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Economic Development and Economic Growth: Case Study

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ABSTRACT: The paper motion to differentiate the terms of economic growth and economic development, the first being a quantitative component of the second one. Economic development also has a qualitative element on the quality of life or living conditions. We propose a case study to compare the level of economic growth measured by GDP with that of economic development, measured by several indicators, that would cover aspects of quality of life, beside having GDP to cover the quantitative aspect. The database is composed from World Bank for countries on 3 continents, the purpose being to cluster the countries according to their level of development, respectively economic growth. For the given data set, the results prove to be identical for both studies, i.e. grouping by the levels of economic development could have been done only based on GDP.

KEYWORDS: k-means, hierarchical clustering, economic development, economic growth, data mining.

I. INTRODUCTION

In the context of the current global economic development, it is necessary to study the economic growth and economic development of countries. One of the key objectives of macroeconomic policy is to achieve high growth rates. Therefore, in the specialized literature there is a big amount of comparative or explanatory studies of the level of economic growth and development of a country.

The importance of growth lies in its contribution to the general prosperity of the population. Economic growth is necessary because it allows the community to consume more goods and services, and helps to ensure a higher quantitative level of goods and services, which leads to a real improvement in living standards. However, accelerated economic growth can lead to the depletion of natural resources and the worsening of environmental pollution problems (Scutaru, 2013).

According to Boldeanu and Costantinescu (2015), economic growth is a main component in the wellbeing and prosperity of people. Economic growth is usually measured by the level of GDP. This variable covers the quantitative aspect of economic development, as mainly, it represents the level of growth of goods and services existing in a nation over a period. GDP can be increased by other components too: public expenditure, investments, employment rates, exchange rates, capital formation etc..

Industrialization and technological progress have left a shortage between developed and poor countries. For example, now, in the 21st century, the GDP / capita of many poorer countries is lower than the GDP per capita of nineteenth-century Europe. Economic growth was a peak of the twentieth century, which ensured the development of the Western world and improved the standards of the quality of life of the people (Boldeanu and Costantinescu, 2015).

On the other hand, economic development contains the quantitative aspect represented by economic growth, but also the qualitative aspect, which aims to increase the quality of people's lives. Without the qualitative aspect, measuring only the quantitative level, the characterization of the level of economic development can be totally incorrect. An example is provided by Stilglitz, Fitoussi and Durand (2018). They pointed out that in September 2008, before the global recession, economists said that the economic situation was in good shape. Even in 2009, the President of the United States announced that the economy was recovering since GDP had begun to grow. The crisis continued, and aggregate economic indicators, such as GDP, could not characterize the real state of the country's economy.

The complex aspect is the fact that economic development is a multidimensional process and cannot be represented by a one-dimensional economic indicator. Therefore, when it comes to classifying countries according to their level of development, there is no generally accepted criterion (Nielsen, 2013).

Over the years, various organizations have created their own methods of measuring the qualitative aspect of economic development. An example is the Human Capital Index, created by the World Bank in 2018. The created index ranks the performance of 157 countries on a set of four health and education indicators, according to an estimate of economic

productivity lost due to poor social performance. Prasad and Castro (2018) observes that the main benefit is that the index is oriented on outcomes, rather on inputs. For example, measuring the actual adjusted learning is better than checking the years of schooling variable. However, they point out that the main criticism to the HCI is that it might over valuate the material benefits of education and health, thus commoditizing people, instead of their societal contributions and their inherent aspect of being basic human rights.

The United Nations Development Program (UNDP) classification system is using the Human Development Index (HDI). HDI is a composite index created based on education, income, and longevity indicators. Other aspects of development, such as political freedom and personal security, have been recognized as important, but the lack of data has prevented their inclusion in the HDI (Nielson, 2011). Another indicator created is the Social Progress Index, developed by the non-profit, Social Progress Imperative. SPI is a refinement of HDI. In comparison to this one, the newest index uses many more composite indexes (54) in a wide range of areas, including basic human needs, opportunities for progress and the foundations of well-being. Therefore, this index is able to summarize the most relevant aspects that determine development. For example, access to water and sanitation, public crime, educational and health outcomes, public crime, housing, access to information and communication. Due to the variety of used indicators, the main disadvantage of SPI is its relatively high complexity and lack of practicality when used to inform policies (Prasad and Castro, 2018).

In this study we measure economic growth through GDP, and economic development through 10 indicators that include GDP, HDI and other variables that define the quality of life: Inflation, Life expectancy at birth, Access to electricity, Cause of death, by communicable diseases and nutrition conditions, People using at least basic drinking water services, Cost of business start-up procedures, Time required to start a business, GDP per capita, HCIS: learning - adjusted years of school and HCI: total.

The aim is to cluster countries according to economic growth, respectively according to economic development and to compare the results: if the countries that are part of the countries with a high economic growth are the same as those that are part of the category of economically developed countries.

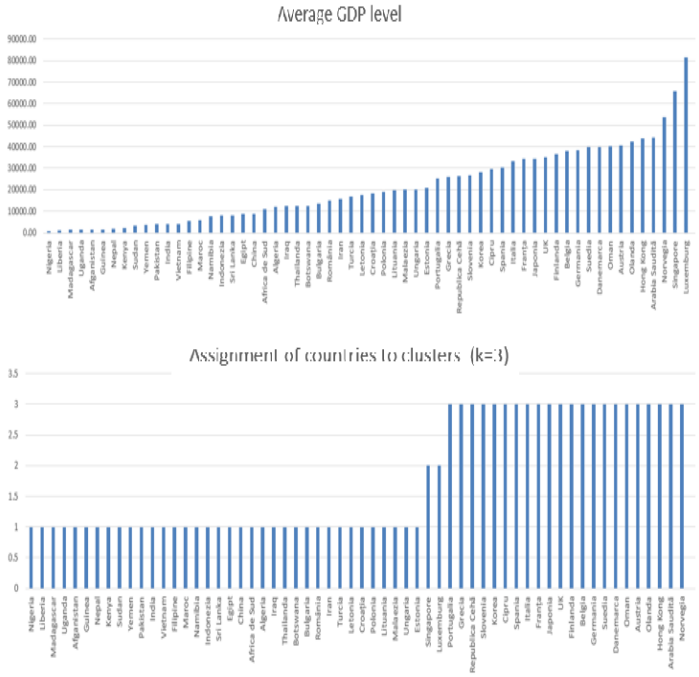
II. CHARACTERIZING THE ECONOMIC GROWTH OF COUNTRIES THROUGH GDP LEVEL

In the first part of this paper we propose the clustering of countries from three continents based on the level of GDP over the last 20 years. The aim is to observe whether the composition of the clusters is the same as the membership of the countries at continental level, but also to offer a differentiation of the countries according to the economic level.

The database is made up of the GDP values taken from World Bank for 72 countries for the period 1999-2018. Missing data is replaced in SPSS by the Linear Trend at Point technique that calculates the prediction for missing values.

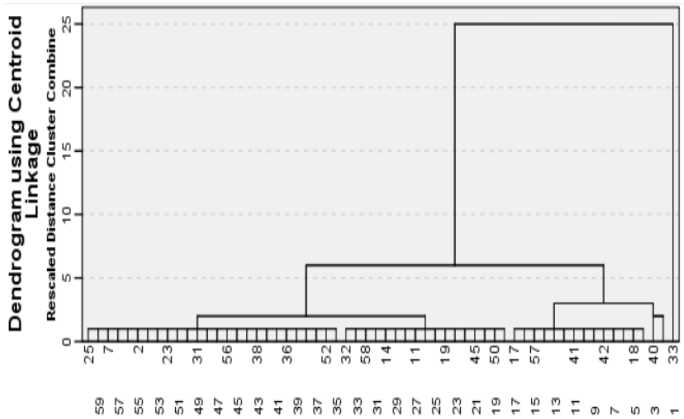
Table 1 presents the situation of the selected countries in the analysis in terms of normal distribution or not, but also in terms of average GDP value over the 20 years. Because the database does not contain a multitude of records, the normality test chosen is Shapiro-Wilk. Of the 72 countries, ten do not have a normal distribution: Qatar, Ireland, Israel, Ukraine, Mongolia, Ethiopia, Russia, Angola, and Zimbabwe. We remove from the analysis countries without normal distribution, so as not to affect the results.

Next, we use the average GDP values to cluster countries. The technique used is K-means, and the aim is to observe or not a similarity between the level of GDP and the geographical position of countries. This technique involves supervised learning, so it is needed to have set the number of clusters in which the observations are divided according to the distance of the nearest centroid. Since there are three existing continents in the dataset, the number of selected clusters is three.

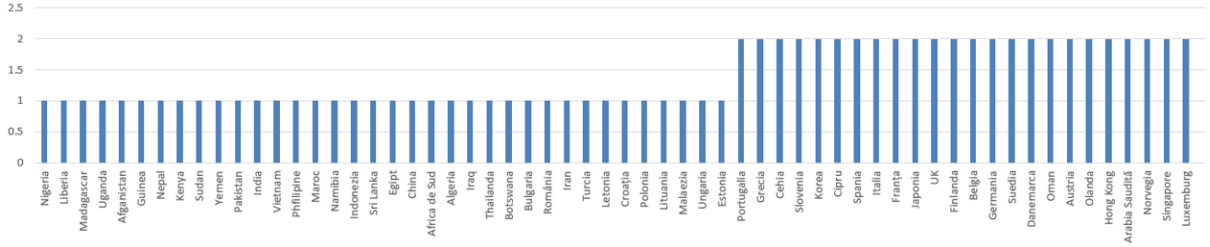


As can be seen in the figure, the two countries with the highest level of GDP form the second cluster. The third cluster, which is next in terms of GDP, mainly includes European countries, and the first cluster consists of African and Asian countries, but also among them European countries: Romania, Poland, Bulgaria, Estonia, Croatia, Latvia, and Hungary. Therefore, clustering did not lead to groupings at the continent level.

Because clustering is not uniform, we use the hierarchical clustering technique to find the ideal number of groups. Hierarchical clustering creates multiple cluster solutions, called cluster hierarchies. The main feature is that the number of clusters is not known in advance, nor it is suggested by the user. Hierarchical clustering methods are considered heuristic methods (Ionescu, 2015). The chosen method is that of the centroid, and the distance is measured by the Euclidean distance squared. According to the dendrogram, the optimal number of clusters for the data set is: 2.



We apply k-means clustering by setting the results to be grouped into two clusters, two opposing categories in terms of economic growth. Thus, the 60 countries in the database can be divided in terms of economic level into two parts, as shown in the figure. We notice that the two countries that formed the second cluster of the high growth countries, when the k is set to 3, has joined the third cluster.

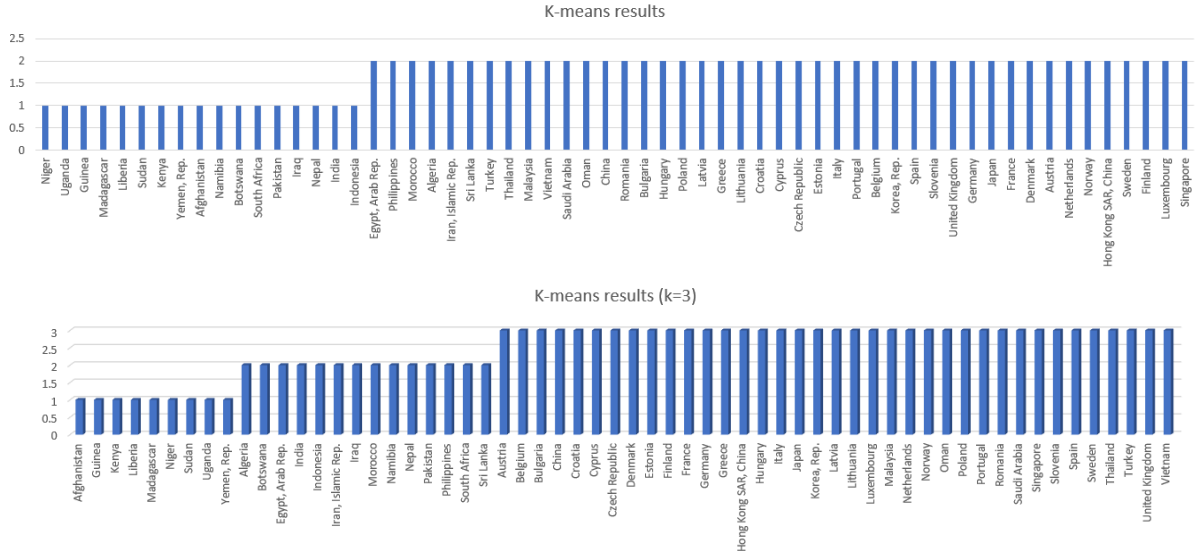


III. CHARACTERIZING THE ECONOMIC DEVELOPMENT OF COUNTRIES

Because GDP does not show the level of a country's development, but is only a component part of its characterization, we increase the existing database with indicators that cover several areas that influence or are influenced by the economic development of a country.

We propose to characterize the economic situation of the countries in the database by grouping them into clusters that express a different level of economic development. This is done through several indicators: Inflation, Life expectancy at birth, Access to electricity, Cause of death, by communicable diseases and nutrition conditions, People using at least basic drinking water services, Cost of business start-up procedures, Time required to start a business, GDP per capita, HCIS: learning - adjusted years of school and HCI: total. Because the World Bank database does not contain annual data (period 1999 - 2018) for all indicators chosen for the 60 countries, the analysis is performed on the most recent year with available data, namely 2015.

Keeping the GDP clustering model, we will cluster with the help of k-means the new data set, setting the number of clusters equal to 3, respectively with 2. The country assignment to clusters is shown in below figures.



Cluster characterization (k-means a**p**plied based on the 10 indicators) is done based on below figure. Choosing to have 2 clusters, one of them suggest poor economic development, while the other is having greater results on the indicators who suggest good economic development. So, the countries that are part in the second cluster have a good development.

Having the number of clusters set to three, does not change very much the characteristics. We see that the first two clusters do not present a good economic development and that they are characterized almost the same with the exception that the second cluster has more encouraging results. The third cluster is the positive one.

Final Cluster Centers

	Cluster 1	Cluster 2
Zscore(Inflation)	-.93119	.46559
Zscore: Life expectancy at birth	-1.21738	.60869
Zscore: Access to electricity	-.96504	.48252
Zscore: Cause of death, by communicable diseases and maternal, prenatal and nutrition conditions	-1.12639	.56319
Zscore: People using at least basic drinking water services	-1.04116	.52058
Zscore: Cost of business start-up procedures	-.87020	.43510
Zscore: Time required to start a business	-.80306	.40153
Zscore: GDP per capita	-.91660	.45830
Zscore: HCI: Learning-Adjusted Years of School	-1.18106	.59053
Zscore: HCI: Total	-1.19613	.59806

Final Cluster Centers

	Cluster 1	Cluster 2	Cluster 3
Zscore(Inflation)	-1.13417	-.65502	.52372
Zscore: Life expectancy at birth	-1.63363	-.66124	.64757
Zscore: Access to electricity	-2.07850	.04210	.48965
Zscore: Cause of death, by communicable diseases and maternal, prenatal and nutrition conditions	-1.81546	-.38030	.58549
Zscore: People using at least basic drinking water services	-2.11153	-.14041	.56674
Zscore: Cost of business start-up procedures	-1.77141	-.10619	.47106
Zscore: Time required to start a business	-.17688	-.95866	.40576
Zscore: GDP per capita	-1.13147	-.73201	.55220
Zscore: HCI: Learning-Adjusted Years of School	-1.52754	-.83102	.68600
Zscore: HCI: Total	-1.49014	-.86622	.69023

IV. COMPARATIVE ANALYSIS OF RESULTS

The final part of this study is to compare if the countries that are developed form an economic growth perspective are also developed for the economic point of view. We are doing this by checking the cluster assignment of countries in the economic growth category (in both cases when we choose to have 3 clusters and 2 clusters) and we compare with the assignment of the countries to the economic development clusters.

Because we cannot compare the results obtained by applying k-means on the variable data set for 2015 with the clustering of the average GDP for the years 1999-2018, we will cluster the GDP for 2015.

We use the K-means clustering technique on the data set formed and we repeat the steps performed for the data set consisting only of the GDP average. Therefore, the table below summarizes the k-means analysis for the data set comprising GDP from 2015 and for the data set with several indicators.

Interestingly, the results shown in Table 2 conclude for our case that GDP shows the economic development of a country, as the observations are grouped in the same clusters. We can group countries in terms of economic development with the help of GDP. An important observation is that this conclusion is found because of the present case study, done only for the year 2015.

V. CONCLUSION

Even if they are sometimes confused, economic development is different from economic growth, by the fact that the latter is a component of the former. To study economic development, the analysis must also cover the quality aspect of life. In other words, a country is developed economically if it grows economically and if the standard of living grows.

This paper involves the analysis of economic growth of some countries and clustering in classes to explain a certain level of economic growth. In the second part, the same clustering steps are performed, but on a data, set constructed with variables that show the level of economic development. Clustering is performed using the k-means technique, and the number of clusters chosen is three, as the countries are from three continents. We tested if the results will somehow divide the countries into three clusters, equivalent to each continent. Because the results are not homogeneous, we apply hierarchical clustering to find the optimal number of clusters, ie two classes. The differentiation of clusters depends on the level of growth, respectively development. When k is set to two, one cluster groups economically developed or economically developed countries, and the other cluster is at the opposite pole. When k is set to three, then one cluster is positive, and the other two show a low level of economic developers, respectively of economic growth.

Thus, comparing the results of membership in the cluster between the two categories, the countries that are part of a cluster in the category of economic growth, are part of the same cluster in the category of economic developers. The results show that for our dataset, the economic development groups could be found based only on GDP.

VI. FIGURES AND TABLES

Table 1. List of the countries with the average GDP level and the normal distribution type

Country	Continent	Normal distribution	Average GDP
Afghanistan	Asia	Yes (p=0,1)	1376,49
Algeria	Africa	Yes (p=0,53)	11964,39
Angola	Africa	No (p=0,04)	5488,55
Austria	Europe	Yes (p=0,33)	40734,34
Belgium	Europe	Yes (p=0,62)	37947,79
Botswana	Africa	Yes (p=0,13)	12483,13
Bulgaria	Europe	Yes (p=0,36)	13394,91
China	Asia	Yes (p=0,09)	8735,33
Croatia	Europe	Yes (p=0,37)	18349,06
Cyprus	Europe	Yes (p=0,06)	29705,25
Czech Republic	Europe	Yes (p=0,425)	26236,14

Denmark	Europe	Yes (p=0,32)	40017,66
Egypt	Africa & Asia	Yes (p=0,19)	8683,96
Estonia	Europe	Yes (p=0,36)	20996,88
Ethiopia	Africa	No (p=0,04)	1025,98
Finland	Europe	Yes (p=0,17)	36496,23
France	Europe	Yes (p=0,5)	34495,55
Germany	Europe	Yes (p=0,19)	38377,36
Greece	Europe	Yes (p=0,23)	25933,36
Guinea	Africa	Yes (p=0,38)	1552,91
Hong Kong	Asia	Yes (p=0,28)	43879,69
Hungary	Europe	Yes (p=0,67)	20275.97
India	Asia	Yes (p=0,11)	4069,29
Indonesia	Asia	Yes (p=0,15)	7940,1
Iran	Asia	Yes (p=0,25)	15642,69
Iraq	Asia	Yes (p=0,19)	12381,78
Ireland	Europe	No (p=0,03)	46676,37
Israel	Asia	No (p=0,03)	29376,88
Italy	Europe	Yes (p=0,22)	33424,32
Japan	Asia	Yes (p=0,52)	34510,18
Jordan	Asia	No (p=0,005)	8241,63
Kenya	Africa	Yes (p=0,08)	2368,68
Korea	Asia	Yes (p=0,67)	28138,31
Latvia	Europe	Yes (p=0,44)	17690,13
Liberia	Africa	Yes (p=0,10)	1071,78
Lithuania	Europe	Yes (p=0,30)	19896,77
Luxembourg	Europe	Yes (p=0,17)	81541,18
Madagascar	Africa	Yes (p=0,38)	1330,82
Malaysia	Asia	Yes (p=0,3)	20084,84
Mongolia	Asia	No (p=0,03)	7846,21
Morocco	Africa	Yes (p=0,3)	5904,89
Namibia	Africa	Yes (p=0,2)	7871,52
Nepal	Asia	Yes (p=0,18)	1856,36
Netherlands	Europe	Yes (p=0,27)	42470,94
Nigeria	Africa	Yes (p=0,06)	788,93
Norway	Europe	Yes (p=0,08)	53566,57
Oman	Asia	Yes (p=0,06)	40226,22
Pakistan	Asia	Yes (p=0,32)	4043,05
Philippines	Asia	Yes (p=0,17)	5370,26

Poland	Europe	Yes (p=0,11)	19182,23
Portugal	Europe	Yes (p=0,4)	25316,69
Qatar	Asia	No (p=0,03)	112195,76
Romania	Europe	Yes (p=0,19)	15155,57
Russia	Europe & Asia	No (p=0,04)	17933,29
Saudi Arabia	Asia	Yes (p=0,17)	44293,27
Singapore	Asia	Yes (p=0,27)	65988,42
Slovenia	Europe	Yes (p=0,42)	26656,6
South Africa	Africa	Yes (p=0,18)	10918,67
Spain	Europe	Yes (p=0,21)	30350,28
Sri Lanka	Asia	Yes (p=0,07)	8067,95
Sudan	Africa	Yes (p=0,1)	3272,87
Sweden	Europe	Yes (p=0,32)	39831,23
Thailand	Asia	Yes (p=0,4)	12385,25
Turkey	Europe & Asia	Yes (p=0,05)	16853,88
Uganda	Africa	Yes (p=0,17)	1369,59
Ukraine	Europe	No (p=0,03)	7057,57
UK	Europe	Yes (p=0,78)	35186,81
Vietnam	Asia	Yes (p=0,26)	4089,58
Zimbabwe	Africa	No (p=0,12)	1991,78
Yemen	Asia	Yes (p=0,63)	3566,12

Table 2. Comparative results between the clusters of economic growth and economic development

Country	Cluster assignation k=2 (GDP)	Cluster assignation k=2 (economic development dataset)	Cluster assignation k=3 (GDP)	Cluster assignation k=3 (economic development dataset)
Afghanistan	1	1	1	1
South Africa	1	1	1	1
Algeria	1	1	1	1
South Arabia	2	2	3	3
Austria	2	2	3	3
Belgium	2	2	3	3
Botswana	1	1	1	1
Bulgaria	1	1	1	1
Czech Republic	2	2	3	3
China	1	1	1	1
Cyprus	1	1	3	3

Croatia	1	1	1	1
Denmark	2	2	3	3
Egypt	1	1	1	1
Estonia	1	1	3	3
Philippines	1	1	1	1
Finland	2	2	3	3
France	2	2	3	3
Greece	1	1	1	1
Germany	2	2	3	3
Guinea	1	1	1	1
Hong Kong	2	2	3	3
India	1	1	1	1
Indonesia	1	1	1	1
Iran	1	1	1	1
Iraq	1	1	1	1
Italy	2	2	3	3
Japan	2	2	3	3
Kenya	1	1	1	1
South Korea	2	2	3	3
Latvia	1	1	1	1
Liberia	1	1	1	1
Lithuania	1	1	3	3
Luxembourg	2	2	2	2
Madagascar	1	1	1	1
Malaysia	1	1	1	1
Morocco	1	1	1	1
Namibia	1	1	1	1
Nepal	1	1	1	1
Nigeria	1	1	1	1
Norway	2	2	3	3
Netherlands	2	2	3	3
Oman	2	2	3	3
Pakistan	1	1	1	1
Poland	1	1	1	1
Portugal	1	1	3	3
Romania	1	1	1	1
Singapore	2	2	2	2
Slovenia	1	1	3	3
Spain	2	2	3	3
Sri Lanka	1	1	1	1
Sudan	1	1	1	1
Sweden	2	2	3	3
Thailand	1	1	1	1
Turkey	1	1	1	1
Uganda	1	1	1	1
UK	2	2	3	3
Hungary	1	1	1	1
Vietnam	1	1	1	1
Yemen	1	1	1	1

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