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Review

Determinants of profitability in Iranian manufacturing industries: Further evidence, using a dynamic panel data approach

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Abstract

This paper is intended to study the determinants of profitability of manufacturing industries, based on the Iranian experience. The focus is on R and D and advertisement expenditures as well as the degree of concentration as the main determinants of profitability. The theoretical underpinning of the paper is provided by the so called Structure-Conduct-Performance paradigm, discussed rather extensively in the literature on industrial economics. The methodology consists of a dynamic panel data procedure. The data covers the Iranian plants employing ten or more persons, aggregated at a manufacturing industry sector level for 141 manufacturing industry sectors carrying four digit codes and observed over the 1994-2007 period. Our findings indicate that the non-price variables of R and D expenditures and advertisement costs have a significantly positive effect on profitability (performance). The effect of increases in concentration (structure) on profitability varies depending on industry size as measured by investment expenditures. The degree of concentration on profitability has a significantly positive effect on profitability in the large manufacturing industries or heavier investment consumer manufacturing industries. But, profitability decreases with concentration in the small manufacturing industries. The paper has draws implications for pursing a more active advertisement and R and D policy in manufacturing industries.

Keywords: Concentration, R and D expenditures, Advertisement costs, Profitability, DynamicPanel data procedure. **JEl classification:** L_{10}, M_{31}, C_{23}, O_{32}

INTRODUCTION

The history of the use of the structure-conduct-performance (SCP) paradigm in analysis of industries and markets goes back to early 1940's. Whereas, the concepts of structure, conduct and performance have been considered as the three indispensable elements of markets in industrial economics, there is consensus on the mode that these elements interact. Early discussions on the relationship of these market elements began with Mason (1939) and his students. Mason and Bain (1959), for example, studied the effect of entry barriers on economic conduct and performance of firms drawing attention to the then warranted focus on market structure. Following the SCP track of Mason and Bain, Demetz (1974) studied the "efficient- structure" hypothesis and concluded that increases in firm efficiency lead to increases in profitability, market share and eventually the degree of market concentration. This, in a sense, says: performance determines structure; a conclusion that is

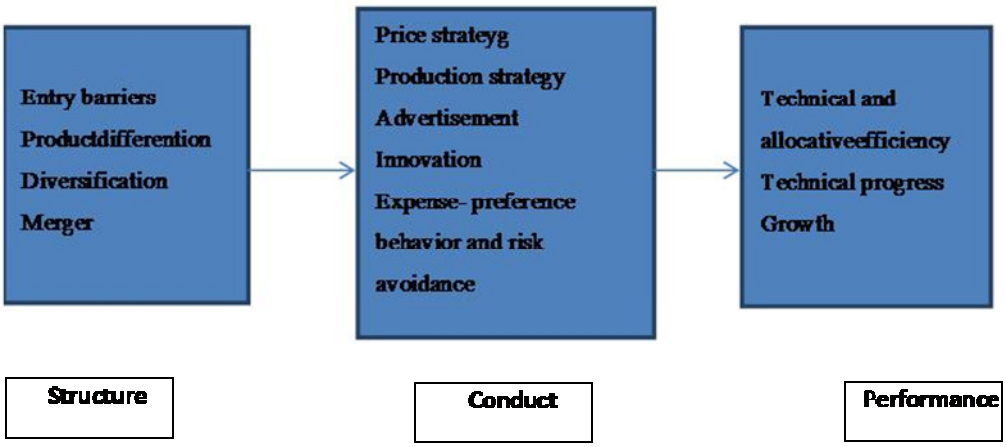

Figure 1. Parameters of the market element

different form predictions of the SCP paradigm as we know it today that in fact says structure determines performance. Cowling and Waterson (1976) provided new theoretical impetus along the SCP lines, revealing the definitive role and importance of structure in determining market performance. In their version, the profitability rate of industries turned out to be a function of the degree of concentration. Clark and Davidson (1982), expanding on the theoretical model of the Cowling and Waterson, verified the role and importance of conduct in market performance (note that the collusion parameter is a behavioral variable). They further showed that the industry profitability rate is a function of the degree of collusion and collaboration.

In spite of these seemingly divergent views, there seems to be an emerging consensus on how to measure each market element. In particular, the degree of concentration, and product differentiation seem to be the more widely concurred measures of structure, advertisement, pricing and R and D of conduct and profitability of performance (Figure 1).

Studies in the area of SCP paradigm conveniently can be divided into three categories

Single equation models (mainly based on static panel or cross-sectional analysis)

Beginning with single equation models, we may refer to Caldor (1950). His contention is that advertisements increase producers' profit, because, he elaborates, advertisements perform as complements to the advertised product. Drucker (1954) postulates two behavioral functions for every firm: a marketing function and an innovation function. The marketing function depicts expenditures on advertisement as part of the marketing activities. The innovation function depicts expenditures on R and D as part of the innovation related activities. Theoretically, R and D expenditures as measures of market conduct are expected to yield positive returns to firms. A subsequent empirical by Comanor and Wilson (1968) revealed that industries with intensive advertisement also exhibit a high degree of diversity that can act as a barrier to entry of other firms and industries. Mansfield (1968), using a production function approach and Grabowski and Mueller (1978) showed that the relationship between R and D expenditures and profitability is positive and significant. Gisser (1991) argues that advertisement and concentration have a direct effect on profitability and the effect of advertisements on profitability is more pronounced in industries with a higher degree of concentration. Erickson and Jacobson (1992) argue that investments in advertisements and R and D lead to an increase in a firm's value, because these investments lead to adoption of a different strategy than the competitor firms, which in turn gives the firm a comparative advantage. The strategy will lead to creation of a new product or a new production process. Lee and Sougiannis (1996) view profitability as a function of physical and non- physical assets. They consider firms'non- physical assets to be under the influence of advertisements and R and D expenditures. Their findings indicate that each year's profitability is a function of the current or the preceding year's advertisements and R and D expenditures.

Simultaneous equation models

Under simultaneous equation models, Lunn (1989) finds that in US, R and D expenditures, advertisement and industry concentration have a positive and significant effect on concentration and the relationship between advertisement intensity and market structure is non-linear. Nakao (1993) found that expenditures on advertisements had a positive and meaningful effect on

Table 1. Pearson coefficient by expenditure types

Expenditure types	*Sk*
Advertisement expenditures	3.8
RandD expenditures	2.5
Investment expenditures	1.1

profitability of industries, but the effect of R and D expenditures on profitability was not statistically meaningful. Santos (1995) finds a weak relationship between advertisements and firms' profitability. Delorme et al (2005) argues that industry performance depends more on industry structure rather than industry conduct and that profitability is a function of concentration.

Single equation models based on dynamic panel methodology

Among model category (3), we may refer to McDonald (1999), and Goddard (2005). These authors insist on the positive effect of the conduct, and structure variables on the on market performance.

These and other studies that have been undertaken under model category (1) mostly conclude a positive effect of structure variables (mainly concentration) and conduct variables (mainly R and D and advertisement) on profitability. Alternative to this model category are model categories (2) and (3). Model category (2) considers the interrelationship of structure, conduct and performance in a simultaneous fashion that is believed to yield results that are more rigorous compared to results obtained under model category (1). Both these types are essentially static models with limitations that are inherently due to static models.

Studies using models of type (3) are in fact rare. To fill the gap, this paper uses a dynamic panel data model, especially, as advised by Roberts and Samuelson (1998), because in oligopolistic industries, the non-price variables such as: advertisement, quality and R and D, have a lasting effect that is not captured in full by static models. In a similar vain, Asterio (2006) argue, the relationship between variables is more accurately revealed over long periods of time and this is something that is best captured within the framework of dynamic analysis. Just as By the same token that models category (2) are generally believed to yield results that are more rigorous that model category (1), dynamic panel data models also are believed to yield results that are more rigorous than either of model category (1) or (2). In this paper, we use a dynamic panel data approach, focusing on concentration as a measure of structure and advertisement and R and D expenditures as measures of conduct and estimate their effect on the profitability of manufacturing industries in Iran. Section 2 will review the manufacturing sector of Iran. In section 3 we introduce the dynamic panel data and our modeling approach and the data that goes with it. Estimates are presented tested and discussed in Section 4. Finally we conclude the paper and draw some implications in section 5.

Advertisement and R and D expenditures by manufacturing industries in Iran

Our study covers manufacturing carrying four digit codes, but since the total number of manufacturing falling under this code are 141 and two large for the purpose we have on hand in this section, we only concentrate on industries carrying two digit codes. Table 1 summarizesadvertisementand R and D expendituresof these manufacturingindustries by sector. Figures are averages taken over the 1994-2007 period. We have calculated the Pearson coefficient of skewness using the following formula:

$$Sk = \frac{3(\mu - med)}{\sigma} (1)$$

Whereσ is standard deviation, μ is the mean and med is the median.

Our calculation (Table 1) shows that the distribution of advertisement and R and D expenditures has a relatively normal distribution. Although the skewnesscoefficient is positive, but it is trivial, meaning that advertisement and R and D expenditures are concentrated around the mean.Both advertisement and R and D constitute investments in intangible assets that Iranian manufacturing industries almost have used simultaneously as indicated by tables 1. Investment expenditures have been used to classify manufacturingindustries by size(smaller and larger groups) in order tocapture the size effect in our model. Hence, Table 2 provides ranking of inductees by relative size. We may say that the top ten manufacturing industries ranked by advertisement and R and D expenditures are in fact almost industries that we may call relatively large industries. They mostly comprise material production and chemicalproduct industries, food and beverages, motor vehicles and trailers, other non –metallicore products, machinery and equipment, coke production, refinery products and nuclear fuel.

Table 2. The distribution of investment, advertisement and RandD expenditures in manufacturing industries carrying two digit codes(data averaged over the 1994-2007 period).

Code	Industry groups	Investment expenditures	R and D expenditures	Advertisement Expenditures
15	Food and Beverages	20292884.8	18341.3	97403.4
16	Tobacco products and cigarettes	367607.5	39.3	159.8
17	Textile	8353446.9	1941.51	21009.3
18	Clothing, and processing and dying fair skins	381966.1	58.58	3933.6
19	Processing and finishing leather hides and manufacturing purses, shoes, suitcase andhorse …saddles and ..	741358.7	166.7	1652.2
20	Wood and wood products,exceptfurniture,cane products and drapers	685232.2	255	2494.3
21	Paper and paper products	1552342.6	759	4859.4
22	Publishing and photocopying	1624704.7	333.9	2878.5
23	Coke , refinery products and nuclear fuel	5754022.8	6959	15188
24	Chemical material and products	17961311.9	34477.2	329212
25	Rubber and Plastics p	4256008.14	3483.9	17577.4
26	Other non metallicore products	17021157.2	20506.72	44827.5
27	Basic metals	13703645.5	101321	14078.6
28	Fabricated metal products, except machinery and equipment	5262382.1	4865.4	18503.8
29	Machinery and Equipment, not classified elsewhere	5830147.1	9830.2	61180.1
30	Office and calculating Machinery	149511.6	933.5	2463.4
31	Electric machinery and equipment, not classifiedelsewhere	2693737.6	8575	17465.4
32	Radio TV sets and other communication equipment	595145.8	2134.7	9827.7
33	Medical and optical products precision equipment and watches and clocks	690833.5	3951.3	4895.3
34	Motor Vehicle and trailer equipment	7340220.6	21410.8	49683.4
35	Other transportation equipment	1099540.6	1415.4	7592.3
36	Furniture and manufacturing products, not classified elsewhere	1382131.3	893.7	6181.6
37	Recycled products	21874.9	4.9	9
38	Agro- industries	1181.1	1.2	1.8

The model and the data

Dynamic Panel Data (DPD) methodology

A dynamic model may be as simple as entering the lagged dependentvariable to represent an explanatory variable in a model. Hence we have:

$$Y_{it} = \alpha_i + X'_{it}\beta + \rho Y_{it-1} + \varepsilon_{it} \quad (2)$$

WhereY represents the dependent variable and X represent a vector of independent or explanatory variables, α is the special effect of the unit under study, ε represents the disturbance term and the subscripts i and t refer the the unit under study and time respectively. The basic issue with the dynamic models is that the use of the traditional OLS estimator inthese types of models does notyield unbiased and consistent estimates. The reason we get biased estimates from OLS estimators in dynamic models is the dependence of Y_{it}includingY_{it-1} on α_i. The variable Y_{it-1} which is an explanatory in the model is correlated to the disturbance term and that is why OLS based estimates yield biased and inconsistent estimates. There are two ways to resolve this issue. One is to use Generalized Method of Moments (GMM) and the other is to use the estimators known as “bias correction estima-

Table 3. Ranking industry groups (from 1-24) according to Investment, Advertisement and R and D expenditures

Industry group		Rank according to:		
Code		**Investment expenditures**	**R and D expenditures**	**advertisement expenditures**
15	Food and Beverages	1	4	2
16	Tobacco products and cigarettes	21	22	22
17	Textile	5	13	6
18	Clothing, and processing and dying fair skins	20	21	17
19	Processing and finishing leather hides and manufacturing purses, shoes, Suitcases and horse …saddles and...	16	20	21
20	Wood and wood products, except furniture, cane products and drapers	18	19	19
21	Paper and paper products	13	17	16
22	Publishing and photocopying	12	18	18
23	Coke , refinery products and nuclear fuel	8	8	10
24	Chemical material and products	2	1	1
25	Rubber and Plastics p	10	11	8
26	Other non metallic ore products	3	3	5
27	Basic metals	4	5	11
28	Fabricated metal products, except machinery and equipment	9	9	7
29	Machinery and Equipment, not classified elsewhere	7	6	3
30	Office and calculating Machinery	22	15	20
31	Electric machinery and equipment, not Classified elsewhere	11	7	9
32	Radio TV sets and other communication equipment	19	12	12
33	Medical and optical products precision equipment and watches and clocks	17	10	15
34	Motor Vehicle and trailer equipment	6	2	4
35	Other transportation equipment	15	14	13
36	Furniture and manufacturing products, not classified elsewhere	14	16	14
37	Recycled products	23	23	23
38	Agro- industries	24	24	24

Table 4. Result of model (3) estimates using different estimation methods.

	β_0	β_{01}	β_1	β_2	β_{21}	β_3	β_{31}	β_4	β_{41}
	3.5	-0.27	0.32	-0.3	0.23	0.04	0.1	0.34	-0.03
OLS	(12)*	(-0.79)	(14)	(-5.03)	(3.41)	(1.55)	(2.43)	(9.48)	(-0.63)
	5.1	-0.84	0.06	-0.28	0.35	0.02	0.17	0.51	-0.02
LSDV**	(14.47)	(-2.32)	(2.61)	(-3.83)	(4.34)	(0.84)	(3.87)	(13.55)	(-0.49)
		-0.66	0.18	-0.14	0.28	0.07	0.12	0.7	-0.001
LSDVC***		(-1.54)	(0.77)	(-1.57)	(2.87)	(1.88)	(2.24)	(6.98)	(-0.03)
[log$\pi_{i,t-2}$]	0.006	-0.67	-0.05	-0.13	0.25	0.05	0.126	0.62	-0.008
Anderson-	(0.38)	(-1.53)	(-0.62)	(-1.58)	(2.89)	(1.51)	(2.37)	(10.63)	(-0.14)
Hsiao	0.012	-0.86	-0.28	-0.12	0.21	0.07	0.11	0.52	0.01
[dlog$\pi_{i,t-2}$]****	(0.76)	(-1.87)	(-1.98)	(-1.47)	(2.34)	(1.94)	(2.06)	(7.06)	(0.26)
	5.15	-0.53	-0.39	-0.17	0.26	0.07	0.08	0.6	0.01
Arellano-Bond	(20)	(-1.94)	(-2.77)	(-4.50)	(5.8)	(3.14)	(2.63)	(18.82)	(0.5)
	4.52	-0.61	0.001	-0.17	0.27	0.06	0.10	0.63	0.01
Blundell-Bond	(13.5)	(-1.82)	(0.09)	(-3.25)	(5.76)	(1.84)	(2.89)	(18.16)	(-0.37)

Values inside brackets are t or z statistics *
** The method measures fixed effeccs
***The method is direct bias correction due to Kiviet

Table 5. The results of Sargan test for the credibility of the instrumental variables.

χ2 Statistic	Degrees of Freedom	(P-value)
69	62	0.22

Table 6. The results of the Arellano-Bond test fordetermining order of auto-correlation in the error term

Lags	ZStatistic	(P-value)
1	-4.2067	0.000
2	1.01192	0.3081

Table 7. Coefficient estimates by small and large industries.

Variables	Coefficient		
	Small industries	Large industries	Coefficient Difference
$Log\pi_{it-1}$	-0.39	-0.39	
$LogHHI_{it}$	-0.17	0.09	0.26 (5.8)
$LogRD_{it}$	0.07	0.15	0.08 (2.63)
$LogAD_{it}$	0.60	0.61	0.01 (0.5)

Sargan Test and Arellano-Bond Test results is provided here (Tables 5 and 6).

The Sargan Test indicates a non-rejection of Zero Hypothesis andthus the validity of instrumental variable choice (Table 6). There is no correlation of order two among the differenced error terms and hence the use of the Arellano-Bond for removingcorrelationamong the individual effectof subsectors and the lagged dependent variables has been appropriate. Therefore we proceeded to estimate the parameters of the model for both small and large manufacturing industries, using the Arellano-Bond method (Table 7).

It is form (Table 7) that R and D expenditures increase profitability in both small and large manufacturing industries. But the effect is more pronounced in large industries that small industries such that a one percent increases in R and D expenditures in each of the large and small industries will lead to 0.07 and 0.15 percent increase in the profitability of these two groups of industries, respectively. Advertisement expenditures also increase profitability, the effect is almost the same in both large and small industries so that a one percent increase in advertisement expenditures leads to 0.6 percent increase in the profit rate in both industry groups. Furthermore the effect of advertisement expenditures on profitability is more pronounced than the effect of R and D expenditures. One reason might be that it takes more one year for R and D expenditures to reveal their full effect and that a one year horizon underestimates the effect of R and D expenditures.

Another revealing feature of table 7 is that more concentrated large industries make more relative profit so that in large industries a one percent increase in concentration leads to a 0.09 percent increase in the profit rate. But this hold reverse for small industries.Therefore contrary to what is sometimes suggested, an increase in concentration and monopoly power in small industries does not increase market power and profitability. Finally, the effect of lagged profitability is negative and meaningless.

Summary and policy implications

To summarize, this paper attempted to evaluate the effect of advertisements and R and D expenditures on profitability of the manufacturingindustries with evidence from Iran using data that spanned across 141 four digit code manufacturing industries covering the 1997-2007 period. Within each manufacturing industry only plants that employ 10 or more persons were considered for thesake of data compilation. This data is available from the Iranian statistical center. The model used is a special formulation within the framework of the dynamic paneldata analysis class of methodology. Our findings indicate that in large industries, the relative effect of advertisement expenditures on profitability exceeds the effect of R and D expenditures and the degree of concen-

tration on profitability. Furthermore the relative effect of R and D on profitability exceeds the relative effect of concentration on profitability. Therefore, we may conclude that given the large industry market performance is influenced by both market conduct and market structure, the effect of conduct on performance exceeds the effect of structure on performance.

Analysis of the small industry group yields somewhat conclusion than the large industry group. Here the effect of advertisement expenditures on profitability exceeds the effect of R and D expenditures on profitability, but the relation between concentration and profitability is negative by a significant degree. This negative relationship is also concluded inKwoka and Ravenscraft (1986) in a study that concentrated on firm level data and a model based on the existence of rivals and snop-effect. Their explanation of the negative relationship has to do with the tendency of better firms not to abide by joint agreements and cause a break in the collution. Another explanation, following Edwards (1977), is that firm managers in concentrated markets participate in the conduct inspired by "expense-preference" and this leads to an increase in expenses and a decrease in profits. On theother hand as Heggestad(1977) maintains, in more concentrated markets, managers are avert to risk so that they accept less risk for less profit. Yet a different explanation may be that in the more concentrated markets, there is more price completion that may result in lower profits for most firms.

We end this paper with following policy implications:

1. The Iranian manufacturing industries are heavily influenced by market conduct variables (advertisement and R and D expenditures). The Iranian manufacturing industries can increase their profitability by intensifying their R and D activities.

2. The Iranian large manufacturing industries are influenced by market structure (concentration) so that an increaseof concentration in the Iranian large manufacturing industries will lead to an increase in the profitability of the active firms within the industry. Hence any attempt at promotion of market concentration and oligopolistic behavior will lead to an increase in the profitability of these industries. However, there are also reasons that government policies need to opt for measures that encourage competition and reduce oligopolistic behavior. There are other means such as advertisements and enhanced domestic and marketing activities marketing promotion that industrial managers can use in order to increase their profitsbility.

3. The findings of this research point to a need for provision of resources required by investments in R and D. In this conjunction, the role of the government in suppoting R and D promotionin the various economic sectors becomes crucial.

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