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BASING POINT PRICING AND PRODUCTION CONCENTRATION*

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Basing point pricing is a delivered price system in which the price quoted for delivery of a commodity is the sum of the price quoted at a predetermined basing point plus the cost of transportation from the basing point to the point of delivery, whether or not the commodity is actually shipped from the basing point. Thus, a seller who is not located at the base site absorbs freight for shipments toward the base point and charges phantom freight on shipments away from the base point.

Basing-point pricing has been widely practiced throughout the world. For example, testimony of the Federal Trade Commission before the TNEC (1941, p. 33) alleged that industries in the United States which then or previously followed basing-point pricing included: lumber, iron and steel, pig iron, cement, lime, brick, asphalt, shingles and roofing, window glass, white lead, metal lath, building tile, floor tile, gypsum, plaster bolts, nuts and rivets, cast iron, soil pipe, range boilers, valves and fittings, sewer pipes, paper and paper products, salt, sugar, corn derivatives, industrial alcohol, linseed oil, fertilisers, chemicals, transportation equipment, and power cable.

Almost from its inception, economists have generally considered basing-point pricing to reflect a cartel or price leadership arrangement (Hoover, 1937; Stigler, 1949; Machlup, 1949) and such practices have been attacked under antitrust statutes; for example, *Aetna Portland Cement Co. vs. FTC*, 157 F. 2nd 533 (1946), *Triangle Conduit Cable Co. vs. FTC*, 168 F. 2nd 175, 7th Cir. (1948), *Cement Institute vs. FTC*, 157 F. 2nd 533 (1948). Nonetheless, basing-point pricing remains prevalent, particularly outside the United States. OPEC has used a Gulf-based price plus transport costs to determine the delivered prices of crude oil to most places in the world, Haddock (1982, p. 290), the pricing of cement in Great Britain and steel in Europe can be characterised as multi-base point systems: Greenhut (1987).

Recent attempts by, for example, Haddock (1982) to return to the theme that the basing-point system could be competitive and desirable have been challenged by Thisse and Vives (1988), and Benson *et al.* (1990) on the basis of recent advances in the analysis of pricing policy. Given, then, that we assume basing-point pricing to be a collusive device adopted by incumbent firms to impose some kind of price discipline on potential entrants – the price leadership point referred to above – important strategic and locational issues arise. In particular, a major concern of the early analysis of basing-point pricing was the effect such a pricing policy would have on location choice of entrant firms.

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It was contended in the work, for example, of Machlup (1949) and Greenhut (1956) that basing-point pricing encourages concentrated production at or near the base point while discouraging entry at distant sites. Empirical support for this view derived from the work of Wilcox (1963) who noted that the growth of the Southern and Western United States was retarded by the Pittsburgh plus basing-point system in steel (p. 284). This contention was further supported by the relatively rapid expansion of steel production capacity in the South and West, in Detroit and Cleveland and along the Eastern seaboard after basing-point pricing was abandoned in July, 1948. Similarly, within three years of the 1948 *Cement Institute* antitrust decision, 52 new cement plants were started or planned in 28 states (Congressional Record, March 31, 1951, p. 4564).

This paper concentrates upon these locational issues, particularly in their effects on a new entrant. Specifically, a spatial model is developed which allows us to analyse the location choice of an entrant when that entrant *either* accepts the ruling basing-point pricing system *or* enters in price competition with the incumbent firms. The model sheds more analytic light on the claim noted above that basing-point pricing encourages more localisation of production than would otherwise occur. The specific conditions under which this claim is justified are identified but it is also shown that there will be cases in which basing-point pricing and competitive entrants will adopt *identical* locations.

The paper is organised as follows. Section I outlines the spatial model upon which the analysis is based. Price equilibrium under basing-point and competitive entry are analysed in Section II. Location choice for the two types of entrant is computed in Section III and Section IV compares location choice under competitive and basing-point entry for different values of the relevant parameters. The main conclusions are summarised in Section V.

I. THE MODEL

A very simple spatial model is used that is now familiar in the literature. The market area is assumed to be a bounded line, denoted by the interval $[0, Z]$, over which identical consumers are uniformly distributed at unit density. Two types of firms are assumed to exist in the market:

(i) A set B of firms that are coincidentally located at the single basing-point. B contains $n \geqslant 2$ firms. Without loss of generality we assume that the basing-point is the left-hand extremity of the market;

(ii) A potential entrant firm that is assumed to locate at some distance x to the right of the basing point, where x is a decision variable. The potential entrant is denoted by subscript x.[1]

[1] It might appear that this treatment of the firms in the market is somewhat restrictive for two reasons: (i) that the basing-point system may be a multiple basing-point system (we are grateful to an Associate Editor for raising this point), and (ii) that there may be more than one entrant. Consider (i). So long as the entrant is assumed to enter the market 'to the right' of the basing-point that is 'furthest to the right' in the market our analysis will go through essentially unaltered. All that needs to be considered, therefore, is entry between two basing-points. Intuition suggests that the entrant would be driven to a central location no matter the pricing system the entrant adopts. In addition, there is little sense in talking of greater or lesser production concentration in such a case: a move toward one of the basing points is, by definition, a move away from the other. Given the focus on pricing policy and location choice, it is more interesting to treat the entrant as coming into the periphery of the market. After all, this has long been considered the major potential threat

Both types of firm produce a homogeneous product. Individual demand for this product is assumed linear in delivered price and given for a consumer located at s by the normalised demand function:

$$q(s) = 1 - p(s) \quad (s \in [0, Z]) \tag{1}$$

where $q(s)$ is quantity demanded and $p(s)$ delivered price at s. The linear assumption eases computation but, as is well known from spatial price theory, Greenhut *et al.* (1987), can be taken as representative of a wide range of concave, or 'not too convex' demand forms.

Consumers buy from the firm offering the product at the lowest price. If the entrant *chooses* to follow the basing-point price *throughout a market segment* then demand in this area will be shared equally between the entrant and the basing-point firms. This is in the spirit of the historical justifications advanced in favour of basing-point pricing: it was (and is) claimed that basing-point pricing facilitates interpenetration of markets.

With competitive entry there may also be points where delivered prices from the basing-point and x are the same. Assume that price competition is Bertrand-at-every-point, at least for the entrant. So long as the basing-point firms' delivered price is greater than the entrant's costs at a particular market point, the entrant can undercut the basing-point firms and win that market. This is sometimes referred to as the ϵ-argument: the low-cost firm can undercut its competitor by ϵ, where ϵ is 'small'. It is assumed, therefore, that the left-hand boundary of the competitive entrant's market area is the market point at which the entrant's marginal production and transport costs just equal the basing-point firms' delivered price. This does *not* mean that the basing-point firms are necessarily passive actors in the competitive game with the entrant. Indeed, one of the issues to be considered below is the 'best' choice of price for the basing-point firms *given* that they anticipate the entry of a price-competing firm.

Production is assumed to be characterised by constant marginal costs which are normalised to zero at the basing-point. Locations distant from the basing-point suffer a production cost penalty: perhaps because the basing-point enjoys favourable access to production inputs. The cost penalty is assumed linear in distance and output. Thus marginal production costs at location x are given $Kx (K \geqslant 0)$. Note that the assumptions regarding the linearity of the market and the end-point location of the basing point allow reference to be made interchangeably to 'location x' and 'the firm (or consumer) distance x from the basing point'.

Transport is assumed linear in distance and quantity,[2] and given by t per

to a collusive basing-point system. There remain, of course, interesting strategic issues with respect to 'central' as opposed to 'peripheral' entry, but these are outside the scope of this paper. Reason (ii) also raises some interesting questions. Certainly, it would be possible to model multiple entry as a sequential process; see, for example, Prescott and Visscher (1977) and subsequent extensions. The qualitative conclusions on the location choice of a single entrant will, however, be essentially unaffected if the analysis is extended to allow for multiple entry. In other words, the additional insights that might come from allowing for multiple entry do not justify the increased analytic intractability such a generalisation necessitates.

[2] Nonlinear transport costs in distance could be considered but this severely complicates the analysis without affecting the qualitative conclusions.

unit, per unit distance. It will prove convenient to rewrite the production cost penalty by the substitution:

$$k = K/t; \quad Kx = ktx. \tag{2}$$

Note that demand and cost conditions imply that the right-hand boundary of the market is at most at distance $1/t$ from the basing point. In other words, the market area is some subset of the interval $[0, 1/t]$. Z is, therefore, either limited exogenously by natural geographic conditions to something less than $1/t$, or it is determined by the maximum delivered price a consumer is willing to pay.[3] In addition, for the potential entrant to be able to compete with the basing-point firms, a required restriction is that:

$$0 \leqslant k < 1. \tag{3}$$

$k > 1$ implies production costs at *any* non-base site exceed production costs at the base point plus transportation costs from the base point.

II. PRICE EQUILIBRIUM

In identifying price equilibrium in this spatial model, assume that the locations of the basing-point firms are fixed.

II.1. *The Incumbent B-firms*

Although the incumbent firms are assumed to collude on pricing *policy* – they adopt basing-point pricing which is, by definition, f.o.b. – there may still be competition between them on the *actual* base-point price: of course, in equilibrium all active B-firms will charge identical delivered prices. It appears, therefore, that price competition among the B-firms should be modelled as a repeated game. This is a complicated exercise much of the essence of which can be captured by parameterising price competition among the incumbents.[4] Given our demand structure, this is equivalent to assuming that the B-firms charge a mill price α, where:

(i) $\alpha = 0$ is equivalent to unrestricted price competition: the incumbents act as Bertrand competitors with marginal cost pricing the only Bertrand equilibrium for two or more B-type firms;

(ii) $\alpha = \alpha^*$ is equivalent to perfect collusion between the incumbents: where α^* remains to be determined (see below);

(iii) $0 < \alpha < \alpha^*$ can then be interpreted as being equivalent to different degrees of collusion between the incumbents.

The approach implicit in (iii) allows analysis of the impact on the entrant's location of different degrees of collusion among the incumbents: in essence, α is taken as exogenous. The perfect collusion case (ii) should be treated

[3] This implies, of course, that the entrant is constrained to supply only customers in $[0, Z]$ perhaps because it is constrained to operate within a particular basing-point area. In the formal analysis, the effect on location choice of imposing different limits on the market area is considered.

[4] We are grateful to an anonymous referee for suggesting the following argument. It is consistent with the Folk Theorem which suggests that many equilibria are possible in repeated price games: Friedman (1971); Tirole (1989).

somewhat differently. This case is equivalent to α being determined endogenously. The price charged by the incumbents will affect the location of the entrant and this will affect the post-entry profit of the incumbents. With perfect collusion between the incumbents there is an optimal price they should charge which need not – and with competitive entry typically will not – be the monopoly price. The optimal base-point price α^* is likely to be affected by:

(i) the number of incumbents;
(ii) the cost penalty incurred by the entrants; *and*
(iii) the pricing policy adopted by the entrant.

II.2. *A Competitive Entrant*

The potential competitive entrant in choosing whether to enter the market and the location at which it will enter anticipates the price equilibrium that will apply post-entry. The post-entry price equilibrium for *any* location choice $x \in [0, Z]$ of the entrant, denoted $p_x(.)$, can be described by direct application of the analysis of Thisse and Vives (1988), on the assumption that the entrant competes in price with the incumbents.

For any location choice $x > 0$, the entrant can profitably undercut the basing-point firms in the market interval $Z_x = (z, Z)$ (see Fig. 1) where z is defined by:

$$z: \alpha + tz = ktx + t(x - z) \Rightarrow z = x(1+k)/2 - \alpha/2t. \tag{4}$$

The entrant has monopoly pricing power – defined by $p_x^M(s) < \alpha + ts$ – for consumers in the interval $Z_x^M = (v, Z)$ where v is defined by:

$$v = \begin{cases} [(1-2\alpha)/t + x(1+k)]/3 & \text{for } v \leqslant x \\ (1-2\alpha)/t - (1-k)\,x & \text{for } v \geqslant x \end{cases} \tag{5}$$

and the optimal monopoly pricing policy for the entrant is the familiar '50 per cent freight absorption' policy:

$$p_x^M(s) = \tfrac{1}{2}(1 + ktx) + \tfrac{1}{2}t|x - s|. \tag{6}$$

Note that $v < 1/t$ for $x > 0$. Hence the potential entrant always has monopoly pricing power for some nonempty set of consumers provided that the market area is sufficiently extensive, i.e. that $Z > v$.

Finally, profit to the entrant is concave in $p_x(s)$. Thus, if the entrant has a cost advantage at s, but no monopoly power, its profit maximising price is $\alpha + ts$ (the price charged by the basing-point firms).

The price equilibrium for the competitive entrant can now be stated:[5]

$$p_x^c(s) = \begin{cases} p_x^M(s) & \text{for } s \in Z_x^M \\ \alpha + ts & \text{for } s \in Z_x - Z_x^M \\ ktx + t|x - s| & \text{otherwise.} \end{cases} \tag{7}$$

[5] See Thisse and Vives (1988), Lederer and Hurter (1986), Gee (1976), and Hoover (1937). Our analysis is a slight variation on Thisse and Vives in that the incumbent firms are assumed not to respond to the entrant's price competition by changing α post-entry. Of course, the comments above regarding the endogenous choice of α imply that the incumbents may set prices optimally given that they know entry will occur.

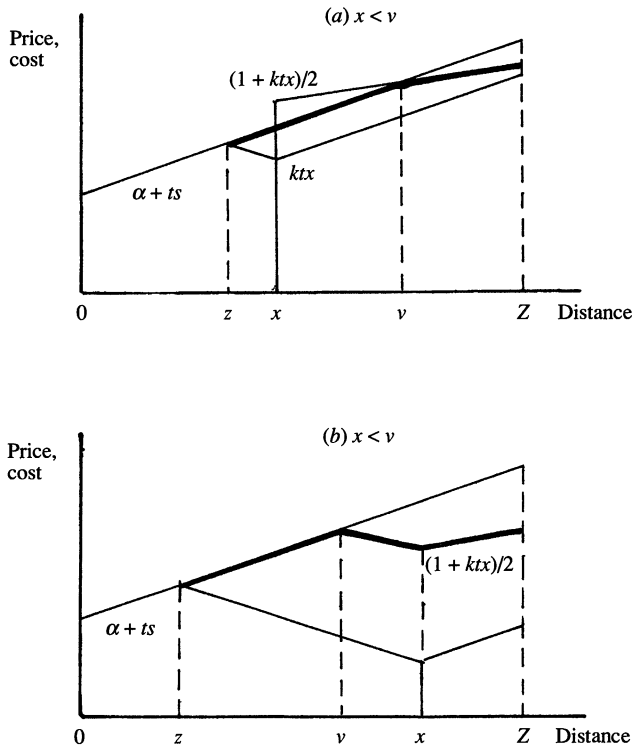

Fig. 1. Competitive (Nash) price equilibrium.

The market area for the entrant is the interval in which it can profitably undercut the incumbents. Demand for the entrant's product is:

$$q_x^c(s) = \begin{cases} 1 - p_x^c(s) & \text{for } s \in Z_x \\ 0 & \text{otherwise.} \end{cases} \tag{8}$$

The price equilibrium is illustrated by the heavy lines in Figs. 1 (*a*) and (*b*) for the entrant's market area.

The market area for the basing-point firms is $Z_b = (0, z)$. Since it is assumed that demand from consumers in Z_b is shared equally among these firms:

$$q_i^c(s) = (1 - \alpha - ts)/n \quad \text{for} \quad s \in Z_b \quad \text{and} \quad i \in B. \tag{9}$$

Z_x^M is nonempty for any location choice $x > 0$ provided only that $Z > v$, so the price equilibrium for the potential entrant is *not* basing-point pricing. There is a region (z, v) over which prices 'look like' basing-point prices, but in this region the entrant is able to use its cost advantage to secure a monopoly position.

II.3. *A Basing-Point Pricing Entrant*

Suppose that the entrant chooses (by threat or free will) to follow the basing-point pricing policy. Delivered price to the consumer location s is then:

$$p_x^b(s) = \alpha + ts \tag{10}$$

and the entrant will want to supply those consumers for whom $p_x^b(s) > ktx + t|x-s|$. This is just the market interval Z_x (see Fig. 1). But now the entrant shares demand in this interval with the basing-point firms. (Recall our discussion of basing-point pricing as a method of market interpenetration.) Demand for the entrant's product is

$$q_x^b(s) = \begin{cases} (1-\alpha-ts)/(n+1) & \text{for} \quad s \in Z_x \\ 0 & \text{otherwise.} \end{cases} \tag{11}$$

III. LOCATION CHOICE

No matter whether the entrant's pricing policy is the Nash equilibrium discriminatory policy (7) or the basing-point policy (11), the entrant firm's objective is to find the location x^* that will maximise its profit at the post-entry price equilibrium. Profit from location choice of x (gross of fixed costs) with pricing policy $\hat{p}_x(.) \in [p_x^c(.), p_x^b(.)]$ is

$$\pi[x, \hat{P}_x(.)] = \frac{1}{N}\int_{Z_x} [\hat{p}_x(s) - ktx - t|x-s|]\,[1-\hat{p}_x(s)]\,ds, \tag{12}$$

where N is the number of firms supplying consumers in Z_x. With discriminatory pricing $N = 1$, while basing-point pricing implies $N = n+1$. The entrant is assumed to choose the location $x^*[\hat{p}_x(.)]$ that maximises profit under pricing policy $\hat{p}_x(.)$.

III.1. *Competitive (Nash Equilibrium) Pricing*

The profit equation is, from equation (7),

$$\pi[x, p_x^c(.)] = \int_z^v (\alpha + ts - ktx - t|x-s|)\,(1-\alpha-ts)\,ds$$
$$+ \int_v^Z [p_x^M(s) - ktx - t|x-s|]\,[1-p_x^M(s)]\,ds, \tag{13}$$

where profit is written gross of fixed costs and z and v are given by equations (4) and (5) respectively. The first term is profit in the market area $Z_x - Z_x^M$, in which price is determined by delivered price from the basing-point, while the second term is profit in the market area Z_x^M in which the entrant has a monopoly position.

Given the assumed demand and cost conditions, the profit function (13) is a cubic in tx. The first order condition is a quadratic, the appropriate form of which depends on whether x is less than or greater than v, i.e. whether the optimal location is described by Fig. 1 (*a*) or (*b*) (recall equation (5)). We can write this quadratic in the form:

$$dt^2x^2 + etx + f = 0, \tag{14}$$

where the parameters d, e and f of the quadratic are determined by the relative

values of v, x^* and Z: see below. Second order conditions then determine optimal location with competitive entry by the familiar equation:

$$tx_c^* = \frac{-e-\sqrt{(e^2-4df)}}{2d}. \tag{15}$$

Three cases must be considered in evaluating the solutions of (14) and (15):[6]

(i) $v < x_c^* < Z$: this is equivalent to the case illustrated in Fig. 1 (*b*). The values of d, e and f are:

$$\left.\begin{aligned} d &= 36k-5(1+k)^3, \\ e &= (8+2\alpha)(1+k)^2-24+12tZ(1-k)^2 \\ f &= (1+k)(\alpha^2-4\alpha-2)+12tZ(1-k)(1-tZ/2). \end{aligned}\right\} \quad v < x_c^* < Z, \tag{15a}$$

(ii) $x_c^* < v < Z$: this is the case illustrated in Fig. 1 (*a*) and assumes that the interval Z_x^M is non-empty. In other words, this case assumes that the entrant can charge the monopoly discriminatory price to some set of consumers. From equation (5), the condition $v < Z$ is equivalent to the constraint

$$x_c^* > (1-2\alpha-tZ)/t(1-k). \tag{16}$$

The direction of the inequality arises, as can be seen from Fig. 1 (*a*), since, if $x_c^* < v$ then a move to the left by the entrant (a move nearer to the basing-point) *increases* v and so *reduces* the market interval in which the entrant has a monopoly position.

In this case the values of d, e and f are:

$$\left.\begin{aligned} d &= 1+\tfrac{1}{4}(1-k)^3-\tfrac{1}{8}(1+k)^3, \\ e &= [\tfrac{1}{2}(1+k)^2-2](1-\alpha)+\tfrac{1}{4}(1+k)^2\alpha \\ &\quad -\tfrac{1}{2}(1-k)^2(1-2\alpha-tZ) \\ f &= \tfrac{1}{4}(1-k)(1-2\alpha)^2-\tfrac{1}{8}\alpha(1+k)(4-3\alpha) \\ &\quad +\tfrac{1}{2}tZ(1-k)(1-tZ/2). \end{aligned}\right\} \quad x^* < v < Z, \tag{15b}$$

(iii) $v \geqslant Z$: this is similar to the case in Fig. 1 (*a*), but now the entrant does not have a monopoly position anywhere. The second term in the profit equation (13) disappears and the appropriate values of d, e and f are:

$$\left.\begin{aligned} d &= 1-\tfrac{1}{8}(1+k)^3, \\ e &= [\tfrac{1}{2}(1+k)^2-2](1-\alpha)+\tfrac{1}{4}\alpha(1+k)^2, \\ f &= tZ(1-k)\left(1-\alpha-\frac{tZ}{2}\right)-\tfrac{1}{8}\alpha(1+k)(4-3\alpha). \end{aligned}\right\} \quad v \geqslant Z. \tag{15c}$$

[6] The relevant case is determined by the parameters α, k and Z. The optimal value of x^* is continuous across the boundaries defining these cases. Proof of the results presented below is tedious and can be obtained from the authors on request.

III.2. *Basing-Point Pricing*

If the entrant chooses to follow the basing-point price, the entrant's profit gross of fixed costs is given by:

$$\pi[x, p_x^b(.)] = \frac{1}{N}\int_z^Z (\alpha + ts - ktx - t|x-s|)(1-\alpha-ts)\, ds. \tag{17}$$

The first-order condition is again quadratic in tx, with solution (from the second-order conditions):

$$tx_b^* = \frac{-e-\sqrt{(e^2-4df)}}{2d} \tag{18}$$

where:

$$\left.\begin{aligned} d &= 1-\tfrac{1}{8}(1+k)^3 \\ e &= [\tfrac{1}{2}(1+k)^2-2](1-\alpha)+\tfrac{1}{4}\alpha(1+k)^2 \\ f &= tZ(1-k)(1-\alpha-tZ/2)-\tfrac{1}{8}\alpha(1+k)(4-3\alpha). \end{aligned}\right\} \tag{19}$$

IV. COMPARISON OF LOCATION CHOICE

Some limited analytic investigation is possible of equations (15*a–c*) and (19). It can be shown, for example, that an increase in the basing-point price α, in the cost penalty k, or a decrease in the market boundary Z encourages entry nearer to the basing-point – reduces x^* – no matter the pricing policy of the entrant. What is not so obvious is the impact of the entrant's pricing policy upon the entrant's location choice, or the comparative statics of this relative location choice. Numerical analysis is straightforward, however, and the discussion below presents the results of a number of such numerical simulations.

One preliminary remark is in order. It might be thought, from an examination of equations (15*a–c*) and (19), that location choice by the entrant is independent of the number of *B*-type firms. This is so, however, only if:

(i) the *B*-type firms are Bertrand competitors – in which case $\alpha = 0$; or

(ii) the degree of collusion as measured by α is exogenous, i.e. is independent of the number of incumbents, the impact of entry, *and* the pricing policy of the entrant.

If α is endogenous, then the optimal choice of α, as indicated above, is likely to be affected by the number of incumbents. There will, therefore, be an interaction between the number of incumbents and the entrant's location choice.

IV.1. α *Exogenous*

Location choice by a basing-point and competitive entrant are compared in Tables 1 and 2 for a number of different combinations of the parameters α, Z and k. Some brief comments are, perhaps, necessary on our choice of parameter range. This has been made in part for purely illustrative reasons, but there is also an important economic constraint on this range. The increased agglomeration induced by an increase in α, decrease in Z or increase in k results

Table 1

Optimal Location Choice with Different Values of Cost Penalty k: $Z = 0{\cdot}667$

	$k = 0$		$k = 0{\cdot}05$		$k = 0{\cdot}1$	
α	BP	CE	BP	CE	BP	CE
0·000	0·381	0·382	0·374	0·374	0·367	0·367
0·017	0·371	0·372	0·363	0·364	0·356	0·356
0·033	0·360	0·363	0·352	0·354	0·344	0·345
0·050	0·350	0·354	0·341	0·344	0·333	0·334
0·067	0·339	0·346	0·330	0·334	0·320	0·323
0·083	0·328	0·337	0·318	0·324	0·308	0·312
0·100	0·316	0·329	0·306	0·315	0·295	0·301
0·117	0·304	0·321	0·293	0·305	0·282	0·290
0·133	0·292	0·313	0·281	0·296	0·269	0·280
0·150	0·280	0·306	0·268	0·287	0·255	0·269
0·167	0·267	0·298	0·254	0·278	0·241	0·259
0·183	0·254	0·292	0·241	0·269	0·227	0·249
0·200	0·241	0·286	0·227	0·261	0·212	0·238
0·217	0·227	0·280	0·212	0·253	0·197	0·229
0·233	0·220	0·275	0·207	0·245	0·194	0·219
0·250	0·216	0·271	0·204	0·238	0·191	—
0·267	0·213	—	0·200	—	0·188	—
0·283	0·209	—	0·196	—	0·184	—
0·300	0·204	—	0·192	—	0·180	—

Note: BP denotes basing-point pricing entry and CE competitive entry.

Table 2

Optimal Location Choice with Different Values of Market Boundary Z: $k = 0{\cdot}05$

	$Z = 0{\cdot}667$		$Z = 0{\cdot}6$		$Z = 0{\cdot}1$	
α	BP	CE	BP	CE	BP	CE
0·000	0·374	0·374	0·346	0·346	0·299	0·299
0·017	0·363	0·364	0·336	0·336	0·290	0·290
0·033	0·352	0·354	0·326	0·326	0·281	0·281
0·050	0·341	0·344	0·316	0·316	0·272	0·272
0·067	0·330	0·334	0·306	0·306	0·263	0·263
0·083	0·318	0·324	0·295	0·296	0·253	0·253
0·100	0·306	0·315	0·284	0·285	0·244	0·244
0·117	0·293	0·305	0·273	0·275	0·234	0·234
0·133	0·281	0·296	0·261	0·266	0·224	0·224
0·150	0·268	0·287	0·249	0·256	0·214	0·214
0·167	0·254	0·278	0·237	0·246	0·203	0·203
0·183	0·241	0·269	0·225	0·237	0·192	0·193
0·200	0·227	0·261	0·212	0·227	0·185	—
0·217	0·212	0·253	0·202	0·218	0·183	—
0·233	0·207	0·245	0·199	—	0·182	—
0·250	0·204	0·238	0·197	—	0·180	—
0·267	0·200	—	0·194	—	0·178	—
0·283	0·196	—	0·191	—	0·176	—
0·300	0·192	—	0·188	—	0·174	—

Note: BP denotes basing-point pricing entry and CE competitive entry.

in the left hand boundary (z) of the entrant's market area approaching the basing-point. From equation (4) the entrant's market area will be the entire interval $[0, Z]$ for any (α, Z, k) combinations such that

$$(1+k)\, tx^*(\alpha, Z, k) - \alpha \leqslant 0. \tag{20}$$

With competitive entry, such (α, Z, k) combinations would result in the entrant capturing the entire market. We rule out such (α, Z, k) combinations by assumption, confining attention to parameter values in the set:[7]

$$\zeta(\alpha, Z, k) = \{\alpha, Z, k : (1+k)\, tx_c^*(\alpha, Z, k) - \alpha \geqslant 0\}. \tag{21}$$

As was indicated above, agglomeration is encouraged – the optimal location of the entrant moves towards the incumbents' site – with an increase in α, an increase in k and a decrease in Z. So far as relative location choice is concerned, the simulation results indicate that:

$$x_b^*(\alpha, Z, k) \leqslant x_c^*(\alpha, Z, k) \quad \text{for all } \alpha, Z, k. \tag{22}$$

The competitive entrant never locates nearer to the basing-point than does the basing-point pricing entrant. Basing-point pricing does, indeed, appear to support production agglomeration as Greenhut and Machlup suggested.

It is also clear from these simulations, however, that there are parameter combinations for which the two types of entrant will choose identical locations. Comparison of equations (15c) and (19) identifies the precise circumstances under which identical location choice arises: see also equation (16). For the two types of entrant to choose *different* locations the competitive entrant must have a monopoly pricing advantage with respect to some sub-set of consumers: this sub-set will, of course, be located at the right-most extremity of the market.

Fig. 2 and Table 3 illustrate these results. Feasible combinations of α and Z for any given cost penalty k are defined by three constraints:

(i) the demand constraint: $\alpha + tZ \leqslant 1$;

(ii) the monopoly pricing constraint: $\alpha \leqslant \alpha_m = \frac{1}{2} - tZ/4$ where α_m is the optimal monopoly price for the basing-point firms: see Greenhut *et al.* (1987, p. 118);

(iii) the market area constraint: $\alpha, Z \in \zeta(\alpha, Z, k)$ (recall equation (21)).

These constraints define the feasible region $OABC$ in Fig. 2.

We can also define the set:

$$\chi(\alpha, Z, k) = \{\alpha, Z, k : v(\alpha, Z, k) \geqslant Z\}. \tag{23}$$

For all (α, Z, k) combinations in $\chi(\alpha, Z, k)$ the competitive entrant has no monopoly pricing advantage anywhere and so adopts the identical location as would a basing-point pricing entrant. The set $\chi(\alpha, Z, k)$ is defined within the feasible set by the shaded area OAD in Fig. 2.

Only for (α, Z, k) combinations in the region $ABCD$ does the competitive entrant have a monopoly pricing advantage to a non-empty sub-set of consumers.

[7] No such complications arise with basing point entry since the entrant shares the market with the incumbents.

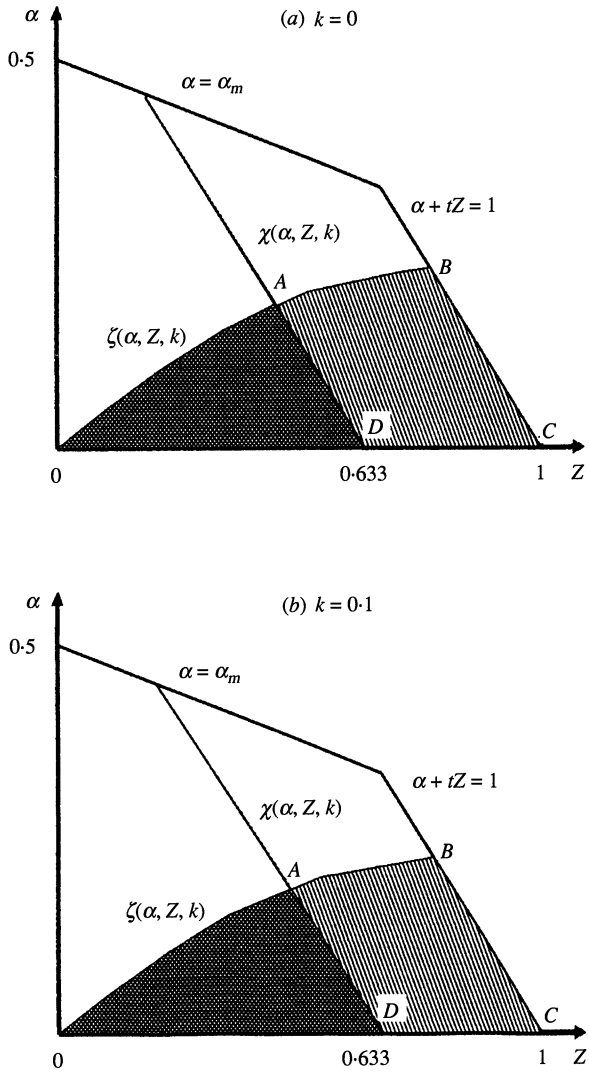

Fig. 2. Parameters generating coincident location.

The existence of such a sub-set of consumers is more likely the more extensive the market (the greater is Z), the lower the cost penalty (k) incurred by the entrant, and the higher the price (α) charged by the incumbent basing-point firms: in our interpretation of α made here, the greater the degree of collusion between the incumbent basing-point firms.

Machlup's conclusion that basing-point pricing leads to greater production concentration must, therefore, be qualified. This conclusion is much more likely to hold true in extensive market areas, where the incumbent firms hold off to at least some extent from price competition between themselves and where these firms enjoy no great production cost advantage with respect to new entrants.

Table 3

Boundaries of $\zeta(\alpha, Z, k)$ and $\chi(\alpha, Z, k)$

$\zeta(\alpha, Z, k)$ α	$k = 0$ Z	$k = 0{\cdot}05$ Z	$k = 0{\cdot}10$ Z
0·0	0·633	0·651	0·669
0·15	0·483	0·498	0·513
0·30	0·333	0·345	0·358
0·45	0·183	0·192	0·202
0·60	0·033	0·040	0·047
$\chi(\alpha, Z, k)$ α	$k = 0$ Z	$k = 0{\cdot}05$ Z	$k = 0{\cdot}10$ Z
0·0	0·0	0·0	0·0
0·05	0·103	0·103	0·104
0·10	0·214	0·216	0·218
0·15	0·343	0·346	0·351
0·20	0·517	0·527	0·541

IV.2. α *Endogenous*

The discussion of section IV.1 assumes that the incumbent basing-point firms adopt the same base-point price no matter the pricing policy of the entrant. It is difficult to maintain such an assumption once perfect collusion between the incumbents is allowed. There is a relationship between the incumbent firms' post-entry profit and the base-point price they adopt. This relationship identifies an optimal base-point price, α^*, that perfectly colluding incumbents should adopt. Recall that the entrant chooses the optimal location *given* the price level charged by the incumbents. Thus, the optimal base-point price α^* is identified on the assumption that the incumbents do not attempt to deter entry but do correctly anticipate the location the entrant will choose. Effectively, the incumbents are acting as leaders of a Stackelberg game.

Basing-Point-Pricing Entry

A complication arises if the entrant adopts basing-point pricing since the incumbents' profit/base price relationship can have two maxima. From our discussion in section IV.1, an increase in the base-point price induces the entrant to locate nearer to the base-point. But this implies that the left-hand boundary (z) of the entrant's market area will approach the basing-point, i.e. z will tend to zero. From equation (4) the entrant's market area will be the entire interval $[0, Z]$ for any base-point price which is such that

$$x_b^*(\alpha)\,(1+k)/2-\alpha/2t \leqslant 0. \tag{24}$$

Define the base-point price α' as:

$$\alpha' : x_b^*(\alpha')\,(1+k)/2-\alpha'/2t = 0. \tag{25}$$

For any base-point price greater than α' the base-point firm and the entrant

share the total market, with each firm taking $1/(n+1)$ of total demand. Profit for the incumbents will increase as the base-point is increased above α' until the base-point price is raised to the monopoly price

$$\alpha_m^* = \tfrac{1}{2} - tZ/4. \tag{26}$$

For base-point prices less than $\alpha', z > 0$. The incumbents are sole suppliers in the interval $[0, z]$ and share with the entrant the interval $[z, Z]$. Profit to the incumbents is:

$$\pi_b^i = \frac{1}{n}\int_0^z \alpha(1-\alpha-tr)\,dr + \frac{1}{n+1}\int_z^Z \alpha(1-\alpha-tr)\,dr \quad (0 < \alpha < \alpha'). \tag{27}$$

A necessary condition for this profit function to have an internal maximum in the interval $[0, \alpha')$ is:

$$\frac{\partial \pi_b^i}{\partial \alpha} < 0 \quad \text{as} \quad z \to 0. \tag{28}$$

Differentiating (27) gives:

$$\frac{\partial \pi_b^i}{\partial \alpha} = \frac{1}{n}\int_0^z (1-2\alpha-tr)\,dr + \frac{1}{n+1}\int_z^Z (1-2\alpha-tr)\,dr$$
$$+\alpha(1-\alpha-tz)\frac{\partial z}{\partial \alpha}\left(\frac{1}{n}-\frac{1}{n+1}\right). \tag{29}$$

The first two terms are positive. They constitute the increase in profit arising from the price effect of the increase in the basing-point price. The third term is negative – since $\partial z/\partial \alpha < 0$. It is the reduction in profit arising from the market area effect of the increase in the basing-point price. Increasing the basing-point price reduces the market area in which the incumbents are the sole suppliers or, equivalently, increases the market area in which the incumbents must share demand with the entrant. Only if the market area effect dominates the price effect is condition (28) satisfied.

As z tends to zero, (29) simplifies to:

$$\left.\frac{\partial \pi_b^i}{\partial \alpha}\right|_{z\to 0} = \frac{1}{n+1}\left[\frac{2-4\alpha-tZ}{2} + \frac{\alpha(1-\alpha)}{n}\frac{\partial z}{\partial \alpha}\right]. \tag{30}$$

The first term is the (positive) price effect. It is smaller the more extensive is the market area and/or the nearer the basing-point price approaches to the monopoly price: see equation (26). The second term is the (negative) market area effect and is greater in absolute magnitude the smaller is the number of incumbent basing-point firms.

This can be put another way. Assume that the incumbents anticipate the entrant will follow the basing-point pricing scheme. Then perfect collusion among the incumbents is more likely to lead to the optimal basing-point price being the monopoly price of equation (26) the greater is the number of incumbents and the less extensive is the total market area.

Table 4

Optimal Basing Point Price (α_c^*) with Competitive Entry

Entrant's cost penalty (k)	Optimal basing point price (α_c^*)	
	$Z = 0{\cdot}667$	$Z = 0{\cdot}6$
0·00	0·1215	0·1093
0·01	0·1205	0·1088
0·02	0·1196	0·1084
0·03	0·1187	0·1079
0·04	0·1178	0·1074
0·05	0·1170	0·1069
0·06	0·1161	0·1064
0·07	0·1153	0·1059
0·08	0·1145	0·1054
0·09	0·1137	0·1049
α_b^*	0·3333	0·350

For the particular cases considered in this paper, condition (28) is not satisfied for any combination of parameter values, and the optimal, perfectly collusive base-point price is the monopoly price of equation (26).[8]

Nash Equilibrium Pricing Entrant

Similar ambiguities do not arise if the entrant competes on price with the incumbents. If the incumbents choose a base-point price equal to α'[9] then the entrant takes the whole market and the incumbents' profit falls to zero.

Table 4 identifies the optimal, perfectly collusive basing-point price with competitive entry. The optimal basing-point price is lower:

I. the greater the cost penalty incurred by the entrant;

II. the more constrained is the market area.

Comparison of Optimal Collusive Prices

Table 4 also provides for comparison the perfectly collusive basing-point price with basing point entry. In comparing the optimal basing-point price for different pricing policies of the entrant, assume initially that condition (28) is satisfied and, in addition, that the internal maximum is a global maximum. Then conditions I and II above also characterise the optimal basing-point price in the event of basing-point entry. There is, in addition, a third condition:

III. with basing-point entry, if there is an internal equilibrium the optimal basing-point price will be lower the fewer incumbents there are.

If condition (28) is not satisfied, equation (26) gives the optimal basing-point price for the incumbents in the event of basing point entry. In this event only condition II characterises the optimal basing point price (see Table 4).

Whether or not condition (28) holds, the incumbents' optimal basing point

[8] Preliminary investigations indicate that condition (28) would be satisfied by alternative specifications of, for example, the demand function.

[9] This value of α' will typically not be the same α' as would apply with basing-point entry.

price is always higher with basing point than with competitive entry, a conclusion that should not be surprising given the market sharing arrangements that characterise the former type of entry.

Some comments are, perhaps, in order as to why the number of incumbents may affect the optimal incumbent price with basing-point entry but not with competitive entry. Consider first competitive entry. The entrant takes *all* demand in its market area and the best the incumbents can do is choose α to maximise aggregate post-entry profits in their remaining market area. The resulting optimal value of α will be independent of the number of incumbents. By contrast, basing-point entry allows the incumbents to share demand with the entrant in the entrant's market area. Profit to each incumbent is then an $(n+1)$th share of profit in the entrant's market area and an nth share of the remaining market area. Aggregate profit to the incumbents is no longer independent of the number of incumbents. Hence, the optimal incumbent price (α^*) will be some function of the number of incumbents: provided always, of course, that this is not the monopoly price with basing-point entry.

Conditions I, II and III may appear to be counter-intuitive. I and II arise because an increase in the cost penalty incurred by entrants, or a reduction in the overall market area, will encourage the entrant to locate nearer to the incumbents for any given incumbent price level. This reduces the monopoly market area of the incumbents, and so encourages them to lower the base-point price in order to maintain sales and profitability, and in order to limit market penetration by the entrant.

So far as III is concerned, recall that the assumption that α is endogenous is equivalent to perfect collusion on the part of the incumbents. The greater the number of incumbents the less will be the impact of a basing-point entrant on their aggregate profitability: the entrant takes an $(n+1)$th share of demand in its market area. As a result, the greater the number of incumbents the nearer will the collusive, post-entry price approach the monopoly price.

Relative Location Choice

Now consider relative location choice with different types of entry. When α is endogenous, it is unlikely that basing-point pricing and competitive pricing will ever give rise to the same location choice by the entrant. The optimal price, α^*, charged by the perfectly collusive basing point firms is determined by the pricing policy of the entrant and, with basing-point entry, the number of incumbents. As we have seen, the expectation of basing point gives rise to a higher basing point price than will the expectation of competitive entry. This difference in basing-point price is sufficient to ensure that the expectation of competitive entry will lead to greater decentralisation of production than will expected basing-point entry. The degree of decentralisation of production decreases the lower the cost penalty of location choice distant from the basing-point and the less constrained is the market area. Nevertheless, even if the market area is sufficiently constrained to eliminate any monopoly pricing advantage for the entrant, there will still be a difference in location choice resulting from the pricing policy of the entrant. In other words, the traditional

conclusion is correct *provided that* the incumbent basing-point firms collude perfectly in their choice of the basing-point price.

V. CONCLUSIONS

The contention that basing-point pricing encourages production concentration has long been part of received wisdom. What has not been appreciated are the precise conditions under which this received wisdom is, indeed, correct. It has been shown in this paper that two conditions are sufficient.

First, if there is imperfect collusion among basing-point firms, a basing-point entrant will locate nearer to the basing-point than a competitive entrant *only if* the competitive entrant has a monopoly pricing advantage with respect to a non-empty sub-set of the consumer market. The existence of such a sub-set of consumers is more likely in extensive market areas in which the incumbent firms enjoy no great production cost advantage with respect to new entrants and in which the incumbent firms hold off to at least some extent from price competition between themselves.

In the event of perfect price collusion among the incumbent basing-point firms, the expectation of basing-point entry will lead to a higher base-point price than will the expectation of competitive entry. Even if the market area is sufficiently small as to eliminate any monopoly pricing advantage for a competitive entrant, there will be a difference in location choice resulting from the anticipated pricing policy of the entrant. In other words, perfect collusion among the incumbent base-point firms is sufficient to generate concentrated production.

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References

Benson, B., Greenhut, M. L. and Norman, G. (1990). 'On the basing point system.' *American Economic Review*, vol. 80, pp. 584–8.

Friedman, J. (1971). 'A noncooperative equilibrium for supergames.' *Review of Economic Studies*, vol. 28, pp. 1–12.

Gee, J. M. A. (1976). 'A model of location and industrial efficiency with free entry.' *Quarterly Journal of Economics*, vol. 90, pp. 557–74.

Greenhut, M. L. (1956). *Plant Location in Theory and Practice*, Chapel Hill: University of North Carolina Press.

—— (1987). 'Basing-point system.' In *The New Palgrave Dictionary of Economics* (ed. J. Eatwell, M. Milgate and P. Newman), London, Macmillan Press.

—— Norman, G. and Hung, C. S. (1987). *The Economics of Imperfect Competition: a spatial approach*. London: Cambridge University Press.

Haddock, D. D. (1982). 'Basing-point pricing: competitive vs. collusive theories.' *American Economic Review*, vol. 72, pp. 289–306.

Hoover, E. M. (1937). 'Spatial price discrimination.' *Review of Economic Studies*, vol. 4, pp. 182–91.

Lederer, P. and Hurter, A. P. (1986). 'Competition of firms: discriminatory pricing and location.' *Econometrica*, vol. 54, pp. 623–40.

Machlup, F. (1949). *The Basing Point System*. Philadelphia: The Blackiston Press.

Prescott, E. G. and Vischer, M. (1977). 'Sequential location among firms with foresight.' *Bell Journal of Economics*, vol. 8, pp. 378–93.
Stigler, G. (1949). 'A theory of delivered price systems.' *American Economic Review*, vol. 39, pp. 1143–59.
Thisse, J.-F. and Vives, X. (1988). 'On the strategic choice of spatial price policy.' *American Economic Review*, vol. 78, pp. 122–37.
Tirole, J. (1989). *The Theory of Industrial Organization*. Cambridge, Mass.: The MIT Press.
TNEC (1941). *Final Report and Recommendations*. Washington, D.C.: Government Printing Office.
Wilcox, C. (1963). *Public Policies Toward Business*, 6th. ed., Homewood Ill.: Richard D. Irwin.