

Quality of Life Index Analysis for the Case of Romanian Regions

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Abstract—The analysis of the quality of life has become an increasingly complex process through which a number of economic, political and social factors are examined in order to identify the necessary measures to be taken for the social inclusion of disadvantaged people, to reduce the poverty rate of the population and to increase the living conditions. Through a detailed analysis of the determinants of living standards, we identified the progress that Romania has made since 2007, the year of accession to European Union, until 2016, the year for which the latest open data sets are available. Thus, an important discrepancy it has been identified between the level of quality of life from the region that has obtained the highest score, the region which covers the Romanian capital has been excluded, and the one which has obtained the lowest score. With an income difference of 28% and with four times higher of foreign investments attracted in the Central Region against the North-Eastern Region, the identification and adoption of administrative politics become imperative for ensuring a unitary development of the eight Romanian regions of economic development.

Keywords—*quality of life index; quality of life dimensions; open data quality; QoLI Framework.*

I. INTRODUCTION

Measuring the quality of life represents an important instrument in determining the level of development of a determined region, as an increased value of life satisfaction reflects at the same time the individual's and the society's economic welfare, individual's satisfaction, which reflects not only in his/her good emotional state, but also in the assessment of the local economy by the increase of productivity, capital attraction, increases of workplaces, etc.

For an identification as accurate as possible of the level of the quality of life it is necessary not only to use the economic dimensions, which consider the rate of income and expenses, or other financial elements, but also to turn towards the factors which measure the citizens' safety level, the medical facilities' capability to ensure public interest healthcare, the education level accessible to citizens, the individuals' satisfaction and other social factors which might have significant influence both on the economic welfare and on the social welfare of individuals belonging to a certain society.

On the same hand, even though the data sets come from official sources, for calculating the level of the quality of life, an analysis of the former must be realized in order to ensure a level of data quality as high as possible by correcting possible errors present in the analyzed data sets.

For the atomization of the calculation of the quality of life index, the QoLI Framework represents an authentic solution as it absolves the analysts from the application of complex sets of formulas in order to determine the level of quality of life of a determined community. Through this framework, the analysis becomes easier, involving only the preparation of the date which will be used to realize the calculation and to interpret the results obtained after applying the calculation formulas over a sphere of eight economical-social dimensions and of two supplementary indicators, the net medium income and the level of resident population. Thus, the quality of life indicator calculated using the QoLI Framework becomes a robust indicator, which has in mind both the financial nature factors which influence the purchasing power of individuals and the social nature factors as well, which affect the physical and emotional state of the population.

The present case of study aims at realizing a study relative to the level of the quality of life in Romania centered on the economic development areas for the period 2007-2016, the year of accession of Romania to the European Union (2007), respectively the last year for which statistics are available. For this reason, we will briefly present the most important indexes for measuring the quality of life used after 1990, followed in Section III by a focus over detailing the economic and social dimensions which make up the formula for calculating the Quality of Life Index (QoLI).

Section IV is reserved to presenting the used open data sources, followed on the next section by a focus on the process of ensuring the quality of data by identifying and suggesting solutions for rectifying the sensitive aspects regarding the increase of the data's quality. The framework's structure implementation will be presented in Section VI, while in Section VII it will be presented the result of the calculation of the QoLI for the laps of time analyzed so that the following section exposes a series of findings regarding the approached subject will be revealed.

II. STATE OF ART

One of the most used metrics for determining the level of development of a country [1], the Human Development Index (HDI) [2], has its origins in year 1990, when the United Nations Development Programme launched a formula for calculating the rate of the welfare of the population using the following three factors:

- a) the population's health status and longevity;
- b) the level of knowledge the citizens have access to;

- c) the population's life standard reflected through the rate of its income.

The recognition of the multi-dimensional nature of the factors that affect the quality of life has determined the identification of a new index, the World Health Organization Quality of Life (WHOQOL) [3], which treats more dimensions than the HDI:

- a) physical domain;
- b) psychological domain;
- c) level of independence;
- d) social relationships;
- e) environment;
- f) spirituality, religion, personal beliefs.

Although HDI and WHOQOL are two indexes useful in determining a country's level of development, the European Union's Statistical Office (Eurostat) proposed that in official reporting, to measure the quality of life using the following relations [4]:

- a) material and living conditions;
- b) productive or main activity;
- c) health;
- d) education;
- e) leisure and social interactions;
- f) economic and physical safety;
- g) governance and basic rights;
- h) natural and living environment;
- i) overall experience of life.

As far as the quality of the data is concerned, in the literature [5] [6] [7] can be distinguished the following four central dimensions which ensure a level of data quality as high as possible: i) data accuracy - measures the degree of representativeness of the data from the database in relation to the elements from real life which they represent; ii) data consistency - is the data's property of respecting the integrity constraints; iii) information completeness - measure the capacity of the database to offer complete information at the user's queries; iv) data currency - reflects the degree of update of the data.

III. QUALITY OF LIFE INDICATORS

Although the Gross Domestic Product Index (GDP) is one of the most used indicators for determining the level of development of a country [8], it is limited as it measures the quality of life only from a financial perspective. Therefore, scientists headed towards the identification of all factors which might have a significant influence over the population's quality of life, such as social indicators, measures for the increase of the population's welfare, economic measure [9], etc. As Eurostat itself specifies [4], the dimensions of the quality of life are grouped according to the functional capacities the citizens should have in order to identify a decent living.

A. Material and Living Conditions

The Material and Living Conditions (MLC) is a dimension which reflects the living conditions of a population, not only from a material point of view, but also from the perspective of the place where they live in. If the

pay grade is a component which highlights the rate of standard living, MLC includes other relevant factors to be taken into account, such as the purchasing power of a household, the relative poverty rate, poverty risk and severe material deprivation, etc. These distinctive factors reflect, on the one hand, the difficulty of satisfying the basic needs of a decent living, and on the other hand, the capacity of a population to afford expenses in order to support a decent living, such as contacting mortgage loans, paying bills, purchasing household appliances, tacking voyages inside and outside the frontiers of the country, etc.

B. Productive or Main Activity

As the time spent at work represents a significant lapse of time at which the individual renounces so that he/she might obtain benefits for him/herself, it represents an important factor in determining the self-respect. Thus, through a fair remuneration of the work undergone and through the evolution of the social status, individuals may feel their work appreciated, and their mental health is enriched by professional life success [10]. Therefore, the Productive or Main Activity (PMA) dimension is particular one as it measures the quality of life from the perspective of the individual's social status.

C. Health

Health is another determining factor in calculating the rate of the quality of life because it directly affects the life of the individuals. This dimension can be calculated from the perspective of several factors, such as the quantity of fruits and vegetables consumed, the quantity of alcohol consumed (with a negative effect on the quality of life), the population's degree of access to healthcare and the medical facilities' capacity of ensuring public interest healthcare both from the point of view of the available infrastructure and of the existing qualified personnel, the rate of incidents (with a negative influence), average life expectancy, as well as other factors which directly affect the individual's health quality.

D. Education

An important factor which has a significant contribution in determining the quality of life is represented by the level of education of the population, because a group with a high educational level may have access more easily to well-paid employment, which contributes to the possibility of accessing higher quality healthcare and to the increase of the living conditions. Moreover, the high level of education of the population is reflected in the governing and lawmaking, in creating a friendly environment both from the point of view of social interaction and from the point of view of nature preservation.

E. Leisure and Social Interactions

The fifth dimension which can measure the population's quality of life, the Leisure and Social Interactions (LSI), is closely linked both to factors which facilitate the social interactions in environmental areas, such as museums, spectacles and to factors which are found in sports environments, such as the number of sports facilities.

F. Safety

Another dimension which has a significant influence over the quality of life of the population is represented by Safety. As the Law no. 51/1991 on National Security of Romania defines national security as a state of social, economic and political stability, we can look at the safety term as being a state of stability both social and economic. Therefore, the Safety dimension considers the individual analysis of the economic security (of the measures the society or individuals take for ensuring the individual economic security in case of loss of employment, variation of monthly expenses, mortgage and other exceptional situations) and of the physical security (of the factors that reflect the physical insecurity of a population, as the crime rate, the percentage of the population with a definitive penal sentence, etc.).

G. Governance and Basic Rights

The dimension Governance and Basic Rights (GBR) represents that series of factors which influence the life of population from the perspective of the governing and law making, but also from the perspective of the equality of opportunity no matter the political, religious or cultural background of the individuals in a society.

H. Natural and Living Environment

The dimension Natural and Living Environment (ENV) considers the calculating of the level of standard living of the population considering the quality of the environment where the individuals live by analyzing a series of factors, such as the level of pollution of the area, the measures taken to combat pollution, the degree of the population's access to basic services (drinking water systems, electrical power supply systems, etc.).

IV. OPEN DATA SOURCES

From a simple perspective, by the term open data it can be seen as being that concept which defines the freedom of use, reuse and distribute data. Nevertheless, some data suppliers may have different perspectives regarding what it can be understood by openness [11], in the sense that the use, reuse, reworking, redistribution and reselling might have terms and conditions by their own, so that, even though the access to data is free, their use in one way or another, might be restricted.

The collection of statistical was made through the API's offered by the National Institute of Statistics of Romania (INSSE) [12], which allows the selection of open data sets according to topics, years and economic development area both in XLS format but also in CSV format. For the analyzed period, there have been identified data sets referring to the eight main topics, as the level of income and the average expenses of a household, the living standard of the population, the GDP value, the average number of employees and of unemployed workers, the population's state of health, the level of development of the healthcare and educational system both from the state and private area, the number of leisure places, data regarding the measure for assistance and social protection, the rate of green spaces per head of

population, the dimension of the drinking water supply system and a two data sets referring to the level of the average net income and the level of resident population which permits to calculate the main topics indicators as they have been presented in Table I.

Due to the fact that INSSE does not make available a set of public data regarding the result of the parliamentary elections, these data were extracted using the portal of the Permanent Electoral Authority of Romania [13], where we identified two PDF files containing information regarding the turnout at the parliamentary election dated year 2008 and 2012, and one HTML file dated year 2016.

V. OPEN DATA QUALITY ASSESSMENT

Considering that the open data is a concept that enforces the existence of a free license for accessing the data, the open data quality may be expressed as it is expressed the quality of the data regardless their licenses, as being that state of the data which allows their use by consumers [14] [15]. The most frequently mentioned dimensions of this property [16] [5] in the literature being accuracy, completeness, consistency and timeliness. Therefore, the rate of the quality of data is directly related to the accuracy of the presented elements.

TABLE I. DATA SOURCES

Dimension Name	Dimension Indicator Name
Material and Living Condition (5 CSV files)	Household income rate Poverty Rate Poverty Risk Deprivation Rate
Productive or Main Activity (4 CSV files)	Researchers Rate GDP Rate Employment Rate Unemployment Rate
Health (17 CSV files)	Infrastructure Rate Medical Staff Rate Food Consumption Rate Injured Rate Natural Population Growth Rate Life Expectancy
Education (5 CSV files)	Teaching Staff Rate Infrastructure Rate Abandon Rate
Leisure and Social Interactions (3 CSV files)	Museums Rate Cinematographic Performances Rate Sports Sections Rate
Economic and Physical Safety (8 CSV files)	Family Support Allowance Rate Social Assistance Rate Social Canteens Rate Pension Rate Convicts Rate Crime Rate Offences Rate Police Solved Offences Rate
Governance and Basic Rights (1 CSV file, 2 PDF file, 1 HTML file)	Employee Rate by Gender Parliamentary Elections Rate ^a
Natural and Living Environment (2 CSV files)	Green Spaces Rate Drinking Water Access Rate
Auxiliary Dimensions (2 CSV files)	Net Average Wage Resident Population

^a Sets of data downloaded from the portal of the Permanent Electoral Authority of Romania

A. Data Currency Issue

Data currency or timeliness is an indicator which measures the quality of data which reflects the degree of their timeliness in relation to the nature of the activity for which the date is being used [7]. Although the API of the INSSE includes an entry regarding the last date of update of the data sets, this date is available only for the data sets as entities, and not for the records from the data sets. This feature does not allow to identify whether the data set has been modified due to adding new records or whether the existing records have been modified.

B. Data Source Inconsistency

For the analyzed data sets, the data model is divided into categories having only 4 common columns: the economic development area, the reporting year, the measurement unit and the actual value. This discrepancy of the data sets implies the application of separate rules for each data category. Another relevant aspect of the way data is stored – the use of the Comma Separated Values (CSV) files, which implies storing data on columns in a text file, columns separated only by a comma or another specific separator. Therefore, storing data in text format restricts the user in terms of types of data related to the stored values, which urge the user to identify the data types based on the columns’ description and of the existing values before using these data.

C. Data Inconsistency

The data inconsistency can be seen as the state of the data of not being consistent, that is of not having the format and the value in conformity with the chosen data model [17] or of having discontinuities of data.

TABLE II. ENTRIES STATISTICS

Dimension Name	Expected Input ^a	Missing Values	Inconsistency Rate (%)
Material and Living Condition	400	16	4.00
Productive or Main Activity	320	8	2.43
Health	1,440	0	0.00
Education	480	81	16.88
Leisure and Social Interactions	240	0	0.00
Economic and Physical Safety	640	64	10.00
Governance and Basic Rights	240	8	3.33
Natural and Living Environment	160	8	5.00
Auxiliary Dimensions	142	16	11.27
TOTAL	3,182	201	6.32

^a The total number of entries that should exist for the data set to be complete

For the analyzed data sets, the data inconsistency is determined by the value of the missing record, as shown in Table II, considering that due to the periodical method of organization of the parliamentary election, the values of the

missing years have been corrected with the one of the last years when parliamentary election has been organized in Romania. For example, for the years 2008, 2009, 2010 and 2011, for each year it has been considered the value related to year 2008, year when parliamentary elections have been undergone, proceeding the same manner for the following periods.

As an exception to the previous calculation mode of the results of the turn-out, lacking the statistical data regarding the turn-out for the parliamentary elections from 2004, the value for the year 2007 has been calculated applying (1), realizing the arithmetic mean of the values relative to year 2008-2016.

To decrease the negative effect of the missing records during the process of calculating the QoLI, we have proceeded, taking in consideration that: i) the value fluctuation from one year to the other is linear; ii) by using (1) to calculate the average of the series, the magnitude of the majority of the series is low under 50% than the average.

$$avg = \frac{\sum_{i=start}^{end} data_i}{n} \tag{1}$$

- start = beginning year
- end = end year
- data = the values related to the analyzed column
- n = the number of the years for which data are available

Another aspect important to be mentioned regarding the data inconsistency is represented by the absence from certain data sets of the records classified for each county; this shortage restricts to an analysis on economic development areas, not including a detailed analysis on counties.

VI. THE FRAMEWORK ARCHITECTURE

Considering the complex character of the calculation of the Quality of Life Index, the present case of study, at the same time, aims at presenting the way the framework [18] has been conceived for the calculation of this economical-social indicator. Thus, who is interested in realizing the analysis referring to the state of living of the population is absolved from implementing the formulas of calculation of the QoLI, the only tasks that must be done being the supply of the input data and the interpretation of the obtained results.

Figure 1 presents the diagram of the processes of realizing the QoLI framework, the first step being the analysis of the downloaded data sets in order to identify the common elements and the types of data for each individual column. After that, based on the formulated findings, the data model will be created for each analyzed data category, and for the missing records, the average of the respective period will be calculated using (1), so that the impact of the data set inconsistency will have an influence as light as possible when calculating the QoLI.

The second stage implies the actual calculation of the values of the 8 QoLI main topics as they have been described and of the following complementary indicators:

- a) the average number of resident persons;
- b) the average net salary,

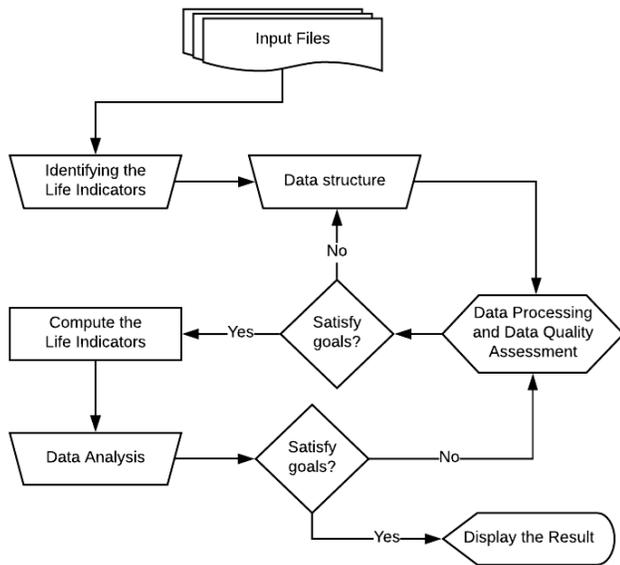


Figure 1. The framework architecture.

values calculated according to the reporting year and to the chosen economic development area. These indicators are used in determining the complementary statistic data, such as the share of the overall income of a household in relation to the average net earnings for the specific area; the share of the education establishments related to 1,000 resident persons, the number of square meters of green space for each inhabitant, and so on.

The intermediate stage to presenting the QoLI result is represented by the analysis of the data, which aims at identifying errors and discrepancies in the calculation process of the indicators. For example, the school drop-out rate, the rate of persons involved in accidents, etc., they are all elements which negatively influence the calculation of the indicators they belong to, which implies that in the final formula their reverse must be considered, that is, to determine the proportions of population that is not affected.

With the identification of the correction that must be made on the data so that they can reflect the real-life situation, the flow of operations come back to the sub-stage “Data

Processing and Data Quality Assessment” for applying the mentioned modifications, a cycle that will be repeated until obtaining the expected results. In the end, the user will have the possibility of extracting the final result of the Quality of Life Index calculation classified on reporting years and on economic development area calculated using (2).

$$QoLI = \sqrt[8]{conditions * activity * health * edu * interactions * safety * law * env} \quad (2)$$

- conditions = Material and Living Conditions Indicator
- activity = Productive or Main Activity Indicator
- health = Health Indicator
- edu = Education Indicator
- interactions = Leisure and Social Interactions Indicator
- safety = Safety Indicator
- law = Governance and Basic Rights Indicator
- env = Natural and Living Environment Indicator

Using the geometric mean for the calculation of the QoLI is imposed by the asymmetric character of the indicators which compose the eight dimensions so that the linear compensation of the reduced values of one dimension with the higher values of another dimension will be avoided [19]. Thus, using the geometric mean for calculating the QoLI, will allow that a reduction of 1% of one dimension to register the same impact as a reduction of 1% of any other dimension.

VII. DATA USAGE

The result of the current analysis can be used both by governmental factors which have at their disposal the legal measures for combating poverty and increasing the living standard of the population and to other actors of the society interested in following the evolution of the economic and social development level in time. The analysis uses a series of statistic data broken down on reporting years and economic development area, which facilitates both the identification of the area which met a considerable advantage, and to those which present an index of the quality of life lower than the other areas.

TABLE III. FOREIGN DIRECT INVESTMENT IN ROMANIA BY YEARS AND REGIONS (MILLIONS OF EURO)

Region \ Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bucharest-Ilfov	27,516	30,594	31,699	32,720	34,021	35,859	36,808	35,665	38,243	42,021
Center	3,541	4,146	3,703	3,909	4,215	4,625	5,179	5,833	5,831	6,379
North-East	672	2,108	975	1,244	1,627	1,767	1,685	1,624	1,662	1,606
North-West	1,907	1,226	1,940	2,232	2,454	2,814	2,665	3,384	3,783	4,108
South-East	2,448	3,551	2,938	3,290	2,970	3,253	2,529	2,898	2,869	3,477
South-Muntenia	2,942	3,411	3,576	3,816	4,059	4,230	4,599	4,194	4,626	4,837
South-West Oltenia	1,379	1,226	2,058	1,928	1,806	2,068	1,912	1,954	2,172	2,080
West	2,365	2,626	3,095	3,446	3,987	4,510	4,581	4,646	5,237	5,605

The result of the calculation of the QoLI is presented using the histograms from Figure 2 and Figure 3, where it can be observed the evolution of the indicators in time, according to the economic development regions. Thus, it can be noted that, as expected, the Bucharest-Ilfov Region, the one which comprises the Romanian capital, is the most developed, being followed by the North-Western Region, the Western Region and the Central Region, and on the other side, the most underdeveloped region being the North-Eastern one, being followed by the South-Western Oltenia Region, the South-Muntenia Region and the South-Eastern Region.

The growth trend of the Quality of Life Index from the central-western region of Romania may be considered as being the result of the consolidation of the industrial poles as Cluj-Napoca, Timisoara and Brasov [20], evolution that can be noticed even from the statistical data regarding the foreign direct investment rate which the National Bank of Romania supplied [21] as it is in Table III. As the statistical data are presented, the Bucharest-Ilfov Region and the Central Region remain on the entire analyzed period on the top of the regions with the height's foreign investment capital in Romania, and the North-Eastern Region and the South-Western Oltenia Region being classified as the most unattractive regions from the point of view of foreign capital attraction.

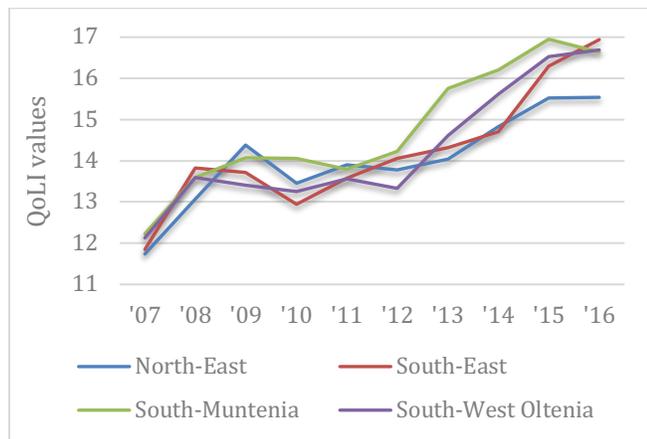


Figure 2. Lowest evolution of QoLI.

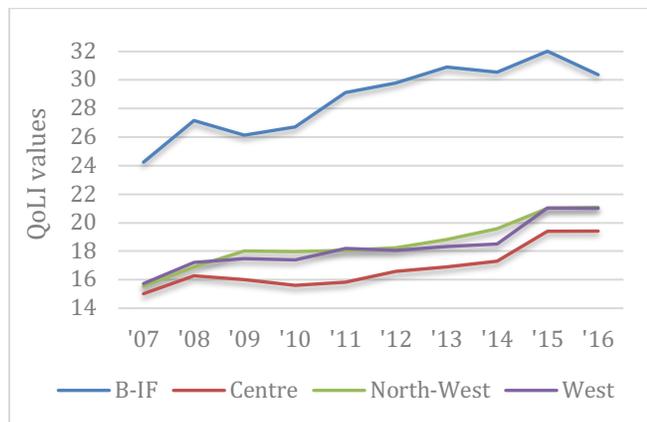


Figure 3. Highest evolution of QoLI.

The importance of foreign capital attraction occurs due to the relation which has in the increase of the state of living of the population. If the financial value of the investments is inconstant, alongside the advantage of attracting the capital for the development of the private area, at the same time, the investors may realize technological and knowledge transfers with the host country, may integrate both highly-qualified employees and unqualified employees, investing, thus in human resources, they may bring new management concepts, may influence the local market structure determining the sector in which they activate to be more productive and, of course, may contribute to the local and national budget by paying taxes, which can materialize in the increase of the level of public investments done in the interest of the citizen [22].

Another important component which has a major impact on the increase of the state of living of the population is represented by the correct financial remuneration of the work, because, alongside the financial factor needed to each person for leaving, individuals can feel more appreciated if they are remunerated accordingly to the performed work [10]. Therefore, the increase of the self-esteem influences not only the individual satisfaction but also his/her productivity, which translates by the increase of the value of the company they work for, a value which can attract financial investments and can create new workplaces for the resident population.

By analyzing the data relative to the value of the monthly income on household for year 2016 [12], presented in Table IV, it can be noted that in the four regions which register a higher QoLI indicator, the level of the income reaching almost 700 euro; in the Bucharest-Ilfov Region the income is reaching to 911 euro. On the other hand, the level of income on household relative to the other economic development regions do not even reach the level of 600 euro, in the North-Eastern Region, the one which presents the lowest QoLI indicator, the level of income barely reaching 525 euro.

VIII. CONCLUSION

The analysis of the population's living standard is a complex process which is considered the determining of the level of economic development and the degree of satisfaction which a group of individuals has in the society. From this point of view, for calculating the Quality of Life Index, analysts must take into account the use not only of economic indicators which reflect the financial situation but also of the social indicators which reveal the level of satisfaction of individuals, both on personal and professional level.

Analyzing the statistical data previously presented, except for the Bucharest-Ilfov Region, it can be noted a considerable discrepancy between the most developed and the less developed economical region from Romania, for which the level of monthly income per household differs with up to 28%, and the value of foreign investments attracted in the North-Eastern Region represents only 25% of the value of the investments from the Central Region. Thus, the existence of these discrepancies between the economic development regions from Romania may represent an alarm

TABLE IV. MONTHLY AVERAGE OF TOTAL INCOME PER HOUSEHOLD BY YEARS AND REGIONS (EURO)^a

Region \ Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bucharest-Ilfov	x	714	746	709	723	703	742	763	812	911
Center	x	535	542	537	574	565	611	563	644	673
North-East	x	480	505	478	504	510	514	474	481	525
North-West	x	551	537	539	582	570	582	589	640	694
South-East	x	483	494	474	504	490	492	477	524	584
South-Muntenia	x	517	532	553	541	548	542	545	545	594
South-West Oltenia	x	492	489	498	500	509	527	510	541	580
West	x	548	574	547	588	617	602	577	618	689

^a The monthly average of total income per household has been converted from RON to EUR accordingly to the exchange rate provided by The National Bank of Romania [23]

signal for the authorities, enforcing the realization and application of the public politics which should advantage the less developed regions for reducing the existent discrepancy and the increase of the level of the population state residing in less developed regions.

Thus, extending dimensions proposed by Eurostat, QoLI Framework allows for a more complex analysis of the level of quality of life in a region by including factors, such as the degree of school and health infrastructure development, the number of square meters of green spaces per inhabitant, the share of the number of researchers per thousand inhabitants, etc., factors that have a significant influence on the social life of individuals. At the same time, the utility of the framework can be easily extended to any level of administrative detailing by including, in the constant lists, the name of the administrative unit which is desired to be analyzed, regardless of the fact that it is a city, a county, a region, a country or any other administrative form.

The utility of this indicator is incontestable for any part involved in society, from government which need accurate data to identify and apply the best measures for combating poverty, to nongovernmental organizations which supervise the application of the measure on social welfare and regional development, up to individuals who, on the basis of the data supplied by the state institutions or by specialized organizations, can take decisions upon migration towards a more developed area.

If the state institutions authorized to make forecasts and analysis regarding the living standard of the population have access to the data, natural or legal persons are strictly limited to the public data offered by the state institutions, which, unfortunately, cannot be used before processing them. Therefore, it is mandatory to make an analysis in order to ensure the quality of the data by identifying errors and applying specific technics for adjusting them, so that the identified errors will have an impact as light as possible on the calculation.

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