



## International Journal of Social Economics

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### Article information:

To cite this document:

Baris K. Yoruk, Osman Zaim, (2003) "Measuring the quality of life in European Union: The case of Turkey as a candidate country", International Journal of Social Economics, Vol. 30 Issue: 11, pp.1162-1176, <https://doi.org/10.1108/03068290310497503>

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# Measuring the quality of life in European Union

## The case of Turkey as a candidate country

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**Keywords** *European Union, Quality of life, Human Development Index, Turkey*

**Abstract** *This paper is aimed at measuring and comparing the quality of life in European Union (EU) and Turkey as an important candidate country on the process of integrating with the EU. Rather than using per capita income as a classical measure, this study uses social indicators of development as a measure of well-being. Instead of using human development index (HDI) – an index commonly referred as “deprivation index” – we adopt the indices that are developed in Zaim, Fare and Grosskopf. The “achievement index” measures the success of a country in the provision of standard of life. On the other hand “improvement index” is used to measure the improvement of the country over time in terms of its life quality. The stated results suggest that Turkey should improve its quality of life on the way of integrating with the EU.*

### Introduction

The history of the EU begins in 1950s. The union, which was originally established by six countries, now with 15 members, is on the way to being the economical and political center of the world. As a result of the integration policy of the union with the other countries of Europe, many countries including Turkey, Hungary, Bulgaria, Cyprus, Malta, Estonia, Poland, Slovenia, Latvia, Bulgaria and Czech Republic formally applied to join the European Community. Among the candidate countries, although Turkey has applied earlier (1987), she is still considered as the weakest candidate. Despite the fact that arguments mostly focus on the political and economical qualifications of Turkey, it should also be noted that Turkey lags behind the member countries in terms of its quality of life. Motivated by this fact, this study measures the well-being in both EU countries and Turkey and aims to provide a well-established methodology for the other candidate countries in measuring their quality of life in their integration process to union.

Table I, provides a comparison of EU and Turkey in terms of their economic and social indicators as an average of eight years from 1990 to 1997 included. The table clearly shows that Turkey lags behind EU in terms of seven social indicators (see “mean” row in Table I). It is known that there exists a positive correlation between the performance in social indicators and the performance in economic figures. This is particularly evident in Turkey’s case with low performance in social indicators and correspondingly low labour productivity as measured by GNP per worker. It is clear that Turkey cannot transform its



Country	Literacy	Primary	Secondary	Hospital	Survival	Life	Health	Capital	Labor	GNP
Austria	100.00	101.79	104.91	9.54	993.36	76.45	1632.50	5.61E+11	3.70E+06	2.25E+11
Belgium	100.00	102.20	134.80	7.55	992.71	76.83	1647.00	5.77E+11	4.12E+06	2.70E+11
Denmark	100.00	99.94	116.89	5.04	994.13	75.13	1734.88	3.07E+11	2.93E+06	1.70E+11
Finland	100.00	99.04	117.54	10.31	994.44	75.99	1457.38	2.85E+11	2.59E+06	1.20E+11
France	100.00	106.26	107.14	9.13	993.67	77.49	1839.63	3.28E+12	2.56E+07	1.50E+12
Germany	100.00	101.05	103.19	9.55	994.00	75.83	2047.88	4.98E+12	4.05E+07	2.37E+12
Greece	95.91	95.03	94.63	5.01	992.30	77.39	941.00	1.25E+11	4.34E+06	1.16E+11
Ireland	100.00	103.80	111.83	3.81	994.16	75.66	1050.38	1.14E+11	1.40E+06	5.22E+10
Italy	98.03	102.26	90.18	6.66	993.12	77.57	1509.50	2.24E+12	2.49E+07	1.05E+12
Luxembourg	100.00	98.52	79.18	9.96	993.09	75.96	1855.63	3.28E+10	1.73E+05	1.90E+10
The Netherlands	100.00	104.44	130.18	11.38	993.44	77.30	1695.63	9.78E+11	7.12E+06	3.89E+11
Portugal	89.24	126.40	98.76	4.33	992.29	74.25	951.75	2.59E+11	4.90E+06	1.02E+11
Spain	96.84	108.42	115.19	4.09	993.65	77.13	1044.25	1.23E+12	1.65E+07	5.44E+11
Sweden	100.00	104.11	122.86	7.79	994.47	78.32	1646.25	3.59E+11	4.72E+06	2.18E+11
UK	100.00	111.94	119.53	5.07	993.67	76.36	1224.63	5.01E+12	2.91E+07	1.07E+12
Mean	98.67	104.35	109.79	7.28	993.50	76.51	1485.22	1.36E+12	1.15E+07	5.47E+11
Turkey	80.81	103.44	54.06	2.43	958.89	67.66	276.50	4.34E+10	2.67E+07	1.67E+11

**Notes:** Literacy: literacy rate (% of people aged 15 and above); Primary: school enrolment, primary (% of gross); Secondary: school enrolment, secondary (% of gross); Hospital: number of hospital beds, per thousand people; Survival: infant survival rate, per thousand births; Life: life expectancy at birth, total years; Health: health expenditures, per capita, PPP (current international \$); Capital: capital stock, constant 1995 prices; Labor: labor force, total; GNP: gross national product, constant 1995 prices

labour force to economic performance and human well-being. When we compare Turkey with the countries in the EU, which has comparable GNP levels such as Greece, Denmark, Finland and Spain, we observe that these countries shows a better performance in social indicators. Although Table I gives us a general idea about the well-being of our sample countries, the formal approach is to use indices as measurement tools.

United Nations Development Programme (UNDP) currently uses the Human Development Index (HDI) – also referred to as the “deprivation index” (Mazumdar, 1999) in measuring the quality of life in different countries. These indices suggest that the European Union countries are high achievers in terms of their social indicators. On the other hand Turkey is not able to transform its capital stock and labour force into human well-being, which is clearly a problem in its integration process with the Union.

Although UNDP uses HDI as a measure of well-being, it is known that these indices lack some desirable axiomatic properties as laid out by the literature on index numbers theory. Most important of all, HDI is designed to measure the performance of a country at a point in time and fail to measure the performance comparisons across time (Ivanova *et al.*, 1999; Anand and Ravallion, 1993; McGillivray, 1991).

Motivated by this fact, this study uses alternative indices to HDI with desirable axiomatic properties that alleviate the problems associated with the over time comparisons (Zaim *et al.*, 2001). The methodology used to translate social indicators of development (e.g. literature rate, infant survival rate, etc.) to indices is known as microeconomic approach to index numbers theory and relies on the assumptions of maximizing behaviour. Our so called “achievement index” measures the performance of a particular country with respect to other countries in terms of the provision of social goods while the “improvement index” shows the improvement of our sample countries over time. All defined measures depend on the computation of distance functions, which are shown to be complete characterizations of production technology (Färe and Primont, 1995).

This paper is organized as follows. The following section constructs the model and introduces the methodology used in this study. The next section is reserved for the application and comparison of Turkey and EU countries and in the final section we conclude.

### **Methodology**

In measuring the achievement of a particular country with respect to other countries in the provision of social goods and the improvement she shows over time, we adopt the indices that are developed in Zaim *et al.* (2001). More specifically while measuring the achievement of country  $i$  with respect to another country  $j$  the index used is a quantity index of social goods

$$Q_s(x^0, y^0, s^i, s^j) = \frac{D_s(x^0, s^i, y^0)}{D_s(x^0, s^j, y^0)},$$

defined over two sub-vector distance functions. Here, the distance function in the numerator shows the success of country  $i$  (which uses the same amount of inputs  $(x^0)$ , and produces the same amount of private goods  $(y^0)$  as country  $j$ ) in expanding its social goods vector  $(s^i)$  with respect to a technology common to both. With the distance function in the denominator defined similarly for country  $j$ , this index compares social goods  $s^i$  and  $s^j$  given a vector of inputs  $x^0$  and a vector of private goods  $y^0$  common to both countries. This quantity index, which is essentially a Malmquist quantity index (see Färe and Primont, 1995) satisfies a number of desirable properties such as homogeneity, time-reversal transitivity and dimensionality due to Fisher (1922).

Since our measures rely on computation of distance functions, this calls for a more formal definition of a distance function. For country  $k$ , which is endowed with resource vector  $x^k$  and producing private goods  $y^k$  and social goods  $s^k$ , a sub-vector distance function is defined by

$$D_s^k(x^k, y^k, s^k) = \inf\{\theta^k : (x^k, y^k, s^k/\theta^k) \in P(x)\}.$$

This function expands the social goods vector (i.e.  $\theta^k \leq 1$ ), so that the expanded social goods vector, the input vector and the private goods vector falls on the frontier (defined as output set  $P(x)$ ), which is common for all the countries. In other words this distance function measures the success of a country in expanding its social goods with respect to a frontier common to all countries. Since the common frontier technology  $P(x)$  is not observed it has to be constructed over the observations on inputs and outputs of  $K$  countries, i.e.  $\{(x^k, y^k, s^k) : k = 1, \dots, K\}$ . For this purpose we formulate an activity analysis or DEA problem.

To describe the output set, suppose we observe a sample of  $K$  countries each of which use inputs  $x = (x_1, \dots, x_N) \in R_+^N$ , to produce a vector of private goods  $y = (y_1, \dots, y_M) \in R_+^M$  and a vector of social goods  $s = (s_1, \dots, s_J) \in R_+^J$ . For a particular country  $k$ , the technology can be described as all feasible vectors  $(x, y, s)$  i.e.  $T^k = \{(x^k, y^k, s^k) : x^k \text{ can produce } (y^k, s^k)\}$ . We further assume that knowledge is freely transferable between countries i.e.  $T^k = T$  for  $k = 1, \dots, K$ . The technology  $T$  may be modeled by output sets  $P(x), x \in R_+^N$  each consisting of all vectors  $(y, s)$  that can be produced by the input vector.

The DEA or piecewise linear output set (see Färe *et al.*, 1994), is:

$$\begin{aligned}
 P(x) = (y, s) : & \sum_{k=1}^K z_k y_{km} \geq y_m, m = 1, \dots, M, \\
 & \sum_{k=1}^K z_k s_{ki} \geq s_i, i = 1, \dots, I, \\
 & \sum_{k=1}^K z_k x_{kn} \leq x_n, n = 1, \dots, N, \\
 & z_k \geq 0 \quad k = 1, \dots, K,
 \end{aligned}$$

where  $z_k$  are the intensity variables, which serve to form the technology from convex combinations of the data.

While measuring the improvement, we will evaluate the success of a particular country in expanding its social goods from year  $t$  to year  $t + 1$  measured with respect to a common (world) benchmark technology constructed for the period  $t$ . Our improvement index:

$$IMP^{t,t+1} = \frac{D_s^{k,t}(x^{k,t}, y^{k,t}, s^{k,t+1})}{D_s^{k,t}(x^{k,t}, y^{k,t}, s^{k,t})}$$

is the ratio of two distance functions where:

$$D_s^{k,t}(x^{k,t}, y^{k,t}, s^{k,t+1}) = \inf\{\theta^{k,t+1} : (x^{k,t}, y^{k,t}, s^{k,t+1}/\theta^{k,t+1}) \in P^t(x^t)\}$$

and

$$D_s^{k,t}(x^{k,t}, y^{k,t}, s^{k,t}) = \inf\{\theta^{k,t} : (x^{k,t}, y^{k,t}, s^{k,t}/\theta^{k,t}) \in P^t(x^t)\}.$$

The first distance function shows the success of an observation, say  $k$ , in expanding its social goods in year  $t + 1$  (with respect to a common frontier which represent the technology at  $t$ ) while using the same level of inputs and producing the same level of private goods as in year  $t$  (i.e.  $x^{k,t}$  and  $y^{k,t}$ ). Similarly, the second distance function measures the success of the same observation in expanding its social goods in period  $t$  with respect to a common frontier representing the technology at  $t$ . Note that, since the distances are measured with respect to the same benchmark (while holding resources and private goods at their year  $t$  levels), the ratio provides the improvement in social good provision for observation  $k$ .

**Application and comparison**

There are various views regarding the selection of the indicators as the measure of quality of life and human development. Human development report (HDR) defines the criteria for this selection process by declaring that:

...the three essential measures are for people to lead a long and healthy life, to acquire knowledge and to have access to resources needed.

In line with this argument this study used seven social indicators as well as gross national product as a proxy for private goods. The seven social indicators are infant survival rate, life expectancy at birth, health expenditures and hospital beds per thousand people as a measure of healthy life, primary and secondary school enrolment and literacy rate as a measure of access to knowledge.

The resource constraint is represented by two aggregate inputs, capital stock and labour force. The data used to compute the achievement and improvement indices of European Union and Turkey is taken from world development indicators (World Bank, 2000) and capital stock is estimated with base year 1995 in line with the methodology used in a recent paper (Nehru and Dhareshwar, 1993).

In constructing our achievement index, Denmark is assigned as our reference country. Then we are assuming that  $l = 0$  which refers to the associated quantities for Denmark. We let  $k = 1, \dots, K$  index the countries in our sample. Thus for a particular year, for each country  $k' = 1, \dots, K$  we compute the following problem:

$$\begin{aligned}
 &(D_y(x^0, s^{k'}, y^0))^{-1} = \max \theta \\
 &st \\
 &\sum_{k=1}^K z_k s_j^k \geq \theta s_j^0 \quad j = 1, \dots, J \\
 &\sum_{k=1}^K z_k y_m^k \geq y_m^0 \quad m = 1, \dots, M \\
 &\sum_{k=1}^K z_k x_n^k \leq x_n^0 \quad n = 1, \dots, N \\
 &z_k \geq 0 \quad k = 1, \dots, K
 \end{aligned}$$

which is the numerator for  $Q_s(x^0, y^0, s^i, s^j)$ . The denominator is computed by replacing  $s^{k'}$  on the right hand side of the social goods constraint with the observed social goods for Denmark, i.e.  $s^0$ . This problem constructs the best practice frontier by using the data, and computes the scaling factor on social goods required for each observation to attain the best practice. This scaling



factor is an aggregate performance measure where weights ( $z$ 's) are determined optimally using observations on inputs, social goods and private goods over the countries for a particular year which is also the property that alleviates the problems regarding the "aggregate deprivation index".

In Table II we present the achievement index of our sample countries between 1990 and 1997, which is constructed by using the methodology above. It should be indicated that, figures greater than 1 (and less than 1) represent a better achievement (and an inferior achievement) with respect to Denmark (respectively). On the other hand, since our index is transitive it allows for bilateral comparisons among all country pairs. By using this fact, for each year, we normalized all the indices by the value of the best performer by assigning a value of 100 for the best achiever so as to provide an easier exposition. These are provided in Table III. Obviously the rankings of the countries in Tables II and III are the same. Both tables show that, although ranking of countries differ considerably from one year to another; Turkey and Luxembourg are the worst performers and Belgium, The Netherlands and Sweden are the top three achievers on average.

To provide a comparison with the alternative, in Table IV we also report the scores obtained from the conventional "aggregate deprivation index" (Mazumdar, 1999; Ivanova *et al.*, 1999) that is used to construct HDI. This index is defined as:

$$A_{ij} = \frac{X_{ij} - X_{i\min}}{X_{i\max} - X_{i\min}}$$

where  $X_{ij}$  is the value of  $i$ 'th indicator for the  $j$ 'th country,  $X_{i\min}$  and  $X_{i\max}$  are the minimum and maximum values for the particular indicator respectively and the aggregate achievement index for the  $j$ 'th country at a particular time is defined as:

$$A_j = (1/n) \sum_{i=1}^n A_{ij}.$$

For a particular year a comparison of quantity index, with aggregate deprivation index, reveals that variation in the aggregate deprivation index is larger. This is theoretically expected since the quantity index is homogenous of degree one in social goods and the aggregate deprivation index has a larger range. On the other hand, although by construction the aggregate deprivation index and quantity index used are different from each other, for the given years, they are approximately in agreement in ranking Belgium, The Netherlands, the UK and Sweden among the top while Luxembourg, Turkey, Greece and Portugal among the worst. The general picture states that Turkey clearly lags behind EU countries in terms of general socio-economic figures indicated.

Country	1990	1991	1992	1993	1994	1995	1996	1997	Average	Rank
Austria	0.9496	0.9600	0.9526	0.9235	0.8864	0.8613	0.8344	0.8323	0.900	11
Belgium	0.9423	0.9401	1.2672	1.2557	1.2306	1.2081	1.1834	1.1725	1.150	1
Denmark	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.000	6
Finland	1.0659	1.0963	1.0545	1.0296	0.9756	0.9571	0.9491	0.9385	1.008	5
France	0.9020	0.9210	0.9088	0.9574	0.9360	0.9191	0.8998	0.8906	0.917	10
Germany	0.9002	0.9119	0.9428	0.9191	0.8813	0.8588	0.8376	0.8384	0.886	13
Greece	0.8544	0.8674	0.8302	0.8217	0.7963	0.7870	0.7706	0.7628	0.811	14
Ireland	0.9203	0.9319	0.9946	0.9870	0.9680	0.9571	0.9499	0.9441	0.957	8
Italy	0.7774	0.7684	0.7721	0.7922	0.7811	0.7754	0.7641	0.7604	0.774	15
Luxembourg	0.6832	0.6267	0.6434	0.6461	0.6780	0.7023	0.7108	0.7229	0.677	17
The Netherlands	1.0943	1.0963	1.0974	1.2183	1.1726	1.1346	1.0622	1.0391	1.114	2
Portugal	0.9305	0.8299	0.8436	0.8852	0.8948	0.9141	0.9216	0.9393	0.895	12
Spain	0.9533	0.9700	1.0018	1.0061	0.9958	1.0083	0.9661	0.9808	0.985	7
Sweden	0.8260	0.8311	1.0795	1.1078	1.1111	1.1272	1.1341	1.1510	1.046	3
UK	0.7857	0.8047	1.1376	1.1339	1.1246	1.0991	1.0420	1.0280	1.019	4
Mean	0.9057	0.9037	0.9684	0.9789	0.9621	0.9540	0.9350	0.9334	0.943	9
Turkey	0.7472	0.6569	0.6447	0.6270	0.7147	0.7488	0.7647	0.7815	0.711	16

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**Table II.**  
Achievement index

**Table III.**  
Achievement index,  
best = 100

Country	1990	1991	1992	1993	1994	1995	1996	1997	Average	Rank
Austria	86.78	87.57	75.17	73.54	72.03	71.29	70.51	70.99	75.98	11
Belgium	86.11	85.75	100.00	100.00	100.00	100.00	100.00	100.00	96.48	1
Denmark	91.38	91.22	78.91	79.64	81.26	82.77	84.50	85.29	84.37	6
Finland	97.40	100.00	83.21	81.99	79.28	79.22	80.20	80.04	85.17	5
France	82.43	84.01	71.72	76.24	76.06	76.08	76.04	75.96	77.32	10
Germany	82.26	83.18	74.40	73.19	71.62	71.09	70.78	71.51	74.75	13
Greece	78.08	79.12	65.51	65.44	64.71	65.14	65.12	65.06	68.52	14
Ireland	84.10	85.00	78.49	78.60	78.66	79.22	80.27	80.52	80.61	8
Italy	71.04	70.09	60.93	63.09	63.47	64.18	64.57	64.85	65.28	15
Luxembourg	62.43	57.17	50.77	51.45	55.10	58.13	60.06	61.65	57.10	17
The Netherlands	100.00	100.00	86.60	97.02	95.29	93.92	89.76	88.62	93.90	2
Portugal	85.03	75.70	66.57	70.49	72.71	75.66	77.88	80.11	75.52	12
Spain	87.12	88.48	79.06	80.12	80.92	83.46	81.64	83.65	83.06	7
Sweden	75.48	75.81	85.19	88.22	90.29	93.30	95.83	98.17	87.79	3
UK	71.80	73.40	89.77	90.30	91.39	90.98	88.05	87.68	85.42	4
Mean	82.76	82.43	76.42	77.96	78.19	78.96	79.01	79.61	79.42	9
Turkey	68.28	59.92	50.88	49.93	58.08	61.98	64.62	66.65	60.04	16

Country	1990	1991	1992	1993	1994	1995	1996	1997	Average	Rank	Measuring the quality of life
Austria	0.6005	0.6847	0.6641	0.6593	0.6454	0.6394	0.6335	0.6406	0.6459	7	
Belgium	0.6051	0.6527	0.6935	0.6917	0.6852	0.6832	0.6805	0.6772	0.6711	5	
Denmark	0.5975	0.6050	0.5788	0.5898	0.5850	0.5868	0.5896	0.5929	0.5907	12	
Finland	0.6038	0.7127	0.6735	0.6507	0.6358	0.6244	0.6238	0.6166	0.6427	8	
France	0.7141	0.7873	0.7611	0.7683	0.7611	0.7608	0.7524	0.7490	0.7568	2	
Germany	0.7272	0.7992	0.7930	0.7836	0.7793	0.7876	0.7950	0.7813	0.7808	1	1171
Greece	0.4941	0.4990	0.4724	0.4688	0.4675	0.4616	0.4667	0.4669	0.4746	16	
Ireland	0.5300	0.5341	0.5491	0.5393	0.5330	0.5310	0.5290	0.5288	0.5343	14	
Italy	0.6168	0.6609	0.6453	0.6348	0.6172	0.6094	0.6108	0.6055	0.6251	10	
Luxembourg	0.5016	0.6021	0.6193	0.6574	0.5992	0.5969	0.5955	0.5969	0.5961	11	
The Netherlands	0.6582	0.7424	0.7192	0.7777	0.7662	0.7589	0.7487	0.7455	0.7396	3	
Portugal	0.4670	0.4993	0.5068	0.5166	0.5226	0.5251	0.5216	0.5306	0.5112	15	
Spain	0.5950	0.5947	0.5821	0.5790	0.5727	0.5769	0.5803	0.5759	0.5821	13	
Sweden	0.6087	0.7109	0.6912	0.6859	0.6794	0.6830	0.6847	0.6784	0.6778	4	
UK	0.5920	0.6152	0.6931	0.6855	0.6853	0.6833	0.6760	0.6760	0.6633	6	
Mean	0.5941	0.6467	0.6428	0.6459	0.6357	0.6339	0.6325	0.6308	0.6328	9	
Turkey	0.1644	0.0256	0.0310	0.0356	0.0412	0.0555	0.0623	0.0609	0.0596	17	

**Table IV.**  
Deprivation index

To expose a definite comparison, in Table V, we provide the Spearman rank correlations between the aggregate deprivation index and our achievement index. Owing to the difference in methodology used – our index accounts for the resource use and the provision of private goods, the aggregate deprivation index does not – the correlation between two indices is quite low in given years. Highest correlation observed is in 1993 (0.587). Another difference worth noting is that, while achievement index produce quite different rankings of countries in subsequent time periods (as evidenced by low Spearman correlations) aggregate deprivation index produces more or less the same ranking.

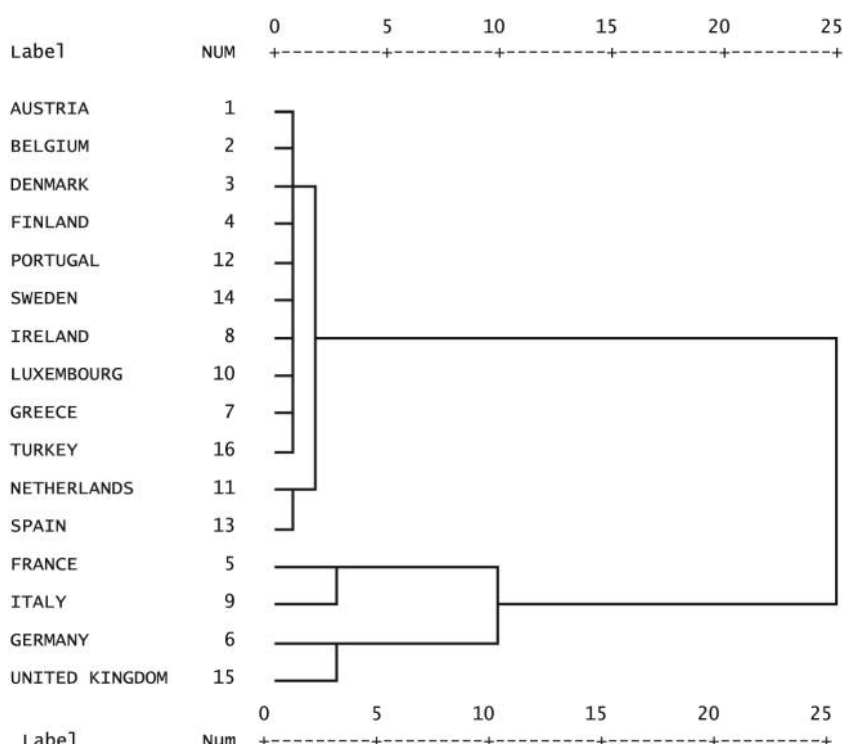
In Figures 1 and 2, we report the cluster analysis for our sample countries. In Figure 1, economic variables are used for analysis and social indicators are excluded. It can be seen that France, Italy, the UK and Germany are grouped together while remaining countries form another group. The analysis shows that Turkey can be grouped with EU in terms of its economic indicators. On the other hand, Figure 2 shows the cluster analysis for the sample countries in terms of their achievement in seven different years for seven social indicators and GNP figures. In this analysis we observe small groups. Luxembourg and Turkey are grouped together as expected. Cluster analysis shows that Turkey is grouped with the best achievers such as France, Germany, the UK, Belgium and The Netherlands only at the final stage.

As a final analysis, to compute the improvement index used in this study, for the numerator of  $IMP^{t,t+1}$ , for each  $k'$ , we solve the following linear programming problem:

**Table V.**  
Spearman rank  
correlations

	D90	D91	D92	D93	D94	D95	D96	D97	A90	A91	A92	A93	A94	A95	A96	A97
D90	1.000															
D91	0.977	1.000														
D92	0.966	0.986	1.000													
D93	0.955	0.980	0.994	1.000												
D94	0.965	0.980	0.994	0.997	1.000											
D95	0.965	0.978	0.992	0.995	0.999	1.000										
D96	0.968	0.979	0.993	0.995	0.999	1.000	1.000									
D97	0.965	0.978	0.992	0.995	0.999	1.000	1.000	1.000								
A90	0.438	0.408	0.342	0.348	0.381	0.375	0.371	0.374	1.000							
A91	0.584	0.541	0.480	0.472	0.505	0.497	0.495	0.495	0.963	1.000						
A92	0.566	0.523	0.568	0.546	0.585	0.585	0.582	0.581	0.604	0.692	1.000					
A93	0.593	0.553	0.592	0.587	0.626	0.626	0.620	0.620	0.636	0.705	0.978	1.000				
A94	0.488	0.446	0.494	0.494	0.534	0.536	0.530	0.530	0.567	0.618	0.961	0.986	1.000			
A95	0.424	0.386	0.435	0.437	0.476	0.480	0.473	0.474	0.528	0.565	0.937	0.963	0.993	1.000		
A96	0.368	0.339	0.386	0.383	0.421	0.426	0.421	0.421	0.495	0.519	0.910	0.929	0.970	0.989	1.000	
A97	0.329	0.304	0.350	0.346	0.384	0.391	0.386	0.387	0.463	0.478	0.881	0.898	0.948	0.976	0.996	1.000

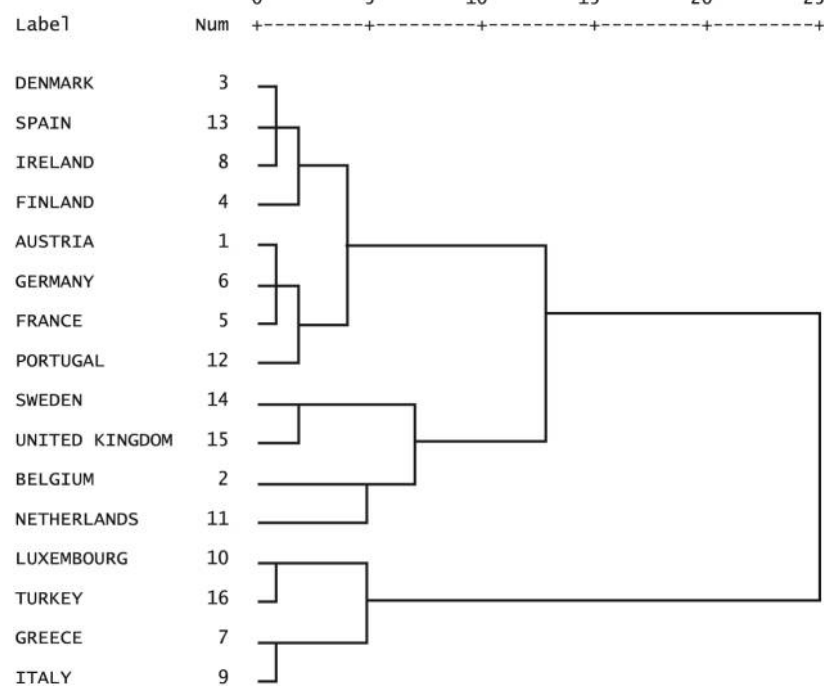
**Note:** A indicates Achievement Index, D indicates Depreciation Index



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**Figure 1.**  
Cluster analysis  
excluding social  
indicators



**Figure 2.**  
Cluster analysis,  
achievement index

$$(D_s^{k',t}(x^0, s^{k'}, y^0))^{-1} = \max_{st} \theta^{k',t+1}$$

$st$

$$\sum_{k=1}^K z_k s_{kj}^t \geq \theta^{k',t+1} s_{k'j}^{t+1} \quad j = 1, \dots, J$$

$$\sum_{k=1}^K z_k y_{km}^t \geq y_{k'm}^t \quad m = 1, \dots, M$$

$$\sum_{k=1}^K z_k x_{kn}^t \leq x_{k'n}^t \quad n = 1, \dots, N$$

$$z_k \geq 0 \quad k = 1, \dots, K.$$

The denominator can be computed in a similar fashion by replacing  $\theta^{k',t+1}$  with  $\theta^{k',t}$  and  $s_{k'j}^{t+1}$  on the right side of the first inequality with  $s_{k'j}^t$ .

In Table VI, we provide the improvement indices for the sub-periods as well as for the entire period from 1990 to 1997, which we construct by using the methodology above. Note that the improvement between 1990 and 1997 is computed by the sequential multiplication of the improvements in each year period. An analysis of the figures in Table VI shows that, although improvement index varies both between the countries and also from one sub-period to another one, the most significant improvement has been during 1991-1992 period. Evaluated with respect to the entire time span between 1990 and 1997, we observe that all countries improved in terms of the quality of life. The significant fact is that Turkey is the best improver while Luxembourg is the second for the entire time span. This is expected since these countries are among the worst in achievement index and are trying to catch up with EU.

### Conclusion

In this study we report the achievement indices of Turkey and the EU, which is used to measure the well-beings of individuals in different countries and geographic locations. We also use an improvement index, which alleviates the problems associated with overtime comparisons of “aggregate deprivation index”. Cluster analysis is applied to observe the similar country bundles.

The “achievement index” measures the success of a country in the provision of standard of life. On the other hand “improvement index” is used to measure the improvement of the country over time in terms of its life quality.

In our analysis we found that Turkey lags behind the EU in given achievement index, that is used as a measure of well-being. On the other hand the results of improvement index show that Turkey improves its quality of life by considerable amount during a given time span. The general picture states

Country	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1990-1997	Average	Rank
Austria	1.0193	1.0085	0.9962	0.9915	0.9905	0.9904	1.0087	1.0047	1.0007	17
Belgium	1.0058	1.3700	1.0183	1.0125	1.0007	1.0014	1.0020	1.4265	1.0587	5
Denmark	1.0082	1.0163	1.0277	1.0330	1.0194	1.0223	1.0113	1.1464	1.0197	11
Finland	1.0369	0.9776	1.0034	0.9789	1.0000	1.0138	1.0000	1.0094	1.0015	16
France	1.0294	1.0030	1.0826	1.0100	1.0009	1.0009	1.0009	1.1320	1.0182	13
Germany	1.0214	1.0508	1.0019	0.9905	0.9933	0.9971	0.9952	1.0498	1.0072	15
Greece	1.0236	0.9728	1.0172	1.0818	1.0725	1.1528	1.0416	1.4111	1.0518	6
Ireland	1.0209	1.0848	1.0198	1.0132	1.0078	1.0147	1.0051	1.1762	1.0238	10
Italy	1.0145	1.0213	1.0544	1.0187	1.0119	1.0075	1.0063	1.1417	1.0192	12
Luxembourg	1.0552	1.1146	1.1230	1.0834	1.0800	1.0342	1.0392	1.6609	1.0757	2
The Netherlands	1.0100	1.0174	1.1409	0.9943	0.9864	0.9571	0.9894	1.0888	1.0136	14
Portugal	1.0259	1.0331	1.0784	1.0442	1.0414	1.0307	1.0307	1.3204	1.0406	7
Spain	1.0259	1.0496	1.0321	1.0225	1.0321	0.9795	1.0268	1.1796	1.0241	9
Sweden	1.0144	1.3202	1.0546	1.0361	1.0341	1.0286	1.0264	1.5976	1.0735	3
UK	1.0327	1.4368	1.0244	1.0245	0.9963	0.9692	0.9977	1.5002	1.0688	4
Geometric Mean	1.0229	1.0899	1.0442	1.0219	1.0174	1.0125	1.0120	1.2401	1.0315	8
Turkey	1.1429	1.1454	1.0654	1.0543	1.0380	1.2088	1.1424	2.1077	1.1139	1

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Table VI.  
Improvement index



that although Turkey has high economic potential, it is not able to transform this to human well-being. This is one of the biggest problems that Turkey has to overcome during the process of integration with the EU.

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