THE IMPACT OF ECONOMIC GROWTH ON ROAD TRANSPORTS IN ROMANIA. AN ECONOMETRIC ANALYSIS

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Abstract
Transport is considered a priority field in any development context, especially if we take into consideration its interdependence with all other branches of national economy. Development of transports includes improving the road, railroad, river, sea and air services. Once the constant target for each country is reached — meaning the economic increase — we expect the problem of protecting the environment to gather more and more interest, and, of course, the results should be good. But the available statistical data shows that, especially in urban areas, atmospheric pollution represents a problem which has newer and newer dimensions, increasing in size, being a consequence of the urbanisation phenomena. We focused our attention on the main factors responsible for this pollution and we observed that producing energy and transport are its the main sources. We have chosen to concentrate our attention in this paper on the problem of transport, to analyse the link between economic indicators and those related to the evolution of the number of passengers that use public transportation and the number of registered passenger cars, underlining the need to come up with a sustainable transport. To test the relationship between these variables, we use a simple regression model, to show how the GDP influences the two variables, the number of passenger that traveled using mass transit means and the number of registered road vehicles in circulation at the end of the year.

Key words: sustainable transport, pollution, GDP, passengers, cars.

JEL Classification codes: O10, B23, C20

1. Sustainable transports

The problem of sustainable transport is a relatively new one, being met in specialized literature for the first time barely 15 years ago. This can be defined the same as the sustainable development notion, as being “the transport or any means of moving of persons and goods that does not compromise the possibility of future generations to satisfy their need to develop” (Black, 2010) [3].

As to what the criteria a transport should fulfil in order to be sustainable, Daly has identified in his works a number of three criteria (Black, 2010) [3]:

1. The rate with which the renewable resources are used does not surpass their renewable rate (here we think it refers especially at biomass, geothermal waters and hydrologic resources);
2. The rate with which the non-renewable resources are used does not pass the rate at which the renewable resources can be developed;
3. The rate of harmful gas emissions to the environment does not pass its capacity to absorb them.

Sustainable transport seeks to reduce the costs felt by each individual in part as well as by the entire society, and to diminish the dependency of economic agents towards automobiles (Schiller et. al., 2010) [7].

To better observe the difference between sustainable transports or, we could call it ideal transport and what we have today, we have made a small SWOT analysis in the table below:
Table no. 1 Differences between the objectives of sustainable transport and what we have today

<table>
<thead>
<tr>
<th>Sustainable transports</th>
<th>Actual transports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable transport seeks to increase the accessibility and the quality of it (the closer to the environment, the better)</td>
<td>At present, transport seeks the increase of mobility and its quantity (to be faster, to be more accessible)</td>
</tr>
<tr>
<td>Seeks to interrupt actual tendencies of transport, whose effects are irreversible</td>
<td>When it comes to measuring the quality of transport, the problem of pollution is being analysed only for a few decades, but from our point of view, it is not being given enough importance</td>
</tr>
<tr>
<td>Sustainable transport proposes giving funds to mass transit and solutions meant to reduce atmospheric pollution.</td>
<td>In order to increase the quality of transports, the most important attention and largest financing (at least in Romania’s case) are sent towards increasing the number of highways and auto parks, etc.</td>
</tr>
<tr>
<td>The planning of transport is primarily done in accordance with the social needs and the environment of the individuals.</td>
<td>In local and national planning of transport, the environment problems and the social problems are subordinate to the financial ones.</td>
</tr>
</tbody>
</table>

Source: made by the authors

Development of transport has the role of stimulating public transport services as well as guaranteeing the general minimum accessibility of public services for all citizens. Vulnerable persons or groups of persons need not and should not be omitted: children, elderly and disabled people, for which certain European Union standards should be respected.

William Richard Black and Peter Jijkamp have stated a great truth from our point of view, saying that “transport and communication are the most visible manifestations of a modern economy” (Black and Nijkamp, 2002)[2]. Communicating with people over long distances or those from a virtual environment has become a way of life with multiple economic and social implications. As to what transport is concerned, its development has brought not only a series of economic, social implications, but also ecologic. In short, in the figure below, we can see the role of transport and communication on the economic development and its effects.

![An integrative view of transport](Source: Black and Nijkamp, 2002, [2]

The objectives of Romania for 2013 seek to promote a transport system that will ensure safety, speed and efficiency for people and for goods at a national and international level, respecting international standards.

During 2001-2005, the statistical data highlight the fact that increasing the total value of transport activities has been done integrally through an extra use of resources. Unfortunately, although the increase of transport is estimated to be done directly proportional with the GDP, this will have the same tendency in using a lot of resources, as it happened in 2001-2005.
The objectives of the EU seek especially the modernisation of transport infrastructure, be it roads, maritime or by air, which would result in increasing the speed of goods deliveries, fluidisation of traffic, attracting foreign investors in various areas, accelerating the renewal of the auto park and removing those vehicles that are morally and physically worn out, which, on top of that, are extremely pollutant; the re-launching of maritime transport through Romanian harbours and progressively meeting the performance imposed through standards and regulations on the freight market, etc. All these objectives have as their main purpose the reduction of energy consumption, cutting transport costs and increasing competition in the national transport system.

To fulfil these objectives that were stated before, a Sectorial Operational Program has been made for the 2007-2013 period, named “Transport” and it comprises the Strategy for Sustainable Transport 2007-2013, 2020 and 2030. This strategy follows the reduction of negative effects generated by transport on the environment.

By implementing the Sectorial Operational Program “Transport” for 2007-2013, the development and modernisation of the national and European transport network wanted to be done, but on top of that, the creation of a sustainable transport. To make this latter come true, a strategy that follows the reduction of negative effects of transportation on the environment has been created, a strategy that is in close connection with the policy of the European Union.

For 2020, the national objective is: reaching the present environment level of the EU in regards to economic, social and environmental efficiency and making substantial progress in developing the transport infrastructure (The national development strategy of Romania, 2008) [6].

It must not be forgotten that the national transport system of Romania, analysed from an infrastructure point of view, of the means of transport and transport operators, is a medium developed system, this being, at present, able to satisfy at a reduced level, the needs and wishes of economic agents from within the country, or internationally. In regards to increasing the capacity of the infrastructure, of its transport efficiency and safety, there have been a lot of efforts made, starting from 1990, but we must not forget that these efforts need to be intensified because of the fact that demand in this field has been increasing constantly.

According to the principles mentioned in the European Strategy for Sustainable Transport, the sustainable transport policy has the role of fluidizing traffic, to reduce the noise and pollution produced by it and, by using some less environmental damaging transport means.

The objectives taken into account through fulfilling the sustainable transport policy are (The national development strategy of Romania, 2008) [6]:

- Respect the environment, with the purpose of creating a durable mobility and transport system
- Modernizing the European framework of public services, passenger transport, to encourage the improving of the efficiency and performance by 2010
- Decoupling the economic increase from the transport needs, with the purpose of reducing the environmental impact

Through this present paper, we want to point out the fact that Romania, at present, has not managed to do this decoupling, the economic growth determining the number of passengers (in our study we present only the passengers of road mass transit). But not their increase is the main problem, but that they use less and less mass transit systems when their income increases, becoming owners of vehicles themselves. By synthetizing, we can say that more cars lead to more pollution.

We chose to analyse only the road transport implications, because, as it can be seen in the graph below, it is responsible for the largest energy consumption as well as the highest pollution level from all categories of transports:

![Energy consumption based on means of transport](image)

*Figure no. 2 Energy consumption based on means of transport
Source: National Statistics Institute – TEMPO-online, Subsection Transport [5]*

- Diminishing polluting emissions generated by transports at levels which reduce to a minimum the effects on health of the population and/or the environment
2. The connection between GDP and the number of passengers

In analysing simple regression, firstly we take into account aspects related to identifying explanatory variables. We will use data referring to the total number of passengers that traveled using mass transit means (PS$_t$), the value of the GDP and the number of registered road vehicles in circulation at the end of the year (INMV$_t$) from Romania, during 1990 – 2014. Starting from these variables, we want to identify the impact the GDP has on the number of passengers and on the number of registered road vehicles.

Specifying an econometric model assumes choosing a mathematical function ($f(x)$) with the help of which the connection between the two variables can be described. In the case of a single factor model, the most common used method is the graphical representation of the two strings of values with the help of the scatter plot. As it follows, in order to identify the connection between the two variables mentioned, we have made a graphic representation of the pairs of points that contain the PS and GDP values in figure 3, and the INMV and GDP values, in figure 4.

![Figure 3: PS – GDP correlation](image1)

![Figure 4: INMV – GDP correlation](image2)

*Source: National Statistics Institute – TEMPO-online and Eurostat*

Seeing that the points are situated in a well-defined area in both figures, we can say that between the dependent variable – number of passengers that used mass transit vehicles and the independent variable – GDP – there is an inverted connection, while between the dependent variable – the number of registered road vehicles at the end of the year and the independent variable – GDP – there is a direct connection. In order to identify the connection between these variables and of the intensity of their connection, we will suppose that between the variables there is a linear connection form. In this way, the simple linear regression model proposed in studying the evolution of the number of passengers that have used mass transit vehicles (Y) in relation to the GDP has the form:

$$PS = c(1) \times GDP + c(2) + \epsilon_t$$  \hspace{1cm} (1)$$

The main problem of each regression model is determining the parameters of the model. For determining these parameters, we will use the generalized least squares method. In order to test the validity of the hypothesis on which the classic model is based on, various statistical tests will be used. To estimate the parameters of the model (1), we have used the Eviews program, with the help of which we obtained the following results at a sample level:
Table no. 2 Estimate the parameters of the model (1)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>-0.354284</td>
<td>0.135173</td>
<td>-2.620974</td>
<td>0.0153</td>
</tr>
<tr>
<td>C(2)</td>
<td>420372.6</td>
<td>45341.94</td>
<td>9.271165</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.229984 Mean dependent var 335744.5
Adjusted R-squared 0.196505 S.D. dependent var 177563.1
S.E. of regression 5.83E+11 Akaike info criterion 26.86987
Sum squared resid 5.83E+11 Schwarz criterion 26.96738
Log likelihood -333.8734 Hannan-Quinn criter. 26.89692
F-statistic 6.89504 Durbin-Watson stat 0.148711
Prob(F-statistic) 0.015275

Source: author’s calculus based on data from INSSE and Eurostat

The values of the estimated coefficients at a sample level are: c(1)=-0.354284 and c(2)=420372.6. The c(1) value shows how much the number of passengers using mass transit vehicles decreases when the GDP rises with a unit, while the c(2) value shows what the passengers that used mass transit vehicles value would be 420372.6 if the GDP would be zero.

It can be seen that at a sample level, the function through which we define the model is descending. This shows us the sign of the estimated coefficient c(1), which is negative. To find out the influence the independent variable has on the dependent variable at the population level starting from the simple linear regression model, we will generalize the results of the two estimated coefficients by applying the Student Test. In choosing the correct hypothesis by using the Student test, we compare $t_{calc}$ with $t_{tab}=2.08$.

Based on the data from the table above, we can see that c(1) is significantly different from zero, with a significance level of $\alpha = 0.05$ because $t_{calc} = 2.62 > t_{tab} = 2.08$, which means that the null $H_0$ hypothesis is rejected. This fact can be observed through the c(1) parameter associated probability too, which is equal to 0.01, which confirms the fact that the parameter is significant at the whole population level. Also, in the case of parameter c(2), it can be seen that $t_{calc} = 9.27 > t_{tab} = 2.08$, and the probability associated to parameter c(2) is zero. This confirms the fact that the parameter is significant, from where we can see that the $H_0$ null hypothesis is rejected.

Following the calculations made with the help of the Eviews program, we can see that the two parameters are significantly different from zero, from where we draw the conclusion that the model has been correctly specified, identified and estimated, so we can continue the econometric discussion.

In order to measure the intensity of the endogenous variable’s dependency from regression factors, the determination coefficient needs to be found out. Based on the obtained results, at a sample level, there is a strong link between the endogenous and exogenous variables.

$$R^2 = 1 - \frac{\epsilon - 1}{\epsilon - p} (1 - R^2) = 0.196505$$ (2)

This has the name of adjusted correlation report. We can state that there is a strong link between the variables of the sample.

To study the size of $R^2$ at the entire population’s level, we use the Fisher test.

$H_0$: $R^2 = 0$

$H_1$: $R^2 \neq 0$

In order to choose the correct hypothesis, we compare $F_{calc}$ with $F_{tab}$, read from the Fisher annex. Because $F_{calc} = 6.89 > F_{tab} = 3.10$, the result is that the null hypothesis is rejected, and the influence of the exogenous variable on the endogenous variable is significant. If the difference between $F_{calc}$ and $F_{tab}$ increases, the link between the variables in the total population is stronger.
Testing the fundamental hypothesis referring to the random variable $\varepsilon$

The first hypothesis we are going to test is that of the $\varepsilon_i$ residual variable independence values. For this study, we will use the Durbin-Watson test. Starting from the relation (Stancu, 2011) [8]:

$$\varepsilon_t = \rho \varepsilon_{t-1} + u_t$$

(3)

The following hypotheses are stated:

$H_0: \rho = 0$, with the alternative

$H_1: \rho \neq 0$

This $\rho$ is the autocorrelation coefficient from the first order of errors. In order to choose a correct hypothesis, the $\text{DW}_{\text{calc}} = 0.14$ (table 2) statistic is determined. Working with a significance level of $\alpha = 0.01$, the number of exogenous variables being $k=1$, and the number of observations $T=25$, from the Durbin-Watson distribution table, we read the following values: $d_1 = 1.05$ and $d_2 = 1.21$.

Because $0 < \text{DW}_{\text{calc}} = 0.14 < d_1 = 1.05$, the errors are positively auto correlated and the $H_0$ hypothesis is the one rejected, so the error independence hypothesis is not valid.

For eliminating the auto correlation phenomenon, we will estimate the $\rho$ parameter with the help of the Cochrane-Orcutt method (Andrei și Bourbonnais, 2008) [1]. Following the calculations, we have obtained the value of the parameter:

$$\rho = 1 - \frac{\text{DW}_{\text{calc}}}{2} = 0.79$$

(4)

In this way, the residuum series can be written:

$$\varepsilon_t = 0.79 * \varepsilon_{t-1} + u_t$$

(5)

From the multiple linear regression model:

$$PS_t = C(1) * \text{PIB}_t + C(2) + \varepsilon_t$$

(6)

$$PS_{t-1} = C(1) * \text{PIB}_{t-1} + C(2) + \varepsilon_{t-1}$$

(7)

Replacing in relation (5), we obtain:

$$PS_t - (0.79 * PS_{t-1}) = C(1) * (\text{PIB}_t - 0.79 * \text{PIB}_{t-1}) + C(2) * (1-0.79) + u_t$$

(8)

Estimating the new regression model

We check the qualities of the new model representing the same stages as the previous model. For estimating the parameters of the new regression model, we used the method of the smallest squares again. The results are show in the table below:

<table>
<thead>
<tr>
<th>Table no. 3</th>
<th>Estimate the parameters of the model (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable:</strong></td>
<td>$PS_t - (0.79 * PS_{t-1})$</td>
</tr>
<tr>
<td>Method:</td>
<td>Least Squares</td>
</tr>
<tr>
<td>Sample (adjusted):</td>
<td>1991 2014</td>
</tr>
<tr>
<td>Included observations:</td>
<td>24 after adjustments</td>
</tr>
<tr>
<td>$PS_t - (0.79 * PS_{t-1}) = C(1) * (\text{GDP}<em>t - 0.79 * \text{GDP}</em>{t-1}) + C(2) * (1-0.79) + u_t$</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>0.147390</td>
<td>0.072611</td>
<td>2.029833</td>
<td>0.0143</td>
</tr>
<tr>
<td>C(2)</td>
<td>187305.3</td>
<td>66054.05</td>
<td>2.835673</td>
<td>0.0096</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.345990</td>
<td>Mean dependent var</td>
<td>50283.32</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.292626</td>
<td>S.D. dependent var</td>
<td>43703.60</td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>43664.18</td>
<td>Akaike info criterion</td>
<td>24.28527</td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>4.19E+10</td>
<td>Schwarz criterion</td>
<td>24.38345</td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>3.960556</td>
<td>Durbin-Watson stat</td>
<td>1.552451</td>
<td></td>
</tr>
</tbody>
</table>

*Source: author’s calculus based on data from INSSE and Eurostat*
The results related to the two parameters of the new model show that the values of the Student statistics are greater in absolute value than the table value of 1.96 for a significance level of 5%. We can conclude that the null hypothesis $H_0$ is rejected for all parameters of the regression equation, these parameters being different from zero at the level of the entire population.

In order to measure the intensity of the link between the two variables, the determining coefficient is found. At a sample level, between the endogenous and exogenous variables, there is a medium intensity link. In order to determine if this intensity remains the same for the level of the entire population, we have used the Fisher test. Because $F_{calc} = 3.96 > F_{tab} = 3.48$, it results that the null hypothesis according to which between the variables there is no connection, is rejected. The influence of the exogenous variables on the endogenous ones is significant.

Testing the basic hypotheses referring to the random $u_t$ variable

A. The $u_t$ variable residual independence value – To find the auto correlation of the residual variables, we will use the Durbin-Watson test. This time we will start from the following relation:

$$u_t = \rho u_{t-1} + \omega_t$$

The following hypotheses are stated:

$H_0: \rho = 0$, with the alternative $H_1: \rho \neq 0$

In this case, the Durbin-Watson statistic is equal with 1.552451, so $d_2 = 1.21 < DW_{calc} = 1.552451 < 4-d_2 = 2.79$. We can conclude that the errors are independent and the error independence hypothesis checks.

B. The homoscedasticity of the residual variable $u_t$ – in order to check this homoscedasticity hypothesis, we will use the White test. Through the homoscedasticity of errors we understand:

$$E(u_t) = 0, (\forall) t=1,25;$$

$$V(u_t) = \sigma^2_{u_finită}, (\forall) t =1,25.$$  

The White test is a statistical test that has at its base the explanation of the $(\hat{u}^2_t)_{t=1,\ldots,n}$ series, in report with one or more exogenous variables. In using this test, the regression model is defined by one of the following relations (Andrei și Bourbonnais, 2008) [1]:

- In case the series $(\hat{u}^2_t)_{t=1,\ldots,n}$ is explained compared to some independent variables and their squared, the following regression model is defined:

$$\hat{u}^2_t = \sum_{j=1}^{k} \alpha_1 x_{jt} + \sum_{j=1}^{k} \alpha_2 x^2_{jt} + \omega_t$$  

- In case the series $(\hat{u}^2_t)_{t=1,\ldots,n}$ is explained compared to some independent variables, their squares and various first order combinations of them, then the following regression model is defined:

$$\hat{u}^2_t = \alpha_0 + \alpha_1 x_t + \alpha_2 X^2_t + \omega_t$$

The first regression model is recommended in situations in which we make use of a large number of exogenous (independent) variables, while the second regression model is recommended when we use a moderate number of exogenous variables for characterizing the homoscedasticity of the second model (2). Because we chose a regression model with only one exogenous variable, we will use the second model to characterize the homoscedasticity.

Starting with the relation:

$$u^2_t = \alpha_0 + \alpha_1 x_t + \alpha_2 X^2_t + \omega_t$$

we want to analyze if there is or there isn’t a link between the variables of the relation. Because $F_{calc}=3.35$ and $F_{tab}=3.46$ the $H_0$ hypothesis is accepted and the model is homoscedastic. The $H_0$ hypothesis cannot be rejected, this being guaranteed with a 54% probability.

C. Testing the normality of the $u_t$ variable’s distribution

Because of the importance of the normal repartition in modelling various statistics, different special concordance test have been created in order to check the normality of various distributions.
One way of checking the normality distributions of errors is the Jarque-Berra test, which is an asymptotic test, useful in case of a large volume sample, which follows a chi square distribution, with two degrees of freedom, having the following form (Meșter, 2012) [4]:

$$JB_{\text{calc}} = T \left[ \frac{\alpha^2}{6} + \frac{(\beta - 3)^2}{24} \right]$$

where:

- \( T \) = number of observations
- \( \alpha \) – skewness coefficient; it measures the symmetry of error distribution around their mean (which is null),
- \( \beta \) – Pearson’s kurtosis coefficient, which measures the kurtosis in report with the normal distribution.

The Jarque-Berra test is based on the hypothesis that normal distribution has an asymmetry coefficient equal to zero, \( \alpha=0 \) and an flattening coefficient equal with three, \( \beta=3 \).

Based on the calculations made in the Eviews program, we have obtained:

$$\text{JB}_{\text{calc}} = 5.29 < \chi^2_{0.05;4} = 9.49$$

Because \( JB_{\text{calc}} = 5.29 < \chi^2_{0.05;4} = 9.49 \), the normality hypothesis of errors cannot be rejected at the level of the entire population, the errors being normally distributed. Because all three hypotheses referring to the random variable have checked, the result is that the model is valid.

3. Estimating the relation between the number of registered road vehicles in circulation by the end of the year and GDP

We will deal with the analysis of the connection between the number of registered road vehicles in circulation by the end of the year and GDP. As in the case of the first estimated model, we suppose that between the variables there is a form of linear connection. Thus, the simple regression model proposed for studying the evolution of the number of registered road vehicles in circulation by the end of the year (\( Y_t \)) based on the GDP has the following form:

$$\text{INMV}=c(1) \times \text{GDP} + c(2) + \varepsilon_t$$

(13)

The results relating to the two parameters of the model show that the Student statistic values are larger in absolute value than the table value equal to 1.96, with a significance level of 5%. Thus, we can conclude that the second null hypothesis \( H_0 \) for the two parameters of the regression equation, because they are significantly different from zero, at the total population level.

In order to measure the intensity of the endogenous variable’s dependency to regression factors, we will find the determination coefficient. At a sample level, between the endogenous variable and the exogenous one, there is a strong intensity link. In order to determine if this intensity is kept at the entire population too, we will use the Fisher test. Because \( F_{\text{calc}}=51.98 > F_{\text{tab}}=3.48 \), the result is that the null hypothesis according to which there is no link between the variables is rejected, so the influence of the exogenous variable on the endogenous one is significant.

In order to estimate the parameters of the regression model, we have used the Eviews program. The obtained results are reproduced in the table below:

| Source: author’s calculus based on data from INSSE and Eurostat, processed in Eviews |}
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Series: Residuals</td>
<td>Sample 1991 2014</td>
</tr>
<tr>
<td>Observations</td>
<td>24</td>
</tr>
<tr>
<td>Mean</td>
<td>1.39e-11</td>
</tr>
<tr>
<td>Median</td>
<td>-2103.268</td>
</tr>
<tr>
<td>Maximum</td>
<td>114320.3</td>
</tr>
<tr>
<td>Minimum</td>
<td>-117322.8</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>42686.80</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.064275</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>5.297430</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>5.294711</td>
</tr>
<tr>
<td>Probability</td>
<td>0.070838</td>
</tr>
</tbody>
</table>
Table no. 4 Estimate the parameters of the model (13)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(1)</td>
<td>1903342.</td>
<td>260088.9</td>
<td>7.318042</td>
</tr>
<tr>
<td>C(2)</td>
<td>5.590412</td>
<td>0.775372</td>
<td>7.209970</td>
</tr>
</tbody>
</table>

R-squared: 0.693267
Adjusted R-squared: 0.679930
S.E. of regression: 912990.0
Akaike info criterion: 30.36346
Log likelihood: -377.5432
Schwarz criterion: 30.46097
F-statistic: 51.98366
Prob(F-statistic): 0.000000
Durbin-Watson stat: 1.264646

Source: author’s calculus based on the dates from INSSE and Eurostat

Testing the fundamental hypothesis referring to the random variable \( \varepsilon_t \)

A. The hypothesis of independence of the residual values of \( \varepsilon_t \).

In order to find the autocorrelation of the residual variables, we will use the Durbin-Watson test. This time we will start from the following relation (Stancu, 2011) [8]:

\[ \varepsilon_t = \rho \varepsilon_{t-1} + u_t \]  

(14)

The following hypotheses are stated:

- \( H_0 : \rho = 0 \), with the alternative
- \( H_1 : \rho \neq 0 \)

In this case, the Durbin-Watson statistic is equal to 1.264646, so \( d_2 = 1.21 < DW_{calc} = 1.264646 < 4 - d_2 = 2.79 \), thus we can say that the errors are independent and the error independence hypothesis checks.

B. The homoscedasticity hypothesis of the residual variable \( \varepsilon_t \).

In order to check the homoscedasticity hypothesis, we will use the White test. To settle if the hypothesis is valid, we issue two hypotheses:

- \( H_0 : R^2 = 0 \) – homoscedastic error
- \( H_1 : R^2 \neq 0 \) – heteroskedastic errors.

We will determine the calculated size of the Fisher test. Because \( F_{calc} = 0.46 \) and \( F_{tab} = 2.46 \), the \( H_0 \) hypothesis is accepted, which means that the errors of the model are homoscedastic. \( H_0 \) hypothesis cannot be rejected, this being guaranteed with a 95% probability.

C. Testing the normality of the distribution of the random variable \( \varepsilon_t \).

Because of the importance of the normal repartition in modeling different statistics, various special concordance tests have been created to see the distribution of normality. A way of checking the normality hypothesis of errors is the Jarque-Berra test, which is an asymptotic test, valid in the case of a large volume sample, which follows a chi squared distribution, with 2 degrees of liberty (Meșter, 2012) [4].
4. Conclusions

Starting for this econometrical models, we can affirm that between the number of passengers and GDP there is a inverted link, while between the number of registered vehicles by the end of the year and GDP there is a direct link. In conclusion, we can state that, in the case of Romania, the increase of the GBP leads to the increase of purchased road vehicles but also the decrease of the number of passengers that are using the mass transit system. All these contribute to the increase of urban pollution and determine, in a certain way, Romania’s distancing from its target of creating a sustainable transport. (2030 follows that all the parameters of a sustainable transport activity to be as close as possible to those imposed by the European Union).

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6. Bibliography