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DOES INSTITUTIONAL RANK ORDERING QUALITATIVE OR QUANTITATIVE?

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ABSTRACT

In competitive markets, companies search their positions according to their competitors with internal resources or make use of the services of market research firms. Various credit and rating agencies or co-ordination for sectors with some social and political remediation also examine and rank the companies in these sectors. These companies are listed on the Stock Exchange Istanbul. Petroleum and derivatives industries, which are important sources of energy for industrial and Turkey, have been reconsidered in the Fortune 500 ranking by MOORA and COPRAS optimization methods and with statistical factor analysis with various efficiency and size indicating financial ratios. The results obtained are consistent within themselves and differ from the Fortune 500 rank order. The difference between quality and quantity can lead companies to wrong strategies in this sort of ranking. The study might be important to bring out efficiency and productivity in the sense of planning possible strategic changes.

1. INTRODUCTION

Firms were in need of measuring continuously their performances and their places in their industrial market with several mathematical methods, due of intensive competition and instability. Measuring internal performances of the companies is insufficient at competitive markets and there would a need to locate their product mix and /or their place against competitors. That aim also meant competitive advantage and market discrimination purposes (Alfaro *et al.*, 2016). This strategic performance evaluation pursued through comparison of the companies in the industry, which would allow a SWOT analysis. Some international organizations and industrial research and credit companies evaluated also the related industrial organizations for several purposes. They ranked them according to several mathematical models subject to predefined criteria.

This research aimed to compare the ranking results of often used methods throughout investigating 14 Turkish petroleum and related products companies, which were figured in Fortune 500 list. Many financial ratios have been unknown or they have been not publicly declared. Therefore, some financial ratios have been calculated with the given balance sheet items. First, they were ranked with the help of MOORA and COPRAS, which are

effective sorting methods, and then sorted by factor analysis and evaluated comparatively. The ranking is compared with the list that Fortune magazine made for Turkey, which determines the Global 500 Company regularly every year.

2. OIL AND DERIVATIVES DISTRIBUTION MARKET IN TURKEY

Energy is one of the most basic and influential requirements of the economic and social development of an country. From this standpoint, "energy security" is a vital element of economic security and national security. Energy is an indispensable input for almost all the processes we need to be able to sustain our social lives; Industrial, transportation, residential and commercial sub-sectors. Petroleum has the largest share of the world's primary energy consumption, especially as the main energy source of the transportation sector. Natural gas and coal, which follow oil, are used for electricity generation in a large scale. According to the a-priori data of the year 2015, oil accounted for 32.6% of world energy demand and 23.7% of natural gas. Until now, according to various projections made by various international institutions (International Energy Agency, US Energy Administration, BP, Exxon Mobil etc.), it is predicted that oil and natural gas will also protect their share in primary energy consumption in the long run (TPAO Raporu, 2015).

Turkey is a country rich in natural resources. However, our country is not as rich as Iran, Iraq and Syria in terms of oil compared to 65% of the world's total oil reserves and 41% of its production in the neighboring geography of our country. This is due to the difference in geological structure of Turkey. It is also true that there is not enough governmental and private geographical exploration activity in our country (Petrol İş Sendikası Raporu, 2016). The reason might Turkish law and regulations on natural resources usage and operation.

Table-1. October 2015 and October 2016 Period Oil Market Overview (000 tons)

	Production			Import			Export			Internal Consumption			Total Supply		
Product Type	Oct. 2015	Oct. 2016	Change	Oct. 2015	Oct. 2016	Change	Oct. 2015	Oct. 2016	Change	Oct. 2015	Oct. 2016	Change	Oct. 2015	Oct. 2016	Change
Oil Types	456	424	-7,02%	0	0	None	299	201	-32,78%	174	182	4,60%	174	182	4,60%
Diesel Types	854	931	9,02%	976	970	-0,61%	2	7	250,00%	1.907	2.051	7,55%	1.909	2.087	9,32%
Fuel Oil Types	30	-36	-220,00%	110	120	9,09%	12	0	-100,00%	58	53	-8,62%	128	53	-58,59%
Aviation	438	389	-11,19%	5	12	140,00%	331	317	-4,23%	120	104	-13,33%	120	104	-13,33%
Marine	115	114	-0,87%	10	0	-100,00%	77	161	109,09%	0	3	Firstly	26	115	342,31%
Kerosene	9	-1	-111,11%	0	0	None	0	0	None	6	1	-83,33%	6	1	-83,33%
Others	708	729	2,97%	68	36	-47,06%	47	68	44,68%	5	16	220,00%	5	16	220,00%
Total	2.608	2.550	-2,22%	1.168	1.139	-2,48%	767	755	-1,56%	2.270	2.410	6,17%	2.368	2.558	8,02%

3. METHODOLOGY

In the study, companies will be listed with the help of MOORA, COPRA methods. As a more statistical approach, the factor scores determined with Factor Analysis belonging to a single factor by means of the maximum likelihood method from the same variables, and the ranking was obtained throughout the z values. The statistical correlations between ratings and ranks have been calculated for the consistency of the results of the methods. Parametric Pearson's and nonparametric Tau correlations was used to compare the results.

3.1. COPRAS Method

In real situations, most criteria for evaluating alternatives are related to the uncertainty feature and the values of criteria cannot be expressed in integers. As a result, this approach found by Zavadskas and Kaklauskas who depended on step-by-step ranking and listing of alternatives process in terms of importance and benefit is called COPRAS (Complex Proportional Assessment) method. COPRAS method consists of 6 steps. However, the variables which will be used in the model are defined as follows:

$$A_i: i.alternative \qquad i = 1,2,,\ldots,m$$

C_j: $j.$ evaluation criterion $\quad j = 1,2,\dots,n$

w_j: level of improtance of $j.$ evaluation criterion $\; j = 1,2,\dots,n$

x_{ij}: value of $i.$ alternative in terms of $j.$ evaluation criterion

Step 1: x_{ij} values create the decision matrix symbolized by D. decision matrix is as follows.

$$D^* = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}$$

Step 2: Decision matrix is normalized with the help of the formula below.

$$x_{ij}^* = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \qquad j = 1,2,\dots,n$$

Step 3: Using the decision matrix normalized with the weight value (w_{ij}) of each evaluation criteria, the normalized decision matrix is formed which is showed with D^* and consisting d_{ij} elements. Weighted normalized decision matrix is formed as a result of the following operation:

$$D^* = [d_{ij}] = x_{ij}^*.w_j$$

where weights of evaluation criteria are taken as equal.

Step 4: At this stage useful and useless criteria are determined. Useful criteria indicate the criteria where higher values show better situation in the way for achieving targets, whereas useless criteria show the criteria where lower values show better situation in the way for achieving targets. The sum of values in weighted normalized decision matrix is calculated for useful and useless criteria.

$S_{i+} = \sum_{j=1}^{k} d_{ij} \;\; j = 1,2,\dots,k$ showing useful criteria and

$S_{i-} = \sum_{j=k+1}^{n} d_{ij} \;\; j = k+1, k+2, \dots, n$ showing useless criteria.

Step 5: For each alternative, relative importance value is calculated which is symbolized as Q_i.

$$Q_i = S_{i+} + \frac{\sum_{i=1}^{m} S_{i-}}{S_{i-}.\sum_{i=1}^{m} (\frac{1}{S_{i-}})}$$

Step 6: The highest relative priority value is calculated as follows:

$$Q_{max} = highest\ \{Q_i\}\ i = 1,2,\dots,m$$

For each alternative, the performance index symbolized with P_i is calculated with the following formula

$$P_i = \frac{Q_i}{Q_{max}} . 100\%$$

where the alternative with 100 performance index symbolized as P_i is the best alternative. Preference ranking of alternatives is from smallest to largest of performance index values.

3.2. MOORA Method

MOORA (Multi-objective optimization based on proportional analysis), which is a multi-objective optimization method, is used in various decision problems and offers alternative solutions. As well as being a new method in comparison with other multi-criteria techniques such as AHP, TOPSIS, ELECTRE, VIKOR etc., MOORA as an optimization method has been used in different areas in recent years (Kalibatas and Zenonas, 2008). It has become a method used to develop different applications in order to support decision making problems. There are many studies carried out by MOORE method. In these studies, MOORA method was applied in various fields. Some studies using MOORA method in the literature might be summarized as privatization at transition economies (Brauers and Zavadskas, 2006) multi-objective optimization of road design alternatives (Brauers *et al.*, 2012) strength of regional development studies in Lithuania (Brauers and Zavadskas, 2009) testing the economies of Belgian regions with MULTIMOORA (Brauers *et al.*, 2010) and the regional development in Lithuania with MOORA artificial intelligence method (Brauers *et al.*, 2010). It is possible to see examples in many other areas such as parameter optimization at granulation process decision making at production processes evaluation of interval data in decision making models (Stanujkic *et al.*, 2012) selection of personnel and material selection problems (Karande and Chakraborty, 2012). The determination of the generalities of tourist places in Istanbul example (Önay and Cetin, 2012) was a national literature model of the use the mentioned technique.

In the first step of the MOORA Ratio method, the initial data of the alternatives are normalized based on the criteria. Each alternative on the criterion basis is compared to a divisor that represents all the alternatives for that criterion (Kistik and Kocak, 2016).

$$D^* = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}$$

The x_{ij} elements of matrix D^* present the values of *i.* criterion and for *j.* alternative. There are m alternatives $j = 1,2, \ldots, m$ and n criteria $i = 1,2, \ldots, n$ in the problem. Normalized values are no dimensional and unmeasured numbers (Brauers and Zavadskas, 2009).

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{m} x_{ij}{}^2}}$$

The normalized x_{ij}^* values are defined in $(0,1)$ or $(-1,1)$ interval. Afterwards the target function might design as a minimization or a maximization problem.

$$y_j^* = \sum_{i=1}^{g} x_{ij}^* - \sum_{i=g+1}^{n} x_{ij}^*$$

There are g $i = 1,2, \dots, g$ maximization criteria and, n-g $i = g+1, g+2, \dots, n$ minimization criteria in the target function. The y_j^* defines total rank index of the j. alternative for each of m alternatives $j = 1,2, \dots, m$, which would rank the alternatives apparently according to their magnitude (Brauers and Zavadskas, 2009).

4. EMPIRICAL FINDINGS

The research used the data of the 14 petroleum companies in top 500 list of Turkey, which have been obtained from the Istanbul Stock Exchange 2015 yearly fact sheet. The data consisted equity capital, assets, number of employees, net sales, profit before tax and financial interests and net change of last year changes. Some financial ratios have been calculated from the raw data. These are equity multiplier, equity turnover rate, profit margin before tax and financial interest, equity gross margin and sector employment index. The following Table-2 presented the financial ratios able to calculated with publicized data.

Table-2. Financial Ratios

Petroleum Company	Equity Multiplier	Equity Turnover Rate	Profit Margin	Equity Gross Margin	Sector Employment Index
BOTAŞ	2,0391	3,7245	2,2362	8,3287	250,5298
TP RAF A.Ş.	3,0437	4,4086	,0501	,2210	430,0665
OMV PETROL OFİSİ A.Ş.	4,9203	18,0020	,4787	8,6179	74,6812
OPET	2,9734	13,3253	1,9541	26,0386	66,9700
TURCAS	3,0523	11,8394	,3925	4,6472	59,8455
AYGAZ	1,5000	2,4588	11,1209	27,3445	116,8413
IGDAŞ	2,4686	2,8004	9,8873	27,6887	176,4354
THY OPET	3,6791	34,4080	2,3028	79,2335	36,2929
İPRAGAZ	2,3811	6,5159	3,3859	22,0624	77,5310
KADOOĞLU	2,9210	6,6157	1,4019	9,2746	9,6390
TERMOPET	1,7917	9,8686	1,2131	11,9710	5,8672
SİYAM PETROL	8,8313	27,1955	,5689	15,4715	6,3701
ENERJİ PETROL ÜRÜNLERİ	3,1639	14,2781	,3412	4,8716	10,3095
ÇELİKLER	6,7671	,7026	232,1184	163,0830	78,6206

The descriptive statistics of the financial ratios of the mentioned companies have been shown in Table-3.

Table-3. Descriptive Statistics

Financial Ratio	Mean	Std. Deviation
Equity Multiplier	3,53802966039732	2,031057332267675
Equity Turnover Rate	11,15306369299905	9,841025675516880
Profit Margin	19,10371624841052	61,407160093877700
Equity Gross Margin	29,20387644625764	43,208554156556330
Sector Employment Index	100,00000000000000	117,647145585247300

The statistical bivariate correlation matrix among each pair of ratios has been presented in Table-4. None of variables show statistical significant relation at %5 level except the profit indicators.

Table-4. Correlation Matrix

	Equity Multiplier	Equity Turnover Rate	Profit Margin	Equity Gross Margin	Sector Employment Index
Equity Multiplier	1,000	,434	,437	,406	-,256
Equity Turnover Rate	,434	1,000	-,328	-,031	-,452
Profit Margin	,437	-,328	1,000	,899**	-,046
Equity Gross Margin	,406	-,031	,899**	1,000	-,155
Sector Employment Index	-,256	-,452	-,046	-,155	1,000

Table-5 contains the maximum relative priority values according to the COPRAS method and multi-objective optimized value according to the MOORA analysis and their related rankings.

Table-5. COPRAS and MOORA Methods Results, Related Rankings

Petroleum Company	COPRAS P_i	Ranking	MOORA y_j^*	Ranking
ÇELİKLER	95,75	2	0,213	2
AYGAZ	90,24	4	0,180	4
IGDAŞ	100	1	0,254	1
İPRAGAZ	88,0	5	0,175	5
THY OPET	95,01	3	0,192	3
BOTAŞ	87,90	6	0,161	6
OPET	75,75	8	0,155	8
KADOOĞLU	84,12	7	0,158	7
TERMOPET	65,47	11	0,122	11
SİYAM PETROL	68,15	10	0,140	10
OMV PETROL OFİSİ A.Ş.	70,25	9	0,143	9
TURCAS	60,23	12	0,120	12
ENERJİ PETROL ÜRÜNLERİ	55,79	13	0,101	13
TP RAF A.Ş.	55,00	14	0,099	14

Beside the operations research ranking methods factor analysis was used to rank the companies with maximum likelihood method. Actually, the KMO measure should have been expected to reach a level greater than %70, but the correlation levels among variables were enough to use factor analysis (Çilingirtürk, 2011).

Table-6. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,271
Bartlett's Test of Sphericity	Approx. Chi-Square	43,448
	Df	10
	Sig.	,000

As the paper aimed to rank the companies, all the indicators should show one structural factor of a measure in terms of financial ratios. This factor explains approximately 42% of the information included by five financial ratios. The second factor was also important according to some dimension due to the its eigenvalue and scree plot represented in Figure-1.

Table-7. Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,248	44,960	44,960	2,107	42,133	42,133
2	1,688	33,764	78,724			
3	,696	13,923	92,647			
4	,350	7,008	99,655			
5	,017	,345	100,000			

The first factor correlates with Equity Multiplier at 0,437, with Equity Turnover Rate at -0,326, with Profit Margin at 1,000, with Equity Gross Margin at 0,899 and with Sector Employment Index at -0,046 levels. That means it presented mostly profitability, and negatively related greatness according to capital and employment. The goodness of fit of the estimated factor to the data is statistically significant ($\chi 2$=21,285; p-value=0,001). Factor scores have been calculated according to coefficients in Table-7 after normalization.

Table-8. Factor Score Coefficient Matrix

	Factor 1
Equity Multiplier	,001
Equity Turnover Rate	,000
Profit Margin	,995
Equity Gross Margin	,005
Sector Employment Index	,000

The resulting ranking has been represented in Table-8.

Table-9. The Resulting Ranking

Petroleum Company	Factor Score	Ranking
BOTAŞ	-,27573	6
TP RAF A.Ş.	-,31185	14
OMV PETROL OFİSİ A.Ş.	-,30387	11
OPET	-,27843	7
TURCAS	-,30596	12
AYGAZ	-,12977	2
IGDAŞ	-,14950	3
THY OPET	-,26762	5
İPRAGAZ	-,25557	4
KADOOĞLU	-,28892	8
TERMOPET	-,29211	9
SİYAM PETROL	-,30095	10
ENERJİ PETROL ÜRÜNLERİ	-,30680	13
ÇELİKLER	3,46709	1

The company ranks have been summarized in Table-10 according to the three analyses.

Their correlations have been analyzed with Kendall's $\tau_{j,l}; j \neq l$ coefficient. Rank orders calculated with Factor Analysis had significant correlations (α=0,05) with MOORA rank orders about 0,9473 and with COPRAS rank orders about 0,9637. The rank orders obtained with the two optimization methods had significant correlation about 0,9065. That means the two optimization method accounted more different priorities or targets by calculations and FA gave a more averaged rank orders with these two methods. The results have been visualized in Figure-1.

Table-10. Comparative Ranks of Companies According to FA, COPRAS and MOORA

Petroleum Company	Fortune 500	FA Ranks	MOORA	COPRAS
ÇELİKLER	14	1	2	2
AYGAZ	6	2	4	1
IGDAŞ	7	3	1	4
İPRAGAZ	9	4	5	3
THY OPET	8	5	3	5
BOTAŞ	1	6	6	6
OPET	4	7	8	8
KADOOĞLU	10	8	7	7
TERMOPET	11	9	11	9
SİYAM PETROL	12	10	10	12
OMV PETROL OFİSİ A.Ş.	3	11	9	10
TURCAS	5	12	12	9
ENERJİ PETROL ÜRÜNLERİ	13	13	13	13
TP RAF A.Ş.	2	14	14	14

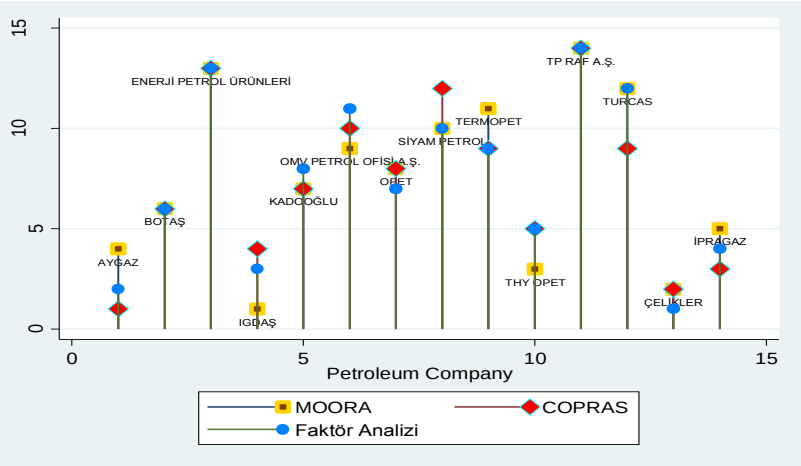

Figure-1. Rank Orders of the Companies 1-14 According to Three Methods

As the difference among the points for each company decreases, so the volatility of measurements according to the different methods also decreased. On the other side, Fortune 500 rank orders had about -5% insignificant correlations with the mentioned methods rankings. Therefore, it was required to investigate the Fortune 500 rank orders' correlation with the related financial ratios with the Spearman's Rank Correlation coefficient. It just showed a negative 60% correlation with the employment index significantly. Equity gross margin had %38 and equity multiplier %30 insignificant correlation with the Fortune 500 rank ordering.

5. CONCLUSION

Mathematical methods and financial ratios give as much as possible objective results and efficiency oriented. The ranking of Fortune magazine is based mostly on the size of the balance sheet items. As a result, the question was foregrounding that whether quantitative or qualitative in the institutional or special ordering of the units having the measurable properties.

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