# Do European Funds Contribute to the Sustainable Development of Romania?

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**Abstract**

*The social, economic well-being and the sustainability of the planet are European strategic goals that characterize a good standard of living, but often, a successful economy depletes natural resources far beyond limits. The European Union is achieving its objectives by providing European non-reimbursable funds to the member states, thus enabling the development of those states to reduce regional inequalities. The economic growth is an important factor in the economic development of a country, several factors being able to favour this growth, and which can be measured through the gross product per capita. This study focuses on the sustainable development of Romania by measuring two relevant indicators, gross product per capita and the Happy Planet Index in relation to the value of the funds absorbed per capita. This study also identifies the trend line of the correlation between the aforementioned indices and established the intensity through the Pearson correlation coefficient.*

**Key words**: European funds, correlation report, gross domestic product per capita, Happy Planet Index, sustainable development
**J.E.L. classification:** C1, C2, C12.

## 1. Introduction

The sustainable development idea is a concept aimed at achieving a balance between social aspects, economic activities, and the environment, thus the sustainable development term is frequently addressed in current political and environmental discourses. Today, most countries in the world face countless challenges, from youth unemployment to population aging, climatic changes, pollution, sustainable energy sources, international migration, and depopulation of rural areas. The United Nations (UN) Agenda 2030 for Sustainable Development was adopted in 2015, it is an international plan for global well-being for present and future generations, at the heart of which are the most important 17 Sustainable Development Goals (SDGs), representing a continuation of the Millennium Development Goals (European Commission, 2019).

The European Union promotes a policy of economic and social cohesion whose main goal is to reduce the existing regional inequalities and prevent regional imbalances by formulating guidelines and setting priorities at community level for the harmonization of national regional policies with the help of financial instruments, specially created for this purpose (Gheorghiu, 2008). Since 2007, Romania has faced one of the biggest challenges for it as a country, joining the European Union as part of the fifth wave of its enlargement. This debut marked the beginning of a new stage of economic development based on the principle of economic and social cohesion, while emphasizing the reduction of regional development gaps, economic growth, sustainable and balanced development and ensuring a high level of employment.

By becoming an EU member state, our country had the opportunity to access European non-reimbursable funds, financial instruments through which the country's development and modernization projects can be implemented, primarily pursuing EU objectives.

The chosen research topic is important since EU development policy does not only target the European space but also that of third-party countries, giving it worldwide notoriety. Development policy does not consist only in economic development, but in progress at all levels considering the social, technological, political, and economic field. World welfare and peace are closely linked to continuous and uniform development, not only in the European or American space, but throughout the planet. The object of the research is in line with the current realities as we are facing the end of a development period 2014-2020 and in the beginning of a new stage of development at European level, being thus a favourable moment for the analysis of the results.

The main objective of the proposed research is to identify and measure the effects of the use of EU funds in Romania in terms of sustainable development and quality of life. In this context, this paper aims to conduct a study on the indirect effects and impact of European projects on the sustainable development of Romania. The research is structured in two parts, the first chapter of the paper outlines the theoretical framework by basing the theme on the defining aspects of sustainable development and identifying the main benefits of European projects involving grants. The second chapter aims to conduct an empirical study starting with the presentation of the methodology used, implicitly the ways to measure sustainable development at national and international level through specific indicators such as Gross Domestic Product per capita, Happy Planet Index (Happy Life Year Index, Ecological Footprint Index), but also the correlation between them. The analysis carried out in this chapter aims to highlight the impact of European projects on the sustainable development of Romania. Subsequently, the results obtained, and their analysis are presented, and the end of the paper contains discussion and conclusions.

## 2. Theoretical background. Perception regarding the concept of sustainable development

The sustainable development concept did not appear in the twentieth century, as most of us tend to believe, due to the prominent emphasis that has been placed in recent years on the many issues related to the environment and sustainability, but it has made his presence felt in 1789, when Thomas Jefferson, the president of the United States, referred to it in a speech.

In Romanian, the terms sustainable development and sustainable change do not have a uniform definition, being frequently used as synonyms, "Sustainable change is a complex and dynamic process that promises a step forward towards the balance of sustainable development" (Gończ, 2007). Sustainability is not just about ecology. In most of the definitions of sustainability, we often find concerns about social equity and economic development. In the report entitled Our Common Future, also known as the Brundtland Report (1978) prepared by the United Nations World Commission on Environment and Development (WCED), we find one of the best-known definitions of this concept, "sustainable development is the development of which meets the needs of the present without compromising the ability of future generations to meet their own needs".

At the European level, sustainable development is considered a major challenge, being included as a key objective in the 1997 Treaty of Amsterdam. The European Union's Sustainable Development Strategy, adopted by the European Council in 2006, addresses economic, social and environmental issues in an integrated way, with the aim of continuously improving the quality of life and well-being of the present and future generations (European Commission, 2009). Morton (2009) argues that in a dynamic environment with a high level of competitiveness, there has been a need to make progress towards economic development without depleting natural resources or harming the environment. Improving territorial cohesion and raising regions of difficulty is the main reason why change is needed at European level.

Nagy et al. (2018) conducted a study that addresses sustainability at the local level before measuring the rate of achievement of the objectives by which a Romanian metropolitan area achieves the SDG. The paper analysed 16 of the 17 objectives of sustainable development through quantitative data, using the method of normalization and aggregation based on arithmetic mean to calculate the scores obtained by each component locality of the metropolitan area (Cluj-Napoca) within the SDG and the general index to the SDG. The study showed that the municipality had very good results in the metropolitan area where a process of vertical development from west to east predominated.

There are different approaches to sustainable development indicators, with different portfolios of indicators being used by international organizations or governments to measure sustainable development. The portfolio of indicators must be balanced in terms of the dimensions approached, be transparent, accessible to the public and not offer contradictory messages. All indicators selected for sustainable development must meet well-defined criteria (Wolff, 2006):

- The indicators must capture the essence of the problem and have a clear and universally accepted interpretation.
- The data used must be statistically valid, so that the values can be compared over time and the fluctuations can be explained;
- Indicators must be influenced by policy interventions, reflect results, but cannot be manipulated;
- The way of measuring the indicators must be comparable in different countries and, if possible, be comparable with the standards applied at the national level;
- Indicators must be timely and can be revised if necessary;
- Where possible, indicators should be based on existing data collections provided by internationally recognized sources.

Many scientific papers discuss the results of EU-funded projects in relation to the level of financial resources allocated, contracted, and absorbed, or analyse the dimensions of sustainable development from different perspectives and perform analyses and measurements at the level of projects or regions. The work is largely aimed at EU Member States, such as Georgescu (2007), who presents the conclusions regarding the lack of appropriate indicators of absorption rates in EU countries.

For other authors, such as Zidanšek (2007), environmental sustainability indicators mainly measure whether development improves the quality of life and the quality of the environment, as a rule they are often directed towards economic and environmental measures regarding development. He argues that the link between indicators of sustainable development and life satisfaction is often difficult for an individual to measure, and at the same time raises the question of whether the current generation must sacrifice its happiness to have a more prosperous future. The researcher argues that strategies and measures need to be developed to improve happiness and sustainability at the same time.

Grzebyk and Stec (2015) compared the levels and assessed the progress made by EU countries in the fields of sustainable development, for the period 2005-2012 using statistical analyses. Using the dynamic approach of the median method, the authors designed, for the analysed period, a synthetic measure, which was the basis for ordering EU countries in terms of their levels of sustainability, as well as their classification into groups of countries with similar levels of the phenomenon. The results of the research show that a gradual progress in the implementation of sustainability concepts was observed in EU countries in the period 2005-2012. The highest values of the applied measurements were reached in Sweden, Latvia, Finland, Denmark and the Czech Republic, and the lowest were recorded in Malta, Cyprus, Romania, Greece and Slovenia. Although there is a gradual convergence of developing EU countries in terms of sustainable development levels, most countries still have sustainability measures below EU average levels.

Moldan et al. (2011) analysed the different approaches and types of indicators used to assess environmental sustainability, emphasizing that an important aspect is setting targets and then measuring the distance to that target to obtain information about the current state or trend. It also suggests that once sustainable development indicators are defined, they need to be measured broadly, both by qualitative and quantitative techniques, but more and more often, the availability of data, i.e., the value of sustainability indicators, is not a problem. Difficulties arise in the selection, interpretation, and use of indicators. He mentions that in recent decades, a lot of environmental sustainability indicators and targets have been developed, tested, and suggested to be used, but there is still a difficult correlation between indicators that reflect environmental quality and target levels created by perspective of sustainable development, therefore considers that the indicators should be linked in the analysis to well-defined reference values and targets.

In 2006, Nic Marks, founder of the New Economics Foundation's Welfare Centre (NEF), developed the Happy Planet Index (HPI), a relatively new indicator that reports national well-being in terms of living a long, happy, and sustainable life. Unlike other indicators, it does not explicitly use income or income-adjusted variables but uses both objective and subjective data. It is one of the indicators frequently mentioned in studies to monitor the performance with which it is measured whether a good standard of living can be achieved without depleting the Earth's resources. This indicator represents a combination of three objectives: life expectancy, experienced well-being, and ecological footprint. The HPI level varies between 0 and 100, high levels can only be achieved by meeting all the objectives set by the index, mentioned above. The HPI report (Marks, 2006) set the standard when it proved that the most economically developed countries are not necessarily the happiest. Studies also show that these countries have been inefficient in terms of population happiness. The report confirmed that there was no correlation between material consumption and happiness. Once basic needs (food, shelter, and health) are covered, other expenses arise due to cultural pressures and values. On the other hand, it has been shown that social capital and activities such as socializing, exercise, participation in cultural activities, and engaging in activities of interest are closely associated with happiness (Escobar, 2009).

The results of the HPI 2021 - NEF Report reveal the extent to which countries around the world offer a long and happy life to their people. Western countries with richer populations are not at the top of the HPI rankings, they recognize the financial standard of living as a measure of their success. Thus, the study included 152 countries, and in the top of the countries ranked with the highest score in Europe we find the following: Germany - 29 (52.7), Spain - 30 (52.3) and France - 31 (51.8). We also identified three countries with the lowest score: Lithuania - 125 (36.9), Estonia - 133 (34.4) and Luxembourg - 143 (31.7), while Romania is on the 64th place (46.2).

On the other hand, one of the most relevant indicators for a country's economy is the Gross Domestic Product per capita (GDP per capita expressed in standard purchasing power parity - PPS), which is often considered an indicator of a country's standard of living. There has been a continuous growth over the last 10 years, with Romania reaching 73% of the EU average in 2021, compared to 2011. Today, Romania is still at a disadvantage compared to the average of European countries.

## 3. Research methodology

Sustainability assessment is a complex process and involves a thorough analysis. Ever since the concept of sustainable development came to light, efforts have been made to develop a set of methods and sustainability indicators to monitor progress in implementing this concept worldwide or individually in each country. Sustainability indicators are the parameters or values that characterize the state of economic, social, and environmental phenomena that make up the concept of sustainable development. They allow the interpretation of the condition and through time analysis, determine the modification trends for the individual parameters. In the current research the following indicators were chosen to measure the effects of the use of EU funds in Romania in terms of sustainable development and quality of life:

- Happy Planet Index - since in relation to the level of funds absorbed, the level of well-being and satisfaction of people should be measured, respectively if it is improved through the use of funds received;
- GDP / capita - because it measures the level of quality of life of a country and the level of prosperity felt by each country for each of its citizens.

This research reflects a statistical analysis of the intensity of the correlation between GDP per capita, Happy Planet Index and the value of funds absorbed by Romania in the period 2014-2020. The aim of the research is to determine the trend model and the intensity of the correlation between the variables listed above. Thus, the following hypothesis can be formulated:

H1: There is a positive correlation between GDP per capita and the value of funds absorbed by Romania in the period 2014-2020.

H2: There is a positive correlation between Happy Planet Index and the value of funds absorbed by Romania in the period 2014-2020.

The statistical methods applied in the research are the following:

- the coefficient of variation method,
- the least squares method, used to calculate the parameters of the regression equation,
- the Pearson correlation coefficient method, used to measure the statistical relationship between the variables mentioned above.

The first part of the data analysis refers to the methodology for achieving the trend model, applying the least squares method to solve the linear system between the value of non-reimbursable funds absorbed per capita and GDP per capita in 2014-2020, to obtain the coefficient Pearson correlation and its interpretation. In the second part, the ratio between the value of non-reimbursable funds absorbed per capita and Happy Planet Index was analysed, the trend model was determined, the system was solved, and the Pearson correlation coefficient was interpreted.

In table no.1 are presented the following indicators for the 2014-2020 financing period: GDP, population, GDP per capita and the value of contracted non-reimbursable funds. The following upward trend in GDP per capita can be seen until 2020, which was deeply marked by macroeconomic imbalances due to the pandemic, when production and population fell sharply.

*Table no.1 Statistical data regarding the period 2014-2020 in Romania*

| Year | Annual GDP (EUR) | Population (mil) | GDP/ capita (EUR) | Contracted grants (EUR) |
|---|---|---|---|---|
| 2014 | 150,708.6 | 19.94 | 7,040 | 0 |
| 2015 | 160,149.8 | 19.87 | 7,290 | 666,249,202 |
| 2016 | 170,063.4 | 19.76 | 7,670 | 1,272,081,645 |
| 2017 | 187,722.7 | 19.64 | 8,280 | 2,495,304,769 |
| 2018 | 204,496.9 | 19.53 | 8,700 | 10,025,782,682 |
| 2019 | 223,162.5 | 19.41 | 9,120 | 18,059,087,321 |
| 2020 | 218,863.3 | 19.32 | 8,820 | 24,496,959,481 |

*Source:* own conception based on Eurostat Data, 2021 and MIPE, 2022

Regarding the table no.2, it presents data about Happy Planet Index, as well as its components such as Life Expectancy, Wellbeing and Ecological Footprint. At the bottom, we have the results of the Pearson (r) correlation coefficients calculated in advance. Correlation coefficients demonstrate the dependence between HPI and its components with the value of grants paid per capita in Romania in the period 2014-2020.

*Table no.2 Correlation between paid grants per capita and, HPI and index components*

| An | Contracted grants /capita ( EUR) | HPI | HPI Rank | Life expectancy (years) | Wellbeing (0-10) | Ecological Footprint (g ha) |
|---|---|---|---|---|---|---|
| 2014 | - | 49.6 | 37 | 75.3 | 5.73 | 2.73 |
| 2015 | 33,530,408 | 48.9 | 37 | 75.5 | 5.78 | 2.93 |
| 2016 | 64,376,601 | 49.6 | 38 | 75.6 | 5.97 | 3.03 |
| 2017 | 127,052,178 | 48.5 | 42 | 75.8 | 6.09 | 3.40 |
| 2018 | 513,352,928 | 47.6 | 55 | 75.9 | 6.15 | 3.64 |
| 2019 | 930,401,202 | 46.2 | 64 | 76.0 | 6.13 | 3.93 |
| 2020 | 1,267,959,565 | 48.4 | - | 74.6 | - | 3.72 |
| r | | -0.6489 | -0.2917 | -0.3547 | -0.7045 | 0.8447 |

*Source:* own conception based on data from Happy Planet Index Report, 2021

## 4. Data analysis and results interpretation

### 4.1. GDP/capita vs Paid Grants/capita

To identify the value of the correlation between the factor X (GDP per capita) and the factor Y (the value of grants per capita) (H1), we performed the following steps:

Step 1 – the analysis of the correlation regarding the factor Y, where Y equals the value of non-reimbursable funds absorbed per capita, as the next function $Y_{ti} = a + b \cdot X_i$, and the parameters a and b of the adjusted linear function, can be calculated using the following system:

$$\begin{cases} n \cdot a + b \sum_{i=1}^{n} X_i = \sum_{i=1}^{n} Y_i \\ a \sum_{i=1}^{n} X_i + b \cdot \sum_{i=1}^{n} X_i^2 = \sum_{i=1}^{n} X_i Y_i \end{cases} \qquad a = \frac{\sum_{i=1}^{n} X_i^2 \sum_{i=1}^{n} Y_i - \sum_{i=1}^{n} X_i \sum_{i=1}^{n} X_i Y_i}{n \sum_{i=1}^{n} X_i^2 - (\sum_{i=1}^{n} X_i)^2}, \quad b = \frac{n \sum_{i=1}^{n} X_i Y_i - \sum_{i=1}^{n} X_i \sum_{i=1}^{n} Y_i}{n \sum_{i=1}^{n} X_i^2 - (\sum_{i=1}^{n} X_i)^2}$$

*Table no.3 Estimation of the value for the coefficient of variation in case of adjustment of the linear function, assuming the linear evolution of the correlation between GDP per capita and the value of non-reimbursable financing absorbed per capita in the period 2014-2020*

| Years | $X_i$ | $Y_i$ | LINEAR TREND | | | |
|---|---|---|---|---|---|---|
| | | | $X_i^2$ | $X_iY_i$ | $Y_{Xi} = a + b \cdot X_i$ | $\lvert Y_i - Y_{Xi} \rvert$ |
| 2014 | 7,040 | - | 49,561,600 | - | -151,665,718 | 151,665,718 |
| 2015 | 7,290 | 33,530,408 | 53,144,100 | 244,436,672,647 | -20,830,250 | 54,360,658 |
| 2016 | 7,670 | 64,376,601 | 58,828,900 | 493,768,533,338 | 178,039,662 | 113,663,060 |
| 2017 | 8,820 | 127,052,178 | 68,558,400 | 1,051,992,030,775 | 497,278,204 | 370,226,027 |
| 2018 | 8,700 | 513,352,928 | 75,690,000 | 4,466,170,472,780 | 717,081,791 | 203,728,863 |
| 2019 | 9,120 | 930,401,202 | 83,174,400 | 8,485,258,957,682 | 936,885,377 | 6,484,176 |
| 2020 | 8,820 | 1,267,958,565 | 77,792,400 | 11,183,394,545,860 | 779,882,816 | 488,075,750 |
| **TOTAL** | **56,920** | **2,936,671,882** | **466,749,800** | **25,925,021,213,083** | **2,936,671,882** | **1,388,204,251** |

*Source:* own conception

After calculating the statistical data for the adjustment of the linear function according to the previously mentioned system, we obtain the following values for parameters a and b:

a = $\frac{466{,}749{,}800 \cdot 2{,}936{,}671{,}882 - 56{,}920 \cdot 25{,}925{,}021{,}213{,}083}{7 \cdot 466{,}749{,}800 - (56{,}920)^2}$ = -3,835,992,503

b = $\frac{7 \cdot 25{,}925{,}021{,}213{,}083 - 56{,}920 \cdot 2{,}936{,}671{,}882}{7 \cdot 466{,}749{,}800 - (56{,}920)^2} = 523{,}342$

Therefore, the coefficient of variation for the linear function is:

$$v_I = \left[ \frac{\sum_{i=m}^{m} \lvert Y_i - Y_{Xi}^I \rvert}{n} : \frac{\sum_{i=m}^{m} Y_i}{n} \right] \cdot 100 = \frac{\sum_{i=m}^{m} \lvert Y_i - Y_{Xi}^I \rvert}{\sum_{i=m}^{m} Y_i} \cdot 100 = \frac{1{,}388{,}204{,}251}{2{,}936{,}671{,}882} \cdot 100 = 47.2713\%$$

Step 2 **-** the analysis of the correlation regarding the Y factor, where Y equals the value of non-reimbursable funds absorbed per capita, as the next quadratic function $Y_{Xi} = a + bX_i + cX_i^2$, where the parameters a, b and c of the quadratic linear function can be calculated using the following system:

$$S = \sum_{i=1}^{n} (Y_i - Y_{X_i})^2 = min \Leftrightarrow S = \sum_{i=1}^{n} (Y_i - a - bX_i - cX_i^{\,2})^2 = min$$

$$\begin{cases} \frac{\partial S}{\partial a} = 0 \\ \frac{\partial S}{\partial b} = 0 \\ \frac{\partial S}{\partial c} = 0 \end{cases} \Rightarrow \begin{cases} 2\sum_{1=1}^{n} (Y_i - a - bX_i - cX_i^{\,2})(-1) = 0 / \left(-\frac{1}{2}\right) \\ 2\sum_{1=1}^{n} (Y_i - a - bX_i - cX_i^{\,2})(-X_i) = 0 / \left(-\frac{1}{2}\right) \\ 2\sum_{1=1}^{n} (Y_i - a - bX_i - cX_i^{\,2})(-X_i^{\,2}) = 0 / \left(-\frac{1}{2}\right) \end{cases} \Rightarrow \begin{cases} n \cdot a + b\sum_{i=1}^{n} X_i + c\sum_{i=1}^{n} X_i^{\,2} = \sum_{i=1}^{n} Y_i \\ a\sum_{i=1}^{n} X_i + b\sum_{i=1}^{n} X_i^{\,2} + c\sum_{i=1}^{n} X_i^{\,3} = \sum_{i=1}^{n} X_iY_i \\ a\sum_{i=1}^{n} X_i^{\,2} + b\sum_{i=1}^{n} X_i^{\,3} + c\sum_{i=1}^{n} X_i^{\,4} = \sum_{i=1}^{n} X_i^{\,2}Y_i \end{cases}$$

*Table no.4 Estimates of the value for the coefficient of variation in the case of the quadratic function, in the hypothesis regarding the parabolic evolution of the correlation between GDP per capita and the value of non-reimbursable financing absorbed per capita in the period 2014-2020*

| PARABOLIC TREND | | | | |
|---|---|---|---|---|
| $X_i^3$ | $X_i^4$ | $X_i{}^2Y_i$ | $Y_{Xi} = a + bX_i + cX_i^2$ | $\|Y_i - Y_{Xi}\|$ |
| 348,913,664,000 | 2,456,352,194*10^6 | - | 17,586,193 | 17,586,193 |
| 387,420,489,000 | 2,824,295,364*10^6 | 1,781,943,343*10^6 | -7,387,988 | 40,918,396 |
| 451,217,663,000 | 3,460,839,475*10^6 | 3,787,204,650*10^6 | 37,484,562 | 26,892,039 |
| 567,663,552,000 | 4,700,254,210*10^6 | 8,710,494,014*10^6 | 318,468,499 | 19,416,321 |
| 658,503,000,000 | 5,728,976,100*10^6 | 38,855,683,113*10^6 | 661,614,085 | 148,261,157 |
| 758,550,528,000 | 6,917,980,815*10^6 | 77,385,561,694*10^6 | 1,126,829,805 | 196,428,604 |
| 686,128,968,000 | 6,051,657,497*10^6 | 98,637,539,894*10^6 | 782,076,726 | 485,881,839 |
| **3,858,397,864,000** | **32,140,355,658*10^6** | **229,158,426,710*10^6** | **2,936,671,882** | **1.107.384,549** |

*Source:* own conception

To obtain the parameters a, b and c of the quadratic function we solved the system by the Cramer method, implicitly by the rule of triangles, and we obtained the following values:

$$\begin{cases} 7a + 56{,}920 \cdot b + 466{,}749{,}800 \cdot c = 2{,}936{,}671{,}882 \\ 56{,}920 + 466{,}749{,}800 \cdot b + 3{,}858{,}397{,}864{,}000 \cdot c = 25{,}925{,}021{,}213{,}083 \\ 466{,}749{,}800 \cdot a + 3{,}858{,}397{,}864{,}000 \cdot b + 32{,}140{,}355{,}658{,}260{,}000 \cdot c = 229{,}158{,}426{,}710{,}852{,}000 \end{cases}$$

$$\Rightarrow a = 18{,}478{,}326{,}856 \,,\; b = -5{,}058{,}131 \quad c = 346$$

Therefore, the coefficient of variation for the quadratic function has the following value:

$$v_{II} = \left[\frac{\sum_{i=m}^{m} |Y_i - Y_{Xi}^{II}|}{n} : \frac{\sum_{i=m}^{m} Y_i}{n}\right] \cdot 100 = \frac{\sum_{i=m}^{m} |Y_i - Y_{Xi}^{II}|}{\sum_{i=m}^{m} Y_i} \cdot 100 = \frac{1{,}107{,}384{,}549}{2{,}936{,}671{,}882} \cdot 100 = 37.7088\%$$

To reflect the intensity of the linear correlation between the two variables we use the Pearson correlation coefficient denoted by r:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}} = \frac{2{,}045{,}683{,}570{,}334}{2{,}442{,}567{,}917{,}985} = 0.8375$$

### 4.2. Happy Planet Index vs. Paid Grants/capita

To identify the value of the correlation between factor H - Happy Planet Index and factor G - the value of non-reimbursable funds absorbed per capita (H2), the following steps were made:

Step 1- the analysis of the correlation regarding the factor G, where G equals the value of the non-reimbursable funds absorbed per capita, considering the following function $G_i = a + b \cdot H_i$

*Table no.5 Estimation of the value for the coefficient of variation in case of adjustment of the linear function, in the hypothesis regarding the linear evolution of the correlation between HPI and the Value of non-reimbursable financing absorbed per capita in the period 2014-2020*

| Years | $H_i$ | $G_i$ | LINEAR TREND | | | |
|---|---|---|---|---|---|---|
| | | | $H_i^2$ | $H_iG_i$ | $G_{Hi} = a + b \cdot H_i$ | $\|G_i - G_{Hi}\|$ |
| 2014 | 49.61 | - | 2,461 | - | 85,866,075 | 85,866,075 |
| 2015 | 48.86 | 3,530,408 | 2,387 | 1,638,295,724 | 292,964,442 | 259,434,034 |
| 2016 | 49.56 | 64,376,601 | 2,456 | 3,190,504,369 | 99,672,633 | 35,296,031 |
| 2017 | 48.54 | 127,052,178 | 2,356 | 6,167,112,702 | 381,326,411 | 254,274,234 |
| 2018 | 47.63 | 513,352,928 | 2,269 | 24,450,999,956 | 632,605,763 | 119,252,835 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2019 | 46.21 | 930,401,202 | 2,135 | 42,993,839,521 | 1,024,712,003 | 94,310,802 |
| 2020 | 48.40 | 1,267,958,565 | 2,343 | 61,371,307,824 | 419,524,555 | 848,434,011 |
| **TOTAL** | **338.81** | **2,936,671,882** | **16,407** | **139,812,060,097** | **2,936,671,882** | **1,696,868,022** |

*Source:* own conception

Since for 2020 we could not obtain the HPI value due to the non-existence of all data, we estimated an average of it. After calculating the statistical data for adjusting the linear function according to the afore mentioned system, we obtain the following values for parameters a and b:

$$a = \frac{16{,}407 \cdot 2{,}936{,}671{,}882 - 339 \cdot 139{,}812{,}060{,}097}{7 \cdot 16{,}407 - (339)^2} = 13{,}784{,}732{,}693$$
$$b = \frac{7 \cdot 139{,}812{,}060{,}097 - 339 \cdot 2{,}936{,}671{,}882}{7 \cdot 16{,}407 - (339)^2} = -276{,}131{,}155$$

Therefore, the coefficient of variation for the linear function is calculated below:

$$v_I = \left[\frac{\sum_{i=m}^{m}|G_i - G_{Hi}^{I}|}{n} : \frac{\sum_{i=m}^{m} G_i}{n}\right] \cdot 100 = \frac{\sum_{i=m}^{m}|G_i - G_{Hi}^{I}|}{\sum_{i=m}^{m} G_i} \cdot 100 = \frac{1{,}696{,}868{,}022}{2{,}936{,}671{,}882} = 57.7820\%$$

Step 2 – the analysis of the correlation regarding the factor G, where G equals the value of the non-reimbursable funds absorbed per capita, as the next quadratic function $G_{Hi} = a + bH_i + cH_i^2$, where a, b and c are parameters of the quadratic linear function.

*Table no.6 Estimation of the value for the coefficient of variation in case of adjustment of the quadratic function, assuming the linear evolution of the correlation between HPI and the value of non-reimbursable financing absorbed per capita in the period 2014-2020*

| Years | $H_i$ | $G_i$ | PARABOLIC TREND | | | | |
|---|---|---|---|---|---|---|---|
| | | | $H_i^3$ | $H_i^4$ | ${H_i}^2 G_i$ | $G_{Xi} = a + bH_i + cH_i^2$ | $\lvert G_i - G_{Hi}\rvert$ |
| 2014 | 49.61 | - | 122,098 | 6,057,270 | - | 155,884,734 | 155,884,734 |
| 2015 | 48.86 | 33,530,408 | 116,643 | 5,699,199 | 80,047,129,058 | 321,220,462 | 287,690,054 |
| 2016 | 49.56 | 64,376,601 | 121,729 | 6,032,887 | 158,121,396,541 | 167,023,700 | 102,647,098 |
| 2017 | 48.54 | 127,052,178 | 114,367 | 5,551,356 | 299,351,650,562 | 390,623,182 | 263,571,004 |
| 2018 | 47.63 | 513,352,928 | 108,054 | 5,146,623 | 1,164,601,127,912 | 584,258,813 | 70,905,886 |
| 2019 | 46.21 | 930,401,202 | 98,675 | 4,559,780 | 1,986,745,324,281 | 875,394,669 | 55,006,533 |
| 2020 | 48.40 | 1,267,958,565 | 113,392 | 5,488,343 | 2,970,473.584,210 | 420,414,207 | 847,544,359 |
| **TOTAL** | **338.81** | **2,936,671,882** | **794,958** | **38,535,458** | **6,659,340,212,564** | **2,914,819,766** | **1,783,249,667** |

*Source:* own conception

To obtain the parameters a, b and c of the quadratic function we solved the system by the Cramer method, implicitly by the rule of triangles, and we obtained the following values:

$$\begin{cases} 7a + 339 \cdot b + 16{,}407 \cdot c = 2{,}936{,}671{,}882 \\ 339 + 16{,}407 \cdot b + 794{,}958 \cdot c = 139{,}812{,}060{,}097 \\ 16{,}407 \cdot a + 794{,}958 \cdot b + 38{,}535{,}458 \cdot c = 6{,}659{,}340{,}212{,}564 \end{cases}$$

$\Rightarrow a = 3{,}018{,}207{,}290\,;\ b = 107{,}552{,}897\,;\ c = -3{,}330{,}969$

Therefore, the coefficient of variation for the quadratic function has the following value:

$$v_{II} = \left[\frac{\sum_{i=m}^{m}|G_i - G_{Hi}^{II}|}{n} : \frac{\sum_{i=m}^{m} G_i}{n}\right] \cdot 100 = \frac{\sum_{i=m}^{m}|G_i - G_{Hi}^{II}|}{\sum_{i=m}^{m} G} \cdot 100 = \frac{1{,}783{,}249{,}667}{2{,}936{,}671{,}882} = 60.7235\%$$

To reflect the intensity of the linear correlation between the two variables we use the Pearson correlation coefficient denoted by r:

$$r = \frac{n(\sum HG) - (\sum H)(\sum G)}{\sqrt{[n\sum H^2 - (\sum H)^2][n\sum G^2 - (\sum G)^2]}} = \frac{-2{,}327{,}753{,}424}{3{,}586{,}996{,}428} = -0.6489$$

Applying the coefficient of variation method as a selection criterion for the best unidentified trend model, the following can be observed, the fact that a lower coefficient of variation indicates a better grouping around, because of which:

- In the case of the first test, according to the obtained results, the correlation between the two variables reflects a parabolic trend, so the hypothesis is confirmed.$H_2$ ($v_{II} = 37.7088\% < v_I = 47.2713\%$)
- In the case of the second tests, we have a linear tendency, so the hypothesis is confirmed.$H_1$ ($v_I = 57.7820\% < v_{II} = 60.7235\%$).

The Pearson correlation coefficient can take values between 1 and -1. In the analysed case, the coefficient calculated for the two variables from the first test is 0.8375. This indicates a positive link of very strong intensity. Therefore, due to the positive intensity, we can say that the increase of the value of one variable determines the increase of the value of the other variable. Respectively, in the second test, the Pearson coefficient registers the value of -0.648, which indicates a strongly negative intensity connection.

## 5. Conclusions

According to the mentioned hypotheses, we can specify the fact that there is a parabolic correlation between the GDP/ capita values and the values of the absorbed / per capita non-reimbursable financing, in Romania in the period 2014-2020. Also, regarding the negative correlation between Happy Planet Index and the values of non-reimbursable absorbed/ per capita funding, we can say that the well-being of the population is not necessarily due to EU-funded support. In other words, EU-funded projects do not necessarily lead Romania to sustainable development. If the HPI is accepted as an index that reflects the sustainable development of a country, then a significant negative correlation has shown that Romania will not achieve sustainable development just based on the absorption of European funds, other measures and efforts being needed to support the sustainable change al national level.

A limitation of the current research is that sustainable development can be measured in a variety of ways, using different sets of indicators, so for future research other sets of indicators can be analysed to identify the trend and test correlations. Also, the time lag can be considered a limitation of the study since achieving sustainable development is a long-term objective. The research should be replicated on longer periods of time to confirm the results.

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