

Investigating Performances of Turkish Manufacturing Industry Firms by Logistic Regression Analysis Method

Semra Taşpunar Altuntaş

Istanbul University, School of Business, Finance Department,

Istanbul University, Avcılar Campus, Turkey

Tel: 212-473-7000 E-mail: staspunar@istanbul.edu.tr

Abstract

Performance evaluation, especially financial performance evaluation is extremely important for firms to maintain their existence, to cope with sustainable competition conditions, and to enhance their operations. Financial performance evaluation is assumed to be unbiased and objective as it contains net and easily interpretable indicators. In this study, the relationship between financial performance indicators and the factors affecting the performances were analyzed by logistic regression analysis. Financial performance indicators, which have great importance for the enterprise, have been analyzed in terms of profitability, productivity, market performance and growth, liquidity ratios, financial structure ratios, operating rates, the ratio of exports in sales and capital intensity. Clustering Analysis (CA) was examined how many clusters could be collected by using performance indicators and performance levels were determined by using the number of clusters resulting from Logistic Regression Analysis (LRA) and CA. Consequently, Logistics Regression Analysis (LRA) is used to identify the factors that impact performance on the basis of low, medium, and high based on the number of clusters generated by CA.

In the analysis, the effects of financial structure ratio, liquidity ratio, activity rate, capital density, export rate and market share, which are expected to affect performance, were examined. As a result, it is seen that the power of the firms to pay their short-term debts, the amount of borrowings in proportion to their assets and equity, affect the performance levels of their size and export rates within the sector.

Keywords: Financial Performance, BİST, Clustering Analysis (CA), Logistics Regression Analysis (LRA)

1. Introduction

In order to determine the performance of the firms, the evaluation of each company's own activities and the measurement criteria must be defined. The design of performance evaluation systems for modern industrial firms has increased the interest of both academics and researchers. One of the weaknesses of performance evaluation systems, which are widely used by many businesses, is that they focus on a narrow space, one-dimensional. Kaplan and Norton (1992) suggest that this problem can only be solved if companies adopt balanced measurement.

Operational performance is a very complex concept which is very difficult in terms of determining performance criteria and measuring them. Kaplan and Norton (1996), according to which none of the performance criteria can not meet exactly what you want, businesses should develop multiple performance metrics to measure their performance. In this way, they will be able to adapt to changing environmental conditions and achieve their goals. Multiple performance criteria should consist of Financial dimension, Customer size, Internal business process size, Learning and growth dimension.

Financial performance of business is interpreted as a measure of the change in the financial position or financial outputs of the entity. While the financial statements present events and records about the past period, they provide information about what situations are more important and what can be important in the future. The financial data used in performance measurement can be obtained by the balance sheet, income statement and activity reports of the firms, while the data related to the organization can be collected from the firms by survey. In this study, the factors affecting the performance and performance of firms operating in manufacturing industry will be examined in Borsa İstanbul (BİST). The scope of the study will consist of indicators with higher reliability, generally accepted, obtained from objective sources (income statement, balance sheet, activity report).

2. Literature

2.1 Performance Evaluation and Importance in Enterprises

In an increasingly competitive environment, businesses can remain competitive and their presence in the market

depends on their ability to improve their performance. Performance is a multidimensional concept that can measure the success of a firm and the level of reaching the objectives of the firm as qualitative (quality) and quantitative (quantity). In order to determine the performance of the firms, it is necessary to evaluate each its own activities and define the measurement criteria (Maris Martinsons et al., 1999).

The design of performance evaluation systems for modern industrial firms has increased the interest of both academics and researchers (Neely et al., 1997). One of the weaknesses of performance evaluation systems widely used by many companies is that they focus on a narrow area. Kaplan and Norton (1992) suggest that this problem can only be solved if companies adopt balanced measurement.

Performance evaluation is an important part of the control function. Here, the control function aims to reveal the objectives of the business, then to determine the extent to which these goals are realized and to reveal and improve the reasons for the differences (Yıldız, 2011).

2.2. Performance Indicators of Businesses

Business performance is a very complex concept which is very difficult in terms of determining performance criteria and measuring them (Goodman, Pennings, 1977). When the resources that contribute to the value creation of the business are used efficiently; the value created is larger than expected, and only in this way the company is maintained and growing (Carton, Hooper, 2006).

Financial performance of businesses; and as a result of the management decisions and the implementation of these decisions are interpreted as a measure of the change in the financial position or financial outputs of the entity.

Although the financial statements present events and records about the past period, they provide information about what situations are more important and what can be important in the future (Tekbaş, 2015). There are many ratios (ratios) in the literature that show the financial status of enterprises and allow them to compare with their competitors in the sector. The indicators of profitability, productivity, growth and market (BIST) as indicators of performance of enterprises will be discussed.

2.2.1. Profitability Ratios

Profitability ratios are the ratios that show both the profit / loss situation in all of the operations carried out by the company and the extent to which these operations are effective and efficient. Profitability is the most concrete result of many policies and decisions of enterprises. While many of the other rates examined reveal different perspectives from the firm's activities, profitability gives definite results on how efficiently the firm is managed (Weston, Brigham, 1979).

2.2.2. Market Value Ratios

In today's conditions, one of the most preferred situations for businesses to grow is the IPO option. One of the places where the performances of the public enterprises are considered the best is the stock exchanges. For this reason, comparison of stock market data and financial statements is important in this respect (Gürsoy, 2007).

2.2.3. Productivity

Productivity is a value of how effectively resources are used. Productivity is one of the most important indicators used in performance measurements and enabling the evaluation of firms (Baş, Artar, 1991). Efficiency allows companies to make comparisons with their competitors in measuring the adequacy of firms. According to Akdeniz and Durmaz (1998), efficiency is a widely used performance criterion because it can be easily identified and simple for all firms.

2.2.4. Growth

Growth, which is one of the economic objectives of firms that are significantly effective on their behavior and activities, means increase in volume or increase in quantity. It is possible to interpret the growth as the increase in the following factors which vary according to the fields of activity of the firms. Lee (2009) states that the size of the enterprise has a significant impact on the profitability of 7000 different American companies. On the other hand, Kaen and Bauman (2010) examined the data of companies in the American manufacturing industry in 1987-2002 and found a negative relationship between large scale and profitability.

2.3 Factors Affecting Business Performance

2.3.1. Financial Ratios

Financial results of the activities of the companies are measured and evaluated with the financial statements. The determination and management of the assets, debts and equity of a firm requires the good reading, understanding

and interpretation of the financial statements.

Financial analysis is the process of extracting summary information from the figures in the balance sheet and income statement, which reflect the different dimensions of the entity, in order to generate meaningful financial ratios.

2.3.2. Market share

According to the balanced scorecard method, which is one of the multidimensional performance measurement tools, the performance has a customer dimension. According to Uygur (2009), customer size reveals customer and market segments where the firm will compete and measures of performance of the business in these target segments.

2.3.3. Export

Many business management aims to expand to foreign markets due to increased competition and saturation in the domestic market or limited resources in the domestic market (Cooper, Elko, 1985). Innovation is a tedious process, which means changing processes such as process, product, and management and so firms can increase their performance due to the increasing demand in the foreign market despite domestic crises.

3. Empirical Research and Discussions

In this study, performance indicators of firms operating in the manufacturing industry sector and the factors that are expected to affect performance in 2016 were examined. The research was carried out with 192 firms in the manufacturing industry sector. Receivable turnover rate and inventory turnover rate are not preferred since the collection periods of the receivables in the companies operating in different sub-sectors in the manufacturing industry and the inventory holding periods vary, and the firms of the rates cannot be made correctly.

SRC results of current ratio, cash ratio and acid-test ratio as liquidity ratios are shown in the Table 1. As the current ratio and acid-test ratio are highly correlated with each other at the significance level of 0.001, the current ratio is considered as the liquidity ratio of the enterprises.

Table.1 SRC coefficients and significance levels

	Current Ratio	Cash Ratio	Asid test ratio
Current Ratio	1	0.582 p=0.000	0.939 p=0.000
Cash Ratio	0.582 p=0.000	1	0.607 p=0.000
Asid test ratio	0.939 p=0.000	0.607 p=0.000	1

The leverage ratio, debt ratio, and equity / total asset ratio, which are considered as financial structure ratios, have been determined after the firms are listed separately. According to these results, these three ratios were highly correlated with each other at significance level of 0.001. However, since the leverage ratio and the equity / total asset ratio are the complement of each other, in other words, they can easily pass over each other because they are 1 in total. Therefore, it is sufficient to use one of these ratios. In this study, it was decided that the leverage and debt ratios would be averaged and included as financial structure ratio.

Operating rates, which are thought to affect operational performance, are discussed. It is determined that only Spearman Rank Correlations of asset turnover and equity turnover were significantly related. However, the high equity turnover rate shows that working capital is used effectively or that external debt is high. In this case, the interpretation of this indicator alone will not give meaningful results and may cause misinterpretations if used in the analysis. Therefore, only asset turnover rate is included in the model as the rate of activity of the enterprises.

Accounts receivable turnover rate and stock turnover rate from operating rates are not preferred because the collections of the receivables of the firms operating in different sub-sectors in the manufacturing industry and the turnover periods of the stocks differ because of the fact that the comparisons of these ratios cannot be made correctly.

The same steps have been applied in the growth rates of the enterprises and the growth in the assets and the growth in the equity capital have been correlated with SRC at the level of significance level 0.001. It was

decided that the average of the growth in assets and equity would be included in the model as growth variable. As mentioned, after the calculation of each of the growth criteria, the effect of the inflation was eliminated.

“Net Profit Margin” as a measure of probability, “Market Value / Book Value” ratio as a measure of market performance, Total Factor Productivity Ratio as an indicator of productivity, “Export / Total Sales” Ratio was used as the export criterion of the firms, “Total Sales / Sector Sales” Ratio was used as the market share criterion.

Although the share of R & D expenses in total expenses is an important indicator of the purpose of the new product and technology production of the enterprise, it shows how the company gives importance to innovation. Therefore, R & D expenses are considered as a variable that can affect operational performance; however, R & D expenditures which are considered as innovation variable could not be included in the total expenditures due to the fact that most of the enterprises within the research are not R & D expenses.

After the selection of the variables, the variables to be used in the analyzes and whether there are multivariate outliers in the 192 manufacturing industry enterprises were tested according to the χ^2 distribution by calculating Mahalanobis Distance. As a result, 17 firms with outliers were excluded from the analysis and all analyzes were continued with 175 operations.

3.1 Logistic Regression Analysis Results

In logistic regression analysis, dependent variable is categorical and independent variables should be categorical or metric. When the firms with outliers are excluded from the analysis, the variables that used in the evaluation of the performances of 175 manufacturing companies in the BIST are profitability, productivity, market performance and growth. Since logistic regression analysis will be used in a categorically dependent variable model, these variables are applied both in the values of the firms in the data set and in the light of the information in the literature. In this way, four performance variables are transformed into a single categorical variable form as Table 2.

Table.2 Performance variables in a category

Indicator	
Net Profit Margin	Firms that < 0 - Low profitability $[0,0.1)$ – mid.level profitability ≥ 0.1 – high profitability
MV/BV	Firms that < 1 – low market performance $[1,2)$ – mid.level market performance ≥ 2 – high market performance
Growth	For asset and equity’s average growth Firms that < -0.07 low growth $[-0.07,0)$ – mid.level growth ≥ 0 – high growth
Efficiency	Firms that < 1.2 – low efficiency $[1.2,1.4)$ – mid.level efficiency ≥ 1.4 – high efficiency

The following Table 3 shows the frequency of the categories of the dependent variables (low / medium / high) after the transformations are applied. In the criteria of profitability; 83 firms have the medium level of profitability, followed by high profitability (50) and finally low profitability (42). While the categories of market performance include a similar number of firms, there are 68 firms are medium level, 53 firms are low and 54 firms have a high market performance indicator. When the average of the change in assets and equity, which is included in the model as the growth indicator of firms, is examined, it is found that 83 firms have high level, 50 firms have low and 42 firms have medium growth. When the firms were classified according to efficiency, it was determined that 66 firms had low productivity, 63 of them had middle and 46 of them had high efficiency.

Table 3. Frequency and percentage of categories for post-transformation dependent variables

Dependent Variable (N=175)	Category	Frequency	Percentage(%)
Profitability	Low	42	24.000
	Medium	83	47.429
	High	50	28.571
Market Performance	Low	53	30.286
	Medium	68	38.857
	High	54	30.857
Growth	Low	50	28.571
	Medium	42	24.000
	High	83	47.429
Efficiency	Low	66	37.714
	Medium	63	36.000
	High	46	26.286

After categorizing the 4 performance indicators, a new and single dependent variable was generated by taking weighted averages of these variables for each firm. Weights of four performance variables with the highest effect on CCA-dependent canonical variable profitability (0.35), efficiency with less impact (0.25) and limited market performance (0.20) and growth (0.20). From this stage onwards, there will be only one common variable that includes the effect of profitability, productivity, market performance and growth indicators as dependent variables in the model. The Table 4 shows the frequencies and the percentages of the categories of dependent variable. According to this variable which expresses performance, 31 enterprises have low performance, 105 enterprises have medium and 39 enterprises have high performance.

Table.4 Dependent variables' frequency and category

	Category	Frequency	Percentage (%)
Performance	Low	31	17,7
	Medium	105	60
	High	39	22,3

As the logistic regression analysis uses the maximum likelihood method as describe, there are no assumptions such as the normality, peer variance and linearity of LSM. In the analysis, there should be no multiple linear link between the independent variables and the observations should be independent. As the dependent variable, six independent variables will be used with the above mentioned performance variable and financial structure ratio, liquidity ratio, activity ratio, capital structure, export rate and market share. All variables, which are considered as independent variables and which are thought to affect performance, have a metric scale.

In addition to the main effects of all independent variables, different combinations of interactions with each other were investigated in the model. Different stepwise methods (forward entry, backward elimination, forward stepwise, backward stepwise) and all the same results have been obtained and therefore the meaningful variable in each step entered into the model and the process until the significant change in the method of forward entry was preferred.

As is known, logistic regression model is primarily used in log similarity test. When the Table 5 is examined, the value of -2LL is only 331,816 with a constant, whereas the financial structure ratio, market share, export and liquidity ratio, which is meaningful from six independent variables, fall to 268,993. Other explanatory variables such as activity ratio and capital density are not significant ($p \geq 0.05$).

The χ^2 value, calculated by proportioning the similarity value of the initial model to the final model, was also as large as 62,542. In this case, it is concluded that at least one of the independent variables in the model has explanatory and the model is meaningful, by rejecting the hypothesis 0 that the independent variables do not have any contribution ($p = 0,000$).

Table 5. Log similarity test

	-2log sim.	χ^2 value	df	p value
Initial Model	331,816			
Final Model	268,993	62,542	8	0,000

Pearson ($\chi^2=283,203, p=0,989$) and Deviance ($D=269,131, p=0,998$) statistics, which measure the goodness of fit of the independent variables in the logistic regression, indicate that the data are appropriate for the model and there is no difference between the observed frequencies and the estimated frequencies.

Cox and Snell R^2 0,301 and Nagelkerke R^2 were found to be 0,354 in logistic regression. These R^2 equivalents give values smaller than R^2 in the classical regression. In this case, the results obtained from the logistic regression model should not be interpreted to be weaker.

Table 6. Similarity ratio test

	Model Adaptive Value	χ^2 value	df	p value
Constant	292.826	2.164	2	0,367
Market share	311.419	20.758	2	0,000
Liquidity	298.625	7.964	2	0,026
Financial Structure	306.946	16.284	2	0,001
Export	304.306	13.645	2	0,002

Table 6 shows the effects of each dependent variable entering the model with similarity tests. Here, the hypothesis 0 that the variables are claimed to have no effects are investigated separately for each variable. When the table is analyzed, it is seen that market share ($p=0,000$), liquidity ratio ($p=0,026$), financial structure ratio ($p=0,001$) and export ratio ($p=0,002$) have a significant effect on firm performance. Capital density and activity rate, which are thought to affect performance, were not included in the model because they were not statistically significant.

Parameter estimations, Wald values and p-values for each of the categories of the performance variable defined as Low / Medium / High Performance are as in the Table 7. According to these results, market share, financial ratio and export coefficients were statistically significant for both medium performance and high performance firms. The liquidity ratio is meaningful for middle-level firms which are meaningless and high-performing firms.

For medium level performance, Wald statistical values and significance levels for market share, financial structure ratio and export rate were 36,300 ($p=0,005$), -0,611 ($p=0,014$) and 3,964 ($p=0,002$), respectively. For high-performing enterprises, the Wald values for all variables included in the model were found as 29,981 ($p=0,027$), 0,712 ($p=0,004$), -1,374 ($p=0,002$) and 3,258 ($p=0,026$) respectively.

Table 7. Parameter estimates and wald test results

	Performance	B	Std. error	Wald value	df	p value	Exp(B)
MEDIUM	Constant	-0.238	0.700	0.116	1	0.741	
	Market share	36.300	13.002	7.873	1	0.005	4.10E+18
	Liquidity	0.419	0.330	1.625	1	0.207	1.529
	Financial Structure	-0.611	0.248	6.106	1	0.014	0.551
	Export	3.964	1.283	9.647	1	0.002	51.159
HIGH	Constant	0.944	0.807	1.385	1	0.244	
	Market share	29.981	13.513	4.972	1	0.027	7.86eE+12
	Liquidity	0.712	0.340	4.417	1	0.037	2.044
	Financial Structure	-1.374	0.438	9.925	1	0.002	0.259
	Export	3.258	1.460	5.027	1	0.026	25.436

When estimating by logistic regression analysis, the probability of occurrence of each category is calculated by using the variables in the table and their coefficients. In this case, by calculating the independent performance of any business by using the independent variables, the calculation of the probability of medium level performance will be as follows:

$$P_{med} = \frac{e^{\beta_0^* + \sum_{j=1}^k \beta_j^* k_j}}{1 + e^{\beta_0^* + \sum_{j=1}^k \beta_j^* k_j} + e^{\beta_0 + \sum_{j=1}^k \beta_j k_j}}$$

Here, $\beta_0^* + \sum_{j=1}^k \beta_j^* k_j$ is the regression equation for medium performance companies and $\beta_0 + \sum_{j=1}^k \beta_j k_j$ is the regression equation for high performance enterprises.

$$P_{high} = \frac{e^{\beta_0 + \sum_{j=1}^k \beta_j k_j}}{1 + e^{\beta_0^* + \sum_{j=1}^k \beta_j^* k_j} + e^{\beta_0 + \sum_{j=1}^k \beta_j k_j}}$$

$$P_{low} = 1 - (P_{Med} + P_{High})$$

The table does not include coefficients of low performance and their tests. The reason for this is the calculation of the results by reference to this category. The probability of entering into the low performance category is calculated by subtracting the probability sum of the other two categories from 1 as there is no available data. The reference category chosen here does not have any significance and it is the same if the category is given the reference.

In the performance categories of firms, the estimated assignments are given in the Table 8. In total, 63.4% of the assignments made by the model are correct. According to the classification table, 12 of the 31 enterprises (38.7%) with low performance, 92 of the 105 medium-performance enterprises (87.6%), and finally 7 of 39 high-performance enterprises (17.9%) assigned to the right group by the model.

Table 8. Logistic regression classification

Observed	Predicted			Right Ass. Perc.
	Low	Medium	High	
Low	12	18	1	38,7
Medium	7	92	6	87,6
High	0	32	7	17,9
Overall (%)	10.857	81.143	8.000	63.429

The reason for the low percentage of the general assignment is that only two of the independent variables in the model were not statistically significant except for the model and the remaining market share, liquidity ratio, financial structure ratio and export ratio could not explain the performance sufficiently. The low incidence of Cox and Snell R^2 and Nagelkarke R^2 can be interpreted as an indicator of this.

To summarize the results obtained from Logistic Regression Analysis; dependent and categorical performance variables including performance indicators, profitability, productivity, growth and market performance were formed. Performance is defined as low, medium and high level firms. It was determined that the export rate, market share, financial structure ratio and liquidity ratio had effects on performance. These variables determine the performance level of the firms. The ratio of the financial structure showing the borrowing level to the same direction as the performance ratio, except for the financial structure ratio, was found to have a negative effect on performance.

In addition, when the success rate of the logistic regression model in the grouping according to the performances of the firms was examined, it was observed that the model assigns quite good (88.6%) enterprises with medium performance. According to the model, it was observed that the firms with low performance had a correct assignment rate of 41.9% and those with high performance were 15.4%.

4. Conclusions

Firms' performance should be evaluated in order to determine the extent to which the enterprises realize their purposes. Firstly they need to measure their performance. Performance consists of many different sizes like customer, process and finance. In this study, the financial dimension of performance is discussed. For this

purpose, the data obtained from the balance sheet and income statements of the firms in Borsa İstanbul are used. Profitability, efficiency, market performance and growth are the variables that define performance by using the researches in the literature; the financial structure ratio, liquidity ratio, operating ratio, capital density, export ratio and market share were determined as the variables affecting performance.

The relationships between the indicators and the variables in their groups were examined with Spearman Rank Correlation and the variables to be included in the model were selected. Accordingly, as performance indicators; net profit margin for profitability, total factor productivity for efficiency, market value for market performance and book value, and average growth in assets and equity for growth. It was decided to use as the variables affecting performance; average ratio of leverage ratio and debt ratio for financial structure ratio, asset turnover ratio for operating ratio, average ratio of acid-test ratio and current ratio for liquidity ratio, ratio of total assets for capital density to total number of employees, ratio of export to total sales for export ratio and ratio of the sales of the business to the total sales of the sector for market share

The 2016 annual reports of the 192 manufacturing enterprises in the data set were examined. Since the 17 enterprises that were found to be contrary to the Mahalanobis distances could not be included in the analysis so, analyzes were made with 175 enterprises. Before logistic regression analysis, all performance variables were transformed into a single categorical (low / medium / high) variable.

In the analysis, the effects of financial structure ratio, liquidity ratio, activity rate, capital density, export rate and market share, which are expected to affect performance, were examined. As a result, it is seen that the power of the firms to pay their short-term debts, the amount of borrowings in proportion to their assets and equity, affect the performance levels of their size and export rates within the sector. The performance variable to be used in Logistic Regression Analysis is obtained in three categories and in order to assign the enterprises to any category respectively; market share, financial structure ratio, export rate and liquidity ratio were found to be effective.

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Semra Taşpunar Altuntaş, was graduated Istanbul University, School of Business in 2008. She completed her master's degree in 2010 and PhD in finance in 2016 on capital structure. She has many works and projects in the field of finance. The faculty offers courses in Business Finance, International Finance and Capital Markets. Her research areas are behavioral finance, risk management and international finance.