Chapter 2
Concentration, Profitability and (In)Efficiency in Large Scale Firms

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2.1 Introduction

The relationship between efficiency and market structure has been under investigation in the literature for a long time. According to Hicks (1935), firms with higher market power can survive in the economy even if they have higher costs since they can charge prices above the marginal cost. Although the relationship between firm performance measured by profits and market structure is obvious (Peltzman 1977), the direction of causality remains ambiguous (Clarke et al. 1984). There are different explanations of this relationship. One is to start with market power and relate the higher firm efficiency to the ability of firms with higher market power to charge prices above the cost margin. The second one, originally developed by Demsetz (1973), is based on the efficient structure of production and relates higher market power to the higher profits brought about by higher efficiencies. Although these two approaches try to explain the same relationship from the firm side, the welfare implications would be completely different. The reason for this is that in the first approach, that is, the market share hypothesis, firm performance (efficiency) is measured by the profitability of a firm and the relationship with market structure examined. According to this hypothesis, market power and efficiency are either negatively related, or not related. In the second approach, firm performance is measured by the efficiency of production. According to efficiency hypothesis, market power and efficiency are positively related. Feeny and Rogers (1999), Choi and Weiss (2005), Oustapassidis et al. (2000) and Bhattacharya and Bloch (1997) test both hypotheses for different countries and sectors and report controversial results. Thus, there is no clear evidence supporting any of the two hypotheses.

Large enterprises have a special place in economic modelling since they may be both triggering and detrimental in the growth process. From a Schumpeterian perspective, a large firm has a higher tendency to make product and process innovations which increases

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productive efficiency, and hence, is one of the primary sources of growth. On the other hand, a higher market power is related to loss of efficiency by charging prices above the marginal cost, and by producing output less than the optimal level (Hicks 1935).

Turkey is one of the most industrialized economies in its region, with a strong manufacturing industry. The share of manufacturing industry in GDP has been historically increasing since the establishment of the country. However, the efficiency structure of Turkish manufacturing firms has not been subjected to any analysis in a general framework. The most extensive study on the efficiency of Turkish manufacturing sector is by Taymaz and Saatçı (1997), where the efficiency structure of medium and small sized Turkish manufacturing firms in cement, textile and motor vehicles industries are analyzed. They use firm specific variables for technological change in production, ownership of firm and inter-firm relations as efficiency explanatory variables. Taymaz (2005) extends the same analysis to the years 1987–1997. However, Taymaz and Saatçı (1997) and Taymaz (2005) did not relate the inefficiency of firms to market structure at all. Another study that focuses on firm level efficiency in the manufacturing industry is Önder et al. (2003) in which the efficiency structure of the Turkish manufacturing firms are analyzed at a regional level. However, Önder et al. (2003) does not relate technical efficiency to any market structure factors, but give a detailed picture of the relationship between efficiency and regional factors as well as ownership structure. Çakmak and Zaim (1992) and Saygılı and Taymaz (2001) measure the change in efficiency of Turkish cement firms under the privatization practices. The former uses a non-parametric method, while the latter follows a parametric method to estimate the efficiency. However, both methods exclude market structure from the analysis.

All the studies on the efficiency of Turkish manufacturing industry are based on either small and medium firms, or few industries of manufacturing. This notwithstanding, 60% of the manufacturing output of Turkey is produced by the 500 largest manufacturing firms. This paper, therefore, aims at investigating the relationship between concentration, profitability and efficiency in large scale enterprises in the manufacturing industry of Turkey. In this paper, Stochastic Frontier Analysis (SFA) is used to estimate the firm level efficiencies and its relationship with market structure and some other firm specific variables by making use of a panel data on the 500 largest industrialist firms of Turkey from 1993 to 2003.

The paper is organized as follows: The next section gives a brief survey of Stochastic Frontier Analysis and presents the specification of the Stochastic Frontier Analysis used as the method of estimation in the paper. The data and variables used in the econometric analysis are introduced in the Section 2.3. Section 2.4 presents the estimation results and discusses their interpretations. Section 2.5 of the paper summarizes the conclusion of the study.

2.2 Theoretical Background and the Model

Attempts to define the sources of efficiency in economic activities are dated back to Smith (1776) who tried to explain the relationship between land tenure and efficiency of crop production. Although a detailed analysis of the efficiency structure of firms has been ignored by mainstream economists, activity analysis developed by Koopmans (1951) and Debreu (1951) has prepared the scene for efficiency measurement analysis. Farrell (1957) is assumed to be the first systematic contribution in the literature which has developed a systematic approach to measure the firm level efficiency. Analytical tools supplied by Koopmans (1951) and Debreu (1951) were in the core of the analysis of Farrell (1957), although he did not refer to any of these leading authors.

Farrell's (1957) approach was calculating an efficient frontier that envelopes all observations by using linear programming methods. Once an efficient frontier is calculated, the efficiencies of individual firms are measured by their distance to this frontier. Although the idea is simple, the contribution broke down a new ground for deployment of quantitative methods to elaborate the efficiency of individual firms. Farrell's (1957) contribution has been extended by many authors, since late in the 1970s. These include, Førsund and Hjalmarson (1974), Fare (1975), Fare and Grosskopf (1983a, b), Fare, et al. (1983). to mention a few. Kumbhakar and Lovell (2000) and Murillo-Zamorano (2004) give a detailed survey of the literature about theoretical contributions.

Applied work based on these theoretical contributions has followed two different paths. Data Envelopment Analysis (DEA) which is based on Charnes et al. (1978), has deployed linear programming models while Stochastic Frontier Analysis (SFA) which is based on Afriat (1972), has deployed econometric methods. Both approaches used the deterministic model developed in Aigner and Chu (1968). A recent survey and detailed description of DEA is given in Cooper et al. (2004), while a comprehensive review of SFA is given in Kumbhakar and Lovell (2000).

The stochastic frontier approach defines efficiency as deviation from an efficient frontier which is estimated by various econometric methods. The deviation is modeled by a compound error term. The compound error term is the sum of a normally distributed noise term, and an asymmetrically distributed "inefficiency" component, which is always negative. The most general form of the model can be written as

$$Y = F(X;\beta)\exp(v-u) \tag{2.1}$$

where,

$$v \sim N\left(0,\sigma_v^2\right)$$

$$u \sim \left|N\left(0,\sigma_u^2\right)\right|$$

The random component of composite error term v, and the inefficiency component of the error term u, are distributed identically and independently from each other and regressors. Y is a one by $i \times t$ vector consisting of output level. $F(.)$ is the imposed functional form of the frontier and it takes X which is a $k + 1$ by $i \times t$ matrix consisting of a column of ones and k input variables. β is a one by $k + 1$ vector of parameters. u and v are one by $i \times t$ vectors of inefficiency and random components respectively.

This model can be estimated under both time invariant and time-varying inefficiency by using maximum likelihood estimation methods. Details of the former can be found in Kumbhakar and Lovell (2000) while Batesse and Coelli (1992) describe the latter.

The model in (2.1) is non-linear in this form. Hence, logarithms of output and input variables are used to make a log–log transformation and a functional form appropriate for this transformation is selected. Generally, the Cobb–Douglas or transcendental logarithmic (translog) production functions are assumed in applied work.

Batesse and Coelli (1995) further modify the model in (2.1) to incorporate the firm specific effect variables that explain the inefficiency of firms.[1] They specify the efficiency component of compound error term as a linear function of the factors that affect production process but are not arguments of production frontier. Accordingly, the following model is estimated in one-step by maximum likelihood methods

$$Y = F(X;\beta)\exp(\nu - \mathrm{u}) \tag{2.2}$$

where

$$v \sim N\left(0, \sigma_v^2\right)$$

$$u \sim \left|N\left(G\left(Z;\delta\right), \sigma_u^2\right)\right|$$

and Z is a $l + 1$ by $i \times t$ matrix which consists of a column of ones and l exogenous variables, while δ is a one by $l + 1$ vector of parameters. Here, distributional assumption about w guarantees that $u_{it} \geq 0$ since it assigns a truncated normal distribution to u by truncating w at the point $Z\delta$. Equation (2.2) is also non-linear in this form. Same transformations are also applied to (2.2). G (.) is assumed to be a linear function of Z with coefficients δ in applied work.

In this paper we use a common specification of (2.2) by assuming a translog production and efficiency effects functions.[2] Our model can be written as

$$\begin{aligned} \ln Y_{it} &= \beta_0 + \sum_{k=1}^{K} \beta_k \ln x_{kit} + \sum_{k=1}^{K} \eta_k \left(\ln x_{kit}\right)^2 \\ &\quad + \frac{1}{2} \sum_{r \neq s} \sum_{r=1}^{K} \theta_r \ln x_{rit} \ln x_{sit} - u_{it} + w_{it} \end{aligned} \tag{2.3}$$

Where

$$u_{it} = \left(\delta_0 + \sum_{l=1}^{L} \delta_l z_{lit} + \sum_{s=1}^{K} \sum_{p=1}^{L} \alpha_l z_{pit} x_{sit} \right)$$

[1]This approach is also known as technical efficiency effects model.

[2]This model is introduced by Batesse and Broca (1997).

The frontier part of the model in (2.3) consists of inputs, their squares and cross multiplications. This specification allows interaction between inputs and thus it models production in a quite elastic way. The inefficiency effects part consists of inefficiency effect variables and their multiplications with inputs allowing for interaction between these two. This model is quite useful in investigating the reasons of inefficiency and in explaining the relationship between firm efficiency and exogenous factors. Besides, it allows one to see the relationship between input utilization and efficiency effects. Thus, it is used very frequently in the literature. Among others, Fitzpatrick and McQuinn (2005), Kern and Süssmuth (2005), Berg (2005) and Lin (2005) can be given as recent examples.

2.3 Data

The data used in this analysis is obtained from the 500 largest industrial enterprises of Turkey prepared by Istanbul Chamber of Industry (ICI). The ICI announces the top 500 manufacturing firms of Turkey every year, since 1993. The data set consists of output, revenue, profits, employment, export figures, ownership structure, and the location of the 500 largest firms. The ranking is done according to sales from production of the firms. This criterion is related to both efficiency of production and market power of the individual firms.

All variables in the ICI-500 data set are reported in nominal values. The nominal values are converted into real values by using industry-specific deflators separately for public and private firms. The export figures are not transformed into real values, since they have been reported in US Dollars.

The dependent variable used in the analysis is the real gross value-added. The variables that are incorporated in the production function are labour, capital, their square and cross multiplications as well as time trend, its square and its multiplication with input levels. Labour is measured by the number of employees for each firm. However, no economically sound capital data is reported in the ICI database. “Net assets” which is obtained by discounting accumulated depreciation from total assets of the firm is used as a proxy for capital. The time-trend is incorporated to catch the effect of technical change on production over time.

A well-known trick to obtain the elasticities of labour and capital directly from the translog production function is using mean deviation form of input variables in estimations. Thus, the estimated coefficients of labour and capital are corresponding elasticities of output. The coefficients of their cross terms shows the marginal effect of inputs over each other. A positive coefficient implies that employing an additional unit of one of the inputs increases the effect of the other input on output level. On the other hand, the coefficients of the squared terms show the marginal effect of a change in the level of relevant input on the output. A positive coefficient for the squared terms will however show that the effect of a change in the level of input on the output increases as the level of output increases. The coefficients of time trend and its square show the direction of technical change and its “acceleration” in the sense that the latter captures the marginal effect of technical change on production level. A positive time trend coefficient shows a technical change that increases the level of output, ceteris paribus. A positive coefficient for the square of the time trend depicts an increasing positive (or negative if the coefficient of time trend is negative) effect of the relevant input on the output.

The efficiency effect variables used in the analysis are size, export share, profitability, ownership, and market share of a firm together with sectoral concentration and time dummies. The size of each firm is measured by the logarithm of number of employees. Export share is the ratio of exports in domestic currency to the output. Exports, which are reported in US Dollars in the original data set, are converted into domestic currency by using a weighted average of effective exchange rates of Central Bank of Turkey. Profitability is the ratio of accounting profits (or losses if negative) to the output. There are two dummy variables for ownership structure of the firms, one for public firms and the other for foreign firms. These dummies take the value one if the firm is in the appropriate ownership group. Sectoral concentration is measured by the Herfindahl–Hirschman Index.[3] This index is not calculated from ICI-500 database but is taken directly from State Institute of Statistics (2002). The market share is used as a proxy for market power. It is calculated as the ratio of output of each firm to the total output of corresponding ISIC-4 level industries. Industry level output is obtained from State Institute of Statistics.[4] We also incorporate the multiplication of sectoral concentration and market share to account for the effect of interaction of these two factors on efficiency of firms. Time dummies take the value of one if the observation is on the relevant year. A positive coefficient of the efficiency effect variables means that the relevant factor decreases the efficiency.

We have also incorporated cross multiplication of inputs and efficiency effect variables. A positive coefficient for these cross terms will imply a positive relationship between the relevant input and efficiency effect variable. That is, an increase in the input increases the effect of efficiency effect variable on efficiency. Since data for 2001–2003 period is not available from SIS (2002), we have used linearly interpolated series of industry level outputs from the data for 1993–2000 period.

Table 2.1 shows the mean values of the variables used in the estimation. The firms in labour-intensive industries are characterized by lower output and capital as well as lower concentration, larger size and exports and lower average market share. Firms in resource-intensive industries, on the other hand, have a higher output, smaller size, very low exports, higher number of firms, more public and private firms and a significantly less competitive market structure. Firms in resource-intensive industries employ a higher number of employees than the average. The most important properties of the firms in scale-intensive industries are lower average employment, high profitability, and high number of private and foreign firms. The firms in

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[3] Herfindahl–Hirschman Index is calculated by squaring the market share of each firm competing in the ISIC-4 sector and then summing the resulting numbers.

[4] Since data for 2001–2003 period is not available from SIS (2002), we have used linearly interpolated series of industry level outputs from the data for 1993–2000 period.

Table 2.1 Mean values of variables used in estimation

Period	Variable	Unit	RI	LI	SI	SB&SS	ALL
1993–1996	Output	TRY[a]	702,975	1,425,399	1,332,137	1,248,893	1,197,656
	Capital	TRY	685,162	1,241,866	1,240,494	1,083,526	1,080,891
	Labour	Person	1015	1159	924	928	1,033
	Size		6.6	6.15	6.25	6.46	6.33
	Export share	Percent	34.66	16.16	21	20.72	22.61
	Profitability	Percent	6.6	6.78	8.96	1.23	6.52
	Public firms	#	23	70	67	13	173
	Private firms	#	415	516	326	162	1,419
	Foreign firms	#	15	72	63	77	227
	Concentration		0.06	0.07	0.14	0.12	0.09
	Market share	Percent	10.45	42.11	28.36	24.47	28.33
1997–2000	Output	TRY	890,015	1,395,782	1,543,871	1,967,224	1,388,115
	Capital	TRY	1,031,794	1,429,031	1,496,808	1,795,323	1,399,629
	Labour	Person	1,189	1,127	909	1,014	1,069
	Size		6.8	6.19	6.35	6.56	6.43
	Export share	Percent	42.18	18.18	26.73	24.51	27
	Profitability	Percent	1.69	4.76	6.22	6.25	4.61
	Public firms	#	10	52	47	8	117
	Private firms	#	417	553	371	146	1,487
	Foreign firms	#	16	76	84	83	259
	Concentration		0.03	0.07	0.11	0.12	0.08
	Market share	Percent	10.34	44.36	30.58	27.19	30.37
2001–2003	Output	TRY	880,566	1,216,047	1,647,751	2,286,385	1,385,400
	Capital	TRY	960,381	1,221,009	1,497,505	2,377,839	1,377,900
	Labour	Person	1,127	1,010	875	1,038	1,005
	Size		6.75	6.12	6.21	6.52	6.35
	Export share	Percent	51.65	22.03	35.05	35.76	34.66
	Profitability	Percent	1.6	4.39	3.53	6.32	3.7
	Public firms	Number	4	37	24	5	70
	Private firms	Number	316	370	287	99	1,072
	Foreign firms	Number	21	78	69	68	236
	Concentration		0.04	0.06	0.1	0.12	0.08
	Market share	Percent	15.37	60.52	39.77	34.76	40.43

Source: Authors' calculations from ICI (2002, 2003 and 2004). *RI* resource-intensive industry; *LI* labour-intensive industry; *SI* scale-intensive industry; *SS* specialized-supplier industries; *SB* science-based industries

[a]TRY is the New Turkish Liras

scale-intensive firms are similar to firms in the resource-intensive industries, but the latter operate in a more competitive market environment. Firms in science-based and specialised-supplier industries are significantly distinguished by a higher number of foreign firms and quite impressive development: doubling output, 11% increase in employment, and 10% increase in export share. However, the market structure for these industries has become significantly less competitive since 1993. Table 2.1

show that the worst performing group has been the firms operating in resource-intensive industries. There is a significant 15% and 13% decline in output and employment, respectively. Besides, the profit rates have also fallen. However, the share of exports in output has increased by 5%. Number of scale-intensive firms in the top 500 has declined nearly by 30%. These figures suggest that firms in the resource-intensive industries have significantly been affected by the 2001 economic crisis. Although there has been a slight decline in the aforementioned figures between 1993 and 1998, the decline after the 2001 economic crisis is drastic.

In spite of the fact that the firms in labour-intensive industries do not seem to be affected from the crisis as seriously as the firms in the resource-intensive industries, they have experienced a significant decline in their output, employment, capital along with an increase in exports. The most likely reason for the labour-intensive firms not to be affected by the crisis is the fact that they could take the advantage of undervalued local currency better than the firms in the resource-intensive industries.

The firms in the scale-intensive industries have gone through a transformation during the era under investigation. They increased their output and capital along a decline in employment, and became less profitable but more export-oriented. Although the sectoral concentration has fallen, average market share of the firms has increased.

The main conclusion of the descriptive analysis can be summarized in two main points: Firstly, it is possible to see the tremendous effects of the 2001 crisis from the descriptive statistics. The firms in resource-intensive industry, which employ more people on the average, are the ones that are most seriously affected by the crisis. Secondly the market structure for the sectors in which there has been a noteworthy privatization effort, became more monopolistic, rather than being more competitive.

2.4 Estimation

The model is estimated for four different groups of industries. The ISIC-4 level industries are classified according to their orientation based on OECD (1992). This classification, in fact, is based on the factor use in product ion. Therefore, they may as well reflect the differences in production technologies. The classification of the manufacturing industries into five categories is as follows: resource-intensive, labour-intensive, scale-intensive, specialised-supplier and science-based industries. The list of industries in each group is given in Appendix Table 2.7. The production of resource-intensive industries crucially depends on natural resources such as food, paper or cement industries. The labour-intensive industries use labour more intensively compared to the other industries such as textile, furniture and musical instruments. The scale-intensive industries depend on the returns to scale in production such as ship building, chemical industry and iron production. Lastly, the science-based and specialised-supplier industries are those whose production activity is closely related to scientific (or technological) knowledge, or which supplies special products to specific consumers such as agricultural machinery, aircrafts and medicine.

The estimations are held separately for each group. Making separate estimations for each group makes it impossible to compare the efficiencies across different groups, but it is likely to yield more precise estimations of efficiencies. All estimations are made by FRONTIER 4.1® software. The details about FRONTIER 4.1® can be found in Coelli (1996).

Table 2.2 gives the results of some statistical tests run on the estimation results. All the tests are likelihood ratio tests except the constant returns to scale test. To test CRS we use a t-test. The first null hypothesis is tested for the validity of Cobb–Douglas production function specification by imposing the restriction $\eta_k = \theta_k = 0$. The null hypothesis is rejected for all orientation groups except the labor intensive

Table 2.2 Test results

Whole sample	RI	LI	SI	SS&SB	Critical value	Degrees of freedom
Cobb–Douglas production function: $\eta_k = \theta_k = 0$						
211.57	185.49	0.51	48.29	39.21	7.81	3
(Reject)	(Reject)	(Accept)	(Reject)	(Reject)		
Constant returns to scale: $\beta_L + \beta_K = 1$						
1.98	0.35	−0.32	−0.06	−0.11	1.96	1
(Reject)	(Fail)	(Fail)	(Fail)	(Fail)		
Returns to scale: $\beta_L + \beta_K$						
1.04	1.02	0.98	0.99	0.99		
(IRS)	(CRS)	(CRS)	(CRS)	(CRS)		
No inefficiency: $\gamma = \delta_i = \alpha_i = 0$ [a]						
2087.72	1125.27	560.15	910.35	356.91	55.19	56
(Reject)	(Reject)	(Reject)	(Reject)	(Reject)		
No stochastic inefficiency: $\gamma = 0$ [a]						
75.84	43.46	97.29	114.61	80.53	8.76	4
(Reject)	(Reject)	(Reject)	(Reject)	(Reject)		
No efficiency effects: $\delta_i = \alpha_i = 0$ [b]						
527.07	580.12	237.11	588.14	200.03	73.31	54
(Reject)	(Reject)	(Reject)	(Reject)	(Reject)		
Neutral model: $\alpha_i = 0$						
716.51	422.03	108.99	142.17	93.30	51.00	36
(Reject)	(Reject)	(Reject)	(Reject)	(Reject)		
Time invariant inefficiency: $\beta_t = 0$ [c]						
105.36	194.55	10.25	51.12	17.45	43.77	30
(Reject)	(Reject)	(Fail)	(Reject)	(Fail)		

RI resource-intensive industry; *LI* labour-intensive industry; *SI* scale-intensive industry; *SS* specialized-supplier industries; *SB* science-based industries

[a]Test statistic has a mixed chi-square distribution

[b]For $i > 0$

[c]Coefficients of time variables and their cross products are equal to zero

industries. We continue to use translog production function assumption for labor intensive sectors, to be able to make comparisons among sectors. The second row of Table 2.2 shows the results of the tests for constant returns to scale (CRS). The null hypothesis is that the sum of coefficients of labor and capital equals to one. The test fails to reject CRS for all the groups of sectors. The fourth row of Table 2.2 reports the test statistics for the null hypothesis of "no inefficiency". This test statistic has a mixed chi-square distribution as noted in Coelli (1996), and the critical values are taken from Kodde and Palm (1986). The test fails to reject the hypothesis of "no inefficiency" in all orientation groups. On the other hand, the fifth row of Table 2.2 reports the test statistics for null hypothesis of "no stochastic inefficiency". This test statistic also has a mixed chi-square distribution and hypothesis of "no stochastic inefficiency" is also rejected for all the groups.

A test for the significance of inefficiency effects is run by imposing the restriction of $\delta_i = \alpha_i = 0$ for $i > 0$. Also, a separate test is run by imposing only $\alpha_i = 0$ for $i > 0$ to test the neutrality of efficiency effects. Both tests rejected the null hypothesis of "no inefficiency effects" and "neutral model" for all the groups.

Lastly time invariant inefficiency is tested by restricting the coefficients of time variables and their cross products to zero. The test failed to reject time invariant efficiency for the labor-intensive and the science and specialized-supplier-intensive groups. The test statistic rejects the time invariant inefficiency for the resource and the scale-intensive industries.

Table 2.3 gives the coefficients of estimated frontier for different orientation groups. The coefficients of labor and capital show that marginal productivity of capital is higher in all sectors. The output elasticity of capital is higher in the specialized supplier and science based sectors.

Trend and interaction of inputs with trend are incorporated into the analysis to account for the technical change. Coefficients of time and time square variables are insignificant for the labor intensive sectors indicating the fact that there is no

Table 2.3 Coefficients of estimated frontier

Variable	ALL	RI	LI	SI	SS&SB
Constant	13.05***	13.04***	12.86***	13.19***	13.27***
Labour	0.27***	0.23***	0.24***	0.23***	0.07
Capital	0.77***	0.79***	0.74***	0.76***	0.92***
Labour square	−0.01	−0.03	−0.01	0.08**	0.07**
Capital square	0.04***	0.08***	0.01	−0.02	0.03
Labour X capital	0.07***	−0.02	−0.02	0.02	0.02
Time	−0.02	−0.09***	−0.03	−0.04*	−0.01
Time square	0.00	0.01***	0.00	0.00	0.00
Time X labour	−0.01*	−0.05***	−0.01	0.00	0.02*
Time X capital	0.03***	0.07***	0.00	0.00	−0.02

Source: Authors' calculations from ICI (2002, 2003 and 2004). *RI* resource-intensive industry; *LI* labour-intensive industry; *SI* scale-intensive industry; *SS* specialized-supplier industries; *SB* science-based industries.
*Significant at 10%, **Significant at 5%, ***Significant at 1%

technical change in these sectors. The results also show an evidence of decreasing technical change in the scale-intensive and the resource-intensive industries. For the characteristics of technical change, the findings suggest significant labor saving technical change only in resource-intensive industries.

Table 2.4 presents the estimated coefficients of the efficiency effect variables. The results may be summarized as follows: Larger firms turn out to be more efficient in all groups of industries except the resource intensive sectors. The resource intensive sectors turn out to be less concentrated as the Herfindahl–Hirschman index for this sector is the lowest among the sector groups. Hence, it can be concluded that size loses its effect on efficiency as the market become more competitive. In Turkey, there is a prevailing conviction about the fact that exporting firms are more efficient. However, our finding on the relationship between exporting and efficiency

Table 2.4 Effects of efficiency effect variables

Variable	All	RI	LI	SI	SS&SB
Constant	6.44***	2.16**	6.66*	8.46***	10.68***
Size	–0.95***	–0.22	–1.16**	–1.24***	–2.01***
Export	0.77***	0.82***	0.63***	0.64***	1.36***
Profit.	–0.03***	–0.03***	–0.05***	–0.04***	–0.05***
Public	–0.14	0.23	–3.11***	–0.19	
Foreign	–0.56***	–0.40***	–1.94***	–0.24*	0.17
Herf.	–0.95***	–0.92*	1.63	–1.65***	1.98**
Mrk Shr.[a]	–3.82***	–5.90***	0.00	–11.41***	–0.00
Herf. X Mrk.[a]	–0.57***	–1.01***	0.00	–2.29***	0.00
D 1994	0.29**	0.05	0.82**	0.41**	1.38***
D 1995	0.14	–0.06	0.43	0.28	0.91*
D 1996	0.17	–0.06	0.34	0.22	0.58
D 1997	0.01	–0.06	–0.19	–0.15	0.02
D 1998	0.14	–0.04	0.21	0.13	0.31
D 1999	0.39***	0.32**	0.07	0.41*	0.46
D 2000	0.46***	0.65***	0.51	0.15	0.12
D 2001	0.48***	0.71***	0.15	0.21	1.56***
D 2002	0.62***	0.88***	0.83**	0.58***	–0.23
D 2003	0.71***	1.04***	1.09***	0.54**	0.29
Sigma Squared	0.66***	0.44***	1.00***	0.70***	1.19***
Gamma	0.85***	0.86***	0.93***	0.95***	0.91***
Log-like.	–4,358.84	–1,302.49	–877.34	–1,003.80	–480.66
LR 2,087.72	1,125.27	560.15	910.35	356.91	
Iterations	181	240	121	249	66
Firms	926	332	233	238	123
Years	11	11	11	11	11
Total Obs.	4,794	1,720	1,193	1,268	613

Note: $\sigma^2 = \sigma^2_v + \sigma^2_u$ and $\gamma = \sigma^2_u / \sigma^2$. Source: Authors' calculations from ICI (2002, 2003 and 2004). RI resource-intensive industry; *LI* labour-intensive industry; *SI* scale-intensive industry; *SS* specialized-supplier industries; *SB* science-based industries.

[a]Both variables are multiplied by 1,000 for normalization

*Significant at 10%, **Significant at 5%, ***Significant at 1%

suggest the reverse: higher volume of exports is associated with lower firm efficiency in all industries. This result may be explained by the fact that exporting is not necessarily related with higher firm efficiency in Turkish manufacturing, but related with export promotion policy of Turkey which is based upon persistently devaluated national currency during the last decade.

The estimation results indicate a very strong and significant relationship between profitability of a firm and its efficiency. In fact, the causality between these two variables may run from efficiency to profitability.

When the ownership structure of firms is considered, public firms are found to be more efficient in labor intensive industries. On the other hand, there is no statistically significant difference between public and private firms with respect to efficiency operating in the resource-intensive, science-based and specialized-supplier industries. We also found that foreign firms are more efficient in all the groups with an exception of the science-based and the specialized-supplier industries.

The estimation results suggest a positive relationship between the degree of competition measured by the Herfindahl & Hirschman Index and the efficiency of the firms operating in the resource and the scale intensive industries. However, in the science-based and the specialized-supplier industries, we found a significant association between concentration and lower efficiency. Finally, no significant relation is found between concentration and firm efficiency in the labor intensive industries. Similar results were obtained for the market share-efficiency nexus: Firms having relatively higher shares in the market are more efficient in the resource and scale intensive industries. No significant relationship between market share and efficiency is found in the other two industries.

A negative or insignificant relationship between sectoral concentration and efficiency is postulated by the market share hypothesis, while efficient market structure hypothesis anticipates the inverse. Thus, our findings support the latter for all the industries with an exception of the specialized-supplier and science-based industries. The positive coefficient of Herfindahl–Hirschman index for the specialized-supplier and science-based industries, which are characterized by less competitive market structures supports the market share hypothesis. The scale incentives industries also have high concentration and but are significantly different from the specialized-supplier and science-based industries with respect to firm size and profitability. This difference implies that the market dynamics are as important as the market structure. If larger firms dominate the market, then concentration hampers the efficiency while in a market that is dominated by smaller firms, efficiency and concentration is positive.

The coefficient of the product of market share and the sectoral concentration is negative in all the industry groups, but is significant only in the labor-intensive industries. This implies that the second derivative of efficiency with respect to market share and concentration is negative. That is to say that, the effect of the market share, which was found to be positive, decreases as the concentration in the sector increases. This shows that concentrated market structure hampers efficiency not only by itself but also by impeding the positive effect of market share on efficiency.

This finding also explains the relationship between market share and concentration. However, for relatively more competitive sectors, sectoral concentration decreases the negative effect of market share.

The coefficients of the cross terms of inputs and efficiency effect variables, which are given in Appendix Table 2.6, reveal that input composition of the firms are effective in determining the relationship between monopoly power, market structure and efficiency. The cross terms are more effective in the resource and labor intensive industries.

The positive effect of concentration on efficiency in the resource intensive sectors increases as capital employment increases, while employing more capital decreases the positive effect in the scale-intensive industries. This shows the importance of strong capital structure of firms in more competitive markets, while the scale intensive industries that are characterized by a more monopolistic structure employ excess capital.

Capital decreases the positive effect of the market share in resource intensive markets and increases it in the scale-intensive industries. That is to say that firms employing more capital in more competitive industries are less likely to benefit from the positive relationship between market share and efficiency, while the inverse is true in less competitive industries.

The most significant conclusion that can be derived from the interaction of capital with efficiency effect variables is that capital increases the effect of size regardless of the market structure. Note that size is measured by labor employment. Hence this implies that labor becomes more productive as the capital employment increase.

The significant interactions of labor with efficiency effect variables is mostly negative implying that labor employment decreases the effect of all factors on efficiency in the resource-intensive sectors. The interactions of labor in the other industries are mostly insignificant. The most notable exceptions are the interaction of labor with the market share in the scale intensive sectors and public ownership in the labor intensive sectors. Labor increases the positive effect of the market share on efficiency in the scale intensive sectors and the effect of being a public firm on efficiency in the labor intensive sectors. The latter is an interesting finding in the sense that public firms are criticized for over-employment.

The mean efficiencies are given in Table 2.5. The mean efficiencies of all the industry groups decline overtime. The most significant decline is in the resource intensive sectors with 25%. The scale intensive industries follow with 12%. The decline in the labor and specialized supplier and science based sectors is rather moderate. The effects of the economic crisis of 1994 and 2001 can be observed in the mean efficiencies. The mean efficiency increases in the resource intensive sectors during the crisis. The scale intensive sectors are characterized by a high share of exports in firm revenue. There have been considerable devaluations after the 1994 and 2001 crisis, which turned out to be an advantage for exporting firms. In fact, the most significant decline in the mean efficiency of the scale intensive industries has occurred under the fixed exchange rate regime in 1998 and 2000.

Table 2.5 Mean Efficiencies according to estimations for each group

Year	RI	LI	SI	SS&SB	All
1993	0.56	0.65	0.57	0.71	0.61
	(0.23)	(0.21)	(0.28)	(0.19)	(0.24)
1994	0.58	0.61	0.52	0.56	0.57
	(0.23)	(0.24)	(0.24)	(0.24)	(0.24)
1995	0.60	0.65	0.56	0.66	0.61
	(0.23)	(0.2)	(0.25)	(0.21)	(0.23)
1996	0.56	0.65	0.55	0.66	0.59
	(0.22)	(0.22)	(0.25)	(0.24)	(0.24)
1997	0.54	0.68	0.57	0.68	0.60
	(0.22)	(0.19)	(0.24)	(0.22)	(0.23)
1998	0.52	0.60	0.54	0.66	0.56
	(0.24)	(0.22)	(0.27)	(0.22)	(0.25)
1999	0.42	0.59	0.45	0.57	0.49
	(0.24)	(0.23)	(0.25)	(0.26)	(0.25)
2000	0.35	0.57	0.48	0.65	0.48
	(0.24)	(0.2)	(0.25)	(0.19)	(0.25)
2001	0.36	0.59	0.45	0.53	0.47
	(0.26)	(0.25)	(0.27)	(0.25)	(0.27)
2002	0.35	0.57	0.43	0.66	0.47
	(0.25)	(0.23)	(0.25)	(0.19)	(0.26)
2003	0.31	0.52	0.45	0.64	0.44
	(0.25)	(0.22)	(0.24)	(0.22)	(0.26)

Standard deviations in parenthesis. Source: Authors' calculations from ICI (2002, 2003 and 2004). *RI* resource-intensive industry; *LI* labour-intensive industry; *SI* scale-intensive industry; *SS* specialized-supplier industries; *SB* science-based industries

The mean efficiencies of the other sectors has severely declined during the crisis years, as expected.

Figure 2.1shows the average mean efficiencies according to the orientation group over time, when the whole sample is used to estimate the efficient frontier. The efficiency orderings of the groups became more apparent and systematic in this case. The resource-intensive firms are at the bottom while the specialized-supplier and science-based firms are at the top. The movement of the mean efficiencies of the scale and labor-intensive firms are similar.

2.5 Conclusion

The results based on the Stochastic Frontier Analysis may be summarized as follows: (1) Our findings support the efficient market structure hypothesis for all industries except the sectors in the specialized-supplier and the science-based industries, which are characterized by less competitive market structures. (2) Private and foreign firms

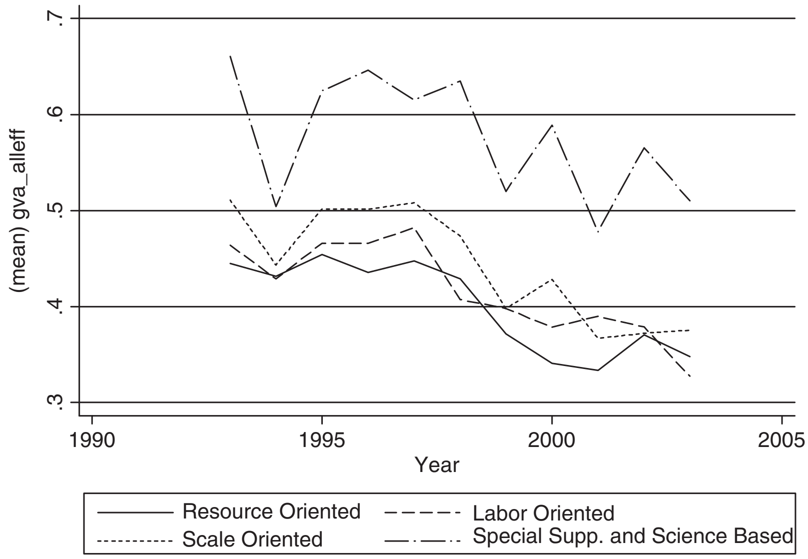

Fig. 2.1 Mean efficiencies for the whole sample over time, Source: Authors' calculations from ICI (2002, 2003 and 2004)

are less efficient in all cases. (3) Profitability of firms is associated with lower inefficiency in Turkish manufacturing industry. (4) Export-oriented firms are less efficient. (5) Higher market share consolidates efficiency in all industries.

Combining all these findings shows the importance of the level of competition in explaining the relationship between market structure, efficiency and profitability. Firm's own monopoly power, which increases the profits, helps to increase the efficiency in relatively competitive sectors. The sectoral concentration reinforces this effect. This suggests that the negative relationship between monopoly power and efficiency is not due to the firm's profits which are thought to hamper firms' incentive in the sectors that are open to more competition. Consequently, for highly competitive firms, the efficient market hypothesis works. On the other hand, market concentration hampers efficiencies for the industries which are less open to competition such as the specialized supplier and science based industries. In those sectors, the market share hypothesis holds.

As a result, it seems that the market share and the efficient market hypotheses explain different dynamics of markets. The former explains the implications of increasing market share and monopoly power of a firm on the efficiency, while latter focuses on the efficiency of monopolist firms. Thus, the firms that increased their monopoly power in a competitive market can be more efficient, but that can not be generalized to all the sectors under all circumstances. The firms that are in the sectors which were initially monopolistic are likely to be less efficient.

Appendix

Table 2.6 Coefficients of cross terms of efficiency effects and inputs

Variable	All	RI	LI	SI	SS&SB
Capital times					
Size	0.14***	0.09***	0.16***	0.13***	0.43***
Export	−0.11	−0.14*	−0.29	−0.40**	−0.10
Profit.	0.00	0.01***	0.01	0.01***	0.00
Public	0.99***	−1.60***	−1.08	1.57***	−0.10
Foreign	−1.30***	1.32**	0.00	−0.80**	0.00
Herf.	−1.21***	−1.74***	0.00	−0.77***	0.00
Mrk Shr[a]	0.03	−0.02	−0.05	0.02	
Herf. X Mrk[a]	0.15*	0.13	0.04	0.44**	−0.30***
D 1994	0.01***	0.00**	0.01**	−0.01**	1.10*
D1995	−1.06***	1.41**	0.62	0.07	0.04***
D 1996	1.79***	0.00	−0.13	3.78***	−2.34**
D 1997	−0.37***	−0.92***	−0.01	0.28***	0.00
D 1998	0.04	0.15	1.48*	0.43*	0.00
D 1999	0.01	−0.22**	0.29	−0.15	−0.29
D 2000	−0.22	0.29**	−0.22	−0.44	−1.82*
D 2001	−0.44***	0.06	0.17	−0.55*	−0.39
D 2002	−0.16	0.36**	0.11	−0.21	−0.81
D 2003	−0.24	0.29*	−0.21	−0.18	0.45
Labor times					
Size	−0.11	0.44***	−0.04	−0.27	−0.90
Export	−0.01	0.54***	0.17	−0.24	0.36
Profit.	−0.25*	0.35**	−0.50	−0.25	−1.09
Public	−0.04	0.54***	0.06	0.08	−1.47*
Foreign	−0.23	0.56***	−0.71	−0.52*	−1.50
Herf.	−0.19	0.58***	−0.54	−0.53*	−1.75*
Mrk Shr[a]	−0.05	−0.30*	−1.09**	−0.41	
Herf. X Mrk[a]	0.00	0.31***	−0.89	0.15	0.05
D 1994	0.25*	−0.24*	0.65	0.58*	2.32**
D1995	0.59***	−0.06	0.58	0.87***	1.11
D 1996	0.26*	−0.29*	−0.06	0.42	0.42
D 1997	0.51***	−0.13	1.08*	0.51*	−0.27
D 1998	0.35***	−0.26	0.53	0.52*	1.17
D 1999	0.20	−0.55***	0.77	0.47*	0.01
D 2000	0.41***	−0.25	0.73	0.34	1.84**
D 2001	0.35**	−0.42**	0.60	0.26	2.43***
D 2002	0.47***	−0.37**	1.02**	0.74***	2.22**
D 2003	0.27*	−0.50***	0.80	0.55*	2.18**

Source: Authors' calculations from ICI (2002, 2003 and 2004)
[a]Both variables are multiplied by 1,000 for normalization
*Significant at 10%, **Significant at 5%, ***Significant at 1%

Table 2.7 Classification of industries according to orientation

	Resource intensive industries
3111	Slaughtering, preparing and preserving meat
3112	Manufacture of dairy products
3113	Canning and preserving of fruits and vegetables
3114	Canning, preserving and processing of fish, crustaceans and similar foods
3115	Manufacture of vegetable and animal oils and fats
3116	Grain mill products
3117	Manufacture of bakery products
3118	Sugar factories and refineries
3119	Manufacture of cocoa, chocolate and sugar confectionery
3121	Manufacture of food products not classified elsewhere
3122	Manufacture of prepared animal feeds
3131	Distilling, rectifying and blending spirits
3132	Wine industries
3133	Malt liquors and malt
3134	Soft drinks and carbonated waters industries
3140	Tobacco manufactures
3411	Manufacture of pulp, paper and paperboard
3412	Manufacture of containers and boxes of paper and paperboard
3419	Manufacture of pulp, paper and paperboard articles not classified elsewhere
3420	Printing, publishing and allied industries
3530	Petroleum refineries
3540	Manufacture of miscellaneous products of petroleum and coal
3610	Manufacture of pottery, china, and earthenware
3620	Manufacture of glass and glass products
3691	Manufacture of structural clay products
3692	Manufacture of cement, lime and plaster
3699	Manufacture of non-metallic mineral products not classified elsewhere
3720	Non-ferrous metal basic industries
	Labour Intensive Industries
3211	Spinning, weaving and finishing textiles
3212	Manufacture of made-up textile goods except wearing apparel
3213	Knitting mills
3214	Manufacture of carpets and rugs
3215	Cordage, rope and twine industries
3219	Manufacture of textiles not classified elsewhere
3220	Manufacture of wearing apparel, except footwear
3231	Tanneries and leather finishing
	Labour Intensive Industries (cont.)
3232	Fur dressing and dyeing industries
3233	Manufacture of products of leather and leather substitutes, except footwear and wearing apparel
3240	Manufacture of footwear, except vulcanized or moulded rubber or plastic footwear
3811	Manufacture of cutlery, hand tools and general hardware
3812	Manufacture of furniture and fixtures primarily of metal
3813	Manufacture of structural metal products
3819	Manufacture of fabricated metal products except machinery and equipment not classified elsewhere
3901	Manufacture of jewellery and related articles
3902	Manufacture of musical instruments
3903	Manufacture of sporting and athletic goods

(continued)

Table 2.7 (continued)

	Resource intensive industries
3909	Manufacturing industries not classified elsewhere
	Scale Intensive Industries
3311	Sawmills, planing and other wood mills
3312	Manufacture of wooden and cane containers and small cane ware
3319	Manufacture of wood and cork products not classified elsewhere
3320	Manufacture of furniture and fixtures, except primarily of metal
3511	Manufacture of basic industrial chemicals except fertilizers
3512	Manufacture of fertilizers and pesticides
3513	Manufacture of synthetic resins, plastic materials and man-made fibres except glass
3521	Manufacture of paints, varnishes and lacquers
3523	Manufacture of soap and cleaning, preparations, perfumes, cosmetics and other toilet preparations
3529	Manufacture of chemical products not classified elsewhere
3551	Tyre and tube industries
3559	Manufacture of rubber products not classified elsewhere
3560	Manufacture of plastic products not classified elsewhere
3710	Iron and steel basic industries
3841	Shipbuilding and repairing
3842	Manufacture of railroad equipment
3843	Manufacture of motor vehicles
3844	Manufacture of motorcycles and bicycles
3849	Manufacture of transport equipment not classified elsewhere
	Science based and specialised supplier industries
3821	Manufacture of engines and turbines
3822	Manufacture of agricultural machinery and equipment
3823	Manufacture of metal and wood-working machinery
3824	Manufacture of special industrial machinery and equipment except metal and wood-working machinery
3829	Machinery and equipment except electrical not classified elsewhere
3831	Manufacture of electrical industrial machinery and apparatus
3832	Manufacture of radio, television and communication equipment and apparatus
3833	Manufacture of electrical appliances and household goods
3839	Manufacture of electrical apparatus and supplier not classified elsewhere
3522	Manufacture of drugs and medicines
3825	Manufacture of office, computing and accounting machinery
3845	Manufacture of aircraft
3851	Manufacture of professional and scientific, and measuring and controlling equipment, not classified elsewhere
3852	Manufacture of photographic and optical goods
3853	Manufacture of watches and clocks

Source: OECD (1992)

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