STRATEGIC COMPETITION AND THE PERSISTENCE OF DOMINANT FIRMS : A SURVEY

by

David ENCAOUA
Paul GEROSKI
Alexis JACQUEMIN

Working paper n° 8206

Institut des Sciences Economiques
Centre de Recherches Interdisciplinaires Droit & Economie Industrielle
3, Place Montesquieu - B-1348 LOUVAIN-LA-NEUVE (Belgique)

D/1982/3082/08

April 1982.

STRATEGIC COMPETITION AND THE PERSISTENCE OF DOMINANT FIRMS : A SURVEY*

by

David ENCAOUA[1]
Paul GEROSKI[2]
Alexis JACQUEMIN[3]

I. *INTRODUCTION*

1. In the rivalrous struggle to create, maintain and expand favourable market positions, firm's actions are intended not only to directly affect the current conduct of rivals, but also to have an indirect effect by altering market structure in a way which constrains rival's subsequent actions. In this dynamic process, market strategies or conduct (the control variables) interact with market structure (the state variable), and current conduct can become imbedded in future market structure through strategic investments made by firms to bar entry and reduce intra-industry mobility (for some analysis of this view of industry dynamics, see Jacquemin, 1972; Caves, 1976, Part I; Caves and Porter, 1977; Spence, 1981a, p. 51; and Stiglitz, 1981, p. 187). Of course, not all investments made by firms have the

*Revised version of a paper presented at the Conference of the International Economic Association on "New Developments in Market Structure", Ottawa, May 1982. We wish to thank R. Gilbert, S. Salop, R. Selten, M. Spence, and O. Williamson for helpful comments. The usual disclaimer applies.

[1]University of Paris I.

[2]University of Southampton and Catholic University of Louvain.

[3]Catholic University of Louvain.

intended effect on market structure, and the purpose of this survey is to consider a recent body of literature which has devoted itself to precisely this point[1]. This work is of interest because of the new light it has shed on the combined structural and strategic origin of market power; that is, on the hoary question of the persistence and profitability of dominant firms (compare Posner, 1972, p.130 with Williamson, 1975, p. 218 for recent contributions to this old debate; Worcester, 1957 is the classic source of doubt about persistence). The literature seems to have coalesced around two basic types of model. By far the most common approach is to assume an initial asymmetry in favour of incumbent firms : this makes them dominant in the sense that it allows them to make commitments prior to entry (i.e. it gives them first mover advantages). A second type of model treats the entrant and the incumbent symmetrically, allowing each the ability to affect the other's strategy; in equilibrium, a dominant firm, in the sense of having gained a first mover advantage, may or may not emerge as a consequence of some other asymmetries, such as asymmetry in information.

In Section II, we shall make some general reflections on how strategic investments can affect market structure, and on the nature of the entry process. In Section III, we take up the topic of strategic investments by first movers made to exploit their initial advantages and, by way of contrast, in Section IV we highlight models in which a more symmetrical view of strategic aspects of entry is taken. Our conclusion, in Section V, is that this literature

[1]The attention focused on conduct (a reaction to the structuralist school of Bain, 1959) is a hallmark of the "New Industrial Organization" (e.g. Schmalensee, 1980) and is the common feature of most of the papers to be discussed here; it is, of course, a return to earlier methodologies, albeit with more analytic rigor. This same kind of shift of attention has seen a move from *inter*-industry to *intra*-industry empirical work; for example, compare the work surveyed in Weiss, 1974 to the intra-industry structure-performance work of Gale, 1972; Shepherd, 1972; Newman, 1978; Porter, 1980 and those surveyed in Geroski, 1981b; Cowling, 1976 discusses some of the virtues of intra-industry work relative to inter-industry work.

gives good reasons for thinking that dominant firms will persist.

II. GENERAL REFLECTIONS ON ENTRY

2. In this section, we wish to make a few remarks on the nature of the strategic investments which can be expected to have an effect on market structure. To do this, we first need to discuss a fairly general representation of the entry problem (Subsection A). Second, we wish to discuss industry dynamics. To make the transition from static entry equilibrium (i.e. theory describing the outcome of entry attempts) to industry dynamics, one must discuss the entry process itself (i.e. theory describing the generation of entry attempts) as a source of change (Subsection B).

A. *Precommitment, Credibility and the Entry Problem*

3. Consider any competitive weapon, X, (price, location, capacity, etc), which an existing firm can use to discourage entrants. The necessity for, and the profit maximizing extent of these expenditures depend basically upon the exogenous variables determining demand, costs of production, cost of movement and so on[2]. Since some expenditures on X will be made absent entry, it is conceptually worth separating out that proportion of such expenditures as would be incurred by profit maximizing firms absent entry from that part strategically chosen to obstruct entrants (this is the basis of the distinction by Salop, 1979, between "innocent" and "strategic" entry barriers[3]); the ratio between them depends upon

[2]These exogenous variables are not necessarily to be regarded as barriers per se, for as stressed by Caves and Porter (1977), *entry barriers* are "... *partly structural but at least partly endogenous*" (p. 241). For various definitions of entry barriers, see Bain (1956); Stigler (1968); von Weizsäcker (1981); and Baumol and Willig (1981). Some of this discussion is purely terminological, arising from the alleged pejorative implications of the term 'entry barriers'; in addition to all other papers referenced below, see Yamey (1972); and Hay (1981, pp. 162-4) who argues that predation can have an undesirable effect even when the victim is inefficient.

[3]The first situation would correspond to the case of an incumbent being superior (because of its technological efficiency and so on) and able to deter entry as a by-product of simple profit maximization; i.e. deterrence depends only on the exogenous elements of cost and demand. .../...

the various exogenous variables in a way familiar since Bain's distinction (1956) between "blockaded", "effectively impeded" and "ineffectively impeded" entry. Thus, whether or not an incumbent has to incur strategic expenditures (and the extent to which he has to do so) depends on the extent of his scale economies (relative to market size), those enjoyed by the entrant, and so on.

Since we are concentrating on strategic conduct regarding the choice of X, it is natural to think in game theoretic terms. Let us commence by distinguishing two time periods, pre-entry ($t = 0$) and post-entry ($t = 1$)[4], and let us consider first the simplest possible non-cooperative equilibrium of a post-entry game, the Nash equilibrium. A rationality for such an outcome is that the game is played in secret, with no communication between players at $t = 0$; hence, there is no possiblity of rivals learning each other's reaction functions and using such information. When we open up the possibility of pre-play communication (and allow firms to make pre-commitments for example), we introduce the possibility that firms can make threats and can incorporate information about rivals reaction functions into their maximizing decisions. The result is two types of (*two* person) games : those in which there are no advantages to make the first move and assume the initiative of leadership ("Stackelberg Rational" solvable games) and those in which there are ("Non-Stackelberg Rational"). A game is said to be Stackelberg Rational if no player has an incentive to change its strategy and commit itself to another, and let the other player know, and this results in each receiving at least as much as what could be gained by maximizing subject to the other's reaction function.

The second situation occurs when an incumbent is equally (or less) efficient but enjoys an advantage because of its early commited ressources. To a certain extent however the distinction is artificial; e.g. scale economies may be strategically manipulated by research to perfect larger scale facilities (Porter, 1981, p. 145) and some investments in advertising and promotion are not strategic, but are an innocent response to information costs. For a methodological start to untangling these two components, see Salop and Shapiro, 1980.

[4] Limit pricing is strategic behavior occuring in period $t = 0$ to affect the $t = 1$, post-entry outcome. Predatory pricing is post-entry behaviour ($t = 1$), which may be threatened in $t = 0$ and whose strategic effects apply also to subsequent entrants. Much of what follows can be applied (with some modification) to both types of competitive practices.

Persistence and entry deterrence are outcomes which result only from Non-Stackelberg Rational games (in which it matters who moves first), and that is the nature of the entry games we shall be concentrating upon here. Two possible ways of insuring a final equilibrium in such games are to put some restrictions on pre-play (i.e. period $t = 0$) behaviour, for example allowing only one player to make pre-play commitments; or, to alter the context of the game, for example by introducing incomplete information. We shall consider these two types of restrictions in Sections III and IV below[5].

4. It is clear that when we allow pre-play communication, we introduce the possibility of strategic action through pre-commitment, and so must face the problem of distinguishing between empty and non-empty threats.

We begin by noting that a strategic move is : "... *one that influences the other person's choice in a manner favourable to oneself by affecting the other person's expectations of how oneself will behave* ..."(Schelling, 1969, p. 160). In anticipation of Section III (for an equivalent discussion in the absence of a first mover, see footnote 27), consider a model with an assumed first mover[6] who, at $t = 0$, makes a strategic choice X, recognizing the possibility of entry at $t = 1$. The choice of X may affect the pre-entry output choice of the existing firm, $Q = Q(X)$; more importantly, it gives rise to an *expectation* by the entrant of what the post-entry output by the incumbent will be, $\beta = \beta(X)$. The entrant chooses output, q, to maximize : $\pi_2(\beta(X),q)$; call the solution to that problem $q^* = q(\beta(X))$. The value of β which the entrant takes to be implied by choice of a particular X is a credible one if it is that $\beta = \beta^*(X)$ which the incumbent

[5]An equivalent distinction is between situations in which the rules of the post-entry game are exogenous or endogenous (respectively). When we allow the first player only to make a commitment (as in Section III), then it is in its advantage to adopt a Stackelberg strategy; if not, then it is in its interest to adopt another view (such as described in Section IV).

[6]That is, a firm which has actually moved first rather than a firm which rivals know will move faster. Asymmetries in speed of movement open up the possibility that strategic investments do not actually have to be executed to be effective -- rivals merely have to accept that they will lose any race they care to initiate because it will be in the interest of faster rivals to block them once they begin.

would choose given entry; i.e. β^* maximizes post-entry profits $\pi_1^1(\beta, q(\beta))$ for the existing firm given X. Hence, an investment strategy (with the incumbent acting as a Stackelberg leader) in which the existing firm chooses X to maximize the sum of pre- and post-entry profits, $\pi_1^0(Q(X),0) + \pi_1^1(\beta^*(X), q(\beta^*(X)))$, is one which can be said to credibly pre-empt the entrant if $P(\beta(X),q) \leq c(q)/q$ for all q, (where P(..) is the post-entry price and c(.) the entrants cost function); such a strategic investment, if executed, becomes embedded in the structure of the industry and so enhances the persistence of dominance. Notice that X is not a *threat* and therefore there is no question of it being credible; it is the *beliefs* of the entrant, $\beta = \beta(X)$, which are (or are not) credible[7]. To say that the investment strategy derived above credibly pre-empts the entrant is simply something about its power vis-à-vis sophisticated entrants.

It follows that an investment, X, must be *irreversible* if it is to credibly pre-empt; if it is reversible then it will not enter as a parameter (or initial condition) in the t = 1 maximization problems, and so will not give rise to a credible belief, $\beta = \beta^*(X)$, by the entrant. Of course, irreversibility is not an inherent property of investments, and thus it is not only a matter of degree, but also of rational calculation (by the entrant) given the circumstances. A second relevant characteristic of the capital created by strategic investments is its *durability*, which determines the time interval within which pre-emption may credibly occur. For example, investment in plant leads to credible pre-emption depending (among other things) on its *industry specificity*[8] (i.e. the proportion of it which is sunk; see the results of Baumol and Willig, 1981; or Grossman, 1981 and the not unrelated notion of exit barriers; Caves and

---

[7]The common practice of thinking of the beliefs $\beta = \beta(X)$ as threats (and $\beta = \beta^*(X)$ as "credible" threats) is no more accurate than thinking of the commitment X as a threat. A commitment fixes one's course of *action* and a threat fixes a course of *reaction* to the other player : "... *the commitment is a means of gaining the first move in a game in which the first move carries an advantage; the threat is a commitment to a strategy for the second move ... it is a credible reclamation of a conditional choice for second move*" (Schelling, 1960, p. 124).

[8]*Product* or *firm* specific capital is relevant for discussion of mobility rather than entry barriers. Firm specificity exists if there is no alternative use for such capital that would increase the value of the firm controlling it.

Porter, 1976) which determines the extent to which entrants can reasonably believe that it is irreversible; and on its *depreciation*, which determines for how long it can reasonably keep entrants at bay (see Eaton and Lipsey, 1980 and 1981).

5. The question of how pre-commitment gives rise to credible beliefs by the entrant becomes a good deal more tortuous in a world of *incomplete information*. Although a priori incomplete information could equally affect the incumbent and the entrant, and both could devise strategies of deception and bluff (see Easterbrook, 1981), informational asymmetries have usually been linked to presence in the market : the incumbent is viewed as facing less uncertainty about its own costs since they are actual rather than potential and, similarly, the incumbent is assumed to know more about market demand characteristics than the putative entrant[9]. The main implication of incomplete information seems to be that for a belief to be credible, it doesn't have to correspond to the actual ex post optimal response by the incumbent; it is sufficient that the probability of it being ex post optimal is sufficiently high in the eyes of the entrant. Of course, what the entrant thinks likely depends upon what he knows and can infer. Hence, expenditures on X not only give rise to credible beliefs, but may also generate inferences by the entrant which affect his view of what is, in fact, likely to be a credible belief to hold.

Since rationality is a moot point in such contexts, all kinds of apparently "irrational" behaviour is likely to appear and affect the nature of entry equilibria (for a general discussion, see Scherer, 1980, p. 246; and Schelling, 1960). The distinction between *substantive* and *procedural* rationality may be useful in this connection. According to Simon (1978), substantive rationality is the extent to which appropriate courses of action are chosen and procedural rationality is the effective-

[9] In conventional Dominant Firms (or Stackelberg) models (Saving, 1970; Gaskins, 1971; Worcester, 1957), the dominant firm knows the fringe's reaction function but not vice versa. This asymmetry in information is not a necessary consequence of assuming a first mover advantage; indeed, it is not clear at all where it arises from (but, see Section IV). Spence (1979) is an example of how prior or faster movement affects the outcome of an exogenous post-entry game in a way which *looks* as if informational asymmetries have been introduced.

ness (in light of human cognitive powers) of the procedures used to choose actions. Given the complexity of the problems they face and the limitations of decision makers, it might be more appropriate to shift attention away from substantive and towards procedural rationality. In this light it would seem that some types of substantively irrational behaviour might nevertheless characterize otherwise acceptable entry models.

B. *The Nature of the Entry Process*

6. Entry models are a necessary part of any discussion of the persistence of dominance, for the process generating trials is the force potentially generating strategic investment. However, the lacuna in our knowledge concerning what brings an entrant to a market (as opposed to what determines the outcome of any particular trial) is a major obstacle in the way of developing dynamic models of industry structure. To understand the entry generating process, we must first understand how firms are attracted to industries and the factors which translate general interest into actual entry attempts.

Not unrelated to this is the problem of what type of entrant will appear. There seems to be a general presumption that entry is likely to be by firms established elsewhere rather than by de novo firms, and that it will occur with less delay and inhibition, in the face of given obstacles, by such firms (Hines, 1957; Farrar and Phillips, 1959; Penrose, 1959; Jacquemin, 1967; Caves and Porter, 1977, use this line of observation to broaden the notion of entry barriers to a theory of intra-industry mobility) : "*The already established outsiders could command financial strength, managerial experience, and prestige among customers sufficient to prevent old-timers from frightening them away by threats ... Their history and their diversified operations would attest their power to survive*" (Hines, 1957, p. 142). Entry trials involving firms established in related product, geographical or temporal markets then depend on the type of interrelationship between markets (Klevorick and Joskow, 1979; Porter, 1981; Spence, 1981a; Salop, 1981); even the plausibility of non-

cooperative behaviour is not clear, as when two firms, potential entrants into each other's market, "internalize" the mutual threats by merging. About the best that has been done in this regard is to try and relate some or all of these points to stages in the industry life cycle; the argument frequently encountered here is that entry is rather less of a threat to established firms at mature stages (Kaysen and Turner, 1959, pp. 73-5; Williamson, 1975, Chapter 1), and that such stages are those for which the assumption of first mover advantages are reasonable.

What lies behind these considerations is, inter alia, the question of what kind of asymmetry one can reasonably postulate between entrant and incumbent. One could argue that to ignore the rich details about differences between firms and to assume symmetry in all respects (except, perhaps, first movement) is to deal with the general case (but see Schelling, 1960, Appendix B; in a related vein, consider the remarks of Eaton and Lipsey, 1981, p. 603, on product specific capital). The trouble with this view is that it does lead to some rather unpersuasive generalizations arising from confusing the convenience of assuming symmetry with the likelihood of symmetry actually being a property of real world entry processes. We are only beginning now to see models in which asymmetry emerges from prior axioms; in what follows we shall primarily be exploring the consequences of assuming certain types of asymmetries.

III. STRATEGIC INVESTMENTS BY FIRST MOVERS.

7. Of the various types of investments that existing firms can make, much of the literature since Bain (1956) has emphasized limit pricing, developing the proposition that potential competition disciplines pricing decisions in the short run. In Subsection A, we reassess this proposition assuming the existence of a first mover, arguing that the strategic importance of pricing decisions has been overstated in the Bain tradition. This theme re-emerges in Section IV, but, before that we take a slight digression to consider (Subsection B) some simple entry processes which open up insights on industry dynamics. Such models are a first step in

exploring the familiar distinction between "immediate" and "general" conditions of entry (Bain, 1956).

A. *Static Models*[10]

8. The simplest limit pricing model assumes homogeneous goods and scale economies, considers price alone as a strategic weapon, and invokes the Sylos Postulate (i.e. that the entrant believes that incumbents will maintain the same output after entry) as the entrant's conjecture about the post-entry equilibrium (Modigliani, 1958; Fisher, 1959; and Bhagwatti, 1970; and Spulber, 1981 are instructive on the Sylos Postulate in different ways); in the Modigliani model, incumbents are constrained to bar entry. Relaxing this (Osborne, 1973; Dixit, 1979) to allow existing firms to tolerate entry if that is in their best interests puts a lower bound on the limit price (and so an upper bound on expenditures to deter entry) one is liable to observe (i.e. it will pay to deter entry only when scale economies are "large"). The difficulty with this, of course, is that the Sylos Postulate is not a credible belief for scale entrants[11]. Substituting a credible post-entry output conjecture by the entrant (based upon knowledge about the existing firm and the rules of the post-entry equilibrium game) does not suppress entry barring equilibrium; rather, as the pre-entry strategic choice (price/output) is reversible, it no longer affects the entrants computations. Hence choice of pre-entry price will no longer be fettered by strategic considerations and will be set at monopoly levels.

---

[10]We restrict attention here to private firms. Harris (1978) and Harris and Wiens (1980) discuss the case of public ownership, suggesting that a public firm having a first mover advantage could announce a reaction function and make it credible to private entrants in a way that privately owned first movers could not.

[11]For a game theoretic treatment of this point, see Friedman (1979) who shows that limit pricing is not a Nash equilibrium. Strictly speaking, whether a quantity taking conjecture is a consistent or credible belief (e.g. Bresnahan, 1981a; Ulph, 1981) depends on the slope of rivals marginal cost curves and on demand (for some interesting interpretations of conjectural variations, see Grossman, 1981; and Boyer, 1981). However, very small entrants may not be unreasonably in taking the incumbents output (or price) as fixed (for some defense of the virtues of entering at small scale to avoid predation, see Gelman and Salop, 1982). Also note that the large scale entry case (in which quantity taking conjectures are unlikely to be reasonable) may not be empirically important (Bain, 1956; Scherer, 1980, chapter 4; Schmalensee, 1981).

However, if price does have some dynamic effects through habit formation by consumers (Rosenthal, 1982) by signalling information to entrants (e.g. Milgrom and Roberts, 1982), by creating reputations (see Section IV below), and so on (see also Salop, 1981, p. 16 for similar arguments used against the McGee (1958)-Telser (1966) proposition that predatory pricing will be unlikely), then, because such phenomena create a link between pre-entry prices/outputs and the post-entry choices of incumbents and the putative entrant, a limit pricing policy *can* emerge as a credible strategic investment by first movers.

9. While one can contrive circumstances in which limit pricing gains a certain credibility, other strategic investments command interest. To the extent that it is irreversible, *capacity choice* is subject to strategic considerations[12] (Wenders, 1971b; and Pyatt, 1971); constrained, unconstrained, and entry decisions with the restriction of credibility have been considered (respectively by Spence, 1977; Dixit, 1979 and 1980; for some extensions of the last model, see Schmalensee, 1981; the continuous time models of Spence, 1979, and Fudenberg and Tirole, 1981, can be thought of as loosening the constraints of these two period models). Generally speaking (and unless entry is blockaded), the existing firm will choose more capacity than would be the case in the absence of putative entrants; in the latter two cases, this is done to a lesser extent because excessively high capacity choice necessitated by small scale economies may be less profitable than allowing entry, and in any case, is unlikely to be credible; credibility also seems to rule out the possiblity of observing idle capacity when marginal production costs are independent of capacity, the post-entry concept is Nash (Dixit, 1980; Spulber, 1981), and capital is infinitely durable (Eaton and Lipsey, 1981)[13].

[12] Smith (1981) points out that these commitments may help coordinate industry responses to altered conditions, a problem likely to be found in moderately concentrated industries (Esposito and Esposito, 1974; Caves et al, 1979). Such commitments may also facilitate collusion amongst existing firms, a use which can conflict with their strategic use against entrants (Spence, 1977, p. 537).

[13] If we allow market uncertainty to come into the model, the argument becomes considerably more complex. For example, the excess capacity a firm may hold to meet demand fluctuations may also (innocently) help to deter entry. There may also be a conflict in the durability required for both making credible commitments and dealing with uncertainty.

The list of other weapons which can be used to discourage entrants is fairly lengthy, and we need mention only a few. *Advertising*[14] is a pre-commitment with, perhaps, rather high depreciation rates. More substantial are *location decisions* in geographical or product space[15]. Such spaces exaggerate the natural limits on numbers posed by scale economies; moreover, by localizing competition, such spaces may make entry prevention less of a collective good (on the problems this presents, see Wenders, 1971a; Caves and Porter, 1977)[16], and so perhaps more likely to occur. However, mere presence at a location is only part of the story; repositioning costs determines the credibility of the pre-emption and, in any case, it is the extent of presence as much as mere presence itself which discourages would be entrants. Thus, location choices do not build up strategic capital so much as facilitate the formation and exploitation of such capital. Other possible investments can be aimed at altering cost functions (whether or not scale economies exist). One possibility is *investment in learning* (Lee, 1975; Spence, 1981b) : by keeping its price low initially, the incumbent can stimulate rapid expansion of demand for its product, and so progress further down its learning curve before rivals begin competing. *Investments in style change* (Menge, 1962; see also Scherer, 1980, pp. 398 - 401) which raise the fixed component of costs, and *investments on higher wages* when small scale production is relatively labour intensive (Williamson, 1968) are also substantive, fairly irreversible pre-commitments which could supplement basic capacity, location and other choices by putting entrants at an absolute cost disadvantage. It is worth recognizing that a large part of total labour costs may come into this category because of the quasi-fixed nature of some or many labour inputs. These last possibilities suggest a broader class

[14] For recent discussions on advertising and entry, see Comanor and Wilson (1979); Schmalensee (1980); Cubbin (1981); Spence (1980) and Williamson (1963) are interesting on the interaction between advertising and scale economies.

[15] E.g. Schmalensee (1978); Salop (1979); Eaton and Lipsey (1978). The latter (pp. 464-6) present an interesting discussion of the reasonableness of entrants conjectures that existing firms are immobile. Lancaster (1979, pp. 59-61) is informative on the differences in the two types of space. For a geographical model with uncertainty, see Jovanovic (1981).

[16] If the established firms act non-cooperatively in the face of entry, it is possible that entry would be less likely than if they cooperated.

of pre-emptive strategies based on activity in *input markets* (e.g. Salop and Scheffman, 1981); aside from labour markets, capital markets (e.g. Caves et al, 1980, chapter 13) and activities in R & D (Gilbert, 1981; Dasgupta and Stiglitz, 1981; see the general survey by Kamien and Schwartz, 1982) both open up further weapons[17]. For example, an R & D strategy could create entry difficulties as competitor's costs of product development and production lag behind those of an early mover; increases in this gap may enable the dominant firm to reduce R & D expenditures without increasing the risk of entry. Another familiar example is securing control over scare inputs through vertical integration, and these are both instances of the well-known argument that vertical strategies may have important horizontal effects (perhaps even when incumbents costs rise by as much as entrants; Salop, 1981).

10. An interesting question that emerges from all of this is which of the many such weapons (or what combination of them) potentially at its disposal incumbents will use. The models we have discussed suggest that price is unlikely to be used strategically vis-à-vis entrants (i.e. that potential competition is unlikely to discipline pricing behaviour); in the absence of actual competition (but not necessarily in the absence of potential competitors) price will be set at or near monopoly levels[18]. At the level of what mix of weapons will be chosen, little progress has been made (for an exception, see Schmalensee, 1978) to go past the (not entirely persuasive) proposition that the most credible investment(s) will be the ones most relied upon, thus ranking of weapons by probability of choice according to their durability and inter-industry immobility.

---

[17] For not unrelated problems in second-hand markets for their goods faced by firms producing durable goods, see Bulow (1982) and references there in; Schmalensee (1979) is a good survey on quality choice restricted to this single dimension.

[18] That level may, however, depend on which strategic investments are made to block entrants. For example, when capacity expansion reduces marginal costs, pre-entry monopoly marginal costs (and so price) are lower when threatened entry leads to pre-emptive capacity expansion than when no putative entrants loom on the horizon. See Spence (1977, Section 3).

A second interesting question is how different exogenously given post-entry solution concepts affect the analysis. Dixit (1980) is informative on the implications of differing post-entry game rules for the effectiveness of strategic investment in capacity, as in Spulber (1981); Fudenberg and Tirole (1981) consider how Spence's (1979) model of strategic expansion is affected by alternative solution concepts while, in a not unrelated vein, Geroski (1981a) considers how variations in the post-entry solution concept affect the incidence of entry in a simple model where credible pre-emption is not possible. It is also possible empirically to make some inferences about solution concepts in the matter of price (e.g. Iwata, 1974; Gollop and Roberts, 1979; Summer; 1981; Panzar and Rosse, 1981; Geroski, 1981b; Bresnahan, 1981b), but it remains to be seen if this can also be done for capacity choice, etc.

B. *Simple Sequential Entry Processes*

11. In this and the subsequent three paragraphs, we propose (by way of a slight digression) to apply the lessons learned with the static model to a few fairly simple entry processes which provide the kind of backdrop to the dynamic analysis necessary for assessing the persistence of first movers.

Consider a process in which one identical entrant per period ($t = 0,\ldots,\infty$) arrives and tries to enter; let t^* be the number of successful trials[19]. Suppose that we are concerned with immobile location choice (each firm is allowed to move only once and to choose only one fixed size plant) when there are some scale economies. As long as commitment to a location is fixed, it represents a credible pre-commitment; as before, we allow the first firm correctly to anticipate the post-entry solution conditional on its location choice. However, when scale economies are small relative to market size, the second firm to enter will have a chance to make a pre-commitment vis-à-vis the third, fourth, and

[19]For a model of dynamics commencing with a steady stream of new ideas pertinent to product improvement which are then developed by firms, see Dasgupta and Stiglitz (1981).

so on, and similarly with each new aspirant in turn. It is thus natural to give all firms perfect foresight in this context[20].

Models considering geographical (Hay, 1976; Prescott and Visscher, 1977) or product (Lane, 1980) space suggest the not unsurprising result that the extent of scale economies determines both t* and profits at t*; further, if the market supports more than two firms, they will be evenly spaced (at about twice the minimum required distance for a single plant; compare this to Eaton and Lipsey (1975), who generate a wide range of equilibria with pairs or clusters of firms dispersed throughout space when plants are mobile). These models also provide predictions about how the space is filled up, and show clearly that location patterns differ as between a fixed numbers ($T < t^*$) model and one in which trials continue as long as t^*[21].

12. The really interesting feature of these models, however, occurs when we remove the artificial restrictions that firms are allowed to choose only one plant when they make their moves, or, instead, if we focus on capacity choice. In either event, it is clear that the first firm could always monopolize the market from the outset. To avoid such an embarassment, one must appeal to multiplant diseconomies or (rather more plausibly)

[20] This leads to solution through backward induction (see Cyert and de Groot, 1970, in a related context). The post-entry solution concept is usually taken to be Nash, but it is in some ways difficult to imagine firms with the foresight to anticipate models behaviour contenting themselves with altering only the initial conditions of the post-entry game and not its rules (e.g. becoming cooperative with some or all entrants). A difficulty with empirical application of these models is that, in the circumstances posited, it is not easy to see how an early firm which makes an irrevocable mistake would eventually be eliminated so as to insure that the equilibrium pattern is robust to miscalculations by firms.

[21] Hay (1976, pp. 247-51) considers location in a growing market in which firms must trade off short and long run profits by locating closer or further away from existing rivals. If all firms have the same discount rate, then presumably even spacing will still occur.

significant costs to large scale expansion[22]. Retaining an expansion rate of one plant per period, but now letting existing firms gradually expand by installing another new plant each period reproduces the same tendency for the model to yield highly concentrated outcomes. For example, if the market could support 10 fixed size plants, then, after four periods, entry will cease; the first mover controls 40% of the market, the second 30%, the third 20% and the marginal firm 10%.

This tendency towards monopolization is at least partly due to the artificial restrictions on both the timing and ordering of movements in the entry process considered (for an example showing the advantage of being late, see Guasch and Weiss, 1980; such advantages would further complicate the problem of determining the order of entry). Let us now suppose that the existing firm has the option of setting up a second plant when it wishes and let entrants be free to choose to enter when they wish. Since the latter are all identical, they will all choose to move at the same time (but see the related discussion in Reinganum, 1981, who shows that a Nash equilibrium in adoption dates of a new technology involves *diffusion* rather than *simultaneous* adoption). To avoid the problems that this occasions (Sherman and Willet, 1967; Goldberg and Moirao, 1973; Kalish et al, 1978), we take the case of only one entrant. Suppose that one firm already operates in the market, and that something like market growth makes feasible the existence of a second firm (for a race when the entrant is free to start at $t = 0$ as well, see Rao and Rutenberg, 1979). Eaton and Lipsey (1979) suggest that, in this case, the monopolist will move first and pre-empt the entrant because differen-

[22] This is clearly recognized by Prescott and Visscher (1977, Section 3). For empirical evidence on multiplant diseconomies; see Scherer et al (1975). It is important not to confuse such expansion costs with the fact that large firms beyond a minimal optimal size do not seem to suffer great cost disadvantage because of decentralization within the firm (Chandler, 1977; Williamson, 1970, 1975; Marris and Mueller, 1980). Penrose (1959) is the classic source on growth constraints; see Spence (1979) for a model which makes plain their role in avoiding monopoly outcomes. Jovanovic (1981) suggests that when firms have private information which is only revealed in their actual location choices, then an intertemporal trade-off (acting sooner on the basis of less information) exists which may retard initial moves to monopolize and may help to explain the actual sequence of entry. This model, it should be noted, is in the spirit of those discussed in Section IV in not assuming a first mover but in assuming incomplete information.

tial risk arising from the possibility that post-entry price competition falls unevenly between entrant and incumbent. That is, there always exists a strong presumption of pre-emption by a first mover because any possibility of less than perfect post-entry collusion makes the move less profitable for the entrant than for the incumbent who would be free to set monopoly prices if it pre-empted[23]. This lack of collusion would be a strong incentive for merger if it happened that the entrant did enter (although obviously subsequent entrants will be less likely to be deterred if such a merger occurred). Notice that whilst there are many similarities between entry barriers and mobility barriers, this differential risk argument is not as persuasive in the context of intra-industry mobility as it is in the case of entry.

A rather different race occurs when we consider renewing less than infinitely durable commitments, and allow firms to choose when to renew plant, and how durable to make it (Eaton and Lipsey, 1980 and their model III, (1981), in which the existing firm faces the possibility of predatory entry, i.e. that the entrants may displace it in a market which can only support one firm; for an interesting study of cycles in the balance of power between host nations and foreign firms determined by just this type of consideration, see Moran, 1974). The wrinkle here is that, unlike exogenous market growth, the time when entrant would like to enter is at least partly determined by actions of the existing firm. The presumption remains, however, that (however it is done) the existing firm will pre-empt the rival simply because the expected loss in profits it faces is larger than the gain to the entrant, absent perfect post-entry collusion.

13. These two kinds of model suggest a basic distinction to be made between entry processes. In the one entry trial per period model (or the exogenous market growth model), entrants appear *exogenously*; the actions of existing firms determine the *outcome* of the entry trial but not the *likelihood of occurrence* of that trial. Alternatively, the entry process

---

[23] See also Schmalensee (1978, pp. 316-8) and Gilbert (1981, p. 22) for similar remarks. Eaton and Lipsey (1979) allow the existing firm also to relocate (which gives an added incentive to pre-empt). Schmalensee (1978, pp. 316-8) adds multiplant economies to the list of inducements, but in the question of natural ready to eat cereals, he found that shifts in consumer tastes which opened up this new segment of the market were not well anticipated by existing firms. The oft-alleged sleepiness of dominant firms may be as important a limitation to the formation of monopoly as multiplant diseconomies!

can be considered *endogenous* when the number of trials (either more trials per period or an increasing frequency of trials) depends on the actions of incumbent firms, whether that be renewal of durable capital or any other action. In this second sort of model, then, choices are made about strategic variables, X, which determine not only the initial conditions of the post-entry game (i.e. the likelihood of successful entry given that a trial will occur), but also the likelihood that it will be played at all. It seems at least conceivable that the strong tendency toward monopolization evident in previous models may be weakened when entry is made endogenous.

At this stage, it is worthwhile recalling the classical model of Gaskins (1971) which lies squarely in this second tradition : in that model, the rate of entry (i.e. the rate of successful trail occurrences) is proportional to the difference between the current price of the dominant firm and the limit price (determined by entrants costs). The optimal price is such that, in the absence of absolute cost advantages, the competitive fringe will asymptotically approach total industry output[24]. All of these optimal control models work easily because of the simple conjectures the small scale entrants are assumed to hold (i.e. they take existing market data as given); in a sense, the occurrence and the outcome of each trial is blurred by the small scale nature of the entrant. When entrant try to enter at a larger scale, however, it is worth considering the entry process as consisting of at least two phases : *the generation of players* from agents scattered throughout the economy picking up signals pointing out attractive opportunities for investment, and *the generation of outcomes* by those players who elect to make a trial plus incumbents (an intermediate phase is the transformation of some/all players into those willing to generate a trial). It is clear that rational players contemplating outcomes before deciding whether to generate a trial will not be persuaded by pre-entry prices, and will require much more substantial pre-commitment before being deterred. But, such rationality depends on substantial investment in information about the market by the would be entrant and

[24] Extensions to the model include : Ireland (1972) on growing markets; Kamien and Schwartz (1971), Baron (1973), De Bondt (1976), Lippman (1980) on uncertainty, entry lags, etc; Jacquemin (1972), Jacquemin and Thisse (1972), Encaoua and Jacquemin (1980) on non-price competition;

on the type of entrant. Price (or profitability) is clearly just exactly the kind of signal which may convert a footloose agent into a player willing to invest in information, even if it is not the signal converting such a player into a successful/unsuccessful entrant[25].

Let us illustrate this endogenous process with a sketch of a model in which price can be made to re-emerge as a strategic weapon. From what has passed above, we evidently need some restrictions on the movement of the incumbent firm, and we are going to suppose limitations required by the need to finance investment[26]. Against his evident and perfectly sensible desire to completely pre-empt the market, the incumbent firm now has the constraint that his ability to do so (setting high prices, making large profits and so financing high investment rates) is the engine which makes the race all the more intense. By attracting more and more players at exactly the time at which he is most vulnerable (having not yet pre-empted), the incumbent risks generating the entry that his actions are designed to discourage. In this model of *limited first mover* advantages, price re-emerges as a strategic weapon because of its role in attracting players (and thus trials) as well as because of its role in generating finance to enable the sort of strategic investment and pre-emption which turns such trials against these entrants; it *directly* affects the likelihood of trials and *indirectly* affects their outcomes.

Kamien and Schwartz (1972) on capital stock; Lee (1975) on learning; and Encaoua et al (1981) who consider switches between dominant price leadership and monopolistic competition regimes.

[25] Obviously, use of other strategic weapons (hurried capacity expansion or rapid brand proliferation, etc) may attract attention and so increase trial frequency, but we concentrate on price to economize on space. There is some dispute about whether price or profits ought to be the signal (Baron, 1972; Caves and Porter, 1977, p. 243)

[26] For the literature on finance and capacity expansion, see Nickel (1978) and the recent note by von Ungern-Sternberg (1980). In view of the possibility that such strategic brinkmanship may lead to bankruptcy, further actors (like bankers) may be involved in strategic decisions; the bankruptcy model of Bulow and Shoven (1978) is suggestive in this context, as are some of the remarks in Shepherd (1976).

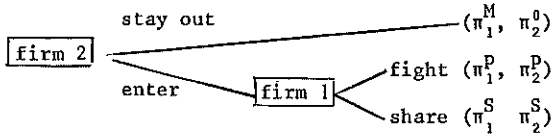
C. *A Summing Up*

14. It is now time to sum up what we have on first movers. First, from the discussion in III.A, it would seem that price is unlikely to be used as a strategic weapon, and only when consumer habits, uncertainty, or financing necessities are important. As a rule of thumb, it would seem that one can thus look to the forces of *actual* competition as those which primarily determine price. Second, from III.B, it seems that, given a first mover, strategic weapons like capacity expansion, spatial pre-emption, and so on can (at a cost) convert first movement into monopolization fairly easily even when scale economies are unimportant. Large dominant firms which stubbornly persist is the likely outcome, it seems, of unbridled strategic competition when there are first movers. This second observation also points up the importance of history in explanations of market structure. Finally, it suggests that an interesting question is not so much how a first mover can take advantage of his situation, as why it doesn't always appear to do so fully in practice. We have suggested that, in addition to phenomena like multiplant diseconomies or capacity expansion costs, the limitations may lie in the possibility that in the sheer act of running as fast as he can he attracts the attention which weaks his persistent hold in the market.

IV. STRATEGIC SYMMETRY IN PRE-ENTRY PLAY

15. Having in Section III, discussed at length entry deterrence and the persistence of positions of market power in the case where there is an exogenously given first mover, it is now time to relax this assumption. The question of interest is whether or not the conclusions derived in Section III from this assumption will survive.

Consider first the following stylized example involving two players; the second firm must decide whether or not to enter, while the first must choose either to fight or share the market with the entrant. In extensive form the payoff matrix is :



and we assume that : (i) $\pi_1^M > \pi_1^S > \pi_1^P$, and (ii) $\pi_2^S > \pi_2^0 > \pi_2^P$; (i) reflects the assumption that predation is costly for the predator, and (ii) ensures that the entrant would rather stay out than be preyed upon if it enters. Without communication the Nash equilibrium is (π_1^S, π_2^S). Allowing communication and giving *both* firms the option of having pre-play moves makes relevant the distinction between Stackelberg and Non-Stackelberg Rational games, and the stability of the Nash equilibrium is altered (see Aumann, 1974; d'Aspremont and Gérard-Varet, 1980; Moulin, 1981). The point is that when players do not move secretly, they can make agreements which, even if not binding, may be enforced by bilateral threats. The next step is to ask whether such threats are credible in this game and the answer is no; that is, the game is not Stackelberg rational and competition for the first move arises[27]. For example, the threat to fight by firm 1 is not credible because it is not its optimal response to the fact of entry and this is known by the entrant; sharing is the optimal response $(\pi_1^S > \pi_1^P)$

[27] Let $\Gamma = \{X,Y,f,g\}$ be a two-person normal game form with X and Y the sets of strategies and f and g the payoff functions. A *deterrence scheme* is a pair of strategies (x,y) and response functions (α,β) which satisfy : (i) $\alpha(y) = x$, $\beta(x) = y$; (ii) $\forall x' \in X$, $f(x',\beta(x')) \leqslant f(x,y)$ and $\forall y' \in Y$, $g(\alpha(y'),y') \leqslant g(x,y)$. Denoting best replies by $B_X(.)$, $B_Y(.)$, a deterrence scheme is *credible* if : (i) $\forall x' \in X$, $\beta(x') \in B_Y(x')$; and (ii) $\forall y' \in Y$, $\alpha(y') \in B_X(y')$; this is the same definition as in Schelling (1960). An outcome (x,y) is *Stackelberg Rational* if : (i) $\forall x' \in X$, $\exists y' \in B_Y(x')$ such that $f(x',y') \leqslant f(x,y)$; and (ii) $\forall y' \in Y$, $\exists x' \in B_X(y')$ such that $g(x',y') \leqslant g(x,y)$, where $(x,y) \in X \times Y$. The payoffs are : $S_X = \max_{x' \in X} \min_{y' \in B_Y(x')} f(x',y')$ and similarly for S_Y. Finally, a game is Stackelberg Rational (see also d'Aspremont and Gérard-Varet, 1980) if S_X and S_Y are compatible; i.e. if there exist $(x,y) \in X \times Y$ such that : $S_X \leqslant f(x,y)$ and $S_Y \leqslant g(x,y)$. The assertion of the text follows from the following result (see Moulin, 1981, for a proof) : the class of two-person normal form games for which there is no outcome which may be guaranteed by a credible deterrence scheme is the same as the class of games which are not Stackelberg rational.

as in Nash equilibrium without pre-play communication, and so entry will occur[28].

Suppose we now imagine that this game is played a finite number of times by the incumbent against different potential entrants (in a manner similar to the sequential entry process discussed in Section III.B above), allowing all information about past moves to be known at each stage by all the players. The problem is to see whether past behaviour may affect current behaviour (the same problem emerges in a super-game context where the stage game is repeated infinitely often; see Rubenstein, 1979) and whether this provides conditions for entry deterrence. Somewhat surprisingly, even in the context of this game, predatory strategies will not be adopted by the incumbent (Selten, 1978). The solution proceeds by backward induction as with the sequential entry process in Section III : in the last stage, the incumbent will not adopt the predatory strategy because it is not in its short run interest ($\pi_1^P < \pi_1^S$) and because it has no effects on future entry (since there are no more entrants). Given this, the incumbent has no incentive to deter entry in the second to last stage. Given that it has perfect information, the entrant has no reason to expect predatory behaviour at this stage and thus, by continued backward induction, it emerges that predation will never occur and, at each stage, each potential competitor will enter. The apparent absence of bluffs or other attempts to dissuade the entrant in this argument arises because of the use made of perfect equilibria which, roughly speaking, restrict the set of Nash equilibria to those which are sub-game equilibria, thus eliminating empty threats[29]. This result is the essence of "the chain-store paradox" (see Selten, 1978; for one interesting suggested resolution even with complete information, see Rosenthal, 1981).

[28] Using the definitions in footnote 27, the payoffs corresponding to a Stackelberg rational outcome are : $S_X = \pi_1^M$ and $S_Y = \pi_2^S$. They are not, however, compatible; i.e. there does not exist a couple of strategies $(x,y) \in X \times Y$ such that : $f(x,y) \geqslant \pi_1^M$ and $g(x,y) \geqslant \pi_2^S$.

[29] The Nash equilibrium concept is appropriate only in static games -- taking one's competitor's strategies as given is reasonable only when such strategies concern current moves. Perfect equilibria (Selten, 1973 and

It is thus evident that relaxing the assumption of a first move and allowing pre-entry symmetry in the ability of both firms to make threats and establish pre-commitments makes it hard to see the basis for the conclusions derived in Section III. Such results can re-emerge, however, when we alter the *context of the game*.

16. An obvious (and not very interesting) alternate environment is that of an infinite horizon version of the model just discussed and, in this case, there exists an equilibrium in which any attempted entry is met by predation. Unfortunately, there are in fact many equilibria of such a game (see Dixit, 1981, for an elementary demonstration; and Friedman, 1977 on infinitely repeated prisoners dilemma games). To see this, consider the moves of the two players at some stage n in equilibrium. For the incumbent : (i) if there has been no entry before stage n, or if the incumbent has fought previous entrants, then continue to fight at stage n; (ii) if it has accomodated previous entrants, then continue to share at stage n. For the entrant : (i) if there has been no entry before n (or if previous entry attempts have not been accomodated), then stay out; (ii) if previous entrants have been accomodated, then enter. Clearly, two completely different sequential equilibrium outcomes occur : always fighting and no entry, or accomodation and entry by all potential competitors.

Returning to finite stage games, a more promising possibility is to relax the property of *common knowledge* which has, until now, characterized the game. This common knowledge is the fact that each player knows that the other knows that cooperation is the best response to entry and that entry is the best response to cooperation[30], and it turns out that lack

1975) are more acceptable for dealing with multistage strategies. A proper sub-game of a game in extensive form is a game beginning at some node (there are two in the figure on p. 21) and involving all its successors; a set of strategies is a perfect equilibrium if the strategies yield a Nash equilibrium for every proper sub-game (for a definition in terms of normal form games, see Myerson, 1978; see also the related concept of sequential equilibria, Kreps and Wilson, 1982).

[30] The definition of common knowledge has been formalized by Aumann (1976) and has been given an axiomatic characterization by Milgrom (1981a) who writes (p. 219) : "... *intuitively, an event A is common knowledge among a group of agents if each agent knows A, each knows that all know A, each knows that all know that all know A, ..., etc. In this case, the 'etc' encompasses an infinite sequence of conditions each more stringent than the one before*".

of common knowledge can be sufficient to generate predatory strategies in equilibrium. The basic idea is that each entrant does not know whether a profitable commitment to the market exists, because it cannot distinguish "innocent" from "strategic" situations. As a simple illustration of the argument, consider a three state world and a two stage game (a monopolist confronted by two potential entrants, one after the other). In one state of the world, the game is played at each stage in such a manner that entry automatically results in predatory responses by the incumbent; in the other two states, the game is the same as in paragraph 15 above. Let the three states of the world be equally likely but not observed, and suppose that the information sets of the players are such that, in the latter two states of the world, the incumbents' aversion to predation is not obvious to the entrants. Then, a sequential equilibrium can involve a strategy of predation because the entrant can no longer clearly distinguish the three states of the world, and, in particular, it cannot infer them from the actions of the incumbent.

This basic notion underlies the rather different models of Milgrom and Roberts (1980; see also their 1982 paper) and Kreps and Wilson (1980; see also Kreps et al, 1981 for application of these ideas to the prisoners' dilemma game). Let us suppose that the incumbent has perfect information, while the entrants are not so informed[31], and believe that the incumbent is either in a "strong" or "weak" position (this is one of the two cases analyzed by Kreps and Wilson). The first entrant in the (finite) sequence has some subjective probability about which state applies to the incumbent, and each subsequent entrant has full knowledge of all that occurred in previous stages of the game. What turns out to be essential is that there exists a non-null probability that the incumbents payoffs will be higher if it fights entry than if it accepts entry without fighting; hence it is not longer clear to the entrant whether a state of the world in which the incumbent is "strong" has occurred or whether predation is occurring when the monopolist is "weak". The equilibrium leads to fighting at early stages of the game and the creation of a

[31] The obvious cause of this ignorance is their outsider position. The other possibility - that such ignorance can be strategically created by the incumbent - can only occur if we allow first movement.

reputation effect[32]. A rather different type of departure from common knowledge is introduced by Milgrom and Roberts. Here fighting always gives a smaller payoff than sharing, but now there is always some doubt in the minds of the entrants about the characteristics of the existing firm. This is represented by the belief (by entrants) at each stage that some simple behavioural rule guides the incumbent's behaviour; all the rules are given a non-null probability of realization. The point now is that the possibilities expected by an entrant at stage n include both predatory and cooperative responses, so that, once again, the actions of the incumbent do not permit precise inferences about unknown parameters. When the number of stages is fairly large, predation will occur in early stages, since failure to do so would encourage entry while preying keeps alive the possibility that future entrants will meet a similar response.

It is thus clear that reputation effects can arise from the lack of common knowledge inherent in each situation, with the corresponding uncertainty giving some rationality to predatory practices; in particular, in the context of a repeated play game with incomplete information, the threat of predation is credible even if it is not the ex post optimal response. A not dissimilar result can also emerge when it is not a reputation for toughness that matters but a reputation for weakness; i.e. where the incumbent tries to persuade the entrant that the market is inherently unprofitable. Easley et al (1981) show that, even when all parties have rational expectations but incomplete information, a multi-market incumbent facing entrants who are not sure which markets are inherently unprofitable can deter entry[33].

---

[32] If the same firm attempts entry repeatedly, it may also have the opportunity to build a reputation. Alternately, if the entrant is a large, established firm (see II.B above) then it may bring a reputation into the game.

[33] On games of persuasion, see Milgrom (1981b). Rosenthal (1981), in the same decision analysis framework (rather than game theoretic) as Easley et al (1981) shows that predatory strategies may occur when potential competitors have ad hoc expectations expressed by assigning, at every move, subjective probabilities to every subsequent choice.

17. Having started this section by showing that, when we relax the first mover assumption of Section III but retain assumptions about perfect information, we lose a rational basis for deterrence strategies, we wind up with fairly similar looking results when we relax the perfect information assumption. It is important to recognize that the reputation established by an incumbent in these models is not the result of allowing the incumbents to make a choice first; it is a natural feature of the solution of a non-Stackelberg Rational game in which it matters who has the first move, and so is a *consequence* of the analysis (and in particular, assumptions about information symmetries) rather than an initial assumption : a *functional* relationship between the established firms actions and those of the entrant emerge endogenously of the equilibrium. It is clear that the rigid exogenous sequencing of these multistage games must be relaxed (along the lines of Section III.B) and the arbitrary imposition of incomplete information must be given justification before one can completely accept the claim that these models provide a persuasive rationale for predation in the absence of assumed first movement[34] ; such modifications ought also to continue to soften the unacceptably ahistorical tone of many of these models. Without such extensions, the choice between the two approaches -- assuming a first mover or allowing strategic symmetry under conditions of imperfect information -- can only be made on empirical grounds, for both contain different but ultimately no less arbitrary bases.

V. CONCLUSIONS

18. We have surveyed here what might be thought of as dynamic extensions to the familiar static structure-conduct-performance paradigm, in the sense that we have allowed conduct to become embedded in subsequent market structure. This occurs as firms make strategic investments to retard or deter entry. The main conclusion to be drawn from this discussion is

[34] A further question is whether the non-cooperative framework is the best one to adopt for treating all entry problems. In virtually all the models using sequential entry processes, the possibility of cooperation with an entrant arriving at time t to fight all subsequent entrants is either ruled out or neglected.

that strategic investment using non-price variables is likely to be used for the necessary pre-commitments to deter entry; when there is strategic symmetry but a lack of common knowledge, then price *may* be used strategically, but it is possible that other weapons dominate even in such situations. A second conclusion is that when first mover advantages are present, strong tendencies towards monopoly based on strategic pre-emption exist. In a nutshell, much support can be found in this literature for the notion that dominant firms can profitably persist (which is, in fact, what they appear to do; see Mueller, 1977; Shepherd, 1975; and Scherer, 1980, for a discussion of the evidence).

19. The interesting question that remains concerns the normative implications of this analysis. A full discussion is beyond the scope of this survey, but it is worth closing with a few remarks on some recent arguments which suggest that observed market structure constitute reasonable approximations to efficient structures. One argument is that if entry is free, exit costless and, more generally, if markets are contestable, then no strategic weapon could enable a dominant firm to avoid marginal cost pricing; all things required for a first best optimum would be present (Baumol et al, 1982; Baumol, 1982). A second, alternate, argument is that, in a less than perfect world, what is called an entry barrier may actually reflect consumers interests broadly considered (Demsetz, 1982; see also von Weizsäcker, 1981, for a less extreme view). Rather than allowing resources into high profit industries, it might be better from the point of view of consumer welfare more generally to take into account the role of externalities, information, and transaction costs, and to consider entry barriers to be valuable second best answer to real world frictions[35]: "... *existing firms have an advantage insofar as their existence commands loyalty ... (that is) it reflects lower real costs of transacting, industry specific investments, or a reputable history as, in general, it will ... A reputable history is an asset to the firm possessing it because information is not free ...*" (Demsetz, 1982, pp. 50-1).

[35] Compare this with Stiglitz (1981), who argues that in precisely this case -- where markets are incomplete, information is costly, and where R & D expenditures are important -- *increases* in competition may have *adverse* effects on welfare.

However, to the extent that entry is not free (e.g. that most fixed costs are sunk, that all firms are not identical, and so on), and to the extent that a large part of the costs of entry result from the deliberate creation of asymmetries by existing firms, and to the extent that prices are more easily than one cannot accept such a sanguine view that : *"what is, is reasonably efficient"*. If, in addition, the costs of monopoly are high (as argued, for example, by Cowling and Mueller, 1978), then one is entitled to view strategic conduct as, at best, a mixed blessing. There are examples of reasonably contestable markets and cases where entry costs are innocently created, and, the use of some strategic weapons does have ambiguous effects on welfare. But it seems to us[36] that there are no strong normative conclusions in this literature to calm the apprehensions of those who have never been persuaded that the unregulated activity of the large dominant firms characterizing many modern markets has benign effects on welfare.

[36] For a rejection of "per se" rules one way or the other and arguments in favour of a cautious case by case approach, see Spence (1981a). Certainly a case by case approach has at least the virtue of generating the precise empirical knowledge which will ultimately prove decisive in this matter.

BIBLIOGRAPHY

Aumann, R. (1974), Subjectivity and correlation in randomized strategies. *Journal of Mathematical Economics*, 1, 67-96.

Aumann, R. (1976), Agreeing to disagree. *The Annals of Statistics*, 4, 1236-1239.

Bain, J. (1956), *Barriers to New Competition*. Cambridge (Mass.), Harvard University Press.

Bain, J. (1959), *Industrial Organization*. New York, Wiley.

Baron, D. (1972), Limit pricing and models of potential entry. *Western Economic Journal*, 10, 298-307.

Baron, D. (1973), Limit pricing, potential entry and barriers to entry. *American Economic Review*, 63, 666-74.

Baumol, W. (1982), Contestable markets : an uprising in the theory of industry structure. *American Economic Review*, 72, 1-15.

Baumol, W. and R. Willig (1981), Fixed costs, sunk costs, entry barriers, public goods and the sustainability of monopoly. *Quarterly Journal of Economics*, 96,

Baumol, W., J. Panzar and R. Willig (1982), *Contestable Markets and the Theory of Industry Structure*. Harcourt, Brace and Jovanovich, San Diego.

Bhagwatti, J. (1970), Oligopoly theory, entry prevention and growth. *Oxford Economic Papers*, 22, 297-310.

Boyer, M. (1981), Strategic equilibrium with reaction threats. Mimeo, CORE, Université Catholique de Louvain.

Bresnahan, T. (1981a), Duopoly models with consistent conjectures. *American Economic Review*, 71, 934-46.

Bresnahan, T. (1981b), Departures from marginal cost pricing in the American automobile industry. *Journal of Econometrics*, 17, 201-27.

Bulow, J. and J. Shoven (1978), The bankruptcy decision. *Bell Journal of Economics*, 9, 437-56.

Bulow, J. (1982), Durable goods monopolies. *Journal of Political Economy*, 90, 314-332.

Caves, R. (1976), The determinants of market structure : Design for Research, in Jacquemin, A. and H. de Jong (eds), *Markets, Corporate Behaviour and the State*. The Hague, M. Nijhoff, 3-18.

Caves, R. and M. Porter (1976), Barriers to exit. In R.T. Masson and P.D. Qualls (eds), *Essays on Industrial Organization in Honnor of Joe S. Bain*. Cambridge, Ballinger.

Caves, R. and M. Porter (1977), From entry barriers to mobility barriers : conjectural decisions and contrived deterrence to new competition. *Quarterly Journal of Economics*, 91, 241-61.

Caves, R., J. Jarrett and M. Loucks (1979), Competitive conditions and the firm's buffer stocks : an explanatory analysis. *Review of Economics and Statistics*, 61, 485-96.

Caves, R., M. Porter and M. Spence (1980), *Competition in the Open Economy*. Cambridge (Mass.), Harvard University Press.

Chandler, A. (1977), *The Visible Hand : the Managerial Revolution in American Business*. Cambridge (Mass.), Harvard University Press.

Comanor, W. and T. Wilson (1979), The effect of advertising on competition : a survey. *Journal of Economic Literature*, 17, 453-76.

Cowling, K. (1976), On the theoretical specification of structure-performance relationships. *European Economic Review*, 8, 1-14.

Cowling, K. and D. Mueller (1978), The social costs of monopoly power. *Economic Journal*, 88, 727-48.

Cubbin, J. (1981), Advertising and the theory of entry barriers. *Economica*, 48, 289-98.

Cyert, R. and H. De Groot (1970), Multiperiod decision models with alternating choice as a solution to the duopoly problem. *Quarterly Journal of Economics*, 84, 410-29.

d'Aspremont, C. and L.A. Gérard-Varet (1980), Sincere pre-play communication and Stackelberg competitive games. *Journal of Economic Theory*, 23, 201-17.

Dasgupta, P. and J. Stiglitz (1981), Entry, innovation, exit : towards a dynamic theory of oligopolistic industrial structure. *European Economic Review*, 15, 137-58.

De Bondt, R. (1976), Limit pricing, uncertain entry and the entry lag. *Econometrica*, 44, 939-46.

Demsetz, H. (1982), Barriers to entry. *American Economic Review*, 72, 47-57.

Dixit, A. (1979), A model of duopoly suggesting a theory of entry barriers. *Bell Journal of Economics*, 10, 20-32.

Dixit, A. (1980), The role of investment in entry deterrence. *Economic Journal*, 90, 95-106.

Dixit, A. (1981), Recent developments in oligopoly theory. Mimeo, Princeton University.

Easley, D., R. Masson and R. Reynolds (1981), A dynamic analysis of predatory pricing with rational expectations. Mimeo, Cornell University.

Easterbrook, F. (1981), Predatory strategies and counter-strategies. *University of Chicago Law Review*, 48, 263-337.

Eaton, B.C. and R. Lipsey (1975), The principle of minimum differentiation reconsidered : some new developments in the theory of spatial competition. *Review of Economic Studies*, 62, 27-49.

Eaton, B.C. and R. Lipsey (1978), Freedom of entry and the existence of pure profit. *Economic Journal*, 88, 455-69.

Eaton, B.C. and R. Lipsey (1979), The theory of market pre-emption : the persistence of excess capacity and monopoly in growing spatial markets. *Economica*, 46, 149-58.

Eaton, B.C. and R. Lipsey (1980), Exit barriers are entry barriers : the durability of capital as a barrier to entry. *Bell Journal of Economics*, 11, 721-9.

Eaton, B.C. and R. Lipsey (1981), Capital, commitment and entry equilibrium. *Bell Journal of Economics*, 12, 593-604.

Encaoua, D. and A. Jacquemin (1980), Degree of monopoly, indices of concentration and threat of entry. *International Economic Review*, 21, 87-105.

Encaoua, D., A. Jacquemin and Ph. Michel (1981), Stratégies dynamiques de prix et structures de marché. *Cahiers du Séminaire d'Econométrie*, 23, 153-168.

Esposito, F. and L. Esposito (1974), Excess capacity and market structure. *Review of Economics and Statistics*, 61, 188-94.

Farrar, D. and Ch.Phillips (1959), New developments on the oligopoly front : a comment. *Journal of Political Economy*, 47, 414-17.

Fisher, F. (1959), New developments on the oligopoly front : Cournot and the Bain-Sylos analysis. *Journal of Political Economy*, 67, 410-13.

Friedman, J. (1977), *Oligopoly and the Theory of Games*. Amsterdam, North-Holland.

Friedman, J. (1979), On entry preventing behaviour and limit price models of entry, in Brams, S.J., A. Schotter and G. Schwödiauer (eds), *Applied Game Theory*, Vienna, Physica-Verlag.

Fudenberg, D. and J. Tirole (1981), Capital as a commitment : strategic investment in continuous time. Mimeo, MIT.

Gale, B. (1972), Market share and rate of return. *Review of Economics and Statistics*, 54, 412-423.

Gaskins, D. (1971), Dynamic limit pricing : optimal pricing under threat of entry. *Journal of Economic Theory*, 3, 306-22.

Geroski, P. (1981a), The incidence of entry in three oligopoly models. Mimeo, Université Catholique de Louvain.

Geroski, P. (1981b), The empirical analysis of conjectural variations in oligopoly. Mimeo, Université Catholique de Louvain.

Gelman, J. and S. Salop (1982), Judo economics, entrant advantages, and the great airline coupon wars. Mimeo, FTC.

Gilbert, R. (1981), Patents, sleeping patents and entry deterrence, in Salop, S. (ed), *Strategy, Predation and Anti-Trust Analysis*. Washington, F.T.C.

Gilbert, R. and R. Harris (1982), Competition with lumpy investments. Berkeley, Department of Economics, mimeo.

Goldberg, V. and S. Moirao (1973), Limit pricing and potential competition. *Journal of Political Economy*, 81, 1460-66.

Gollop, F. and M. Roberts (1979), Firm interdependence in oligopolistic markets. *Journal of Econometrics*, 10, 313-31.

Grossman, S. (1981), Nash equilibrium and the industrial organization of markets with large fixed costs. *Econometrica*, 1149-72.

Guasch, J. and A. Weiss (19), Adverse selection by markets and the advantage of being late. *Quarterly Journal of Economics*, 94, 453-466.

Harris, R. (1978), Entry regulation, fixed costs and dominant public firms. Mimeo, Queen's University.

Harris, R. and E. Wiens (1980), Investment in capacity and a normative theory of the dominant public firm. *Canadian Journal of Economics*, 13, 125-31.

Hay, D. (1976), Sequential entry and entry deterring strategies in spatial competition. *Oxford Economic Papers*, 28, 240-57.

Hay, G. (1981), A confused lawyers guide to the predatory pricing literature, in Salop, S. (ed), *Strategy, Predation and Anti-trust Analysis*. Washington, F.T.C.

Hines, H. (1957), Effectiveness of entry by already established firms. *Quarterly Journal of Economics*, 71, 132-50.

Ireland, N. (1972), Concentration and the growth of market demand. *Journal of Economic Theory*, 5, 303-5.

Iwata, G. (1974), Measurement of conjectural variations in oligopoly. *Econometrica*, 42, 947-66.

Jacquemin, A. (1967), *L'entreprise et son pouvoir de marché*. Paris, PUF.

Jacquemin, A. (1972), Market structure and the firm's market power. *Journal of Industrial Economics*, 20, 122-34.

Jacquemin, A. and J. Thisse (1972), Strategy of the firm and market structure : an application of optimal control theory, in Cowling, K. (ed), *Market Structure and Corporate Behaviour*. London, Gray-Mills.

Jovanovic, B. (1981), Entry with private information. *Bell Journal of Economics*, 12, 649-660.

Kalish, L., J. Hartzog and H. Cassidy (1978), The threat of entry with mutually aware potential entrants. *Journal of Political Economy*, 86, 147-53.

Kamien, M. and N. Schwartz (1971), Limit pricing and uncertain entry. *Econometrica*, 39, 441-54.

Kamien, M. and N. Schwartz (1972), Uncertain entry and excess capacity. *American Economic Review*, 62, 918-27.

Kamien, M. and N. Schwartz (1982), *Market Structure and Innovation*. Cambridge, Cambridge University Press.

Kaysen, C. and D. Turner (1959), *Antitrust Policy*. Cambridge (Mass.), Harvard University Press.

Klevorick, A. and P. Joskow (1979), A framework for analyzing predatory pricing policy. *Yale Law Journal*, 89,

Kreps, D. and R. Wilson (1980), On the chain-store paradox and predation : reputation for 'toughness'. Forthcoming in *Journal of Economic Theory*.

Kreps, D., P. Milgrom, J. Roberts and R. Wilson (1981), Rational cooperation in the finitely repeated prisoner's dilemma. Forthcoming in *Journal of Economic Theory*.

Kreps, D. and R. Wilson (1982), Sequential equilibria. Forthcoming *Econometrica*.

Lancaster, K. (1979), *Variety, Equity and Efficiency*. Oxford, B. Blackwell.

Lane, W. (1980), Product differentiation in a model with endogenous sequential entry. *Bell Journal of Economics*, 11, 237-60.

Lee, W. (1975), Oligopoly and entry. *Journal of Economic Theory*, 11, 35-54.

Lippman, S. (1980), Optimal pricing to returned entry. *Review of Economic Studies*, 47, 723-31.

McGee, J. (1958), Predatory price cutting : the standard oil case. *Journal of Law and Economics*, 1, 137-69.

Marris, R. and D. Mueller (1980), The corporation and competition. *Journal of Economic Literature*, 18, 32-63.

Menge, J. (1962), Style change costs as a market weapon. *Quarterly Journal of Economics*, 76, 632-47.

Milgrom, P. (1981a), Good news and bad news : representation theorems and applications. *Bell Journal of Economics*, 12, 380-92.

Milgrom, P. (1981b), An axiomatic characterization of common knowledge. *Econometrica*, 49, 219-22.

Milgrom, P. and J. Roberts (1980), Predation, reputation and entry deterrence. Forthcoming in *Journal of Economic Theory*.

Milgrom, P. and J. Roberts (1982), Limit pricing and entry under incomplete information : an equilibrium analysis. *Econometrica*, 50, 443-59.

Modigliani, F. (1958), New developments on the oligopoly front. *Journal of Political Economy*, 66, 215-32.

Moran, T. (1974), *Multinational Corporations and the Politics of Dependence*. Princeton, Princeton University Press.

Moulin, H. (1981), Deterrence and cooperation : a classification of two-person games. *European Economic Review*, 15, 179-94.

Mueller, D. (1977), The persistence of profits above the norm. *Economica*, 44, 369-80.

Myerson, R. (1978), Refinements of the Nash equilibrium concept. *International Journal of Game Theory*, 7, 73-80.

Newman, H. (1978), Strategic groups and the structure-performance relationship. *Review of Economics and Statistics*, 60, 417-427.

Nickell, S. (1978), *The Investment Decisions of Firms*. Oxford, Oxford University Press.

Osborne, D. (1973), On the rationality of limit pricing. *Journal of Industrial Economics*, 22, 71-80.

Panzar, J. and J. Rosse (1981), Structure, conduct and comparative statics. Mimeo, Bell Labs.

Penrose, E. (1959), *The Theory of the Growth of the Firm*. Oxford, B. Blackwell.

Porter, M. (1980), The structure within industries and companies performance. *Review of Economics and Statistics*, 62, 214-227.

Porter, M. (1981), Strategic interaction : some lessons from industry histories for theory and anti-trust policy, in Salop, S. (ed), *Strategy, Predation and Anti-trust Analysis*. Washington, F.T.C.

Posner, R. (1972), *Economic Analysis of Law*. Boston, Little, Brown and Company.

Prescott, E. and M. Visscher (1977), Sequential location among firms with foresight. *Bell Journal of Economics*, 8, 378-93.

Pyatt, G. (1971), Profit maximization and the threat of new entry. *Economic Journal*, 81, 242-255.

Rao, R. and D. Rutenberg (1979), Pre-empting an alert rival : strategic timing of the first plant by analysis of sophisticiated rivalry. *Bell Journal of Economics*, 10, 412-28.

Reinganum, J. (1981), Market structure and the diffusion of new technology. *Bell Journal of Economics*, 12, 618-624.

Rosenthal, R. (1981), Games of perfect information, predatory pricing, and the chain-store paradox. *Journal of Economic Theory*, 25, 92-100.

Rosenthal, R. (1982), A dynamic model with customer loyalties. *Journal of Economic Theory*, 27, 69-76.

Rubenstein, A. (1979), Strong perfect equilibria in supergames. *International Journal of Game Theory*, 9, 1-12.

Salop, S. (1979), Monopolistic competition with outside goods. *Bell Journal of Economics*, 10, 335-38.

Salop, S. (1979), Strategic entry deterrence. *American Economic Review*, Papers and Proceedings, 335-38.

Salop, S. and C. Shapiro (1980), A guide to test market predation. Mimeo, Princeton University.

Salop, S. and D. Scheffman (1981), Strategic interaction in multiple markets : a beginning to a general theory of dominant firm industries. Mimeo, F.T.C.

Salop, S. (1981), Strategy, predation and anti-trust analysis, in Salop, S. (ed), *Strategy, Predation and Antitrust Analysis*. Washington, F.T.C.

Schelling, T. (1960), *The Strategy of Conflict*. Cambridge (Mass.), Harvard University Press.

Scherer, F.M., A. Beckenstein, E. Kaufer and R. Murphy (1975), *The Economics of Multiplant Operation : an International Comparison Study*. Cambridge (Mass.), Harvard University Press.

Scherer, F.M. (1980), *Industrial Market Structure and Economic Performance*. Chicago, Rand McNally.

Schmalensee, R. (1978), Entry deterrence in the ready to eat breakfast cereal industry. *Bell Journal of Economics*, 9, 305-27.

Schmalensee, R. (1979), Market structure, durability, and quality : a selective survey. *Economic Inquiry*, 17, 177-196.

Schmalensee, R. (1980), The new industrial organization and the economic analysis of modern markets. Mimeo, MIT.

Schmalensee, R. (1981), Economies of scale and barriers to entry. *Journal of Political Economy*, 89, 1228-38.

Selten, R. (1973), A simple model of imperfect competition where 4 are few and 6 are many. *International Journal of Game Theory*, 2,

Selten, R. (1975), Re-examination of the perfectness concept for equilibrium points in extensive games. *International Journal of Game Theory*, 4, 25-55.

Selten, R. (1978), The chain-store paradox. *Theory and Decision*, 9, 127-59.

Shepherd, W. (1972), The elements of market structure. *Review of Economics and Statistics*, 54, 25-36.

Shepherd, W. (1975), *The Treatment of Market Power*. New York, Columbia University Press.

Shepherd, W. (1976), The elements and evolution of market structure, in Jacquemin, A. and H. de Jong (eds), *Markets, Corporate Behaviour and the State*. The Hague, M. Nijhoff.

Sherman, R. and T. Willett (1967), Potential entrants discourage entry. *Journal of Political Economy*, 75, 400-3.

Simon, H. (1978), Rationality as process and as product of thought. *American Economic Review*, 68, 1-16.

Smith, R. (1981), Efficiency gains from strategic investments. *Journal of Industrial Economics*, 30, 1-24.

Spence, M. (1977), Entry, capacity, investment and oligopolistic pricing. *Bell Journal of Economics*, 8, 534-44.

Spence, M. (1979), Investment strategy and growth in a new market. *Bell Journal of Economics*, 10, 1-19.

Spence, M. (1980), Notes on advertising, economies of scale and entry barriers. *Quarterly Journal of Economics*, 94, 493-504.

Spence, M. (1981a), Competition, entry and antitrust policy, in Salop, S. (ed), *Strategy, Predation and Anti-trust Analysis*. Washington, F.T.C.

Spence, M. (1981b), The learning curve and competition. *Bell Journal of Economics*, 12, 49-70.

Spulber, D. (1981), Capacity, output and sequential entry. *American Economic Review*, 71, 503-14.

Stigler, G. (1968), *The Organization of Industry*. Homewood, Irwin.

Stiglitz, J. (1981), Potential competition may reduce welfare. *American Economic Review*, Papers and Proceedings, 184-9.

Telser, L. (1966), Cut-throat competition and the long purse. *Journal of Law and Economics*, 9, 259-77.

Ulph, D. (1981), Rational conjectures in the theory of oligopoly. Mimeo, University College, London.

von Ungern-Sternberg, T. (1980), Current profits and investment behavior. *Bell Journal of Economics*, 11, 745-8.

von Weiszäcker, C. (1981), A welfare analysis of barriers to entry. *Bell Journal of Economics*, 11, 399-420.

Weiss, L. (1974), The concentration-profits relationship and antitrust. In H. Goldschmid, H.M. Mann and F. Weston (eds), *Industrial Concentration : the New Learning*. Boston, Little, Brown.

Wenders, J. (1971a), Collusion and entry. *Journal of Political Economy*, 79, 1258-77.

Wenders, J. (1971b), Excess capacity as a barrier to entry. *Journal of Industrial Economics*, 20, 14-19.

Williamson, O.E. (1963), Selling expense as a barrier to entry. *Quarterly Journal of Economics*, 77, 112-28.

Williamson, O.E. (1968), Wage rates as a barrier to entry : the case in perspective. *Quarterly Journal of Economics*, 82, 85-116.

Williamson, O.E. (1970), *Corporate Control and Business Behavior*. Englewood Cliffs (N.J.), Prentice-Hall.

Williamson, O.E. (1975), *Markets and Hierarchies*. New York, Free Press.

Worcester, D. (1975), Why dominant firms decline. *Journal of Political Economy*, 65, 338-47.

Yamey, B. (1972), Predatory price cutting : notes and comments. *Journal of Law and Economics*, 15, 129-42.