Analysis of the correlation between taxation indicators and economic growth at the macroeconomic level in European Union and Romania

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Abstract. *In this paper, the author attempts to verify, on the basis of a selected set of data, if the influence of the causal variables (taxation indicators), namely Taxes on production and imports less subsidies and Taxes less subsidies on products on the Gross Domestic Product falls under the category of Granger causalities, and the research hypotheses are defined accordingly. Since the variables were supposed to be, and actually found to be non-stationary, the chosen research method is based on the Toda-Yamamoto approach, adapted to the structure of the data. The results allow the validation of the hypotheses in a limited number of cases, the analysis aimed to test the causalities between the nominal values and, on the other hand, their elasticities.*

Keywords: causality, taxation, products, imports, GDP.

JEL Classification: H71, O40.

Introduction and literature review

The structure of the Gross Domestic Product includes the taxation component, and the main objective of this research is to study the possible Granger causality between two taxation indicators and the Gross Domestic Product (a measure of economic growth), in European Union and Romania. This objective is determined upon the study of relevant literature, and the chosen causal indicators cover products, production and imports.

International literature abounds in studies designed to analyze the connection between taxation and the economic growth of a country (Stoilova and Patonov, 2013; Pessino and Fenochietto, 2010; Tiwari and Mutascu, 2014).

Some studies considered that the level of economic development of a country influences the level of taxes. Pessino and Fenochietto (2010) found, in their study developed on 96 countries, a significant connection between tax revenues-as percentage of the GDP (as dependent variable) and the level of development of a country- as GDP per capita. They consider that countries with a high level of per capita GDP may have high tax revenue as percentage of the GDP. Tanzi and Zee (2000) consider that, in theory, there is a causality connection that runs from economic development to the tax level.

Other studies support the hypothesis that the level of taxes determines the economic growth of a country, due to taxation. Taxation is viewed as a fundamental element of the economy, seeing that it contributes to the gathering of necessary funds for public expenditures and, at the same time, supports the allocation of resources and income redistribution, and contributes to the economic stability and the economic growth of a country (Stoilova and Patonov, 2013; Stoilova, 2017).

Taxes may also have an impact on economic growth through investment in R&D and return on capital accumulation (Tiwari and Mutascu, 2014), Păunică et al. (2019) have assessed the impact of remittances on economic growth. In addition, taxation can impact economic development through its influence on basic elements such as human and physical capital, and productivity (Stoilova and Patonov, 2013).

Stoilova (2017) is among the authors that consider that tax revenues may have a positive influence on economic growth. But, despite the benefits that taxation can generate, there is no consensus in the international literature in regard to the correlation between taxes and GDP: some studies report a positive connection, while others a negative one (Tiwari and Mutascu, 2014).

This can also be seen in the study of Vasiliauskaitė and Stankevičius (2009), which analyzes the interdependence connection between changes of tax burden and changes in GDP per capita for EU countries, from 1995 to 2007 and find that in less rich countries, an increase of taxes can negatively influence the GDP growth. In return, in developed countries, a slow growth in tax variation has a positive influence on the increase of the GDP, while a decrease of taxes determines a decrease of the GDP. The correlation between changes in tax burden and GDP is considered to be stronger in countries with a stable tax system and a historically high tax burden.

Taking in to consideration the importance of taxation and the mixed results generated by previous analysis, many studies focus on the influence that tax structure has on the GDP, or the economic growth (Stoilova and Patonov, 2013; Stoilova, 2017).

Tax structure can be seen as the key to understand the impact that the tax system of a country has on its economic development.

By splitting tax revenues into direct taxes, indirect taxes and social contribution, Stoilova and Patonov (2013) consider that a tax structure that relies on direct taxes contributes more to the economic growth, based on their regression analysis of 27 EU countries for the period 1995-2010. The authors consider that indirect taxes are subject of inequity, so there are less efficient.

By splitting tax revenues in to different categories, based on their source, we can observe that international literature reports different results. For example, some studies report that corporate and personal income taxes negatively influence economic growth, in oppose to consumption and property taxes that are less harmful (Stoilova and Patonov, 2013).

Stoilova and Patonov (2013) considered that taxes on land, buildings and other types of structure, income taxes and social contribution taxes have a positive influence on economy growth. Stoilova (2017) conclude, from their study on 28 EU countries for the period 1996-2013, that a tax structure that focuses on consumption, personal income and property taxes will contribute more to the economic growth (are less harmful).

In this context, we wonder what about taxes on production and import? Are they important? Are these types of taxes influencing the GDP? To what extent? Can tax policies that rely on taxes on production and import be efficient for the economic development?

Taxes on production and imports are considered a part of tax revenues (Stoilova and Patonov, 2013). Moreover, taxes less subsidies on production in considered a component of the GDP in the income approach (Lacey, 2000). Therefore, we estimate that taxes on production and imports will have an influence on the GDP. But taxes on production and imports are also considered indirect taxes (Spoerer, 1998; Tiwari and Mutascu, 2014), and indirect taxes are a component of the GDP (Alesina and Ardagna, 2010).

If indirect taxes are more harmful, then the taxes on production and imports will have a positive or a negative impact on the economic development? Will they contribute to the economic growth or diminish it?

The test performed by Tiwari and Mutascu (2014) on the particular case of the United States of America, for the period 1947-2009, shows that taxes on production and imports are causing, based on the Granger-causality test, the GDP.

Stoilova and Patonov (2013) found a quadratic connection between taxes on production and imports and the growth rate of the GDP, concluding that these particular taxes are not very effective for economic development. At the same time, Stoilova (2017) reports that taxes on production and imports have a strong positive connection with economic growth.

Păunică et al. (2018) analyzed the influence of foreign trade on the Gross Domestic Product, considering the foreign trade as a component of the globalization.

In regard to production, if we see taxation as taxes from income and taxes from production, studies consider that taxes on production may be less evil in their impact on growth on the long-run (Tanzi and Zee, 2000).

In regard to import, Pessino and Fenochietto (2010) consider that taxes depend, among others, by the level of openness of an economy. The authors report different opinions from the literature regarding this factor of influence. On one hand, an open economy can reduce taxes on import and export, while increasing exports. These measures, in turn, can lead to a decrease in taxes revenue. On the other hand, liberalization may increase tax revenues, due to compensatory measures and improved customs procedures. But, while most countries do not perceive taxes on export, imports are still restrained by taxes (Stoilova and Patonov, 2013; Pessino and Fenochietto, 2010; Hines and Desai, 2005).

This aspect may encourage exports at the expense of internal consumption and imports (Hines and Desai, 2005). Nevertheless, Hines and Desai, 2005 found a negative connection between a country's VAT reliance and international trade, regardless of the fact that export are not, as imports are, subject to the VAT. That means that countries relying on VAT may experience a decrease in exports and imports. But is a decrease in import detrimental to the economic growth? How important are imports to the economic development of a country? These are some of the main questions that we seek to answer in this present paper.

Research methodology and data

The character of non-stationary variable associated with the Gross Domestic Product involves the application of a method designed to deal with such parameters. The taxation indicators chosen are also components of the GDP, but the author wishes to outline the existence of a Granger causality of those indicators on the GDP. All indicators are macroeconomic, and the GDP was selected, in this article, the measure of the economic growth. The analysis pursues the situation in Romania (author's country) and the European Union as a whole.

The following indicators have been selected for analysis:
a) Causal variables:
    a. *Taxes on production and imports less subsidies*. This indicator is included in the Eurostat dataset *Annual national accounts (nama10)*. It is used in the computation of the Gross Domestic Product through the income approach.
    b. *Taxes less subsidies on products*. Extracted from the same dataset.
b) Target (dependent) variable:
    a. *Gross Domestic Product*. Is the main indicator of the *nama10* dataset, *GDP and main components (output, expenditure and income) [nama_10_gdp]*

Based on the indicators, two research hypotheses have been defined:

H1. Taxes on production and imports less subsidies Granger causes the Gross Domestic Product in the European Union and Romania.

H2. Taxes less subsidies on products Granger causes the Gross Domestic Product in the European Union and Romania.

The data covers the interval between 1996 and 2019. All data were extracted from the Eurostat database, and processed in EViews®[1], on the basis of guidelines of Giles (2011) for applying Toda-Yamamoto methodology, adapted to our data panel:

a) Unit root tests. The purpose for their application is the determination of the maximum order of integration for each pair of variables that allow the evaluation of a research hypothesis. The author chose the Augmented Dickey-Fuller (ADF) and Phillips-Perron tests, set with the following parameters:

    a1. ADF: a maximum of five lags are included (as suggested by the software), the lag selection is done automatically by the Schwarz Info Criterion. The evolutionary characteristics of the variables led to the choice of the *Trend and intercept* option.

    a2. PP: the *Trend and intercept* option is applied in this case too, together with the default (*Bartlett kernel*) spectral estimation method, bandwidth is automatically selected by the *Newey-West* method.

b) VAR estimation. For each pair of variables, an unrestricted Vector Autoregressive (VAR) model is estimated and adjusted to the optimum number of lags, out of a maximum of 5. This choice pursues the lag length indicated by the majority of the test criteria and, if no valid conclusion is reached, the author resorted to the opinion of Chirilă and Chirilă (2017), who plead for the Schwarz Info Criterion as being the most appropriate for limited samples (in the present article, each indicator has a number of 24 observations).

c) Specification tests for each model. The models have been subjected to the stability (one) and residual tests (three) in order to check for proper specification:

    c1. AR roots test for stability.

    c2. *Autocorrelation LM test*, for a number of lags equal to the one suggested by the software.

    c3. Normality test, with the orthogonalization method *Cholesky of covariance (Lutkepohl)*.

    c4. *White Heteroskedasticity test (no cross terms)*.

Considering both Giles (2011) and Hacker and Hatemi-J (2003), only models that pass all tests are used in the next step. As Giles (2011), for the first stability and autocorrelation test, the number of lags can be gradually extended by one unit (the author applies this approach until the model passes the test or the number of observations makes impossible to further increase the lag length). But, failure of normality or heteroskedasticity tests leads to the interruption of the procedure for the model.

d) Modification of the VAR model (optimum lag length, eventually corrected against stability and/or autocorrelation issues), by adding, as exogenous variables, the additional number of lags corresponding to the maximum order of integration.

e) Application of the Wald test for the updated model.

f) Interpretation of the results – is there any Granger causality? Is it one-way or bidirectional? If it exists, it can allow for the validation of the research hypothesis?

Results and discussions

1. H1 testing – European Union

1.1. Nominal values

The unit root tests have returned the following orders of integration for the two variables:

Table 1. *Orders of integration, H1 hypothesis, European Union, nominal values*

Variable	ADF test	PP test
Gross Domestic Product	1	1
Taxes on production and imports less subsidies	1	1
Maximum order of integration	1	

Source: author's representation of EViews results for ADF and PP tests.

As both variables are integrated of order one, the maximum order of integration is also

1. All tests reported the same value, so no reconciliation is necessary.

The VAR model was assessed as having the optimum form of VAR(5), a stable model but with autocorrelation issues. The residuals for VAR(6) present also serial correlation, VAR(7) is not stable, and this is the maximum number of lags permitted by the number of observations. The autocorrelation tests were applied for a number of l+1 lags, where l is the maximum limit of the model's lag length.

According to the interpretation rules for the VAR specification tests, the model cannot be used to test Granger causality.

1.2. Logarithm values

Subsequent to the unit root tests, the individual and maximum orders of integration have been found to have the same values as the nominal values, as presented in Table 2.

Table 2. *Orders of integration, H1 hypothesis, European Union, logarithm values*

Variable	ADF test	PP test
Gross Domestic Product	1	1
Taxes on production and imports less subsidies	1	1
Maximum order of integration	1	

Source: author's representation of EViews results for ADF and PP tests.

All lag order selection criteria have indicated the VAR(5) as the optimum designed model, which responds well to the AR roots test. Serial correlation is found at the level of the residuals (tests up to 12 lags), but VAR(6) passes the first two tests, the residuals are found to be normal, but the heteroskedasticity test cannot be applied with the use of the software.

Given the fact that the model passed the initial three tests, and not failed the fourth one, the procedure can be continued, but the results are to be treated with caution. The updated model can be represented as such (without substituted coefficients):

LEUIT = C(1,1) × LEUIT(-1) + C(1,2) × LEUIT(-2) + C(1,3) × LEUIT(-3) + C(1,4) × LEUIT(-4) + C(1,5) × LEUIT(-5) + C(1,6) × LEUIT(-6) + C(1,7) × LEUG(-1) + C(1,8) × LEUG(-2) + C(1,9) × LEUG(-3) + C(1,10) × LEUG(-4) + C(1,11) × LEUG(-5) + C(1,12) × LEUG(-6) + C(1,13) + C(1,14) × LEUIT(-7) + C(1,15) × LEUG(-7)

LEUG = C(2,1) × LEUIT(-1) + C(2,2) × LEUIT(-2) + C(2,3) × LEUIT(-3) + C(2,4) × LEUIT(-4) + C(2,5) × LEUIT(-5) + C(2,6) × LEUIT(-6) + C(2,7) × LEUG(-1) + C(2,8) × LEUG(-2) + C(2,9) × LEUG(-3) + C(2,10) × LEUG(-4) + C(2,11) × LEUG(-5) + C(2,12) × LEUG(-6) + C(2,13) + C(2,14) × LEUIT(-7) + C(2,15) × LEUG(-7)

Coefficients in Table 3 display a bidirectional causality, but the validation of the first hypothesis must be considered with caution.

Table 3. *Block Exogeneity Wald Tests, H1 hypothesis, European Union, logarithm values*

VAR Granger Causality/Block Exogeneity Wald Tests			
Date: 10/25/20 Time: 16:46			
Sample: 1996 2019			
Included observations: 17			
Dependent variable: LEUIT			
Excluded	Chi-sq	df	Prob.
LEUG	33.64697	6	0.0000
All	33.64697	6	0.0000
Dependent variable: LEUG			
Excluded	Chi-sq	df	Prob.
LEUIT	22.60259	6	0.0009
All	22.60259	6	0.0009

Source: author's capture, of the VAR Granger Causality/Block Exogeneity Wald Tests in EViews.

2. H1 testing – Romania

2.1. Nominal values

The first step involves measuring the order of integration for each variable, by applying the two instruments (ADF and PP tests) and establishing the maximum order. The tests were designed as described in the research methodology section, and the results are presented in Table 4.

Table 4. *Orders of integration, H1 hypothesis, Romania, nominal values*

Variable	ADF test	PP test
Gross Domestic Product	2	2
Taxes on production and imports less subsidies	1	1
Maximum order of integration	**2**	

Source: author's representation of EViews results for ADF and PP tests.

The maximum order of integration is 2. After shaping a VAR model with default parameters, as indicated by the software (this is not affecting the study, as the next step involves the modification to the optimum lag), three tests out of five indicate a lag length of 1,…, 5.

By evaluating the specification tests for VAR(5), the AR roots test has two values above 1. If a correction to VAR(6) is made, the number of roots greater than 1 increases to three, while for VAR(7) there are eight such roots that testify against the stability of the model.

As the model is not stable, the research methodology prevents the application of the subsequent steps of the Granger causality test.

2.2. Logarithm values

The two tests lead to the same order of integration as in the case of the nominal values, and the same maximum order of integration applies for the future eventual modified VAR model.

Table 5. *Orders of integration, H1 hypothesis, Romania, logarithm values*

Variable	ADF test	PP test
Gross Domestic Product	2	2
Taxes on production and imports less subsidies	1	1
Maximum order of integration	2	

Source: author's representation of EViews results for ADF and PP tests

For Romanian logarithm variables, the initial VAR model is configured for an optimal lag length of 1,…, 2, this model is stable and the residuals are not serially correlated. As normality and heteroskedasticity tests display proper values, the model is suitable for proceeding to the next step.

The updated model is characterized by the following equations:

$$LRUIT = C(1,1) \times LRUIT(-1) + C(1,2) \times LRUIT(-2) + C(1,3) \times LROG(-1) + C(1,4) \times LROG(-2) + C(1,5) + C(1,6) \times LRUIT(-3) + C(1,7) \times LROG(-3) + C(1,8) \times LRUIT(-4) + C(1,9) \times LROG(-4)$$

$$LROG = C(2,1) \times LRUIT(-1) + C(2,2) \times LRUIT(-2) + C(2,3) \times LROG(-1) + C(2,4) \times LROG(-2) + C(2,5) + C(2,6) \times LRUIT(-3) + C(2,7) \times LROG(-3) + C(2,8) \times LRUIT(-4) + C(2,9) \times LROG(-4)$$

No Granger causality can be asserted between the two variables that characterize the first hypothesis, as the Chi-sq coefficients have values well below the limit corresponding to the accepted significance level.

3. H2 testing – European Union

3.1. Nominal values

All variables are found to be stationary on their first differences, so the maximum order of integration is 1 (see Table 6).

Table 6. *Orders of integration, H2 hypothesis, European Union, nominal values*

Variable	ADF test	PP test
Gross Domestic Product	**1**	**1**
Taxes less subsidies on products	**1**	**1**
Maximum order of integration	**1**	

Source: author's representation of EViews results for ADF and PP tests

For a maximum of 2 lags, the VAR presents autocorrelation issues. When modified for 3 lags, it complies with all tests and thus the model can be updated with another exogenous lag.

The results of the Granger causality test are presented in Table 7:

Table 7. *Block Exogeneity Wald Tests, H2 hypothesis, European Union, nominal values*

VAR Granger Causality/Block Exogeneity Wald Tests			
Date: 10/25/20 Time: 18:30			
Sample: 1996 2019			
Included observations: 20			
Dependent variable: EUPT			
Excluded	Chi-sq	df	Prob.
EUG	5.362831	3	0.1471
All	5.362831	3	0.1471
Dependent variable: EUG			
Excluded	Chi-sq	df	Prob.
EUPT	8.988649	3	0.0294
All	8.988649	3	0.0294

Source: author's capture, of the VAR Granger Causality/Block Exogeneity Wald Tests in EViews.

The interpretation of the coefficients and probabilities demonstrates the validation of the H2 hypothesis for EU nominal values. *EUPT Granger causes the Gross Domestic Product* in the case of the European Union.

3.2. Logarithm values

After interpreting the values of the unit root tests, the situation matches the case of nominal values. The initial VAR(2) has problems with serial correlation, so update to VAR(3) is made, the result is a stable model, no autocorrelation, but it does not pass the normality test.

4. H2 testing – Romania

4.1. Nominal values

The orders of integration observed for the two variables are described in the Table 8, and the maximum order is given by the measure of GDP, being equal to 2.

Table 8. *Orders of integration, H2 hypothesis, Romania, nominal values*

Variable	ADF test	PP test
Gross Domestic Product	2	2
Taxes less subsidies on products	1	1
Maximum order of integration	2	

Source: author's representation of EViews results for ADF and PP tests.

The optimum lag length is shown to be 1,…, 2. At this setting, the model is not stable, as is VAR(3). VAR(4) is stable, but has issues of serial correlation, and VAR(5),VAR(6) and VAR(7) are not stable. Thus, this correlation cannot be tested due to the improper results of the specification tests.

4.2. Logarithm values

For the logarithm values that describe the Romanian GDP and *Taxes less subsidies on products*, the application of the two tests granted the results on the orders of integration:

Table 9. *Orders of integration, H2 hypothesis, Romania, nominal values*

Variable	ADF test	PP test
Gross Domestic Product	2	2
Taxes less subsidies on products	1	1
Maximum order of integration	2	

Source: author's representation of EViews results for ADF and PP tests.

The lag length criteria for the VAR model led to an optimum specification of 2 lags. When tested, the model responds well to the *Roots of Characteristic Polynomial* test, there is no serial correlation in the residuals, the null hypothesis of the *VAR Residual Normality Tests* is accepted, thus the residuals are normal, and the heteroskedasticity test is also passed.

Therefore, this model respects the validity criteria in order to be used for the Granger causality test. After the additional lags are added, the Wald test displays that no Granger causality can be asserted, thus the research hypothesis H2 cannot be validated for Romania.

Conclusions

For the research hypotheses verified against nominal values, the only significant conclusion reached is the fact that the *Taxes less subsidies on products*, in the European Union, Granger causes the *Gross Domestic Product*. The other models were not suitable for the actual testing for causality, because of the responses given to the specification tests. The application of the research methodology pursued all steps in three of the four cases, two tests indicated no causality, only one asserted bidirectional Granger causality between

Gross Domestic Product and *Taxes on production and imports less subsidies* but, due to the error encountered during the application of the last specification test for that model, this result cannot be accepted as a validation of the hypothesis. Thus, the results achieved by this paper shows that the influence exerted by the two causal variables on the GDP cannot be categorized, in all cases, as Granger causality.

Note

[1] EViews® is a registered trademark of IHS Global Inc.

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