# ANALYSIS OF CORRELATION BETWEEN CHANGES IN HEALTH SPENDING PER CAPITA AND GROSS DOMESTIC PRODUCT ON AN INHABITANT OF ROMANIA DURING 2000-2014

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**Abstract:**

*Currently, due to economic changes facing us, we see more and more the existence of labor market changes and the associated labor structure. This article aims that over time, the health system and beyond, are permanent changes in the status of human resources and thus held an enhancement of the role of company personnel, mainly due to increase and diversify the tertiary sector in the economies world.*

*The research analyzes the correlation between changes in health expenditure per capita and GDP per inhabitant of Romania in 2000-2014. The high level of requirements from increasingly diversified customer took delivery of services by competent staff, and that change has brought about a new name for the activity in question, implicitly for the person dealing with it.*

**Keywords**: *GDP; health spending; economic growth.*

**JEL Classification**: *C51; E23.*

## 1. Introduction

In the traditional theory of the enterprise, employees were viewed through the prism of how they executed the "disciplined" certain predetermined operations, put in motion machinery and technological devices.

Thus appear the concept of "labor". What interested them was the ability to put into practice, under the rules, decisions of the leaders (Aceleanu, 2010).

The concept of “labor” designates all physical and intellectual skills which man used in the process of obtaining goods and services (Balan et al, 2012). In totalitarian regimes was made the division of labor "productive work" and creator of material goods on one side and "unproductive work" and "unproductive personnel" on the other hand, the latter being associated with the dealing with intellectual activities (Cole, 2000). Any action to improve labor directly targets the ability to work better, more (Burghelea et al, 2011). The concept of labor is in the singular designate a whole mass of people. Thus, the individual personality, needs, behavior, specific vision leaders not included in the scope (Mathis et al, 1997).

## 2. Econometric model definition

The statistical data that will be used to develop single factor model of health expenditure per capita according to GDP (Burghelea et al, 2014, Bălan, 2009) per inhabitant refers to the period 2000 - 2014 and are presented in Table 1.

***Table 1.***

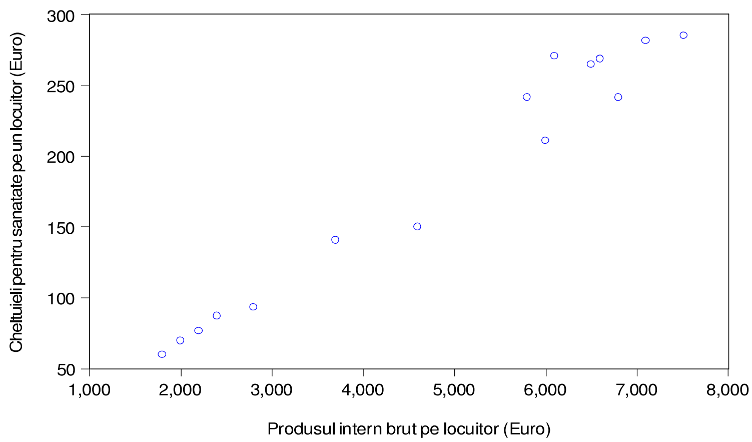
***Health expenditure per capita and GDP per inhabitant in 2000-2014 (Romania)***

| Year | Health expenditure per capita (Euro) $y$ | GDP per inhabitant (Euro) $x$ |
|---|---|---|
| 2000 | 59.67 | 1,800 |
| 2001 | 69.42 | 2,000 |
| 2002 | 76.25 | 2,200 |
| 2003 | 86.95 | 2,400 |
| 2004 | 93.08 | 2,800 |
| 2005 | 140.45 | 3,700 |
| 2006 | 149.94 | 4,600 |
| 2007 | 210.77 | 6,000 |
| 2008 | 241.29 | 6,800 |
| 2009 | 241.35 | 5,800 |
| 2010 | 270.48 | 6,100 |
| 2011 | 264.62 | 6,500 |
| 2012 | 268.56 | 6,600 |
| 2013 | 281.36 | 7,100 |
| 2014 | 285.00 | 7,516 |

**Source:** www.ec.europa.eu/eurostat

Note. Data for 2014 were extrapolated using the trend.

Both expenses for health, who as financing public revenues (Bălan et al, 2011) recorded in the state budget, and gross domestic product (Albu et al, 2005) are denominated in foreign currency, the euro. To identify the shape mathematical econometric model of health expenditure per capita by gross domestic product per inhabitant proceed to analyze graphical representation of the correlation between variables system under study (Fig. 1).




**Source:** own calculus

***Fig. 1. Graphical representation of correlation between health expenditure per capita and GDP per inhabitant***

The distributed cloud of points in the graph offers suggestive enough information on the form of the interdependence of two variables (Stanica et al, 2005). In these circumstances opting for a regression equation simple linear which has the general form of representation of actual levels: $y = a + b \cdot x + u$ where y is the endogenous variable (dependent) - health expenditure per capita, x is variable exogenous (Burghelea et al, 2015) (independent) - GDP per inhabitant and u is the residual variable.

Form mathematical model health expenditure per capita by gross domestic product per inhabitant (Balan et al, 2013) is based on estimation of parameters (coefficients) of simple linear regression equation using the method of least squares.

The resulting system of equations by the method of least squares is:

$$\begin{cases} \Sigma y = n \cdot a + b \cdot \Sigma x \\ \Sigma y \cdot x = a \cdot \Sigma x + b \cdot \Sigma x^2 \end{cases} \rightarrow$$

$$\begin{cases} 2739{,}190 = 15 \cdot a + 71916{,}00 \cdot b \\ 15680081 = 71916{,}00 \cdot a + 4{,}06\text{E} + 08 \cdot b \end{cases}$$

Solving this system, we have the following estimation for parameters:

$$a = \frac{\begin{vmatrix} 2739{,}190 & 71916{,}00 \\ 15680081 & 4{,}06\text{E}+08 \end{vmatrix}}{\begin{vmatrix} 15 & 71916{,}00 \\ 71916{,}00 & 4{,}06\text{E}+08 \end{vmatrix}} = -15{,}85293 \qquad b = \frac{\begin{vmatrix} 15 & 2739{,}190 \\ 71916{,}00 & 15680081 \end{vmatrix}}{\begin{vmatrix} 15 & 71916{,}00 \\ 71916{,}00 & 4{,}06\text{E}+08 \end{vmatrix}} = 0{,}041395$$

Hence the model of health spending per capita by gross domestic product per inhabitant in Romania for the period 2000-2014 the following form:

$\hat{y} = -15{,}85293 + 0{,}041395 \cdot x$.

To obtain estimators of the parameters defining the econometric model was necessary to proceed to the calculations in Table 2.

The parameter "b" (regression coefficient b = 0.041395) provides information indicating that an increase by one independent variable (GDP per inhabitant), spending (Vidrascu, 2015) for health per capita is increased on average by 0.041395 units.

In the last column of Table 2 are exposed the figures estimated levels of health expenditure per capita by gross domestic product per inhabitant which is achieved by successive replacement of the regression equation, the corresponding values of the independent variable. There were obtained lawfulness series formalizing levels estimated statistical correlation between the variables included in the model, in the 2000-2014 period for Romania.

***Table 2.***

***Table interim results and calculations needed for the definition of estimated expenditures for health per capita***

| Year | Health spending per capita (Euro) $y$ | GDP per inhabitant (Euro) $x$ | $y \cdot x$ | $x^2$ | Estimated levels of health spending per capita based on linear regression equation (Euro) $\hat{y} = -15{,}85293 + 0{,}041395\, x$ |
|---|---|---|---|---|---|
| 2000 | 59,67 | 1.800 | 107406 | 3240000 | 58,6586 |
| 2001 | 69,42 | 2.000 | 138840 | 4000000 | 66,9377 |

| | | | | | |
|---|---|---|---|---|---|
| 2002 | 76,25 | 2.200 | 167750 | 4840000 | 75,2167 |
| 2003 | 86,95 | 2.400 | 208680 | 5760000 | 83,4958 |
| 2004 | 93,08 | 2.800 | 260624 | 7840000 | 100,054 |
| 2005 | 140,45 | 3.700 | 519665 | 13690000 | 137,310 |
| 2006 | 149,94 | 4.600 | 689724 | 21160000 | 174,565 |
| 2007 | 210,77 | 6.000 | 1264620 | 36000000 | 232,519 |
| 2008 | 241,29 | 6.800 | 1640772 | 46240000 | 265,635 |
| 2009 | 241,35 | 5.800 | 1399830 | 33640000 | 224,240 |
| 2010 | 270,48 | 6.100 | 1649928 | 37210000 | 236,658 |
| 2011 | 264,62 | 6.500 | 1720030 | 42250000 | 253,216 |
| 2012 | 268,56 | 6.600 | 1772496 | 43560000 | 257,356 |
| 2013 | 281,36 | 7.100 | 1997656 | 50410000 | 278,054 |
| 2014 | 285,00 | 7.516 | 2142060 | 56490256 | 295,274 |
| Total | 2739,190 | 71.916,00 | 15680081 | 406000000 | 2739,190 |

**Source:** own calculus

### 3. Significance of the findings and conclusions on model validation

Interpretation of results refers to the significance of representation econometric indicators on which appreciates the quality and viability of the model attestation respectively.

Uni-factorial linear econometric model of health expenditure per capita by gross domestic product per inhabitant has the following analytical form $\hat{y} = -15{,}85293 + 0{,}041395 \cdot x$, and is confirmed as a viable model as key conditions are met:

- correlation ratio has a size large enough (R = 0.983537) to obtain confirmation that there is a very strong correlation health spending per capita by gross domestic product per inhabitant. Also the size of the coefficient of determination ($R^2$ = 0.967346) may indicate that 96.7346% of change in health spending per capita is explained by the change in GDP per inhabitant, the difference up to 100% is the proportion of the residual component or is the influence of other factors, not included in the model;

- uni-factorial linear model for health spending per capita, in terms of correlation ratio is viable because the result is significantly different from zero with a probability of over 95% and validated, so there is a statistical correlation into real variables system studied because $F_{statistic}$ = 385.1109 has a size exceeding one important measure value of 4.67 ($F_{tabelar}$ = 4.67);

- Coefficient regression model, "b" is significantly different from zero (the null hypothesis), under "Criterion t" with a significance level of 5% below the maximum limit for rejecting the null hypothesis. In these circumstances the independent variable (exogenous), GDP per inhabitant, has a significant influence on the level of health expenditure per capita;

- Coefficient Durbin-Watson statistic (DW = 1.054737) has a size that is not positioned within the phenomenon of non-acceptance of variants term residual autocorrelation. The conclusion is made under distribution Durbin - Watson both for materiality, q = 1% and 5%, the number of exogenous variables, k' = 1 and the number of observations, n = 15;

For a significance threshold of 1% acceptance range of non-autocorrelation hypothesis is: $d_2 = 1.070 < DW < 4 - d_2 = 4 - 1.070 = 2.930$

It stated that the state of autocorrelation of residuals can affect the correct interpretation of the following statistical indicators:

- an estimate of the standard deviation of the equation is less than the actual value and hence the coefficient of determination and correlation ratio that are oversized. In these conditions the intensity of the interdependence of system variables is greater than in reality;
- "criterion t" used to test the significance of the estimates of the parameters of the regression equation is not fully conclusive in this case t-statistic values are overstated, which would better confirm the significance of the parameters;

- Expression relative standard error of the estimate equation $\left(\hat{V}_{y.\hat{y}} = 9{,}0613\%\right)$ that provides information model (regression equation) is viable for an estimate of forecast because it has a size that does not exceed the 10% acceptance considered restrictive;

- Statistical significance similar to that which presents the estimate of the relative standard error of the regression equation is obtained by calculating and interpreting "irregularity coefficient (inequality) of Theil" (Th $= 3{,}8275\%$). The econometric model of health expenditure per capita is certified as sustainable in terms of this indicator as "irregularity coefficient (inequality) of Theil" has a value not exceeding the limit of 5%;

- Statistical description of the series of the error term (residual) is shown graphically and by indicators: mean, median, maximum, minimum, standard deviation (standard deviation), the coefficient of asymmetry (Skewness), kurtosis-flattening (Kurtosis), the coefficient statistically Jarque-Bera (JB = 0,046283) and the related probability coefficient JB (97.7124%). This information underlying acceptance hypothesis disposition values of the error term under the law of normal distribution (test for normality of the distribution of the residual variable) because the probability associated coefficient JB is higher than the critical limit of 60%, which sustain the viability of the developed model;

- Test there is the heteroscedasticity of errors (residual variable) confirms property of homoscedasticity model health expenditure per capita by gross domestic product per inhabitant, based on two statistical criteria applied, "Criterion F" and "$\chi^2$ Criterion" the auxiliary regression equation correlation squared residual levels of the independent variable, GDP per inhabitant. In these conditions can be made the following remarks:

- dispersion error is constant;
- application "Criterion t" for the significance of regression equation parameters is fully conclusive;
- econometric model attaches importance to all discriminatory remarks related to the residual variable.

Econometric study viability for uni-factorial linear model health spending per capita by gross domestic product per inhabitant of Romania for the period 2000-2014 can be completed by a synthetic conclusion made with full statistical certainty as favorable and practical to base macroeconomic decisions policy, given that the statistical support testing confirms this assessment, with one exception.

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