
New Developments in the Analysis of Market Structure

Edited by

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for the

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New Developments in the Analysis of Market Structure

Proceedings of a conference held by the
International Economic Association
in Ottawa, Canada

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Introduction

Joseph E. Stiglitz

This volume contains the proceedings of the International Economic Association Round Table Conference on New Developments in the Analysis of Market Structures held in Ottawa, Canada from 10 to 14 May 1982.

The past decade has been marked by a number of important developments in the theory of market structures. These have affected both our views of how markets function and the tools which we use in our analyses. The purpose of the conference was to survey some of these developments, to push forward our understanding of some of the important issues and to give some direction for future research in this area.

In this introduction I do not propose to summarise each of the chapters. They are written with a clarity which is unusual for such technical pieces, and speak for themselves. The excellent summary of the discussion by Frank Mathewson and Michael Peters provides the reader with at least a hint of the lively exchange of views that occurred during the four days of the conference. What I would like to do in this introduction is bring out a few of the major themes that reappeared both in the papers and the discussions, themes which reflect some of these major developments.

My discussion will be organised around six topics:

1. *The determinants of market structure.* What determines the number of firms in an industry, and whether a firm which is in a dominant position in a market remains so.
2. *The determinants of the 'force' of competition.* The behaviour of a market is determined not only by the number of firms in the market. What are other factors determining the effective degree of competitiveness of the market?
3. *The new theory of the firm and the role of competition.* The consequences of alternative market structures obviously depend, in part, on the behaviour of those who manage the firm.

What difference does it make if managers pursue some objective other than maximising the (present discounted value of) profits of the firm?

4. *Decentralisation and co-ordination.* The classical question in industrial organisation, which concerns the consequences of vertical integration, can be placed within a broader context. What is at issue is not only the extent to which various economic activities should be organised through markets rather than hierarchies, but also the scope for a much broader set of contractual relationships not adequately described by these two polar forms of organisation.
5. *Competition and market structure in Socialist economies.* The literature on market structure has primarily developed as an outgrowth of problems facing developed, mixed capitalist economies. Yet similar issues arise in economies in which government enterprises play a more dominant role.
6. *Welfare economics.* The recent developments in the theory of market structure have suggested that the kinds of models underlying traditional anti-trust policy are inappropriate. This has led to some marked changes in views concerning government policies aimed, for instance, at encouraging competition.

I now consider these issues in more detail.

1. *The determinants of market structure.* A central set of questions, around which the conference was focused, concerns the nature of competition and the determinants of market structure. Few markets – particularly for goods produced by the industrial sector – are perfectly competitive. There are few firms that act as price takers – which believe that were they to raise their price by 1 per cent, they would lose all their customers. Yet firms do compete: in most industries, there are several firms; even when there are relatively few firms, there is often the possibility of entry; potential competition *may be* as effective as actual competition. And firms compete not only on price; they compete by their choice of products, the quality of the services they provide, and their advertising; and they compete in R & D, and in the development of new products and new techniques of production.

These ideas are, of course, not new. In the 1930s Robinson (1934) and Chamberlin (1933) each developed their own version of theories of imperfect or monopolistic competition. And Schumpeter developed his own theory, in which one firm succeeds another in a

position of temporary monopoly, as each develops inventions which supersede those which have gone before. These ideas remained almost dormant for forty years. In the meantime, there were rapid advances in the economists' tool-kits. When the resulting new techniques were applied to these old problems, new insights were obtained and new questions posed.

While much of the earlier literature took the market structure (e.g. the number of firms) as given, the new theory of market structure begins by asking what determines the number of firms? What are the barriers to entry? To what extent and by what mechanisms can existing firms deter entry? And will they wish to do so?

The objective of this line of research is to identify *exogenous* variables – characteristics of technology (including the technology of innovation and invention) and of demand. These exogenous variables determine the market structure, which is thus viewed to be *endogenous*.¹

Two general features of technology play a central role in explaining both market structure and the nature of competition: non-convexities and irreversibilities (sunk costs). While many production technologies may exhibit one or both of these characteristics, technological change (whether arising from explicit expenditures on research and development or from learning by doing) and information technologies (both those associated with consumers' learning about products and firms, for example, through advertising or search, and firms' learning about customers and technologies) are characterised by non-convexities and irreversibilities (see for example the chapters by Schmalensee and Dasgupta in this volume.)

Recent research has also attempted to identify *strategies* by which existing firms might deter entry, and to assess whether such *strategies* are ever equilibrium strategies. That is, it must not only be possible for existing firms to deter the entry of new rivals: it must also be in their interests to pursue such strategies. (More precisely, entry deterrence must be shown to arise in equilibrium, in response to the equilibrium strategies pursued by other firms, including potential entrants.)

The tools of game theory have proved of invaluable assistance in clarifying ideas here, though, as research has progressed, it has become increasingly clear that the central problems to be solved are economic and not just mathematical problems. We can analyse the Nash equilibrium, given the strategy spaces of each of the participants; but there are usually many equilibria; the mathematics does

not tell us which to choose. And the set of equilibria is likely to differ markedly, depending on the strategy spaces assumed; again, the mathematics does not tell us what is the 'correct' strategy space to assume. Should we assume that firms set their own prices, and take the prices of other firms as given? Or should we assume that firms set quantities, and take the quantities of other firms as given? Or should we consider some alternative strategy space, such as that employed by Grossman (1981)? Should we restrict strategies to depend only on a current pay-off relevant to 'state' variables; or should they be at least allowed to depend on history? What kinds of commitments are feasible? How can they be made binding?

There are two broad approaches to the analysis of the determinants of market structure (the number of firms in equilibrium). In the first, all firms make their investment decisions simultaneously (or there are no sunk costs). The earlier work on monopolistic competition (as well as the Loury and Dasgupta – Stiglitz analyses of market structure and technical change) is of this variety. In the second, the sequential nature of decision making is central: some firm(s) is (are) already in the market. There are some potential entrants. The incumbent firm(s) may undertake some action(s) which may deter entry.

In the following paragraphs, I want to discuss briefly a few of the general *economic* issues associated with entry deterrence.

The recent literature has made use of an important distinction between *state* variables, variables which cannot be instantaneously changed, and variables which *can* be instantaneously changed (see, for instance, Stiglitz, 1981). An entrant, in deciding on whether to enter, must come to some view concerning the nature of the equilibrium which will emerge *after* he has entered. The nature of that equilibrium will depend on the characteristics of the incumbent firms at that time – on their state variables.²

A class of state variables that is of particular interest comprises binding pre-commitments. The firm signs a contract that it will produce a given quantity of output, or purchase a given quantity of inputs, with a proviso that if it fails, it must incur a large penalty, a penalty sufficiently large that it pays the firm to live up to its commitment. If there were no restrictions on the kinds of binding contract that could be signed, it would be easy for any firm to deter entry. The firm would sign a contract with all its customers that committed it to deliver its good at an outrageously low price so long as another firm was in the market. Given that the incumbent firm had signed such binding contracts, it would not pay any other firm to enter the

market, and so entry would be costlessly deterred. Such contracts do not *seem* to be prevalent. Why? Are there some important contractual arrangements which serve to deter entry (perhaps more subtly than in the above example)? What provides a limit to the use of these contractual arrangements as entry deterrence devices? At present, there are no agreed answers to these questions. (There are some obvious intuitive explanations for why such contracts are not signed; if the event (entry) occurs, it will be very costly to the firm making such a commitment. But in the context of most of the formal models, where all firms are rational, entry *never* occurs if the binding commitment has been made, and hence the costs of enforcement are never incurred.)

A state variable which has been at the centre of discussion since Spence's 1977 paper is the use of *excess* capacity as an entry deterrent. Clearly, in general, the stock of *sunk* capital affects the nature of equilibrium. (If the capital is costlessly mobile, then it is not a state variable, and cannot serve as an entry deterrent.) Spence showed that in his simple model, by increasing the excess capacity, the existing firm could deter entry if the entrant believed that the firm would use the full capacity upon his entry. Dixit (1980) posed the question, was this a reasonable expectation? He postulated that the entrant would assume (a) that his rival was rational, and (b) that once the entrant had entered, and committed himself to a particular sunk capital, his rival would respond in a rational manner. In the equilibrium, the existing firm does not increase its output to use its excess capacity, but accommodates the entrant, in general by lowering its output. Thus excess capacity is not a credible entry deterrent.

This illustrates the central role of beliefs, expectations about what will happen after entry. Much of the recent literature can be viewed as attempting to ask what restrictions can be placed on these beliefs by postulates of 'rationality'. For instance, while the earlier literature suggested that firms would use limit pricing as an entry deterrent – charge a price just low enough to make it unprofitable for a new firm to enter – in the 'new view' at first blush this seems unreasonable: prices are not state variables, and there is no reason for an entrant to assume that the firm will leave its price unchanged in the face of his entry. But Salop, in his important 1979 paper, provided a new interpretation to limit pricing: the prices charged by firms could convey information about these firms' cost functions; low cost firms have an incentive to charge a low price to persuade potential entrants that their costs are low; technology – cost of production – is a state

variable, and if the entrant believes that his rivals' cost functions are low, that will affect the post-entry equilibrium; if they are low enough, entry will be deterred. The high-cost firms wish to persuade potential entrants that they too have low costs; this gives rise to a standard 'self-selection' equilibrium. Here, the high cost firm operates at the point where marginal revenue equals marginal cost, while the low cost firm sells at a sufficiently low price that it does not pay the high cost firm to imitate.³

Pre-entry prices may affect state variables in other ways. In models of exhaustible natural resources, *raising* prices leads to slower rates of exhaustion, and hence higher stocks of natural resources. In models of learning-by-doing, lower prices lead to more sales, and hence lower costs (see Stiglitz, 1981).

Predation represents another important class of strategies aimed at altering beliefs in such a way as to make entry less likely, and is conventionally said to occur when a firm charges a price below marginal cost;⁴ the firm is willing to suffer temporary losses, provided this serves to deter future entry. It does so because if future entry is deterred, long run profits can be higher. Again, though it may be *feasible* for firms to deter entry by this strategy, the question has been posed: Can these strategies be part of an equilibrium? It only pays to take a loss today if it serves to deter *future* entry. In any economy operating over a finite number of periods, it therefore cannot pay to deter predators in the last period; if entry occurs then, the equilibrium in that last period is the standard Nash equilibrium. But now consider what happens in the next-to-last period. It cannot pay to deter entry then, since the entrant firm knows that it will not pay the incumbent to charge a low price in the last period, regardless of what it does in the next to last period. Since it does not serve to deter entry, it does not pay to predate.

There are at least three responses to this seeming paradox: (i) predation does not occur; it turns out to be very difficult to ascertain whether predation has in fact occurred, since it is difficult to ascertain what marginal costs are;⁵ (ii) the analysis hinges on there being a finite number of periods; in a world without end (or with no finite date at which the market will end) then predation may be an equilibrium strategy; (iii) assume there are irrational firms, who respond to entry by predating; if potential entrants know about this irrationality, such firms do better than rational firms. Thus, if potential entrants know that there are some irrational firms, but do not know *which*

these firms are, it pays all firms to act as if they were the irrational firms; predation may then be an equilibrium strategy.^{6,7}

A final category of entry-deterrence strategies, in a dynamic context, is referred to as pre-emption and is discussed below in the paper by Gilbert. The existing firm takes advantage of its current presence in the market to remove the profitable opportunities available to potential rivals.

Thus, the existing firm may pre-empt a research opportunity, engaging in R & D at a sufficiently fast pace that it does not pay any rival to enter (Dasgupta and Stiglitz, 1980b; Gilbert and Newbery, 1982; Dasgupta *et al.*, 1983); or in a growing market with plants exhibiting indivisibilities, the existing firm may anticipate this future demand and build its current capacity in anticipation of the future demand (Eaton and Lipsey, 1980).

Three questions are addressed:

- (1) Is it profitable to pre-empt?
- (2) Does pre-emption arise as an equilibrium strategy?
- (3) To what extent do the dominant firms in markets in which pre-emption occurs exhibit monopoly power?

These questions were first addressed in the context of R & D. It is easy to show that if it pays an entrant to engage in R & D at a particular level, it pays the incumbent firm to engage in the same R & D project at a slightly faster pace, and win the patent (Salop, 1979). The incumbent could behave in the same way as the entrant, and obtain the same profits; but, in addition, he has the advantage arising from the possibility of co-ordination. He can, in other words, operate his two plants (his old plant with the old technology and his new plant with the new technology) independently, obtaining the standard duopoly outcome. But he has the possibility of co-ordinating the action of the two, thus increasing his profits. This says little more than that it would pay one firm to buy out its rival (at its rival's present discounted value of profits, in the duopoly equilibrium). While buying out one's rival may, however, be interpreted as an anti-competitive move, prohibited by anti-trust laws, pre-empting one's rivals – deterring entry – may not be. An important question which has been addressed in the recent literature has been to see how general is this argument. Under what circumstances is such pre-emption not profitable? For instance, if there is a large number of alternative products which might be developed and which can serve

as perfect substitutes, it will not pay the existing firm to pre-empt all entry by obtaining a patent for each (even were it feasible to do so);⁸ similarly, some new entrants may have a comparative advantage over existing firms in the development of new technologies (camera companies like Canon might have a comparative advantage in developing photographic reproduction techniques). Or there may be interactions between a potential entrant's current products and an innovation which will result in greater returns to the research project for it than for the existing firm (Dasgupta *et al.*, 1983).

A new class of arguments is provided by Gilbert in his chapter in this volume. Allowing a second firm into the market affects the nature of the equilibrium which would emerge were a third or fourth firm to enter. It may be impossible for the initial firm to make the kinds of binding commitments which serve (costlessly) to deter entry; in that case, allowing one small entrant may turn out to be a low cost way of deterring entry which would have a more deleterious effect on profits.

But even if it is feasible to take pre-emptive action, to do so may not be part of an equilibrium strategy; assume for instance, that the current firm spends enough to make it not worthwhile for any rival to engage in R & D. But if no rival engages in R & D, it does not pay for him to engage in such a high level of R & D. If the strategy space of the participants is taken to be the level of R & D expenditures, then there is no pure strategy equilibrium. There is, however, a mixed strategy (see Gilbert and Stiglitz, 1979). But if the strategy space of the entrant is allowed to be expanded, so that the entrant specifies for any level of R & D expenditure undertaken by the incumbent what his (subsequent) R & D will be, then pre-emption is a Nash equilibrium.

The issue of pre-emption is of particular importance because of its implications for the persistence of dominant firms. While the Schumpeterian vision had one temporary monopolist being succeeded by the next, when pre-emption is an equilibrium strategy, then the current monopolist may remain a monopolist for an extended period of time. On the other hand, the welfare consequences (discussed more fully below) may not be too serious: to maintain its monopoly position, the firm must continue to compete vigorously, by engaging in the same level of R & D as any entrant would have undertaken. (This result, however, is not general, as we shall remark below.)

The chapter by Gilbert provides a general treatment of the theory of pre-emption, focusing on pre-emptive investment. He concludes:

. . . pre-emptive investment, as alleged in the Alcoa case, is not likely to be a credible threat to market performance unless: (i) scale economies are sufficient to allow only a few firms in an efficient market structure; or (ii) an established firm can convince potential competitors that it would compete aggressively against even small entrants.

Though the general principles of entry deterrence have thus become reasonably well understood within the past decade, there remains considerable work to be done in assessing particular entry-deterrence devices. As we have noted, much of the recent literature has focused on two decisions: capacity and R & D. There are other important decisions, such as the durability and flexibility of the capital, which have entry deterrence effects. The chapter by Schmalensee, on advertising, analyses a class of decisions whose effects on entry and market structure are of particular importance. He shows that the strategic implications of investments in introductory advertising may differ dramatically from those of investments in productive capacity.

2. *The force of competition.* A second central issue with which the recent literature has been concerned is what are the determinants of the degree of 'competitiveness' of a market. While, in the older view, a large number of firms in the market seemed both necessary and sufficient for effective competition, the new view has questioned both premises.

For instance, take the recent developments in monopolistic competition (represented in this volume by the chapter by Archibald, Eaton and Lipsey). Here, it is not only the number of firms in the market which matters, but also their relationship with one another. In the one-dimensional spatial equilibrium model (whether firms are located around a circle or along a line), each firm has two neighbours. Thus, though there may be many firms altogether, each firm interacts with only two other firms; the market is more aptly described as a series of local (overlapping) oligopolies. By contrast, this is not true in the Spence and Dixit/Stiglitz models (where all 'products' are equidistant from all other products.) Nor is it in the higher dimensional spatial equilibrium models (where every firm has many neighbours); or in models with costly search (where individuals of a given type may end up at a number of different stores). All of these models capture better the spirit of Chamberlinian monopolistic competition, where strategic interactions may legitimately be ignored. It is an important empirical question to determine which markets are best

described by the monopolistically competitive structure, in which strategic reactions are not of first order importance.

There are other circumstances in which there are markets with several firms which do not behave competitively: the firms collude together or act *as if* they colluded together. While the chapter in this volume by d'Aspremont and Gabszewicz addresses the question of the stability of these collusive arrangements, Salop shows that a number of practices serve to facilitate co-operative behaviour. Some of these practices, such as a promise to match the lowest prices, look very competitive; but they remove the incentive to lower prices, to deviate from the collusive price.

More generally, the theory of repeated games has shown that it is often easy to get collusive solutions out of non-co-operative behaviour. While the history of cartels suggests that explicit collusive agreements seem to be quite fragile, the extent and stability of these more general collusive outcomes is a subject for continuing research.

A quite different context, in which there are many firms but where the equilibrium price is the *monopoly* price, arises in markets where consumers have imperfect information concerning prices. They obtain information through a process of sequential search, and there are strictly positive search costs. (Diamond, 1971.) Indeed, in these circumstances it can be shown that prices may be lower with two firms in the markets than with many firms (Stiglitz, 1985).

These analyses have provided us with examples of important market structures in which, though there may be many firms, the outcomes are not competitive.

On the other hand, the Theory of Contestable Markets (Baumol, Panzar and Willig) argues that – when there are non-convexities but no sunk costs – there may be important circumstances in which there will be only a single firm in a market, but where the market will behave competitively. The debate over this theory has centred around the issue of the importance of sunk costs, particularly in those technologies for which there are important non-convexities (and which will therefore be characterised by one or a few firms). (See the exchange between Weitzman, 1982 and Baumol, Panzar and Willig, 1982). Even for airlines, where the major asset (aircraft) is not a sunk cost, expenditures to inform customers about their existence and their time schedules may represent important sunk costs.)

Another example illustrating the ambiguity of the relationship between numbers of firms and competitive behaviour, arises with technological change. As we noted earlier, a monopolist could persist

in its monopoly position, by pre-empting potential rivals. But in doing so, the monopolist is behaving, at least with respect to his R & D policy, much as competitors would. A slight change in assumptions, however, alters this conclusion in a dramatic way: if the research project is to be undertaken over a number of years, it is possible that the incumbent firm will begin that research project, and push it to the point where the firm has a commanding lead. The firm then can behave like a monopolist, simply threatening potential entrants that if they do attempt to engage in R & D, the firm will respond (as it can, and as it will be profitable for it to do) by increasing the speed of its research to ensure that it captures the patent. This is referred to as ε -pre-emption. It requires that the existing firm be able to observe and to react (possibly with a lag) to potential entrants.⁹ The smaller the lags in observation and reaction, presumably the more like a monopolist will the behaviour of the entrant be.

What is important about these examples is that they show that the nature of competition in a market may depend on a variety of factors other than simply numbers, e.g., the presence of sunk costs and the information structure.

3. *New theories of the firm, market structure and competitive behaviour.* The past decade has witnessed not only marked developments in the theory of market structures, but also rapid changes in the theory of the firm. The traditional neoclassical models assumed unitary firms, in which all participants work to maximise the value of the firm and where there is unanimity both among shareholders and managers about this objective and about what it entails (that is, what actions are required to maximise profits). Recent work, however, has questioned all of these assumptions: (i) workers and managers must be motivated by a reward structure to pursue the objectives of the firm; only if it were costless to monitor instantaneously all of their actions would it be possible to ensure that they pursued the policies which the owners might wish. (This problem of incentives is now generally referred to as the principal-agent problem; following Mirrlees, 1971; Ross, 1973; and Stiglitz, 1974 a huge literature has developed – too extensive to treat adequately in this brief introduction.)¹⁰ (ii) Workers and managers work according to certain rules of thumb and routines; though some resources may be devoted to assessing and devising improvements in those routines, many of the improvements are a result of chance discovery and it is not at all clear that the process of 'search' can be well described by models of rational maximisers of expected utility. This theme, stressed in the earlier

work of Simon and March (1958), plays an important role in the evolutionary theories of Nelson and Winter, as exemplified in the chapter by Nelson contained in this volume. Improvements are spread by a similar evolutionary process, with firms which have discovered good techniques of production or good managerial techniques surviving, and inefficient firms disappearing.

These new theories of the firm have several important implications for the theory of market structure and for the role of competition. First, our earlier analysis stressed the role of strategies and beliefs in determining the nature of market structure; most of the work focused on what might be called 'rational' strategies and beliefs: that is, strategies and beliefs which were consistent with optimising behaviour by the participants in the market. But the strategies chosen by firms may not be 'optimising' and their beliefs may be based on some interpretation of historical experience, rather than on an analysis of what the rational behaviour of rivals entails. Thus, a firm may be a predator, simply because its managers believe that that is how one should respond to entry. They may have some limited experiences to support their views, but they certainly do not assess the reasonableness of their views by using the kind of game theoretic analysis introduced earlier.

Second, since managers do not appropriate all the returns accruing to their activities, there is the possibility of 'managerial slack', a theme taken up in the chapters by Selten and Stiglitz in this volume. There is a long-standing conjecture that managerial slack is greater in monopolies than in competitive markets. (The neoclassical model denies the existence of slack, and hence cannot say anything about the relationship between market structure and slack.)

Selten puts forward what he calls the 'strong slack hypothesis', which maintains that slack has a tendency to increase so long as profits are positive. This hypothesis has some strong consequences. Consider traditional Cournot oligopoly theory with fixed costs. Under this theory, welfare may be increased by restriction of entry if fixed costs are sufficiently small; under the strong slack hypothesis, free entry is always best. Though workers may gain from consumption at the working place, their welfare gains are less than the cost in inefficiency. And because slack is reflected in marginal costs, prices are higher and consumers worse off.

Stiglitz attempts to relate the managerial slack associated with monopoly to the optimal incentive structure under monopoly (by