ANALYSIS OF CORRELATION BETWEEN TAX REVENUES AND OTHER ECONOMIC INDICATORS IN EUROPEAN UNION MEMBER STATES

BUNESCU Liliana
Lucian Blaga University of Sibiu, Romania

COMANICIU Carmen
Lucian Blaga University of Sibiu, Romania

Abstract:

This paper aims to identify the presence or absence of a connection between some factors that influence the evolution of tax revenue in the EU and to quantify its intensity using Pearson correlation coefficient. Testing the bivariate correlation between tax revenues and a range of 15 causal factors lead to a division of variables that determine the evolution of tax revenues into three categories: significant factors such as GDP, net national income per capita, gross added value, gross salary, current account balance, less significant factors of tax revenue such as the employment rate, public expenditures, public debt, and foreign direct investment, and non-factors of tax revenues such as unemployment rate, population, money and interest rates on deposits and loans.

Key words: *tax revenues, Pearson correlation, determinants of public revenues*

1. Introduction

In all countries there is a great demand for financial resources generated by increasing social needs faster than the development of GDP. But demand for public financial resources is influenced by a combination of factors. Economic factors imprints certain evolution of Gross Domestic Product, which may increase due to increased taxable income. Social factors involve redistribution of resources to ensure the needs of education, health, social protection and insurance, etc. These need more resources and they are followed by an increase in taxation and public funds. Demographic factors may influence, under certain conditions, both the active population and the increasing number of taxpayers. Monetary factors (money, credit, interest) transmit their influence to prices that aggravates inflationary price increases, which in turn generates increased resources from taxes. Political and military factors influence tax revenues by economic, social and financial policy measures. They may have the effect of increasing

production and income, social security contributions, tax rate. Financial factors summarizes the influence of all above factors, such as public spending. And finally we can not forget the action of psychological factors.

Economics studies economic phenomena and processes on the assumption that they are not carried out at random, but based on their own laws, relatively stable and relatively repeatable, specific to the nature of these phenomena. In order to illustrate the correlation between economic variables, economists have tried to explain the effect of the change of variable intensity over the other and translate it in a number.

We intend to identify the presence or absence of a correlation between a number of factors that influence the evolution of tax revenue (as the cause) and tax revenue (considered effect). If it is identified a connection we intend to quantify its intensity by using Pearson correlation coefficient. This first analysis allows us to identify key factors of tax revenue to allow mathematical econometric modeling and implementation using a regression of tax revenue.

2. Research methodology

Correlation analysis is performed on a sample of 27 European Union member states. Without claiming an exhaustive analysis of the many factors that determine, more or less, variations in tax revenue we have focused our attention on the 15 indicators in order to quantify the degree of correlation with tax revenues. For analyzing the economic phenomena it was used econometric theory and statistical measures. Data sets were analyzed for normal distribution, asymmetry, stationarity. It was checked if the data series are cyclical and seasonal, and their autocorrelation in time too. After processing the data series to acquire content it has been quantify the Pearson correlation coefficient of processed series.

Analyzed statistical variables are divided into:

I. Exogenous variables, independent, explanatory (x_i) – they are various economic indicators, financial, monetary or demographic factors that influence the dynamics of tax revenues. From the large variety of indicators calculated and reported at international level it were chosen Eurostat time series, series provided by the International Monetary Fund and World Bank, as can be seen below.

A) ECONOMIC FACTORS

1. Gross domestic product - is the gross value of final goods and services created by companies operating in the country, over a period of 1 year. It is determined by the expenditures method and it is expressed in millions, in current prices of national currency of each analized country. The source is the Eurostat database for the EU-27.

2. Gross domestic product per capita - is obtained by dividing the GDP of each state to the number of inhabitants. For the EU-27 is expressed in millions / person, in current prices, in national currency and provided by Eurostat.

3. Net national income per capita - is obtained from GNP plus income received by residents from the rest of the world minus income paid by residents to non-

residents and consumption of fixed capital. For EU member states is expressed in current prices, in national currency and provided by Eurostat.

4. Foreign direct investment (FDI) - refers to the net inflows of investment by the acquisition of 10% of the capital of a company operating in a country other than that of the investors. It comprises the sum of equity, reinvested earnings, other long-or short-term capital as they appear in the balance of payments. Series shows net inflows data, ie new investment inflows less disinvestment, those reported by each economy. Values are expressed in dollars, at current prices, and the World Bank is the provider.

5. Current account balance - includes currency inflows and outflows to / from a country from export/import of goods and services (trade balance), revenues paid to non-residents or revenues receives from foreign residents and unilateral transfers. It can record surplus (positive case) or deficit (unfavorable) of current account. Data were taken from the database of the International Monetary Fund for the EU, series are expressed in dollars and current prices.

6. Gross value added (GVA) - is the net result of sale price and cost of goods and services valued at purchase price, it is calculated before consumption of fixed capital and totaled for all economic activities. Series are expressed in local currency and are provided by Eurostat for the EU.

B) FINANCIAL FACTORS

7. Public expenditure - include overalll spending of local and central authorities, including non-financial acquisitions. Data serie were collected from the database of the International Monetary Fund for all the states, data are expressed in millions and national currency.

8. Public debt - refers to all direct or guaranteed public debt (SDRs, currency and deposits, debt securities, loans, insurance, pensions and other accounts payable) or accessories that generate principal payments at a time in future. For the EU, public debt is defined according to the Treaty of Maastricht and is summed for all levels of government (local, central, state, social security).

C) DEMOGRAPHIC FACTORS

7. Population - expresses the number of inhabitants of each country provided by Eurostat.

D) SOCIAL FACTORS

10. Unemployment rate - reflects the percentage of unemployed persons in the total labor force according to the International Labour Office, where labor is the number of people employed or unemployed adjusted by seasons. Data sets are provided by Eurostat for the EU and is the unemployment rate in the last month of each year, values are expressed as a percentage.

11. Employment rate - is given by the ratio of employed people aged 15-64 and the total population of the same age. For EU countries, we relied on data series according to Eurostat.

12. Average gross earnings - is given by the average gross wages in cash and kind, or any other wage benefits, including social security contributions payable by

employees, but excluding social contributions paid by companies, according to Eurostat.

E) MONETARY FACTORS

13. Money (M2) - this variable takes into account the total amount of money in circulation outside commercial banks and term deposits with a maturity of less than two years, other than the government. In principle refers to M2 agregate and is expressed in the currency of each country. For all countries in the sample data sets were selected from the database of the World Bank.

14. The average interest rate on deposits - is the interest rate paid by commercial banks for customer deposits, the data series are taken from the World Bank for all countries.

15. The average interest rate on loans - is the interest rate charged by commercial banks on loans to customers, the data series are taken from the World Bank for all countries.

II. Endogenous variable (y):

16. Tax revenues - include national government revenue collected from tax sources aggregated at central and local level, or receipts from taxes and social contributions taxes, according to ESA 95 national accounts. They are expressed in millions and national currency of each country.

The data series used in the present analysis are time series covering the period 1995-2011, the only period that provides data for all 16 variables for the 27 countries surveyed, although there were observations for longer periods of time they were for some variables and not for all countries. Therefore it was decided to take into account a small number of observations, but which, however, provide uniformity across all data sets. Software used for data processing and statistical analysis are SPSS 18.0 and Eviews 4.1.

3. Results

In the first phase of our analysis we proceeded to test *the hypothesis of normal distribution* of data series by the graphic method as histogram and PP plots.

It was found a prevalence of symmetric time series with normal distribution and slightly right asymmetric data series. To ensure the findings, we continued testing the hypothesis by determining coefficients of symmetry (skewness) and flatness (kurtosis). Zero coefficient of symmetry (S) indicates a normal distribution, symmetric, positive value indicates an asymmetry in the right side and a negative value an asymmetry in the left side. Regarding curtotica (K) a value of 3 indicates a normal distribution, mezokurtic, K > 3 leptokurtic distribution and K <3 platikurtic distribution.

Numerical calculations to identify the symmetry or asymmetry of the data series for the 16 variables in the 27 Member States have demonstrated 38 series with normal distribution of a sample of 390 sets for the following variables: net national income / capita in Belgium, Bulgaria, Denmark, Malta, Sweden, tax revenues in the

UK, Slovenia, Italy, Spain, Belgium, gross value added in the UK, Slovenia, France, Denmark, Bulgaria, the average gross salary in Slovenia, Luxembourg and Finland, the account balance in Italy and Hungary, for unemployment rate in Luxembourg, France and Germany, for employment rate in Slovenia, GDP in the UK, Slovenia, France, Spain, Greece, Denmark, Bulgaria, GDP / capita in Slovenia, Sweden, Denmark, Czech Republic, Belgium, the interest rate on loans in Cyprus and public expenditure in Malta. For the rest of variables the series have left or right asymmetry pattern. Variables can be divided according to the value of the coefficients of symmetry in: distributions with reduced asymmetry with coefficients tending to zero (under ≤ ± 0.6) for factors such as net national income, tax revenues, value added or gross earning,, and distributions with a pronounced asymmetry, such as money, foreign direct investment, interest rates, public debt, for which the coefficients exceed the value of 1.

Analysis of flattening and variance's height as compared to the height of series with normal distribution lead to coefficients with a value less than 3 for all analyzed variables indicating the existence of platikurtic series in all Member States. There are of course, some exceptions, but they are reduced as number as follows: leptokurtic series in Slovenia for the current account balance, in Cyprus for variable unemployment rate, the employment rate in Malta, Sweden, Netherlands, Malta, Denmark, Germany, Austria, for foreign direct investment in Spain, Finland, Ireland for debt, in Bulgaria and Lithuania for interest rate on deposits, in Bulgaria and Latvia interest rate on loans. Mezokurtic distributions were observed in Belgium for current account balance, foreign direct investment in Hungary and public debt in Lithuania.

Table 1: Symmetry coefficients' synthesis for EU Member States

Variable	S = 0	S < 0	S > 0
Tax revenues	United Kingdom, Slovenia, Italy, Spain, Belgium	Bulgaria, Denmark, Ireland, Greece, France, Hungary, the Netherlands, Austria, Portugal, Finland, Sweden	Slovakia, Romania, Poland, Malta, Latvia, Luxembourg, Lithuania, Estonia, Germany, Czech Republic, Cyprus
GDP	United Kingdom, Slovenia, France, Spain, Greece, Denmark, Bulgaria	Portugal, Netherlands, Italy, Ireland, Hungary, Finland	Austria, Belgium, Cyprus, Czech Republic, Germany, Estonia, Luxembourg, Lithuania, Latvia, Malta, Poland, Romania, Slovakia, Sweden
GDP/capita	Slovenia, Sweden, Denmark, Czech Republic, Belgium	UK, Portugal, Netherlands, Italy, Ireland, Hungary, France, Finland, Spain, Greece	Austria, Bulgaria, Cyprus, Germany, Estonia, Luxembourg, Lithuania, Latvia, Malta, Poland, Romania, Slovakia

Net National Income	Belgium, Bulgaria, Denmark, Malta, Sweden	United Kingdom, Slovenia, Portugal, Netherlands, Italy, Ireland, Hungary, France, Finland, Spain, Greece	Austria, Cyprus, Czech Republic, Germany, Estonia, Luxembourg, Lithuania, Latvia, Poland, Romania, Slovakia
FDI	-	Ireland	UE-27 except Ireland
Current account balance	Italy, Hungary	Belgium, Bulgaria, Cyprus, Czech Republic, Estonia, Ireland, Greece, Spain, France, Lithuania, Latvia, Poland, Portugal, Romania, Slovenia, Slovakia, United Kingdom	Sweden, the Netherlands, Malta, Luxembourg, Finland, Denmark, Germany, Austria
Gross Added Value	UK, Slovacia, Slovenia, France, Danemark, Bulgaria	Ireland, Italy, Hungary, the Netherlands, Portugal, Finland	Austria, Belgium, Cyprus, Czech Republic, Germany, Estonia, Greece, Spain, Luxembourg, Lithuania, Latvia, Malta, Poland, Romania, Slovakia, Sweden
Public Expences	Malta	-	UE – 27 (except Malta)
Public Debt	-	Slovakia, Sweden, Malta, Denmark, Cyprus, Bulgaria	Austria, Belgium, Czech Republic, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Luxembourg, Lithuania, Latvia, Hungary, Netherlands, Poland, Portugal, Romania, Slovenia, Finland, United Kingdom
Population	-	Portugal, the Netherlands, Malta, Greece, Germany	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Ireland, Spain, France, Italy, Luxembourg, Lithuania, Latvia, Hungary, Poland, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom
Unemployment rate	Luxemburg, France,	Czech Republic, Estonia, Lithuania, Malta,	Austria, Belgium, Bulgaria, Cyprus,

	Germany	Romania, Slovenia, Slovakia	Denmark, Ireland, Greece, Spain, Italy, Latvia, Hungary, Netherlands, Poland, Portugal, Finland, Sweden, United Kingdom
Employment rate	Slovenia	Belgium, Cyprus, Denmark, Ireland, Spain, France, Italy, Luxembourg, Lithuania, Hungary, Netherlands, Poland, Portugal, Slovakia, Finland, Sweden, United Kingdom	Romania, Malta, Latvia, Greece, Estonia, Germany, Czech Republic, Bulgaria, Austria
Gross Salary per capita	Slovenia, Luxemburg, Finland	Great Britain, Sweden, Portugal, Netherlands, Italy, Ireland, Hungary, France, Spain, Belgium	Austria, Bulgaria, Cyprus, Czech Republic, Denmark, Germany, Estonia, Greece, Lithuania, Latvia, Malta, Poland, Romania, Slovakia
Money	-	-	UE-27
Interest rate on deposits	-	Cipru	UE-27 except Cipru
Intrest rate on credits	Cipru	Danemark	UE-27 except Cipru șand Danemark

Source: Own calculations after Eurostat, World Bank, IMF data series

Time series should satisfy the condition of stationarity. Given the fact that economic data series are not stationary, we consider necessary to verify this hypothesis for all variables. To verify *the* ***hypothesis of stationarity*** for time series in SPSS has been used graphical waveforms, because the program did not permit Augumented Dickey Fuller test (ADF test) or any other identification test. However, of the 390 time series we randomly tested in Eviews by the ADF test , which in all cases showed a $p_{ADF} > p_{critic}$ at a confidence level of 1% , which leads to accepting H_0, the series are non-stationary, ie they have a unit root problem (Unit Root Test) , and we are forced to process them by differences. The waveforms, random testing by Augumented Dickey - Fuller and the economic content of the data leads us to conclude that the time series are non-stationary in the EU-27 , therefore we will correct them. To choose the most suitable way to create stationary series in SPSS it was applied partial autocorrelation function (PACF). This indicates the existence of non-stationarity and the required level of differences.

Another problem is time series' autocorrelation of first order or higher, testing

the ***autocorrelation hypothesis*** was obtained by using the SPSS autocorrelation function (ACF), partial autocorrelation function (PACF) and the Box-Ljung test. Tests have shown that the autocorrelation of the data series such as net national income/ capita, tax revenues, gross value added, gross average earnings, GDP, GDP/capita, public spending in all 27 EU Member States. For the other variables were found some non-autocorrelated series such as the employment rate in Malta and Denmark, the money supply in Slovenia, public debt in Ireland, interest on loans in Bulgaria and the Netherlands. It should be mentioned the lack of autocorrelation in 16 countries for foreign direct investment, in 6 countries for the unemployment rate and current account balance as shown in the following table:

Table 2 Autocorrelation series for EU Member States

Variable	Gross non-autocorrelated series	Autocorrelated series after differences of order 1
Tax revenues	-	Ireland
GDP	-	Poland
GDP/capita	-	Poland, Ireland
Net National Income	-	Romania
FDI	Finland, Spain, Greece, Denmark, Germany, Czech Republic, Austria, Slovakia, Slovenia, Portugal, Netherlands, Latvia, Luxembourg, Italy, Ireland, Hungary	Estonia
Current account balance	Slovenia, Latvia, Lithuania, Hungary, Finland, Czech Republic	UK
Gross Added Value	-	Poland, Ireland, Greece
Public Expences	-	Malta, France, Finland, Denmark
Public Debt	Ireland	United Kingdom, Portugal, Hungary, Greece, Czech Republic, Bulgaria
Population	-	France, Finland, Spain, Greece, Estonia, Denmark, Germany, Czech Republic, Cyprus, Belgium, Austria, Great Britain, Sweden, Portugal, Netherlands, Latvia, Luxembourg, Italy, Ireland, Hungary
Unemployment rate	Slovenia, Romania, Malta, Cyprus, Czech Republic, Austria	UK, Ireland, Spain
Employment rate	Malta, Denmark	Poland, the Netherlands, Ireland, Germany, Bulgaria
Gross Salary	-	Poland, the Netherlands, Luxembourg,

per capita		Denmark
Money	Slovenia	Romania, Poland, Estonia
Interest rate on deposits	Netherlands, Latvia, France, Estonia, Bulgaria	-
Intrest rate on credits	Netherlands, Bulgaria	-

Source: Own based on Eurostat, World Bank, IMF data series

For the autocorrelated and non-stationary series it were determined the differences of first order, then the autocorrelation was retest for the new time series. However, in 55 of the 390 data sets in the EU, autocorrelation was preserved and it were determined differences of second order, the autocorrelation coefficients were accompanied by statistically significance and were positioned in the confidence interval (p=0,01). Differences of second order have solved the problem of data series' autocorrelation.

In terms of ***seasonality and cyclical component testing*** it should be noted that the frequency of variables is annual, which excludes seasonality, cyclicity existence was not identified in any of the 390 data sets.

To measure the intensity of the relationship between tax revenue and the factors that determine their evolution it were used for each country stationary series, non-autocorrelated and econometric processed by differences, which led to low values of Pearson coefficients. There is a major discrepancy between the values of Pearson coefficient applied to the unadjusted series and diminished values of the coefficient calculated on econometric processed series.

4. Conclusions

Testing the bivariate correlation between changes in tax revenues in the 27 EU Member States and a palette of 15 causal factors resulted in the division of variables that determine the evolution of tax revenue into three categories: ***significant factors*** such as GDP, net national income / capita, gross value added, average gross earnings, current account balance, ***less significant factors*** such as the employment rate, spending, debt and foreign direct investment, and ***non-factors*** such as unemployment rate, population, money and interest rates on deposits and loans. The highest correlation was found in 25 Member States between tax revenues and GDP per inhabitant. Interestingly, the population regarded by itself as an independent variable of tax revenues has no correlation with them, correlation coefficients are less than 0.3 in most European countries, but the variable GDP / capita equaled a positive correlation by a slightly higher intensity than that of GDP and tax revenues. For a confidence interval of 0.010, correlation coefficients between GDP and tax revenues in 24 states obtained values ranging from 0.67 in Germany and 0.98 in Latvia, which indicates a proportional relationship between the two variables and a high intensity.

Also, it was tested the correlation intensity between GNP and tax revenues by

using time series covering the period 1980-2010 for a sample of 16 states. It was showed that this economic indicator records a strong correlation with tax revenues, the differences between the two indicators vary from state to state, but are insignificant. (Bunescu L., Comaniciu C., 2011, p 65-74)

In 21 EU Member States public revenues performance is closely linked to the evolution of the gross value added in the economy, both evolving in the same direction. The correlation coefficients ranged from 0.63 in Hungary to 0.97 in Latvia for a p-value = 0.010, to which we add 3 states for confidence p-value = 0.050. Strong positive correlations were found between tax revenues and net national income per capita in the 20 Member States, in half of the cases the connection was more close than in case of GDP / capita. Six states are added to these, the ones in which these two variables have a positive and medium correlation. The increase in gross wages per capita lead to an increase in tax revenues in 14 EU countries, the correlation coefficients ranged from 0.66 in Portugal to 0.98 in Lithuania, to which are added six states with correlations of medium intensity ranging between 0.5-0.6. An increase in the sold of current account leads to a decrease in revenue from taxes in 19 European countries, negative correlation coefficients ranged from -0.81 in Slovakia to -0.65 in Latvia. It could not be identified in the EU-27 developments and determining relationships between tax revenues and unemployment rate, money, population, interest rate. The same results were obtained in an analysis carried out in other non-EU countries. (Bunescu L., Comaniciu C., D. Mihaiu 2011, p 253) As regards the correlation between tax revenues and employment rate, the two economic variables evolve in the same direction, but the intensity of correlation is medium for a value of p = 0.01. Pearson coefficients vary around 0.7 in 7 states. In other six states the correlation coefficient was about 0.5 for p = 0.05.

Regarding the impact of foreign direct investment, public debt and public spending on the development of tax revenues it can be said that the three economic variables belong to the category of non-essential factors since the correlation values were located in more than half of the cases around 0.3. For debt it was found a negative correlation with tax revenues and FDI are positively correlated to tax revenues. Regarding the public expenditure impact on tax revenues it is chaotic and uncertain as direction of evolution.

The movement of capital from Western Europe to Central and Eastern Europe is evident in our analysis, the Member States of Central and Eastern Europe such as Slovakia, Slovenia, Romania, Latvia, Lithuania, Hungary, Bulgaria, customizes by a strong positive correlation coefficients between FDI undertaken in their territory and taxes collected by the authorities. Attracting foreign investors can be an alternative to complete insufficient public revenues.

Another feature that was identified for the Member States from Central and Eastern Europe is regarding the importance of fluctuations in exports and imports of goods and services on the tax revenues of a state. It is obvious that the less developed countries face negative trade balance which expands its sold annually. The figures

show a positive and high intensity correlation between the two variables, ie an increase in net exports (imports - exports) leads to higher receipts as tax revenues.

Table matrix allows in each country the observation of the major factors affecting tax revenues in that country, there is not a general rule and a unitary degree of determination.

5. References

Bunescu L., Comaniciu C., (2011), *Which is the strongest determinant of government revenues: GDP or GNI?*, "Nicolae Bălcescu" Land Forces Academy - Sibiu, Romania, *The 17th International Scientific Conference KBO 2011 - "Knowledge - Based Organisation",* Conference Proceedings 2, p. 65-74

Bunescu L., Comaniciu C., Mihaiu D., (2011), *There is a correlation between government expenditures, population, money supply and government revenues?***,** International Journal of Arts and Sciences*,* Vol. 4, No. 12, p. 253

http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home

http://www.imf.org/external/pubs/ft/weo/2011/02/weodata/index.aspx

http://databank.worldbank.org/ddp/home.do?Step=1&id=4