# An analysis on taxes dependence relative to GDP for Romania during 2001-2011

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**Abstract.** In this paper, we have investigated the dependence of taxes based on GDP in Romania during 2001-2011. After determining the regression equation, an apparently surprising conclusion is that there is a weak dependence of tax revenues to the GDP.

**Keywords:** taxes, GDP, regression

**JEL Classification:** R12

## 1. Introduction

The purpose of this paper is to statistically analyze the taxes based on GDP in Romania during 2001-2011.

For accuracy and adequacy of calculations, we have reduced the existing data (GDP, the money demand) using GDP deflator at the level of year 2000.

## 2. The taxes depending to the GDP

In this section we shall investigate the dependence of taxes to GDP. For data consistency calculations we will report all computations to the level of year 2000.

Considering the GDP deflator for year n: $GDP_{deflator,n}=\frac{\text{nominal GDP}_n}{\text{real GDP}_n}$ we first compute the cumulative deflator for the year n relative to 2000:

$$GDP_{\text{cumulative deflator},n}=\frac{GDP_{\text{cumulativedeflator},n-1}}{GDP_{\text{deflator},n}}=\frac{1}{\prod_{k=1}^{n} GDP_{\text{deflator},n}}$$

where $GDP_{deflator,2000}=1$.

Table no.1

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| Year | Deflator GDP-România ($GDP_{deflator,n}$) | Cumulative Deflator-România ($GDP_{cumulative\ deflator,n}$) |
|---|---|---|
| 2000 | 1.443 | 1 |
| 2001 | 1.374 | 0.727802038 |
| 2002 | 1.234 | 0.589790954 |
| 2003 | 1.24 | 0.475637867 |
| 2004 | 1.15 | 0.413598145 |
| 2005 | 1.123 | 0.368297547 |
| 2006 | 1.108 | 0.332398508 |
| 2007 | 1.13 | 0.294157971 |
| 2008 | 1.116 | 0.263582412 |
| 2009 | 1.065 | 0.247495222 |
| 2010 | 1.036 | 0.238895002 |
| 2011 | 1.071 | 0.223057892 |

*Source: The World Bank*

Let now consider GDP for the period 2001-2011:

Table no.2

| Year | GDP (current mil. lei) Y |
|---|---|
| 2001 | 117945.8 |
| 2002 | 152017.0 |
| 2003 | 197427.6 |
| 2004 | 247368.0 |
| 2005 | 288954.6 |
| 2006 | 344650.6 |
| 2007 | 416006.8 |
| 2008 | 514700.0 |
| 2009 | 501139.4 |
| 2010 | 522561.1 |
| 2011 | 578551.9 |

*Source: Romanian National Institute of Statistics*

Considering the cumulative deflator, we get:

Table no.3

| Year | GDP (mil. 2000-lei)<br>Y |
|---|---|
| 2001 | 85841.2 |
| 2002 | 89658.3 |
| 2003 | 93904.0 |
| 2004 | 102310.9 |
| 2005 | 106421.3 |
| 2006 | 114561.3 |
| 2007 | 122371.7 |
| 2008 | 135665.9 |
| 2009 | 124029.6 |
| 2010 | 124837.2 |
| 2011 | 129050.6 |

Also, let the taxes for the period 2001-2011:

Table no.4

| Year | Tax revenues (current mil. lei)<br>TI |
|---|---|
| 2001 | 14685.2 |
| 2002 | 17865.0 |
| 2003 | 25184.5 |
| 2004 | 32107.1 |
| 2005 | 36530.2 |
| 2006 | 37900.2 |
| 2007 | 44824.2 |
| 2008 | 55133.6 |
| 2009 | 48152.9 |
| 2010 | 56304.7 |
| 2011 | 69527.7 |

*Source: Romanian National Institute of Statistics*

At the level of 2000-currency, the situation is as follows:

Table no.5

| Year | Tax revenues (mil. 2000-lei) |
|---|---|

| | TI |
|---|---|
| 2001 | 10687.9 |
| 2002 | 10536.6 |
| 2003 | 11978.7 |
| 2004 | 13279.4 |
| 2005 | 13454.0 |
| 2006 | 12598.0 |
| 2007 | 13185.4 |
| 2008 | 14532.2 |
| 2009 | 11917.6 |
| 2010 | 13450.9 |
| 2011 | 15508.7 |

The research question consists to search the dependence of tax revenues from GDP in comparable prices for the year 2000.

Let therefore the regression equation:

$$TI=i_Y Y+TI_0,\ i_Y \in (0,1),\ TI_0 \in \mathbf{R}$$

where:

- TI – taxes;
- Y – GDP;
- $i_Y$ – the rate of taxes;
- $I_0$ – additive constant (*which is the absence of value added tax charges*)

**The dependence of the taxes from GDP**

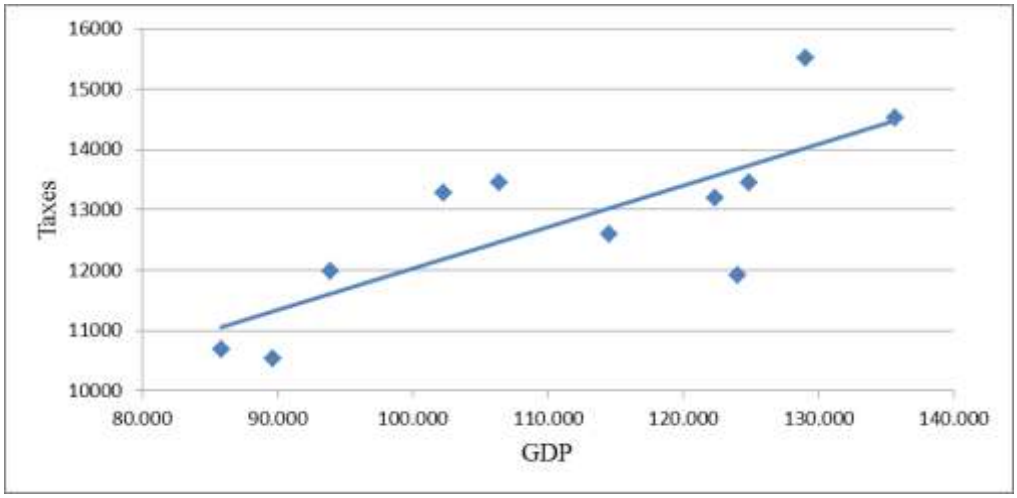


Fig.1

The regression analysis provides the following results:

SUMMARY OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0.78282238 |
| R Square | 0.612810878 |
| Adjusted R Square | 0.569789865 |
| Standard Error | 986.8150528 |
| Observations | 11 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 1 | 13871306.24 | 13871306.24 | 14.24445471 | 0.004388116 |
| Residual | 9 | 8764235.535 | 973803.9484 | | |
| Total | 10 | 22635541.78 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* |
|---|---|---|---|---|---|---|
| Intercept ($TI_0$) | 5117.374767 | 2065.056116 | 2.478080246 | 0.035101828 | 445.8932831 | 9788.856252 |
| X Variable 1 (Y) | 0.069049932 | 0.018295334 | 3.774182655 | 0.004388116 | 0.027663011 | 0.110436852 |

RESIDUAL OUTPUT

| *Observation* | *Predicted Y* | *Residuals* | *Standard Residuals* |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 11044.70331 | -356.8179408 | -0.381144505 |
| 2 | 11308.2709 | -771.6554992 | -0.824264195 |
| 3 | 11601.44247 | 377.2593753 | 0.402979562 |
| 4 | 12181.93858 | 1097.498414 | 1.172321908 |
| 5 | 12465.7562 | 988.2268389 | 1.05560059 |
| 6 | 13027.82781 | -429.8578875 | -0.459164052 |
| 7 | 13567.13341 | -381.7376682 | -0.407763169 |
| 8 | 14485.09362 | 47.15363112 | 0.050368396 |
| 9 | 13681.61066 | -1763.99797 | -1.884261006 |
| 10 | 13737.37731 | -286.4658824 | -0.305996096 |
| 11 | 14028.3076 | 1480.394588 | 1.581322566 |

The regression analysis revealed the following:

- For the number of data N=11 and the number of degrees of freedom k=1 (the number of independent variables), the Durbin-Watson test provides the values[3]: dl=0.93 and du=1.32, and the Durbin-Watson value statistic: $d=\frac{\sum_{i=2}^{n}(e_i - e_{i-1})^2}{\sum_{i=1}^{n} e_i^2}$ (where $e_i$ are residues derived from regression) is d=1.461.

  Because $d \in (du, 4-du)$ follows that the errors are uncorrelated.

- The empirical correlation coefficient ρ (multiple R) is 0.783, while the critical value of the correlation coefficient for N=11 and a significance threshold of 95% is $r_c$=0.602. Because $\rho > r_c$ follows that a linear dependence between variables may exist.

- Significance F=0,00439 (*which means the probability that the regression equation can not explain the evolution of the endogenous variable – the phenomenon having links purely random*) is much smaller than α=0.05. From the econometric theory it is known that if Significance F<α then the null hypothesis H0 is rejected with probability 1-α=0.95, so it is possible that at least one regression coefficient to be different from 0. In this case, we can consider this requirement met.
- The values P-value are an essential indicator for the revealing the variables which significantly influencing the process if they are less than α=0.05. Thus, for the coefficient of the independent variable Y we have P-value=0.0044<0.05 and for the remainder we have P-value= 0.0351<0.05.
- The intervals [Lower 95%,Upper 95%] representing the confidence intervals where are the coefficients, are for the independent variable Y: [0.0277;0.1104]

[3] Savin N.E., White, Kenneth J., The Durbin-Watson Test for Serial Correlation with Extreme Sample Sizes or Many Regressors, Econometrica, Vol.45, No.8, 1977, pp.1989-1996

and for the remainder: [445.8933;9788.8563]. Because 0 not belonging at the appropriate intervals for Y and remainder, implies that for a higher probability of 0.95 their coefficient belong to their respective ranges.

- The regression equation is thus:

$$TI=0,0690Y+5117,3748$$

From these data, it appears that an increase of 1 billion USD GDP, tax revenues increase by 69 million at the level of 2000.

It also should be noted that R Square= $\frac{SPE}{SPT}$ =0.6128 shows that the taxes are explained at the rate of 61.28% of GDP evolution.

## 3. Conclusions

The above analysis shows that for Romania there is a weak dependence of the GDP in tax revenue.

This slightly paradoxical, knowing very high tax rate in Romania, can be explained either by the various forms of tax evasion or through very small percentage of people paying taxes.

## 4. References

Dornbusch R., Fischer S., Startz R. (1997), Macroeconomics, Richard D. Irwin Publishers

Jemna D. (2009), Econometrie/Econometrics, Sedcom Libris, Iasi

Mankiw N.G. (2010), Macroeconomics, Worth Publishers

Nenciu E., Gagea M. (2010), Lecții de econometrie/Econometrics Lessons, Tehnopress, Iasi

Romer D. (1996), Advanced Macroeconomics, McGraw-Hill

Savin N.E., White K.J. (1977), The Durbin-Watson Test for Serial Correlation with Extreme Sample Sizes or Many Regressors, Econometrica, vol.45, No.8

Stancu S., Mihail N. (2009), Macroeconomie. Modele statice și dinamice de comportament. Teorie și aplicații, Ed. Economică, București