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Quality of Life Measurement across European Union Countries – An Exploratory Approach

*Iustina Alina BOITAN – Ionela COSTICA**

Abstract

The paper relies on the newest set of quality of life dimensions defined by the European Commission, in order to achieve a two-fold purpose: to obtain a detailed image of European Union countries' synchronization in terms of each quality of life dimension and to create a new, comprehensive metric of a country's overall quality of life by aggregating the information provided by each specific dimension. Thus, our complementary research approach relies on: i) an in-depth exploratory analysis to assess European Union countries' resemblance in terms of quality of life dimensions; ii) the development of a novel rating system, which serves as a barometer for the quality of life status and allows countries' ranking. The findings revealed that increased resemblance between countries appeared for governance and basic rights indicators, productive activity and education indicators, while the highest dissimilarity was present for the living environment indicators and material living conditions indicators.

Keywords: *quality of life, well-being index, rating system, cluster analysis*

JEL Classification: C38, O10

Introduction

Quality of life is a complex phenomenon covering various dimensions of people well-being, which cannot be accurately assessed by means of a single indicator. Although GDP per capita has been extensively used as a traditional indicator for measuring the degree of economic and social development, increasingly more international organizations, public policy institutes, research institutions or academia have developed their own quantitative measures of a country's quality of life, most often by aggregating several objective or subjective dimensions into an index.

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Against this background of heterogeneity and lack of consensus stemming from the various criteria considered, the index coverage, the mixed advantages and drawbacks which haven't been systematically evaluated, the European Commission has initiated in 2009 the action "GDP and beyond – Measuring progress in a changing world" with the stated purpose of identifying or developing new environmental and social indicators, meant to accurately complement standard economic indicators, such as GDP. As a consequence, in May 2013 the European Commission has launched its own conceptual framework for defining and measuring the quality of life. It is still a work in progress as the European Commission envisages a multidimensional approach in order to cover as comprehensively as possible all aspects of quality of life.

Another influential report devoted to the study of GDP limits as an indicator of economic performance and social progress and to the investigation of alternative measurement tools of the social progress has been elaborated by Stiglitz, Sen and Fitoussi (2008), as an outcome of the Commission on the Measurement of Economic Performance and Social Progress. The report is addressed to political leaders, to policy-makers, to civil society, to academics and statisticians. It emphasizes that people well-being is related both to economic resources and non-economic life issues, quality of life being a broader concept that encompasses all these aspects.

At present, there is an imperative need for new and improved statistical measures of people well-being, "aimed at filling the gap between standard macroeconomic statistics that sometimes are used as proxies of people's welfare and indicators that have a more direct bearing on people's life" (OECD, 2016). This view is fully acknowledged by Eurostat (2015, p. 8) which explains that "the statistical gaps need to be filled in order to complement GDP with indicators that monitor social and environmental progress".

The objective of this paper subscribes to the views above mentioned and aims to investigate the cross-country specific patterns depicted by each of the eight dimensions identified by the European Commission, in terms of strengths and weaknesses and to further aggregate them into a composite rating system. To our knowledge it is the first empirical research that comprehensively employs all the quality of life dimensions recently developed by the European Commission and monitored at European Union level. Most existing studies focus on investigating a single quality of life dimension (for instance health dimension by Romero, Vivas-Consuelo and Alvis-Guzman, 2013; Meiselman, 2016; Pinto et al., 2017; work life by Vinopal, 2009; Clark, 2015; Steffgen et al., 2015; quality of employment by United Nations Economic Commission for Europe 2015; environment by Feneri, Vagiona and Karanikolas, 2013). Moreover, to perform our

analysis we rely on official frameworks and classifications, without any arbitrary, subjective judgments regarding the selection of quality of life indicators and dimensions, as previous studies do.

Given that measuring people well-being is a topic of great importance on the agenda of policymakers and that the results to be obtained might be used as starting point for designing appropriate public policies or for further research, we decided to follow a two-fold approach.

The first research approach aims at performing a granular, in-depth analysis in order to identify European countries depicting similar patterns of the various quality of life dimensions. More specifically, we rely on an exploratory data analysis method called Cluster Analysis, which provides reliable classifications by merging countries into homogenous groups sharing similar features. The main goal of this method is to identify those countries showing increased similarity, by helping explain which factors/indicators accounted for this resemblance. The analysis will be performed distinctly, for each quality of life dimension, to uncover whether the resemblance pattern persists across countries irrespective the dimension considered or there is presence of heterogeneity. The findings retrieved by the cluster analysis method are useful for country decision makers as they allow the screening through a large number of indicators and provide a snapshot of countries' resemblance at a given moment of time.

The second research direction complements the previous one, as it attempts to reconcile the informational content provided by the manifold quality of life dimensions into a single metric or score. The method that best suits our purpose is represented by the configuration of a rating system, similar to the one employed by banking supervisory authorities for monitoring the soundness and stability of banks.

Our research approach was motivated by the increased focus shown by decision makers on the importance of monitoring achievements in raising people's quality of life. Moreover, given the increasing number and complexity of the underlying factors contributing to a sound state of quality of life, further research should be done in order to create a tool meant to aggregate in a single comprehensive metric the various dimensions of the quality of life concept. Therefore, our specific aim is to develop a systematic tool, by relying on the well-known and large scale used rating system methodology, which is able to signal the overall status of quality of life a country exhibits at a given moment of time. The ratings assigned to each country will serve for monitoring purposes and will help decision makers in understanding which quality of life dimensions/indicators have to be improved by designing and implementing appropriate public policies and strategies. The advantages of relying on information provided by a composite

indicator or rating have been discussed in a guideline published by Eurostat (2014, p. 3), claiming that "indicators constitute an essential resource for policy-makers, business leaders and the general public. They assist us in making evidence-based decisions, allow comparisons to be made over time and between policies and programs, countries and regions, social groups and industries, and contribute to increased transparency and accountability. Indicators also provide a very powerful way of communicating information". As this empirical study is devoted to a broad range of audience, from academia to policymakers, the rationale at the root of the statistical models employed throughout the paper has to be reliable, accessible, easy to understand and replicate.

The paper is divided into five main sections, as follows: section 1 provides a comprehensive overview of previous attempts for quantifying people's quality of life, by relying on various indices and metrics. Section 2 outlines the two-fold purpose of our research and its novelty features, describes the methodologies to be employed in order to extract meaningful information from each dimension proposed by the European Commission and summarizes the indicators to be further used in the study. Section 3 depicts the empirical results of the first research direction, represented by performing a cluster analysis for each quality of life dimension, over a couple of years, while section 4 develops a monitoring tool, based on the well-known methodology of rating systems, to assess and monitor the developments recorded by each European Union (EU) member state in terms of inhabitants' quality of life. The last section concludes.

1. Overview of Existing Attempts for Quantifying Quality of Life

In the following we performed a brief review of the historical approaches for the quality of life definition and measurement, developed in the last decades by various institutions, such as research centers, non-governmental organizations, and international organizations to shed light on past achievements and create the background for the introduction of a new barometer of well-being across EU countries.

A first attempt belongs to OECD (1973, p. 1) which elaborated a report meant to contribute to the development of a set of fundamental social objectives to be further brought into the public discussion and governmental decision-making. It has been identified twenty four main social concerns, common to most OECD Member countries, "according to the following basic criteria: a) concerns which are of present or potential interest to Member governments; b) fundamental human aspirations or concerns as opposed to means or instrumental aspects of well-being; c) major, essential aspects of well-being".

In the next years several researchers have individually created various types of social indicators or indices. The International Index of Social Progress (ISP) has been developed in 1974 by researcher Richard Estes from the University of Pennsylvania. It measures economic development, social and political conditions, and the ability of nations to produce welfare services for their citizens.

In 1977 it has been developed the German System of Social Indicators, as a result of a research project carried out by the Social Policy Research Group at Frankfurt and Mannheim universities. According to Noll (2014a), the German System of Social Indicators had been the first full-fledged national system of social indicators in Europe.

At present this indicator system still exists and is maintained by the Social Indicators Research Centre at GESIS-ZUMA. In addition, the centre has developed in 2000 a second system, called the European System of Social Indicators, in order to "continuously monitor and analyze the individual and societal well-being of European citizens in terms of quality of life, social cohesion and sustainability as well as changes in the social structure of European societies" (Noll, 2014b, p. 1).

In 1990 the United Nations Development Programme launched the Human Development Index, which focuses on three key dimensions of human development: a long and healthy life, awareness and decent standard of living. Another researcher (Cummins, 1997), created the Comprehensive Quality of Life Scale (ComQol), which describes quality of life as a sum of both objective and subjective domains: material well-being, health, productivity, intimacy, safety, place in community and emotional well-being.

Redefining Progress, a non-governmental organization located in US launched in 1995 the Genuine Progress Indicator. As well as GDP, it comprises personal consumption adjusted with income distribution, plus the value of household, volunteer work and leisure time, and subtracts the costs of crime and pollution. Starting from the premise that existing indices have a narrow coverage of the well-being dimensions, Diener (1995) defined a basic quality of life index, to be used by developing countries, and an advanced quality of life index, designed for highly industrialized countries.

Another attempt, called Index of Economic Well-being has been launched in 1998 by the Centre for the Study of Living Standards in Canada (Osberg and Sharpe, 1998), having its roots in a research paper written by Lars Osberg (1985). It is composed by four areas of economic well-being: effective per capita consumption flows, net societal accumulation of stocks (in terms of productive resources, housing stocks, natural resources stocks, environmental costs, level of foreign indebtedness, accumulation of human capital, the stock of R&D investment), income distribution, including the intensity of poverty and economic security from job loss and unemployment, illness, family breakup, and poverty in old age.

One of the most recent initiatives belongs to the Organization for Economic Cooperation and Development (OECD) which has launched in May 2011 the Better Life Index. It relies on 11 topics related to living conditions and quality of life, its main peculiarity consisting in the interactive and subjective nature, as each individual might assign his own weight to each of the 11 dimensions of the index. Some research papers (Boarini and D'Ercole, 2013) have analyzed from a qualitative standpoint the multidimensional framework underlying the OECD Better Life initiative, by emphasizing how this new wellbeing measure helps overcoming several GDP limitations, as main measure of people's welfare.

On this historical background the European Commission added in 2013 its own official set of eight quality of life dimensions, lacking however the quantitative methodology for aggregating them into a single, comprehensive metric. According to Eurostat (2015, p. 9), this multidimensional framework "includes the full range of factors that influence what people value in living, beyond the purely material aspects" and acts complementary to the GDP, which has been largely perceived as a traditional measure of economic and social development.

By analyzing the historical approaches for the quality of life measurement one can notice that several dimensions have been considered too by the European Commission in designing its own framework. The dashboard developed as a result of academic and expert group research comprises a series of indicators, grouped into several main dimensions which are closely related with the quality of life status and are seen as of utmost importance in gaining a comprehensive view of quality of life.

A dashboard approach has its own pros and cons. As Stiglitz, Sen and Fitoussi (2008) argue the co-existence of various dashboards is a sign of heterogeneity and lack of harmonization in defining quality of life coverage. The main criticism is that they gather too many indicators to act as efficient communication tools, a suggestion being related to maintaining parsimony when deciding to build it. The multidimensional view of quality of life has the advantage of stimulating the accuracy and statistical production of indicators, the refinement of data collection methods and reporting. This will be further translated into increased soundness and reliability of analyses on quality of life trends over time and across countries.

2. Research Goal, Methodologies and Data Issues

The paper investigates two complementary research directions:

(i) an in-depth, exploratory one, consisting of performing a Cluster Analysis to get an insight on the resemblance pattern, in terms of quality of life indicators,

across the EU countries. The analysis is repeated for each year in the sample (2008 and 2009 as crisis years, and respectively 2014 and 2015 representing the most recent available data) and each quality of life dimension, so as to observe whether clusters' composition changes significantly. These findings allow ascertaining those countries persistently depicting similar developments in terms of quality of life issues, as well as best or worst performers.

(ii) the development of a rating system which aggregates the different quality of life dimensions defined by the European Commission into a single metric, called composite well-being rating. The rating system allows the comprehensive comparison of European countries' relative standing in achieving the European Commission's quality of life goals over time. The final result will consist in creating a barometer for signaling where a country's quality of life positions itself at a given moment in time and how this hierarchy looks like for EU countries. Trends over time and discrepancies or resemblances between EU countries have been discussed by considering a time window of five years, from 2010 to 2014.

In the following we provide a theoretical description of the two methodologies that have been employed. The first research methodology is represented by Cluster Analysis, a statistical procedure that uncovers patterns of similarity between countries, based on the intrinsic features of a given set of variables. Cluster Analysis allows the classification of heterogeneous entities by relying upon one or more variables, and the identification of homogenous groups of countries that depict similar levels of the quality of life indicators. More specifically, the countries gathered in the same group depict increased similarities than those in other groups.

According to Jensen (1971, p. 36), the clustering procedure is built on the implicit "criterion of cluster homogeneity (or compactness), which forms the basis for merging entities into clusters". The author suggests the use of this "quantitative analysis of affinity or similarity" (p. 37) in cases when the researcher holds a large amount of data which has to be first classified, in order to increase its understanding and meaningfulness.

Applying this technique requires the use of a representative sample of countries, as the pattern of resemblance (similarity) identified by means of Cluster Analysis cannot be extrapolated to the entire population, it is valid only for the original sample.

Neri et al. (2017, p. 81) explain that, due to countries' evolution over time, it might be useful to repeat the cluster analysis over successive periods of time in order to assess and compare the development path of every country as well as the dynamics of this process.

Our approach employs an agglomerative hierarchical clustering which first treats each country as a distinct cluster and then, by successive iterations, the most resembling countries will be merged together in larger clusters. The clustering technique comprises a succession of algorithms for computing distances or similarity between countries, with the final aim of classifying them into more meaningful, homogenous groups.

Therefore, in cluster analysis there have to be performed two major computational steps, namely: (i) measuring the proximity or distance (in terms of similarity) between individual countries, and (ii) measuring the proximity between groups of countries, for larger cluster formation purpose. First, the distance between individual countries is computed by means of the squared Euclidean distance algorithm. Some authors (Wolfson, Zagros and James, 2004; Gutierrez and Sorensen, 2006; Irac and Lopez, 2015) are proponents of this linkage rule as it is able to identify outliers, by putting greater weight on countries whose intrinsic features, in terms of quality of life indicators, are highly varying. The larger its value, the more dissimilar the two countries considered. The general formula for computing the proximity between two individual countries is: Squared Euclidean distance = $\sum_{i=1}^{n}\left(pi - qi\right)^2$, where p_i and q_i (i =1, …n) are two points in the Euclidean n-space.

Secondly, the distance between clusters is computed by relying on another metric, called linkage rule. We relied on a well-known and used metric, namely Ward's method for the subsequent merging of already created groups. At the root of this method lies the calculation of variance, as dissimilarity metric, with the aim of minimizing within-cluster contribution to the overall variance of a given variable, or the equivalent of maximizing between-cluster contribution (Irac and Lopez, 2015, p. 6). The general Ward formula for combining clusters A and B = $\frac{nA \times nB}{nA + nB}\left(cA - cB\right)^2$

where

nA and *nB* – the number of countries in clusters *A* and *B*, respectively,
cA and *cB* – the centers of the two clusters.

The results of cluster analysis take the form of a tree-like diagram (dendrogram) which displays the whole hierarchical process of mergers between countries and groups of countries and the progressive cut-off distances at which clusters merge. The peculiarity of agglomerative clustering is the progressive relaxing of the linkage metric, which implies that clusters are merged into larger and larger clusters until the final stage, represented by a single, big cluster. For the purpose of this study we have chosen a cut-off distance equal to 5, so as to preserve the greatest similarity between the countries included in a cluster and soundly interpret the results.

The second research direction proposes a novel approach in the field of quality of life metrics, namely the design of a rating system for the monitoring of people's well-being in a successive timeframe. Due to data availability constraints, the ratings were computed for the years 2010 to 2014. The starting point in the configuration of this rating system is represented by the already existing rating system developed by central banks and banking supervisory authorities, namely CAMELS which is applied for banks. This methodology is worldwide used and accepted by monetary decision makers, at the same time being easy to apply, understand and explain to the public. It will be further adapted in order to serve the specific purpose of our analysis. It worth to be mentioned that it is the first time this rating methodology is used for assessing the overall quality of life status. Existing academic research applies the CAMELS rating methodology exclusively for evaluating the soundness and financial health of a banking system.

CAMELS is a monitoring system developed by the Federal Financial Institutions Examination Council in late 1979 to provide an overall assessment, based on both qualitative and quantitative indicators, on banks' regular activity. It acts as a supervisory tool, the major goal being to monitor the soundness and stability of the whole banking system. Each letter in the acronym stands for a given component, namely: Capital adequacy, Asset quality, Management capability, Earnings, Liquidity and Sensitivity to market risks. Each of the six components is assigned an individual score or rating ranging between 1 and 5, according to the notation scale developed for each component. The rating 1 exhibits best performance while a rating of 5 indicates the weakest performances or practices. The individual ratings are then combined into a composite, general rating to give an overall view on a bank's sound activity. In practice, central banks assign a composite rating of 1 or 2 to a bank only if all the individual ratings obtained by the bank are maintained at a good level (of 1 or 2). Composite ratings of 3 or below suggest the need for increased supervision from supervisory authorities and reconfiguration of managing board's strategies.

The reason for employing this monitoring tool within our paper resides in its flexibility, as the rating system can incorporate anytime new dimensions or indicators, as they will be further defined by European Commission and historical time series become available. Some authors (Costea, 2014) claim that a drawback of existing rating systems resides in central banks' freedom to establish which indicators should be used for evaluating each banking activity dimension (capitalization, liquidity, profitability etc.). Also, the notation scale underlying a given rating score is mostly based on the practical experience of monetary decision makers. Our approach removes this relatively arbitrary, subjective character due to the fact that we employ the dimensions and indicators defined, computed and published by European Commission.

The specific features of a rating system have been adapted to the peculiarities of our research topic. The novelty of our approach consists in:

- broad geographical coverage of EU countries, as it will be generated a composite rating score for each of them;
- reliance on indicators' time series, with no preliminary statistical processing so as not to distort their informational content and implicitly the individual rating to be attributed;
- computation of correlation coefficients between the indicators of each dimension and removal of those indicators highly correlated. Keeping in the analysis of all correlated indicators would have meant an additional weighting of a given characteristic, although we apply the no weighted arithmetic average;
- building notation scales for each indicator, by relying on historical minimum, maximum and average levels of indicators, as well as on benchmarks proposed by the European Commission or OECD.

The specific steps followed in order to design the quality of life rating system and the individual and composite ratings attributed to each country are detailed in section 4.

The input data to rely on during both research directions comprises the eight dimensions defined by the European Commission for an overall assessment of quality of life in European Union and are represented by: material living conditions, productive or main activity, health, education, leisure and social interactions, economic and physical safety, governance and basic rights, natural and living environment. For leisure and social interactions dimension data is available only for 2006 year-end; consequently, it has been removed from our statistical analysis.

Each of the seven remaining dimensions have been quantified through several proxy indicators (proposed too by the EC), summarized in the Table 1 (see the Appendix[1]). We proceeded to testing the presence of correlations between indicators describing a given dimension and removal of strongly correlated indicators so as to not distort the final results of both research directions or to not put excessive weighting on a dimension's feature. This approach is in line with Lorentz et al. (2016, p. 182) which argue that multicollinearity between variables triggers "an uneven influence on cluster solution". Consequently, based on the values recorded by the Pearson correlation coefficient, we removed from the further analyses the indicators exceeding a correlation of 0.75, namely: monetary

[1] Appendix is available on:
<https://www.brainmap.ro/index.php?&sm=module.org.bm2.authMenuPage&ddpN=4210098090&we=e368dfaed7f82d10d78f6c37d2840bfd&wf=dGFCall&wtok=8cd9b319229bb3e36de81416cef2f5c9947ff933&wtkps=HcxbDsIgEEDRvfDfhraWx7gGE7cwU3A0fRmBEDHu3crf/Ti5CAN8AowgcpyXIM4Bhh4EWRxv2nYnlCSlIrQanbaDdFJNNKrqQISHq2VBGBnN9sz8ZhtVUbPuJi4cfdOllTOFpmjFhv78+GdfQ4NYd5cW3+4vbmntW0zxfvFbuiIf5PsD&wchk=02315eb0bdc49285c9ec5f6db144b0d608e708af>.

poverty of employed people (from material living conditions' dimension), unemployment rate (from productive or main activity dimension), and ICT specialists in the labor force (from education dimension). The matrix of correlations computed for indicators included in a given quality of life dimension is presented in Tables 2 – 7 (see the Appendix).

3. EU Countries' Clustering for Each Quality of Life Dimension

The empirical analysis has been run for the year 2008 and then repeated for 2009, 2014 and 2015. It has been chosen the years marking the beginning of the financial crisis and the most recent time frame so as to compare the composition of groups during both distressed and sound periods and identify stable relationships between EU countries in terms of quality of life dynamics. The results of cluster analysis, represented by the classification tree or dendrogram obtained for each quality of life dimension have been summarized and discussed in the following. The visual representation of the dendrograms can be found in the appendix (Figures 1 to 26). The clustering solution obtained by aggregating material living conditions indicators shows the presence of some persistent common patterns across several EU countries, as they have always been positioned in the same cluster, in each year considered. Figure 27 in the appendix illustrates the map of those countries witnessing stable resembling patterns during a four-year timeframe.

The clusters composed by: (i) Portugal, Romania, Belgium, Italy, Cyprus, Slovenia, Lithuania and (ii) Bulgaria, Estonia, Latvia, Croatia reveal the presence of acute problems as regards the distribution of income between people with the highest income and those with the lowest income, as well as for the disposable income for elderly which lies below the at-risk-of-poverty threshold. However, they position slightly better in terms of material living indicators than the remaining countries. For instance, inhabitants in Germany are suffering the most from noise (25.8% of population in 2015), closely followed by those living in Malta and Netherlands. The lowest noise exposure is witnessed by inhabitants from Croatia with only 8.4% of the entire population, followed closely by Bulgaria and Estonia. In terms of housing deprivation rate indicator (dark dwelling lacking indoor shower/bath/toilet), Slovakia and Finland exhibit the highest percentage of deprived population (over 91% for 2015-year end data), Czech Republic being ranked the third. At the opposite is Romania, with the smallest deprivation rate among all EU countries, of only 61.2%. From the standpoint of the number of items lacked by materially-deprived population, the situation is more balanced across EU countries as the indicator ranges from 3.3 to 4.5 lacking items per household. Bulgaria and Romania are the only countries whose material deprivation depth exceeds 4 items.

In terms of productive or main activity indicators, resembling patterns are present during all the four years considered for 25 out of 28 EU countries (see Figure 28 in the appendix).

By analyzing the initial data for those countries merged into the same group, we can notice the following main group-features: (i) Greece shows the highest level of long term unemployment rate (of 18.2%, well above the average of 4.75% computed for all the 28 EU countries) and the highest number of hours worked per week of full-time employment (44.5 hours); (ii) Lithuania, Romania, Malta, UK, Bulgaria, Latvia and Estonia do not face severe problems with the long-term insertion on the labor market, the prevailing manner for hiring people being based on a work contract with unlimited duration; (iii) labor market in Germany, Sweden, Italy, Netherlands, France, Croatia, Poland, Slovenia, Portugal, and Spain is mostly characterized by temporary jobs, seasonal employment, greater fluctuation of employees as they are not hired based on full-time work contracts. In fact, Spain, Poland and Portugal are witnessing the highest percentage of employees with a contract on limited duration (around 64%). At the opposite is Romania with only 3% of employees hired by means of a limited duration contract.

As regards health indicators, it can be noticed that the clustering solution has identified persistent resemblance between several countries, both in times of financial crisis and in periods of recovery (see Figure 29).

The analysis of intrinsic features specific to each cluster reveals that Malta, Sweden, Cyprus, Netherlands, and Ireland depict the highest levels for the healthy life years at birth (80 – 91.6 years), one of the highest levels of life expectancy (81 – 82 years), slightly above average values for people having a long-standing illness or health problem, the highest levels of self-perceived health (very good and good) and below average levels for self-reported unmet needs for medical examination. Hence, the inhabitants of these countries depict the highest prospects for a long, healthy life, and have a good perception regarding their health status although they have some chronically diseases. Another large cluster comprises Belgium, Bulgaria, Denmark, Greece, Spain, Italy, Luxembourg, and Romania. These countries are experiencing too high levels of life expectancy and healthy life years at birth (around 80 years), the lowest percentage of people claiming long-standing illnesses (20 – 22% of population) and a good, above-average self-perceived health. To sum up, apart some peculiarities in terms of chronically, long-standing illness or health problem witnessed by their inhabitants, 13 out of 28 EU countries exhibit longevity prospects.

The cluster composed by Estonia, Latvia and Portugal exhibits the poorest performance in terms of all health indicators considered. More specifically, the prospects for life expectancy and healthy life years are the worst in the sample;

only 50% of population self-assesses its health status as being very good or good, while the percentage of people claiming long-standing illnesses or unmet needs for medical examination is the highest.

In terms of education indicators (Figure 30), all the four years considered revealed persistent common patterns across several EU countries (26 out of 28 countries).

The cluster composed by three northern countries (Finland, Sweden, and Denmark) exhibits high levels for the share of people holding tertiary education degrees in total population (30 – 35%), the highest participation rate of employed persons in education and training (27 – 32%) and below average levels of early leavers from education and training. It seems that inhabitants in these countries are the most concerned on their educational background and lifelong learning.

The highest level of tertiary educational attainment (32 to 37%) is recorded in Belgium, Cyprus, Ireland, Lithuania and Spain, although these countries are recording a below-average participation rate in education and training in the last 4 weeks. Other countries recording an above-average level for the tertiary educational attainment, a large above-average participation in education and training programs and a moderate percent of early leavers from education are represented by: Austria, Estonia, France, Luxembourg, Netherlands, Slovenia and UK. The remaining 13 EU countries hold a below-average tertiary educational attainment for their population, Romania and Italy exhibiting the worst performance, with only 15% of their inhabitants having graduated a tertiary education program.

According to economic and physical safety indicators, the resembling countries in 2008, 2009, 2014 and 2015 are depicted in Figure 31.

The clustering solution reveals the following group features: the cluster comprising Denmark, Finland, Malta, Luxembourg, Netherlands, Belgium, Austria, and Sweden exhibit the smallest values of people's arrears (mortgage or rent, utility bills or hire purchase), the smallest people's exposure to the inability to face unexpected financial expenses (a range between 17 – 28%) and around average frequency of crime, violence or vandalism in the area. The cluster comprising Bulgaria, Greece, Latvia, Hungary, Ireland, Romania, Croatia, and Cyprus gathers countries depicting the highest values for inhabitants' arrears and inability to face unexpected financial expenses, and mixed values for the frequency of crime, violence or vandalism in the area (Bulgaria holds the highest share, of 26.3%). By looking at 2015 country-level data, the safest country from the standpoint of low incidence of crime, violence or vandalism in the area is Croatia with 2.9%, followed by Lithuania with 4.6%. In terms of economic safety, Sweden is best placed regarding the percentage of total population unable to face unexpected financial expenses (only 16%) while the peak is recorded by Hungary

with over 72% of population being at risk. The clustering obtained for the governance and basic rights indicators outlined the presence of common patterns among countries indicated in Figure 32.

The first cluster gathering Malta, Belgium, Luxembourg, Romania, Poland, Italy and Slovenia records the lowest values of the gender pay-gap, with a minimum of 2.9% in Slovenia. These countries exhibit a beneficial case from the viewpoint of lower discrimination between wages paid to men and women. At the opposite are Finland, UK, Germany, Slovakia, Czech Republic, Estonia and Austria which show the highest differences (18 – 28%) between the wages paid to men and those paid to women, and consequently were merged into the same cluster. All remaining countries record moderate levels of the gender pay-gap, of around 15 percent.

The countries depicting similar features of their natural and living environment indicators during all the four years considered are illustrated in Figure 33.

The clustering solution reveals the following intrinsic features: Cyprus, Austria, Spain, Denmark, UK, Ireland, Croatia, Poland, Slovakia, Finland, Sweden, and Estonia depict the smallest levels of pollution, grime or other environmental problems, small levels for the noise from neighbors or from the street and above average values for the average number of rooms per person. Thus, inhabitants in these countries are experiencing comfortable living environments, with low exposure to pollution or noise. At the opposite are Germany and Malta with the highest levels of pollution (23 – 32%) and noise (24.8 – 25.8%) from the entire sample of EU countries. Other countries affected too by pollution and other environmental problems (14.8 – 17.9% of population) are Bulgaria, Czech Republic, Latvia, Lithuania, Hungary, and Slovenia.

To sum up the results of all cluster analyses summarized above, the greatest heterogeneity between EU countries' features has been identified in terms of natural and living environment indicators (only 15 countries depict similar features consistently during the entire time period considered) and material living conditions' indicators (only 16 countries out of 28). The remaining ones change their features one year from another and position themselves in various group compositions, without a stable pattern. The greatest homogeneity and synchronization of national features has been noticed for the governance and basic rights indicators (25 out of 28 countries), for productive or main activity indicators (25 out of 28) and for education indicators (26 out of 28 countries).

The comparison of results obtained within this section with the findings of other similar papers show a common denominator, namely the frequent use of statistical clustering for the purpose of quality of life analyses. Nevertheless, there are differences in terms of the sample of European countries considered

and, more important, in the list of indicators used as proxy for the quality of life status. To the best of our knowledge our study is the first one relying exclusively on the quality of life indicators developed by the European Commission. Thus, our research premises are different from previous research and this is the main reason direct comparison of results is not possible.

For instance, Žmuk (2015) employed seven quality of life indicators, represented by purchasing power index, consumer price index, health care index, safety index, property price to income ratio, traffic commute time index and pollution index to uncover the presence of any differences in European countries' quality of life levels. By using the hierarchical cluster analysis he found that, on average, old EU countries (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom) record higher quality of live level than the new European Union member states. Old EU members achieved the best performance in terms of four quality of life indicators, namely: purchasing power index, health care index, property price to income ratio, and pollution index. The new EU members represented by Bulgaria, Croatia, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Portugal, Slovakia, Slovenia, and Spain depicted the best levels for safety index and traffic commute time index. Overall, they exhibit a medium quality of life level.

Krupka et al. (2013) have investigated the quality of life for a sample of 17 European Monetary Union member states. By relying on cluster analysis they have classified countries into 3 clusters, exhibiting high, average and low standards of living. Other papers are focusing on a broader range of indicators, apart quality of life ones. It is the case of Grein, Sethi and Tatum (2010) which apply the clustering method for 39 developing and developed countries. The analysis is repeated for the years 1995, 2000 and 2005 to identify clusters' change over time. The list of variables comprises economic, technological, cultural, demographic and quality of life variables (human development index, corruption perceptions index).

The overall conclusion is that, in recent years, the classification of countries into meaningful, homogenous groups from the standpoint of quality of life developments has attracted the interest of academia. However, there is not convergence in terms of the most appropriate range of indicators to act as proxy for assessing a country's quality of life.

4. Configuration of a Quality of Life Rating System

The purpose of this second research direction is to develop a rating system in order to serve as a barometer for the quality of life dynamics and provide reliable rankings of EU countries. The rating system aims to act as a uniform and

comprehensive metric for the assessment of the quality of life status in each EU country, based on the 7 dimensions developed and quantified by EC. Each dimension is evaluated by means of several non-correlated indicators (illustrated in Table 1), the final result being the computation of a composite rating for each EU country.

The steps followed for the configuration of this new rating system-type monitoring tool are:

- establishing notation scales for each indicator that defines a given dimension. We applied the best practice, by relying on a scale with 5 levels or ratings, of which rating 1 is the best, while 5 is the lowest. The scales' boundaries have been mainly determined by relying on historical maximum and minimum values recorded by a given indicator across all the EU member states in the last 10 years. A similar approach has been used by EC (2016, p. 5) for setting the scale of a social progress index. The methodological note mentions the reliance on "maximum and minimum values across a time series". When official guidance was available, we relied also on benchmarks proposed by European Commission or OECD. The boundaries for inner intervals are set at an equal distance one from another. Table 8 (see the Appendix) presents the boundaries set for each indicator and explain the reasoning underlying each choice.
- framing the values recorded by an indicator in a particular year within a range of variation (defined at the previous step) and assigning the corresponding individual rating;
- computing the un-weighted arithmetic mean of the individual ratings obtained for each indicator included in a quality of life dimension, in order to find out the rating assigned to a specific dimension;
- repeating the steps above for each of the remaining quality of life dimensions;
- computing the composite rating, that provides an overall assessment of the quality of life status in a given country. It is calculated distinctly, for each of the five years considered, as an un-weighted arithmetic mean of the ratings belonging to each of the seven quality of life dimensions (see Tables 9 to 13 in the Appendix). The choice for the arithmetic mean in computing both individual and composite rating has its roots both in the original rating methodology employed by banking supervisory authorities and in the economic literature. Rijpma et al. (2017) argues that the use of arithmetic mean creates a transparent index and is advisable in cases when the researcher doesn't want to emphasize extreme values of initial variables as being more important. As regards the weighting scheme used, we opted for the un-weighted indicators due to the lack of consensus existing in economic literature related to the most appropriate weighting scheme. As Decancq, van Ootegem and Verhofstadt (2011) argue, after comparing various

weighting methods their findings broadly fluctuated depending on the scheme that was chosen. Moreover, there is no need for defining a weighting system and assigning different weights for the various quality of life dimensions and indicators, each of them are equally important.

By applying the above mentioned steps we have obtained, first, the ratings belonging to each of the seven dimensions which allowed the further computation of the aggregate quality of life rating. This procedure has been employed distinctly for the years 2010 until 2014. As some indicators weren't available for the year 2015 and onwards, we couldn't include this period in the analysis.

The highest individual rating of 1 has been mostly obtained by the second dimension, represented by productive or main activity indicators. Specifically, in 2010 there were 15 countries out of 26 which obtained an individual rating of 1 for a certain dimension, in 2011 were 14 countries, in 2012 it has been reached a peak of 17 countries while in 2013 and 2014 only 13 countries obtained the highest rating. At the opposite, the lowest rating, of 5 has been obtained by Bulgaria in 2010, 2011, 2012 and 2013 for the economic security and physical safety indicators (the fifth dimension) while Estonia obtained it only in 2012, for the gender pay gap indicator (the sixth dimension). In 2014 no country exhibited an individual rating of 5.

Table 14 below synthesizes the final outcome of our analysis, namely the composite ratings computed for each of the five years considered, in order to rank European countries according to the overall quality of life status.

Most countries depict stable composite ratings in the past 5 years (20 out of 26 countries). The countries recording yearly fluctuations in their composite ratings are Czech Republic, France, Lithuania, Malta, Poland, and Slovakia. The prevailing composite rating in 2014 and 2011 was 2 (in 53.85% of cases), in 2013 the spread of ratings was equal, while in 2010 and 2012 the predominant rating was 3 (in 53.85% of cases). Consequently, based on the five-year analysis, the European countries can be ranked in three categories: a) countries with persistent medium-high rating, such as Austria, Belgium, Denmark, Finland, Luxembourg, Netherlands, Slovenia, Sweden, UK; b) countries with persistent medium rating, represented by Bulgaria, Croatia, Cyprus, Estonia, Italy, Germany, Hungary, Latvia, Portugal, Romania, Spain; and c) countries depicting mixed evolutions, from medium to medium-high ratings.

It can be noticed that northern and some central-Europe countries witness, on average, better quality of life conditions than their peers, while the medium rating is widely spread across western, eastern and southern Europe.

When discriminating between old and new EU member states, an interesting finding appears which is also compatible with the one of Žmuk (2015). Although

the author emphasized a different methodology, he uncovered that, on average, old EU countries show higher quality of live levels than the new EU member states. By looking at the composite ratings over the five-year period (Table 14) one can notice that countries recording a stable rating of 2 belong to the old EU members (Austria, Belgium, Denmark, Finland, Netherlands, Sweden, United Kingdom), while those recording a stable rating of 3 or mixed ratings one year from another belong mostly to the category of new EU members.

T a b l e 14

Comparison of Composite Ratings over Time

Country	Quality of life composite rating				
	2010	2011	2012	2013	2014
Belgium	**2**	**2**	**2**	**2**	**2**
Bulgaria	**3**	**3**	**3**	**3**	**3**
Czech Republic	**2**	**2**	**2**	**2**	**3**
Denmark	**2**	**2**	**2**	**2**	**2**
Germany	**3**	**3**	**3**	**3**	**3**
Estonia	**3**	**3**	**3**	**3**	**3**
Spain	**3**	**3**	**3**	**3**	**3**
France	**3**	**2**	**3**	**2**	**2**
Croatia	**3**	**3**	**3**	**3**	**3**
Italy	**3**	**3**	**3**	**3**	**3**
Cyprus	**3**	**3**	**3**	**3**	**3**
Latvia	**3**	**3**	**3**	**3**	**3**
Lithuania	**3**	**2**	**2**	**2**	**2**
Luxembourg	**2**	**2**	**2**	**2**	**2**
Hungary	**3**	**3**	**3**	**3**	**3**
Malta	**2**	**2**	**2**	**3**	**2**
Netherlands	**2**	**2**	**2**	**2**	**2**
Austria	**2**	**2**	**2**	**2**	**2**
Poland	**2**	**2**	**3**	**2**	**2**
Portugal	**3**	**3**	**3**	**3**	**3**
Romania	**3**	**3**	**3**	**3**	**3**
Slovenia	**2**	**2**	**2**	**2**	**2**
Slovakia	**3**	**3**	**3**	**3**	**2**
Finland	**2**	**2**	**2**	**2**	**2**
Sweden	**2**	**2**	**2**	**2**	**2**
United Kingdom	**2**	**2**	**2**	**2**	**2**

Source: Authors.

Conclusion

The fundamental goal at the origin of the development and public launch of each quality of life index found in economic literature and practice resides in policymakers' growing interest and concern in terms of identifying new, reliable criteria for performing a more complete assessment of a country's development, in addition to existing macro-economic indicators (such as GDP).

The novelty of our research resides in relying on the new quality of life dimensions proposed by the European Commission, in order to adequately assess the status and trends of well-being in European Union countries. Starting from these dimensions, we performed first an in-depth exploratory analysis to account for countries' natural clustering with resembling peers and trends recorded over the last decade. By running the cluster analysis for each of the seven quality of life dimensions, we found that most countries preserved their similarity and synchronization of national features (being permanently included in the same group, irrespective of the year considered) in case of the governance and basic rights indicators (sixth dimension), of the productive or main activity indicators (second dimension) and of education indicators (fourth dimension). On the contrary, the highest dissimilarity between countries is present for the natural and living environment indicators (seventh dimension) and material living conditions' indicators (first dimension).

The heterogeneity between countries appears to be more pronounced when assessing the clustering solutions across all the seven quality of life dimensions. More specifically, a group of countries identified as resembling within one particular dimension doesn't maintain the resemblance features for all of the remaining six dimensions. We uncovered that Czech Republic and Slovakia exhibit common features for five out of seven quality of life dimensions, namely for material living conditions, productive activity or employment issues, education, economic and physical safety, and governance and basic rights. These two countries seem to be the highest synchronized among all the EU countries considered and over a four year timeframe.

Belgium and Luxembourg have been always included in the same group for 4 out of seven dimensions, such as health, economic and physical safety, governance and basic rights, and natural and living environment. Lithuania and Hungary exhibit too increased similarity from the viewpoint of three out of seven dimensions: health, governance and basic rights, and natural and living environment. Finland and Sweden are resembling in terms of material living conditions, education and natural and living environment, while Germany and France show increased resemblance in terms of productive activity, health and economic and physical safety.

Secondly, we elaborated on the motivation and methodological approach of a novel tool meant to comprehensively assess countries' quality of life. We developed a rating system in order to aggregate, for each country in the sample, all the quality of life dimensions into a single metric, called composite rating, which allowed the ranking of countries. The result is a broader, comprehensive framework of the aggregate status of well-being featured by a country. The findings

show a relative balanced position between countries holding a composite rating of 2 and those with a composite rating of 3, as well as the persistence of a constant, stable level of the rating during the five years considered for most EU countries (almost 77%). Another interesting conclusion arouse when disentangling between old and new EU member states: old member states recorded better composite ratings (a rating of 2) than newer members.

Being the first empirical analysis of this kind and having practical implications, we are convinced that it will serve as starting point for further researchers and public institutions and authorities, in order to monitor and extract aggregate, meaningful information regarding an EU country's development in terms of quality of life and perform comparative research both across time periods and countries. For instance, decision makers could monitor changes in cluster membership over time to uncover whether their country had followed a similar path with the ones exhibiting the same economic development features.

The main research limitations in conducting the study were related to the availability of updated information on the quality of life indicators. The time series' most recent reporting year was 2015, while for the leisure and social interactions dimension reporting data is available with large time breaks making it impossible to include this eight dimension into our study.

Further research directions should attempt to remove these limitations. When the data for the last recent years will be available, the analytical framework developed within this paper could be performed again in order to observe the new developments and patterns of the quality of life across EU countries. Moreover, the quality of life barometer represented by the rating system proposed in the paper can be used by academics or national authorities to regularly compute and monitor the composite rating, in order to assess country-specific quality of life achievements. The rating system framework is flexible, being easily to adapt it by including new dimensions and indicators.

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