COMMISSION OF THE EUROPEAN COMMUNITIES

# STUDIES

*Spatial pricing and competition*

COMPETITION — APPROXIMATION OF LEGISLATION SERIES — 1976 — 29

The use of certain so-called "geographic" pricing systems, such as delivered prices, basing point systems, etc. – can have a marked effect on the functioning of competition and the unity of the common market.

The present theoretical study is designed to stimulate reflexion on certain entrenched commercial practices. The analysis is of interest to both macro- and micro-economists.

The author demonstrates that, in terms of economic efficiency, only sales f.o.b. are compatible with the optimal spatial allocation of resources, provided that there is scope for the occasional absorption of freight costs. Having regard to the effectiveness of competition, policies which include a systematic absorption of freight costs and are thus discriminatory, appear to buttress often tacit price agreements which have the object to maximise the joint profits.

# Spatial pricing and competition

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# PREFACE

This report has been written for the Commission of the European Communities and at its request. It goes without saying that the Commission bears no responsibility for the opinions expressed in it which are those of the author alone.

I should like to record my thanks to my colleague Jacques Thisse, who specializes in questions of spatial economy and made numerous suggestions, to Jacques Drèze, also at the Catholic University of Louvain, and John Peters, Head of Division in the Commission's Directorate-General for Industrial and Technological Affairs, with whom my conversations provided much food for thought.

I am particularly indebted to Henk Witlox, Adviser in the Commission's Directorate-General for Competition, who encouraged me to undertake the impossible task of integrating the voluminous and well-known literature on antitrust policy applied to spatial pricing techniques with the dispersed and more recent conclusions of the theory of the firm and the equally recent theorems of welfare economics.

Louvain, June 1976

Louis PHLIPS

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## 1. INTRODUCTION

The question studied by this report is to what extent the adoption by industry of certain delivered price systems is compatible with the establishment of a competitive market in the European Communities.

Spatial pricing systems typically use sales conditions such as "delivered" prices (where the seller takes care of carriage) or "fob" prices (free on board, where the seller sets a factory price and the buyer takes care of freight). In certain structural contexts, however, these systems imply rather more than the choice of a particular type of sales conditions : they can help to determine competitive behaviour.

We shall concentrate on industrial structures where the adoption of a given system is apt to have repercussions - favourable or unfavourable - on the competitive conduct of the relevant firms. These are industries which produce relatively homogeneous goods so that there is perfect substitutability at a given place between the goods of one manufacturer and those of another. Furthermore, freight is a significant factor in retail price formation since the goods are of low unitary value and carriage is over fairly large distances. The origin of this last fact lies either in geographical concentration or in the small number of producers. In any case, bearing in mind this spatial differentiation, the number of competitors is low either because freight costs create a series of local oligopolies or because the number of produvers in the whole of the relevant territory is low. Finally, the price elasticity of overall demand in the industry is low, so that sellers have a collective interest in avoiding industry-wide price reductions.

This, then, sets our reference framework. It is broad enough to take in a large number of industries, yet it is narrow enough to preclude abstract generalisations.

After describing the price systems which are to be analysed (Section 2), we shall consider their effects on price competition in Section 3. We shall go on to seek out why firms find it worth adopting such techniques, both on a monopoly market

(Section 4) and on an oligopolistic market (Section 5). Section 6 will consider their compatibility with efficient spatial resource allocation and provides an opportunity to express views on the question of spatial discrimination. After an excursus on perfect markets (Section 7), we shall consider the conditions of market integration which might help to promote economic efficiency (Section 8) and regional development (Section 9).

## 2. SPATIAL PRICE SYSTEMS

Let us attempt a brief description of the pricing techniques under analysis, highlighting their most important characteristics for the purpose of this study. For the sake of clarity certain aspects will be simplified : in business practice, specific circumstances often entail variations on points of detail.

### 2.1 Zone prices (1)

A uniform delivered price is applied throughout a given territory. When the unit transport cost is fairly high, and demand is concentrated at different places, a number of separate areas can be demarcated. Within each such area, a single delivered price applies to all points of delivery. An area might consist, for instance, of a member country of Benelux. Elsewhere it will consist of an economic region, a county or group of counties, etc., precise demarcation depending on the number and location of production and consumption centres, political borders and the history of marketing-sharing agreements.

Between the areas, a rigid price difference is maintained, which means that buyers (dealers or the ultimate consumer) are prohibited from buying or reselling in any area other than that in which they are located (or which is allotted to them). There is thus a need for strict control of shipments. The simplest way of exercising this control is to ban buyers from handling their own carriage. Yet this is not essential : it may suffice to require payment of the delivered price (free at site, free on rail, free alongside ship, or whatever) applying in the buyer's area even when he obtains supplies in another area. In such cases, price gaps between areas must not exceed the cost of freight to each of the main centres of consumption, to exclude the possibility of arbitrage.

(1) See Commons (1924, p. 505-508), Burns (1936, p. 282-288), Möller (1943a, p. 87-89), Mund (1950, p. 366-369), Herlemann (1950, p. 54-59), Report on the Supply of Chemical Fertilizers (1959, paragraphs 537 and 567), Phlips (1962, p. 201-218 and 265-268).

Within each area, a ban on taking delivery at the factory itself ensures that the system will operate smoothly. Once again, however, more flexible arrangements may be possible : it is possible to go so far as to allow reimbursement (sometimes in part only) of freight charges where delivery is taken at the factory, but this presupposes a highly disciplined trade, strict control of destination and tariffs reflecting genuine freight costs.

## 2.2 The basing point system (1)

Sale from a basing point *(point de parité* in French, *Frachtgrundlage* in German) implies a delivered price equal to a base price plus the cost of carriage to the place of delivery calculated from a predetermined basing point, which need not necessarily be the place where the seller's factory is located.

Consider a geographical area in which there are several centres of production. When all manufacturers calculate freight from a single basing point, we have what is called a *single basing point system.* (2) . When there are several basing points, we have a *multiple basing point system.*

In the second case, the calculation of delivered prices can seem complex. What is the basing point for calculation of freight as regards a buyer at a specific place ? In the system which we are to analyse, the formula is very simple : at every geographical location, the delivered price to be applied is equal to the lowest combination of a base price plus freight to that location (from the different basing points to which the base prices relate). This formula is applied by means of the "alignment" rule. Let us take a look at this in more detail.

The base price is the published list price applicable at a given basing point. The industry decides on one or mose basing points (for instance, a port such as

(1) The best known works include Clark (1938), Möller (1943a), Machlup (1949), Stigler (1949), Kaysen (1949), Wagner (1952), Harbers (1953), von Beckerath (1954, p. 199-200 and 263-264), Erb (1956), Erb and Rogge (1958), Imkamp (1958), Justman (1958), Allais (1958), Demaria (1958), Fallon (1958), Loescher (1959, Chap. 1), Zimmermann (1962) and Scherer (1970, Chap. 10).

(2) Examples are the "Pittsburgh-plus", "Thionville" and "Oberhausen" systems applied by American, French and German steelmakers.

Hamburg for foreign wheat imported by sea, or the city of Siegen for German-made fine sheet of ordinary steel, or perhaps even several cities, which may or may not correspond to actual centres of production).

The freight to be added to the base price is worked out from a published tariff accepted by all concerned, such as a railway company's schedule of charges. For places not on railway lines or where the operation of official tariffs would be excessively complicated, the industry itself publishes (or asks the authorities to publish) a common tariff.

All prices are delivered prices. The price to be charged at a given destination is the lowest possible delivered price calculated by comparing all the base prices and freight charges from corresponding basing points. Thus at a given place of destination only a single delivered price is possible, identical and known with precision regardless of the seller and regardless of the distance covered in carriage to the place of destination.

It may thus happen that a seller applies a base price other than his own. In this case, there is alignment on a competitor's base price. By systematically setting excessive base price, certain centres of production may find themselves aligning on the price of other centres for all their sales, including sales in their own immediate vicinity.

On the other hand, it is inherent in the system that the freight incorporated in the delivered price corresponds to actual cost of carriage only if the goods are actually dispatched from the basing point whose base price was used for calculation of the delivered price. If actual costs of carriage are higher than the freight thus calculated, the seller is absorbing part of the freight. If it is lower, the seller benefits from a "phantom freight" incorporated in the delivered price.

If the system is to work, buyers must be prohibited from taking responsibility for carriage in their own means of transportation or, alternatively, only such means of transportation as are controlled by the producers must be authorized, since this is the only way to ensure that at a given point of destination delivered prices are strictly uniform and arbitrage is impossible.

## 2.3 Uniform fob prices (1)

Here, the producers publish a factory price at which buyers may buy goods for carriage at their own expense; alternatively, if they prefer the producer to look after carriage, the actual cost can be added to the factory price. In any event, the net producer price (after deduction of freight) is the same whatever the destination since, at any point of delivery, the delivered price is equal to the factory price plus actual carriage costs.

In a system such as this, the delivered price rises with the distance of the place of delivery from the factory or (if several firms are located at the same place) the centre of production. Each centre thus has a "natural" market where the delivered price of its goods is lower than that of competing centres of production (2). The extent of the natural market changes with each change in factory prices and carriage costs. Assuming carriage costs are at a given level, the only way of penetrating the natural market of a competitor is to cut factory prices (the same for all buyers). Freight absorption and phantom freight are consequently impossible.

## 2.4 Fob prices with non-systematic freight absorption (3)

In the system which we have outlined, the uniformity of factory prices means that each producer must reduce his prices for all customers, either in order to obtain orders from places outside his natural market or in reaction to a price reduction announced by a neighbouring centre of production. We are thus led to imagine a hybrid system where buyers outside the seller's natural market could be quoted a special price.

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(1) This system is generally discussed alongside the basing point system : see main references given above.

(2) The concept of a natural market is analyzed by Fetter (1923-24), Hoover (1936-37), Hyson (1950) and Greenhut (1952).

(3) This system was put forward by Kaysen (1949), Pegrum (1951), Stocking (1954, p. 188) and Loescher (1959, p. 233-242).

A first possibility is to charge a special factory price for distant buyers. But this is a purely hypothetical possibility which will not be considered here. It is unlikely to come about in practice since the person buying at a special price could resell the goods at a profit within the seller's natural market, and the seller would thus have to reduce his factory price for all sales.

The alternative is a system of uniform factory prices coupled with freight absorption outside the natural market to counter the delivered price which the buyer might have obtained from a closer centre of production. The seller handles carriage and bears the cost of freight absorption where the sale is outside his natural market. The buyer always has the right to take delivery at the factory, but since factory prices are uniform the risk of arbitrage is excluded. The means of transport is selected by the buyer in a fob sale. It will be seen that this system is no more than a basing point system in which *each* factory is a basing point as far as the geographical structure of prices is concerned, except for one major difference : in this case, buyers can choose the mode of delivery and may find it is in their interests to take delivery at the factory.

It is worth adding that this fourth system is really no system at all, since the freedom to choose mode of transport means that prices are unlikely to become petrified.

## 3. PRICE COMPETITION

How does the adoption of one or other of the systems described above affect price competition ? To put it more precisely : to what extent does the adoption of such a system promote price competition or help to eliminate it ? Let us also add the further detail that the question concerns competitive conduct in a given market structure. This structure is that described in the introduction : we are considering industries producing a relatively homogeneous product of low value per unit of weight requiring carriage over fairly large distances; demand is inelastic and supply is oligopolistic.

### 3.1 Zone prices

In a system where prices are set by area, the situation is clear and little discussion seems called for : the system is possible only if a geographical market is broken up by tacit or explicit market-sharing agreements. The logic of the system from the price competition angle is obvious : firstly, there can be no competition either at the production or at the wholesale stage; secondly, buyers have no incentive to obtain their supplies from manufacturers nearer by.

The system is manifestly incompatible with the common market. It is typical of the major cartels which segregated national territories (which were reserved for national cartels) and subdivided these national markets into regional markets (reserved for regional cartels or for this or that manufacturer); it will disappear with the agreements or practices through which it operates.

## 3.2 The basing point system

There has been considerably more discussion of the basing point system. Outlawed in a number of individual cases in the United States since the forties, it was officially adopted by Article 60 of the ECSC Treaty and applies (1) in the coal and steel industries.

This system is all the more worthy of discussion as it developed historically, in the United States, in a legal context where price agreements, particularly on a regional basis, were prohibited. This is not to suggest that the system cannot work under a price-fixing arrangement; it is known to have been applied by well-organized cartels such as the German steel cartel (2), and that it preceded their formation (3). But the system is of particular interest to us in that it could be the sequel to a geographical market-sharing agreement. If such an agreement were prohibited, would the adoption of a basing point system be apt to promote or facilitate competitive behaviour ? This is the question which seems most relevant to the European situation.

The answer is : no, quite the contrary. The introduction of a basing point system as described in 2.2 above aims to create the necessary and sufficient conditions for the success of a tacit price-fixing agreement where the structural situation is that which we have assumed. The necessary condition is simply the availability of perfect information on prices : the definition of the delivered price is such that any seller and any buyer can establish it with the highest degree of precision and a minimum amount of research. As has been stressed on a number of occasions, tacit agreement between members of an oligopoly is possible only where all the members know exactly what prices the others are charging. Where the unit value per unit of weight is low, carriage costs constitute a significant price factor and the delivered price is the subject of attention. As soon as there is any uncertainty as to the exact delivered price, buyers may exploit this fact to obtain secret price reductions and then carry out arbitrage through resale, so that general price levels may fall through the weakening of the geographical structure of delivered prices (4).

(1) The way it operates in the ECSC was analysed by Stegemann (1967 or 1968).
(2) See Harbers (1953)
(3) See, for example, Wagner (1952, p. 12).
(4) See Adelman (1948 and 1949), Clark (1950), Mestmäcker (1955), Loescher (1955, p. 26-29), Schmidt (1963) and Phlips (1964). A contrary opinion on the role of perfect information is expressed, among others, by Demaria (1958, p. 33) and Menze (1963).

The rule of systematic alignment is the sufficent condition which accompanies the information constraint. Through alignment, the effect of any price reduction by a competitor is automatically neutralized. Although certain appearances may be to the contrary, alignment thus has no competitive virtues. Although it may, at first sight, point to aggressive conduct, in reality it makes it impossible to undercut competitors' prices. Alignment is a defensive tactic : assuming equal prices, the seller can tie his traditional customers to him wherever they may be located.

It may be worth adding that a tacit agreement can be reinforced by various aspects of the way this system is operated, and particularly through the selection of basing points. The choice of a single basing point where there are several centres of production enables the dominant centre to impose its *price leadership* . The point might be the place where the price leader has his main factory. It can also correspond to the location of small, marginal and distant competitors whose natural markets are thought to deserve protection (while reserving the benefit of "phantom freight" for the main centre). But price *leadership* is not incompatible with the existence of several basing points, for basic prices can be set at such levels that numerous competitors are obliged to align systematically on the base price of a single basing point (so that other base prices never count).

In sum, the basing point system proceeds from the same logic as the zone pricing system for the purposes of price competition : all uncertainty as to prices is to be eliminated as is all incentive to undercut competitors. It has the specific advantage of making tacit price agreements possible where explicit agreements are prohibited.

The vast majority of writers on this subject agree with the foregoing diagnosis. While the view that a basing point system tends to sharpen competitive conduct is rarely held, we more frequently meet the argument (1) that this system develops spontaneously and inevitably in industries with high fixed costs, unstable demand and an oligopolistic structure. This argument is not convincing when it is borne in mind that the system arises from explicit agreements (frequently reached laboriously) and that it is not easy to keep in operation. There are numerous opportunities for breakdowns : at times of serious depression, the temptation to grant clandestine rebates (on the delivered prices resulting from the system) is likely to wear down adhesion to the agreement; at times of economic boom, shortage

(1) See de Chazeau (1938) and Clark (1938) for the United States, and Möller (1943a) and von Beckerath (1954, p. 199-200 and 263-264).

of supply may permit sales at individual prices which are higher than those of the system; finally, and most important of all, imports from non-member countries can destroy the whole system. When it does work, this fact in itself is evidence of intentional adhesion to a tacit price agreement.

## 3.3 Uniform fob prices

Uniform fob prices are found both where there is an organised cartel and where there is tacit collusion, as is the basing point system. Although price information is less perfect as regards delivered prices, since buyers are using their own means of transport, it is perfect as regards factory prices. While the exclusion of alignment confines each centre of production to its own natural market, tacit price-fixing is fostered.

The choice between the two formulae (1) will depend, among other things, on the geographical stability of demand. If demand develops along parallel lines on the various regional submarkets, the fob system is the simplest. Each natural market develops at the same rate, and market shares (or production quotas) can be safeguarded simply by maintaining each operator's natural market. If undesirable shifts in natural demarcation lines were to arise, for instance, through the development of new means of transport, corrections can still be made by adjusting differences between factory prices. On the other hand, if regional demand shifts are frequent and on a large scale, alignment becomes necessary and basing points with it. A centre for which demand is falling can then maintain its market share by supplying growth regions without endangering the structure of prices.

## 3.4 Fob prices with non-systematic freight absorption

Our forth system was clearly thought up in order to offset the disadvantages of the other systems and to provide useful reference criteria. It provides the best prospects for promoting competitive behaviour.

(1) As pointed out by Stigler (1949).

Firstly, freedom to choose terms of delivery *and* means of transport means that there is no certainty as to the delivered price applying at various places of destination. Secondly, interpenetration of natural markets remains possible but alignment on the local price leader is no longer compulsory nor even systematic : undercutting is possible. Furthermore, intermediaries could carry out arbitrage operations by reselling in other natural markets where this is profitable. The result would thus be a network of natural markets with flexible and rather blurred boundaries, and this, as we shall see below, is the salient feature of a spatially integrated market.

# 4. THE EQUILIBRIUM OF AN ISOLATED FIRM

The aim of the foregoing analysis was to establish to what extent different spatial pricing techniques encourage or discourage active price competition between a given number of competing firms. There is much to be gained from taking the analysis further and establishing to what extent these systems are profitable to individual firms. This section will first consider the equilibrium of an isolated firms which maximizes its own profit. The following section will consider the equilibrium of a group of competing firms.

The spatial theory of the firm proceeds from the fact that the location of buyers at different places permits a policy of *spatial price discrimination* where carriage costs are not negligible. By definition there is spatial discrimination when a firm sets net factory prices which vary from one buyer to another according to the buyer's location. As this opportunity for discrimination is the specific result of geographical separation, the general theory of the discriminating monopoly (1) will not suffice on its own : the theory must be adapted to the specific circumstances deriving from the existence of transport costs (2).

## 4.1 Assumptions

Let us take a firm which has one factory and is the only firm to sell a homogeneous and heavy product in a given geographical area. To simplify matters, we assume that in that area demand is concentrated on three geographically separated places and can be represented by three identical linear demand curves. These "gross" demands depend on delivered prices, and are to be distinguished from "net" demands which depend on net factory prices.

(1) As developed by Pigou (1929), Robinson (1933) and E.O. Edwards (1950).
(2) The adaptation is recent, and is due to the work of Stevens and Rydell (1966), Greenhut and Ohta (1972) and Greenhut, Hwang and Ohta (1975).

It is worth noting from the outset that these assumptions imply no loss of generality. The results obtained for three demand locations can be extrapolated without difficulty to $n$ locations. Furthermore, the conclusions which are of interest to us do not depend on the shape of the gross demand curves, so that the assumption of a linear curve, which considerably facilitates presentation, does not restrict the validity of our conclusions (1). The same applies to the assumption of identical gross demand curves, since it will be seen that in fact they entail differing net curves and that only these net curves determine the equilibrium of the firm. The assumption of identical gross curves makes the impact of the existence of the spatial factor on the firm's policy all the more visible. Evidently, the assumption becomes restrictive when the impact of phenomena other than transport costs comes up for analysis.

Since any difference in the distance between the factory and places of demand entails differences in the net demand curves, it can also be assumed, without loss of generality, that these places are at equal distances from each other on a straight line. Let us therefore assume that demand $D_o$ is at the same location as the factory, demand $D_1$ at a certain linear distance and demand $D_2$ at double that distance.

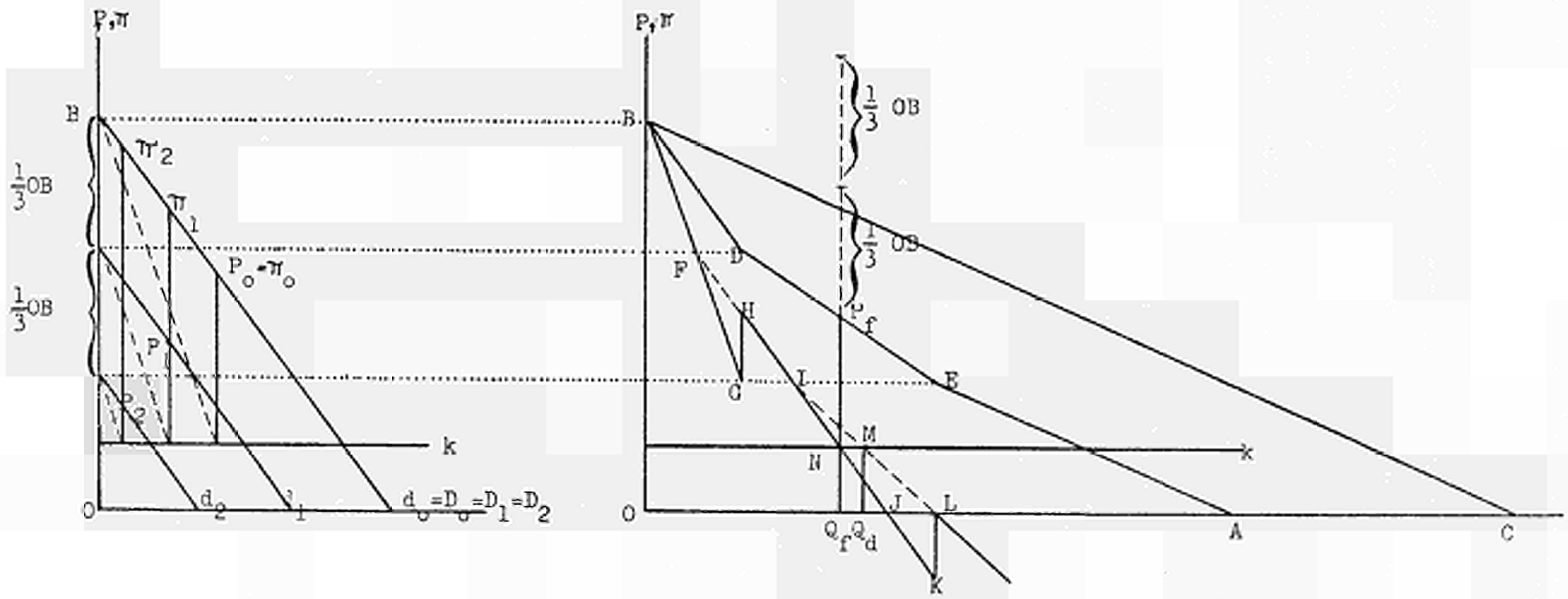
The situation facing the firm in these circumstances is represented in graph form in Figure 1(a). Gross demand curve $D_o$ coincides with net demand curve $d_o$ since demand $D_o$ can be satisfied without any freight being payable. Curve $D_o$, which represents quantities demanded as a function of the delivered price, also represents gross demands $D_1$ and $D_2$. To sum up, $D_o = D_1 = D_2$ since it is assumed that gross demand curves are identical.

Net demand $d_1$ is obtained by drawing a straight line parallel with $D_o$, after deduction of one third of the intercept OB, the assumption being that the unit cost of carriage between the factory and the first distant centre of consumption is (1/3) OB. Net demand $d_2$ is obtained similarly, the cost of carriage now being (2/3) OB.

Horizontal line $k$ represents the marginal cost of production, which is assumed to be constant.

(1) For a demonstration, see Greenhut and Ohta (1972). The conclusions to the contrary reached by Stevens and Rydell (1966) are erroneous.

FIGURE 1


P, π
B
$\frac{1}{3}$OB
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$d_o = D_o = D_1 = D_2$
P, π
B
$\frac{1}{3}$ OB
$\frac{1}{3}$ OB
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F
H
$P_f$
I
E
G
M
N
k
O
J
L
$Q_f$
$Q_d$
K
A
C

(a)

(b)

## 4.2 Non-uniform discriminatory prices

What pricing policy will maximize profits in our firm in the circumstances described above ? The theory of a discriminating monopolist provides an immediate reply : the firm will set its prices at such levels that marginal revenues corresponding to average revenues $d_o$, $d_1$ and $d_2$ will be equal to marginal cost $k$ and therefore equal to each other. The demonstration of this is simple and well-known and there is no need to reiterate it here.

In Figure 1(a), the result of this is net factory prices $p_o$, $p_1$ and $p_2$. As these net prices differ from each other, there is discrimination. By adding respective unit costs of carriage to net prices, we obtain delivered prices $\pi_o$ $(= p_o)$, $\pi_1$ and $\pi_2$, which also differ.

Two points must be made straight away. Firstly, the firm will be meeting demand from the three places. Secondly, it must be stressed that the difference between $\pi_1$ and $\pi_o$ is *less* than the cost of carriage (it is equal to half the cost of carriage because the demand curves are linear). The same applies to the difference between $\pi_2$ and $\pi_o$, so that the firm will find a systematic freight absorption policy on sales to the more distant buyers to be profitable. On the other hand, there is no phantom freight, since no buyer is obliged to pay a delivered price exceeding the sum of the net factory price and actual cost of carriage.

The firm's total output may also be determined from Figure 1(a). But we shall determine it rather in Figure 1(b), which has the advantage of facilitating comparison with other pricing policies.

Figure 1(b) is constructed from the horizontal addition of demand curves (the usual method for the theory of discriminating monopoly). Straight line BC represents the horizontal sum of the three gross demand curves $(D_o + D_1 + D_2)$ and does not interest us for the moment. Broken curve HDEA represents the horizontal sum of $d_o$, $d_1$ and $d_2$. It is the total net demand curve which interests the firm, since it is defined in terms of net factory prices.

Since there is discrimination, the marginal revenue which is of interest to the firm corresponds (1) to regular broken curve BFHIL. It is the point of intersection between this curve and marginal cost $k$ which determines total output $Q_d$.

(1) See Robinson (1933).

## 4.3 Uniform fob prices

Where a firm has a monopoly in a given geographical area, a profitable policy is, as we have seen, to apply different delivered prices with freight absorption. Nevertheless, it may use other tactics, for instance where it is obliged to do so by antitrust law or by the presence of competitors in control of neighbouring geographical areas (1). Considerations relating to overall *market* equilibrium (taking in all the different geographical areas) may then come into play. We shall analyse these considerations in Section 5 : for the moment, we shall assume that, for whatever reason, the relevant firm has adopted a less profitable policy than that of non-uniform discriminatory delivered prices.

The first possibility is setting a uniform fob price. This price is determined by the point of intersection between the marginal cost and the marginal revenue which corresponds to curve BDEA. In this case, the marginal revenue to be taken into consideration is represented by zig-zag curve BFGHIJKL. Point of intersection N gives fob price $p_f$.

It is easy enough to draw a graph establishing the loss of profit as against the operation of non-uniform discriminatory delivered prices. Since the profit of the firm is equal to the geometrical area between the marginal revenue and marginal cost curves and the vertical axis, the loss of profit is equal to the sum of triangles FGH and IMN.

It will be seen that because it has set a fob price the firm will no longer be able to supply the more distant customers. Simply drawing a horizontal line at level $p_f$, and transposing it from Figure 1(b) to Figure 1(a), reveals that this price is higher than the net demand prices on $d_2$. Alternatively, we can repeat the same exercise by adding to $p_f$, firstly, the cost of carriage (1/3) OB and, secondly, (2/3) OB. These delivered prices correspond with a non-zero quantity on $D_1$ and a zero quantity on $D_2$.

It is thus not surprising to find that total output $Q_f$ is less than total output $Q_d$ yielded by discrimination. This is a general result : as compared with fob prices, freight absorption enables more distant markets to be supplied, output to be raised and profits to be expanded.

(1) As will be seen in Section 5.

## 4.4 Uniform delivered prices

By a uniform delivered price, we mean an identical price for a whole area – the geographical area controlled by the firm. Here the obligation to set a uniform delivered price is seen as a constraint imposed on the firm, and implies a loss of profit as compared with the policy of non-uniform delivered prices analyzed in Section 4.2. The question, then, is to determine the level of the single delivered price which will maximize profits under this constraint. For the sake of clarity we shall work from Figure 2, which reproduces the main data of Figure 1.

There are two possibilities. Firstly, we shall assume that, apart from the obligation to set a uniform delivered price, the firm is obliged (by law, for instance) to supply the *entire* territory, in other words to set a uniform delivered price for the three places of demand (including the most distant). Secondly, we shall assume that the firm is free to restrict the geographical area in which the uniform delivered price is applicable and therefore to refuse to sell outside that area.

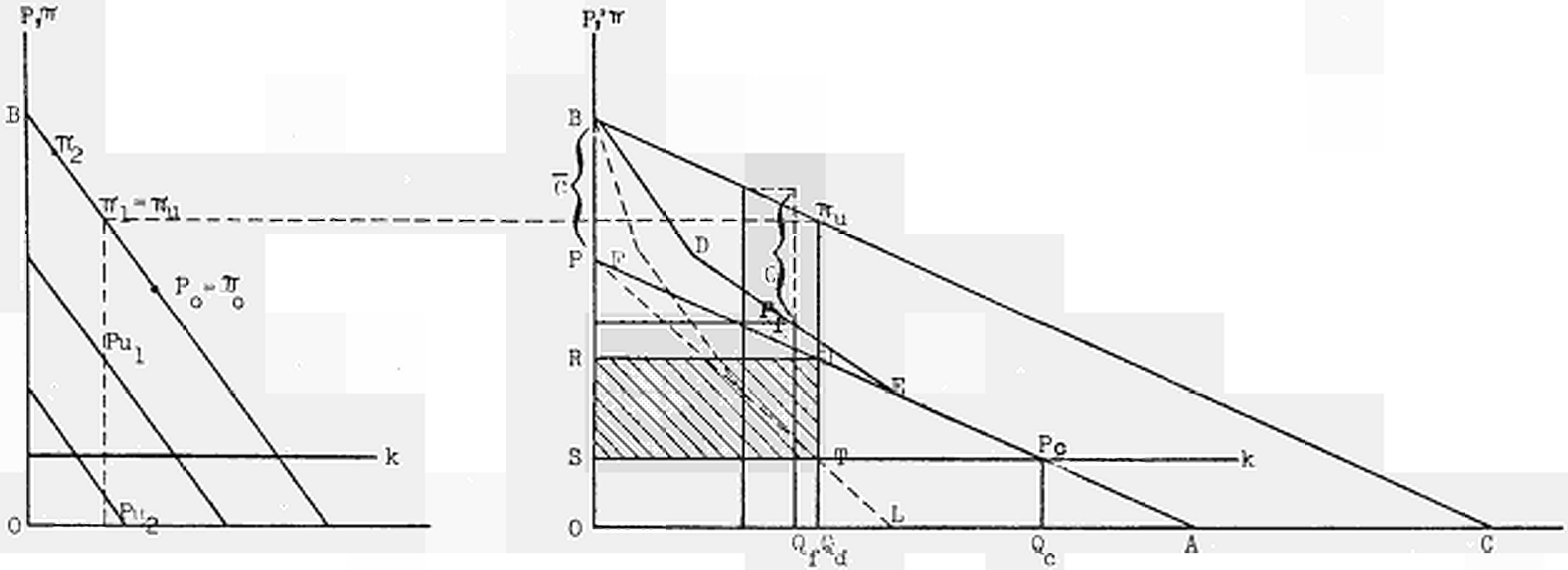
### (a) Obligation to supply the entire territory

As the firm has to set a uniform delivered price for all its three demands, gross total demand wurve BC is used for the analysis and determines the firms total output. Net total demand curve HDEA; considered above, is to be distinguished from straight line PA which is obtained by deducting from BC a distance reflecting average cost of carriage (per unit sold) $\bar{c} = (1/3)$ OB. It is this straight line PA which measures average revenue yielded by the various possible total quantities, and which may here be interpreted as a net average revenue curve. Given the same delivered price, the same quantity is sold at the three centres of consumption (gross demands being identical), so that the average revenue is equal, for each unit sold, to the delivered price less the average cost of transport, i.e. one third of $0 + (1/3)$ OB $+ (2/3)$ OB, that is $(1/3)$ OB.

It is easy to show that, once again, it is the equality of marginal revenue and marginal cost which determines constrained maximum profits and the uniform delivered price $\pi_u$ .

FIGURE 2a)

CASE a : OBLIGATION TO SUPPLY THE ENTIRE TERRITORY




(a)

(b)

But this, of course, is possible only at a reduced profit. We have already shown that a single fob price is less profitable that non-uniform delivered prices. The time has come to note that a uniform delivered price applying throughout the territory is in its turn less profitable than a uniform fob price. This can be shown in graph form with the average revenue curve PA. At a uniform delivered price $\pi_u$, the sale of quantity $Q_d$ gives profits equal to shaded rectangle RSTU. This is smaller than the rectangle determined by the fob price $(p_f)$.

The reader may wonder whether it would not be to the firm's advantage to set a uniform delivered price equal to the fob price plus the average cost of carriage. The answer is : no. Let us add $\bar{c}$ to $p_f$, and find the corresponding delivered price on gross total demand BC. This price yields a smaller output and smaller profits. The same applies to any uniform delivered price above $\pi_u$. Similarly, any uniform delivered price lower than $\pi_u$ yields reduced profit despite increased output.

Let us locate uniform price $\pi_u$ on Figure 2(a). We find that it gives three different net prices $(\pi_1, p_{u1}, p_{u2})$ : there is discrimination. As all buyers are helping to cover total costs of carriage, there is both phantom freight and freight absorption. Buyers in the immediate vicinity of the factory are paying non-existent freight charges which are lightening the burden on more distant buyers. It does not appear possible to determine the relative degree of freight absorption, as there is no net factory price to which one could refer.

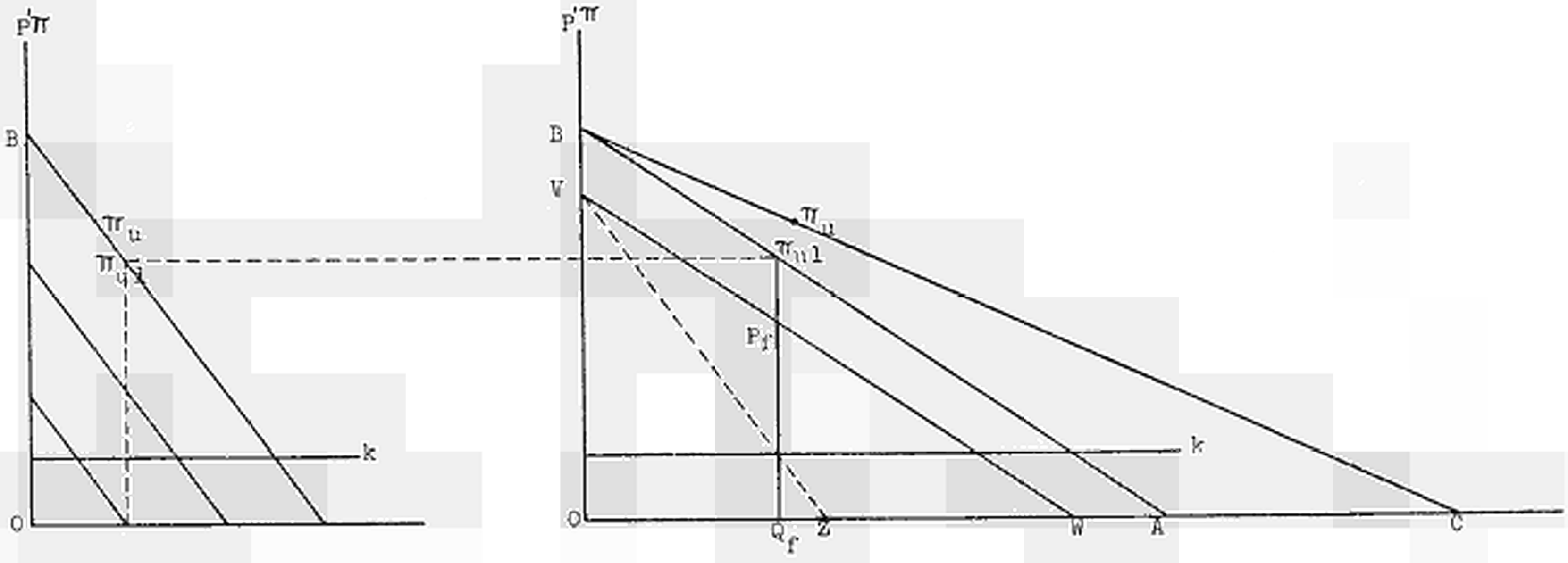
(b) Freedom to restrict the territory

Nevertheless, close examination of Figure 2(a) will have made clear that, in the hypothesis under study above, the firm is selling at the third place of demand at a net price $(p_{u2})$ which is lower than marginal cost $k$. Total profits are therefore also lower than those obtained on a fob price sale. Consequently, the firm can raise its profits by restricting its territory and refusing to supply the most distant demand.

If we take the two demand curves for the nearest places, the gross total demand curve moves from BC to BA. Let us deduct from BA a vertical distance reflecting the average cost of transport, being *half* of (0 + (1/3) OB), in other words (1/6) OB. This gives straight line VW, which we reproduce in Figure 2(d), incorporating the main data of Figure 2(b). This straight line measures net average revenue, and a straight line VZ, measuring marginal revenue, corresponds to it.

FIGURE 2b)

CASE b : FREEDOM TO RESTRICT THE TERRITORY




(c) (d)

The point where marginal revenue equals marginal cost corresponds to output $Q_f$ (obtained with the fob price) and to a net average revenue equal to $p_f$ ! From the firm's point of view, we are in the same situation as with sales at a fob price. Profits have risen through the restriction of the geographical territory. As for the uniform delivered price, it is at an intermediate level between $p_f$ and $\pi_u$ : it is obtained this time by adding the average cost of transport to the fob price and is equal to $\pi_{u\ell}$ ("free" uniform delivered price). Figure 2(c) shows that there is discrimination. This result is well known : it was obtained by Stevens and Rydell (1966) and by Beckmann (1968, p. 33-34).

## 4.5 Sale at marginal cost

The final item for discussion is sale at factory price equal to marginal cost, i.e. to price $p_c = k$ in Figure 2(b). At this price, we have zero profits and maximum output. This policy, which is frequently urged upon public enterprises, holds a central place in the theory of welfare economics, as we shall see in section 6.

## 4.6 Summary and conclusions

We have examined above the equilibrium of an isolated firm assuming a series of spatial price-setting techniques. We have been able to highlight the effect of spatial factors : the costs entailed by the geographical separation of buyers create possibilities of discrimination which firms find profitable.

A policy of freight absorption appears eminently profitable, particularly when it gives rise to delivered prices which vary from one centre of consumption to another. A uniform fob price yields less profit, although greater than those profits yielded by a uniform delivered price, unless firms are in a position to restrict their sales territory. In this case, restriction of the territory in which the uniform delivered price applies, enables the same net average revenue (and therefore the same profits) to be obtained as a uniform fob price.

Freight absorption also ensures the highest level of output (leaving aside sales at marginal cost) and enables buyers at the greatest distance from the place of production to be supplied.

This being said, links must now be established between the pricing policies analysed and the four pricing *systems* described in section 2.

Let us begin by stressing that the equilibrium of an isolated firm, which we have just analysed, gives no indication as to why an industry adopts a given system rather than another. In business practice, the four systems appear, and are often applied side-by-side, in the same industry, although the foregoing theory suggests that it is always profitable for a firm to set non-uniform discriminatory delivered prices. This amounts to saying that our analysis was incomplete, and that the firm must be considered in relation to its competitors. The requirements of group equilibrium, it seems, may induce a firm to adopt other strategies : this we shall see in the next section.

Before going on, however, valuable lessons can be learnt from what we have already said.

For instance, a policy of non-uniform discriminatory delivered prices which maximizes profits may take the form of a *system of zone prices* when the spatial configuration of demand indicates either concentration or a low degree of dispersion by area (as where there is one major town per area).

The same policy may take the practical form of the adoption by a single firm (or a cartel) of *several basing points* , with base prices set at such levels that peripheral buyers (with relation to the place of production) benefit from freight absorption.

On the other hand, systematic freight absorption, organized in the form of an obligation to *align* , seems to be fully outside the foregoing analysis. So does the phenomenon of *occasional freight absorption,* combined with a fob factory price in relation to distant buyers. These phenomena are linked to the state of the market, and in particular to competitive conditions.

# 5. THE EQUILIBRIUM OF AN OLIGOPOLISTIC GROUP OF FIRMS (1)

Let us therefore bring these competitive conditions, which refer to the number of competitors, their location and their production costs, into the analysis. In order to get results, a number of rather restrictive assumptions must unfortunately be made. In fact, we shall only be able to study one particular case, but our hope nevertheless is that it is fairly representative of spatial competition between oligopolies.

## 5.1 Assumptions

Let us keep the assumption of identical linear demand curves, and consider a given place of purchase. At this place, the gross demand curve is

(1) $$\pi = \alpha + \beta q_i \quad (\alpha > 0,\ \beta < 0)$$

for firm $i$, where its unit cost of carriage to that point is $t_i$. Equalization of net marginal revenue and marginal cost gives the equilibrium condition.

(2) $$\pi + \beta q_i = k_i + t_i.$$

Let us suppose that there are $m$ firms ( $i = 1, \ldots, m$ ) in a position to sell *at this buying point*. The summation of these $m$ firms gives the condition of market equilibrium (at one point)

(3) $$m\,\pi + \beta \Sigma q_i = \Sigma k_i + \Sigma t_i,$$

which, after division by $m$, can be rewritten as

(1) This section was inspired by the recent article by Greenhut and Greenhut (1975)

(4) $\quad \pi + \beta \frac{q}{m} = \bar{k} + \bar{t},$

where $\bar{k} = \Sigma k_i / m$, $\bar{t} = \Sigma t_i / m$ and $q = \Sigma q_i$.

If these $m$ firms together adopt condition (4), this condition determines delivered price $\pi$. To put it another way, they decide to set their delivered price according to the average of their marginal costs ($\bar{k}$) plus the average of their unit costs of carriage of the relevant point ($\bar{t}$). This assumption does not seem incompatible with what we know about the business practices of cartels and, indeed, appears all the less arbitrary as spatial separation creates oligopolistic relationships between firms supplying the same geographical markets. In practice, then, $m$ should be a fairly small number.

To show that (4) determines the delivered price at any given point in space, rewrite (4) as

$$\pi \left(1 + \frac{\pi - \alpha}{m\,\pi}\right) = \bar{k} + \bar{t},$$

using (1), to find (after rearrangement) that

(5) $$\pi = \frac{1}{m+1} (\alpha + m\bar{k}) + \frac{m}{m+1} \bar{t}.$$

This equation will enable us to determine the spatial configuration of $\pi$ in different competitive conditions from analysis of $\bar{t}$.

## 5.2 Geographic concentration of production in a single location

The simplest case is the situation in which the competing firms are all located at a single centre of production. The unit cost of transport is then the same for all firms, and $\bar{t} = t$, where $t$ measures the unit transportation cost (or the distance measured in money terms) between the centre of production and any given place of consumption. Equation (5) becomes

(6) $$\pi = \frac{1}{m+1} (\alpha + m\bar{k}) + \frac{m}{m+1} t$$

whereas the price in the absence of transportation costs is

FIGURE 3

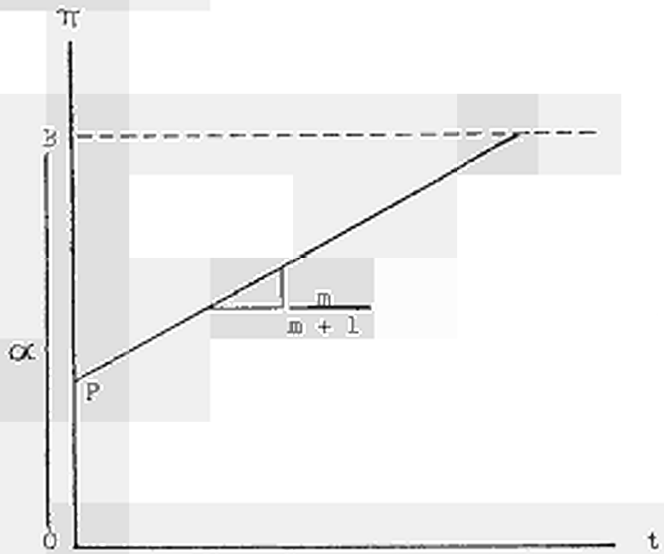



FIGURE 4

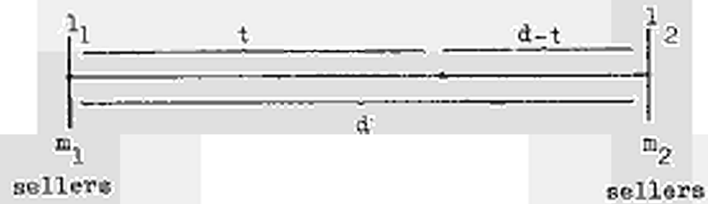
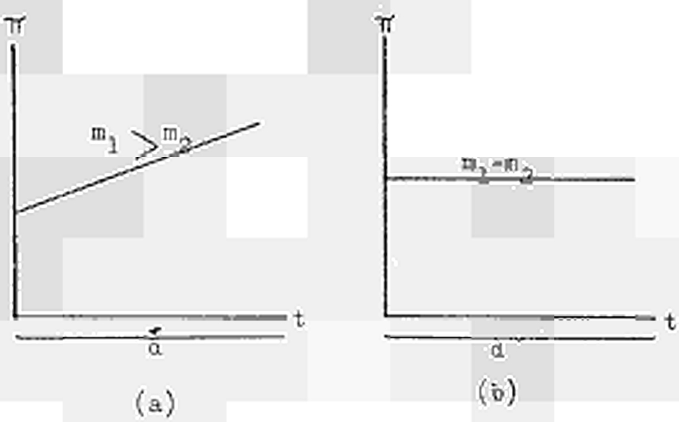



FIGURE 5



(7) $\quad p = \frac{1}{m+1} \quad (\alpha + m\bar{k})$.

It will immediately be clear that the diagrammatic representation of $\pi$ as as function of $t$ gives a straight line (1) with a positive and less than unitary slope, since $m/ (m + 1) < 1$. In other words, a geographically concentrated group of competing firms benefits from freight absorption : only part of $t$ is incorporated in the delivered price (see Figure 3). Furthermore, as the number of firms rises, so the price falls and the slope becomes steeper, corresponding to freight absorption at a lesser degree. The sales area extends up to the point where $\pi$ is equal to the highest demand price which buyers are willing to pay, i.e. intercept $\alpha$ (equal to OB in Figures 1 and 2).

### 5.3 Two centres of production in the same geographical area

Let un render the analysis a little more complicated by supposing that the firms are located at two separate centres of production, and that there are $m_1$ firms at one centre and $m_2$ firms at the other. Buyers are located on a line linking the two centres, which are separated by a distance $d$ (see Figure 4).

For every purchase on that line, the transportation cost is $t$ from centre $l_1$, and $(d - t)$ from centre $l_2$. The average transportation cost $\bar{t}$ is

(8) $\quad \bar{t} = \frac{1}{m_1 + m_2}\{m_1 t + m_2 (d - t)\}$.

Suppose $m = m_1 + m_2$. From equation (5), we see that the delivered prices will obey

(9) $\quad \pi = \frac{1}{m+1} (\alpha + m\bar{k}) + \frac{1}{m+1} \{m_1 t + m_2 (d - t)\}$.

From centre $l_1$, these delivered prices rise at the constant rate

(10) $\quad \frac{1}{m+1} (m_1 - m_2)$

with distance. That is to say that, if most of the firms are located at $l_1$, and only a few at $l_2$, so that $m_1 > m_2$, delivered prices will rise in linear fashion

(1) Greenhut and Greenhut (1975) show that the linear form of the spatial configuration of $\pi$ is unrelated to the assumption of linear demand curves.

from $l_1$ as in Figure 5(a). This may explain sales on *single basing point* (for instance (1) the "Pittsburg plus", "Oberhausen" and "Thionville" systems) by an entire industry, even by firms which are geographically distant from the principal centre of production taken as basing point.

Figure 5(b) illustrates the situation where different centres of production are equal in size ( $m_1 = m_2$ ). Here, it is in the industry's interest to adopt a *uniform delivered price* , the curve representing $\pi$ being horizontal.

## 5.4 Spatial variations in competitive conditions

From the foregoing results, the reader may imagine a variety of more complicated practical situations, and in particular work out the spatial configuration of delivered prices in situations where the geographical areas which can be supplied by the centres of production overlap only partly.

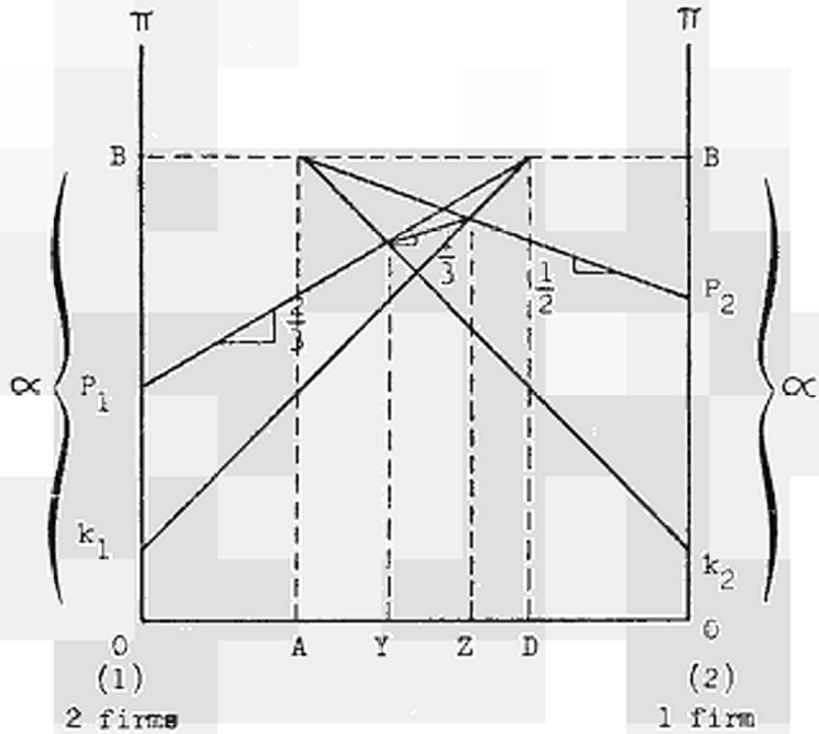
For instance, two centres of production may be in competition only in a central area on each side of which one of the centres of production has a sales monopoly. The delivered price schedule will then turn out to be a combination of three straight lines with different slopes, which vary with the number of competitors in each of the areas.

Figure 6 illustrates the spatial configuration of $\pi$ which maximizes profits for two centres of production which have agreed to set their prices on the terms described at section 5.1.

Centre $l_1$ has two firms and is therefore more important than $l_2$ where there is only one firm. If centre $l_2$ did not exist, the first centre would control the geographical area which extends right up to point D. If centre $l_1$ did not exist, the second centre would control the area from $l_2$ to A. The fact that they both exist narrows the area down to Y for $l_1$ , and to Z for $l_2$ . The natural market of centre $l_1$ extends only up to Y, where its delivered price is equal to the marginal cost at $l_2$ plus transportation cost. The natural market of $l_2$

(1) An historical description of the operation of these systems by American, German and French steelmakers is given by Zimmermann (1962, p. 209-235).

FIGURE 6


π
π
B
B
α
α
$P_1$
$P_2$
$k_1$
$k_2$
$\frac{1}{3}$
$\frac{2}{3}$
$\frac{1}{2}$
O
A
Y
Z
D
O
(1)
2 firms
(2)
1 firm

extends right up to Z, where its delivered price is equal to $k_1$ plus the transportation cost from $l_1$.

Between Y and Z, it is the larger centre which sets delivered prices, following a straight line with a steeper slope $(2 - 1)(2 + 1) = 1/3$. In this area, centre $l_2$ must accept *decreasing* delivered prices as the distance to the point of sale rises.

This may explain why maximization of aggregate profits may entail *alignment* on a competitor's delivered price (meeting competition). Such alignments may take place only occasionally. However, to avoid a collapse of the geographical structure of prices described in Figure 6, particularly where there are geographical shifts in demand or recessions, the industry as a whole stands to gain by institutionalizing alignment, i.e. by adopting the rule of *systematic alignment*, which is the most important feature of sales from *multiple basing points*.

## 6. SOCIAL WELFARE

Although they are somewhat rudimentary, the assumptions made in the preceding section help to make for an understanding of the logic of the chief spatial pricing techniques. The time has come to evaluate these techniques in the light of welfare economics. We have seen that systematic spatial discrimination ensures maximum output, since it enables distant customers to be prospected. One is tempted to deduce (1) that this is therefore the best policy from the point of view of social welfare. This section aims to demonstrate that the deduction is both hasty and erroneous.

### 6.1 Net social benefit

A first-partial-approach works from the concept of net social benefit, which is equal to the "consumer surplus" minus the corresponding cost of production. If the demand curve is expressed as $\pi = f(q)$, as above, the consumer surplus is measured by the area under that curve, from the vertical axis, to the price set by the firm ; for this area measures the sum of money which consumers would be willing to pay rather than go without the relevant goods.

Consider the case of a firm with a *monopoly* in a given geographical area, with *no outside competitors* . This was the situation analyzed in section 4. Holohan (1975) shows that, in this case, spatial discrimination provides a greater consumer surplus than a uniform fob price. The mathematical demonstration of this is rather laborious and would overburden this report. But an intuitive demonstration can be given from Figure 7, which represents the spatial evolution of delivered prices (as a function of $t$ ) under the various pricing techniques analysed in Figures 1 and 2.

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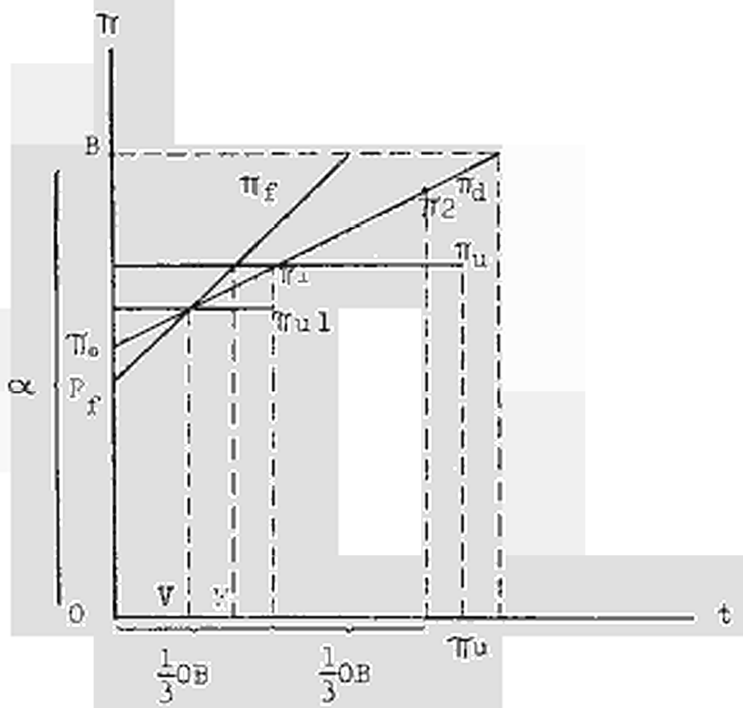
(1) As suggested by Greenhut and Ohta (1972) and Greenhut and Greenhut (1975).

FIGURE 7



First, compare non-uniform discriminatory delivered prices ( $\pi_d$ ) with delivered prices derived from a uniform fob price ( $\pi_f$ ). The former are lower than the latter from distance OV. Consumers located in the immediate vicinity of the factory pay a higher price if there is discrimination ($\pi_o > p_f$ ). Those located at distance (1/3) OB benefit from a discriminatory delivered price ( $\pi_1 < \pi_f$ ) which is lower than the fob price plus cost of carriage ( $\pi_f = p_f + t$ ), so that some compensation is possible. But customers located at distance (2/3) OB gain in welfare from discriminatory price $\pi_2$ , whereas, at that distance, price $\pi_f$ , derived from adding the cost of carriage to the fob price, would be prohibitive ($\pi_f > a$ ). In sum, then, there is a net gain.

Now compare non-uniform discriminatory delivered price ( $\pi_d$ ) with uniform delivered prices, assuming the latter to be applied throughout the geographical area ( $\pi_u$ ). In the immediate vicinity of the factory, the former is lower than the latter; at the most distant place of demand, the opposite situation obtains; half way between the two places, $\pi_d = \pi_u$ . As the positive and negative gaps compensate each other, the two policies appear to have equivalent effect, except that the uniform price is more favourable to distant customers and less favourable to those nearer by.

The uniform price ( $\pi_u$ ), applied throughout the geographical area, consequently entails a net gain as compared with delivered prices derived from a uniform fob price ( $\pi_f$ ).

As for the uniform price ( $\pi_{ul}$ ), obtained where firms are in a position to refuse to supply the most distant buyers, it is equal to $\pi_f$ at distance OV. The upward difference at the factory is equal to the downward difference at distance (1/3) OB which is the boundary of the sales territory : this policy is equivalent to selling as a uniform fob price under the approach taken so far.

At first sight, then, and this is an argument frequently advanced in industrial circles (1), geographical discrimination (through the setting of prices $\pi_d$ or $\pi_u$) is beneficial to the community at large, as a result of freight absorption benefiting distant buyers. But let us stress that *this argument holds good only in the absence of competition.*

(1) See, for instance, Herlemann (1950, p. 54-59) and Semler (1963, p. 435) on uniform delivered prices, and Demaria (1958, p. 81-82) and Fallon (1958, p. 231) on the basing point system.

As soon as competitors appear in the same geographical area, the opposite conclusions are obtained. If, as in Section 5, we assume that competitors are present on the market, the whole of the industry will, as we have shown, find it profitable to adopt discriminatory prices (whether uniform or not). And these are the prices which must be compared with fob prices.

The model to be used, now that *competition* is assumed, is that which Beckmann (1968, 1970, 1971) called "spatial monopolistic competition". The use of this model unfortunately entails rather cumbersome calculations, since analytical solutions have not yet been devised, so that computer simulations are necessary, as in Holahan (1975). Let us simply note that uniform fob prices ensure greater output (per firm) and greater consumer welfare (surplus) (per geographical area) than discriminatory prices. The same conclusion can, incidentally, be obtained by another more elegant and more general approach based on the Pareto optimum, which we shall now consider.

## 6.2 The Pareto optimum

The theorems of welfare economics usually relate to a non-spatial economy. Such an economy is Pareto-optimal when, at the same time and for the same pricing system, the marginal rates of substitution between any given pair of goods are equal for all consumers, the marginal rates of substitution between any pair of factors and products are equal for all firms, and marginal rates of transformation between any factor and any commodity are equal for all firms using that factor and manufacturing that commodity. Such an optimum is defined for a given income distribution, and no value judgment on that income distribution is therefore possible from it. As long as consumers and producers make their choices independently of each other, and assuming the market is not saturated, any competitive equilibrium is a Pareto optimum, and vice versa. Competitive equilibrium arises where, each market being in equilibrium, all consumers maximize their utility and all producers maximize their profits (1). Perhaps it is worth adding that by competitive equilibrium we do not necessarily mean pure and perfect competition. The existence of a non-collusive production oligopoly may be compatible with the concept (2).

(1) This is discussed more throughly by Koopmans (1957, Chapter I).
(2) As demonstrated by Gabszewicz and Vial (1972).

These theorems can be applied to a spatial economy only to the extent that the spatial element is correctly integrated. From the outset the definition of goods has to be enlarged and we must stress, with Debreu (1966, p. 33), that "a good in one place and the same good in another place are *different* economic objects and it is vital to specify the place where the good is available". A ton of steel manufactured in Oberhausen and delivered in Frankfurt, and the same ton of steel delivered in Munich are to be regarded as distinct products for economic purposes.

The equilibrium price of these various "goods" being given, firms will choose to manufacture the good or goods whose price is highest (and will thereby maximize profits) (1). Firms produce "distant" goods (goods for sale at a distance from the place of manufacture) only if they can be sold at a net price which is at least as high as the price of the "nearest" good (in other words the net price obtained on a sale at the place of manufacture). Freight absorption is thus incompatible with a competitive equilibrium and *thence* with a Pareto optimum. All sales are thus at fob prices : firms supply distant customers only if the customers bear all costs of carriage. And if, by way of hypothesis, it were necessary to sell at discriminatory delivered prices (whether uniform or not), firms would sell only at one place,namely the place where their plant is located.

The foregoing reasoning considers the properties of competitive equilibrium and deduces that optimal allocation is incompatible with sales at discriminatory delivered prices. The same result van be obtained by direct analysis of the optimum, as is shown by Mougeot (2) (1975, Chapter 2) in a recent work in which he generalizes a model by Negishi (1960).

In addition to the constraint of a given income distribution, Mougeot adds a number of constraints reflecting the spatial nature of the economy. Features of the economy then include fixed location of economic agents, and regional availabilities of given factors. Transportable resources, whose utilization involves using the services of a transport firm and therefore payment of transport costs, are distinguished from fixed resources which can be used only locally. There are $n$ markets, with a variable number of consumers, located in $n$ regions (defined as points in space to simplify analysis), and $m$ transportable goods. These goods can be produced in each of the regions by a variable number of multiproduct firms, and are taken to the user by a carrier.

(1) The rest of this paragraph was inspired by Thisse (1975, p. 69-75).
(2) Takayama and Judge (1971) obtained similar results.

The properties of the optimum are worked out by maximization of the vector of individual utilities

$$(11) \qquad (U_{1_1} \ldots U_{G_1}, U_{1_2} \ldots U_{G_2}, \ldots U_{G_n})$$

where

$$(12) \qquad U_{g_j} = U_{g_j} (q^i_{g_j} \ldots q^m_{g_j}) \qquad \begin{array}{l} g_j = 1, \ldots, G_j \\ j = 1, \ldots, n \end{array}$$

is the ordinal index of utility for consumer $g_j$ residing at place j, and $q^i_{g_j}$ represents the quantity of good i consumed by individual $g_j$ residing at j.

The vector (11) is to be maximized to a series of constraints expressing the equilibrium of the market at each place and for each good (including transport services), the technological constraints on production and transportation and the regional endowments ot transportable and non-transportable factors of production. This maximization, incidentally, in no way implies interpersonal comparisons.

To solve this problem, we use the Kuhn-Tucker theorem which considers it equivalent to a new problem where the maximization of vector (11) is replaced by maximization of a linear combination of its components,

$$(13) \qquad \sum_{g_j} \sum_j \alpha_{g_j} \cdot U_{g_j},$$

where the $\alpha_{g_j}$ are interpreted as the inverse of the marginal utility of income of consumer $g_j$. Expression (13) can be interpreted as a social welfare function. The value of weights $\alpha_{g_j}$ reflect the income distribution.

The maximization of the Lagrangian, composed of the sum of (13) and of these constraints, a multiplier (dual variable) being associated with each constraint, gives a set of conditions which redefine the Pareto optimum in a spatial context. This really is a redefinition and not just a second best optimum (describing the least undesirable situation possible, the true optimum being out of reach). In other words, it is recognized that the conditions of the non-spatial optimum, outlined at the beginning of this section, are generally inapplicable in a spatial context, and the problem is redefined through the explicit introduction of spatial differentiation.

Of the conditions which are valid in a spatial context, let us consider only those which are of direct interest to our problem. The first relates to the consumer optimum and is written

$$(14) \qquad \alpha_{g_j} \frac{\partial U_{g_j}}{\partial q^i_{g_j}} - \pi^i_j < 0 \; ; \quad (\alpha_{g_j} \frac{\partial U_{g_j}}{\partial q^i_{g_j}} - \pi^i_j) \, q^i_{g_j} = 0$$

where $\pi^i_j$ is the dual variable associated with the market equilibrium constraint and can be interpreted as the price of good i at place j.

Equations (14) express this alternative : either good i is bought by individual g, in which case the product of its marginal utility by coefficient $\alpha_{g_j}$ is equal to the price; or this product is less than that price and the good is not bought.

Consequently, the price system no longer has that property of unity which is a feature of the non-spatial model :

"prices vary with location, but at each place there is a single system. In practice there are as many systems as markets, so there are n price systems. The unity of the price system therefore depends exclusively on the unity of the market. As soon as distance is taken into consideration, a single market is inconceivable and prices therefore vary from place to place." (Mougeot (1975), p. 114).

If, at each place, all the properties of the non-spatial optimum are found (equality for all individuals of the marginal rates of substitution), it is not possible to define an overall optimum (which would imply a single price system). The optimum defined here can therefore only be relative, in other words depend on a given income distribution and on the geographical distribution of natural resources and productive equipment.

As for the production optimum, all the classical conditions of the optimum are evidently found when the place of production and place of consumption are the same : the sale is at marginal cost so that marginal rates are equal between firms. Where the place of production and place of consumption are not the same, so that a firm located in region h may sell good i in any region j :

"the price of that good at j is equal to the sum of the marginal cost of transport from h to j and the marginal cost of production. Where the price on the outside market is lower than the sum of these marginal costs, the good is not sold". (Mougeot, 1975, p. 118).

We may conclude that economic efficiency demands that spatial differentiation of products caused by transport costs be fully reflected in delivered prices.

## 7. PERFECT MARKETS

The implications of welfare economics, reformulated to take account of spatial features, can usefully be highlighted in a discussion of the concept of a "perfect market". They help to reveal the fallacious nature of the argument put forward by certain writers, most of them apparently European (1), to the effect that the unity of the price is an element of market perfection (2), even in a spatial context.

The argument is that discriminatory delivered price systems (uniform zone delivered prices, multiple basing points with alignment) guarantee price unity, either throughout an entire geographical area or at every possible geographical location, so that that form of market imperfection which results from the incorporation of actual transport costs into delivered prices can be eliminated. The systems further guarantee perfect market information.

This argument is highly speculative and depends on a clever interplay of concepts. Originally, the elements of perfection (perfect information, price unity, standardization, etc...) described the conditions for the smooth operations of a stock exchange or an organized commodities market. When it is elevated to the level of a model, and associated with atomistic perfect competition, the concept of a perfect market then becomes a normative criterion and reality has at all costs to be adjusted to it.

In the industrial structures which we are considering, this concept is highly irrelevant, since it ceases to be a condition of smooth operation. In Section 3, we saw that perfect information must be removed from the list of criteria of perfection where the market is oligopolistic, the product is of low unit value and the price elasticity of demand is low. Welfare economics show that the same applies

(1) See, for example, Schneider (1934 and 1938), Möller (1941, p. 28-29; 1943a and b), Mund (1948, p. 238-242), Sauermann (1951-52), Justman (1958) and Semler (1968).
(2) For criticism of this concept, see, for instance, Clark (1950, p. 416-420 and 459-460), Hahn (1953, p. 97-98), Erb (1956, p. 67), Allais (1958, p. 524-524), Byé (1958), Guitton (1958), Phlips (1962a, p. 80-87).

to price unity. Where there is spatial differentiation because sellers and buyers are not at the same place and transport costs per unit are high, economic rationality demands that this differentiation be reflected in prices.

The implications of this principle are clear. Consider the zone price system. A uniform delivered price covering a whole area does not reflect spatial differentiation : the most distant buyers are given better treatment than those nearer to the centre of production because of the systematic freight absorption. There is systematic discrimination against well-located buyers. This is not compatible with economic efficiency.

Let us now look at the basing point system. In a market which has several centres of production, it would be absurd to call for introduction of a single basing point by refering to the model of a single-price perfect market. Not only would this give maximum encouragement to a price leadership policy, as we have already seen; but also, peripheral centres of production (with regards to the basing point) would artificially benefit from phantom freight to the detriment of buyers located in their vicinity. The latter would thus be the subject of systematic discrimination.

What about a system with several basing points ? Here, location would be more adequately reflected in delivered prices. But systematic alignment in its turn implies systematic discrimination because of the systematic freight absorption.

It is evident that spatial differentiation is best reflected in prices set on a uniform fob basis. Even then, it should not be deduced that the fob system would create a perfect parket in the structural context which is being considered, for the total exclusion of isolated price reductions would be damaging to active price competition.

Ultimately, it seems more prudent and more realistic to abandon the concept of a perfect market, which leads to dogmatism and misunderstandings.

# 8. THE QUANTITATIVE INTERPENETRATION OF MARKETS

Even if discriminatory delivered prices are not compatible with efficient resource allocation, should it not at least be recognised that they enable firms to supply more distant markets and thereby to develop trade ? And should it not be stressed that uniform fob prices would isolate firms in their natural markets ? Should these delivered price systems therefore not be regarded as a means of promoting the integration of markets in the European Communities trough better quantitive interpenetration ? And, in its turn, surely this interpenetration is the best means of contributing to the development of regions at considerable distance from the major centres of production ?

## 8.1 The development of trade

Let us begin by making it clear that the development of trade is not an end in itself. Trade is worthwhile only if it contributes to greater welfare through better resource allocation.

The next point is that, far from developing trade, the delivered price systems rather tend to hamper it. In practice, uniform delivered prices operate only within strictly limited and segregated areas where competing firms agree both on prices and on output levels. As for the basing point system, the defensive character of the alignment rule (emphasised in Section 3.2), whatever its appearance, enables market-sharing arrangements to be preserved without the need for price warfare (1).

(1) Mr A. Coppé, member of the High Authority of the ECSC, addressing the Consultative Committee, put it this way : "Because producers have been granted the unlimited right to align their prices on those of their competitors, the customer may remain tied to his traditional supplier, since from him he can generally obtain the best possible terms obtainable on the price lists of other suppliers. Certain users, strategically placed between two different basing points, can obtain discounts under this system. But the result of alignment is to freeze all price lists and all trade flows." (Quoted in *L'usine nouvelle* . No 40, 1 October 1953, p. 3).

In the common market, this aspect of the basing point system takes on special importance. Where the former frontiers of areas drawn up by the international cartels do not correspond to the boundaries of natural markets, as where, for instance, they are drawn along political frontiers, the adoption of the fob price system could lead to uncomfortable changes (all changes are uncomfortable) in market shares. Producers might then prefer to adop the basing point system in place of the cartel, so as to benefit from the alignment rule. Apart from its defensive nature, this rule offers firms the advantage of permitting greater flexilibility in any adjustments of gaps between national prices.

Paradoxically, perhaps, it is this same defensive nature which in customs unions preserves those trade flows which were created by former national protective measures in too small territorial areas. For instance, suppose that certain industries in the Benelux had managed to enter markets far away from their national markets because they had surplus capacity after meeting national demand. The alignement rule will then make it possible to avoid *reducing* exports to other Community Member States although this might be the result of reestablishing natural markets.

## 8.2 Cross-hauling

A related point is that discriminatory delivered price systems involve *cross-hauling* - useless carriage operations because of the *excessive* interpenetration of markets. We really do mean excessive interpenetration. As active competition involves a certain degree of interpenetration, writers stress that it is very difficult, if not impossible, to quantify the volume of cross-hauling. Nevertheless, the argument develops as follows (1).

Interpenetration tends to develop at times of recession, or when demand does not rise in step with expansion in production capacity. To maintain their market shares without reducing their prices, firms are obliged to penetrate geographical areas where they have to absorb a growing proportion of freight. This is true in both directions. In boom times, firms endeavour to maintain their business relations in less profitable areas so as to protect themselves against local or temporary drops in demand. With the passage of time, this excessive interpenetration tends to become

(1) See Loescher (1959, p. 208-213).

permanent. In addition to the cost of cross-hauling, there are growing sales expenses for, in order to tie down customers who cannot be offered better price terms, firms have to develop marketing services, offering indirect benefits (such as the preparation of plans and design, or siting and distribution studies, distribution of information, etc.).

This reasoning is probably of general validity. In the case of the European Communities, it can be applied to interpenetration within the major member countries. But it is difficult to see how, in the short-term at any rate, it can be applied to trade between EEC countries, where the problem is how to eliminate national or regional market-sharing agreements. But there are industries, such as the ECSC industries, where trade between Member States is on a large scale. Here, cross-hauling may be the result of frozen trade flows corresponding to traditional locations. In this case the argument has to be related directly to what was said above about the freezing of trade flows.

Finally, there is one implication of the optimality conditions which must be noted : following von Böventer (1962), Mougeot (1975, p. 121-122) shows that, in an optimal situation, trade can flow in one direction only (1) : carriage of a factor from one place to another should only be in one direction at a time.

## 8.3 Distant regions

When trade flows are frozen, locations are also frozen. Although they neutralize geographical barriers, delivered price systems also neutralize geographical advantages and reduce the incentives for firms to improve their location.

For instance, they discourage the siting of new plant in regions where demand is developing, and they curb the entry of new competitors. How is a new firm to become established if potential customers are certain they can still obtain supplies from their traditional suppliers at the same price ? And if the new firm did endeavour to operate an independent pricing policy, the predatory establishment of a

(1) For a formal analysis of spatial trade equilibrium, see Enke (1951), Samuelson (1952), Fox (1953), Fox and Taüber (1955) and Takayama and Judge (1971).

special area price or of a basing point in that region would quickly discourage it. This would reduce to its prospects for development and those, consequently, of the region.

If prices, trade flows and locations remain unchanged, it is probable that buyers in distant regions will ultimately pay prices which are higher than those which would emerge from a system in which each existing or potential manufacturer, intermediary, carrier or consumer can take advantage of his geographical location. Only the freedom to buy fob, with the concomitant freedom to transport the goods oneself, offers this possibility.

## 9. REGIONAL DEVELOPMENTS

In all that has been said so far, it has been assumed that sellers and buyers were located at determined places. The time has now come to drop this restrictive assumption and to consider the potential impact of spatial pricing techniques on location changes, and thence on regional development.

As regards the adaptation of the sellers' location to the regional development of demand, it is clear that the uniform fob system ensures the quickest adaptation through the establishment of new plant in regions where demand is expanding. The geographic dispersion of centres of production is thus promoted (1). Any formula which allows for freight absorption favours traditional locations, and thus makes for geographical concentration. This was described in the previous section and there is no need to return to the point.

Let us rather consider the potential effect of geographical pricing systems on the location of buyers. The problem arises particularly where buyers are themselves manufacturers, and process a basic product sold under this or that pricing system. Here, a distinction mut be drawn.

It would seem that *uniform delivered prices* should deprive the buyer of any interest in locating his factory near that of the manufacturer of the basic product. Geographical dispersion of demand is therefore encouraged (at the cost, of course, of a less perfect spatial allocation of resources).

Under a system of *uniform fob prices* the buyer, ceteris paribus, will find it worth establishing himself near the centre of production of the basic product. However, since the system guarantees rapid geographical adaptation of the production of the basic product, the dispersion of production ultimately entails dispersion of demand.

In constrast, the establishment of a *basing point* system is apt to spark off a cumulative process of geographic concentration of buyers around the basing

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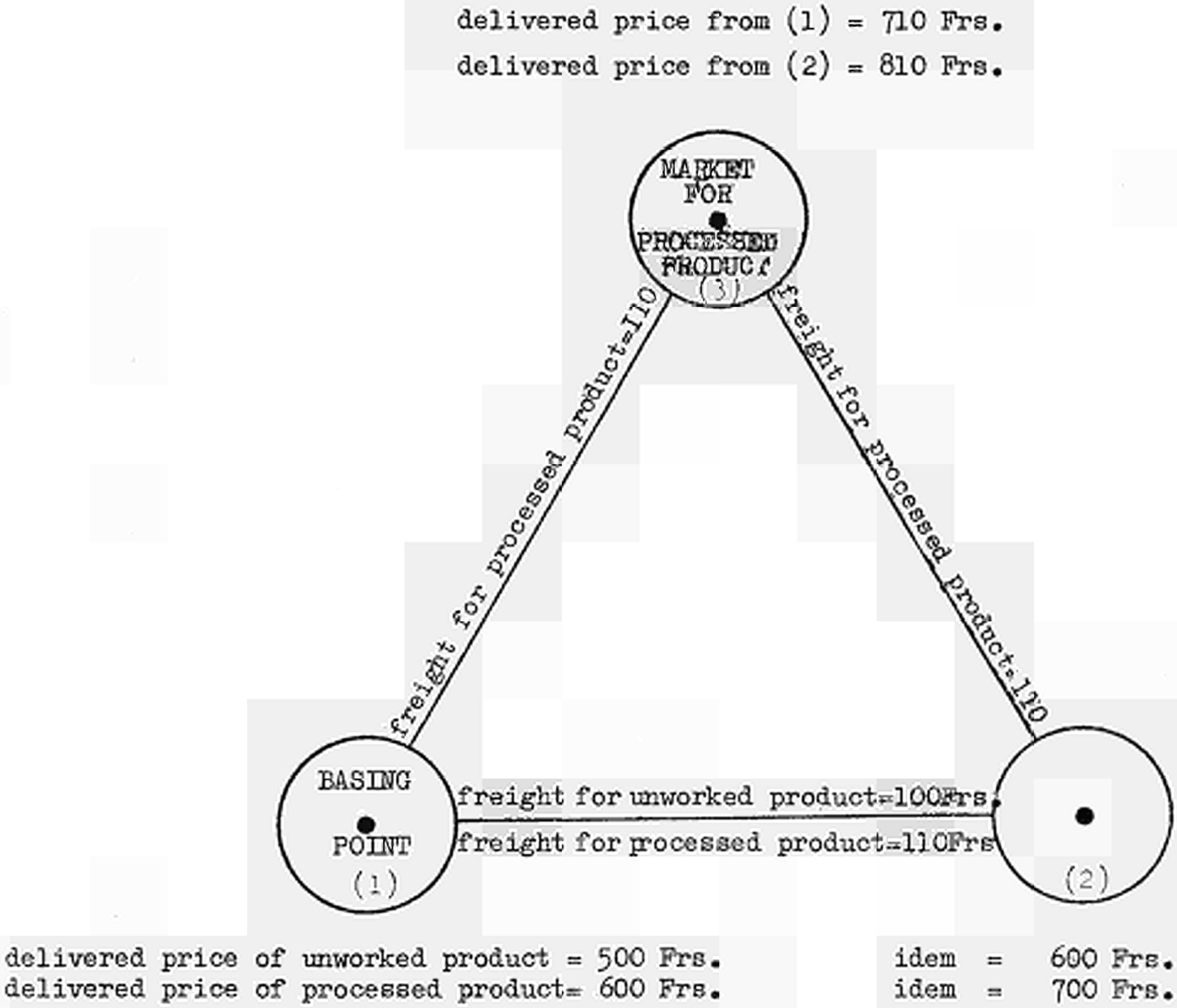
(1) See, for instance, Greenhut (1963, p. 186-191).

FIGURE 8



delivered price from (1) = 710 Frs.
delivered price from (2) = 810 Frs.
MARKET FOR PROCESSED PRODUCT
(3)
freight for processed product=110
freight for processed product=110
BASING POINT
(1)
freight for unworked product=100Frs.
freight for processed product=110Frs
(2)
delivered price of unworked product = 500 Frs.
delivered price of processed product= 600 Frs.
idem = 600 Frs.
idem = 700 Frs.

point of the dominant centre of production (which is usually the oldest centre as well) (1).

The process is particularly clear in the case of a *single basing point*. Suppose that a basio product is manufactured at two centres of production $l_1$ and $l_2$, and that processing industries are located at the same centres (half at each). For some reason $l_1$ is taken as basing point (see Figure 8). Delivered prices consequently rise from $l_1$ to $l_2$.

The cost of production is the same at the two centres (let us assume 500 Frs. per ton) and equal to the base price 500 Frs. at $l_1$. The cost of carriage between the two centres is 100 Frs. per ton for the basic product. The delivered price at $l_2$ ($\pi_2$) is 600 Frs.

Suppose that processing industries place half their orders for the basic product with each centre, so that each of the centres is on an equal footing. The result is an average net price of 500 Frs. both at $l_2$ and at $l_1$. Centre $l_2$ receives 600 Frs. per ton on local sales and 400 Frs. on sales at $l_1$. (This, of course, assumes that demand is higher at $l_2$, which is unrealistic but essential if the two centres are to produce identical amounts.)

Suppose that the cost of processing the basic product is the same at both centres (100 Frs. per ton). The unit cost of carriage of the processed product from one centre to the other is 110 Frs. The cost of the processed product is 500 + 100 = 600 Frs at $l_1$, and 600 + 100 = 700 Frs. at $l_2$. Processors at $l_1$ cannot sell at $l_2$ for the cost of carriage is prohibitive. A fortiori, processors at $l_2$ cannot sell at $l_1$. Each centre thus has a monopoly on its local market.

At first sight, due to the assumption that demand is higher at $l_2$, the choice of basing point does not affect the location of processors. But, in fact, opportunities are not equal. To illustrate this, let us introduce a third market for the processed product at $l_3$. The cost of carriage of the processed product from the first two centres to $l_3$ is the same, say 110 Frs. per ton. Nevertheless, only processors located at the basing point for the basic product will be able to sell at $l_3$, since their delivered prices at $l_3$ are 600 + 110 = 710 Frs., as against 700 + 110 = 810 Frs. for processors located at $l_2$. Processors therefore have a

(1) Here we are taking over the argument by Stocking (1954, and particularly Appendix A), correcting the analysis of Isard and Capron (1949).

clear interest in location near the basing point for the basic product. This, in its turn, promotes expansion of basic product production capacity at the basing point, and destroys that equality of opportunities which was assumed at the outset. For as long as a single basing point is maintained at $l_1$ , the process is irreversible and cumulative.

What, then, is the situation in a *multiple basing point system* ? If each centre of production has its own basing point, and if there are no price fixing agreements, the system creates no distortion. But these ifs are highly unrealistio. In practice, the system is designed to reinforce a price-fixing agreement and to safeguard the interests of the dominant centres. These centres will impose a geographical price structure of such a nature that delivered prices will rise with distance from the dominant centre. Peripheral centres will be forced to operate base prices which are at least as high as those of the basing point, even if their production costs are lower. The typical spatial configuration of prices is then as described in Figure 6. The same cumulative concentration process works in favour of the geographical area where the dominant basing point is located. This area tends to be an intensely and traditionally industrialized one.

## 10. CONCLUSIONS

This study has revealed that an *isolated* firm selling its goods in a spatial context maximizes profits by setting non-uniform discriminatory delivered prices involving freight absorption to the benefit of more distant buyers.

If, then, firms adopt one of the spatial pricing techniques which we have considered, for instance by fixing uniform delivered prices, by determining delivered prices from basing points or by selling at uniform fob prices, this cannot be explained but by the fact that *several* competing firms are in business in the same geographical area.

Our study also makes it abundantly clear that these spatial pricing techniques cannot be interpreted as sales conditions resulting from the trade usage of certain regions or certain industries, and neutral with regard to active competition and economic efficiency. In reality, they have a profound impact. Any antitrust policy which claims to be effective will ignore these techniques at its peril.

The fact is that, from the point of view of active price competition, techniques which involve freight absorption and are therefore discriminatory, such as sales at uniform delivered prices, sales based on a single basing point and sales based on multiple basing points with alignment, turn out to be the indispensable foundations for price agreements designed to preserve a spatial configuration of delivered prices which maximizes joint profits. In oligopolistic industries producing heavy goods of low unit value, these systems indicate the existence of tacit price-fixing agreements. They should be prohibited if the prohibition of price-fixing agreements is to work. Otherwise, explicit price-fixing agreements will be replaced by tacit agreements workable through the perfection of information and through the freight absorption rules which characterize these systems.

From the point of view of economic efficiency, only sales at fob prices are compatible with the efficient spatial allocation of resources, whether the analysis be based on given locations, or new locations be taken into account.

However, the adoption of a fob price system would not by itself achieve optimum allocation. It is further necessary that prices be brought down to the level of marginal costs, and this can be done only through active price competition. Yet a system of fob prices does not ensure active price competition.

Accordingly, we do not recommend the system of binding uniform fob prices. We would prefer a hybrid system, combining sales at fob prices with possible occasional freight absorption. In such a system, special attention would be paid to ensuring that buyers, and particularly processors and intermediaries, are able to buy at fob prices and to choose between different means of transport, while producers are able to grant isolated price reductions through occasional freight absorption. In such conditions, perfect information, the availability of which is essential to tacit price-fixing, can no longer be had, and active price competition can reemerge. The result will be an economic structure reflecting the costs linked to spatial differentiation and, in the longer run, the spatial allocation of resources will be made more efficient through the establishment of new plants and geographical deconcentration.

Unfortunately, it cannot be asserted that a prohibition on delivered price systems will suffice to ensure real active price competition. The human imagination is boundless, and would no doubt dream up other means of reestablishing that unimpeded flow of information which is indispensable to price maintenance. However, the means to do this will be all the more difficult to find as the freedom to buy fob, combined with the freedom to sell at delivered prices, will be guaranteed in the sales conditions.

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