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THE VALUE OF MARKET SHARE AND THE PRODUCT LIFE CYCLE--A GAME-THEORETIC MODEL

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LIFE CYCLE--A GAME-THEORETIC MODEL

Abstract

The paper presents a dynamic, game-theoretic model of marketing competition in an oligopoly. The equilibrium solution to this model is used to investigate how a firm's optimal marketing expenditure, which can be interpreted as a measure of the value of market share, depends on current and future market demand, which in turn can be related to the product life cycle. The results support and refine the conventional wisdom that the earlier it is in the life cycle, the greater is the value of the market share.

Conventional wisdom in business policy and marketing suggests that the appropriate strategy regarding market share depends on the stage of the product life cycle (for example, Abell and Hammond, 1979, Ch. 4). It is often recommended that a firm should try to increase market share during the growth stage of the life cycle, hold share during the maturity stage, and harvest during the decline stage. This is equivalent to saying that the earlier it is in the life cycle, the greater is the "value" of market share. However, this leaves several questions unanswered. For example, does the value of market share decline linearly over the life cycle, or does it decline more rapidly in the early stages? How is it possible to compare the value of market share in different markets, each having its own distinct life cycle? What other factors interact with characteristics of the product life cycle to determine the value of market share? This paper uses a formal modeling approach to provide at least partial answers to these questions.

This paper presents a game-theoretic, dynamic model of marketing competition in an oligopoly in which the firms sell differentiated products. It is assumed that the firms in the oligopoly coordinate their pricing policies but compete on the marketing dimension. It is also assumed that the market shares of the firms have inertia, or are correlated over time, as the result of phenomena such as brand loyalty. It is this assumption that makes the model a dynamic model, and makes it possible to deduce a dynamic relationship between the value of market share and the product life cycle.

In the equilibrium solution to the game, the market shares of the firms change over time, in general. Under certain conditions, however, these market shares do not change; this situation defines the steady state equilibrium solution. This solution is used to investigate how a firm's optimal marketing expenditure, which can be interpreted as a measure of the value of market share, depends on current and future market demand, which in turn can be related to the product life cycle.

It is shown that the value of market share at any time is directly proportional to the ratio of the "discounted present value of demand" to the current demand. The discount factor used to determine the discounted present value of demand depends on how "sticky" the market shares are, on how the gross margins (price minus the average per-unit production cost) change over time, and on the interest rate used by the firms to discount their future profits.

Using a hypothetical life cycle as a numerical illustration, it is shown that under certain conditions, the value of market share decreases monotonically during the life cycle, a finding which is consistent with the conventional wisdom in strategic planning. However, it is also shown that, under other conditions, the value of market share increases for a short period in the beginning of the life cycle, and then decreases throughout the remainder. In both cases, the rate of decrease in the value of market share is nonlinear and is most rapid during the growth stage of the life cycle. Therefore, it is important for a firm to build market share early in the growth stage.

After discussing the assumptions of the model, a mathematical statement of the model is given. A characterization of the equilibrium solution to the game and conditions for the existence of a steady state equilibrium solution are derived. Finally, the results are interpreted and related to the previous research in marketing and business policy.

Marketing Competition

Much of the literature on oligopoly models has focused on product price as the decision variable, implying that oligopolistic firms compete primarily on the basis of price (for example, Shubik, 1959; Friedman, 1977). In fact, price competition is not as prevalent in practice as is suggested by the literature on oligopoly models. In oligopolistic rivalry, "there is reason to expect, at least as a first approximation, that the sellers will cooperate on joint maximizing strategies" (Scherer, 1980, p. 380). Scherer (1980, Ch. 6), after citing several instances, concludes that joint maximizing policies with respect to prices in oligopolies are widespread. It is a generally accepted "stylized fact" of industrial organization that price competition is relatively rare in concentrated markets with differentiated products (Schmalensee, 1976).

It is assumed here that the product price is the same for all the firms in the oligopoly, and that it is determined exogenously through some coordination mechanism, such as price leadership. Hax and Majluf (1977) similarly assume that prices are maintained at levels which accord with the "normal practice" of the firm and industry. One interpretation of the growth-share matrix approach to business portfolio planning also assumes a single industry-wide price (Salter and Weinhold, 1979, p. 68).

In order to really maximize collective profits, an oligopoly would have to coordinate both pricing and output decisions. However, achieving a consensus on price alone can be difficult enough; negotiating both price and output jointly is much harder in the absence of an elaborate cartel organization. Typically, therefore, the coordination process in an oligopoly focuses primarily on price. Such a passive policy with respect to price is often accompanied by actions to increase one's market share through nonprice measures, such as advertising, promotion, and customer service.

Many economists have argued that in a concentrated industry there is, in general, less price competition and more nonprice competition (Schmalensee, 1972, 1976; Scherer, 1980, Ch. 14; Simon, 1970, Ch. 4).[1] This conclusion is based on the observation that marketing competition is different in several respects from price competition. First, since firms vary their marketing effort all the time, it is more difficult to detect systematic changes in relative expenditure levels by a given firm than to detect secret price cutting. Thus, price coordination is easier to police than coordination on the marketing dimension. Second, price cuts can be matched almost instantaneously, whereas there is a significant time lag before a retaliatory marketing campaign can be set in motion. During this lag period, the initiator can gain market share at the expense of the laggard; therefore, there is an incentive to compete on marketing. Third, matching a price cut is easy, but counteracting a marketing campaign is much more difficult and requires more creativvity. Firms often overestimate their own ability to gain market share through marketing activities and underestimate their rivals' ability to retaliate successfully, which leads to their ignoring oligopolistic interdependence on the marketing dimension. Finally, since price competition is unappealing in an oligopoly, managers often seek to compete on nonprice dimensions where the drawbacks are not so obvious. Especially if prices are held well above marginal production cost, the quest for higher market share through nonprice rivalry is more attractive than it would be under competitive pricing.

The oligopoly model presented in this paper uses marketing expenditure as the decision variable; that is, the firms are assumed to compete on the basis of marketing. Marketing expenditure is broadly defined to include all expenses aimed directly at securing or maintaining market share. These include expenses for advertising, promotion, incentives to distributors, and additional customer service.

Market Shares

As discussed above, it is assumed that the firms collude, implicitly or explicitly, on price, but compete against each other on the basis of marketing expenditure for market share. It is this conflict which motivates the introduction of game theory. Several previous papers have used the game-theoretic approach and the above assumption to model oligopolistic competition and to derive the optimal marketing strategy for a firm (Friedman, 1958; Mills, 1961; Shakun, 1965, 1966; Baligh and Richartz, 1967; Balch, 1971; Schmalensee, 1976).

Given that firms compete for market share, an assumption relating a firm's market share to its marketing expenditure and the marketing expenditures of its competitors is needed in order to model marketing competition. The firms are assumed to be differentially competent at marketing. Let the parameter a_i measure the relative marketing competence of firm i. Let m_i be the marketing expenditure and s_i be the market share for firm i. Most of the previous research in this field has assumed that market shares are given by the functional form suggested by Mills (1961):

$$s_i = \frac{a_i m_i^e}{\sum_{j=1}^{n} a_j m_j^e}, \qquad e > 0, \tag{1}$$

where the parameter e captures the economies-of-scale effect in marketing. The previous research has often made the simplifying assumption that $e = 1$, that is, that there are constant returns to scale in marketing. The relative marketing competence parameters, a_i, can be interpreted by considering two firms which spend equal amounts on marketing; in this instance, the ratio of their market shares is equal to the ratio of their a_i's. The product $a_i m_i^e$ can be interpreted as the marketing effectiveness of firm i; a firm's market share is equal to the ratio of its marketing effectiveness to the total marketing effectiveness of all the firms.

The model represented by equation (1) belongs to the class of "market share attraction" models. Bell et al. (1975) use an axiomatic approach to derive a general market share attraction model. Naert and Wenerbergh (1981) argue that attraction models are theoretically and empirically superior to linear additive and multiplicative specifications. Aside from its use in the theoretical research cited earlier, the model represented by equation (1) has also been used in empirical work (see Schmalensee, 1972, sections 4.2 and 6.1).

However, one of the drawbacks of the market share model of equation (1) is that it is a static model. Equation (1) states that a firm's market share is equal to its share of marketing effectiveness. Clearly, however, a firm's current market share must also depend on its past market share, because of the effect of habit formation and learning behavior on part of the customers. It is well known that market shares possess inertia over time. Several empirical studies on market share use lagged market share as an independent variable; for some examples of such studies, see Schmalensee (1972). Other empirical studies use change (either absolute or relative) in market share as the dependent variable (Horsky, 1977; Buzzel and Wiersema, 1981), which implies that market shares are correlated over time.

Accordingly, the market share model assumed here is

$$s_{it} = \theta \cdot \frac{a_{it} m_{it}}{\sum_{j=1}^{n} a_{jt} m_{jt}} + (1-\theta)\, s_{i(t-1)}, \tag{2}$$

where the subscript t denotes the time period, and θ is a constant between 0 and 1. A firm's market share in a given period is equal to the weighted average of its share of marketing effectiveness in that period and its market share in the previous period. The lower the value of θ, the more "sticky" are the market shares over time. It is assumed that there are constant returns to scale in marketing, that is, $e = 1$.

Balch (1971) uses a market share model similar to the one in equation (2), but then assumes that the firms optimize over only one period. His model is, therefore, essentially static. Shakun (1966) presents a dynamic model of marketing competition using a functional form different from the one in equation (2). However, Shakun's model is too complex to yield an analytical solution; moreover, he does not present any numerical results. Hence, his paper does not yield much insight into the competitive dynamics of the situation.

Other Assumptions

Total industry demand in any time period t, denoted by d_t, is assumed to be constant and given exogenously. The market parameters--price (p_t) and demand (d_t)--change over time in some manner determined exogenously to the model.

Each firm is assumed to incur two types of costs: marketing and production. Marketing costs have already been discussed; production costs include purchasing, manufacturing, and distribution costs. It is assumed that production costs are characterized by constant returns to scale. Let y_{it} be the sales volume (in units) and c_{it} be the average per-unit production cost for firm i in period t.

In practice, because of the experience curve effect, the firm parameters a_{it} and c_{it} probably depend on the past sales volumes of the firm. In trying to determine the optimal marketing expenditure, firms ideally should take this experience curve effect into account; doing so, however, makes the model mathematically intractable. It is therefore assumed that the firms do not take the experience curve effect into account; however, the experience curve is brought into the picture in a different way, as will be seen later in the paper.

The Model

It is assumed that the firms maximize the discounted present value of their profits over a rolling horizon of T time periods. Letting r_i be the discount rate, the optimization problem for firm i in time period t can be represented as

$$\text{Maximize } \Pi_{it} = \sum_{\tau=t}^{t+T} (1+r_i)^{t-\tau} \left[(p_\tau - c_{i\tau})\, y_{i\tau} - m_{i\tau}\right]$$

$$\text{subject to:} \quad y_{i\tau} = d_\tau \left[\theta \cdot \frac{a_{i\tau} m_{i\tau}}{\sum_{j=1}^{n} a_{j\tau} m_{j\tau}} + (1-\theta) \cdot \frac{y_{i(\tau-1)}}{d_{(\tau-1)}} \right],$$

$$\text{for } \tau = t, t+1, \ldots, t+T,$$

$$m_{i\tau} \geq 0, \qquad \text{for } \tau = t, t+1, \ldots, t+T,$$

where the intial market shares $y_{i(\tau-1)}/d_{(\tau-1)}$, $i = 1, 2, \ldots, n$ are given. The equilibrium solution is obtained when all the firms solve the above problem simultaneously.

The above nonlinear optimization problem can be solved by introducing Lagrange multipliers (for example, Avriel, 1976). Let $\lambda_{i\tau}$ be the multiplier associated with the equality constraint corresponding to time period τ. Treating the nonnegativity constraints implicitly, the first-order optimality conditions required to determine the optimal solution, m^*_{it}, are

$$-1 + \frac{\lambda_{it} a_{it} \theta d_t \sum_{j\neq i} a_{jt} m_{jt}}{\left(\sum_{j\neq i} a_{jt} m_{jt} + a_{it} m^*_{it} \right)^2} \begin{cases} = 0, & \text{for } m^*_{it} > 0, \\ \leq 0, & \text{for } m^*_{it} = 0, \end{cases} \tag{3}$$

$$\frac{(p_\tau - c_{i\tau})}{(1-r_i)^{\tau-t}} - \lambda_{i\tau} + (1-\theta)\, \lambda_{i(\tau+1)} \frac{d_{(\tau+1)}}{d_\tau} = 0,$$

$$\text{for } \tau = t, t+1, \ldots, t+T-1, \tag{4}$$

and

$$\frac{\left[p_{(t+T)} - c_{i(t+T)} \right]}{(1+r_i)^T} - \lambda_{i(t+T)} = 0. \tag{5}$$

It is possible to show that the second-order optimality conditions are satisfied, although the details are omitted since they provide no additional insight. Therefore, equations (3) through (5) are necessary and sufficient conditions for m^*_{it} to be an optimal solution.

At the noncooperative, or Nash, equilibrium--that is, when $m_{it} = m^*_{it}$ for all i--equation (3) can be written in a simpler format. Define

$$k^*_{it} = \frac{a_{it} m^*_{it}}{\sum_{j=1}^{n} a_{jt} m^*_{jt}}, \tag{6}$$

and

$$F^*_t = \frac{1}{\theta d_t} \sum_{j=1}^{n} a_{jt} m^*_{jt}. \tag{7}$$

Then, equation (3) can be rewritten as

$$a_{it}\lambda_{it}\,(1-k^*_{it}) \begin{cases} = F^*_t, & \text{for } k^*_{it} > 0, \\ \leq F^*_t, & \text{for } k^*_{it} = 0. \end{cases} \tag{8}$$

Clearly, we must have

$$\sum_{j=1}^{n} k^*_{jt} = 1. \tag{9}$$

The values of λ_{it} can be determined from equations (4) and (5) by repeated substitution:

$$\lambda_{it} = \sum_{\tau=t}^{t+T} \left(\frac{1-\theta}{1+r_i}\right)^{\tau-t} \frac{d_\tau}{d_t}\,(p_\tau - c_{i\tau}). \tag{10}$$

Hence, equations (8) and (9) constitute a set of (n+1) equations in (n+1) unknowns F^*_t and k^*_{it}, $i = 1, 2, \ldots, n$. It can be shown that this set of equations always has a solution, and that the solution is unique (Karnani, 1981, Ch. 2). It can also be shown that the solution is of the form

$$k^*_{it} = \Phi\left(\frac{a_{it}\lambda_{it}}{a_{jt}\lambda_{jt}},\ j = 1, 2, \ldots, i-1, i+1, \ldots, n\right), \tag{11}$$

where the function Φ is some monotonically increasing function. It is not possible to determine a closed-form expression for this function. However, an algorithm for numerically evaluating the function Φ, which is equivalent to solving the set of equations (8) and (9), is given in Karnani (1981, Ch. 2).

From equations (6), (7), and (8) it can be seen that the marketing expenditure at equilibrium for firm i is given by

$$m^*_{it} = \theta d_t k^*_{it}(1-k^*_{it}) \lambda_{it}. \tag{12}$$

The market share at equilibrium for firm i is given by

$$s^*_{it} = \theta k^*_{it} + (1-\theta) s_{i(t-1)}. \tag{13}$$

This completes the derivation of the equilibrium solution to the model presented above. By virtue of the fact that equations (8) and (9) always have a unique solution, a unique equilibrium solution to the above model always exists. Substituting T = 0 and $\theta = 1$ in the above results yields the results obtained by Mills (1961) for the static model.

Competitive Strength

In the above model, each firm can be interpreted as being characterized by parameters which measure its competence in the three functions: production, marketing, and finance. The more competent a firm is in production, the lower is its per-unit production cost--that is, the lower are its values of c_{it}. The firm's competence in marketing is measured by its values of a_{it}. The discount rate, r_i, can be interpreted as a measure of the firm's financial strength. In a rough sense, the more financial strength a firm has, the lower should be its cost of capital; that is, the lower should be its discount rate.

A firm's market share can be interpreted as a measure of its performance. In that case, a firm's market share at competitive equilibrium, as determined by equation (13), can be interpreted as a measure of how well the firm can expect to perform if all the firms in the market choose their optimal competitive strategies. Thus, a firm's equilibrium market share can be interpreted as a measure of its competitive strength vis-à-vis its competitors (Karnani, in press).

From equations (11) and (13) it can be seen that a firm's equilibrium market share is an increasing function of $a_{it}\lambda_{it}$, where

$$a_{it}\lambda_{it} = a_{it} \sum_{\tau=t}^{t+T} \left(\frac{1-\theta}{1+r_i}\right)^{\tau-t} \frac{d_\tau}{d_t} (p_\tau - c_{i\tau}). \tag{14}$$

Therefore, a firm's competitive strength is an increasing function of its current competence in marketing (a_{it}) and its current and future competence in production ($c_{i\tau}$, τ=1, t+1, ..., t+T), as well as its discount rate (r_i). As expected intuitively, the more competence a firm has in the three functional areas, the higher is its overall competitive strength. The above model yields a specific relationship between a firm's underlying competences and its overall competitive strength.

Steady State Equilibrium

The equilibrium investigated above is transient in the sense that equilibrium market share changes over time. It is shown below that, under certain conditions, there exists a steady state equilibrium which is defined as having the following characteristics: (1) the transient equilibrium market shares, s^*_{it}, approach their steady state values over time; and (2) if the initial market shares are equal to the steady state equilibrium values, then the equilibrium market shares do not change over time.

Note that the steady state equilibrium solution, as defined above, does not imply that the decision variables (that is, the marketing expenditures of the firms) are in a steady state; rather, it is the market shares of the firms which are in a steady state. The transient equilibrium, which can be interpreted as the short-run equilibrium, always exists, whereas the steady state equilibrium, which can be interpreted as the long-run equilibrium, exists only under certain conditions. Below, conditions for the existence of the steady state equilibrium solution are derived.

Starting with initial market shares s_{i0}, i=1, 2, ..., n, the transient equilibrium market shares are given by

$$s^*_{it} = \begin{cases} \theta k^*_{i1} + (1-\theta)\, s_{i0}, & \text{for } t = 1, \\ \theta k^*_{it} + (1-\theta)\, s^*_{i(t-1)}, & \text{for } t \geq 2. \end{cases} \tag{15}$$

Let s^*_i be the steady state equilibrium market share of firm i. By definition of the steady state, we have

$$s_{i0} = s^*_i \quad \text{implies} \quad s^*_{it} = s^*_i, \qquad \text{for all } t \geq 1,$$

which yields

$$s^*_i = k^*_{it}, \qquad \text{for all } t \geq 1. \tag{16}$$

Therefore, a necessary and sufficient condition for the existence of a steady state equilibrium is that k^*_{it}, i = 1, 2, ..., n are invariant over time.

From equation (11) it can be seen that k^*_{it} are invariant over time if and only if $a_{it}\lambda_{it}/a_{jt}\lambda_{jt}$ are invariant over time for all i and j. Therefore, a necessary and sufficient condition for the existence of a steady state equilibrium solution is

$$\frac{a_{it}\lambda_{it}}{a_{jt}\lambda_{jt}} = \frac{a_{i1}\lambda_{i1}}{a_{j1}\lambda_{j1}}, \qquad \text{for all i, j, and all } t > 1. \tag{17}$$

If steady state equilibrium market shares do exist, then equation (15) can be rewritten as

$$s^*_{it} = s^*_i + (1-\theta)^t \, (s^*_i - s_{i0}).$$

Therefore, transient equilibrium market shares exponentially approach the steady state values. The less sticky are the market shares, that is, the higher the value of θ, the faster is this approach.

Scenario for Existence of Steady State Equilibrium

This section presents a scenario for which condition (17) is satisfied, and, therefore, for which a steady state equilibrium solution exists.

It is expected that firms improve their competence at marketing over time. However, it is reasonable to assume that their marketing competence relative to each other does not change over time; that is,

$$\frac{a_{it}}{a_{jt}} = \frac{a_{i1}}{a_{j1}}, \qquad \text{for all i, j, and all } t \geq 1. \tag{18}$$

The experience curve effect leads one to expect that average production cost per unit, c_{it}, declines over time for all the firms. It is assumed that all the firms are going down the same experience curve at the same rate, and that price is also declining at the same rate.[2] Then, we have

$$\frac{p_t - c_{it}}{p_t - c_{jt}} = \frac{p_1 - c_{i1}}{p_1 - c_{j1}}, \qquad \text{for all i, j, and all } t \geq 1. \tag{19}$$

Finally, suppose that all the firms use the same discounting rate, that is,

$$r_i = r, \qquad \text{for all i.} \tag{20}$$

Since all the firms are operating in the same industry, it is reasonable to assume, at least as a first approximation, that they use the same discount rate.

Using equations (18) through (20) and the value of λ_{it} from equation (10), we have

$$\frac{a_{it}\lambda_{it}}{a_{jt}\lambda_{jt}} = \frac{a_{i1}\lambda_{i1}}{a_{j1}\lambda_{j1}} = \frac{a_{i1}(p_1-c_{i1})}{a_{j1}(p_1-c_{j1})}, \quad \text{for all i, j, and all t} \geq 1. \quad (21)$$

Therefore, condition (17) is satisfied, and a steady state equilibrium solution exists. It is interesting to note that in this scenario, the steady state equilibrium market shares are the same as those which would be obtained using a static model, that is, the above model with $T = 0$ and $\theta = 1$ (Karnani, 1982).

From equations (11), (16), and (21) it can be seen that the steady state equilibrium market shares are given by

$$s_i^* = \Phi\left(\frac{a_{i1}(p_1-c_{i1})}{a_{j1}(p_1-c_{j1})}, \quad j = 1, 2, \ldots, i-1, i+1, \ldots, n\right).$$

Therefore, the steady state equilibrium market shares do not depend on the size of the total market or on how the demand changes over time. However, as expected intuitively, the optimal marketing expenditure per unit sold for the firms does depend on the market demand, as shown below.

Value of Market Share

For the scenario described above, the optimal marketing expenditure for a firm at the steady equilibrium solution can be obtained from equations (12) and (16) as

$$m^*_{it} = \theta d_t s^*_i (1-s^*_i)\ \lambda_{it}.$$

Substituting the value of λ_{it} from equation (10) into the above equation, and noting that the sales volume (in units) of firm i is given by $s^*_i d_t$, we get the optimal marketing expenditure per unit at the steady state equilibrium solution to be

$$\frac{m^*_{it}}{d_t s^*_i} = \theta(1-s^*_i)\ (p_t - c_{it}) \left[\sum_{\tau=t}^{t+T} \left(\frac{1-\theta}{1+r}\right)^{\tau-t} \frac{d_\tau}{d_t} \frac{(p_\tau - c_{i\tau})}{(p_t - c_{it})} \right]. \tag{22}$$

Therefore, the optimal marketing expenditure per unit depends, among other factors, on $\frac{d_\tau}{d_t}$, $\tau = t+1, t+2, \ldots, t+T$. The optimal marketing expenditure per unit does not depend on the current market demand, d_t; but it does depend on the ratios of demand in the future periods to the current demand. In other words, it depends on the pattern of how demand changes over time rather than on the absolute level of demand at any time.[3]

In the model presented in this paper, firms spend on marketing to compete for market share. Therefore, the optimal level of marketing expenditure can be interpreted as a measure of the "value" of market share. The more valuable the market share, the greater will be the optimal marketing expenditure. Equation (22) can be used to investigate how the value of market share depends on the pattern of demand over time which is, of course, the life cycle of the product. Therefore, equation (22) indicates how the value of market share changes over the life cycle of a product.

Since the terms outside the square brackets in equation (22) do not depend on market demand, the term inside the square bracket can be interpreted to be an index of the value of market share as a function of the demand pattern. Let this index be denoted by I_t; we then have

$$I_t = \frac{1}{d_t} \cdot \left[\sum_{\tau=t}^{t+T} \left(\frac{1-\theta}{1+r}\right)^{\tau-t} \frac{(p_\tau - c_{i\tau})}{(p_t - c_{it})} d_\tau \right]. \tag{23}$$

The minimum value of this index of the value of market share is 1, which is obtained when there is no future demand at all, that is, when $d_\tau = 0$, $\tau = t+1, t+2, \ldots$. The greater the future demand, the greater is the value of market share and the greater is the index, I_t. The logic underlying this result is simple: since market shares are correlated over time, a high market share today leads to a high market share in the future. The value of market share today depends on the value of market share in the future, which in turn depends on the future demand in the market. However, equation (23) goes further than stating merely the directionality of this relationship. The term in the square brackets in equation (23) can be interpreted as the "discounted present value of demand," where the discount factor applied to demand in period τ is $\left(\frac{1-\theta}{1+r}\right)^{\tau-t} \frac{(p_\tau - c_{i\tau})}{(p_t - c_{it})}$. Then, the value of market share at any time is directly proportional to the ratio of the discounted present value of demand to the current demand.

The more sticky the market shares, that is, the lower the value of θ, the higher is the discount factor used to discount future demand, and, hence, the higher is the value of market share. The underlying rationale is that if the market shares are more sticky, the beneficial effect of a high market share today will persist for a longer time in the future, and hence market share is more valuable. The higher the rate, r, used to discount future profits, the higher is the discounting of future demand, and the lower is the value of market share, as expected intuitively. Finally, the discounting of future demand depends on how the gross margin (that is, price minus the average per-unit production cost) varies over time. If the gross margins are eroded rapidly in the future, that is, if $(p_\tau - c_{i\tau})/(p_t - c_{it})$ are low, the future demand is heavily discounted. As expected intuitively, the less profitable the future demand, the less important it is in determining the value of market share today.

Given the pattern of demand over time (that is, the product life cycle) for any market and the values of the various parameters, equation (23) can be used to determine the value of market share at any time in that market. We now numerically illustrate how the value of market share changes over time for a hypothetical product life cycle. For the sake of convenience it is assumed that

$$\frac{p_\tau - c_{i\tau}}{p_t - c_{it}} = g^{\tau - t},$$

where g is some constant. That is, it is assumed that the gross margins change by a certain constant percentage in every time period. Let

$$v \equiv \frac{(1-\theta)}{(1+r)} \cdot g.$$

Figure 1 plots the index of value of market share, I_t, as a function of time for the indicated hypothetical life cycle for different values of the parameter v.

Insert Figure 1 About Here.

From Figure 1 it can be seen that for low values of the parameter v, the value of market share first increases for a short period and then decreases during the remainder of the product life cycle. Low values of the parameter v are obtained when the market shares are not very sticky (i.e., have high values of θ), when the interest rate (r) is high, and the when gross margins are decreasing rapidly (i.e., g has a low value). Under these conditions, it may be advantageous for a firm to fight most strongly for market share, not at the very beginning of the life cycle, but somewhat later. From Figure 1 it can be seen that the highest value of market share, in the case of low values of v, occurs at approximately the transition point between the development stage and the growth stage of the life cycle. However, for high values of v, the value of market share decreases monotonically over the life cycle.

Regardless of the value of the parameter v, the value of market share decreases very rapidly during the growth stage of the life cycle, and less rapidly during the later stages. This supports the conventional wisdom that a firm should try to build market share during the growth stage. In fact, Figure 1 can be interpreted to mean that it is important to build share as early as possible in the growth stage, since the value of market share decreases most rapidly during that period.

From Figure 1 it can be seen that the higher the value of parameter v, the more rapid is the decrease in the value of market share during the growth stage of the life cycle. Therefore, the higher the value of v, the more important it is for a firm to build share early in the growth stage. In general, equation (23) can be interpreted as refining the conventional wisdom that the earlier it is in the life cycle, the higher is the value of market share.

Suppose a diversified firm has the option of investing in market share in several different businesses. The "growth-share matrix" approach to business portfolio planning (for example, Abell and Hammond, 1979, Ch. 4) recommends that the firm should try to build market share in the business units operating in high-growth markets (that is, "question mark" business units), as opposed to those in low-growth markets (that is, "dog" business units). The implication is that the higher the market growth rate, the more valuable is market share. However, it is intuitively obvious that the value of market share must also depend on other factors besides the growth rate, such as the length of the life cycle, the future profitability in the market, and the brand loyalty effect.

Equation (22) can easily be used to compare the value of market share in different markets characterized by different cycles and different parameters. Equation (22) takes into account not just the current market growth rate, but the shape of the entire life cycle, as well as certain other factors mentioned above which interact with the life cycle in determining the value of market share.

Conclusion

Of the several possible ways to extend the above model, one obvious way is to relax the assumption that the firms do not consider the experience curve effect in determining their optimal marketing expenditure. However, it can be argued that while it would be interesting and useful to do so, it would not alter the qualitative conclusions deduced above. In a dynamic context, market share is valuable for two reasons. First, because of phenomena such as brand loyalty, a high market share today tends to lead to high market share, and hence high profitability, in the future. This paper has investigated the effect of such market share inertia on the value of market share. Second, because of the experience curve effect, a high market share today leads to lower costs, and hence higher profitability, in the future. Clearly, market share inertia and the experience curve effect both impact on the value of market share in the same direction. Thus, taking into account the experience curve effect in the optimization problem would serve only to reinforce the conclusions deduced in this paper.

To summarize, a game-theoretic, dynamic model of oligopolistic competition was used to investigate the determinants of the value of market share. It was shown that the value of market share depends on the pattern over time of market demand and of the gross margins, the discount rate used by the firms, and how strongly the market shares are correlated over time. The results of this model were then related to existing hypotheses and theories in marketing and business policy.

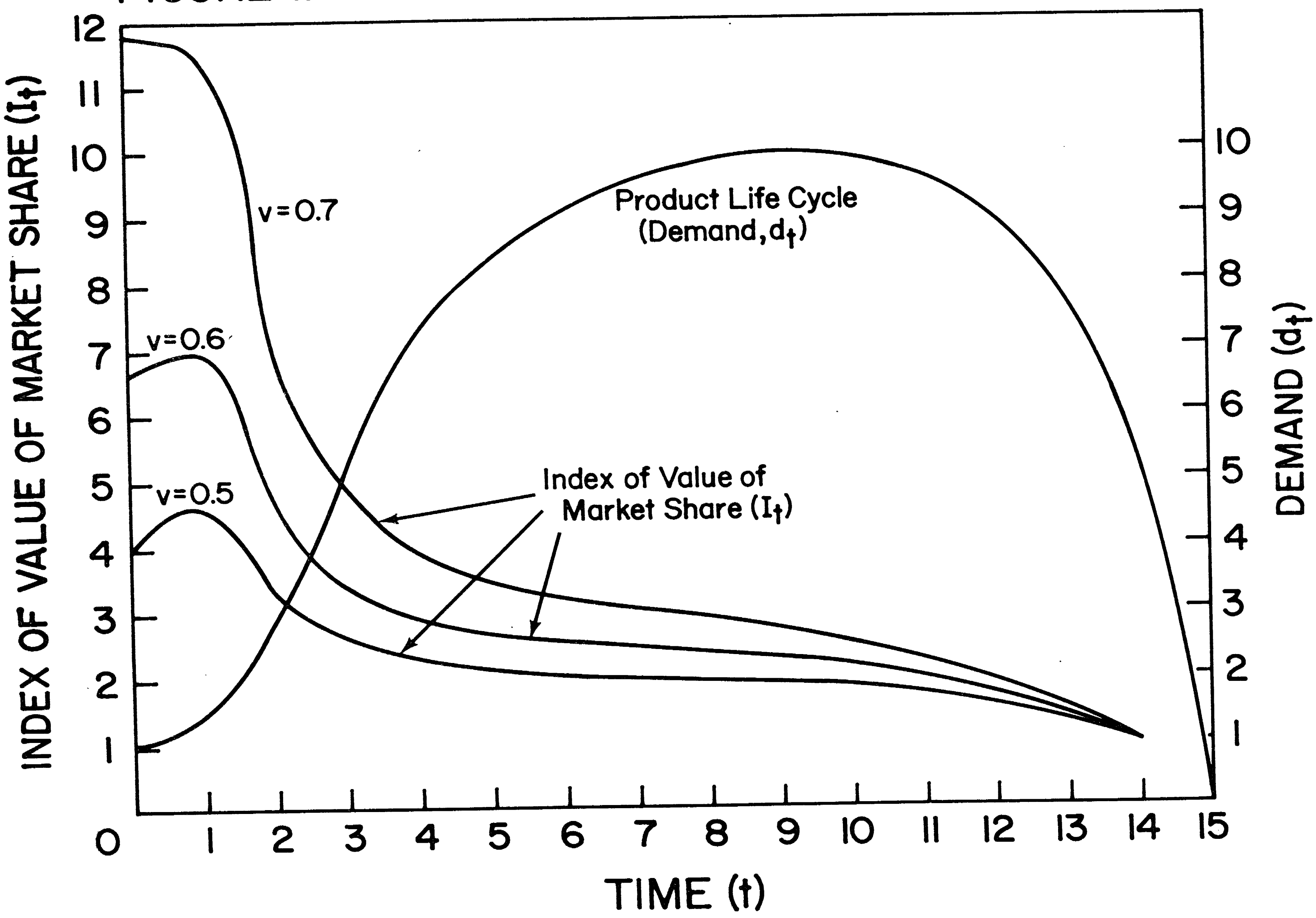
Footnotes

1. For a dissenting view, see Ferguson (1974, pp. 25-27).

2. For a discussion about costs and prices declining according to the experience curve, see Boston Consulting Group (1972).

3. This result is not counterintuitive once it is realized that it is the marketing expenditure per unit sold which is independent of the absolute level of demand.

FIGURE I. VALUE OF MARKET SHARE



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