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Industrial Concentration in the Iranian FoodP roducts and Beverages Industries

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Abstract

The paper examines industrial concentration in Iranian food products and beverages industries using firm level data aggregated to the 4-digit ISIC industry level between 2002 and 2004. Based on different concentration indices the average level of concentration has increased slightly for the period of study. The empirical results show that increase in the level of concentration is more likely in industries that are more profitable. The results also show that initial capital requirement has positive and significant effect on the likelihood of changes in the level of concentration in the selected industries. Factors such as size, advertising intensity and R&D intensity do not have a significant effect on the probability of changes in concentration.

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Introduction

There are two different ideas associated with concentration; one is usually called overall concentration, and the other is called industrial concentration. Overall concentration is concerned with the output produced by the top, say 100, firms in an economy no matter in what particular industry these firms are operating (Ferguson 1994). Industrial concentration refers to the extent to which production or sale is concentrated among large incumbent firms in an industry. The concept plays a crucial role in the field of industrial economics. This paper focuses on the second definition of concentration, that is industrial concentration. The measurement of industrial concentration is important for several reasons. Concentration is regarded as a significant dimension of market structure and concentration indices are used when determining the level of competitiveness in a market. In general, it is believed that highly concentrated industries suffer from less competitive environment. Furthermore, concentration as an important dimension of market structure is believed to affect market efficiency in a variety of ways such as creating market power in the hand of top firms.

Significant theoretical advances have been made in the analysis of industrial concentration for last few decades. According to Structure–Conduct–Performance (SCP) paradigm of Bain (1954), concentration is mainly caused by entry barriers and economies of scale. He managed to show that monopolistic and oligopolistic market structure would lead to welfare loss, as a few incumbent firms tend to exercise market power. Sutton (1991, 1998) criticized the SCP paradigm by identifying price competition intensity and the level of endogenous sunk costs as the key determinants of concentration. In brief, it can be said that strong relationship between concentration and the level of prices, profitability and efficiency is expected at any particular market. In this study, we tend to identify the main determinants of changes in concentration in Iranian Food products and beverages industries.

1. Methodology

The study investigates the determinants of changes in industrial concentration in Iranian food products and beverages industries between two points of time, (2002 and 2004). The type of industrial classification used in the study is International Standard Industrial Classification (ISIC). This kind of classification is widely used for empirical studies because of lack of industrial data on the base of other classifications. We use firm level data aggregated to the 4-digit ISIC code of industries are used. The sample of industries is reported in table (1).

Table (1)
Food Products and Beverages Industries

	ISIC Code	Industry
1	**1512**	Processing and preserving of fish and fish products
2	**1514**	Manufacture of vegetable and animal oils and fats
3	**1515**	Slaughter animals and birds
4	**1516**	Processing and preserving meat and meat products
5	**1517**	Date packing
6	**1518**	Pistachio packing
7	**1519**	Processing and preserving vegetables and fruit products except date and pistachio
8	**1520**	Manufacture of dairy products
9	**1531**	Manufacture of grain mill products
10	**1532**	Manufacture of starches and starch products
11	**1533**	Manufacture of prepared animal feeds
12	**1542**	Manufacture of sugar
13	**1543**	Manufacture of cocoa, chocolate and sugar confectionary
14	**1544**	Manufacture of macaroni, noodles, couscous and similar farinaceous products
15	**1545**	Bakery
16	**1546**	Confectionary products
17	**1547**	Processing tea products
18	**1548**	Miscellaneous
19	**1551**	Distilling, rectifying and blending of spirits; ethyl alcohol production from fermented materials
20	**1555**	Soft drinks
21	**1556**	Mineral water

The advantage of using firm level data is the possibility to calculate a wide range of concentration indices. Firm level data also enables us to carry out an analysis at a more disaggregated level than the officially released aggregated data.

2. Changes in Concentration

There is a wide variety of concentration indices that can be used to illustrate the changes in the level of concentration. The most widely used industrial concentration indices are the Hirschman-Herfindahl index (HHI), Hannah Kay (HK) index and the k-firm concentration ratio index. For empirical investigation, HHI index can be calculated using the following formula.

$$HHI = \sum_{i=1}^{n} S_i^2$$

Where S_i is the market share of firm i. The other index is Hannah Kay concentration index, which is introduced by Hannah and Kay in 1977. The index can be calculated by the following formula.

$$HK = \left(\sum_{i=1}^{n} S_i^{\alpha} \right)^{\frac{1}{1-\alpha}}$$

In this index, α is a weight parameter, which can be chosen by the investigator. A higher α means that the larger firms are assigned a heavier weight. The higher HK index indicates a lower degree of concentration. The other index is k-firm concentration ratio which is defined as the cumulative share of the K top incumbent firms, and it can be calculated using the following formula.

$$CR_k = \sum_{i=1}^{K} S_i$$

The share of each firm can be expressed in terms of sale, value added, employment etc. k-firm concentration ratio usually is calculated for four or eight top firms.

We use concentration ratios for four (CR_4) and eight (CR_8) firms, Hannah Kay (HK), and Hirschman-Herfindahl (HHI) indices are used to illustrate the changes of concentration in the selected industries These indices of concentration have been calculated based on firm's sale for all the 4-digit industries.

HK and HHI concentration ratio indices for the industries are presented in Table (2). To evaluate the level of concentration based on of Hirschman-Herfindahl index (HHI), the US antitrust policy can be used. According to the policy if the number of HHI is between 0 and 1000, it is regarded as an industry that is un-concentrated. If the index lies between 1000 and 1800, it is regarded as a moderately concentrated industry, and if the index in an

industry is above 1800, it is regarded as a concentrated industry. Column 2 of Table 2 shows that the average HHI indices in 2002 is about 912. This indicates that the group of industries is un-concentrated and, therefore, a merger can happen without any concern about exerting monopoly power by the incumbent firms. The index has increased slightly to 987 in 2004. The results for concentration ratio for four top firms (CR_4) in 2002 column 3 of Table 2. One can observe that on average the four largest firms account for about forty two percent of the total sale of the industries.

Table (2) Concentration Indices

ISIC	2002				2004			
Code	HHI	CR4	CR8	HK	HHI	CR4	CR8	HK
1512	579	39%	54%	17	532	35%	54%	19
1514	917	52%	77%	11	865	47%	78%	12
1515	254	22%	35%	39	230	19%	31%	43
1516	776	41%	53%	13	298	28%	39%	34
1517	333	24%	41%	30	349	25%	43%	29
1518	4,282	89%	97%	2	1,876	79%	97%	5
1519	313	29%	42%	32	277	27%	37%	36
1520	443	33%	47%	23	290	26%	40%	34
1531	1,249	55%	81%	8	1,336	69%	84%	7
1532	2,306	79%	89%	4	2,884	73%	84%	3
1533	299	23%	38%	33	301	25%	40%	33
1542	364	28%	41%	27	446	32%	46%	22
1543	890	54%	73%	11	1,372	57%	68%	7
1544	103	11%	18%	97	838	37%	45%	12
1545	169	17%	27%	59	249	22%	31%	40
1546	496	37%	53%	20	516	38%	55%	19
1547	909	41%	51%	11	955	46%	60%	10
1548	349	29%	39%	29	267	25%	34%	38
1551	1,592	70%	89%	6	1,929	74%	93%	5
1555	430	30%	43%	23	578	40%	54%	17
1556	2,100	77%	100%	5	4,343	87%	94%	2
Average	912	41.8%	56.5%	24	987	43.4%	57.3%	20

Source: SCI Manufacturing Survey

Based on the above data source indices have been calculated.

It can be seen that instances of very high concentration are relatively rare in the group of industries. The majority of the industries have industrial concentration below fifty percent and only few industries have an industrial concentration above seventy percent. The measure of concentration (CR_4) has increased slightly to forty three percent in 2004. The results for concentration ratio for eight top firms (CR_8) show that on average the eight largest firms account for about fifty seven percent of the total sale of the industries in 2002. The index also supports the notion that these industries are not highly concentrated. The measure of concentration (CR_8) also has increased slightly in 2004. Column 5 presents Hannah Kay index. The average value of the index is about 24 in 2002 that indicates a low level of concentration in the group of industries. The index has decreased to 20 in 2004.

Table (3) summarizes the basic properties of the sample data.

Table (3) Average Concentration in Food products and beverages industries

year	no. of industries	no. of firms	HHI	CR4	CR8	HK
2002	21	2,531				
Average			912	41.80%	56.50%	24
Standard deviation			984	0.2177	0.2383	21
Coeff. of variation			1.08	0.5208	0.4218	0.8705
2004	21	2,669				
Average			987	43.40%	57.30%	20
Standard deviation			1,042	0.2122	0.2235	13
Coeff. of variation			1.06	0.4889	0.3901	0.637

The sample consists of 21 industries and the number of incumbent firms is 2,531 in 2002. The number has increased to 2,669 in 2004. The average level of all concentration indices has increased slightly in 2004. The correlation coefficients among these indices are reported in Table (4). They indicate that the choice among these concentration indices for empirical investigation is not important as they are highly correlated. The correlation coefficients among these indices are reported in table (4).

Table (4)
Correlation coefficients among concentration indices in 2004

	HHI	CR4	CR8	HK
HHI	1	0.9011	0.8237	-0.7525
CR4	0.9011	1	0.9725	-0.8933
CR8	0.8237	0.9725	1	-0.9067
HK	-0.7525	-0.8933	-0.9067	1

2.1 Model Specification

It is suggested that in the long run the level of concentration is adjusted towards its stable state which is called long run equilibrium of concentration. Therefore, changes in industrial concentration can be interpreted as the process of adjustment towards the long run equilibrium of concentration because The steady state (or equilibrium) concentration level in an industry is mainly determined by underlying demand and supply conditions (Bhattacharya and Bloch 2000). The process of adjustment leads industry to the steady state level of concentration (C^*).

$C_t - C_{t-1} = \lambda (C^* - C_{t-1})$

where C_t and C_{t-1} are the current and past level of concentration. C^* stands for the steady state level of concentration and it is determined mainly by supply and demand conditions. Particularly, important factors affecting the steady state level of concentration are the economies of scale, the level of

technology, and the entry barriers. The coefficient (λ) represents the partial adjustment of concentration $(0 \le \lambda \le 1)$ towards equilibrium.

Models developed to identify the determinants of changes in concentration usually take the form of an OLS regression equation in which a measure of concentration is the dependent variable. The study seeks to explain changes in concentration by discrete variable rather than continuous variable. Therefore a logistic model, rather than a conventional regression model has been chosen. The dependent variable y_i is binary (dichotomous), taking the value of 1 if concentration increases during the period of time, zero otherwise. The model is expressed in terms of the probability of a change in concentration in industry i as follows:

$$p_i = E(Y = 1|X_i) = \frac{e^{Z_i}}{1+e^{Z_i}} \qquad (1)$$

Where $Z_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + ... + \beta_n X_{ni}$.

Equation (1) represents what is known as the (cumulative) logistic distribution function. As Z_i ranges from $-\infty$ to $+\infty$ p_i ranges between zero and one. Equation (1) can be rewritten as:

$$\frac{p_i}{1-p_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \qquad (2)$$

$p_i/1\text{-}p_i$ is simply the ratio of the probability that an industry witnesses an increase in concentration level to the probability that the industry does not witness an increase in concentration level. If we take the natural logarithm of equation (2), we obtain:

$$L_i = \ln\left(\frac{p_i}{1-p_i}\right) = Z_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + ... + \beta_n X_{ni}. \qquad (3)$$

L is called the logit and for estimation purpose we can use the following final form.

$$L_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + ... + \beta_n X_{ni} + u_i \qquad (4)$$

2.2 Explanatory Variables

The empirical literature on the determinants of industrial concentration can be broadly classified into two groups. The first group encompasses those examining variations in the level of concentration across industries and the second group those examining its changes over time. The majority of the studies (Like Bhattacharya M (2002), Yoon S (2004), Young J K and Masson T R (2003)) [this is not in the reference] have consistently found that the following factors have significant effect on industrial concentration.

Minimum Efficient Scale

Most of previous empirical studies have supported the notion that technological factors have a crucial role in explaining variations of concentration across industries. Technological factors are usually measured by the minimum efficient scale (MES), defined as that size of firm at which the long run average cost is at minimum. This may not be a unique size. Empirical evidence suggests that L-shaped long run average cost curves are quite common so there will be a range of firm sizes which are at the minimum efficient scale. The empirical findings are consistent with both Structure-Conduct-Performance (SCP) paradigm and the theoretical approach of Sutton (1991). The (SCP) paradigm, emphasizes that a high minimum efficient scale creates entry barrier and leads the structure of market to higher level of concentration. Sutton argues that a firm's decision as to whether or not enter an industry at a given (fixed) sunk cost is determined by the technology in the form of minimum efficient scale. Therefore, Concentration will be a positive function of the size of sunk costs. A rise in minimum efficient scale, ceteris paribus, will increase the level of concentration. There is no consensus among economists on the way of measuring minimum efficient scale. It can be measured by calculating the average size of half larger incumbent firms in an industry. Firm size can be expressed in terms of sale, capital or employment. Minimum efficient scale can also be expressed in terms of initial capital requirement measured by capital sale ratio. It is another proxy to show the extent of approximate efficient scale in a market. Many empirical studies use the proxy to explain the changes in the level of concentration across different industries.

Research and Development (R&D) Intensity

R&D intensity is another determinant of the level of concentration. According to S-C-P paradigm R&D expenditures are purely entry barrier which can raise initial entry costs. To justify the claim, it can be said that R&D costs is usually classified into sunk costs category that create exit barrier which in turn create entry barrier. Therefore, R&D expenditure is usually regarded as an entry barrier. R&D expenditures also create entry barrier through patents because incumbent firms in R&D intensive industries usually enjoy a wide variety of patents which raise entry barriers. So it is expected that those industries characterized by high R&D expenditures be more concentrated compared to those with low R&D expenditures. The R&D intensity for each industry can be measured by R&D expenditures sale ratio.

Profitability

Many empirical studies support the belief that there is a positive relationship between profitability and concentration. New firms will enter, if profitability of market is high which leads the structure of market to a higher level of concentration. Incumbent large firms may exit if profitability is low, which may lead the market structure to a lower level of concentration. Profitability can be measured in terms of sale, value added, capital or property. The study uses the ratio of profit to sale as a measure of profitability.

Market Size

The market size can also influence on the level of industrial concentration. The positive effect of the market size on the level of concentration has been demonstrated in a large number of studies. Market size is usually expressed in terms of sale share of an industry in the total sale of a sector.

Advertising Intensity

There is a widespread belief that product differentiation is an important determinant of the level of concentration in any market. In fact product differentiation creates entry barrier and leads to a higher concentration ratio. Product differentiation is usually measured by advertising intensity in a market. Advertising expenditures - sale ratio is a common proxy to show the extent of product differentiation. It is expected that a higher advertising expenditures - sale ratio is associated with a higher level of concentration.

With the above choice of explanatory variables, specific form of the model is given by

$$L_i = \beta_1 + \beta_2 PROF_i + \beta_3 CAP_i + \beta_4 SIZE_i + \beta_5 ADV_i + \beta_6 RD_i + u_i \quad (5)$$

where

$PROF_i$: Profitability and is measured by profit – sale ratio for industry i.

CAP_i: Initial capital requirment and is measured by capital – sale ratio for industry i.

$SIZE_i$: The size of industry and is measured by the sale share of industry i in the manufacturing sector.

ADV_i : Advertising intensity and is measured by the advertising – sale ratio for industry i.

RD_i : R&D intensity and is measured by the R&D expenditures – sale ratio for industry i.

Hirschman-Herfindahl index (HHI) used to make binary variable for changes in concentration level between two years. The index satisfies all basic desirable characteristics of a concentration measure.

3. Empirical Results

The model developed above is used in order to identify determinants of the likelihood of changes in industrial concentration in food products and beverage industries. It is expected that the results of estimation will not be sensitive to the choice of concentration index because these indices are highly correlated. In order to see whether the empirical results are sensitive to the method of estimation, the specified model is estimated by the methods of logit and probit. The main difference between these two methods of estimation is that the logistic distribution has slightly fatter tails. In other words, the conditional probability approaches zero or one at a slower rate in logit than in probit. Estimation results are reported in table (5). It is observed that the empirical results by these two methods support each other. In other words, the results are not sensitive to the method of estimation. As it is observed from the table the estimated coefficient for profitability is positive and significant. It indicates that the probability of an increase in the level of concentration has a direct relationship with the level of profitability in this group of industries. In other words, it shows that an increase in the level of concentration occurs more likely in more profitable industries. The estimated coefficient of initial capital requirement (capital – sale ratio) is also positive and significant. It supports the argument that initial capital requirement create barrier to entry and consequently leads to a higher level of concentration.

Table (5)

Estimated Coefficients by Logit and Probit Methods

Variable	Logit	Probit
Constant	-9.49 (0.09)	-5.65 (0.07)
PROF	40.91 (0.08)	23.97 (0.06)
CAP	2.89 (0.08)	1.76 (0.07)
SIZE	21.35 (0.89)	12.65 (0.89)
ADV	-173.73 (0.27)	-100.90 (0.26)
RD	-483.99 (0.62)	-268.22 (0.62)
LR statistic (5 df)	15.19	15.42
Probability(LR stat)	0.00959	0.00872
McFadden R-squared	0.54415	0.55244
Obs with Dep=0	8	8
Obs with Dep=1	13	13
Total observation	21	21

p values in brackets

So the result demonstrates the fact that initial capital requirement has positive and significant effect on the likelihood of an increase in the level of concentration in the selected industries. The estimated coefficients of other variables including size, advertising intensity, and R&D intensity are not significant. It indicates that these factors do not have a significant effect on the likelihood of changes in the level of concentration in the selected industries. In high technology industries, R&D intensity usually has strong and significant effect on the changes of concentration. but as the selected industries are not among this group of industries, we found a weak and insignificant effect. The market size of the industries remained stable during these two points of time so the coefficient of the variable is insignificant. Advertising intensity also has insignificant coefficient that may be justified by the theory of Nelson. He classifies goods into search goods and experience goods and argues that the demand for search goods is not very sensitive to advertising. Many products supplied in the selected industries can be classified into search goods so we found a weak and insignificant effect of advertising on the changes of concentration. Overall, it can be concluded that profitability and initial capital requirement are the main determinants of the likelihood of an increase in the level of concentration in Iranian food products and beverage industries.

3.1 Policy implications

Empirical results demonstrate the fact that profitability and initial capital requirement are the main determinants of the likelihood of increase in the level of concentration in Iranian food products and beverage industries. Therefore, government can regulate these industries effectively by any policy which can change the level of profitability and initial capital requirement. Higher level of profitability leads the industries toward higher concentration that enable incumbent firms to enjoy more economies of scale. For example if government provides financial assistance to the incumbent firms in the industries, it may enhance profitability and consequently leads the industries towards a higher concentration and economies of scale.

4. Concluding remarks

We examine changes in concentration level of Iranian food products and beverages industries between 2002 and 2004. We use firm level data aggregated to the 4-digit ISIC industry level because of the possibility to calculate a wide range of concentration indices, which are not released officially. Our measures of the concentration indices show that the average concentration increased slightly during the period of study, which indicates that the structure of the markets is changing towards less competitive environment. Our estimation results show that an increase in the level of concentration is more likely in industries that enjoy higher level of profitability. The results also show that initial capital requirement as a proxy for minimum efficient scale, has significant effect on the likelihood of changes in the level of concentration in the selected industries. Factors such as size, advertising intensity and R&D intensity do not seem to have a considerable and significant effect on the probability of changes in concentration.

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