EFFICIENCY ANALYSIS BASED ON THE CORRELATION BETWEEN NATIONAL INCOME AND SOCIO-ECONOMIC DEVELOPMENT LEVEL IN OECD COUNTRIES[1]

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Abstract

The present study aimed to measure the degree to which OECD member countries utilize their national income efficiently in terms of socioeconomic development output and assess the findings comparatively. Data envelopment analysis (DEA), which is a non-parametric mathematical programming methodology, was used for the measurement of efficiency in the study. DEA which is described as a linear programming model aims to measure the relative performances of decision-making entities when it is difficult to evaluate because of multi inputs and outputs. There are two different types of DEA, one the input oriented and one the output oriented. Since the per capita national income variable is used as the sole input in the present study, the output oriented DEA model was preferred. Life expectancy at birth, infant survival rate, rate of college graduates, employment rate, internet use rate, female representation in politics and per capita electricity consumption variables were used as the outputs. As a result of the analysis, the socio-economic efficiency levels of the OECD countries are determined according to the per capita national income and the target values are determined for the countries that are inefficient. In addition to individual assessment of the nations, countries with similar national income were categorized under certain efficiency groups. Finally, similarities and differences between Turkey and other OECD countries were identified.

Keywords: Socioeconomic development, efficiency, data envelopment analysis, OECD countries
JEL classification*: O11, C61*

ULUSAL GELİR VE SOSYO-EKONOMİK GELİŞMİŞLİK DÜZEYİ İLİŞKİSİ BAĞLAMINDA ETKİNLİK ANALİZİ: OECD ÜLKELERİ

Öz

Bu çalışmada OECD üyesi ülkelerin ulusal gelirlerini sosyoekonomik gelişmişlik çıktıları açısından ne derece etkin kullandıkları ölçülmekte ve karşılaştırmalı olarak değerlendirilmektedir. Çalışmada etkinlik ölçümü için parametrik olmayan bir matematiksel programlama yöntemi olan Veri Zarflama Analizi (VZA) kullanılmıştır. VZA birden fazla girdi ve çıktının değerlendirme yapmayı zorlaştırdığı durumlarda, karar verme birimlerinin göreli performanslarını ölçmeyi hedeflemekte ve bir doğrusal programlama modeli olarak ifade edilmektedir. VZA'nın girdiye ve çıktıya yönelik olmak üzere iki farklı türü mevcuttur. Bu çalışmada tek girdi olarak kişi başına ulusal gelir değişkeni kullanıldığı için çıktıya yönelik VZA modeli tercih edilmiştir. Çıktı olarak; doğumda beklenen yaşam süresi, bebek hayatta kalma oranı, üniversite mezun oranı, istihdam oranı, internet kullanım oranı, politikadaki kadın temsiliyet oranı ve kişi başına düşen elektrik tüketimi değişkenleri alınmıştır. Yapılan analizler sonucunda OECD ülkelerinin kişi başına ulusal gelirlerine göre göre sosyo-ekonomik etkinlikleri belirlenmiş ve etkin çıkmayan ülkeler için hedef değerler belirlenmiştir. Ülkelerin bireysel değerlendirmelerine ilaveten ulusal gelir açısından birbirine yakın olan ülkeler belli etkinlik grupları altında toplanmışlardır. Son olarak Türkiye ile diğer OECD ülkeleri arasındaki benzerlikler ve farklılıklar ortaya koyulmuştur.

Anahtar Kelimeler: Sosyo-ekonomik gelişme, etkinlik, veri zarflama analizi, OECD ülkeleri
JEL sınıflandırması: O11, C61

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1. Introduction

It is observed that countries or the regions and provinces in countries do not demonstrate the same level of development, and that these spatial developmental differences constantly escalate socioeconomic problems. Irrespective of the reasons for the differences in development and the tools used to eliminate them, one of the most important points is whether the resources are used effectively. To this end, countries determine their regional policies in line with their national requirements to adapt to the global economic and social transformations, to avoid adverse effects, to take advantage of available opportunities and to construct the development of the region (Takım, 2010; Bakırcı et al., 2014). In particular in the EU and OECD countries, but various policies have been adopted in order to overcome developmental differences among countries, the regions and sub-regions within a country as required by the advances in global economy (Aydemir, 2002).

To this end, the main regional objectives and policies of the EU could be summarized as social, economic and spatial integration, conservation of the environment, strengthening the local governments, establishment of an integrated socio-economic and geographical information system, creation of development axes that would strengthen the functional ties in medium-size cities and a focus on the problems and potentials of sub-regions. For OECD countries, the goals and policies are to ensure efficient institutionalization, to strengthen the public-private sector collaboration, to ensure sustainable land use, to support local entrepreneurship and to provide social equality (DPT, 2000).

In addition to policy-making efforts to reduce developmental disparities, it is also crucial to conduct research and assessments on the extent to which the countries utilize their existing resources efficiently and which countries perform better in utilizing their resources efficiently, thus which countries are more successful than others in productivity. Because, efficient use of limited resources is very significant in achieving developmental and growth objectives, as well as ensuring the sustainability of these objectives. In the pre-1970 era, only the GDP was used as a developmental criterion, however the number and quality of socio-economic criteria utilized as developmental criteria have been increased since then. The regional GDP per capita figures and whether these figures have met the pre-planned target levels are regarded as demonstration of the relative regional development. However, in these activity-based assumptions, a significant problem can be noticed. A solely GDP-centric approach can provide a fine measure of the success in reaching a targeted outcome, but it cannot provide any indication as to how efficiently the available resources were used to achieve the outcome. While achieving the target results is indicative of the "effectiveness" of the system, the efficiency of the use of resources in achieving the target is an indicator of "productivity" (Aydemir, 2002).

In this context, the present study aimed to measure and comparatively assesses the efficient utilization of national income to achieve the socioeconomic development output in OECD countries. For this purpose, Data Envelopment Analysis (DEA), which is an efficiency measurement methodology based on linear programming, was used in the present study.

2. Socioeconomic Development

The concepts of "growth", "progress" and "development" have been used as synonyms based on the assumption that they reflect the same phenomenon. After the World War II, the economic development efforts in underdeveloped countries have increased considerably due to the abundance of economic needs and the poverty of the people (Hall, 1983; Das, 1999). Until the 1970s, per capita gross national income (GDP) was considered as the sole indicator of development, however later on, it was claimed that this mean income figure was inadequate in measuring human development (Cahill and Sanchez, 2001). As a result, in 1970s, the interest focused on other socio-economic variables and it was suggested that the concept of development should be balanced with social, cultural, environmental and spatial dimensions in other areas of life. These developments that led to the concept of "sustainable development" on the one hand, on the other hand, directed

the concept of development from “economic growth” towards "social development". This approach, especially since the 1970s, was reflected in the literature of development and modernization, improving the clarification of the said concepts. Today, it is generally accepted that the above-mentioned phenomena are different concepts (DPT, 2003).

The concept of development is used in the context of economic development (individual productivity and income increase) in certain occasions, while in others, in the context of social development (more balanced income distribution and equal utilization of services by all), or in other occasions, it is used to reflect economic and social development. Development means an increase in production and per capita income, as well as a change and development in socio-economic and cultural structure. Thus, development is closely associated with social, cultural, political and psychological factors. The concept of development includes not only the transformation of production and employment structure to increase the volume of production, physical capacity and national income, but also a change in social and cultural indicators such as the fair distribution of income among social segments and regions, the improvement of nutrition and health conditions, and the increase in educational opportunities (Kafalı, 2002, Demir, 2011).

Countries and societies are always in a process of change. In this process, the distribution of resources, production techniques, institutional structure, social values, attitudes and behavior of the people change and progress in a certain direction. Thus, development is a dynamic concept (Oakley and Garforth, 1985), which suggests that change occurs by moving from a previous or present position forward and closely related to the positive interventions conducted to influence the social change (Oakley and Garforth, 1985) and it is a change in the structural qualities of a country in the positive direction (Geray, 1991; Tolunay and Akyol, 2006).

The topics that emerged with the introduction of the new development concept during the last 20 years are regional imbalances (Puga and Venables, 1998; Rapley, 2001; Gezici and Hewings, 2007; Barrios and Strobl, 2009), human capital (Mercer, 2002), technological innovations, the role of the institutions in development (Lucas, 1993; Easterly, 2002), gender issues (Chant and Guttmann, 2002; Dedeoglu, 2004), poverty (Sen, 1982), climate change and disasters (Pelling et al., 2002) and sustainability of development (Ersoy, 2012).

On the other hand, Socio-economic development includes the concept of economic growth that can be summarized as increasing income per capita, as well as social variables that include structural and human development (Kalkınma Bakanlığı, 2013; DPT, 2003). Because, economic development that is a characteristic of nations and regions beyond individuality (individual actors/corporations), also depends on the development in social, cultural and political structures (Rutten and Boekema, 2007; Amin and Thrift, 1994). In this context, the term "socio-economic development" was proposed instead of "social development", since social development cannot exist without economic development (Ersoy, 2012).

As was the case in the past, there are still great differences between the national socio-economic development levels. These differences are considered as one of the main factors that fueled the global chaos and conflicts. It would not be adequate to explain the said chaos and conflicts only by economic factors. Because, as long as economic opportunities are not used to achieve social opportunities, they do not have a positive effect on welfare. For this reason, it is clear that economic and social development are closely related to each other and are inseparable concepts.

3. Literature Review

There are several DEA studies that were conducted on relative efficiency measurement and assessment in several fields such as banks, healthcare institutions, insurance companies, schools, and corporations. In one of the earliest DEA studies on national, regional or provincial efficiency measurement, Charnes et al. (1989) investigated the economic activities in 28 People's Republic of China provinces. In this study, labor, capital, investment variables were used as inputs and total industrial added value, state economic enterprise profits and taxes paid by these enterprises and

local product sales were used as outputs for the 1983-1984 period. As a result, the provinces of Shanghai, Anshan, Ningbo, Suzhou, Wuxi and Nontang were found efficient.

Chang et al. (1995) identified the relative change in regional development between 1983 and 1990 and the regional development priorities of 23 administrative regions in Taiwan with the DEA method. Population density, ratio of non-agricultural population to total population, the ratio of planned urban area, commercial zone ratio, average household income, per capita local administration expenditures were considered as input variables. The output variables were accepted as the number of landline telephone subscriptions per 100 individuals, the length of the drinking water lines, the number of doctors per thousand, the number of newspapers and magazines per thousand and the rate of educated population to the population of individuals over 15.

Golany and Thore (1997) used the DEA method to measure the social and economic performances of 72 developing and developed nations between 1970 and 1985. In the study, the ratio of real domestic capital investments to nominal GDP, the ratio of real public spending except education and defense industry to real GDP, the ratio of public expenditures in education to nominal GDP were accepted as inputs, while the increase in per capita GDP, 0-1 year old infant mortality rate, secondary school enrollment rate and the ratio of social security payments to nominal GDP were considered as outputs.

Karkazis and Thanassoulis (1998) assessed the comparative / relative efficiency of public investments in infrastructure and investment incentives using the DEA method to attract private investments to Northern Greece. In the study, total public investments and total investment incentives were accepted as inputs and private industrial investments, private investments in the agricultural industry and private investments in the services industry were utilized as outputs. As a result, regions where public expenditures were relatively efficient in attracting private sector investments were identified.

Byrnes and Storbeck (2000) analyzed the productivity in regional economic development in 28 Chinese cities between 1983 and 1984 with the DEA method based on the example of a study by Charnes, Copper and Li conducted in 1989. In the study, labor force and fixed capital investments variables were considered as inputs, and total industrial value added was considered as the output. Analysis results demonstrated that cooperation between the provinces in the same region on resource utilization might improve the efficiency. It was also stated that this method would provide additional information to policy makers on how to channel the planned investments.

Halkos and Tzeremes (2005) examined the effectiveness of fiscal policies implemented in Greek provinces in the 1980s, 1990s and 2000s. The study also determined the distribution of resources and the efficiency of local authorities in encouraging regional development and increasing the quality of life. The number of hospital beds per thousand, the number of public schools per 1000 students and the number of public buses per thousand were considered as inputs, while the provincial GDP ratio, the rural-urban population gap and the number of new houses per thousand were considered as outputs in the study and it was determined that the resources in a province did not provide absolute efficiency for that province.

Labaj et al. (2014) conducted an efficiency analysis for 30 European countries (EU-27, Iceland, Norway and Switzerland) in 2010 using the DEA based on eco-productivity, economic growth and social welfare data. In the study, GDP and "Inequality" were used as output variables, while capital, labor force, emissions were used as input variables. As a result, it was emphasized that it is necessary to consider economic, social and environmental indicators beyond the GDP for prosperity and the efficiency of 30 European countries was determined with in different models that were constructed with different indicators and the study provided a significant support for policy makers in their decisions.

Rabar (2013) measured the regional efficiency in the three-year period between 2005 and 2007 using the DEA method in Croatian administrative regions. The inputs were unemployment rate and

number of individuals who received support payments and the outputs were secondary sector in gross value added, GDP, number of graduate students (by residence) and the level of import coverage by exports in the study. As a result, certain guiding principles for accurate monitoring of the developmental dynamics among the regions with significant differences and improvement of these dynamics in inefficient regions were determined.

Demirci (2012) attempted to measure the economic and social activities in OECD member countries between 2006 and 2010 using the DEA method. Furthermore, the two efficiency values that were evaluated separately were compared within the scope of the study. 6 inputs and 6 outputs were used for economic efficiency measurement. In the study, GNP per capita, purchasing power parity, benchmark price index, income index, total exports and per capita CO2 emissions were selected as economic outputs, while unemployment rate, annual mean working hours, direct foreign investments, food production index, total imports and tax revenues were selected as economic inputs. For social efficiency measurements, 4 inputs and 4 outputs were selected. Social inputs were the population per square kilometer, the ratio of service industry employees to total employees, total energy production, total health expenditures, while total energy consumption, total cellular subscribers, health index and average life span variables were set as social outputs. Study findings demonstrated that there was no linear correlation between economic and social activities of countries.

Örkcü and Doğan (2013) attempted to measure socio-economic performance in OECD countries between 2010 and 2011 using the DEA method. Unemployment rate, inflation rate and infant mortality rate were used as input variables and per capita national income, human development index, life expectancy at birth variables were used as output variables. As a result, it was determined that the socio-economic performance was effective in Iceland, Luxembourg, Norway, Sweden, Switzerland, the United Kingdom and the USA.

One of the studies conducted in Turkey with the DEA method was the study by Aydemir (2002) that aimed to determine to which extend 77 provinces in Turkey utilized their resources efficiently in value added production processes. For this purpose, the total number of corporate establishments / closures per capita, the ratio of the university, college, master's and PhD graduates to the population, per capita railway, maritime, airway and road transportation infrastructure investment, per capita small business, crafts and small industry investments, per capita grants related agricultural investments, per capita grants related manufacturing and mining industry investments, per capita grants related investments in energy and other services, per capita total investment and business loans to small businesses in agriculture and manufacturing industries were set as input variables, while per capita GDP variable was used as the output. The study comparatively investigated the efficiency of the transformation of the resources into value added in 77 provinces in Turkey.

Atan et al. (2004) attempted to compare the success of 73 provinces in Turkey in determining their development levels using multivariate analysis techniques and the DEA method. Population, number of businesses in manufacturing industry, share of employees in total employment, share of employers in total employment, GDP, cultivated agricultural land, number of tractors, agricultural employment, the ratio of asphalt roads to total roads, industrial energy consumption and population density were used as input variables and urbanization and literacy were used as the output variables in the study. As a result, it was stated that as the number of variables increased, the efficiency of DEA decreased when compared to multivariate analysis techniques.

Düzakın and Kıran Bulgurcu (2010) attempted to determine whether the economies of priority region provinces were efficient in 1995-2000 period with DEA method. In the study, public investments, grants related investments and total bank loans were used as input variables, while GDP, employment created with grants, number of newly established businesses and trade balance were used as output variables. As a result, it was determined that the number of provinces that were

relatively efficient in each year was less than the number of provinces that were inefficient, and that the year with the most efficient provinces was 1996.

Öncel and Şimşek (2011) conducted a study to determine whether regional resources were effectively utilized in 26 sub-regions in Turkey with the DEA method. Labor force, per capita bank loans, per capita public investments, per capita grants based investments variables were used as input and as output variables, per capita GDP, number of private automobiles per thousand, urbanization rate, number of hospital beds per thousand, the ratio of college graduates were used. In the study, the status of the regions that were found to use their resources inefficiently was assessed based on their position in the socio-economic development scale.

Köse et al. (2012) examined the extent to which regions that were categorized as level 2 according to the Turkish Statistical Regional Unit Classification (SRUC) could effectively use economies of scale and the available resources. Three different models were used in the study and the per capita gross value-added was taken as the single output variable. Entrepreneurship (number of newly established firms), public investments, patent applications, utility model and industrial design applications, the ratio of employment in medium-advanced technology industries to total employment and exports input variables were common in all models. In the first model, total employment, in the second model, employment in the services industry and employment in the manufacturing industry, in the third model, employment among secondary education graduates and employment among tertiary education graduates were added to the common variables. DEA results demonstrated that the six level-2 regions (TR52, TR62, TR63, TR72, TR90 and TRC1) in Central Anatolia, Central and Eastern Black Sea and Southern Anatolia did not benefited sufficiently from economies of scale and had relatively low input utilization efficiency in production.

Şengül et al. (2013) attempted to determine the economic activities in Level-2 regions in Turkey during the period between 2007 and 2008 with the DEA method. As input variables, per capita public investments, grants related investments, total bank loans were used, while gross value added (GVA) as output, employment created with grants related investments, established firms and foreign trade balance were used as output variables. As a result, it was found that TR33 (Manisa, Afyon, Kütahya, Uşak) and TR51 (Ankara) regions were efficient between 2007 and 2008, and there was an increase in the number of efficient regions as the years progressed.

Bakırcı et al. (2014) aimed to determine the effects of Turkish regional development policies on regional employment in 12 level 1 sub-regions and with DEA method using 2007-2012 data. In the study, input variables were total public investments, regional distribution of investment incentive certificates based on fixed investments and outputs were employment variables for manufacturing, agriculture and service industries. As a result, it was determined that the efficiency values varied based on years and the western regions demonstrated higher levels of efficiency when compared to the eastern regions.

Çakmak and Örkcü (2016) attempted to measure the efficiency in 81 Turkish provinces in Turkey using the DEA method and socio-economic indicators determined in the fields of health, education, economy and banking. In the study, 7 input and 3 output variables were used in the health field, 8 input and 5 output variables were used in the education field. In the economy field, 4 input and 2 output variables and in banking, 4 input and 2 output variables were used. As a result, the findings on the efficient provinces in the four socioeconomic fields were consistent with the findings of previous studies conducted with the DEA method.

4. Efficiency Analysis: Data Envelopment Analysis

Performance measurement models include ratio analysis which is limited by a conventional input-output structure, parametric econometric models and non-parametric modern techniques that are considered in new approaches category. The most known non-parametric method is the Data Envelopment Analysis (DEA). This approach assesses the efficiency of homogeneous units that produce the same output with the same input and compares each unit with the most efficient unit

or units. Thus, it is considered that the use of DEA, which is a homogeneous cluster approach in the measurement of efficiency, is more adequate when compared to other approaches (Düzakın and Kıran, 2010).

Data Envelopment Analysis is a method that uses linear programming to measure the relative efficiencies of decision units that transform input into output. It was initially developed by Charnes, Cooper and Rhodes in order to measure and evaluate the technical efficiencies of public institutions. DEA has several advantages over other alternative efficiency measurement methods. The most important of these advantages is the multi variate structure of the DEA. Because, real life problems have complex structures that require the concurrent assessment of several factors. Contrary to the parametric methods that utilize the regression line for the optimization of the decision-making units (DMU) included in the analysis, the DEA evaluates each DMU based on its position against the Pareto efficiency boundary. In parametric methods, each DMU is represented by a simple regression equation and evaluated with respect to a mean value, while DEA evaluates each observation based on other observations. The parametric approach requires a precondition on the distribution of the error term, while the DEA requires no prerequisites. The effectiveness assessment with DEA, which evaluates all DMUs separately based on their position above or below the efficiency boundary, includes a three-stage process (Golany and Roll, 1989):

- Definition and selection of decision-making units that would be included in the analysis,

- Determination of appropriate input and output variables for the assessment of the relative activities of selected DMUs,

- Application of DEA models and analysis of the findings.

The basic efficiency score in DEA is calculated by dividing the weighted sums of the outputs by the weighted sums of the inputs. This score is calculated as given in Formula 1 (Charnes et al., 1994). u_i = weight assigned to output i, Y_i = quantity of output i, v_j = weight assigned to input j and X_j = quantity of input j;

$$e_k = \frac{\sum_{i=1}^{n} u_i Y_i}{\sum_{j=1}^{m} v_j X_j}, \text{ k=1,2,..K} \quad (1)$$

In DEA, efficiency of decision-making unit k is measured either by maximizing the outputs for a given input level or by minimizing the inputs for a given output level and the resulting value is between 0 and 1. If the efficiency of a decision-making unit is less than one, it is assumed that the efficiency of this unit is relatively lower when compared to other units. Units with an efficiency score of 1 are considered as the most efficient units among all decision-making units (Charnes et al., 1994).

DEA models are divided into two main groups as input oriented or output oriented models. In the input oriented model, the aim is to minimize the input quantity to obtain a fixed output quantity. It is possible to control the input in this model, while the output that would be produced is controlled in the output oriented model. In the output oriented model, the aim is to produce the maximum amount of output with the constant input at hand, which can be achieved by minimizing the ratio of weighted sum of inputs to the weighted sum of outputs (Charnes et al., 1994). In addition to these two main types of the model, a third type is called basic oriented DEA model. Here, the model aims to optimize a mixture of inputs and outputs of decision making unit (Charnes et al., 1978).

DEA can also be made under fixed or variable return assumptions depending on the purpose of the study. Under the assumption of constant return to scale, an increase in the amount of input is

assumed to lead to an increase in the amount of output in the same way. On the contrary, assuming variable return to scale, it is accepted that the rate of change in output may be lower or higher than the rate of change in inputs. In this study, since the variable return to scale approach would not allow adequate interpretations to the objectives of the present study the costant return to scale approach was preferred, and the output-oriented DEA model by Charnes, Cooper and Rhodes (CCR) was utilized. For example, it could be recommended that the units (countries) that exhibit decreasing return to scale should lower their scale. However, in the present study, it would be unrealistic to expect any country to reduce national income since the factor that determines the scale is the national income. Also, to propose countries that exhibit increasing returns to scale to raise their scale, i.e. national income, would not enrich the interpretation. For all these reasons, costant to return scale approach is preferred in the study. In fact, the supplementary methods implemented in addition to the CCR exceed the informativeness of the variable return to scale analysis The mathematical expression of the output-oriented CCR model is as follows:

$$\begin{aligned} &\max Z_0 = \phi \\ &\phi Y_{r0} - \sum_{j=1}^{n} \lambda_j Y_{rj} + S_r^+ = 0 \qquad \mathrm{r} = 1,..,\mathrm{s} \\ &\sum_{\mathrm{j}=1}^{\mathrm{n}} \lambda_{\mathrm{j}} X_{ij} + S_i^- = X_{i0} \qquad \mathrm{i} = 1,..,\mathrm{m} \\ &\lambda, \mathrm{S}_+, S_- \geq 0 \end{aligned} \tag{2}$$

In Equation (2), s depicts the output count, m depicts the input count and n is the decision unit count. The S^+ and S^- are dummy variables useful in the analysis of inefficient decision-making units. If any S^+ value of a decision making unit is different from 0, it can be argued that the decision-making unit could achieve the efficiency limit by increasing the related output and similarly, if the S^-value of a decision making unit is different from 0, it can be argued that the decision-making unit could achieve the efficiency limit by decreasing the corresponding input (Charnes et al., 1994; Atan et al., 2004).

5. The correlation between national income and socioeconomic development level

In the present study, 1 input and 7 output variables were determined for the analysis based on the literature and available data. As seen in Table 1, per capita national income, which is the sole input variable, is the ratio of the net monetary value of goods and services produced in a given period in a country to the population of the country. The per capita national income of an country is generally defined as a measure of the level of prosperity and development of the country, but in this study it is also considered as a means of achieving all kinds of opportunities that increase the level of prosperity. The 2015 data for input and output variables were compiled mainly from official OECD website and official web sites of certain other international organizations.

Due to the use of per capita national income as the sole input variable and the difficulty of controlling this variable compared to the outputs, output-oriented DEA model was preferred. Efficiency scores of 35 OECD countries that were obtained with the output-oriented CCR model are presented in Table 2, under the title of Phase 1. Classical DEA results demonstrated that Estonia, Iceland, Latvia and Mexico were efficient among 35 OECD countries in the first phase.

At this stage, analysis results include impossible targets to reach, albeit accurate theoretically. Thus, the target were limited by determining the maximum target values initially. These values were 100 years for life expectancy at birth, 100% for infant survival, 100% for university graduation rate, 100% for employment rate, 100% for internet use, and 50% for female political participation (to prevent injustice for males).

Table 1. **Socioeconomic Variables Used in the DEA Analysis**

Input	***Output***
Per capita national income	Life expectancy at birth Infant survival rate Rate of college graduates Employment rate Internet use rate Female representation in politics Per capita electricity consumption

Table 2: **Efficiency Scores for Income on Socioeconomic Development in OECD Countries**

	Efficiency score							
Country	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**	**Stage 6**	**Stage 7**	**Stage 8**
Australia	0,3928	0,4463	0,6141	0,6512	0,8034	0,9323	**1**	
Austria	0,3664	0,4319	0,5493	0,6557	0,7715	0,9305	**1**	
Belgium	0,4375	0,5462	0,6396	0,7244	**1**			
Canada	0,5758	0,6587	0,95	**1**				
Chile	0,8307	0,9283	**1**					
Czech Republic	0,764	0,8767	**1**					
Denmark	0,313	0,3851	0,4567	0,5285	0,7319	0,8731	0,8908	**1**
Estonia	**1**							
Finland	0,5911	0,7235	**1**					
France	0,4262	0,479	0,6478	0,7315	0,8948	**1**		
Germany	0,3886	0,5111	0,5882	0,6837	0,9077	**1**		
Greece	0,6691	0,713	0,9386	**1**				
Hungary	0,9122	**1**						
Iceland	**1**							
Ireland	0,3004	0,3465	0,4256	0,471	0,6299	0,7684	0,8384	**1**
Israel	0,6733	0,7785	0,9563	**1**				
Italy	0,3837	0,5563	0,6345	0,6779	**1**			
Japan	0,4823	0,5549	0,6894	0,7495	**1**			
Korea	0,8853	**1**						
Latvia	**1**							
Luxembourg	0,9889	**1**						
Mexico	**1**							
Netherlands	0,3657	0,4536	0,531	0,5987	0,8377	0,9898	**1**	
New Zeland	0,5209	0,6033	0,821	0,9807	**1**			
Norway	0,348	0,4215	0,7596	0,9329	**1**			
Poland	0,9514	**1**						
Portugal	0,6159	0,8664	0,9769	**1**				
Slovak Republic	0,7779	0,8883	**1**					
Slovenia	0,6964	0,9388	**1**					
Spain	0,5938	0,8204	0,8937	**1**				
Swedish	0,4524	0,5799	0,7675	0,9745	**1**			
Switzerland	0,2705	0,3018	0,3995	0,4262	0,5606	0,6656	0,7275	0,9793
Turkey	0,8839	**1**						
United Kingdom	0,4808	0,5578	0,6852	0,7938	**1**			
United States	0,4623	0,5291	0,7745	0,8644	0,9536	**1**		

Since the resulting extreme target values could also be a consequence of very large differences in the input levels among the countries, it was deemed appropriate to use a method inspired by

context dependent DEA at the later stages of analysis. In context dependent DEA, decision-making units are evaluated based on a special assessment context. Each assessment context represents an efficiency boundary established by decision-making units at a particular performance level. Here, countries that were found to be efficient at every stage of the analysis were separated from other countries and DEA was repeated with the remaining non-efficient countries and the process was repeated until only a single country (Switzerland) remained.

In the study, the groups of countries that are evaluated separately may be called "co-efficiency levels," as well as "socio-economic development groups with respect to the per capita national income". The groups formed thusly are presented in Table 3.

Table 3: **Socio-Economic Development Groups Based on Per Capita National Income**

Group No	*Co-efficiency Groups*
1	Estonia, Iceland, Latvia, Mexico
2	Korea, Luxembourg, Poland, Turkey, Hungary
3	Chile, Czech Republic, Finland, Slovak Republic, Slovenia
4	Canada, Greece, Israel, Portugal, Spain
5	Belgium, Italy, Japan, New Zeland, Norway, Swedish, United Kingdom
6	France, Germany, United States
7	Australia, Austria, Netherlands
8	Denmark, Ireland
9	Switzerland

6. Conclusion

In the present study, the extent to which the national income was used efficiently in OECD member countries for socioeconomic development outputs was measured with the DEA method. As a result of the analysis, the socio-economic efficiencies of the scrutinized OECD countries were determined. Based on the findings, the following conclusions could be formulated:

At the first stage of the research, the countries considered to be effective in the level of socio-economic development are successful compared to their national per capita incomes successful. It is not appropriate to set target values based on the outputs for these countries, because their national income is sufficient only to produce the current output volume. Thus, it is not possible for these countries to increase their output unless they increase their national income.

It was found that rich western countries, in other words, countries with high per capita income, were not effective. Because they have very high income levels when compared to other nations. Even among these countries there are significant differences. Thus, even if these countries produce much more, they do not appear to be relatively effective. In fact, the solution of the model assigned unrealizable target values to these countries. However, these unattainable targets are a sign of the abundance of their resources when compared to other countries not failure of these countries. In other words, if it was possible to attain these targets physically, it would be observed that these countries had already reached these targets.

In the present study, DEA was initially applied to the whole sample, then to different groups of countries successively. This method is preferred because countries within a group have similar input-output combinations and it is more realistic to value each country within its own group. Although the application corresponded partially to “context dependent DEA” method, in the present study, the progress and attractiveness scores were not calculated. The said calculations could be the topic of a future study.

The wealthy western countries, which are inefficient in this study, still have large financial resources in their hands after they have utilized their opportunities to increase their socio-economic

development levels, ie to increase the prosperity of their people. They can contribute to the development of these by directing some of these possibilities to underdeveloped poor societies.

On the other hand, countries with little or medium financial resources that have been found to be inefficient in this study, they should allocate a significant portion of their facilities not to armament but to increase the socio-economic development of their country.

Turkey was included in the second efficiency group with Korea, Luxembourg, Poland and Hungary. Although Turkey was ranked in the last place of the group in terms of both single input and all output, it showed similarity with other countries in the group with respect to output value compared to input.

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