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OPTIMIZATION OF ADVERTISING RESOURCES OVER TIME: A STRATEGIC ANALYSIS

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Strategic behaviour has long been a crucial issue for modern corporations. To maximize potential profits and market share, firms are more than willing to invest in sales promotion to boost long term manufacturing output. Knowing that the sales of the firm not only respond to own advertising budgets, but also depend upon rivals' advertising strategies, oligopolistic firms form part, therefore of a continuous race with reference to non-price competition. Efficient use of investment resources is crucial for business operations and long term strategic success. This paper aims to investigate the key issue of optimization of strategic advertising outlays. By using mathematical modelling techniques, strategic linkages between rival companies are identified and advertising impacts explained. Since advertising influences can persist through time, our discussion extends to explore this fundamental point by constructing a more advanced model to examine into the problems of optimization over time. Empirical data is used to test the predictive power of these models and assess relative efficiencies. All in all, this paper intends to highlight the importance of continuous strategic advertising investment and consequently provides comprehensive insights into the impact of modern advertising functions over time.

1   Introduction

Strategic conduct is an important issue for competitive oligopolised industry. Since the 1970s, the new industrial economics, has stressed the significance of game theory and industrial case studies. Industrial economists such as Cowling & Waterson (1976) [12], Clarke & Davis (1982) [9], Dixit (1982) [16] & Tirole (1988) [42] stress the role of strategic conduct and place relatively less emphasis on market structure. According to the SCP

paradigm, the central methodology for the theory of industrial organisation, conduct is strategically implemented to enhance performance under specific market structures.[1]

Needham (1978) believes that there is a strong systematic relationship between industrial structure and conduct of a firm. However, Rumelt (1991) [35] indicates that the number of players in an industry only slightly affects the variance of performance outcomes between firms.[2]

Since the market structure of an industry cannot reflect performance variations, analysis of performance differences may rely on the substructures of industry. However, due to geographical advantages, some players may possess enormous monopoly power. Hence, spatially speaking, the nature of competition is more complex than simply oligopoly models consider. Oligopoly varies in different market subregions. To explain the superior performance of market leaders and heterogeneity in performance for others, the concept of strategic groups is employed, which was emphasised by Newman (1978) [32], Caves and Proter (1977) [7], and Porter (1979) [33]. With significant performance variations between players in the same industry, it is important to understand the composition and nature of strategic groups in an industry. Amel & Rhoades (1988) [1] examined strategic groups concerning portfolio specialisation in the US banking industry. Day et al. (1995) [14] used Data Envelopment Analysis to examine the source of heterogeneous performance in the US brewing industry. In strategic groups analysis, firms in a industry are classified with reference to distinctive performance characteristics or business motives. If an established firm aims to increases market share by widening its product portfolio. This means the firm intends to break down mobility barriers erected by other strategic groups. Mobility barriers are difficult to break as each strategic group possesses distinct market achievements which take time to establish and always relate to forms of firm-specific assets.[3] Advertising, is intrinsically an intangible asset nature, and is commonly used by oligopolies to increase mobility barriers. This kind of intangible asset is very important in industries crowded with differentiated products. Cable (1972) [11] and Sawyer (1985) [36] discussed the issue of the suitability of effective advertising strategies, believing that highly differentiated product markets are more desirable.[4] This

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[1]The methodology of analysing the linkages between market structure, actions taken by firms and economic performance was first introduced by Mason (1939) [29]. Bain (1951) [2] produced more comprehensive generalisations regarding the SCP paradigm to explain economic relationships between profit and levels of industrial concentration. However, the Austrian School criticises neo-classical assumptions relating to the SCP paradigm and believes that barrier to new entry do not exist and competition is an on-going process in a world of uncertainty and imperfect knowledge in changing business environments.

[2]Baumol (1982) [3] adopted the concept of constable rnarkets for the SCP methodology. His studies suggest that barriers to entry and exit should not exist permanently and efficient performance is an automatic outcome of competition which does not rely on market structure. Moreover, the Chicago School economists such as Stigler and Demsetz (1979) [15] believe that market competitive forces predominate over morket structure in the long run.

[3]Ferguson & Ferguson (1994) [20] believe that entry to a specific strategic group is more difficult then entry to a market (indvstry) as a whole since strategic groups possess high mobility bariiers which persist over time. Day et al (1995) [14] suggests that the heterogeneity in performance across the US brewing industry resulted from firm-specific assets (e.g. firm -specific barriers to imitation).

[4]Sawyer (1985) [36] also suggests that advertising is a signal rather than a cause of product differentiation. The signalling feature of advertising were explored more thoroughly by Schmalensee (1978) [38], Kihlstrom & Riordan (1984) [26] and Milgrom & Roberts (1986) [30].

conduct variable is employed for several reasons: for example it can be used to reduce competitiveness of rivals, strengthen market positions and limit the chances of successful entry.[5] Obviously, in a competitive market environment, the underlying reasons for executing a conduct variable like advertising, is primarily strategically motivated. Since advertising assets take time to accumulate momentum to influence sales and rivals react correspondingly, the key problem for decision markers concerns the optimised use of resources through time. The investigation of this issue is the primary thrust of this paper.

2 Strategic advertising

In strategic terms, advertising delivers its inherent long run value to business as it helps build a stock of "goodwill" over time. Empirical evidence from Ferguson (1974) [19] and Cowling et al. (1975) [11] show that the advertising effect on sales persists longer than the advertising period, producing a future demand effect despite the fact that its strength fades gradually in time. Based on the fact that competition is a non-stop process and the stock of "goodwill" is subject to depreciation, the efficient use of advertising investment can affect strategic outcomes in different time periods. Observing both the decaying nature of and constructive impacts of advertising, Ling et al. (1997) [28] consider an advertising strategy based on a continuous advertising investment approach, to examine the long and short run impacts of the strategic conduct in UK brewing. This empirical study concludes that advertising produced no significant effects on the aggregate market demand, because of the declining trend of beer sales in the UK. However, this study provides a useful modelling technique for evaluating the impact of continuous advertising for strategic groups.[6] An important insight of these studies refers to the situation that leading brewers do not necessarily employ advertising to block long run entry, but that their advertising investment can motivate potential entrants to mimic their behaviour, making new entrants' short run promotional campaigns more costly.[7] This perspective is consistent with the Neo-Austrian view which treats advertising as delivering only short run entry barriers. However, firm-specific barriers such as brand reputations take time to establish. Even firms follow the Neo-Austrian thinking and ignore the existence of long run barriers originated by advertising, every short run advertising investment outlay, will eventually intensify the cumulative stock of "goodwill". If long run outcomes can be imagined to be short run effect in future, long run profit maximisation should not substantially differ from each and every that in every single short run case. Conduct, which seeks to create firm-specific assets or barriers to imitation (e.g. brand images and perceived preferences) deliberately is called "strategic". In a competitive market where players may intentionally or unintentionally lean towards the short run "strategic" impact of advertising in both the short and long run advertising performance can be disregarded.

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[5]Bearne (1996) [4] provided ciitical comparisons between different school of thought regarding economic consequences of advertising.

[6]UK brewers can be basically classified into national and regional groups. A similar definition of strategic groups in brewing is put forward by Tramblay (1985).

[7]Day et al. (1995) [14] assert that attention to strategic group discussion needs to focus on strategic leaders and the attempts of competing firms to mimic the behaviour of the "best practice frontier".

To place emphasis on the strategic impact of advertising through time this paper focuses on continuous advertising investment as employed by key globalised oligopolists.[8]

   Entry deterrence has long been an important strategic aim in oligopoly.[9] Schmalensee (1983) [39] introduced a striking new strategic facet to traditional theory, namely analysis of post-entry reactions between incumbents and potential entrants. The idea was not totally new since strategic outcomes for established firms and entrants relying on post-entry games rather than current advertising outlays was discussed by Cubbin (1981). However, the Schmalensee view received much attention and was further developed by Tirole and Funderberg (1984) [21] with analysis of various circumstances focusing on a taxonomy of business strategies. Moreover, cost components and barriers to entry are inseparable issues for oligopoly markets. Geroski and Murfin (1991) [18] believe that advertising limits entry prospects as the acquisition of huge advertising shares is costly. This accord with the idea of product-specific sunk costs and replaces asset nature arguments (Fugerson & Fugerson, 1994). Von Weizacker (1980) [44] suggests that advertising is a sunk cost and hence the commitment of firms can be illustrated by heavy use of advertising (Hay & Morris, 1991 [23]).[10]

3   Optimal advertising in oligopoly

Firms always try to avoid wasting resources. Only optimal use of advertising can satisfy firms in channelling economically core resources towards creating real sales revenue. Dorfman and Steiner (1954) [17] established the landmark theorem for the investigation of static equilibrium relationships between optimal sales and optimal advertising levels. Utilising the Lerner (1934) [27] Index of market power ($P - MC/P = 1$/elasticity) and profit maximisation criteria ($MC = MR$), a profit maximisation advertising model is established by the following procedures, by equating marginal cost (MC) and marginal revenue (MR) for advertising:

$$MC = MR,$$

where $MR = \dfrac{P(\Delta Q)}{\Delta A}$ and

$$MC = \frac{\Delta Q(MC_Q)}{\Delta A} + 1 = (P)\frac{\Delta Q}{\Delta A}$$

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[8]Apart from the Neo-Aust (ian argument, a lot of theorists mistreat advertising as a pure expenditure item (marketing costs) and do not realise the implicit value deiived from consumer loyalty, improve product images or reputation. Treatment of advertising as an investment item was discussed by Block (1974) [5].

[9]Kaldor (1950) [24] pointed out that better market positions and barrier to entry result from advertising. Comanor and Wilson (1974) [10] indicate higher levels of advertising lead to increased market power. The empirical studies of Schmalensee (1978) [38] suggested that advertising might restrict new entrants into the US ready-to-eat cereals markets between 1950 and 1970.

[10]However, others from the information school such as (Telser, 1965 [41]), (Hart & Clark, 1980 [22]) and (Kessides, 1991 [25]) argue that advertising cannot create barriers, bvt also reduces entry difficulties by providing crucial information to consumers. Ravenscarfts (1983) [34] found that advertising created a negative impact on assets.

P : stands for unit price of product

Q : quality

A : advertising outlay

multiplying both side by $\dfrac{A}{PQ}$, we have

$$\frac{A}{PQ} = \frac{P - MC(E_A)}{P},$$

where $(E_A) = \dfrac{\Delta Q(A)}{\Delta A(Q)}$

(1) $$\frac{A}{PQ} = \frac{1}{E_Q}(E_A)$$

Accordingly, Needham (1977) re-formulated profit maximisation behaviour using both buyer and rival seller elasticities. Hence, the marginal revenue of advertising regarding rival reactions can be written as:

$$MR_A = P\left\{\frac{\Delta Q}{\Delta A} + \frac{\Delta A_R(\Delta Q)}{\Delta A(\Delta A_R)}\right\}$$

multiplying the whole equation by $\dfrac{A}{PQ}$, yields:

$$\frac{\Delta Q(A)}{\Delta A(Q)} + \frac{\Delta A_R(A)}{\Delta A(A_R)}\cdot\frac{(\Delta Q)(A_R)}{\Delta A_R)(Q)},$$

which is equivalent to $[E_A + E_{FF}E_{AR}]$, where, E_A is the responsiveness of a quantity change in demand of the firm to its own advertising outlay; E_{FF} is the advertising response of rivals to the firm's own advertising. E_{AR} is the quantity demand change for a firm induced by rivals' advertising.

While $MC_A = \dfrac{MC_Q[E_A + E_{CC}E_{AR}]}{P} + \dfrac{A}{PQ}$. The resulting profit maximisation model is shown as follows:

(2) $$\frac{A}{PQ} = [E_A + E_{FF}E_{AR}]\frac{1}{E_Q}$$

The essence of this behavioural patterns of responses between rivals was further investigated by Schmalensee (1972) [37], who stressed the strategic advertising influences of rival retaliation. The impact of retaliatory advertising responses is indicated by the model given below:

(3) $$\frac{A}{PQ} = \frac{1}{E_Q}[E_A + \mathbf{R}]$$

Explicit treatments relating to the estimate of the retaliatory rate ($\mathbf{R}$) is important for profit maximisation behaviour. Since the optimal advertising to sales ratio according to

Dorfman and Steiner theorem depends on the relative ratio of advertising elasticity to price elasticity of demand. However, this is purely based on the assumption that advertising influences the advertised firm's demand curve only and the external influences of rivals demand are disregarded. According to the Schmalensee advertising models, then as long as the retaliatory advertising response is known, the overall strength of advertising elasticity and price elasticity can be estimated, as can the profit maximisation advertising outlay. This opens up a new avenue for estimating optimal advertising outlays regarding rival retaliations with strategic advertising. According to this modelling specification, advertising investment is deliberately employed by firms to fulfil company objectives such as market developments in new markets (new strategic groups) or, counter-attacks to limit new entry. The crucial attainment of profit maximisation relies on the knowledge domain of rival responses towards advertising games. Some theorists might argue that advertising investment cannot be entirely competitive and retaliatory in essence in product markets such as the UK brewing industry.

Nerlove and Arrow (1962) [31] introduced a new concept regarding the optimal advertising-sales ratio by specifying the influence of advertising as the stock of goodwill. They argued that advertising influences will erode with time.

$$(4) \qquad \frac{A}{PQ} = \frac{E_A}{E_Q} \cdot \frac{1}{r+d}$$

This model indicates the optimal adjustment process towards the desirable level of advertising goodwill. Basically, the model is identical to the Dorfman and Steiner Theorem apart from the bracketed terms. In equation (4), r stands for market rates for discounting and d refers to the rate of depreciation of goodwill. Most importantly, the sum of the bracketed terms implies that capital inputs decay with time. However, it is impossible to deny that retaliatory advertising strategies exist in UK beer markets. Very often, target audiences see more than two different beer brands broadcasting TV advertisements during a single evening. Similarly, in national newspapers or magazines, it is common to see rival brands advertised next to each other. Alternatively, perhaps all these occurrences are just simple coincidences and brewers possess their own advertising schedules to promote brands and attract specific target groups. Because consumers receive differing advertising messages and are influenced by them, the outcome is the same as any other form of retaliatory advertising strategy.
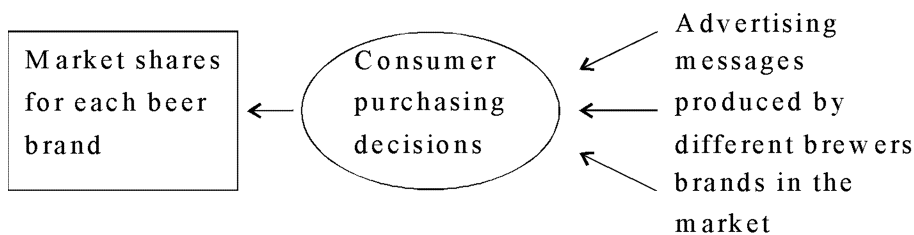

Diagram 1: In-built automatic retaliation outcomes.

Diagram 1 depicts the idea of automatic retaliatory impacts of rival advertising investments. Each advertising message, which is specially designed for a specific brand

has its distinctive function and is assumed to be non-retaliatory. Consumers who are strongly influenced by advertising images and messages decide purchases which in turn then determine the market shares for brands. Consequently, brewers see eventual market share distributions as the result of retaliatory advertising, even when the initial aims of advertising were under no circumstances intended to be retaliatory. This means that as long as there is more than one firm advertising in a market, the value for **R** will always exceed zero, i.e. retaliatory effects always exist.

Evidence from in-depth interviews with marketing executives from UK brewing, indicates that key brewers do not normally intend to attack rivals by raising advertising investments in response to rival advertising. Instead, brewers take a strategic advertising view for each calendar year. This implies that an intentional strategic retaliatory element does not exist in individual firm advertising. Consumers, who constitute the domain in the battlefield, automatically transform advertising messages into competitive weapons when they purchase specific brands. This implies that in a tight oligopoly like brewing it is the 'chaotic' competitive 'super' environment facing business strategists, not the motives of firms which creates the retaliatory features of advertising investment in brewing. Hence, the conduct variable is endogenous in the retaliatory case. To avoid confusion in using the Schmalensee model for analysing strategic responses, the retaliatory element is specified as a deliberate conduct variable in the subsequent analysis.

4   Empirical analysis

(000')

Year	*Actual nominal budget	Budget estimated by Dorfman & Steiner theorem	$^\delta$Budget estimated by Nerlove & Arrow model	Budget estimated by Schmalensee model (3% refaliation)	Budget estimated by Schmalensee model (3.5% refaliation)
1987	1290	3443	4601	1523	1201
1988	1290	3424	4576	1514	1195
1989	1363	3436	4592	1520	1199
1990	970	3321	4439	1470	1159
1991	901	3722	4975	1647	1299
1992	1011	3903	5216	1726	1543
1993	1029	3843	5177	1700	1342
1994	1148	3800	5078	1682	1327

Source: *From A Regional Brewer In The UK.

Note: $^\delta$The values of r and d used for the estimated budgets are 0.25 and 0.5 respectively.

Table 1: Advertising budgets for a regional brewer.

Table 1 shows the results for advertising budgets using different model estimations, Hence, the Dorfman/Steiner condition overestimates the optimal advertising investment

for regional brewers in the long run. Comparing actual budgets with the Dorfman/Steiner condition estimation, means that roughly speaking, there is an overstatement of £2 million in estimation differences throughout the study period. Moreover, the advertising model of Nerlove and Arrow faces the same estimation problem. As the value $(r + d)$ is assumed to be smaller than 1, this implies that if other variables $(PQ,\ E_A,\ E_Q)$ remain constant, the final optimal advertising input (A) will be greater than that which is estimated by the Dorfman/Steiner model. According to the estimations given in Table 1, the most appropriate model to approximate actual advertising inputs is the Schmalensee rnodel. Thus a regional brewer can monopolise local sales easily and the nearest big competitors are not too aggressive in fighting in established local markets. A much lower retaliation rate is therefore the expected result. This is consistent with the general belief that regional brewers in the UK are able to capture the loyalty of customers who have faith in local ales.

If we assume that the regional brewer has been operating with optimal advertising capital, the retaliation rates should be between 3% to 3.5%. The estimated budgets are shown in the last two columns of Table 1. Between 1987 to 1989, a 3.5% retaliation rate underestimates actual budgets. This means that there was less rival retaliation in regional markets. On the other hand, since 1990, this same model underestimates the rivalry effects. For comparison, a 3% model is constructed to indicate that the rivalry effects are underestimated for 1987 to 1989. Consequently, it can be concluded that the estimated retaliatory rate of advertising between 1987 and 1989 should be between 3%. and 3.5%.

Apparently, the Schmalensee model provides better estimates for tracking the empirical findings. However, there are problems when forecasting the retaliatory rate for advertising, which may change rapidly and fluctuate randomly over a very short period of time. Frequent adjustments for **R** can be troublesome. The model also produces too much stress on intercompany elasticities and neglects the real impact of brand building. If the original motives for beer advertising were not retaliatory, then an economic analysis based on the Schmalensee model simply produces misleading predictions and misrepresents the truth.

Most brewers believe in the cumulative intangible impact created by continuous advertising. To create a more dynamic picture for optimal advertising investment through time, an exponential component is included in the Dorfman/Steiner case. Normally, industrial economists employ a simple single equation model to explain the influence of advertising on all types of firm. For regional firms with dominant market shares, the following advertising model was constructed to solve this serious limitation:

$$(5) \qquad\qquad \frac{A(e^{rt})}{PQ} = \frac{E_A}{E_Q}$$

Equation (5) includes an exponential function (e^{rt}); where (r) represents the rate of goodwill accumulation and (t) refers to the time span of an advertising investment impact. This model specification depicts a situation where a dominant firm is expected to continue successful growth induced by its own advertising investment. Since the multiple of (rt) is positive, if other variables $(E_A,\ E_Q$ and $PQ)$ remain unchanged, a lower level

of advertising is desirable to maximize profit. Moreover, since (e^{rt}) is greater than 1, this implies that as compared to the Dorfman/Steiner condition, this model indicates that a lower optimal advertising investment is sufficient to generate the required impact, both for present and future cases, to encourage sales to reach profit maximisation levels. The variable (e^{rt}), is similar to a snowballing process, which inflates the present advertising investment A into greater "future" values. The exponential variable implies the influence of present advertising increases at an increasing rate which reflects neatly the characteristics of dominant firms with a successful advertising strategies.

In a marketing sense, advertising is generally used to promote sales. The main function of it is to stimulate consumers to try new products at introductory stages and encourage repeat purchases in subsequent periods. If a product is experiencing growth in sales, returns on advertising investment become higher. This means effective marketing allows the use of a lower advertising budgets when the sales are at profit maximisation levels. Again, this condition is considered in equation (5) which uses an increasing exponential function to trap the growing future influence on sales.

Year	Actual nominal advertising budget* (£000')	Estimated budget with: $r = 19\%^*$ $t = 5$	Estimated budget with: $r = 18\%^*$ $t = 7$	Estimated budget with: $r = 15\%^*$ $t = 8$
1987	1290	1329		
1988	1290	1321		
1989	1363	1326		
1990	970		940	
1991	901		1054	
1992	1011		1105	
1993	1029		1088	
1994	1148			1142

Source: *Data obtained from a regional brewer.

Table 2: The estimated budgets with different length of advertising impact.

Table 2 is a summary of the empirical analysis which serves to demonstrate the effectiveness of model 5. Column 1 shows the actual advertising budgets of a regional brewer which are assumed to be near optimal levels. A successful dominant firm advertising strategy is employed here to estimate the structural characteristics of advertising investment, namely r (the rate of accumulated advertising impact), t (duration of advertising influence) and A (the expected advertising investment) from equation (5). To simplify the estimation procedure, (r) is set as a known variable with values equivalent to the bench mark rates of return for project appraisals. In fact, when profit is maximised, the rate of increase in advertising impacts should be equal to the chosen rate of return for company projects. Based on equation (5), values of A are worked out by choosing a duration of impact which produces a set of As closest to the actual As.

The bench mark rate for project investment changes from time to time. The findings indicate that the required duration for accumulating advertising impacts are different.

Between 1987 to 1989, 1990 to 1993 and in 1994, the estimated duration times are 5 years, 7 years and 8 years respectively. Shorter durations for advertising impacts recorded between 1987 and 1989 are believed to be the result of primitive or inefficient use of advertising investments. The longer estimated durations since 1990 could explain the underinvestment in advertising by the brewers since then. The range of durations estimated is reasonable and accords with definitions given in the long term strategic plans of regional brewers.

5   Conclusions

The intrinsic significance of advertising in modern oligopolised industry concerns the fact that long run strategic effects result from the interplay of market rivalries and the inherent decay rates of specific advertising messages. That advertising be treated as a strategic conduct variable is obvious from the forgoing analysis. Moreover, that strategic advertising be viewed as our investment over time is necessary. The model developed here can effectively track advertising budget mounted by an actual brewer over a run of years. Hence, the plea in this paper is that advertising be considered within a retaliatory paradigm. This modelling approach allows for intentional and non-intentional advertising campaigns to be considered and relative impacts assessed in oligopolies. The variant of the Schmalensee retaliatory model utilised here delivers a reasonably accurate picture of actual strategic moves and counterplays in the UK brewing industry. Finally, that advertising be treated as an investment in intangible assets is well established. That these assets decay through time, explains the "paradox" that to some extent is seen everywhere in modern industry: namely that advertising continues to increase in real terms at industry levels throughout Europe despite the fact that the players themselves might not perceive strategic investment in advertising as reactive or retaliatory in spirit. The nature of the game in oligopoly means that pro-active strategic advertising by players may through time be seen as simply re-active in long run market share terms. This "paradox" of advertising in modern oligopoly is yet another version of the famous "Chain-store Paradox" game.

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