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Advertising, concentration and profitability in Greek food manufacturing industries

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Abstract

The conventional framework for cross-sectional studies of industrial organisation focuses on the hypothesised relations among structure, conduct and performance (SCP). This paper investigates these relationships for the food and beverage manufacturing industries in a European country, i.e., Greece. 3SLS method is used to estimate the parameters of the profitability, concentration and advertising model for a sample of 38 four-digit industries in 1994. The main results, which are in line with the relevant empirical work, show that profitability is determined by advertising, which, in turn, is affected by both profitability and concentration, while the latter is determined by economies of scale. © 1998 Elsevier Science B.V.

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1. Introduction

Nearly three decades of empirical work have been completed in testing the relationships between industrial market structure, conduct, and performance. New developments in industrial organization (Bresnahan, 1989) suggests that SCP studies must be applied in a homogeneous sample of industries, i.e., food manufacturing. Food manufacturing is an attractive area for SCP studies not only because of its importance as an area of current public concern but also for a number of reasons referring to the intensive use of strategies (e.g., advertising), the good performance and the large contribution of the sector to the total manufacturing activity, in both USA and EU countries (Connor et al., 1985; European Commission, 1997).

There has been a large number of empirical studies that examine the SCP relationships in the US food manufacturing industries by using either single equations or simultaneous models. Such relationships have not been estimated for food industries, in a European country although these are among the most rapidly growing and profitable manufacturing industries in many European Union (EU) countries, including Greece (European Commission, 1997; Trail, 1994).

This paper investigates the SCP relationships in the case of the Greek food industries that achieved recently the highest rate of growth in terms of contribution to the national manufacturing among the EU manufacturing industries (European Commission, 1997). Food manufacturing also has greater contribution to the GDP and better performance than the rest Greek manufacturing (NSS, 1988–94). Given the importance of the food sector for the Greek econ-

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omy, it is interesting to investigate appropriately the factors which affect the performance of the food industries in order to use the obtained results as a basis for policy recommendations. The existence of interrelationships and feedback effects however, among the main SCP determinants requires the appropriate specification of an SCP model along with the choice of the correct method, that is needed to provide consistent estimates.

2. Greek food industries

Food manufacturing is one of the most important sectors of the Greek economy in terms of size, growth and performance. Its contribution to the manufacturing GDP (26.0%), value added (24.3%) and employment (19.0%), in 1994, is greater than any other manufacturing sector. The sector also achieved faster growth than the rest of manufacturing. Output indices for food and beverage industries (1980 = 100) are 103.2 and 168.1 for 1994 and 115.3 and 135.1 for 1988, respectively, against 103.3 and 98.2 for total manufacturing for the same years (NSS, 1988–94).

Profitability indices for the Greek food and beverage industries are 15.6 and 32.4%, respectively, against 12.6% for the total manufacturing for 1994 (NSS, 1994). Also, this sector is characterized by a high advertising intensity level and the contribution of food and beverage industries to the total advertising expenditures is the highest (20%) in manufacturing, in 1994.

Both the size of contribution of the food to total manufacturing output and the growth of the relevant figures indicate the dynamic nature of the sector. Figures for the contribution of the Greek food industry to the national manufacturing output divided by the same figure for the EU, show that this contribution in Greece, Denmark and Ireland is higher than in the rest EU countries e.g., the relative figures for Greece and EU are 1.830 and 1.275, respectively (Table 1). The growth in the relevant figures over the period 1985–1994 from 1.32 to 1.83 for Greece, is higher than for the rest EU member, while the respective mean values for the EU decreased marginally (from 1.285 to 1.275) for the same period. These figures indicate the dynamic nature of the Greek food sector within EU.

Table 1
Contribution of food industry on manufacturing output[a], in EU

Country	1985	1994
Belgium	1.01	0.99
Denmark	2.26	1.97
France	0.96	1.01
Germany	0.71	0.71
Greece	1.32	1.83
Ireland	2.58	2.18
Italy	0.84	0.82
Luxembourg	0.47	0.46
Netherlands	1.57	1.56
Portugal	1.19	1.24
Spain	1.34	1.41
United Kingdom	1.16	1.12
EU[b]	1.285	1.275

[a]Ratio of production in the sector compared to manufacturing industry for each country, divided by the same ratio for the EU. Estimates.
[b]The figure for EU is the average value of 12 countries.
Source: European Commission, 1997.

3. Model specification

Most of studies of SCP relationships use OLS to estimate single equation relationships, assuming undirectional causality running from structure to conduct to performance. However, the underlying theory (Hay and Morris, 1991) suggests that three variables of considerable interest within the traditional SCP paradigm (concentration, advertising, and profits) are more properly considered as jointly determined within a system of equations.

A three equation model takes the general form: $H = f(A/S,\mathrm{PR},Z)$; $A/S = f(H,\mathrm{PR},Y)$; $\mathrm{PR} = f(H,A/S,X)$where H is concentration index, (indicator of structure), A/S is advertising–sales ratio, (indicator of conduct), PR is profitability (indicator of performance) and X, Y, Z are vectors of exogenous variables.

3.1. Concentration equation

Following Martin (1993a), the equation that explains inter-industry differentials in concentration is

based on the proposition that the long-run equilibrium level of industrial concentration (H^*) is determined by scale economies and by other factors that establish the nature of entry conditions. In general such a model can be written:

$$H_t = (1-\theta)H_{t-\lambda} + \theta H^*, 0 < \theta < 1 \quad (1)$$

Subscripts denote time periods and H^* is the long-run level of concentration. The parameter θ measures the speed of adjustment, and indicates how quickly market concentration approaches the long-run level, while λ denotes the number of the years of the study period. The estimated model becomes:

$$H_t = a_0 + a_1 H_{(t-\lambda)} + a_2 \mathrm{MES} + a_3 A/S + a_4 \mathrm{PR}_{(t-\lambda)} + \upsilon_t \quad (2)$$

where H_t and $H_{t-\lambda}$ are the current and the lagged concentration, MES is the minimum efficient scale, A/S is advertising intensity, $\mathrm{PR}_{t-\lambda}$ is the lag profitability and υ_t is the disturbance term.

If a_1, which is equal to $(1-\theta)$, is high, concentration adjusts slowly to the long-run level of concentration. It is expected that high level of past concentration will increase the current concentration level. Since most of the economies of scale in production are associated with technological factors, an estimate of firm minimum efficient scale (MES) will be used as a determinant of concentration. It is expected that the greater the magnitude of scale economies, the higher should be the level of industry concentration ($a_2 > 0$).

Intensive advertising is associated with successful product differentiation and it will erect a barrier to entry which should be conducive to greater concentration. Firms that are successful in differentiating their products are also apt to be successful in attaining large market shares. On the other hand, advertising may serve as a tool of entry, or as an information disseminating device, which might ease entry conditions. Concentration may be affected by advertising, but in principle the direction of the effect is uncertain. Finally, a high level of past profits is expected to attract new entrants into the industry and reduce concentration ($a_4 < 0$).

3.2. Advertising equation

According to Dorfman and Steiner (1954) condition optimal advertising to sales ratio (A/S) for a profit maximizing firm is a function of price–cost margins and elasticity of demand with respect to advertising expenditure. At the industry level the following equation has been used by many researchers (Connolly and Hirschey, 1984; Ornstein, 1987; Gisser, 1991) to estimate the determinants of advertising intensity:

$$A/S = b_0 + b_1 \mathrm{PR} + b_2 H + b_3 H^2 + b_4 G + b_5 D + u_t \quad (3)$$

where H is concentration index and H^2 is the square value of H, PR is a measure of profitability, G is growth in total industry sales, D is a dummy variable which takes the value of 1 for consumer industries and the value of 0 for producer industries and u_t is the disturbance term.

Application of the Dorfman–Steiner condition suggests that, apart from the positive association between advertising intensity and profitability ($b_1 > 0$), if any other elements of market structure (e.g., concentration, growth in demand) affect advertising intensity, it is because they affect the elasticity of demand with respect to advertising. It has been suggested (Buxton et al., 1984; Gisser, 1991) that relationship between advertising and concentration might be non-linear. An explanation is that advertising is used in order to attract sales from the competitors. When the possibility of an increase in sales declines and firms in oligopolistic markets become aware of the impact their advertising on the sales of rivals, there is no reason for more advertising ($b_2 > 0$, $b_3 < 0$).

Since firms may find advertising an alternative mean of expanding or consolidating market shares during periods of growth we expect $b_4 > 0$. Consumer goods are characterized of high levels of differentiation and we expect a positive relationship with advertising intensity ($b_5 > 0$).

3.3. Profitability equation

Following the relevant literature (Martin, 1993b) the price–cost margins (PR) index can be used when

available to test SCP relationships in empirical studies (e.g., Collins and Preston, 1969; Cubbin and Geroski, 1987; Uri, 1988; Gisser, 1991) provided that one controls for differences across industries in capital intensity. Also, concentration and other independent variables, which affect industry structure and conduct, should be included to give:

$$\mathrm{PR} = c_0 + c_1 H + c_2 A/S + c_3 G + c_4 \mathrm{MES} + c_5 K/S + c_6 \mathrm{EX} + w_t \quad (4)$$

where H is the concentration index, A/S is the advertising intensity, G is the growth in demand, MES is the minimum efficient size, K/S is the capital intensity, EX is the export to sales ratio and w_t is a random disturbance term.

Although there are many oligopoly theories, virtually all of them predict an increase in the effectiveness of collusion as concentration rises ($c_1 > 0$). Profitability should also be higher in industries in which barriers to entry exist. The higher the entry barriers, the less established firms have to consider the response of potential entrants when setting profit margins. Thus, industry profits should be positively related to the height of the entry barriers. To account for this source of entry barriers, the advertising to sales ratio is included in the profit equation, with the expectation that higher advertising intensity ought to result in higher profitability $c_2 > 0$.

Growth is expected to influence profitability positively, since it reflects increases in demand or decreases in cost, or both ($c_3 > 0$). Another source of entry barriers is economies of scale in production. The larger the optimal size of firm, the greater will be the addition to industry output and downward pressure on prices as a result of entry. Established firms will be able to set high price–cost margins that may not be eroded by entry. The scale economy measure MES is thus included in the profit equation. The greater the scale economies the higher should be industry profitability ($c_4 > 0$).

Because capital will earn a normal profit under competition, rates of return on sales will be larger, the more capital intensive the production techniques, even in the absence of barriers to entry ($c_5 > 0$). The effect of export intensity is ambiguous. It depends on the degree of domestic industry competition ($c_6 \gtrless 0$).

4. Data and measurement of variables

In contrast to other countries where firm level data are confidential, Greek manufacturing firms are obliged to publish their annual balance sheets. That allows the classification of the firms into the relevant 4-digit industries and the calculation of the relevant variables by using more accurate data than those provided by Census. [1] Following new developments in industrial organization (Bresnahan, 1989), our analysis is applied in a set of related industries consisting of only food and beverage manufacturing industries. Their products share several characteristics: they are relatively material—and advertising—intensive, they are mainly produced from agricultural basic materials, their consumer products are frequently purchased and are sold at low unit prices, mainly through food stores (Connor et al., 1985).

The industry sample utilized in the estimation of the models consists of 38 Greek food processing industries defined by the census at the 4-digit level of the SIC. Due to data deficiencies six industries have been excluded from the sample. A total of 1327 food manufacturing firms which operated in 1994 are classified into industries and the relevant measures calculated for each industry. Data are drawn from the annual reports (ICAP, 1988, 1994) that provide individual balance sheet data for all food manufacturing firms. Advertising expenses are provided by Nielsen (1994). Table 2 shows the mean values and the standard deviations of the variables that are used in this study.

Total sales of all firms in each industry is used as industry sales in 1994 (S). Growth (G) is measured as the annual rate of growth in terms of sales (in constant prices). Advertising intensity (A/S) is the ratio of total industry advertising expenses in 1994 over industry sales in the same year. Similarly, the total value of fixed capital of the industry over industry sales in 1994 gives the capital–sales ratio

[1] Our data could be also used for a firm level analysis. This however, requires the study of issues (e.g., efficiency) that is beyond the scope of this work which deals with the simultaneous estimation of SCP relationships in a European food sector and the comparison with relevant results from other countries that are only available at the industry level.

Table 2
Mean values and ranges of the variables

Variables[a]	Mean value	Standard deviation	Min	Max
H	0.26	0.22	0.05	1.00
PR	0.27	0.10	0.10	0.48
A/S	0.02	0.03	0.00	0.11
G	0.0016	0.0008	0.00011	0.0044
PR88	0.24	0.09	0.13	0.43
H88	0.30	0.19	0.05	0.75
K/S	0.58	0.27	0.20	1.23
EX	0.12	0.21	0.00	0.70
MES	0.30	0.30	0.01	0.90

[a]See text for variable definition.

(K/S), while export intensity is the ratio of the industry exports over sales (EX). Profitability (PR) is measured as the sum of gross profits of the firms of each industry in 1994 over the industry sales in the same year. Despite that data for marginal cost that are required to estimate price–cost margins are not available (Bresnahan, 1989), many empirical studies argue that a gross rate of profits over sales can be used as a proxy for price–cost margins (see, for example, Strickland and Weiss, 1976; Schmalensee and Willig, 1989; Molyneux and Forbes, 1995). Noting that Herfindahl index (H) is considered as a better measure of concentration since it takes into consideration all firms in the market and it weights the contribution of large firms (Curry and George, 1983), we use the Herfindahl index as concentration measure. The index is calculated as the sum of the squared values of firm's shares in each industry. As other studies (Strickland and Weiss, 1976; Curry and George, 1983) a Florence median [2] estimate is used as a measure of the MES. The index is given by the midpoint of the first distribution of firms, measured as the ratio of fixed assets that correspond to the Florence median firm over the industry fixed assets. Lagged variables for both profitability and concentration are estimated for 1988 (PR88 and H88). Following other studies (e.g., Martin, 1986; Gisser, 1991), we use a 6-yr period to estimate the lagged values of the relevant variables.

5. Model estimation and results

Most of SCP studies use OLS to estimate single equation relationships assuming unidirectional causality running from structure to conduct to performance. Some, however, (Strickland and Weiss, 1976; Pagoulatos and Sorensen, 1981; Martin, 1993a) suggests not only that market structure may influence conduct and performance, but market conduct and performance are likely to feed back and influence market structure. Thus, single equation models would suffer from simultaneous equation bias, and they often produce weak and inconsistent relationships that could lead to inappropriate policy recommendations. Consistent estimates are obtained when instrumental variables are used. When there are endogenous variables on the right hand side, correlation between those variables and the disturbance term means that OLS estimates are biased.

A more formal approach to test for exogeneity is the Hausman–Wu test. Following the relevant literature (Wu, 1973; Hausman, 1978; Maddala, 1988; Martin, 1993a; Gujarati, 1995), we apply the test by comparing each of the three equations with the respective equation that also includes the fitted values of the variables whose endogeneity is examined by an F-test. Table 3 presents the results of Hausman–Wu test. The results for Eqs. (2)–(4) shows that there is a simultaneity problem in both profitability and advertising equations. It was suggested that in

Table 3
Hausman–Wu test results[a]

	$\hat{H}$	$A\hat{S}$	PR̂	F-test	
				DF[b]	F
H		−0.69 (−0.40)		1.32	0.28
A/S	0.04 (0.95)		−0.19 (−2.34)	2.31	3.40
PR	−0.25 (−1.07)	3.73 (2.51)		2.29	3.40

[a]Coefficient of the rest independent variables are omitted. $\hat{H}$, AŜ PR̂ are the fitted values for H, A/S and PR. See text for details.
[b]Df denotes degrees of freedom.
t-values in parentheses.

[2] The Florence median is a hypothetical firm of a size such that half of an industry's size measure comes from larger firms and half from smaller ones. The basic argument for using it is that the observed size distribution of firm sizes will be clustered in some way around the optimum size, so that some measure of central tendency will provide a reasonable approximation to MES.

such cases the simultaneous model should include all three equations (Martin, 1993a). We test for contemporaneous correlation across the three equations (Judge et al., 1988) using the Lagrange multiplier statistic (λ). The estimated value is $\lambda = 8.62$ Since the theoretical value for X^2 for 3 degrees of freedom at 5% level of significance is 7.81, we accept the existence of contemporaneous correlation. We can therefore apply 3SLS to estimate jointly Eqs. (2)–(4). Table 4 shows 3SLS results for all three equations. OLS results are presented just for comparative reasons.

3SLS results show the positive and statistically significant effect of the lagged level of concentration and profitability and the value of minimum efficient scale on concentration. The estimated coefficient of lagged concentration is less than one (0.43) indicating a stable dynamic process toward the long-run equilibrium level of concentration. Following the relevant literature (Martin, 1993a), the coefficient of lagged concentration (a_1) transformed as $[a_1/(1 - a_1)]$ and multiplied by the years of the study period, will yield an estimate of the average time it will take for market concentration to reach the equilibrium level. The concentration in Greek food industry will reach the long run level in about 4.5 years, which is a relatively short time. This means that the current concentration level depends more on the long run level than on the past level of concentration and that there have been rapid structural changes in the sector which are expected to be completed soon—if all else remain the same. The positive effect of economies of scale—that also reflect the initial capital requirements in fixed assets—show that technological factors are positively associated with increase in the level of concentration. Thus, food firms that aim to dominate the market, should meet initial capital requirements corresponding to MES. The insignificant coefficient of advertising implies that advertising does not affect concentration.

Concerning the advertising equation, the coefficient of concentration is positive and significant while the coefficient of the square value of concentration is negative and also significant. The results provide evidence for a non-linear relationship between advertising and concentration. As concentration increases, advertising intensity also increases until the point where the Herfindahl index is equal to 0.406. After that point a further increase in concentration is associated with a decline in advertising intensity. It is worth noting however, that $H = 0.406$ is a high level of concentration, corresponding to a market dominated by only $1/0.406 = 2.5$ equally sized firms. Since for the most (31) food industries of the sample the value of Herfindahl is lower than 0.406, the relationship remains always positive for the majority of food industries. For firms, however, that operate in the seven (7) food industries with a

Table 4
OLS and 3SLS regression results for 38 4-digit Greek food industries, 1994

Variables	OLS			3SLS		
	H	*A/S*	PR	*H*	*A/S*	PR
C	−0.11 (−1.79)	−0.04 (−2.66)[a]	0.15 (3.15)[b]	−0.11 (−1.90)	−0.06 (−3.44)[b]	0.09 (1.38)
H88	0.41 (3.41)[b]			0.43 (3.61)[b]		
H		0.14 (2.62)*	0.21 (2.02)[a]		0.29 (3.13)[b]	−0.08 (−0.34)
H^2		−0.15 (−2.70)[b]			−0.33 (−3.16)[b]	
PR		0.13 (3.28)[b]			0.17 (3.80)[b]	
A/S	0.21 (0.26)		2.24 (4.02)[b]	−0.29 (−0.21)		5.23 (2.92)[b]
KS			0.07 (1.32)			0.011 (1.46)
PR88	0.48 (2.00)			0.50 (2.03)[a]		
EX			0.07 (1.16)			0.22 (2.08)[a]
GR		−1.11 (−0.25)	−1.97 (−0.12)		0.01 (0.34)	−0.08 (−0.37)
MES	0.42 (5.83)[b]		−0.09 (−1.38)	0.42 (6.23)[b]		0.001 (0.01)
D		0.01 (1.15)			−0.005 (−0.53)	
R^2	0.73	0.53	0.54	0.73	0.46	0.43

[a] and [b] denote statistically significant results at 5% and 1% level of significance, respectively.
t-values in parentheses.

concentration higher than 0.406, become aware of the impact their advertising has on the sales of the rivals and at that level the recognition of inter dependence starts to influence their advertising expenses. The coefficient of profitability is positive and statistically significant. Firms which have high profitability use advertising intensity strategy to differentiate their products and to make their demand more inelastic. More profitable food firms spend more for advertising per sales than less profitable firms because they have more to gain by increasing sales. The coefficients of growth and dummy variables are insignificant.

Results for the profitability equation show that the coefficient of concentration is positive but insignificant, which means that monopoly power does not affect profitability directly. Profitability is affected by both advertising and export intensity. The coefficient of advertising intensity, as expected, has a significant positive effect. If the A/S ratio increases by 1 unit this will cause 4.23 units increase in profitability. [3] This shows the importance of product differentiation strategy in determining profitability in the Greek food industries. For the industries of the sample, the average A/S is 0.02 or 2%. Doubling A/S from 2 to 4%, would raise the profitability by $2 \times 4.23 = 8.46$ percentage points. The results also show that the higher the export intensity the higher the profits. The coefficient of export intensity is also positive and significant. An increase of 1 percentage point in EX would bring on average an increase of 0.22 points in the profitability. Although both the value and the statistical significance of the coefficient of export show that its effect is not as large as the one caused by advertising, the expansion to export activity seems a promising area for increasing profits. The economies of scale coefficient is insignificant while the coefficient of capital intensity (K/S) has a positive but weak effect on profitability.

Comparison of 3SLS and OLS results, give different results for the profitability equation. 3SLS method, in contrast to the OLS, gives insignificant coefficient for Herfindahl and significant coefficient for exports. The positive relationships between profitability and advertising, advertising and concentration and concentration and economies of scale show the importance of barriers to entry referring not only to advertising but also to economies of scale. Firms, therefore, aiming to enter into these markets should meet the initial capital requirements corresponding to each industry. Thus, established firms with a suboptimal size must apply external growth strategies (e.g., mergers, acquisitions, joint ventures) to obtain a size equal to MES. Given that the results show that the speed of adjustment to the equilibrium structure is rapid, potential entrants and established firms with a suboptimal size must complete soon their structural adjustment.

[3] Since gross profits include advertising expenses the net effect of advertising on profitability is $5.23 - 1 = 4.23$ points (Scherer and Ross, 1990).

6. Conclusions and recommendations

Food sector is an important manufacturing sector in Greece in terms of contribution to manufacturing output, growth and profitability. The paper estimates SCP relationships for a sample of 38 Greek food industries in 1994. A specification of a three equation model consisting of concentration, advertising and profitability is based on the IO literature. The relevant econometric tests suggest the application of 3SLS method and the existence of feedback effects between advertising and profitability.

The main results show that advertising intensity, along with exports, increases profitability and it depends non-linearly on concentration which, in turn, is determined by economies of scale. A number of recommendations based on the obtained results can be made for Greek food firms. Advertising and consequently product differentiation are important strategies in increasing the profitability in the Greek food industries. Therefore, food manufacturing firms aiming to increase their profitability should apply intensively advertising and product differentiation strategies. The relationship between advertising and concentration shows that firms with large market share can spend more on advertising than small firms. Firms, however, with very large market share must not continue to increase their advertising intensity in industries with the Herfindahl index higher than 0.406. For firms aiming to have large market

share, it is necessary to meet technological requirements corresponding to MES of the industry where it operates. Since the results show that export intensity increases profitability, food firms should consider the expansion to foreign markets. This is particularly important for large sized firms operated in small countries. Given the rapid structural change which have occurred in these markets, it is required for potential entrants and established firms with a suboptimal size obtain a size corresponding to the minimum efficient scale in the next few years.

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