

MARKET STRUCTURE
AND THE FIRM'S MARKET POWER

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In Economics there are certain notions which, though they provide a strong emotional appeal to public opinion, possess a very ambiguous scientific content. One such notion is the concept of "economic power". The gap between its apparent precision for the layman and its ambiguity for the economist is probably a reflection of the fact that the phenomenon is very deeply built into the economic system. It is thus quite difficult to obtain a clear and objective view of the reality of economic power. According to B. Russel, "the fundamental concept in social science is power, in the same sense in which energy is the fundamental concept in physics" ¹⁾.

But such a phenomenon never becomes perceptible except through its causes or its effects, and then only in the light of a very broad interdisciplinary approach. "The attempt to isolate any one form of power, more especially, in our days, the economic power, has been, and still is, a source of errors of great practical importance." ²⁾.

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1) Bertrand RUSSEL, Power, A New Social Analysis, Allen and Unwin, 1946, p. 10.

2) Ibid., p. 12.

Nevertheless, following the general approach of this paper, we should like to distinguish two types of firm's economic power. One may be called the "out-market power" and is made of the numerous means, social, political, ethical... aimed at transforming the rules of the market game in favor of the holding firm. The firm manipulates its political and social environment in various ways : pressures to obtain favorable tax and subsidy laws, better credit conditions, important governmental contracts, good labor relations. Firms even set themselves up in strong positions as taste setters, style leaders and social models in our society.

Such a power is economic in character because its scope and its domain, lie in economic activity, though its "bases" extend beyond the framework of the market ³⁾.

The other type may be called the "in-market power" or simply the market power : the firm which owns such a power plays the game, according to the constraints and the objectives of the markets in which it operates; the scope is the economy and the bases are determined by the working of the market as an institutional frame for the interplay of demand and supply ⁴⁾.

The social scientists who have studied the economic power of the firm may be more or less classified according to a similar

3) According to A. KAPLAN, "when we have specified what scope a power has, on what base it rests, over what domain and with what weight it is exercised, then we can say that we have described a distinctive form of power.", in R. KAHN and E. BOULDING, Power and Conflicts in Organizations, Basic Books, 1964, p. 16.

4) There is of course a close connection between the two forms, but as we will see later, it is hard to assert a priori if they are complements or substitutes.

distinction. Researchers in sociology and politics have emphasized the first aspect ⁵⁾. Economists have concentrated their effort on the second type ⁶⁾. Some scholars have tried to offer a synthetic view of the phenomenon, with various degrees of success ⁷⁾.

In the limits of this paper, we should like, first to propose a dynamic analysis of the firm's market power in its relation with market structure. A second part will show how the problem of concentration makes necessary to push the analysis beyond the limits of the industry and even beyond a simple analysis of market relations in order to illuminate the connection between the out-market and the in-market power.

5) See for example R. L. KAHN, op. cit.; D. CARTWRIGHT, A Field Theoretical Conception of Power, Studies in Social Power, University of Michigan, 1959; H. D. LASSWELL and A. KAPLAN, Power and Society, Yale University Press, 1950; M. CROZIER, Pouvoir et Organisation, Archives Européennes de Sociologie, T. V. 1964, no 1; for a general synthesis, A. JACQUEMIN, L'entreprise et son pouvoir de marché, P. U. F., 1967, p. 25 to 35.

6) See for example, F. MACHLUP, The Political Economy of Monopoly, J. Hopkins Press, 1952; E. MASON, Economic Concentration and the Monopoly Problem, Harvard University Press, 1957; J. HOUSSIAUX, Le Pouvoir de Monopole, Sirey, 1958.

7) See for example, A. BERLE, Power without Property, Harcourt, 1959; C. KAYSEN, The Corporation : how much power? What scope?, in The Corporation in Modern Society, Mason (ed.), Atheneum, 1966; J. LHOMME, Pouvoir et Société économique, Cujas, 1966; F. PERROUX, L'Economie du XXe siècle, P. U. F., 1961.

Part I : MARKET POWER USED TO MOULD MARKET STRUCTURE

1. Introduction.

There exist many possible approaches to a study of the rational firm's policy towards market power. One such general approach includes the numerous oligopoly models which view each firm within a given market structure as recognising the interdependence between its own actions and the actions of its rivals. Within this line of attack, the theory of games has provided some useful insights, but little development has taken place beyond the two-person situations ⁸⁾. Application of the theory of the core of the economy ⁹⁾ has raised new hopes, yet this promising line of research remains in the very early stages of development.

Our approach is less theoretical and deals with the industrial organisation outlook as developed by E. Mason ¹⁰⁾, J. Bain ¹¹⁾, R. Caves ¹²⁾ and others.

⁸⁾ See M. SHUBIK, Strategy and Market Structure, Wiley, 1959.

⁹⁾ This theory, originally based on the Edgeworth box, defines the core of the economy as being the set of possible resource allocations which are admissible in the sense that no coalition can block any of these allocations. The coalitions which lead to the allocations in the core may be said to hold economic power. See J. GABSZEWICZ, Théorie du noyau et de la concurrence imparfaite, Recherches Economiques de Louvain, Juillet 1970.

¹⁰⁾ E. MASON, Economic Concentration and The Monopoly Problem, Harvard University Press, 1957.

¹¹⁾ J. BAIN, Industrial Organization, Wiley, 1967, and Barriers to New Competition, Harvard University Press, 1956.

¹²⁾ R. CAVES, American Industry : Structure, Conduct, Performance, Prentice-Hall, 1967.

2. Static profit maximization and market structure.

Under the industrial organization approach, analysis focuses on the study of market structure, market conduct, and market performance, and on the interdependence of these factors. The main elements of market structure are concentration, product differentiation and barriers to entry of new firms. Market performance is concerned with the appraisal of the industry's contribution to efficiency, progressiveness, full employment, and the equitable distribution of income in the economy. Market conduct consists of the behavior patterns which firms in an industry exhibit in the market where they sell their product ¹³⁾. Such firm's behavior is generally pictured as aiming at maximum profits within a given market structure. Its conduct is determined by the structure of the industry in which it operates. "The principal frame of reference is the vision of the static economy or the circular flow, in which... market structure and behavior are taken as structurally determined" ¹⁴⁾.

However, once it is admitted that a more fruitful vision of our modern economy considers the changing contours of business structure and behavior, it becomes clear that market structure may no longer be considered as a "state of nature", as a set of exogenous factors, but as a set of variables open to some manipulation by the firm. For a firm which holds some degree of market power, it is possible and profitable to try to increase or at least to sustain the actual degree of concentration, through mergers, absorptions, collusion or loss-leader selling; to try to maintain or to increase

¹³⁾ R. CAVES, op. cit.

¹⁴⁾ J. P. MILLER in N. B. E. R., Business Concentration and Price Policy, Princeton, 1955, p. 135.

the given degree of product differentiation through advertising investments and the various forms of selling costs; to try to sustain or to develop the barriers to entry, through the acquisition of patents, retail outlets, scarce resources whose markets are imperfect, in order to impede or to prevent the entry of new firms ¹⁵⁾. Different forms of market conduct have the capacity to produce either directly or as side effects, gradual changes in the structure of industries. According to such an approach, the more substantial is the market power of a firm, the more the market structure must be viewed as a strategic variable to the individual firm, not as an exogenously determined parameter. In the so-called "market structure - conduct - performance" pattern, the causal relation can run from conduct to structure to performance.

By analogy with the "prix crié par hasard" of Walras, we may suppose that the powerful firm works on a given structure of industry continuously trying to change it until some kind of equilibrium is reached ¹⁶⁾. Within a limited period of time, the firm will arrive at a position combining a certain level of concentration, of product differentiation and of barriers to entry, such that the highest level

¹⁵⁾ Empirical studies confirm the existence of a positive statistically significant relationship between market shares of the largest firms in the industry and the price-cost margin in that industry (N. Collins and L. Preston, Price-Cost Margin and Industry Structure, Review of Economics and Statistics, August 1969); between advertising outlays in the industry and profit rate (W. Comonor and T. Wilson, Advertising, Market Structure and Performance, Review of Economics and Statistics, November 1967); between barriers to entry controlled by the dominant firms of the industry and profit rate (H. Mann, Seller Concentration, Barriers to Entry and Rates of Return in Thirty Industries, Review of Economics and Statistics, August 1966).

¹⁶⁾ See P. SYLOS-LABINI, Oligopoly and Technical Progress, Harvard University Press, 1962, p. 36.

of profit is attained. As P. S. Andrews writes : "we can still retain ideas of a firm in balance, a sort of equilibrium; but this would be a balance with its environment, the industrial environment" 17).

This conception implies the existence of what may be called a "structural maximum" for the firm. The expenditures or investments aimed at altering the market structure are assumed to suffer from diseconomies of scale, beyond some level. Indeed it is inconceivable that, in a given time span, a firm will increase its size without being handicapped by problems of budget control, decentralization of operation, reorganization; similarly, the expansion of sales expenditures and the multiplication of barriers to entry will be stopped by various forms of saturation and decreasing efficiency 18).

Furthermore, such changes in market structure will be constrained by the antitrust legislation. This legislation is usually more concerned with the market conduct than directly with market structure or market performance 19). Among the practices generally condemned are restrictive agreements, price discrimination, exclusive dealing and full-line forcing, resale price maintenance and so on. It is important to recall that in so far as these practices do arise in conjunction with monopoly, they are more often a symptom

17) P. S. ANDREWS, On Competition in Economic Theory, Mac Millan, 1964, p. 91.

18) However, if a "static" analysis is the appropriate method of exploring the conditions of equilibrium because of a limit to the amount of change any firm can undertake in a given period, there is no reason to assume that there is a limit to its expansion overtime. For some developments, see A. JACQUEMIN, L'entreprise et son pouvoir de marché, P. U. F., 1967, p. 173 to 178.

19) See C. KAYSEN and D. TURNER, Antitrust Policy, Harvard University Press, 1959, p. 240; A. JACQUEMIN, The Criterion of Economic Performance in the Antitrust Policies of the United States and the E. E. C., Common Market Law Review, no. 2, April 1970.

of monopoly power than its source ²⁰⁾.

A worse danger lies in the predatory practices whose aim or effect is to modify the market structure by making the industrial environment less favorable to actual or to potential competition. For example, a strategy of selling below cost may be the best way to drive a competitor out of business by inducing a bankruptcy or by forcing a merger. Equally, monopolistic leverage may be exercised through the institution of tying arrangements : in this case a seller exploits his dominant position in one market to expand his empire into the next.

More fundamentally, horizontal and vertical mergers, pooling of patents, extensive advertising may be dangerous, not so much as means of exploiting the actual market power of the firm, but as means of increasing such a power overtime through changes in the market structure. The large corporations of the "New Industrial State" are not passive economic units which play the game into a given environment. They are actors who try to dominate and to transform in their favor the conditions of their action.

Those considerations may be expressed by a simple model. Let $\pi = p(q, s_1, s_2)q - c(q, s_3) - (s_1 + s_2 + s_3)$ describe the profit function of the firm where :

p = price of the firm's output	s_1 = total expenditures for increasing size, imputed to the given period
c = total variable cost	s_2 = total expenditures for increasing the degree of differentiation
$r = p \cdot q$ = total revenue	s_3 = total expenditures for increasing the level of barriers to entry.

Among the elements of market structure, we distinguish, on the one hand the degree of concentration and the degree of product differentiation, and on the other hand the level of barriers to entry. The expenditures for increasing size, that is the degree of concentration in a given market, encompass what is spent for "interfirm organization" as well as what is required for buying another firm. The expenditures for intensifying the degree of product differentiation include every form

²⁰⁾ L. TELSER, Abusive Trade Practices : An Economic Analysis, Law and Contemporary Problems, no. 3, Summer 1965.

of selling costs. The large fraction of the expenditures on research and development aimed at "product improvements" may also be classified in that category. Those two types, s_1 and s_2 , are assumed for a given level of output to modify the firm's demand function, by shifting it to the right and by making it less elastic. Indeed, an increase in concentration or in product differentiation are usually viewed as increasing the monopoly power of the firm, that is heightening the ability to maintain a margin between the price and the cost levels ²¹⁾. The expenditures for increasing the level of barriers to entry encompass the purchase of patents, the acquisition of all retail outlets in a particular market, the securing of privileged sources of financing... The elevation of entry barriers are supposed to affect the cost of the established firm : the acquisition of a patent or of the control of the natural raw material may reduce the cost of production. For a maximum limit-price (which equals the cost of the potential entrants), the decrease in the cost of the established firm leaves unchanged the limit-price but increases the height of the barrier (the margin between the cost of the established firm and the cost of the potential entrant) ²²⁾.

Furthermore, we assume that the favorable effects of changing market structure, on prices and on costs, do not extend beyond some maximum level of s . We have then :

21) Let us recall that a higher inelasticity of demand, η , leads to a higher price and to a higher degree of monopoly. This is easily shown in the case of a constant positive marginal cost, mc , where the profit-maximizing price $p = \frac{mc \cdot \eta}{1 + \eta}$ with $\frac{dp}{d\eta} > 0$, and by using the Lerner formula $L = \frac{p - mc}{p} = \frac{1}{-\eta}$.

22) See F. MODIGLIANI, New Developments on the Oligopoly Front, Journal of Political Economy, June 1958.

$$\frac{\partial p}{\partial s_1} \geq 0, \quad \frac{\partial p}{\partial s_2} \geq 0 \quad \text{and} \quad \frac{\partial c}{\partial s_3} \geq 0.$$

Finally, we assume the existence of an antitrust legislation which forbids any conduct aimed at changing market structure beyond some predetermined level.

The entrepreneur's problem is then to maximize :

$$\begin{aligned} & p(q, s_1, s_2)q - c(q, s_3) - s_1 - s_2 - s_3 \\ \text{subject to :} \quad & s_1^* - s_1 \geq 0 \quad s_1 \geq 0 \\ & s_2^* - s_2 \geq 0 \quad s_2 \geq 0 \\ & s_3^* - s_3 \geq 0 \quad s_3 \geq 0 \\ & q \geq 0 \end{aligned}$$

The Lagrangian function is :

$$\begin{aligned} \phi(q, s_1, s_2, s_3, \lambda_1, \lambda_2, \lambda_3) = & p(q, s_1, s_2)q - c(q, s_3) - s_1 - s_2 - s_3 \\ & + \lambda_1 (s_1^* - s_1) + \lambda_2 (s_2^* - s_2) + \lambda_3 (s_3^* - s_3) \end{aligned}$$

Assuming the appropriate curvature properties, the Kuhn-Tucker conditions to maximize profit are :

$$\begin{aligned} \text{(a)} \quad & \frac{\partial r}{\partial q} - \frac{\partial c}{\partial q} \leq 0 \quad \left(\frac{\partial r}{\partial q} - \frac{\partial c}{\partial q} \right) q = 0 \quad q \geq 0 \\ \text{(b)} \quad & \frac{\partial r}{\partial s_1} - 1 - \lambda_1 \leq 0 \quad \left(\frac{\partial r}{\partial s_1} - 1 - \lambda_1 \right) s_1 = 0 \quad s_1 \geq 0 \\ \text{(c)} \quad & \frac{\partial r}{\partial s_2} - 1 - \lambda_2 \leq 0 \quad \left(\frac{\partial r}{\partial s_2} - 1 - \lambda_2 \right) s_2 = 0 \quad s_2 \geq 0 \end{aligned}$$

$$\begin{aligned}
 (d) \quad & -\frac{\partial c}{\partial s_3} - 1 - \lambda_3 \leq 0 & (-\frac{\partial c}{\partial s_3} - 1 - \lambda_3)s_3 = 0 & s_3 \geq 0 \\
 (e) \quad & s_1^* - s_1 \geq 0 & \lambda_1(s_1^* - s_1) = 0 & \lambda_1 \geq 0 \\
 & s_2^* - s_2 \geq 0 & \lambda_2(s_2^* - s_2) = 0 & \lambda_2 \geq 0 \\
 & s_3^* - s_3 \geq 0 & \lambda_3(s_3^* - s_3) = 0 & \lambda_3 \geq 0
 \end{aligned}$$

If $q > 0$, that is if the firm is engaged in production, condition (a) requires the classical equality between marginal cost and marginal revenue. If the legal constraint is not binding, that is if $0 < s < s^*$, $\lambda = 0$ and conditions (b), (c) and (d) imply that :

$$\frac{\partial r}{\partial s_1} = \frac{\partial r}{\partial s_2} = -\frac{\partial c}{\partial s_3} = 1.$$

At the equilibrium position, there is an equality between the contribution of expenditures changing structure of type 1 and 2, to the increase of total revenue, and the contribution of expenditures of type 3 to the reduction of cost.

In addition, at any given output, the additional revenue generated must exactly equal the cost of generating that increment.

In terms of elasticity, we have : $\frac{\partial p}{\partial s_i} - q \cdot \frac{s_i p}{s_i p} = 1$. Hence, $\eta_{s_i} = \frac{s_i}{p \cdot q}$, $i = 1, 2$. The percentage of revenue, which is allocated to the expenditures aimed at changing market structure will be, at the equilibrium position, equal to the numerical value of the price elasticity with regard to those expenditures ²³⁾.

²³⁾ If the increase in size is considered as having simultaneous consequences for monopoly power and cost savings, the profit function becomes :

$$\pi = p(q, s_1)q - c(q, s_1) - s_1.$$

Condition (b) becomes : $\frac{\partial p}{\partial s_1} \cdot q - \frac{\partial c}{\partial s_1} - 1 = 0$ or

.../...

This raises a further question. For any given quantity, there is an optimal s_i ($i = 1, 2$) which maximizes profit: will a change in the quantity of output sold in any way affect the level of expenditures aimed at altering market structure ²⁴⁾? Put specifically, what sign will be attached to the expression $\frac{ds_i}{dq}$?

A negative sign would suggest that these spendings have a defensive character and will be increased when the market position of the firm is in danger, due to a shrinkage of sales caused by the aggressiveness of competitors or by fluctuations in the business cycle. This could be the signal to increase expenditures for mergers, for advertising or for new patents. On the other hand, a positive sign would suggest that growing actual sales will lead firms to anticipate the possibility of higher future sales and to increase their aggressive behavior in terms of the considered expenditures.

By adopting the technique that uses Samuelson ²⁵⁾, it appears that the sign of $\frac{ds_i}{dq}$ will depend upon the direction of the shift in the marginal revenue schedule (upwards or downwards) as the spendings s_i change: the sufficient condition for $\frac{ds_i}{dq} > 0$ is to have $\frac{\partial^2 r}{\partial s_i \partial q} > 0$.

.../...

$\eta_{s_1} = \frac{\partial c}{\partial s_1} \cdot \frac{s_1}{pq} + \frac{s_1}{pq_{s_1}} = \frac{s_1}{pq} (1 + \frac{\partial c}{\partial s_1})$. With $\frac{\partial c}{\partial s_1} = 0$, s_1 must be increased until $\eta_{s_1} = \frac{s_1}{pq}$. With $\frac{\partial c}{\partial s_1} = -1$, the simultaneous increase and decrease in costs due to s_1 will cancel each other out, and s_1 must be raised to the level where $\eta_{s_1} = 0$. With $\frac{\partial c}{\partial s_1} < -1$, s_1 must be increased till $\eta_{s_1} < 0$, because such a negative effect on the price will be more than offset by the cost-saving consequence.

²⁴⁾ We neglect the variable s_3 .

²⁵⁾ P. SAMUELSON, Foundations of Economic Analysis, Harvard University Press, 1966, p. 31 to 46. A general procedure is to differentiate totally the first-order maximum conditions. From the resulting equations, we obtain $\frac{ds_i}{dq}$ in terms of the second-order pure and mixed partial derivatives of the profit function.

But if we accept the point made earlier that the goal of those expenditures is to shift the firm's demand function to the right and to decrease its elasticity, we can conclude that $\frac{\partial^2 r}{\partial s_i \partial q}$ is not generally positive and then $\frac{ds_i}{dq}$ will not be generally positive. Hence, the defensive as well as the aggressive character of the spendings which affect the market structure is emphasized. Those findings are in agreement with what can be known from the business world ²⁶⁾.

Let us consider now the case where the legal constraint is binding : $s = s^*$ and $\frac{\partial r}{\partial s_1} = 1 + \lambda_1$, $\frac{\partial r}{\partial s_2} = 1 + \lambda_2$. With $\lambda > 0$, we have $\frac{\partial r}{\partial s_1} > 1$ and $\frac{\partial r}{\partial s_2} > 1$. The firm will be unable to change its market structure up to the point at which the addition to total revenue just equals the costs of the change in market structure.

We also have $-\frac{\partial c}{\partial s_3} = 1 + \lambda_3$ and $-\frac{\partial c}{\partial s_3} > 1$. The cost reduction cannot be accomplished to the point required by the profit maximization.

The meaning of λ is thus clear : it indicates the marginal advantage which would be obtained by the firm in case of a liberalization of the antitrust legislation. Conversely, it measures the maximum price that can be paid, through lobbying, for changing the legislation. When we know the expected monetary value of the penalty of a violation of the antitrust legislation, we can then determine whether or not the advantage to be gained by violating the law outweighs the expected cost.

²⁶⁾ See for example C. CARTER and B. WILLIAMS, Industry and Technical Progress, Oxford University Press, 1957, p. 57 and passim.

3. Dynamic profit maximization and market structure.

Our preceeding analysis has been confined to comparative statics. Yet the interdependence of market conduct, structure and performance is fundamentally a problem of intertemporal analysis. Time plays two crucial roles. First, it is through the temporal dimension that competitive forces play against the market power of the firm and the imperfections of market structure : a high growth of market demand tends to be associated with a low degree of concentration ²⁷⁾; industries with rapidly changing technologies "offer strong inducements to entry in the form of opportunities for gains to innovating firms"... ²⁸⁾. Second, the impact of investments aimed at changing market structure is not limited to a given time period, but affects the whole time-path of the firm.

In order to reformulate our model to take account of these phenomena, let $\psi [s(t), I(t), t]$ be the firm's profit function at time t , as a result of having the "inherited" imperfect market structure, i.e. a given level of concentration, of product differentiation, of barriers to entry at that particular date, together with the current expenditures s , aimed at moulding market structure ²⁹⁾.

The firm attempts to maximize the present value of the stream of profits :

²⁷⁾ NELSON, R., Concentration in the Manufacturing Industries of the U.S., Yale University Press, 1963.

²⁸⁾ GORT, M., Diversification and Integration in American Industry, N.B.E.R., Princeton, 1962, p. 105.

²⁹⁾ In the econometric studies of the relation between profit rates and market structure, the multiple correlation coefficients show that the structural variables typically account for more than half of total variation in industry profit rates : see p.6, note 15.

$$(1) \quad V = \int_0^{\infty} e^{-\rho t} \psi [s(t), I(t), t] dt ,$$

where the discount factor $e^{-\rho t}$ is taken to be positive and constant.

While s is a decision variable, I is not a variable subject to choice but a state variable, a function of the market structure at the initial date and the time-path chosen for the decision variable :

$$(2) \quad \dot{I} = f(I, s, t)$$

More specifically, we suppose that, knowing the initial condition $I(0) = I_0$, the set of imperfect market structure depreciates over time. The constant proportional rate of depreciation β expresses the technological conditions as well as the competitive forces which play, through the temporal dimension, against the market power of the firm and the market imperfections.

On the other hand, the different forms of market conduct have the capacity to produce gradual changes in the structure of industries.

Let us express these assumptions in the following differential equation :

$$(3) \quad \dot{I} = \alpha s - \beta I, \quad \text{with } \beta \geq 0, \alpha \geq 0$$

The problem is then to select the control-path $s^*(t)$ so as to maximize V , subject to (3) and to the initial condition, and taking into account the effect of the choice of s on both the instantaneous rate of profit and the future market structure.

It may be solved by using the Pontryagin Maximum Principle ³⁰⁾.

³⁰⁾ PONTRYAGIN, L. S., BOLTYANSKII, V. G., GRAMKRELIDZE, R. S. and MISCHENKO, E. F., The Mathematical Theory of Optimal Processes, Wiley, 1962.

We construct the Hamiltonian function :

$$(4) \quad H = e^{-\rho t} [\psi(s, I, t) + \lambda(t) (\alpha s - \beta I)]$$

where the auxiliary variable is defined such that $e^{-\rho t} \lambda(t) = \frac{\partial V^*}{\partial I}$; V^* is the value of V which would result from the optimal feasible control-path $s^*(t)$. Hence $e^{-\rho t} \lambda(t)$ is a shadow price, that is the value, at time zero, of the marginal unit of imperfect market structure at time t .

To obtain the necessary conditions for a maximum, let us set the partial derivative of (4) with respect to s equal to zero :

$$(5) \quad \psi'(s) + \lambda(t) f'(s) = \psi'(s) + \lambda(t) \alpha = 0 .$$

Furthermore, the function $\lambda(t)$ must satisfy the differential equation :

$$(6) \quad -\dot{\lambda} = \psi'(I) - \lambda(t)\beta - \rho \lambda .$$

or

$$(7) \quad \lambda(\rho + \beta) = \psi'(I) + \dot{\lambda} .$$

If $\max H$ is concave in I for given λ and t , then a market conduct aimed at changing market structure, satisfying (3), (5) and (6), and the transversality conditions

$$\lim_{t \rightarrow \infty} e^{-\rho t} \lambda(t) = 0, \quad \lim_{t \rightarrow \infty} e^{-\rho t} \lambda(t) I(t) = 0$$

is optimal, if the optimal path exists.

To interpret equations (5) and (6) and (7), we assume some plausible specifications about signs of partial derivatives :

$$a) \quad \psi'(I) > 0, \quad \psi''(I) < 0$$

$$b) \quad \psi'(s) < 0, \quad \psi''(s) < 0$$

Conditions a) assert that, ceteris paribus, the higher the concentration, the product differentiation or the barriers to entry, the more profitable will be the firm's operations, but at a decreasing rate.

Conditions b) say that a higher level of expenditures aimed at changing market structure will decrease, at an increasing rate, instantaneous net revenue, because it simply expresses a higher level of costs whose main returns are not instantaneously obtained.

The economic meaning of equation (5) is then clear : along the optimal path of the decision variable, at any time, the marginal short-run effect of a change in s must be just counterbalanced by the increase in the value of V , due to the changes in market structure imperfections.

Rewriting (5), we have :

$$(8) \quad \lambda(t) = \frac{-\psi'(s)}{\alpha} > 0$$

When the firm has selected the optimal control-path, the shadow price of the level of concentration, of product differentiation, of barriers to entry will all be positive at any point in time.

We may then interpret in (6) $-\dot{\lambda}$ as the rate at which the given set of imperfect market structure loses its virtues for the firm at time t . It is also the loss to be incurred if a (unitary) change in market structure were postponed for a short-time : once the optimal time-path is followed, that loss is the contribution of the unitary increase

in market structure imperfections to the profit realized during the interval, net of the marginal value of the investment to offset decay and of the interest.

According to (7), we may also state that the marginal opportunity cost of investment in changing market structure should equal the sum of the marginal profit from increased imperfections, and the capital gain in market imperfections : this corresponds to the equilibrium relation for investment in capital goods ³¹⁾.

To precise the optimal policy, let us now eliminate $\lambda(t)$ and $\dot{\lambda}$.

Differentiating (8) with respect to time, we have :

$$(9) \quad \dot{\lambda} = \frac{-\dot{s} \psi''(s)}{\alpha}$$

Substituting by their values λ and $\dot{\lambda}$ into equation (6), we obtain the following system of differential equations :

$$(10) \quad \dot{s} = (\rho + \beta) \left[\frac{\psi'(s)}{\psi''(s)} \right] + \alpha \left[\frac{\psi'(I)}{\psi''(s)} \right]$$

$$(3) \quad \dot{I} = \alpha s - \beta I$$

$$\dot{I} = 0 \quad \text{for} \quad s = \frac{\beta}{\alpha} I$$

$$\dot{s} = 0 \quad \text{for} \quad (\rho + \beta) \left[\frac{\psi'(s)}{\psi''(s)} \right] + \alpha \left[\frac{\psi'(I)}{\psi''(s)} \right] = 0$$

³¹⁾ ARROW, K., Applications of Control Theory to Economic Growth, Lectures in Applied Mathematics, Vol. 12, 1968, The Stanford Institute for Mathematical Studies in the Social Sciences; see also ALBOUY, M. and BRETON, A., Interprétation économique du principe du maximum, Revue Française de Recherche Opérationnelle, n° 14, 1968.

On the one hand, the slope of the curve for $\dot{I} = 0$ is

$$\text{positive} = \left. \frac{dI}{ds} \right|_{\dot{I} = 0} = \frac{\alpha}{\beta} > 0.$$

On the other hand, the slope of the curve for $\dot{s} = 0$ is

$$\text{negative} = \left. \frac{ds}{dI} \right|_{\dot{s} = 0} = - \frac{\alpha \psi''(I)}{(\rho + \beta) \psi''(s)} < 0.$$

If the long-run equilibrium where both $\dot{s}$ and $\dot{I}$ are equal to zero is a saddle point ³²⁾, there are two stable trajectories which describe the unique optimum path for $I_0 \neq I^*$, where I^* and s^* correspond to the saddle point.

4. Conclusions.

To conclude, it seems possible and useful to construct models according to which the firm's strategy will include efforts to mould market structure in order to maximize its objective function. The use of the Optimal Control Theory seems particularly valuable for developing the dynamic analysis of industrial organization.

³²⁾ To prove that (s^*, I^*) is a saddle, we have to expand linearly (10) and (3) around this point. From the obtained system, we compute the characteristic roots : if the roots are real and opposite in sign, (s^*, I^*) is a stationary point of long-run equilibrium. But this computation requires to specify the form of our equations.

Yet such an analysis calls for further developments. One possible extension would specify the various functions in order to build a system of simultaneous equations which can then be tested ^{32bis}). Another possible contribution would be a model recognizing explicitly the presence of uncertainty that affects the relevant functions and parameters. The impact of the "structural expenditures" on the price (or the cost) of output may not be known with certainty at the time when the decision is made. In the firm's profit function then, p , the price of output, is assumed to be a subjectively random variable distributed in accordance with the density function $f(p)$ and having an expected value $E[p] = \mu$. A difficulty here is that the firm's beliefs about the sales price is normally assumed to be summarized in a probability distribution that the firm is unable to influence. This assumption of a price taker is not easily integrated in our approach.

It is, in any case, clear that our approach calls for further work and is no more than an introduction to the problem.

32bis)

For such an application, see A. JACQUEMIN, Product Differentiation and Optimal Advertising Policy : A Dynamic Analysis, Institut des Sciences Economiques, Louvain, 1971, mimeographed.

Part II : MARKET POWER AND CONCENTRATION.

1. The Degree of Concentration.

Among different aspects of market structure, the level of concentration has generally been accepted as one of the best empirical indicators of the distribution of power in the market. More specifically the absolute concentration ratio as expressed by the share of the largest firms in some sector of the economy is frequently used to measure the degree of monopoly. Yet there are surprisingly few systematic analysis of the theoretical relation between these two concepts. In a recent article, T.S. Saving has tried to propose a rationale for such a link ³³⁾. Using a price leadership model, Saving shows how concentration ratios may be related to measures of monopoly as expressed by the Lerner and Rothschild indexes.

Even in the limits of these restricted model and indicators, his conclusion is that "Economists have accepted concentration ratios as measures of monopoly too readily".

2. The Overall Concentration.

While concentration ratios within particular industries are challenged as conventional indicators of market power, the use of an "overall concentration" approach has been viewed with still

³³⁾ T. S. SAVING, Concentration Ratios and the Degree of Monopoly, International Economic Review, Feb. 1970, vol. II, n° 1.

more suspicion ³⁴⁾. This approach defines overall concentration as being the proportion of some aggregate of economic activity accounted for by a relatively small number of largest firms taken together.

Nevertheless, the current trends in the form of concentration make ever more important to improve our understanding of overall concentration : its origine, its evolution, and its consequences. The actual degree of firm diversification and the multiplication of conglomerate mergers give birth to entities which cannot be reduced to the classical one-product firm. As a consequence, the concentration of economic power in the hands of these entities is not easily analysed in terms of the traditionnal approach. The increasing extent of firm diversification accross product and industry lines create theoretical as well as empirical problems.

On the one hand, "microeconomic theory has little to offer us by way of testable hypotheses of how multi-industry firms behave" ³⁵⁾. On the other hand, the researcher who uses Census of Manufacturing data on industries must contend with the fact that "parts of a single firm may be included in a number of industries and hence that the observations are not strictly independant" ³⁶⁾. Those considerations explain the resurgent attention paid to the analysis of the size structure of the giant firms, its pattern of change over time and the associated performances.

³⁴⁾ G. STIGLER, Five Lectures on Economic Problems, Mac Millan, 1950, p. 52.

³⁵⁾ H. GRABOWSKI and D. MUELLER, Industrial Organization : The Role and Contribution of Econometrics, American Economic Review, May 1970, p. 100.

³⁶⁾ Ibid. , p. 102.

At the structure level, several studies try to evaluate the evolution of overall concentration. It appears that while the concentration within American industries is more or less stable, at least until 1963 ³⁷⁾, the overall (or aggregate) concentration is rising ³⁸⁾.

The share of manufacturing assets held by the 200 largest companies rose from somewhat over 45 percent in 1929 to over 60 percent in 1968. The 100 largest companies held in 1968 a larger share of corporate assets (49.3 percent) than the 200 did in 1951 (47.7 percent) ³⁹⁾. If the movement goes on, it is possible that around 1985, sixty corporations will hold the major part of the world production. Almost fifty of those corporations will have an American origin. Recent studies also indicate that there may be a strong correlation between the increasing stability, i. e., the ability of old American firms to maintain their relative position, and the rising concentration ⁴⁰⁾.

³⁷⁾ W. SHEPHERD, Trends of Concentration in American Manufacturing Industries, The Review of Economics and Statistics, May 1964; J. BAIN, Changes in Concentration in Manufacturing Industries in the U. S., 1954-66, The Review of Economics and Statistics, Nov. 1970.

³⁸⁾ See W. MUELLER, Economic Concentration Hearings, Subcommittee on Antitrust and Monopoly of the Committee of the Judiciary, U. S. Senate, 88th Congress, 2nd session, March 16 1965; Studies by the Staff of the Cabinet Committee on Price Stability, Study Paper n° 2, Industrial Structure and Competition Policy, Washington, D. C., Jan. 1969.

³⁹⁾ U. S. Federal Trade Commission, Economic Report on Corporate Merger, October 1969.

⁴⁰⁾ See S. BOYLE, Large Industrial Corporations and Asset Shares : Comment, American Economic Review, March 1971, p. 166.

In the case of the largest European firms on the contrary, there is an important degree of instability of asset shares and a tendency to become more equal in relative size, since the constitution of the Common Market ⁴¹⁾.

At the performance level, the rationality of the concentration of economic resources has so far received insufficient attention from economists ⁴²⁾. On the one hand, average growth rates seem to be independent of size ⁴³⁾; similarly, there are serious doubts affecting the Schumpeterien hypothesis of a link between size and technological progress : bigness is not a prerequisite for progressiveness ⁴⁴⁾.

On the other hand, size seems to result in high profit rates ⁴⁵⁾. Among the economic explanations, the role of imperfections

⁴¹⁾ A. JACQUEMIN and A. M. KUMPS, Changes in the Size Structure of the Largest European Firms : An Entropy Measure, The Journal of Industrial Economics, forthcoming.

⁴²⁾ Marxian economists must be excepted of course.

⁴³⁾ See S. HYMER and P. PASHIGIAN, Firm Size and Rate of Growth, Journal of Political Economy, Dec. 1962. This paper is the source of many subsequent confirmations.

⁴⁴⁾ See SCHERER, Market Structure, Opportunity and the Output of Patented Inventions, American Economic Review, Déc. 1965; J. ADAMS, Firm Size and Research Activity : France and the U. S., The Quarterly Journal of Economics, August 1970.

⁴⁵⁾ See M. HALL and L. WEISS, Firm Size and Profitability, The Review of Economics and Statistics, Aug. 1967, and for the case of the largest European firms, A. JACQUEMIN, Dimension, stabilité et performances des plus grandes entreprises européennes, 1956-1967, Revue d'Economie Politique, mars 1970. Also one should note that the variance of profit rates (as well as the variance of growth rates) is less for large firms than for small firms. There are several explanations for this phenomenon of heteroscedasticity.

in the factor markets is proposed. While the increase of size through diversification and conglomerate mergers has weak effects on every specific product market, it offers an opportunity for acquiring scarce factors whose markets are imperfect or inexistant. Firm i producing good A which is neither a close substitute nor a close complement of product B, may acquire firm j which supplies B, because firm j holds important liquidities, high quality management or exceptional channels of information not easily obtainable through the market mechanism. Theoretical and empirical studies are required to assess the value of such a hypothesis.

Yet, the growing importance of giant companies and the corresponding concentration of private power at the international as well as at the national level demonstrate the clear necessity of breaking forth from the constraints of the conventional approach.

3. In-Market Power V. Out-Market Power.

It is necessary to recall that power in the market place is but one facet of industrial concentration. In other words, "industrial concentration has a political dimension of vast importance"⁴⁶⁾. In the language of K. W. ROTHSCILD, "the fact is that when we enter the field of rivalry between oligopolistic giants, the traditional separation of the political from the economic can no longer be maintained... The oligopolistic struggle for position and security includes political action of all sorts right up to imperialism"⁴⁷⁾.

⁴⁶⁾ D. MERMELSTEIN, Large Industrial Corporations and Asset Shares : A Reply, American Economic Review, March 1971, p.170.

⁴⁷⁾ K. W. ROTHSCILD, Price Theory and Oligopoly, Economic Journal, Sept. 1947.

Thus, the actual degree of economic power possessed by a corporation depends upon its influence on certain aspects of the foreign policy of the state or on the use of the mass media quite as much as upon the factors usually considered in economics.

Once such a multidimensional character is perceived, it is useful to examine the type of relation existing between the different forms of economic power.

It is possible to consider that there exists a complementary relation between the out-market and the in-market power. The powerful firm will try to mould in its favor, not only the market structure, but its political, social and institutional structure as well. Instead of playing the market game, it will act on the rules of the game. "The branch manager of the company whose plant is the largest employer in a town or the vice-president of the firm proposing to build a plant which will become the largest employer in a small state treats with local government not as a citizen but as a quasi-sovereign power. Taxes, zoning laws, roads, and the like become matters of negotiation as much as matters of legislation" ⁴⁸⁾.

In this sense, an increase in the underlying power of firms in the markets in which they operate would lead to a corresponding increase in their social and political power. But the inverse is not necessarily true : an increase in the political or the social power may be obtained at the expenses of the market power. The giant firm, socially important because of the number of people they influence directly as employees, suppliers, customers,

⁴⁸⁾ C. KAYSEN, op. cit., p. 100.

may be from an economic point of view, "without muscle" or inefficient. In other words, "the corporation is the vehicle through which power comes to be held and exercised... Power increases with the size of the firm. Here lies an important explanation of the tendency of many large firm to become larger, even if sometimes the profitability of such an expansion is open to serious question" ⁴⁹⁾.

In conclusion, the various forms of power are clearly connected in the hands of the firm but the sign of this connection is somewhat ambiguous. What must be at least emphasized is that today the out-market power is probably much more important than the market power. This situation comes from the increasing institutionalization of the market economy.

Everybody now admits that our system is no more a delicate selfregulating mechanism but a set of institutions open to manipulation by the participants. In this view, the powerful corporation becomes more and more a "body politic", a "rationalized

⁴⁹⁾ R. A. GORDON, Business Leadership in the Corporation, University of California Press, 2e ed., 1961, p. 306. In our model (p.10) it means that management will maximize its utility function where size becomes as such an argument : $U = U(\pi, s)$, with $\pi = p(q, s)q - c(q) - s$.

At the equilibrium position, $\frac{\partial r}{\partial s} = 1 - \frac{\partial U}{\partial s} / \frac{\partial U}{\partial \pi}$.

With $\frac{\partial U}{\partial s} / \frac{\partial U}{\partial \pi} > 0$, we have $\frac{\partial r}{\partial s} < 1$.

The level of expenditures for increasing the degree of concentration or size will be such that the incremental expenditures add less to total revenue than they add to total cost.

system for the accumulation, control, and administration of power" 50).

Such an evolution is also manifest in Eastern countries and shows us that the power of big organizations and its control are universal problems which have to be solved in any economic system.

50) E. LATHAM, The Body Politic of the Corporation, in The Corporation in Modern Society, op. cit. , p. 220.