . On the other hand, if Y has to expect that, if he moves leftward Z also moves leftward even beyond  $A_{18}$ , Y may move to the immediate left of X at  $A_6$  or to the immediate right of Z at some point beyond  $A_{18}$ . X can "punish" X or Z, and X knows that Y can retaliate even though Y may not be able to recover his own market. Then, Why should X bring the windfall gain to Z? X will not run the risk,<sup>6</sup> and neither will Y or Z.

In short, when there are more than three suppliers, they will tend to separate from each other according to Hotelling's logic.<sup>5)</sup> But there are innumerable examples of many sellers selling the same kind of product who are gregarious. What does make them gregarious? Here "The Economics of Information" comes in.

### III

When a buyer wants to buy a commodity, he faces two major problems in the real world: finding a seller and choosing the best quality and price. If solving these two problems requires cost, firms which are already known or which can be reached at a low cost and the qualities and prices of whose commodities are swiftly compared with those of other firms' can attract buyers most easily. Consequently, *firms selling similar products tend to become gregarious*. The elaboration is presented below.

Suppose there is a firm selling a certain good in a community, and the location of the firm and the quality and price of its commodity are well known to the buyers of the community. If a second firm enters into the market, what location will be the best for the entering firm? If the entering firm should satisfy the two conditions that its location be known to the buyers, and the quality and price of its product be swiftly compared with those of the established firm's, will not the best location for the entering firm be one next to the established firm? If the argument is valid for the first entrant, it will be valid also for the second, third, ....., entrants. A graphical exposition is given below.

5) Lerner-Singer and Smithies have both developed an argument that when there are only two suppliers they may be separated from each other.



Figure 3

Suppose that Shop A is far away from Shops B,C,D,E and F, while they are grouped together as in Figure 3. Then a buyer to the right of B who does not know much about the quality and price of a commodity or service (because, for instance, he purchases it infrequently) will make a deal with one of the shops in the group rather than with Shop A. The buyer will not get in touch with A because A can give only marginal information the utility of which probably rapidly decreases to the buyer and hence getting in touch with A may not be worth the transportation cost in terms of money and time. The buyer can reasonably assume that group competition is so keen that the price is pushed down to the minimum and the quality is pushed up to the maximum, so he actually needs to get in touch with only one shop in the group. A buyer on the left of A who is also uncertain of the qualities and prices will probably want to get in touch with the group and may go directly to the the group rather than go to A first and then to the group, because dropping in A may not be costless. For instance, it may be difficult, though not impossible, to find a parking place in the vicinity of A, or additional bus fare may be involved, and negotiating, fruitful or abortive, may be time-and energy consuming. Similarly, buyers between A and B who are uncertain of the qualities and prices all directly go to the group and make deals there. As a result, the established firm may be sandwiched by the entering firms, but it will probably not move out because the transportation cost is likely negligible for a short distance so that it will not lose its customers totally to the sandwiching firms, and if it moves out its new location may not easily be known to its old customers, and the quality and price of its product can not be swiftly compared with those of the other firms'. This argument, of course, does not exclude the possibility of several groups which are separated far from each other.

When no location next to the established firms is available for one reason or another, there is a way for an entering firm to satisfy the two conditions; advertising will do the job. Indeed, if the established firm happens to be located far from the center of the community, an entering firm may deliberately choose a location near to the center, and engage in extensive and intensive advertising. If the location of the entering firm is known to the buyers through advertising, and the quality and price of its product are swiftly compared with those of the established firm's, the entering firm can attract more buyers than the established firm because of the transportation

cost; that is, Hotelling's original argument works.

After all, the answer to the question which one, Hotelling's extended logic or Stigler's applied logic, holds depends on the character of the individual commodity or service. In order for Hotelling's extended logic to hold, information about both the locations of sellers and the qualities and prices of the products should be perfect. If one of them is imperfect, Stigler's applied logic holds. Suppose the first kind of information is perfect but the second kind of information is imperfect; for instance, the product is possibly so heterogeneous that a buyer must examine directly the product of each seller, or the price is potentially so diverse that room for bargaining is large. Then, the sellers tend to become gregarious. Next, suppose the first kind of information is imperfect while the second kind of information is perfect; more precisely, the quality of a product is trusted to be standardized, and the price is well known to be uniform, but the buyer purchases the product so infrequently that he has to search a seller each time he makes a purchase. Then, the sellers again tend to become gregarious.

Systematic advertising or organized exchange of full information may relax the gregarious tendency of sellers discussed above. But advertising or exchange of full information may not be effective due to the very nature of the business or it may be too costly to be effective because of purchasing patterns. If business practice is essentially a sort of "guessing game" among experts based on imperfect information, and it is required to play the game as quickly as possible or as many games as possible for a given time span, advertising or exchange of full information is irrelevant and of no use. If information should be propagated continuously to numerous, unspecified buyers, advertising or exchange of full information will be overwhelmingly expensive unless sales are relatively very large.

#### IV

The following real examples are taken from Korean experience.

##### 1. Cases where Hotelling's extended logic holds.

i. Gasoline stations offer an example. Neighbouring gasoline stations on the same side of a road are rarely seen, but the explanation for this is fairly simple. The quality and price are absolutely same for all gasoline stations selling the same brand (and there are just several brands). Though a gasoline station is typically a small scale firm, and hence advertising for the location is not feasible in terms of cost buyers travel extensively and intensively. Therefore, if a gasoline station is located on a heavily travelled road its locations quickly perceived.

ii. Brand new book stores are usually separated from each other. The buyer make

purchases often, so he is well aware of the locations of sellers. The quality and price of a product for the same title are standardized and uniform, and a buyer knows the content of a product better than a seller, so he is not afraid of making a "poor" bargain. The transportation cost is relatively large in comparison with the price of a product, so transportation cost is a crucial factor in deciding from which seller to buy. Hotelling's extended logic consequently applies.

iii. Barber shops exhibit another example of Hotelling's extended case. A barber must get a license, and hair cutting is a relatively easy job, the product tending to be standardized. Price is fixed for each class, and there are only a few classes. A buyer spends a relatively small amount of money for hair cutting, so time and transportation cost are essential in choosing a barber. Hotelling's extended logic applies; that is, barbers tend to be separated.

iv. Department stores provide an example of effective advertising. Expense for advertising of location does not differ much between a small firm and a large one, so the expense for advertising per unit sale is relatively small for a department store whose sale is typically very large. The prices of commodities remain constant for a considerable length of time, and are supposed homogeneous among competing department stores. The quality is much trusted; therefore, occasional advertising works for the purpose, and hence the adjacency of competing department stores is not necessary. They are rather separated.

## 2. Cases where Stigler's applied logic holds

i. Retail shops for automobile spare parts give an example. Secret price concessions are often made, and the qualities of the products are of dubious character. A buyer may be induced to pay a higher price if he does not know the prices of other shops. Consequently, he avoids a shop far apart from a group of other shops.

ii. Used book stores illustrate another case. Copies of the same title are not many, and not all stores have all titles, so extensive search may be necessary to find a desired title. In addition, used book stores are typically small and have many titles but one or two copies of each title, and hence advertising for location and stock is not feasible. Moreover, the quality of products is extremely unstandardized, and as customers sell and buy infrequently, they are not familiar with the negotiation practices. Further, unlike beef or cabbage, a certain title is desired only by a certain group of buyers, and the intensity of the desire varies greatly among members of the group, so there is much room for negotiation. In consequence, an entering used book store located far away from established firms is very likely to be neglected.

iii. First class tailor shops add one more example. Quality is assumed homogeneous and prices are comparable, but purchase is so infrequent that the location of a seller

may be easily forgotten. First class tailor shops are consequently gregarious. In addition, by joining a group of first class tailors, a tailor enjoys the real or imaginary reputation of a first class tailor.

iv. The offices of stock brokers are grouped together for the reasons discussed above.<sup>6)</sup>

3. Cases where Stigler's applied logic *indirectly* holds.

i. Large, expensive art galleries or antique shops, though selling used products, present a counter example of the used book store case. As there is normally only one original, price comparison is irrelevant. Deals are made between experts, and buyers are well acquainted with the qualities of products (at least they think they are). Customers are wealthy, and their number is small, so they can develop an information system to detect the location of a shop, and a shop can easily advertise its location and stock for a small group of buyers. Anyway, as deals are very big in terms of money, both parties are willing to pay for information cost. As consequence, exclusive art galleries or antique shops need not be adjacent. In contrast, small antique shops are gregarious.

ii. Medical service offers an unusual case. Propagation of information is mostly through personal reference. Quality is of necessity not standardized, and not easily compared. Patients have strong personal preference or attachment to a particular doctor. Often doctors charge or patients pay according to payment ability. Anyhow, patients are relatively less concerned with price. In consequence hospitals do not endeavor to be adjacent.

iii. Banking service presents another special case. The quality and price are absolutely standardized and uniform. A large, imposing bank building does not need planned advertisement for location. Time and transportation cost are negligible in comparison with the importance and amount of a deal. Hence, no systematic pattern is found in the locations of banks.

V. If costs for finding a seller and choosing the best quality and price in terms of time and money are not negligible to the buyer, a seller whose location is already known or can be easily known, and whose quality and price are readily compared with those of other sellers has relative advantage in attracting buyers. In consequence, for certain commodities sellers are gregarious. On the other hand, if the quality of a commodity is standardized and its price is uniform, and sellers are easily identified, then Hotelling's extended logic applies in that they tend to be separated from each other.

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6) See P. 10 above



In metropolitan areas of an underdeveloped country such as Korea, the qualities and prices of products are exceedingly unstandardized and notoriously diverse, and sellers are of such small size that advertisements for their locations are not feasible. There are many kinds of commodities for which sellers are gregarious; no doubt this in turn complicates further the problems of space allocation and traffic flow. For instance, if house wives could do shopping without the disadvantages described above at a shopping center in a residential area, they would be able to save lots of transportation.

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