Competitiveness Review

Methodology research of competitiveness and sample application for Turkey's defense industry

Hakki Ismail Bilgen Abdulkadir Varoglu

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Hakki Ismail Bilgen
Department of Strategy Development, TurkStat, Ankara, Turkey, and
Abdulkadir Varoglu
Department of Administration, Baskent University, Ankara, Turkey

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Abstract

Purpose – The main purpose of this paper is to develop a methodology to analyze the competitiveness based on the diamond model and constructing a composite index; the secondary aim is to apply this methodology to the national index of Turkey's defense industry.

Design/methodology/approach – Instead of providing the results based only on diamond, a composite index study was carried out. The collected variables were distributed using subject-groups under determinants via an expert opinion survey. The variables were analyzed with alternative methods of imputation, normalization and aggregation. Factor analysis (FA) was performed with the aggregated values of each subject to find the years' clusters.

Findings – Turkey's diamond model indicated an improvement in defense industry between 1998-2010. And, FA revealed the clusters as 1998-2000, 2001-2007, 2008-2010. It was found that Turkey had an advantage in demand conditions but needs to give higher importance to factor conditions. In addition, the key provisions were catered to the issues related to government and the defense industry.

Research limitations/implications – Turkey's competitiveness structure between 1998-2010 were researched.

Originality/value – This study provides a qualitative approach of the composite index to the quantitative side of the diamond model.

Keywords Turkey, Competitiveness, Composite indicator, Defense industry, Diamond

Paper type Research paper

1. Introduction

Competitiveness, as one of the main concepts arising because of globalization, puts all countries into a bind. National strategies are developed to allow production countries to have a preferable position in the global market and to provide a continuation in case of their effectiveness. Developing sustainable strategies for their improvement in prosperity increases the pressure of global competitiveness. Therefore, the strategies need the results of research to determine the significant subjects for a competitiveness analysis. It might be considered that with the addition of a strategic management dimension to the economic dimension of the competitiveness analysis offers the countries a more reliable foresight. In this study, in the light of existing competitiveness research, a new method was proposed with the purpose of quantitative contribution to the qualitative side of the diamond model, using the methodologies for constructing a

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composite indicator. As an application, its aim is to determine the competitiveness structure between 1998 and 2010 with Turkey's defense industry. The distribution of variables within subjects and subjects within determinants were decided with an expert group. The country's diamond was determined by interpretation of determinants by means of collected data and then used for the calculation of a national competitiveness index. The methods of factor analysis (FA) and clustering were also used to support the index results for years.

2. Competitiveness concept

Different perspectives on competitiveness have emerged in the past. In fact, the matter of competition was advanced with the start of economic practices and progressed from there. Despite the importance of these theories today, so many indicators are needed in order to analyze a subject in the global environment. Countries try to analyze their competitiveness using an economic perspective to be more effective in the international environment and to figure out their global position. It may be suggested that the integration of a strategic management dimension to the economic dimension in the competitiveness analysis can contribute to the country's ability to predict a future better. The diamond model developed with the perspective of strategic management by Porter (1998) is one of the most favorable methods to find out the competitiveness of a nation or a business environment at a location because of its handling of the important points of economic models under its sub-factors.

Ketels (2006) explained that there were some similarities between company and location strategy that proved helpful in using diamond as a tool to prioritize critical factors. Researches focused mainly on creating large scale empirical datasets to systematically test the hypotheses of a competitiveness framework and developing a conceptual framework for the implementation of competitiveness policies. However, Porter's competitiveness researches always produce information based on the experience from many individual case studies. Ketels concluded that Porter used verbal descriptions and logical reasoning rather than the mathematical models, which dominated the economic profession to provide actionable and accessible advice to practitioners.

The World Economic Forum (WEF) defines competitiveness as the set of institutions, policies and factors that determine the level of productivity of a country, and, the level of productivity, in turn, sets the level of prosperity that can be earned by an economy (WEF, 2011). Also, the International Institute of Management and Development (IMD) states that an economy's competitiveness cannot be reduced only to gross domestic product (GDP) and productivity because enterprises must also cope with political, social and cultural dimensions; therefore, nations need to provide an environment that has the most efficient structure, institutions and policies that encourage the competitiveness of enterprises (IMD, 2011).

As it is clear from these definitions, competitiveness emerges as an issue, especially in determining the level of economic prosperity of a country. In other words, efficiency promotes prosperity and prosperity promotes competitiveness.

3. Competitiveness models

The Council on Competitiveness (COC, 2005) examined the roots of regional economic, performance with a collaborative effort involving Porter to assess the strengths and

weaknesses of five US regions: Atlanta, Pittsburgh, San Diego, Wichita, North Carolina's Research Triangle. The analysis illustrated the relationship between innovation and economic performance and outlined steps that regions can take to improve their innovation capacity. Then, COC worked with six US regions to conduct regional innovation assessments from 2003-2005: Central New Mexico, Northeast Ohio, Wilmington, Delaware, the Inland Northwest, West Michigan, St. Louis. In this study, COC developed a model to reflect a system for an environment of regional innovation with the inputs (assets, networks, culture) and outputs (innovation, productivity, prosperity).

In another study, the National Competitiveness Council (NCC) reports on key competitiveness issues facing the Irish economy and offers recommendations on policy actions required to enhance Ireland's competitive position. Each year, the NCC publishes Ireland's competitiveness scorecard as a collection of statistical indicators of its performance in relation to 18 other economies and organisation for economic co-operation and development (OECD) or European Union (EU) average. The NCC uses a competitiveness pyramid as a model, having three levels such as policy inputs, essential conditions and sustainable growth in living standards (NCC, 2012).

Several researches tried to explain competitiveness by including different factors in diamond model. Federal Ministry of Economics and Technology of Germany studied on Cluster Management Excellence about the development of networks and clusters and their importance for regional competitiveness. In this study, "contingency" and "public players" were used as influencing factors of diamond to explain the cluster competitiveness (Buhl and Kocker, 2009).

Diamond was also used as a part of some models. Within the project of the Cluster Initiative Greenbook (Solvell *et al.*, 2003), the survey data were used to analyze the different shapes of cluster initiatives, especially their evolvement and effects on their success or failure. The respondents are spread over many technology areas in Europe, North America, New Zealand, Australia and Japan. In this study, diamond was used as a level (microeconomic business environment) with two other (general business environment, clusters) in the cluster initiative performance model.

Principally, Porter uses the diamond for competitiveness analysis not only for nations but also for clusters, for example, the position of the industries and locations of USA in the Cluster Mapping Project. Among these, are reports on Turkey's national economic strategy and the role of business in 2009 (Porter, 2009) and for its construction services cluster in 2001-2007 (Katsarakis *et al.*, 2007).

4. Competitiveness index studies

The WEF performs competitiveness analysis on the Global Competitiveness Index (GCI) to measure the micro- and macro-economic foundations of national competitiveness with 111 components grouped into 12 pillars in three main sub-indexes. The GCI uses statistical data obtained from international agencies and executive opinion survey. The first step is the exclusion of surveys with a completion rate inferior to 50 per cent. In the second step, a multivariate outlier analysis is applied to the data using Mahalanobis distance with a 99.9 per cent threshold and then a univariate test at a country level for each question of each survey with the *z*-score method. Finally, the sector-weighted country averages for one year are combined with the averages of previous year to produce the country's scores used to compute GCI (WEF, 2011).

The IMD selected 329 criteria classified in 4 factors and 20 sub-factors, using the international, national, regional sources and executive opinion survey. Every economy's performance is assessed for each criterion using the standard deviation method. Non-normal data are normalized by taking the log to calculate the standardized (STD) value. All the hard data have a weight of one, and the survey data are weighted so that the survey accounts for one-third in the determination of the overall ranking. When data are unavailable, the missing values are replaced by STD values imputed from the average of existing data within the sub-factor. Next, the sub-factor STD values are aggregated to determine the competitiveness factor rankings which are then aggregated to determine the overall scoreboard (IMD, 2011).

The Summary Innovation Index (SII) was developed based on previous research for the European Innovation Scoreboard (Sajeva *et al.*, 2005) to monitor the implementation of the Europe 2020 innovation union flagship with 25 indicators under three groups and computed using a methodology of constructing a composite indicator. First, the outliers are replaced by the respective min-max values observed over all the years and all countries. Second, for each indicator, a reference year is identified based on data availability for all countries (at least 75 per cent). Third, the missing values are substituted with the value for the previous year or with the latest available year. After determining the min-max scores and transforming the data if they are highly skewed, the min-max normalization method is used for calculating rescaled scores. Finally, the composite SII is calculated as the unweighted average of rescaled scores for all indicators (EU, 2012).

Information and Communications Technology (ICT) Development Index was constructed to track progress in the ICT development by the International Telecommunication Union (ITU). The data set was prepared and cleaned to avoid including missing. First, Bartlett's test of sphericity was performed for correlation and principal components analysis (PCA) with 20 indicators in three groups. The results/outputs derived from PCA include three main elements: eigenvalues, the per cent of variance explained in each component and the rotated component loadings. After examination of correlation matrix and the extraction of principal components, the indicators were reduced to 11. For imputation, the hot deck method was chosen with the criteria of GDP per capita and geographic location. For normalization, the methods of distance to a reference measure was chosen and the logarithmic scaling for the indicators with possibility of having high values. Then, they were rescaled to identical ranges [1-10]. The results of PCA were used for weighting. Because no major differences were found among weights in each subgroup, the sub-index value was calculated by equal weighting (EW). For the final index computation, the weight of ICT access, use and skills were 40, 40 and 20 per cent, respectively (ITU, 2009).

The above explained index studies are summarized in Table I.

5. Methodology for calculation of national competitiveness index

The abovementioned researches applied similar statistical methodologies to construct a composite indicator and used similar models based on diamond to explain the competitiveness. As the planned outcome of the study is to achieve a composite index, the methodology proposed by OECD (2008) was explored and adapted, based on diamond model (Figure 1). Diamond model is a powerful tool for understanding the competitiveness of countries, and it also makes a significant contribution for the

Institution	Criteria	Factor	Sub-index	Summary method
WEF	111	12	3	Opinion survey Exclusion of surveys, 50% Multivariate analysis, univariate test with *z*-score Sector weighted country average Index calculation
IMD	329	20	4	Opinion survey Normalization by standardized value Weighting (hard/survey data) Imputation by average Aggregation for overall score
EU	25	–	3	Outlier analysis by min-max values Data availability check, 75% Imputation by previous/latest year value Normalization to calculate rescaled scores of min-max values Aggregation by unweighted average of scores
ITU	20	–	3	Data cleaning to avoid missing values Bartlett's test of sphericity for correlation and principal components analysis Imputation by hot deck method Normalization by distance to reference and logarithmic scaling Aggregation of sub-index values with equal weighting for index calculation

Table I.
Summary of index studies

clarification of the topic with its subjective side. Besides that, it is necessary to supplement by a quantitative dimension for more apparent interpretations. This dimension was achieved by the construction of a composite index for higher reliability and robustness. At the end, the numerical values were obtained for competitiveness by customizing this method with diamond model.

5.1 Theoretical framework

In the first step, a theoretical framework was defined to measure the phenomenon, providing an insight into the competitive structure of defense industry of Turkey. At this stage, preliminarily, the variables were searched, and their data were collected from the competitiveness and other index studies at national and international level. After a general assessment of 938 variables under 62 subjects, the similar variables were considered jointly, and the list was reduced to 524 under 53 subjects.

5.2 Variable selection

These variables were reevaluated according to the quality dimensions of OECD (2008). A questionnaire was prepared to investigate the relevance of variables via an expert opinion survey. Four university professors from the Middle East Technical University and Cankaya University, and one division manager from the Turkish Aerospace Industries participated. After the survey, 350 variables under 47 subjects were accepted. Later the variables whose data did not represent the time series of 13 years were

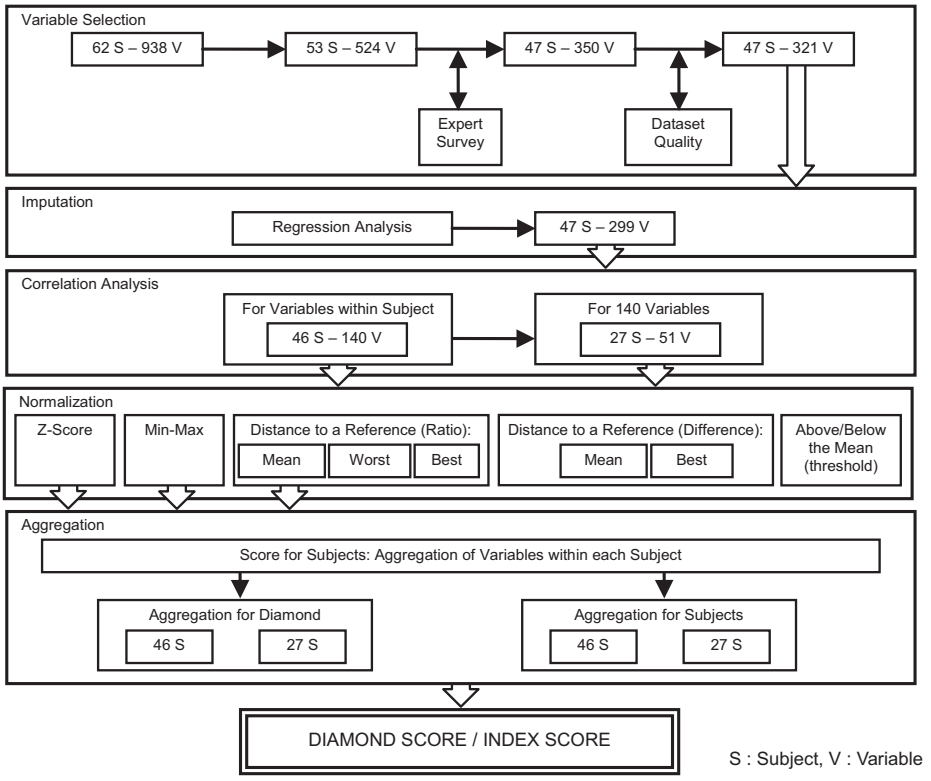

Figure 1.
Model for competitiveness analysis

excluded. As a result, 321 variables (236 hard, 85 soft data) were selected. The soft data variables based on expert opinion were obtained from the sources of IMD and WEF.

5.3 Imputation

For the variables with missing data, the imputation was performed with regression analysis, using SPSS with the "enter" and "backward" methods. As the values obtained by enter method were the closest, it was preferred to add the contribution of all variables to the model. The first important criterion is the consistency of generated data with available data, i.e. the coefficient of determination (R^2) should be high because a linear function of independent variables explains the dependent variable with rate of R^2. To avoid exclusion, the final decision was made after repeating the regression analysis with different independent variable groups. The dependent variables were recorded using the property of "predicted value:unstandardized" of the "save" step and were compared with the available data of the dependent. This method worked well because the data were available for a period of 13 years. Therefore, 22 of 89 variables with missing data were found as inappropriate for imputation, and the data set was constructed with 299 variables under 47 subjects.

5.4 Correlation analysis

The variable groups within each subject were separately analyzed by using SPSS with the "bivariate" method, according to Pearson correlation coefficient. Four criteria were determined for variable selection to exclude the variables with correlation coefficient higher than 0.7, with more imputation, with no data change and to include the variables with hard data when others correlated. As a result, 46 subjects/140 variables were selected (Table AI).

As an alternative, another correlation analysis was performed using all 140 variables together without considering their subjects. Variables were excluded having correlation with more than 20 variables, variables having a value higher coefficient than 0.7, as many as possible defense industry variables were kept in the analysis. In the end, 27 subjects/51 variables were selected (Table AI).

5.5 Normalization

Before normalization, the variables were reevaluated by comparing their values with the measurement criteria. At this point, the country ranking data were transformed because the higher values show the worse country in ranking. Eight different methods were compared (OECD, 2008): standardization (z-score), min-max, distance to a reference by ratio (mean, best, worst), distance to a reference by difference, (mean, worst) and above/below the mean with a threshold (20 per cent). The normalization was carried out by using all the methods for each 140 variables. After the elimination of methods that may give calculation error due to a possibility for the data being zero, the methods of z-score, min-max and distance to a reference by ratio (mean) were chosen.

5.6 Weighting and aggregation

The methods of EW, FA and budget allocation process (BAP) were evaluated. Because the correlation analysis was performed for the variables separately in each subject group, the number of variables was decreased to even one for some subjects. So, it was not possible to obtain factor loadings according to years, preventing the use of weighting based on FA. On the other hand, a survey was designed but could not be organized to apply BAP because the return of questionnaire sent to the defense industry organizations was very unsatisfactory because of data confidentiality. For these reasons, the aggregation process continued with only EW.

The normalization values of all variables obtained with z-score, min-max and distance to reference mean were aggregated in two different ways, as the application of diamond model and the application of all subjects, for both 46 subjects (46S) and 27 subjects (27S).

Afterwards, the subjects were distributed in the diamond determinants according to the expert opinions obtained by the survey at the variable selection step (Table AI).

5.6.1 Aggregation by 46 subjects. For the application of diamond, the aggregation was performed in three steps:

(1) variables of each subject;

(2) subjects of each determinants; and

(3) determinants of diamond (accepted as index value).

For the application of all 46 subjects, a two-step aggregation was used:

(1) variables of each subject; and

(2) subjects together (accepted as index value).

The index values for the three normalization methods indicated a rising trend between 1998-2010. In addition, the change in values for *z*-score and min-max appeared more similar (Figures 2 and 3). It can be seen that the values aggregated using diamond show the change more clearly. Therefore, min-max method was chosen because it provides values in the range of [0-1] and thus more practical for comparing the results.

When the min-max values of determinants are compared (Figure 4), it can be seen that the reason for a decrease in 2010 depends on the determinants of firm strategy, structure and rivalry, related and supporting industries and a little of government. The decrease in 2002 is more general for the determinants with the exception of demand conditions which have an increase.

5.6.2 Aggregation by 27 subjects. For the diamond application of 27S, an identical three-step aggregation was performed, and, for the application of all 27 subjects, an identical two-step aggregation was performed with EW (Figures 5 and 6). The overall trend for the *z*-score and min-max methods appeared similar as well. However, there was no subject under the related and supporting industries (Figure 7).

When compared with the values obtained by the 46 and 27 subjects, it was concluded that the absence of a diamond determinant seriously affected the analysis results. Because the purpose was to investigate the sectoral situation in the span of

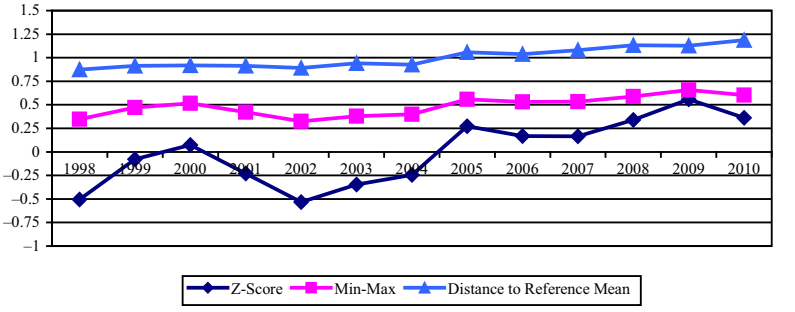

Figure 2.
Index values for diamond of 46S

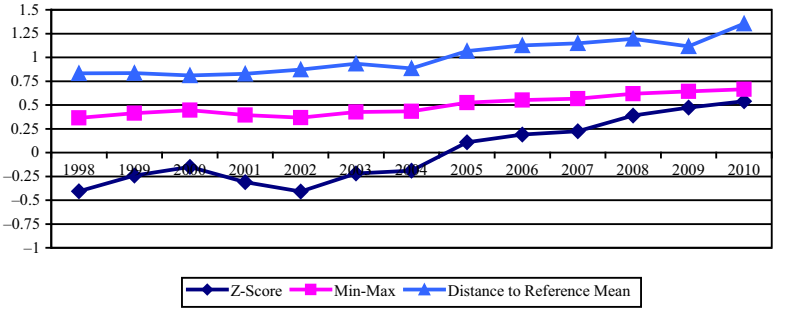

Figure 3.
Index values for all 46S

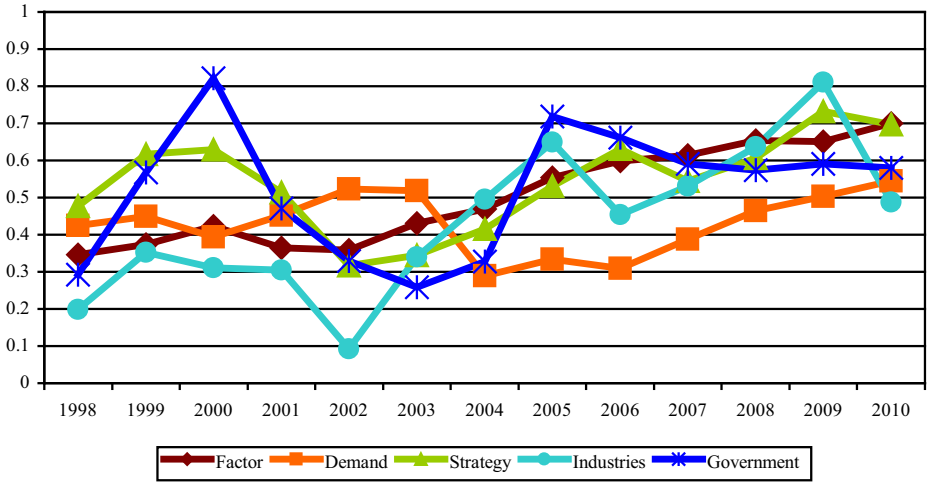

Figure 4.
Aggregated min-max values for diamond determinants of 46S

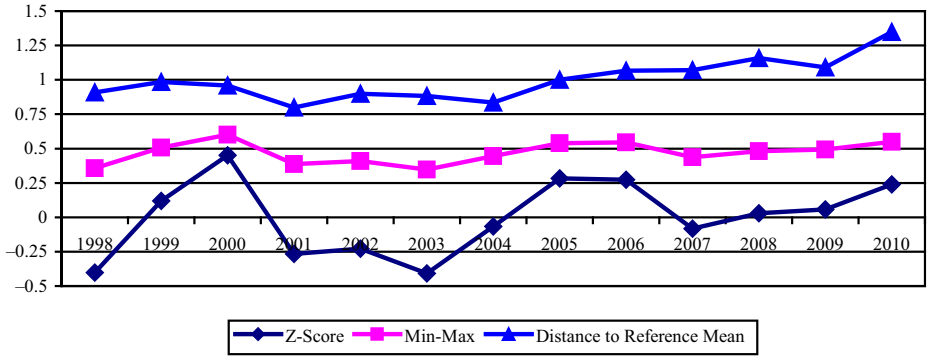

Figure 5.
Index values for diamond of 27S

13 years, these decreases in determinants made a big difference. For example, the weight of 31 subjects under factor conditions (Table AI) was compensated by considering many subjects under one determinant. More specifically, because the sectoral information was mostly under demand conditions, this information seemed to be suppressed for the application of all 46 subjects. More balanced information might be revealed if the aggregation was carried out with diamond application. Besides, it was decided to use 46 subjects to investigate the competitiveness structure of industry because it covers more subjects under all diamond determinants. This decision supported one of the main objectives of using diamond model for competitiveness analysis in this study.

5.7 Index calculation

It was decided to use the application of 46S because it covers more subjects under all of the diamond determinants. The index values based on diamond indicated the improvement of Turkey's competitiveness level in defense industry between 1998-2010 (Table II; Figure 8).

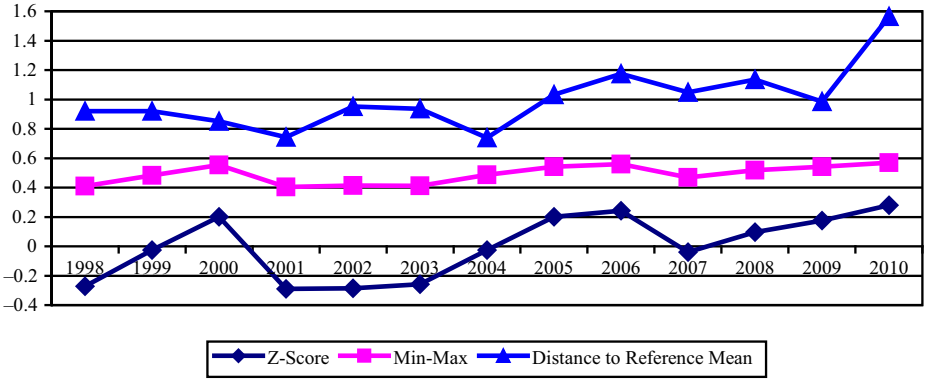

Figure 6.
Index values for all 27S

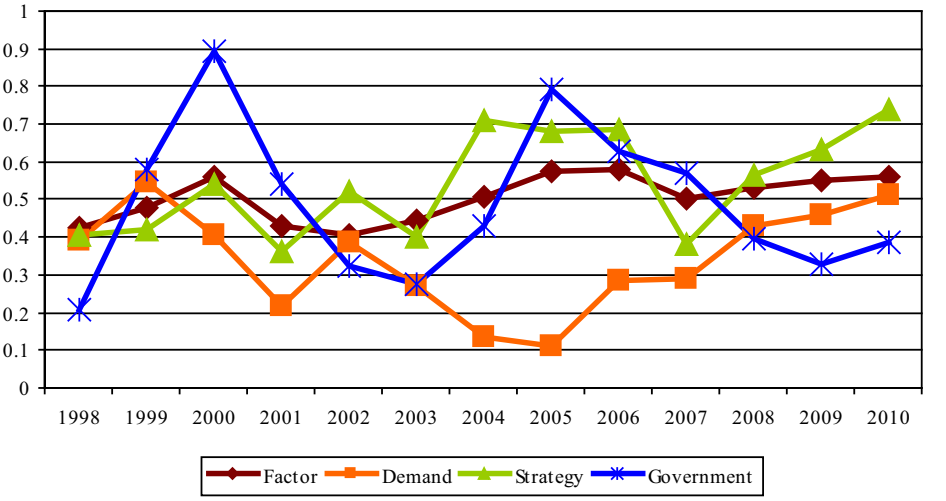

Figure 7.
Aggregated min-max values of diamond determinants of 27S

Diamond and its determinants	Index, 1998	Index, 2010	Change (%)	Improvement, 2010
Factor conditions	0.346	0.701	102.29	+++
Demand conditions	0.425	0.544	28.10	+
Firm strategy, structure and rivalry	0.476	0.698	46.47	+
Related and supporting industries	0.198	0.488	146.69	+++
Government	0.292	0.581	99.05	++
Diamond	0.347	0.602	73.35	++

Note: Showing the low, intermediate and high levels with "+", "++" and "+++" respectively

Table II.
Index values based on diamond for Turkey

The most remarkable point is that there is no significant progress for demand conditions. The variables under demand conditions are directly related with the defense industry. Because the change in variables were in different directions, the change in demand conditions remained stable. In detail, X304, X308, X309, X316 and X318 increased; X294, X298 and X310 decreased; and X320 increased with negative meaning. Therefore, the reasons for least improvement in demand conditions when compared to the other determinants are X294, X298, X310 and X320.

6. Factor analysis application for national index

To search for clustering the years with Turkey's data, the FA was performed with the aggregated values of each of the 46 subjects selected for the national index between 1998-2010.

Because of the correlations between the subject values, some criteria were determined, and, a correlation analysis was made, giving the priority to the subjects related with the research topic. Subjects with higher correlation than 0.7 Pearson coefficient were excluded. Subjects correlated with the defense industry subjects were excluded. In case of correlation between the defense industry subjects and if there was a more comprehensive subject with similar meaning among others, the similar one was excluded. Only two subjects were not excluded because of their significance, although they had correlation higher than 0.7 with other subjects. S1 was correlated with S42 (coefficient of 0.778), S21 was correlated with S13 (0.731) and with S22 (0.720). After correlation analysis with these aggregated subject values, 19 subjects were selected and the FA was repeated.

The initial and extraction values of the communalities were in the range of 0.587-0.908 using PCA as an extraction method. The initial values are one because PCA analyzes all the variance for each subject. The extraction values indicate the proportion of each subject's variance that can be explained by the retained factors. Subjects with high values are well represented in the common factor space. For example, 90.8 per cent of the variance in S1 is explained, whereas 58.7 per cent of the variance in S24 is explained. It was good enough to continue in the analysis because the subjects well represented the factors.

Although FA generates as many factors as the number of subjects, it is expected to find the underlying factors explaining the variation among the subjects. For this reason, as a stopping rule "Kaiser criterion" was used. The eigenvalues for the first five principal components were above one between 6.289-1.514 and explained the variance in different proportions between 33.102-7.966 per cent. "Variance explained criterion" was

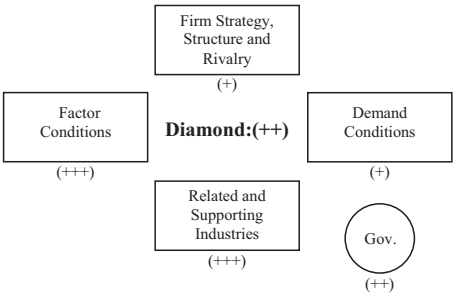

Figure 8. Competitiveness diamond of Turkey's defense industry

used as the second stopping rule to keep enough factors to account for 80-90 per cent of the variation. The first five factors account for 85.176 per cent of the total variance. To validate another stopping rule, "scree plot" was used (Figure 9). It observed that there were five edges before the line starts to level off. Therefore, it was decided to retain five factors.

In the factor matrix, 19 subjects were loaded on five factors as the un-rotated factor loadings, which are the correlations between subject and factor. The higher the absolute value of loading, the more the factor contributes to the subject. For example; S30 loads much more highly on the first factor (0.802) than the second (0.242) and fourth (0.247). Because of the reason the factor loadings are found according to the extracted factors, the original correlation matrix will change. So this matrix must be reproduced from five factors and the difference must be evaluated. If the reproduced matrix is very similar to the original matrix, it proves that the extracted factors explain a great deal of variance in the original matrix and well represent the original data. The values on the diagonal of the reproduced matrix are the extraction values of communalities. For example; the original correlation value between S1-S4 is 0.505, whereas the reproduced correlation value is 0.557, then the residual is computed as −0.052. There were 58 (33 per cent) non-redundant residuals with absolute values greater than 0.05. Ideally, it is expected not to have residuals more than 50 per cent.

Because of the possibility of change in the factor loadings of subjects, the factor matrix may provide a misleading result. After deciding on the number of factors to maintain, it is a standard practice to perform rotation so as to enhance the interpretability of the results. The sum of eigenvalues is not affected by rotation, but changing the axis will alter the eigenvalues of particular factors and will change the factor loadings. The most common rotation method is the "varimax rotation" (OECD, 2008). Higher loadings of subjects on factors are found. Therefore, it may be easier to interpret the meaning of factors, and the loadings of subjects on factors are spread more evenly in the rotated factor matrix. It seems more reasonable to identify the factors according to the subjects that have high loadings on it. If it is hard to identify, it is

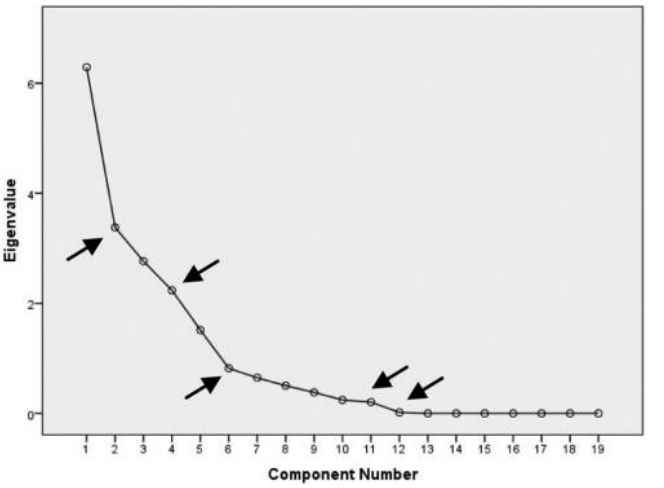

Figure 9.
Scree plot

practical to consider the subjects that have higher loadings. The subject which has a negative loading on a factor displays an opposite relation with the other subjects in that factor (Table III).

As a result, the subject groups that were substantially loaded by factors were identified as shown in italic values:

- *Factor 1*: "Satisfaction of Needs in the Defense Industry" composed of subjects "S22:education, S21:population, S44:defense industry international trade, S30:energy, S13:employment, S39:related and supporting industries".
- *Factor 2*: "Government Support" with "S18:life quality, S11:doing business, S33: R&D, S24:health, S40:government".
- *Factor 3*: "Financial Environment" with "S4:money, S10:financial environment, S26:environment, S42:defense industry expenditure".
- *Factor 4*: "Economy" with "S32:ICT infrastructure, S1:economic performance".
- *Factor 5*: "Labor Opportunity" with "S15:labour skills, S35:social values".

By using the factor values obtained for the application of 19 subjects of the national index, the situation between 1998-2010 was examined with two-dimensional and three-dimensional scatter plots. It can be seen that the years are clustered into three groups (Figure 10): 1998-2000, 2001-2007 and 2008-2010.

	Rotated component matrix[a]				
	Component				
Subjects	1	2	3	4	5
S22	*0.907*		0.120	0.116	
S21	*0.883*		−0.129	−0.301	
S44	*0.731*	0.213	−0.278	0.187	−0.131
S30	*0.701*	0.220	−0.254	0.404	
S13	*0.676*	0.462		−0.214	−0.315
S39	*0.584*	0.258	0.203	0.533	0.421
S18		*0.848*	0.298	0.327	−0.188
S11	0.436	*0.806*	0.128	−0.166	
S33	0.191	*0.749*	−0.333	0.203	0.323
S24	−0.180	*−0.698*	0.225		0.116
S40	0.236	*0.633*	0.242	0.246	0.605
S4	0.249		*−0.914*	0.109	
S10	0.488	0.162	*0.833*	−0.161	
S26	−0.394	−0.423	*0.630*	0.251	
S42	−0.147	−0.336	*0.624*	−0.571	
S32	−0.192			*0.874*	0.166
S1	0.281		−0.450	*0.780*	−0.109
S15	−0.322			−0.119	*0.844*
S35	0.192	−0.473		0.0.370	*0.677*

Notes: Extraction method: principal component analysis; Rotation method: varimax with Kaiser normalization; [a]Rotation converged in nine iterations

Table III.
Rotated component matrix

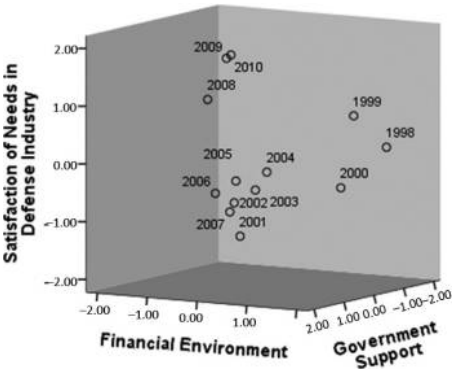

Figure 10.
Dimensional clustering for factors 1-2-3

7. Results

Trying several applications, when constructing the composite indicator based on diamond model, provided an opportunity to identify the impact of each subject used in the analysis making a difference. For example, using two correlation methods with different subject groups changed the number of subjects in the analysis. Therefore, it was possible to form an opinion on the pros and cons of Turkey's competitiveness, allowing a priority to be given according to the diamond model.

Primarily, the government activities should be improved to sufficient levels. The conditions to be counted are the subjects under the influencing determinant of government:

- establishing an appropriate legal environment for competitiveness;
- creating transparency of policies; and
- cutting bureaucracy impact on business.

Then it is necessary to improve the factor conditions because of the impact of its subjects is higher for a country showing its capacity to create basic and specialized factors. In spite of their spread over a large area, the subjects under factor conditions should be investigated whether they make a contribution to the industry. The underlying issues of factor conditions are:

- increasing effectively GDP per capita;
- increasing exports to have a better proportion of imports covered by exports;
- commencing to invest abroad;
- keeping steady exchange rates;
- decreasing consumer prices;
- balancing the tax burden positively spawned by government tax revenue;
- support on banking services;
- having a reliable stock exchange market;
- availability of venture capital;
- increasing number of enterprises;

- decreasing the unemployment rate and developing employment friendly environment using labor skills to have a better labor productivity;
- enhancing life quality with better income and living conditions;
- developing the infrastructure;
- maintaining a planned and regular increase in ratio of urban population to total population;
- increasing the education and health expenditure;
- improving the cultural activities;
- minimizing the negative impact of the decrease in arable land;
- increasing sensitivity to environment;
- increasing the capacity of transportation;
- having better tourism receipts from foreigners;
- building trust on justice for corruption;
- taking precautions to overcome insufficient electric consumption;
- increasing production capacity;
- improving ICT infrastructure;
- providing more support for R&D and extending more to the private sector; and
- giving particular importance to innovation.

The subjects under the determinant of related and supporting industries may be given priority in third order because they are related with the external subjects supporting the industry:

- strengthening cooperation between companies and universities; and
- enhancing quantity and quality of local companies.

The firm strategy, structure and rivalry can be considered in fourth place because this determinant generally includes the subjects directly related with the firms in the industry:

- establishing better financial environment, including enhancement of long-term credit rating, economic freedom and attractiveness of incentives for foreign investors;
- providing ease of doing business;
- improving social values, including better country image abroad, attitudes toward globalization culture for foreign ideas and support for competitiveness in society;
- increasing country competitiveness level with better impact of companies; and
- increasing importance of administrative practices with support by companies.

Eventually, the subjects under demand conditions should be investigated as to whether they make a contribution to the industry. Commonly, subjects other than the demand conditions indicate the conditions strengthening the competitiveness of industry which can be considered the foundation for building a competitive environment. The demand

conditions, as the indicators directly related to defense industry, bunching the local and international demands can be the last concern:

- maintaining the continuity of the number of military personnel;
- providing a sustainable military expenditure;
- ensuring the adequacy of the budget of national defense ministry;
- balancing the international trade;
- supporting companies to provide an appropriate employment environment;
- increasing the R&D expenditure; and
- decreasing the business cost of security.

In addition, the result of FA can be evaluated as in the following:

- The government support increased after 2000.
- The financial environment was only sufficient between 1998 and 2000. Because there was a downward trend after 1999 in the defense industry expenditure.
- The satisfaction of needs in defense industry could not keep its moderate level after 1999, then achieved a better situation between 2008 and 2010. The reason mainly depends on the international trade of defense industry. More specifically, the export of Turkey increased as the import decreased. Besides, the subjects of related and supporting industries, education, population, energy and employment contributed the upward position.

The results of constructing a composite indicator and FA are consistent in the subjects of expenditure and trade in defense industry. Therefore, Turkey should provide a sustainable and more sufficient economic opportunities and a well-planned trade support for the defense industry.

8. Conclusion

Competitiveness index, depending on its framework, displays the improvement of a country for a period of years. However, it is not satisfactory enough to explain the country's competitiveness by means of a single composite index value. It is possible to generate an idea at the supportive layer by using the diamond determinants. That is, the numerical values calculated for each determinant are considered as sub-index. So the improvement in competitiveness can be numerically compared according to these sub-indexes. Nevertheless, the sub-indexes may not provide sufficient information about the investigated industry sector depending on the expected level of detail in the area of interest. It is necessary to make comment about the variables under subjects and subjects under determinants. Therefore, the decisions to be made, using the general index, sub-indexes, subject values and variable values should be consistent. The entire calculation method is summarized in Figure 11.

Under the guidance of key issues included in Turkey's diamond, ten key provisions can be recommended in general to be competitive and sustainable in an industry in the scope of determinants (except demand conditions):

(1) stable and transparent administrative and legal environment;

(2) business environment based on strong economic infrastructure;

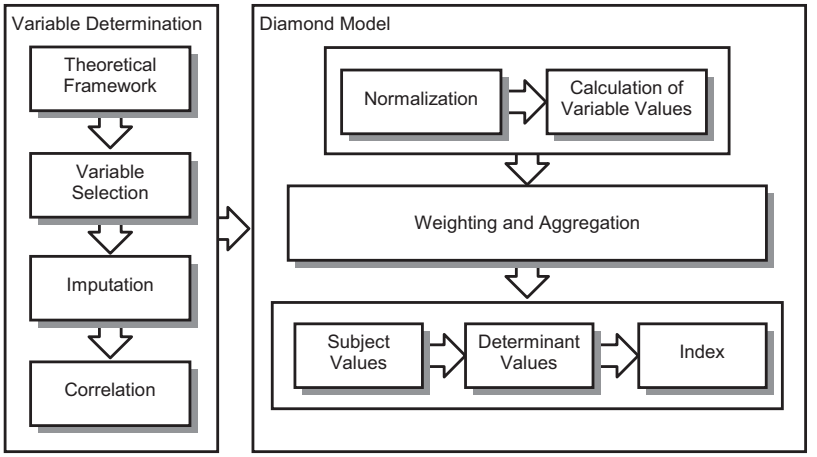

Figure 11.
Model for construction of composite indicator with diamond model

(3) support for local investments;
(4) employment development and enhancement of life quality;
(5) effectiveness in the markets;
(6) support for foreign direct investment home and abroad;
(7) investment in technological infrastructure;
(8) outcome oriented relationship between organizations;
(9) commitment toward R&D and innovation activities; and
(10) understanding the managerial efficiency of organizations.

Five key provisions can also be recommended to perform in the scope of defense industry competitiveness (demand conditions):

(1) sustainability of active military personnel;
(2) benefit from the advantage of local demand created by the capacity of armed forces;
(3) review of the drop in defense spending to balance the potential decrease in local demand in favor of industry and to search the opportunities of visibility and cooperation;
(4) support for the local defense industry on foreign direct investment home/abroad with an expectation that the decrease in defense industry imports will reduce foreign dependency; and
(5) increase the defense industry exports by defining reasonable targets.

If it needs to be more specific for defense industry, the essential point to support the competitiveness seems to be the increase in exports when decreasing expenditure and import. In fact, local customer demand has achieved satisfaction in Turkey. In such case, it becomes more important for organizations to turn toward exports. For example; foreign direct investment abroad and internationalization that can positively affect the exports, and eventually the competitiveness, may have a prominent role.

9. Discussion and suggestions

The first suggestion is to try the alternative methodologies for weighting and aggregation for a robustness assessment. In the analysis, the simplicity of EW was intended to overcome by using a multiple-step aggregation based on diamond model. This method can be compared with the results to be obtained by repeating the steps customized to FA without diamond integration. The similar subjects can be merged to prevent from the risk of only one variable in a subject as a result of correlation analysis. As a second alternative, the BAP can be tried as well. Because of the high number of variables, the process can be applied first to each subject, distributing the points over the variables of each subject, second for determinants and lastly for diamond as a three-step aggregation.

Another suggestion is that the competitiveness analysis can be performed only with the qualitative approach of diamond and that the result can be compared with the quantitative result.

In addition, the methodology can be modified without using diamond. The PCA/FA can be performed by using the competitiveness variables, and an alternative interpretation can be made with the factor loadings found according to the extracted factors. For this purpose, the distribution of variables within subjects can be reviewed, the subjects which have identical meaning can be merged, and the elimination of variables is compared at the stage of correlation analysis.

Eventually, the study should obviously be continued with the recent data after 2011.

Although it may be considered as satisfactory to investigate the competitiveness at national level, an additional evaluation at global level will lead to a better clarification of competitiveness. This methodology has been tested for benchmarking of countries. Therefore, it is also possible to provide a global ranking of countries in defense industry. Specifically, using the similar data, Turkey's position among the world countries can be investigated.

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Corresponding author

Hakki Ismail Bilgen can be contacted at: hakkibilgen@yahoo.com

Appendix

Table AI.
Subject/variable distribution in diamond determinants for applications

Subject (S)/ variable (X)	Determinants/subjects/variables	46S	27S	Subject (S)/ variable (X)	Determinants/subjects/variables	46S	27S
	Factor conditions			S26	Environment	✓	✓
S1	Economic performance	✓	✓	X194	Energy intensity of economy	✓	
X5	GDP per capita	✓		X198	Bio capacity per capita	✓	
X6	GDP per capita, CRR	✓	✓	X199	Ecological footprint per capita	✓	✓
X8	GDP growth rate	✓	✓	X201	Priority of sustainable development in companies	✓	✓
S2	International trade	✓	✓	S27	Transportation	✓	✓
X14	Exports	✓		X202	Roads quality, CRR	✓	✓
X16	Export, rate of change	✓	✓	X205	Railroads	✓	
X22	Proportion imports covered by exports	✓	✓	X206	Air transportation quality	✓	
S3	Direct investment	✓	✓	S28	Tourism	✓	
X24	Foreign direct investment	✓		X210	Tourism receipts from foreigners	✓	
X30	Business impact of rules on FDI, CRR	✓	✓	S29	Justice	✓	✓
S4	Money	✓	✓	X211	Number of judges	✓	
X31	Exchange rate	✓		X214	Freedom from corruption (IEF)	✓	
X35	Foreign exchange	✓		X215	Corruption perceptions index	✓	
X37	Impact of exchange rates on competitiveness of enterprises	✓	✓	X216	Bribing and corruption	✓	✓
S5	Price	✓		S30	Energy	✓	✓
X40	Rate of change in producer price index	✓		X220	Adequacy of future energy supply policy	✓	
S6	Public finance	✓	✓	X222	Gross production of electricity	✓	✓
X41	Fiscal freedom (IEF)	✓		X223	Electricity consumption	✓	
X44	Government spending (IEF)	✓		X224	Average electricity sale price	✓	✓
X45	General budget balance	✓	✓	S31	Production	✓	✓
X48	Income tax rate per capita	✓	✓	X227	Hard coal production	✓	✓
X53	Foreign borrowing	✓	✓	X229	Iron production	✓	
X54	Debt interest payments	✓		X231	Automotive production	✓	
X55	Maximum interest rates for deposits	✓		S32	ICT infrastructure	✓	
X56	Impact of tax evasion on public finance	✓		X233	Communications technology quality	✓	
X58	Impact of corporate taxes on activities	✓		X234	Number of telephone subscribers	✓	
X59	Impact of capital cost on business development	✓		X238	Information technology skills availability	✓	
S7	Bank	✓		S33	R&D	✓	✓
X60	Money stock	✓		X240	Gross domestic expenditure on R&D (GERD), %GDP	✓	
X65	Financial system risk	✓		X244	Government financed GERD, %GDP	✓	✓
X66	Support of banking and financial services on business activities	✓		X249	Science and technology graduates	✓	✓

(*continued*)

Subject (S)/ variable (X)	Determinants/subjects/variables	46S	27S	Subject (S)/ variable (X)	Determinants/subjects/variables	46S	27S
X67	Credit availability for business	✓		X252	Nobel prizes	✓	✓
S8	Stock exchange market	✓	✓	X254	Enforcement of intellectual property rights	✓	
X70	Number of companies	✓	✓	S34	Innovation	✓	✓
X71	ISE price indices	✓		X256	Eurostat innovation index	✓	
X72	Financing of stock exchange markets to companies	✓	✓	X261	Triadic patents	✓	
S9	Venture capital	✓		X263	Scientific research legislation to encourage innovation	✓	✓
X74	Portfolio value of venture capital trusts	✓			*Demand conditions*		
X75	Venture capital availability for business	✓		S41	Defense industry demand conditions	✓	
S12	Business statistics	✓		X294	Number of military personnel	✓	
X96	Number of enterprises	✓		S42	Defense industry expenditure	✓	✓
S13	Employment	✓	✓	X298	Military expenditure	✓	✓
X99	Population, +15	✓		S43	Defense industry economic structure	✓	
X102	Employed population, +15	✓	✓	X304	National defense ministry budget	✓	
X106	Employment growth rate	✓	✓	S44	Defense industry international trade	✓	✓
S14	Employment environment	✓	✓	X308	Defense industry export	✓	
X111	Minimum wage	✓		X309	Defense industry export, SIPRI(TIV)	✓	✓
X112	Hours worked for total employment	✓		X310	Defense industry import, SIPRI(TIV)	✓	✓
X115	Worker motivation	✓	✓	S45	Defense industry employment environment	✓	
S15	Labor skills	✓	✓	X316	Number of defense industry companies	✓	
X117	Skilled labor availability	✓	✓	S46	Defense industry R&D	✓	✓
X118	Priority of attracting and retaining skilled labor	✓	✓	X318	Expenditure on defense industry R&D	✓	✓
X119	Impact of brain drain on country economy	✓	✓	S47	Security	✓	
X120	International experience of senior managers	✓		X320	Impact of business costs of terrorism, CRR	✓	
X121	Competent senior managers' availability	✓	✓		*Firm strategy, structure and rivalry*	✓	
S16	Labor productivity	✓		S10	Financial environment	✓	
X122	Purchasing power parity values	✓		X76	Long-term credit rating, Fitch	✓	
S17	Income and living conditions	✓		X80	Investment freedom (IEF)	✓	
X125	Gini coefficient	✓		X81	Financial freedom (IEF)	✓	
X126	Annual main job incomes, sex ratio	✓		X85	Attractiveness of incentives for foreign investors	✓	
X127	Poverty rate, for 40% risk	✓	✓	S11	Doing business	✓	
S18	Life quality	✓	✓	X88	Business freedom (IEF)	✓	
X130	Level of happiness	✓		X93	Support of regulations for ease of doing business	✓	
X131	Level of hope	✓	✓	S35	Social values	✓	✓
X132	UN human development index	✓	✓	X264	Attitudes toward globalization in society	✓	✓

(*continued*)

Table AI.

Table AI.

Subject (S)/ variable (X)	Determinants/subjects/variables	46S	27S	Subject (S)/ variable (X)	Determinants/subjects/variables	46S	27S
X133	UN HDI, country ranking ratio	✓	✓	X265	Image abroad of country	✓	
X134	Index of economic freedom, IEF	✓	✓	X266	National culture for foreign ideas	✓	
S19	Infrastructure	✓		X267	Value system in society to support competitiveness	✓	
X138	Maintenance and development of infrastructure	✓		S36	Competitiveness perception	✓	✓
S20	Natural infrastructure	✓		X268	Overall competitiveness score, IMD	✓	✓
S21	Population	✓		X270	Global competitiveness index, WEF	✓	✓
X149	Population growth	✓		X273	Impact of subsidies on competitiveness	✓	
X150	Population density	✓		S37	Administrative practices	✓	✓
S22	Education	✓	✓	X274	Adaptability of companies to market changes	✓	✓
X155	Education expenditures, %GDP	✓		X275	Support of technological development of ventures	✓	
X160	Number of students educated abroad	✓		X276	Implementation of ethical practices in companies	✓	
X161	Educational system	✓	✓	X277	Managers credibility in society	✓	
X163	Number of universities in top 200	✓	✓	X278	Corporate boards effectivity to supervise management	✓	
S23	Culture	✓	✓	X279	Emphasis of customer Satisfaction in companies	✓	
X169	Number of books published	✓		X281	Company productivity by global strategies	✓	
X172	Number of attendances, movie, opera, etc.	✓	✓		*Related and supporting industries*	✓	
X173	Number of museums	✓	✓	S38	Cooperation	✓	
S24	Health	✓		X282	Knowledge transfer between companies and universities	✓	
X177	Number of tuberculosis cases	✓		S39	Related and supporting industries	✓	
X179	Health expenditures, %GDP	✓		X285	Adequacy of local supplier quantity, CRR	✓	
X181	Impact of health problems on companies	✓		X286	Local supplier quality, CRR	✓	
S25	Agriculture	✓	✓		*Government*		
X182	Agricultural land area per capita	✓		S40	Government	✓	✓
X183	Wheat production	✓	✓	X287	Legal and regulatory framework to encourage competitiveness of enterprises	✓	✓
X185	Hazelnuts production	✓	✓	X288	Legislation for unfair competition	✓	
X186	Olive production	✓	✓	X289	Government policy adaptability to changes in economy	✓	✓
X188	Meat production per capita	✓		X291	Transparency of government policy	✓	✓
X189	Milk production per capita	✓		X292	Impact of bureaucracy on business activity	✓	
X190	Wheat export	✓					
X192	Wheat import	✓					

Notes: CRR = country ranking ratio; SIPRI, TIV: Stockholm International Peace Research Institute, Trend Indicator Value: TIV, is based on the known unit production costs of a core set of weapons and is intended to represent the transfer of military resources rather than the financial value of the transfer (SIPRI, 2010)