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THINKING ONE STEP AHEAD: THE USE OF CONJECTURES IN COMPETITOR ANALYSIS

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An assessment of opponents' reactions to strategic and functional area policy decisions is shown to require knowledge concerning opponents' beliefs about the firm's behavior. This study introduces a methodology for incorporating such conjectures into the business planning process. It presents an analytical measure for these conjectural variations and discusses several illustrations. Examples of the application of the framework are provided by the Japanese flat glass industry and the U.S. domestic coffee roasting industry. The use of a broad range of conjectural variations in competitor analysis is discussed, and implications for business strategy formulation are highlighted.

INTRODUCTION

One of the central aspects in business strategy formulation is a comprehensive examination of the market strategies of competitors. The business policy literature suggests (e.g. Abel and Hammond, 1979; Hofer and Schendel, 1978) that such analysis usually breaks down into two classes of questions: Who are the firms' present as well as potential competitors, and how do they compete? Abel and Hammond point out that such competitor analysis is useful 'as the basis for identifying areas of relative strength and weaknesses and hence potential market opportunites. In this respect it may suggest, also, how a competitor might react to threat or opportunity in a future competitive situation' (p. 51). Competitor analysis thus lies at the heart of formulating a business strategy which may lead to a sustainable competitive advantage.

The key question is which advantage can be created and sustained. Ghemawat (1986) observed that there are three broad categories of sustainable advantage which are not mutually exclusive: (a) size, (b) superior access to resources or customers, and (c) restrictions on competitors' actions. There are numerous factors which management needs to consider in the process of identifying, evaluating and selecting the investment programs in the firm's tangible (e.g. technology), as well as intangible (e.g. reputation), competitive assets which are likely to yield, over time, a sustained state of asymmetry in the market. This asymmetry is commonly referred to as the company's competitive advantage. Included in the factors that may be considered in selecting the bases for the firm's competitive advantage are the likely responses of its rivals to any strategic move being considered. The idea here is to anticipate such reactions and avoid strategic moves that can be nullified by the firm's competitors. Porter (1980) suggests that knowledge about what the competitor is doing and can do, as well as what drives

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the competitor (its goals and objectives as well as its capabilities), are important elements in projecting the rival's response profile.

In this paper we attempt to carry this line of thought one step further and argue that an assessment of an opponent's reaction also requires knowledge of what this opponent *believes* about the firm's behavior. We illustrate that such assessment, which is a reflection of the firm's tangible and intangible strategic assets, provides managers with vital information on the viability and thereby the profitability of their business strategy. We also suggest that competitors' conjectures concerning the firm's likely actions can be systematically analyzed. It is shown that a summary statistic that measures such conjectures can be compiled using data on the structural characteristics of the industry, and rivals' technical ability to respond. Thus, incorporating the methodology presented in this study into the competitor analysis will augment the ability of managers to anticipate the likely response of the firm's rivals, which in turn should lead to improved strategic decision-making and superior performance.

This paper is organized as follows. In the next section a detailed explanation of the conjectural variations concept is provided. An explicit measure for rivals' conjectures is developed, illustrations of the use of conjectures in business policy formulation are provided which are further supported by an example from the Japanese flat glass industry. In the subsequent section the paper proceeds by incorporating the conjectural variation concept into the strategic group analysis framework. An example from the U.S. domestic coffee roasting industry is provided. In the final section the concept of conjectural variations, derived in the preceding sections, is broadened and ways are suggested for incorporating it into the business strategy formulation process.

CONJECTURAL VARIATIONS IN COMPETITOR ANALYSIS

In markets which are served by relatively few firms,[1] each of which has some influence over the total quantity supplied and the market price, it is reasonable to assume that competitors will retaliate to any moves a firm initiates. Thus, by utilizing its competitor intelligence system to compile a competitor response profile (Porter, 1980: ch.3), a firm might develop a set of contingency plans, which specify its most desirable reactions to a variety of likely moves by each of its major competitors. These plans may be referred to as the firm's *reaction function* (Kamien and Schwartz, 1983). To illustrate this concept, suppose that a firm considers the selection of its desired level of production. Clearly the firm's return-maximizing output level depends on the quantities produced by its competitors. Thus, its reaction function specifies the relationship between rivals' output levels and its optimal output. The slope of this reaction function is the rate at which the firm's desired output level changes with a change in a rival's output. While the analytical procedure for the derivation of such a reaction function is provided in the next section, we provide a numerical illustration for the use of the reaction function concept in setting price policies.

Consider a simple hypothetical situation in which the firm and its one competitor have only four possible price policies available, given in Table 1. Each cell in the table represents the change in the firm's profits, given its pricing policy and a corresponding reaction by the competitor. For example, if the firm lowers price by 5 percent and its competitor responds with a 10 percent price decrease, firm profits decrease by 12 percent. If the firm knows that any price decrease will be matched by the competitor, it has no reason to reduce prices since profits will

Table 1. Change in profits due to hypothetical price strategies

Firms' price policy (percentage change in price)	Competitor's reaction (percentage change in price) 0%	−5%	−10%	−20%
0%	0	−10	−15	−20
−5%	+7	−5	−12	−22
−10%	+30	+15	−8	−25
−20%	+12	+8	+5	−30

Note: Each cell represents the percentage change in the firm's profit, given the pricing policy and a corresponding reaction (change in price) by the competitor.

[1] In the context of this analysis a firm need not necessarily be an independent entity. Rather, it might be a strategic business unit (SBU) of a diversified corporation. We thank an anonymous referee for drawing this point to our attention.

be lost. On the other hand, if the firm knows that the competitor will respond by reducing prices only half as much as the firm, a price reduction may be desirable, since by using an appropriate price strategy, profits can be increased. Given such knowledge about the competitor's reactions a 10 percent price reduction is optimal, as it yields a 15 percent increase in profits.

In practice, a firm does not know with certainty the reactions of its competitors to its pricing policies, and thus additional information is required.

In addition to its own reaction function the firm may further assume that its competitors also have reaction functions which specify their response to actions taken by different companies in the industry. While the form of these functions is not known to the firm, it may have conjectures about the slope of the rivals' reaction functions. These conjectured slopes are referred to as *conjectural variations*. They reflect a competitor's beliefs about the firm's behavior and the corresponding return-maximizing action that will be taken by the competitor.

The type of conjectures discussed analytically in this paper relate to responses to price and output decisions. Clearly, the setting of price and output levels constitutes a set of functional area policy decisions, and may not be considered strategic decisions themselves. Strategic decisions pertain to a pattern that underlies such policy actions (e.g. Hofer and Schendel, 1978: ch.1). For example, a firm's relative cost position may be a desirable strategic asset in a market with homogeneous products where cost is the basis for competition (Amit, 1986). Thus, a strategic decision could be to embark on a cost-leadership strategy which will lead to a state of asymmetry that is not easily nullified by the company's competitors. The implementation of such a strategy may call for certain capital expenditures, as well as for the use of policy levers that control the evolution of such an asset. In this example the setting of prices and output levels are the relevant functional policies which affect the firm's strategic asset—its relative cost position.

In this context the conjecture itself may be viewed as a reflection of a strategic asset—namely, the reputation of a firm. Reputation here relates exclusively to the aggressiveness of firms in responding to changes in rivals' prices or output policies. Although managers may have a good heuristic intuition concerning their own reputation in this regard, the estimation of a summary measure of rivals' conjectures (i.e. their intentions) may be more difficult to assess and may therefore be ignored. As Montgomery and Weinberg (1979) have noted, knowledge of a competitor's intentions can be a primary determinant of any strategy. Clearly the analysis of conjectures adds a new dimension to the rigorous study of competitors, and provides further substantiation for the selection of a viable business strategy.

To assess competitors' reactions, two kinds of information are needed. The first is data on the structural characteristics of the industry and rivals' technical ability and desire to respond. The second is information on rivals' conjectures about the firm's behavior. Of course, other information might be included in the first set, such as rivals' reputation, their marketing, operation, organizational, and financial strengths and weaknesses, as well as some perception concerning their short-run and long-term goals and current position. As the importance of such information is well-illustrated elsewhere (e.g. Porter, 1980), we focus our attention on the role of conjectures in competitor analysis.

Consider the hypothetical situation depicted in Figure 1. Technically, an opponent's conjectures concerning potential responses of the firm can be summarized by a number, which is termed

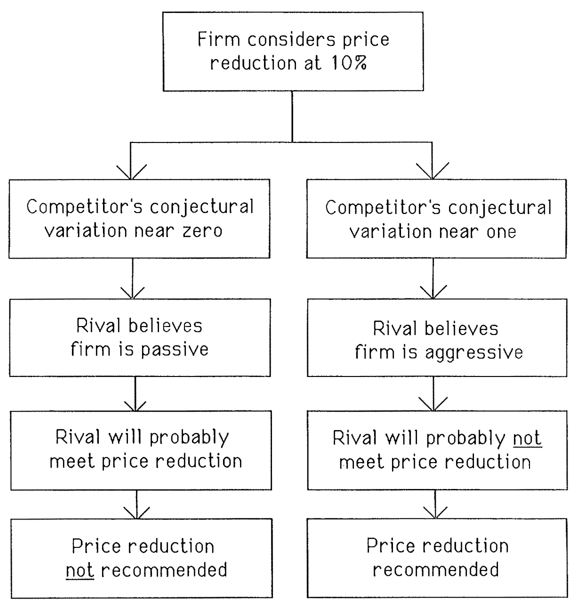

Figure 1. Conjectures and a price reduction policy.

the rival's conjectural variation. The calculation of such a measure is explained below. In the case of price responses, for example, when the conjectural variation is zero, an opponent believes that the firm will not respond to changes in the opponent's strategy. A conjectral variation of one indicates that the competitor expects the firm to match any price change. A conjectural variation, k, can be interpreted as the competitor's belief that for any price redction of 1 percent the firm will respond with a price decrease of k percent.

As illustrated in Figure 1, if the opponent's conjectural variation is near one, the opponent believes the firm to be aggressive in responding to shifts in pricing policy. The rival therefore expects that a price decrease in response to the firm's own decrease may result in further price reductions, i.e. a price war. Depending on the rival's capability to respond, such a price war may well be undesirable, and the rival will not meet the proposed reduction in price. Thus, from the firm's viewpoint a price reduction may be desirable. The opposite situation may be envisaged if the opponent's conjectural variation is near zero.

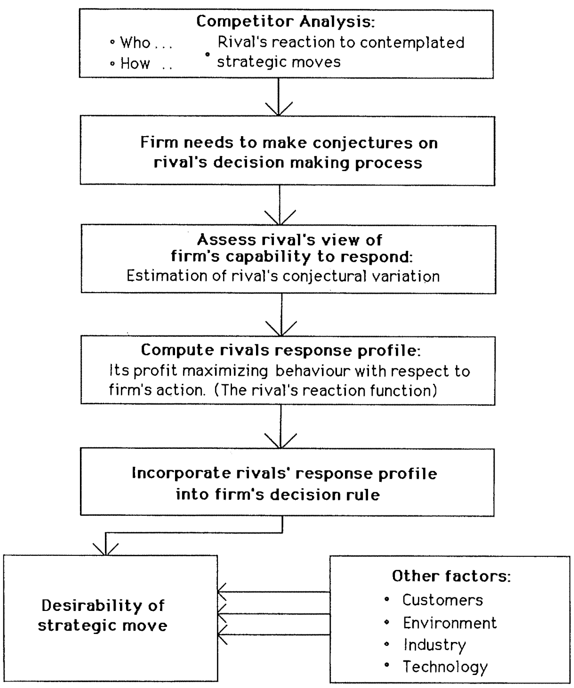

Figure 2. The role of conjectures in competitor analysis.

In this case the opponent believes that the firm will not begin a price war if the reduction is met. The rival may simply match the proposed 10 percent reduction. Thus, from the firm's viewpoint, the price reduction is not recommended.

A more general summary of the use of conjectures in competitor analysis is depicted by Figure 2. One of the objectives of competitor analysis is to obtain a realistic view of likely reactions of rivals. In order to do so we have suggested that the analysis should start with an assessment of the rival's decision-making process. This obviously involves the rival's perception of the firm's own strategic assets. One summary measure of the firm's capabilities, in the eyes of the rival, is the conjectural variation—namely the rival's view of the firm's own response profile. Viewed in this way the concept of conjectural variations can be defined more broadly to incorporate other strategic dimensions. This measure is then incorporated into the rival's profit-maximizing behavior which, in turn, also enters into the firm's own decision-making

THE MEASUREMENT OF COMPETITORS' CONJECTURES

As was suggested earlier, conjectures concerning rivals' behavior can be systematically analyzed. Gathering data about rivals' actions and relative positions within the industry over time is certainly a beginning, but this alone is not enough. Econometric methods have proven to be useful in the empirical estimation of conjectures within industries. As a first step we derive an analytical form of the conjectural variation and its use within the context of a pricing decision.

Consider a market consisting of two firms, A and B, producing slightly differentiated products. The problem of firm A is to find the price P_A^* that will maximize its profits,

$$\pi_A = (P_A - C_A)q_A(P_A,P_B) \qquad (1)$$

where C_A is firm A's unit cost and $q_A(P_A,P_B)$ is A's output demand as a function of both prices. The first difficulty that firm A faces is that P_B is not known. It is clear to firm A that because of the interdependence between the firms P_B depends on P_A. Thus, firm A must first analyze the behavior of firm B, which is also assumed to maximize profits. The profit of firm B is given by

$$\pi_B = (P_B - C_B)q_B(P_A,P_B) \tag{2}$$

In maximizing its profit, B follows the rule

$$\frac{\partial \pi_B}{\partial P_B} = q_B(P_A,P_B) + (P_B - C_B)\left[\frac{\partial q_B}{\partial P_B} + \frac{\partial q_B}{\partial P_A}\frac{dP_A}{dP_B}\right] = 0. \tag{3}$$

This equation constitutes a behavioral rule for firm B. However, it is clear that this rule depends on the conjectures of firm B about the response of firm A. This response is denoted by the term dP_A/dP_B, which is the conjectural variation of firm B. Denote this conjectural variation by k_{AB}. Thus, firm B's pricing policy is given by the behavioral rule

$$q_B(P_A,P_B) + (P_B - C_B)\left[\frac{\partial q_B}{\partial P_B} + \frac{\partial q_B}{\partial P_A}k_{AB}\right] = 0 \tag{4}$$

From this rule, firm A can obtain the reaction function of firm B. If firm A has complete knowledge about the demand function and the production cost of firm B, the pricing policy of firm B can be summarized, using equation (4), as a function $P_B = f(P_A,k_{AB})$. In other words, the price that firm B will charge is described as a function of the price P_A and the conjecture k_{AB}. Since k_{AB} is part of the behavioral rule of firm B, different values of k_{AB} elicit different responses from B to A's price.

The final step is for firm A to maximize its profit, taking the reaction function of B into account. Thus, A maximizes

$$\pi_A = (P_A - C_A) \cdot q_A(P_A,f(P_A,k_{AB})) \tag{5}$$

and the optimal price is calculated from the solution to this profit-maximization problem. These steps, which are summarized in Figure 3, are illustrated by the following example.

Consider a market in which there are two firms, A and B, facing the demand functions

$$q_A = a_0 - a_1P_A - a_2P_B \tag{6}$$

$$q_B = b_0 - b_1P_A - b_2P_B \tag{7}$$

Firm B's profits are

$$\pi_B = (P_B - C_B)(b_0 - b_1P_A - b_2P_B) \tag{8}$$

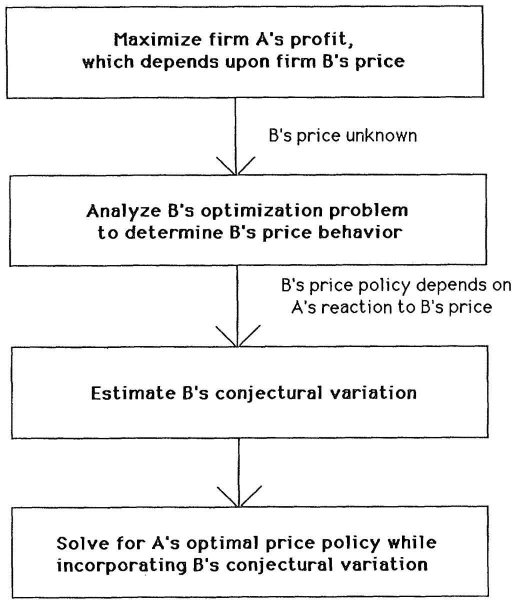

Figure 3. Use of rival's conjectures in setting price. *Note:*'A' refers to the decision-making unit and 'B' refers to the rival, in this example.

In order to maximize its profit, firm B follows the behavioral rule outlined by equation (4):

$$\frac{\partial \pi_B}{\partial P_B} = b_0 - b_1P_A - b_2P_B + (P_B - C_B)\left[-b_1k_{AB} - b_2\right] = 0 \tag{9}$$

By rearranging terms in (9), firm A can obtain the reaction function of firm B, i.e. $P_B^* = f(P_A,k_{AB})$, as

$$P^*_B = \frac{b_O - b_1P_A + C_B(b_1k_{AB} + b_2)}{2b_2 + b_1k_{AB}} \tag{10}$$

Now, firm A can use this information in order to describe its own profit function, taking into consideration the reaction of firm B. Combining equations (5), (6) and (10) yields:

$$\pi_A = (P_A - C_A)\times \left(a_O - a_1P_A - a_2\left[\frac{b_O - b_1P_A + C_B(b_1k_{AB} + b_2)}{2b_2 + b_1k_{AB}}\right]\right) \tag{11}$$

By maximizing the above profit function with respect to P_A, we find that the optimal price P^*A is

$$P_A^* = \frac{a_0 - \dfrac{a_2 b_0 + a_2 C_B(b_1 k_{AB} + b_2)}{2b_2 + b_1 k_{AB}} + C_A\left[a_1 - \dfrac{a_2 b_1}{2b_2 + b_1 k_{AB}}\right]}{\left[2a_1 - \dfrac{2b_1 a_2}{2b_2 + b_1 k_{AB}}\right]} \tag{12}$$

It is important to note that in order to find the price that will maximize its profit, the firm has to know the demand function, i.e. the parameters a_O, a_1, a_2 and b_O, b_1, b_2, its own production cost (C_A) as well as production cost of its rival (C_B). But this information is not sufficient, as demonstrated by (12). The firm also must know the conjectural variation of firm B, i.e. k_{AB}.

In order to illustrate the sensitivity of firm A's optimal pricing policy to estimates of the conjectural variation regarding B's output response, consider the following simple numerical calculations. Let the values of the demand and cost parameters be

$$a_0 = 15; a_1 = 0.2; a_2 = 0.2; C_A = 10$$
$$b_0 = 10; b_1 = 0.1; b_2 = 0.1; C_B = 20$$

Evaluating equation (12) shows that when $k_{AB} =$ O then $P_A^* = 20$. However, when $k_{AB} = 0.5$ then $P_A^* = 24.17$, and when $k_{AB} = 1$ we obtain $P_A^* = 26.25$.

The importance of rivals' conjectures (k_{AB}) is highlighted by this example. The difference in the optimal price, assuming zero conjectural variation and a conjecture of 0.5, is roughly 21 percent.

A similar exercise can be carried out in terms of output, rather than price. In that case, conjectures regarding output response become important, and it will be clear from the empirical examples cited below that these conjectures are not necessarily zero.

Consider a market with relatively few firms producing a single homogeneous product. For the moment the number of firms is assumed to be small enough to consider the conjectures of a single firm j concerning the aggregate response of the rest of the industry to a change in firm j's strategy. The conjectures, or more precisely the conjectural variation of this firm, is defined to be the aggregate output response of other firms anticipated by firm j, in response to an increase in firm j's supply of output. If we also assume that each firm maximizes profits, the conjectural variation of firm j, CV_j, can be written as

$$CV_j = \eta\left[\frac{C_j - P}{p}\right]\frac{Q}{q_j} - 1 \tag{13}$$

where η is the price elasticity of demand, P and Q are the output-price and total market output, respectively, and q_j is the output of firm j, produced at a marginal cost of C_j.[2] For the moment this expression should be viewed simply as a formula for the calculation of a summary measure of firm j's expectations concerning the aggregate output response of other firms. Given estimates of the elasticity of demand, costs, and market share, this formula allows the estimation of the conjectural variation.

It is important to note that the market price, P, in equation (13) is a function that depends upon the conjectural variations of other firms in the industry. Taking this point into account, in

[2] The derivation of this relationship is straightforward. For simplicity, consider an industry consisting of only two firms. The profit of firm 1 is given by

$$\pi_1 = [P(q_1 + q_2) - C_1]q_1$$

where P is the market price, q_1 and q_2 are the output levels of the two firms, and C_1 is the marginal cost. Profit maximization involves differentiating π_1 and setting this expression to zero:

$$\frac{\partial \pi_1}{\partial q_1} = P - C_1 + q_1[(1 + \partial q_2/\partial q_1)(dP/dQ)] = 0$$

where Q = $q_1 + q_2$. The conjectural variation of firm 1 is $CV_1 = \partial q_2/\partial q_1$ Solving the expression above yields

$$CV_1 = \left[(C_1 - P) - q_1\frac{dP}{dQ}\right]/q_1\frac{dP}{dQ}$$

Rearranging and using the formula for the price elasticity of demand:

$$CV_1 = \eta\left(\frac{C_1 - P}{P}\right)\frac{Q}{q_1} - 1$$

The relationship of this measure of a firm's conjectures to indices of industry performance is given by Kamien and Schwartz (1983).

an industry of two firms the market share of firm 1 ($MS_1 \equiv q_1/Q$) can be written as:

$$MS_1 = \eta \left[\frac{(c_1 - c_2)Q + Pq_2/\eta)(1 + \phi_{12})}{Qc_2 - (Pq_2/\eta)(1 + \phi_{12})}\right] \left(\frac{\partial q_2}{\partial q_1} + 1\right) - 1 \qquad (14)$$

where $\phi_{12} = (\partial q_1/\partial q_2)$, which is the conjectural variation of firm 2.[3] As in the case of setting price policy, we observe once more that the conjectural variation for output response of firm 2, enters into the optimization problem of firm 1. Further, equation (14) suggests that the market share of firm 1 depends upon the conjectural variations of both firms as well as on the price elasticity η, the difference in marginal costs ($c_1 - c_2$), market demand Q, and market price P.

A numerical example of the use of conjectural variations expressed in this particular manner is given in the next section.[4]

ESTIMATION OF CONJECTURES: AN EXAMPLE

It is clear from the expressions presented above that a firm's conjectural variation cannot be estimated directly from firm and market data. It can, however, be indirectly calculated using such data. This can be accomplished, for example, by developing estimates of the market demand curve and input factor demands for individual firms, or even groups of firms.

Before giving a specific example, it is useful to characterize broadly the types of data needed in any such analysis.

1. Data relevant to the shape of the market demand curve. Such data generally consists of sales, market prices, and an appropriate measure of consumers' income.
2. Data related to the firm's demand for primary and secondary inputs in the production process. These include price and quantity data for all inputs.
3. Output history of the individual firms: this consists of the level of output of finished goods over time.

Information about the total cost of production is also very helpful, but not required in every application. Additional industry-specific data are sometimes necessary, but these obviously depend on the characteristics of the industry to be analyzed. Although accurate data at the firm level are sometimes difficult to come by, they are not impossible to obtain, as suggested by the examples that follow.

Gyoichi Iwata (1974) estimates conjectures of firms in the Japanese flat glass industry with respect to output changes by an individual firm. The industry consists of three firms: Asahi Glass Co. Ltd, Nippon Sheet Glass Co. Ltd, and Central Glass Co. Ltd, each of which produces two main products: window glass and polished plate glass. The industry is treated as a single strategic group, and estimates of the conjectures of Asahi and Nippon are obtained with respect to each other.

Firms' costs and input demands are estimated using semi-annual accounting data over a period of 10 years. The market demand curves for both products are calculated from data readily available from sources such as the Bank of Japan and government agencies. These data include historical information on wholesale and retail prices, imports, floor space of new building starts, and consumption expenditures, as well as on automobile demand in the case of polished plate glass.

This information is used to estimate indirectly the values of conjectural variations for Asahi and Nippon. The conjectural variations of Asahi for

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[3] The derivation follows from that in footnote 2. Profit maximization for firm 2 involves differentiating

$$\pi_2 = [P(Q) - c_2]q_2$$

with respect to q_2, and setting the resulting expression to zero:

$$P(Q) = c_2 - q_2 \frac{dP}{dQ}\left[1 + \phi_{12}\right]$$

where $\phi_{12} = \partial q_1/\partial q_2$. Substituting this expression for P into the last equation of footnote 2, and rearranging, gives:

$$\frac{q_1}{Q} = \eta\left[\frac{c_1 - c_2 + q_2(dP/dQ)(1 + \phi_{12})}{c_2 - q_2(dP/dQ)(2 + \phi_{12})}\right]\left(\frac{\partial q_2}{\partial q_1} + 1\right) - 1$$

The expression in the text is then obtained using $\eta = (P/Q)(dQ/dP)$.

[4] In practice the expression for the conjectural variation of a firm may be somewhat more complicated than (13), which is based upon a two-firm industry. However, extensions of the basic analysis are not difficult; see, for example, Kamian and Schwartz (1983).

window glass are approximately 0.2. Thus, Asahi anticipated that increasing its own output by 100 units, say, would result in an increase in Nippon's output by 20 units in response.

Table 2. Conjectural Variations in the Japanese window glass industry[a]

	Asahi (1) 1956: 1	Nippon (2) 1956: 1
Price [b]	2.619	2.673
Marginal cost [b]	0.863	1.145
Conjectural Variation (CV)	0.146	0.504
Estimated market share: [c]		
CV = As Computed	0.469	0.354
CV = 0	0.594	0.467
Actual market share	0.571	0.427

[a] The data are retrieved from Iwata (1974), Table 1.
[b] Thousand yen.
[c] The estimated demand elasticity $\eta = -0.98$. Equation (13) is used for these computations.

Table 2 displays data on prices and costs along with estimates of the conjectural variations of the two firms, and their respective market shares for the first half of 1956. We do not have a theory of how conjectures are actually formed; however, some intuition as to the differences in conjectural variations across the two companies can be gained by examining their costs and market shares. Note that the conjectural variation of Asahi is lower than that anticipated by Nippon. Asahi's costs are also lower than Nippon's, while the prices charged are approximately the same. Asahi has the better cost position, and appears to be the more profitable enterprise. It follows that Asahi is more capable of responding vigorously to a change in output on the part of Nippon, and this is reflected by the higher value of Nippon's conjectural variation. One may also expect that as Asahi's market share rises relative to that of Nippon, Asahi's conjectural variation rises as well. Asahi has the better market position, and Nippon can anticipate a correspondingly stronger reaction from Asahi in response to changes in Nippon's output policy. The converse can be expected about Nippon's conjectural variations. Indeed, the data presented by Iwata (1974) confirm such expectations.

This is simply commonsense reasoning, but it has a basis in the actual formula for numerically calculating a conjectural variation, and may help to explain the pattern of conjectures calculated for this industry. It should be stressed, however, that these numerical values of conjectural variations are useful to companies in formulating output strategy, over and above the basic insight gained by examining cost positions and market shares.

To illustrate the importance of conjectural variations for estimating market share, consider the case of Asahi's output of window glass. The price elasticity of demand was estimated to be −0.98 over the sample period. In the first half of 1956 marginal cost was 0.863 and price was 2.62 (both in thousands of yen). Conjectural variation was an estimated 0.146. Asahi's market share, as calculated from (13) was 0.573, and was in reality 0.571. If the conjectural variation had been thought to be zero its share would have been estimated to be roughly 0.657, a difference of 15 percent.

The procedure presented here and illustrated in Figure 2 is a general guide to thinking about the role of conjectures in competitor analysis. In the beginning of this paper, the importance of assessing the potential reactions of rivals to pricing policies was stressed. The example shows that such reactions arise from rivals' own profit-maximizing behavior, into which enter the rivals' conjectures concerning the behavior of other firms. A price or output policy is then developed, taking these expected reactions into account. Differing conjectures on the part of rivals engender different reactions, hence different strategies.

STRATEGIC GROUPS AND CONJECTURES

In industries characterized by firms with different combinations of scope and competitive assets it may not be necessary or practical to consider the conjectures of all rivals. Rather, management may focus the analysis only on one of the competitors which base their business strategy on a similar competitve advantage. This leads naturally to the notion of partitioning an industry into strategic groups. Cool and Schendel (1987) define a strategic group as 'a set of firms competing within an industry on the basis of similar combinations of scope, resource commitments, and intended competitive advantage'. This practical view of a strategic group is derived by Cool and Schendel from the major components of business level strategy. They provide empirical evidence for between-group performance differences. In their examination of the theoretical foundations of the strategic group concept, Cool and Schendel have highlighted the link between this notion and the structure–conduct–performance paradigm.

This was also observed by McGee and Thomas (1986), who note that in terms of this traditional paradigm the strategic group concept is an important unit of analysis. They observe that this concept relates to identifying specific structures within broad industry boundaries which are defined along market (substitutability of products) and technology (process similarities) criteria. In this sense it is a 'structure' (supply-side) concept. However, the observed similarities in behavior of firms serve as the primary identification basis. This is clearly depicted in Table 1 (pp. 143–144) of the McGee and Thomas (1986) study, which classifies the major strategic group studies on the basis of strategic group formation. Thus, a strategic group is also a 'conduct' concept. McGee and Thomas further note the relevance of this concept for business policy formulation: 'strategic groups offer a distinctive slant on the identification of relative competitive position and suggest a systematic and comprehensive way of conducting strength and weaknesses analysis in terms of the framework of relative competitive advantage' (1986: 142).

In the context of this study the important characteristic of strategic groups is that firms within a group are affected by, and respond similarly to, external events and competitive moves in the industry. In other words they base their business strategy on a similar competitive advantage.

Grouping firms in this way makes it possible to analyze the conjectures of blocks of firms in a large industry, rather than of all individual firms. It should be noted that when the number of firms within the group is small it is feasible to analyze the conjectures of all firms within the group with respect to one's own behavior. In the context of the example that was presented in the preceding section, the window glass industry is composed of a single strategic group and within-group is composed of a large number of firms, such analysis may not be practical. In this situation it can be expected that each firm has only a small effect on the group's market segment, and an analysis of blocks of firms may suffice.

In an industry which is characterized by several identifiable strategic groups, the examination of the behavior of blocks of firms may call for a between-group analysis of conjectures. The concept of a reaction function is still applicable, but more dimensions need to be considered in assessing a rival's response profile. For example, a price decrease on the part of a firm in one group may elicit a response from firms in another group with respect to increased advertising intensity. This was referred to in the preceding section as the rival's reaction function. Such differences in policy responses can be expected precisely because rivals in different strategic groups seek or possess different competitive advantages. In this context the conjectural variation refers to the intensity of the advertising response of the rival's strategic group. Such a conjectural variation should be reflected in the firm's pricing decision. It should be noted that the magnitude of the conjectural variation will depend on the rival's conjectures regarding the firm's strategic asset, namely its cost position in this example.

Consider an example of the use of the strategic group concept in analyzing conjectures. In an industry characterized by a single homogeneous product, a distinguishing characteristic may be the different scope of firms. A reasonable dimension of the scope is the size of the firms. Indeed, several authors in the strategic management literature have identified size as a basis for strategic group formation. (See, for example, Caves and Pugel, 1980; Lahti, 1983; and Primeaux, 1985.) The U.S. domestic coffee roasting industry consists of more than 160 firms producing a relatively homogeneous product, with four firms accounting for 65 percent of sales. Gollop and Roberts (1979) estimate the conjectures of benchmark firms in each group defined in terms of size classes regarding the output response they anticipate from all other firms in the industry. They find the conjectures to be quite different across groups. Estimates are obtained directly from estimated input demand functions. The required data are obtained at the level of individual plants from government sources and Economic Information Systems, Inc.[5]

The conjectures of a firm concerning the response behavior of firms in other size classes are estimated in relative terms in this study. The first group consists of only one firm, which is twice the size of its closest rival. The second is composed of five firms, each with at least 4 percent of industry output. The remaining firms are split into an additional two size classes. Even after accounting for differences due purely to size, it is found that firms make a distinction between the expected reactions of competitors in different strategic groups.

The conjectures of the benchmark firms regarding the output response they anticipate from all other firms in the industry to a change in their own output range from -0.021 to 0.318. There is only one firm in the largest size class which is big enough to anticipate that aggregate output, exclusive of its own, will fall in response to a planned increase, given the market demand. The relative expected responses of rivals then becomes positive, steadily increasing as the size of the firm decreases. This pattern of conjectures can again be linked to the relative market positions of firms in given size classes and their relative capacity to respond. In this case a relationship can be seen between the size of a firm and aggressiveness, as measured by the conjectural variation, which is not an unexpected result. In fact it is quite similar to the pattern hypothesized for the Japanese glass industry. The main difference here is that the conjectural variation for the largest firm, in terms of aggregate output, actually turns negative with the interpretation above. At this stage a threshold for market share at which one might naturally expect such a phenomenon cannot be identified although a theoretical model oriented towards the issue might eventually yield some qualitative guidelines. To our knowledge such a study has yet to be conducted, and may prove to be an interesting area for future research.

The overall results of the Gollop and Roberts study suggest that the market experience of firms has ostensibly led to conjectures which differentiate expected reactions according to the size characteristics of the firm implementing the market change, as well as the responding firms, even after accounting for variations that are due to pure differences in rivals' productive capacity. Based on the glass and coffee industry studies it is reasonable to hypothesize a decreasing relationship between conjectures and market power, noting that the conjectures need not simply taper off to zero with size, but can indeed become negative, indicating a substantial expected aggressiveness with respect to a dominant firm.

DISCUSSION AND IMPLICATIONS

This study addressed, both heuristically and quantitatively, the use of conjectural variations in competitor analysis. In a sense this is the way the concept should be considered: an additional piece of competitor analysis to guide the process of strategy formulation. Thinking one step ahead involves getting some idea as to what opponents theorize about a firm's own behavior. This knowledge has been shown to help in the formulation of effective pricing and output policies. As econometric methods have been successfully employed in the estimation of firms' conjectures, it seems useful and practical to incorporate such estimates into the competitor analysis segment of the business planning process.

The derivation of conjecture variations was illustrated in terms of price and output response. Strategy researchers should also consider broader definitions of this concept. Although mathematical models may not be constructed easily, interest lies in measures of conjectural variations that relate to such business policy variables as advertising and promotion expenditures, channels of distribution, R&D programs, new product introductions, etc. As an illustration consider a new product announcement by a technology-based company such as a computer hardware or software firm. Such announcements are usually made well before the product is ready for shipment. They are intended to deter customers from buying a rival's product by, for instance,

[5] Economic Information Systems, Inc. (New York, New York) surveys all domestic manufacturing plants with more than 20 employees. An annual listing of data for all plants by four-digit SIC code, geographic location, and parent company affiliation is available.

promising a superior price–performance ratio. Further, they are aimed at pre-empting competitors and discouraging them from developing the new technology. Conjectural variations (appropriately defined) can be useful to a firm in assessing the credibility of the threat. Specifically, if the rival believes that the firm is engaged in the development of the new technology, he might make such an announcement without an intention (or capability) to carry it out. Realizing this has implications on the firm's R&D decisions regarding the new product technology. Specifically, the firm may disregard the rival's announcement as it presents no threat to the potential profitability of the new product technology.

The preceding example highlights the intuition behind an extension of the conjectural variations concept beyond price or quantity decisions. In what follows, additional extensions of this concept are discussed, and their applicability to the selection of the firm's competitive advantage. This process lies at the heart of formulating a sustainable competitive advantage and a durable business strategy.

Consider a firm which evaluates the attractiveness of competing on the basis of its reputation for quality, reliability, etc. One marketing policy variable which will enable it to enhance its reputation is advertising intensity. The desirability of augmenting advertising expenditures depends in part upon a conjectural variation. Specifically, the firm needs to estimate the likely change in the rival's advertising expenditures in response to its own. That will depend in turn upon the rival's estimate about the aggressiveness of the firm, namely the change in the firm's advertising expenditure in response to the rival's change. In other words, the advertising intensiveness of the firm may be described as a function of two variables; the cost of the firm and the cost to the rival. The latter variable depends on the rival's conjecture about the firm's aggressiveness, and it is this conjectural variation that should enter into the firm's decision on advertising intensiveness. The analytical formulation of this kind of conjecture is similar to the analysis presented earlier in the context of price competition. Empirical implementation of this concept may be facilitated by utilizing available data on advertising expenditures, as well as industry information on the demand schedules. Incorporating this notion of a conjectural variation will improve the firm's capability to anticipate the rival's response and avoid competing on a basis that is unlikely to yield a competitive advantage.

Indeed, the strategic management literature acknowledges the critical role of competitor analysis in formulating effective business strategies (see, for example, Hofer and Schendel, 1978, and Porter, 1985). The aim of such analysis is to anticipate likely moves of competitors and to avoid basing the firm's strategy on a competitive asset that is as (or more) attractive to the competition as it is to the firm, since the firm may not be able to establish its competitive advantage in this instance. Clearly, determining the potential attractiveness to a competitor of any strategic asset involves consideration of the competitor's beliefs about the firm's likely behavior—namely a conjectural variation. To illustrate this, consider one of Ghemawat's (1986) three broad categories for sustainable advantage—the benefits of size. The attractiveness to the competition depends in part on its beliefs about the firm's own ability and commitment to attempt to exploit scale and experience effects in manufacturing and in distribution. If the competitor believes that the firm is capable and committed to exploit the benefits of size, that strategic asset becomes potentially less attractive to the competitor. It is this kind of consideration that should enter into the firm's decision to compete by exploiting the benefits of size. The challenge for the researcher is to develop a measure that reflects these considerations and demonstrate either analytically or empirically the benefits of using it.

The introduction of the conjectural variations concept into the traditional competitor analysis component of strategy formulation poses an interesting strategy research challenge. From a theoretical standpoint, interest clearly lies in formal models that would facilitate the measurement and estimation of conjectural variations for a range of strategic variables as discussed above. Also of interest are normative models that will sharpen our understanding of how conjectures are formed in a dynamic world of incomplete information. Further, how do conjectures evolve over time as the firm's position in the industry (e.g. its market share) changes and the industry structure (e.g. the number and size of firms) changes? Issues that relate to the role of conjectures in facilitating tacit coordination between firms, and the impact of such implicit communication on a firm's business strategy and performance, merit consideration. While such studies are beginning to emerge in the theoretical industrial organization literature (e.g. Gal-Or, 1985), more research is required to substantiate our understanding of the concept of conjectural variations in dynamic settings and its implications.

The application of the conjectural variation concept in business strategy formulation presents a major challenge for empirical strategy research. As a first step it seems that a detailed taxonomy, which draws on the existing and emerging body of theory that relates to conjectural variations, needs to be developed and tested. Such taxonomy should involve the notion of conjectural variation at two major levels: strategic conjectures which are conceptual (e.g. size), and functional conjectures which are operational in nature (e.g. pricing, advertising, etc.). Also, it should highlight the impact of a range of conjectural variations on the selection of functional plans, the interrelationships between such plans and the firm's business strategy, as well as the link between strategic conjectures and the formulation of the desired basis for establishing the firm's competitve advantage. While the main difficulty lies (as usual) in the lack of sufficiently detailed and publicly available data, indirect estimation methods, using the kind of data suggested in this paper, could be used to assess the impact of conjectures on the firm's conduct and performance.

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REFERENCES

Abel, D.F. and J.S. Hammond. *Strategic Market Planning*, Prentice-Hall, Englewood Cliffs, NJ, 1979.

Amit, Raphael. 'Cost leadership strategy and experience curves', *Strategic Management Journal*, **7**, 1986, pp. 281–292.

Caves, R. E. and Thomas Pugel. *Intra-Industry Differences in Conduct and Performance: Viable Strategies in U.S. Manufacturing Industries.* Monograph, New York University, 1980.

Cool, Karel O. and Dan Schendel. 'Strategic group formation and performance: the case of the U.S. pharmaceutical industry. 1963–1982' *Management Science,* **33**,(9), 1987, pp. 1102–1124.

Gal-Or, Esther. 'Incomplete information as a vehicle for implicit coordination'. Working Paper number 621, Graduate School of Business, University of Pittsburgh, Pittsburgh, PA, August 1985.

Ghemawat, Pankaj. 'Sustainable advantage', *Harvard Business Review,* **64**,(5), 1986, pp. 53–58.

Gollop, F.M. and M.J. Roberts. 'Firm interdependence in oligopolistic markets', *Journal of Econometrics*, **10**, 1979, pp. 312-331.

Hofer, Charles W. and Dan Schendel. *Strategy Formulation: Analytical Concepts,* West Publishing Co., St. Paul, MN, 1978.

Iwata, Gyoichi. 'Measurement of conjectural variations in oligopoly', *Econometrica,* **42**, September 1974, pp. 947–966.

Kamien, Morton I. and Nancy L. Schwartz. 'Conjectural variations', *Canadian Journal of Economics,* **7**, 1983, pp. 191–211.

Lahti, A. 'Strategy and performance of a firm: an empirical investigation in the knitwear industry in Finland in 1969–81'. Helsinki School of Economics, 1983.

McGee, John and Howard Thomas. 'Strategic groups: theory, research and taxonomy, *Strategic Management Journal,* **7**(2), 1986, pp. 141–160.

Montgomery, David B. and Charles Weinberg. 'Towards strategic intelligence systems', *Journal of Marketing,* **43**, 1979, pp. 41–52.

Porter, Michael E. *Competitve Strategy: Techniques for Analyzing Industries and Competitors,* Free Press, New York, 1980.

Porter, Michael E. *Competitve Advantage,* Free Press, New York, 1985.

Primeaux, Jr. Walter, J. 'A method for determining strategic groups and life cycle stages of an industry'. In Thomas, H. and Gardner, M. (eds), *Strategic Marketing Management*, John Wiley, Chichester, 1985.