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Influence of selected factors on the volume of consumption (per capita) of Uruguay - in the sense of Granger causality

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ABSTRACT

The project will be tested State Uruguay. The country is characterized by political stability, economic attractiveness of tax-free zones for investors, and also has a good infrastructure, communication network, as well as one of the best education systems in their continent. The aim of the study is to verify whether the selected factors affect the volume of consumption (per unit) in Uruguay. Selected factors are investment (per capita), imports (per capita), exports (per capita), government spending (per capita) and the level of consumer prices. Individual data are annual data, and analysis period in the years 1950-2009. Audit of Granger causality indicates that the inclusion of the individual regression equations delayed variables can better explain and predict the evolution of the size of consumption in Uruguay.

Keywords: Granger causality, Dickey Fuller test, Uruguay, consumption

1. INTRODUCTION

The project will be tested state - Uruguay. This choice was dictated by the fact that this country over the past decades has developed to a very high pace and has a high percentage of European immigrants. The country is characterized by political stability, economic

attractiveness of tax-free zones for investors, and also has a good infrastructure, communication network, as well as one of the best education systems in their continent.

The aim of the study is to verify whether the selected factors affect the volume of consumption (per unit) in Uruguay. Selected factors are investment (per capita), imports (per capita), exports (per capita), government spending (per capita) and the level of consumer prices. To achieve this objective will be used GRETL program. With it will be analyzed Granger causality. The scope of the data will be retrieved from the program GRETL (Penn World Table 7.0). Individual data are annual data, and analysis period in the years 1950-2009. In total, each row has 60 time observation.

2. BRIEF CHARACTERISTICS OF URUGUAY

Uruguay is a country located in the eastern part of South America over the Atlantic Ocean. You are directly borders with only two countries: the north of Brazil and to the west of Argentina. The capital of Uruguay is Montevideo - Atlantic port at the mouth of La Plata.

Uruguay has a relatively stable economy, such as the Latin American conditions. In the past, the state was called the "Switzerland of Latin". Come countries of South America are associated with poverty, however, Uruguay is one of the richest countries on the continent. Currently, Uruguay has a European ambiance, because most of it consists of immigrants from Italy, Spain, Germany, as well as Polish, Hungary and the Baltic States.

It is worth noting that Uruguay is one of the numerous multilateral organizations and economic arrangements[1]:

• WTO: From 01.01.1995. Uruguay is a member of the World Trade Organization.

• UNCTAD: Uruguay is a member of the United Nations Conference. Trade and Development and use of a series of programs of economic and social development.

• FAO: Uruguay is a member of the United Nations. Food and Agriculture.

• ILO: Uruguay is a member of the International Labour Organisation.

• IMF: Uruguay is a member of the International Monetary Fund.

• WIPO: Uruguay is a member country of the World Intellectual Property Organization.

• BID: Uruguay is one of the founding countries of the Inter-American Development Bank.

• Flare: From 30.05.2008. Uruguay is a member of the Latin American Reserve Fund.

• MERCOSUR: Uruguay is one of the founding countries of MERCOSUR - Common Market of the South. In the second half of 2011. Uruguay presided grouping.

• BANK SOUTH: In 2007. Was signed in Buenos Aires act of the constitution of the Bank of the South (Banco del Sur) by Argentina, Bolivia, Brazil, Ecuador, Paraguay, Uruguay and Venezuela. The founding act establishes, as the main target of the Bank of the South "financing economic and social development" of nations.

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[1] More information on the website:
http://www.buenosaires.msz.gov.pl/pl/c/MOBILE/wspolpraca/dyplomacja_ekonomiczna/biuletyn_ekonomiczny/informator_urugwaj/.

• URUPABOL: Along with Paraguay and Bolivia, Uruguay is a signatory to the integration agreement of 1963. Activity group was resumed in 2009. In 2010. Presidents decided to jointly build a gas pipeline from Bolivia to Uruguay (by Paraguay).

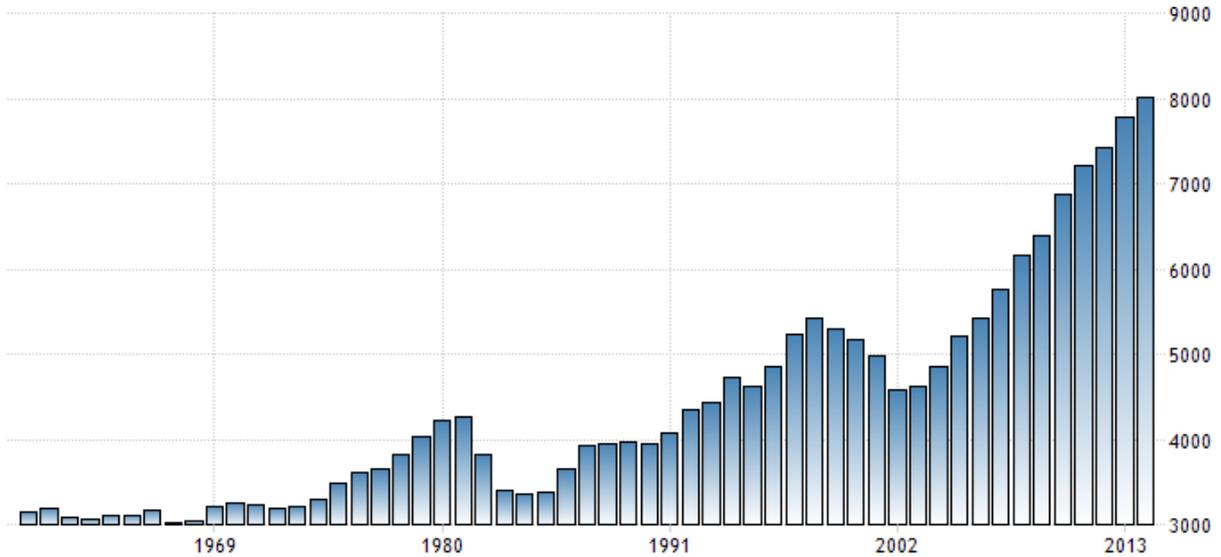The figure below clearly shows how to change the gross domestic product per capita of the country.

Figure 1. Gross Domestic Product per capita of Uruguay in the years 1960-2014 (USD)
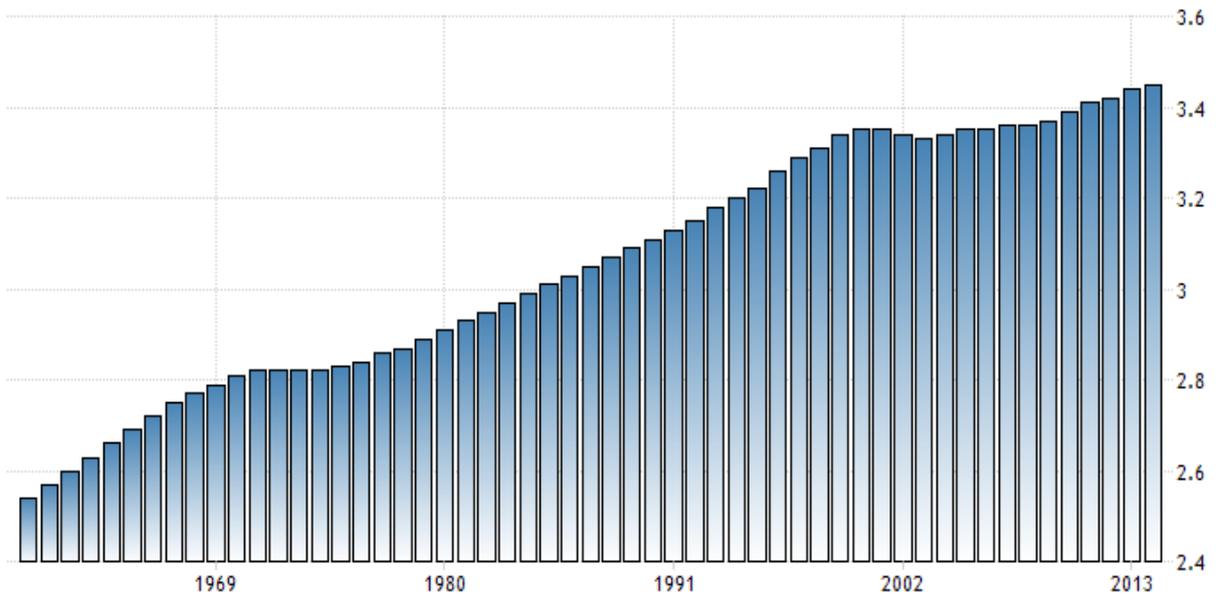Source: Trading Economics, http://pl.tradingeconomics.com

Figure 2. Population Uruguay in the years 1960-2014 (in millions)
Source: Trading Economics, http://pl.tradingeconomics.com

On the 1st graph we can see that the GDP per capita, in the present period increased. The lowest value was 3,021.77 in 1967, while the highest value exceeded $ 8,000 in 2014. Since 2002 he has been a growing trend GDP p.c. This trend shows that Uruguayans are a nation that is enriched. It is worth noting that the growth of GDP per capita was also accompanied by an increase in the number of population in the country. Population Uruguay is a Figure 2.

Noting the two graphs above we can conclude that Uruguay's economy grew fast. Such requests can be extended, since, despite the gradual increase in the number of Uruguayans, GDP per capita also grew exceeding 2014 8000 USD. In literature criticism concerning the definition of wealth through per capita GDP. Therefore, we look at how much they earn an average of Uruguayans, Figure 3.

Figure 3. The average salary Uruguayans in the years 2000-2011 (UYU)
Source: Trading Economics, http://pl.tradingeconomics.com

The data in the chart above represent only values in the twenty-first century, however, it is noted that the average salary in Uruguay has grown from about 6,600 UYU (Uruguayan peso) to over 16600 UYU in 2011, more than 2.5 times.

It should also pay attention to the change in GDP of Uruguay, compared with Latin America and the Caribbean. This relationship is presented in Figure 4.

On the above chart we can see that a change in GDP of Uruguay at the beginning of the period presented had lower values than the average for South America. In 1974, one could observe the alignment presented pointer and since 1985 Uruguayan GDP growth significantly outperformed the rest of the countries of the continent and remained almost the whole period of its dominant position. The above-mentioned factors, that should be a closer look at the country and subjected to analysis.
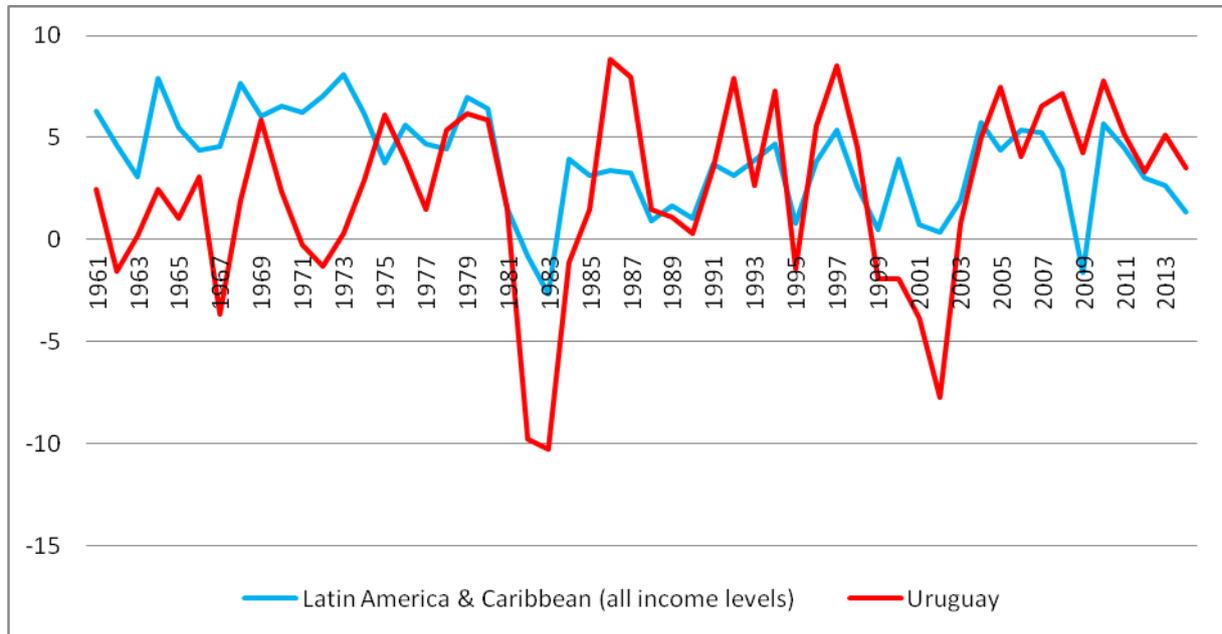
Figure 4. Change in GDP in Uruguay, Latin America and the Caribbean in the years 1961-2014 (%)
Source: The World Bank, http://data.worldbank.org/

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3. GRANGER CAUSALITY – INTRODUCTION

To achieve this objective will be used method of statistical analysis of causal relationships between variables - in the sense of Granger causality. Testing of causality in economics, has undoubtedly started in 1969, when it C.W.J. Granger published an article *Investigating causal relations by Econometric models and cross-spectral methods* [1], on how to detect causal relationships [5].

The definition of causality says that the variable x is a cause in the sense of Granger for the variable y, if taken into account in the model explaining y delayed value of the variable x to order k inclusive improves modeling of the variable y.

The concept of Granger causality is not limited to search the variable whose presence in the model can improve the accuracy of forecasts [2]. He pointed this out himself Granger, stress that he meant that "for the time series, the cause precedes effect of a number of which is the cause (causal series) contains information about the variable being the result of which were not included in other ranks" [7].

Granger causality is one of the key concepts of econometric analysis of the relationship between economic processes. However, so far in the work devoted to this subject tests usually limited to the identification of a linear dependence, the basic tool of this analysis was the model VAR [6].

In this study, time series are generally short, because each of them has 60 observations. Survey will causality in the medium based on test Pierce-Haugh - both researchers have published work in 1977, which represent the approach to causality tests based on correlation coefficient time series [3].

4. STAGES CALCULATING GRANGER CAUSALITY

At the beginning of verified respondents stationarity of time series, using test expanded Dickey-Fuller (ADF). The Granger causality test is required stationarity of variables. The expanded Dickey-Fuller test equation, which is subject to testing is as follows [4]:

$$\Delta y_1 = \delta y_{t-1} + \sum_{i=1}^{k} \alpha_i \, \Delta y_{t-1} + \varepsilon_t.$$

In turn, the hypotheses are as follows [8]:

$H_0: \delta = 0$
$H_1: \delta < 0$

Null hypothesis that $Y_t \sim I(1)$ and the process is integrated into the Government of the first, i.e. the process is unsteady due to the presence of the unit element. While the alternative hypothesis assumes that $Y_t \sim I(0)$, i.e. the process is stationary. If the null hypothesis is rejected, then it ends with a test (the process is stationary), while there is no basis to reject the null hypothesis generating steps [13].

The selection criteria for the hypothesis test ADF are [12]:
ADF < DFα - must reject the null hypothesis, the process Y_t is integrated in the order of 0, ie, the process is stationary, the procedure ends.

ADF ≥ DFα - there is no reason to reject the null hypothesis of non-stationarity studied variable. Accordingly, the process Y_t is integrated into at least one row.
To decide whether to accept or reject the null hypothesis can also be guided by the value of the p-value.

The results of ADF are shown in the table below.

Table 1. The results of extended Dickey Fuller test for d = 1 (p-value = 5%)

	Consumption	Governmen t spending	Exsports	Imports	Investments	Consumer price index
p-value	0,9993	0,9971	1	0,9999	0,878	0,5468
The choice of hypothesis	H_0	H_0	H_0	H_0	H_0	H_0
Interpreta tion of the result	no grounds to reject the null hypothesis. Accordingly, the process Y_t is integrated into at least one row, therefore, necessary to examine whether there	no grounds to reject the null hypothesis. Accordingly, the process Y_t is integrated into at least one row, therefore, necessary to	no grounds to reject the null hypothesis. Accordingly, the process Y_t is integrated into at least one row, therefore, necessary to	no grounds to reject the null hypothesis. Accordingly, the process Y_t is integrated into at least one row, therefore, necessary to	no grounds to reject the null hypothesis. Accordingly, the process Y_t is integrated into at least one row, therefore, necessary to examine whether there	no grounds to reject the null hypothesis. Accordingly, the process Y_t is integrated into at least one row, therefore, necessary to examine whether there is a row of higher integration.

	is a row of higher integration.	examine whether there is a row of higher integration.	examine whether there is a row of higher integration.	examine whether there is a row of higher integration.	is a row of higher integration.	

All time series are not stationary and are integrated into the order of at least 1st. In case you do not reject the hypothesis of lack of stationarity, check whether the first variable increments are stationary.

We estimate the regression equation in the form [10]:

$$\Delta^2 y_1 = \delta y_{t-1} + \sum_{i=1}^{k} \alpha_i \, \Delta^2 y_{t-1} + \varepsilon_t.$$

The null hypothesis means that the growths are non-stationary variable, while the alternative hypothesis is that the gains of the variable are stationary.

Table 2 presents the test results obtained using the ADF first difference variables.

Table 2. The results of extended Dickey Fuller test for d = 1 (p-value = 5%)

	Consumption	Government spending	Exsports	Imports	Investments	Consumer price index
p-value	6,469e-005	0,03735	1,505e-006	0,003825	0,001452	7,655e-008
The choice of hypothesis	H$_1$	H$_1$	H$_1$	H$_1$	H$_1$	H$_1$
Interpretation of the result	must reject the null hypothesis, the process Y$_t$ is integrated in the order of 1st, that the process is stationary, the procedure ends.	must reject the null hypothesis, the process Y$_t$ is integrated in the order of 1st, that the process is stationary, the procedure ends.	must reject the null hypothesis, the process Y$_t$ is integrated in the order of 1st, that the process is stationary, the procedure ends.	must reject the null hypothesis, the process Y$_t$ is integrated in the order of 1st, that the process is stationary, the procedure ends.	must reject the null hypothesis, the process Y$_t$ is integrated in the order of 1st, that the process is stationary, the procedure ends.	must reject the null hypothesis, the process Y$_t$ is integrated in the order of 1st, that the process is stationary, the procedure ends.

Time series of all growth variables are stationary or integrated of order 0 for the first differences. In this test Dickey Fuller that the processes are integrated into the first level of causality for testing the lack of stationarity removed processes for their transformation, i.e. first calculation increments.In the next stage should be added first differences and move on to create the VAR model.

In order to perform Granger causality to estimate the equation VAR model with the same latency for both variables (in this case delays Stage 1, that information criteria Akaike'a and Schwartz suggest as the best) [7].

Before you will be made to analyze the influence of individual variables on the volume of consumption per Uruguayan should be presented, as will shape the individual models prior to estimation.

Model 1. Government spending causing consumption volume

$$Y_t = \beta_{10} + \beta_{11}Y_{t-1} + \alpha_{11}X_{t-1} + e_{1t}$$

Model 2. Export cause consumption volume

$$Y_t = \beta_{20} + \beta_{21}Y_{t-1} + \alpha_{21}X_{t-1} + e_{2t}$$

Model 3. Import cause consumption volume

$$Y_t = \beta_{30} + \beta_{31}Y_{t-1} + \alpha_{31}X_{t-1} + e_{3t}$$

Model 4. Investments cause consumption volume

$$Y_t = \beta_{40} + \beta_{41}Y_{t-1} + \alpha_{41}X_{t-1} + e_{4t}$$

Model 5. The level of consumer prices cause consumption volume

$$Y_t = \beta_{50} + \beta_{51}Y_{t-1} + \alpha_{51}X_{t-1} + e_{5t}$$

where:

Y_t -> dependent variable

β_{n0} -> constans

β_{n1} -> parameter for the delayed response variable

Y_{t-1} -> delayed dependent variable

α_{n1} -> parameter for the delayed explanatory variable

$X_{n,t-1}$ -> delayed explanatory variable

n -> integer denoting another equation with another explanatory variable

After the estimation of these models in GRETL, various empirical models have the following characters:

Model 1. Government spending causing consumption volume

$$Y_t = 9,29 + 0,95Y_{t-1} + 1,40X_{t-1}$$

Model 2. Export cause consumption volume

$$Y_t = 121{,}99 + 0{,}86Y_{t-1} + 0{,}52X_{t-1}$$

Model 3. Import cause consumption volume

$$Y_t = 99{,}42 + 0{,}92Y_{t-1} + 0{,}35X_{t-1}$$

Model 4. Investments cause consumption volume

$$Y_t = 31 + 1Y_{t-1} + 0{,}2X_{t-1}$$

Model 5. The level of consumer prices cause consumption volume

$$Y_t = 151{,}76 + 1{,}05Y_{t-1} - 2{,}14X_{t-1}$$

The present study investigated the relationship is one-way - the influence of individual variables on the volume of consumption per capita. The test Granger compared to models with full information (ie. The explanatory variable X) and models with restrictions (without explanatory variable X). If the parameters of the variables X are not statistically significant, this means that X does not cause Y in the sense of Granger. In order to verify that these explanatory variables are the cause in Granger sense for the response variable must select the appropriate hypothesis by analyzing the result of F or comparing the p-value for the p-value limit (5%). Hypotheses are as follows:

H_0: $\alpha_{n1} = 0$, ie variable Xn is not the cause in Granger sense for the dependent variable Yt.

H_1: $\alpha_{n1} \neq 0$, ie variable Xn is the cause in Granger sense for the dependent variable Yt.

To verify this hypothesis, ie. To examine Granger causality test Granger will be used with the Wald statistics, the following form [11,12]:

$$G = \frac{T(S^2(\varepsilon_t) - S^2(\eta_t))}{S^2(\varepsilon_t)}$$

* T is the sample size.)

This statistic converges to $\chi^2(q)$ distribution. However, the statistic G can be applied to a large sample, that is such a time series count, at least 100 observations. However, the time series in this study are small (count 60 observations), so multiply by T should be replaced with multiplication by the expression T-k/q, it means bringing statistics to the form of F (q, T-k), where q is the number of parameters for which accepted is zero, T is the sample number, and k is the total number of estimated parameters of the model [11,12,14].

For these models, Granger causality is presented in table 3 contained in it are the p-value for the F test and interpretation.

Table 3. Granger causality in the sense of individual variables on the volume of consumption per capita Uruguay (p-value = 5%)

	Government spending	Exsports	Imports	Inwestments	Consumer price index
p-value	0,00	0,00	0,00	0,00	0,00
The choice of hypothesis	H_1	H_1	H_1	H_1	H_1
Interpretation of the result	Government spending is the cause in Granger sense for consumption volume per Uruguayan.	Exsports are the cause in Granger sense for consumption volume per Uruguayan.	Imports are the cause in Granger sense for consumption volume per Uruguayan.	Inwestments are the cause in Granger sense for consumption volume per Uruguayan.	Consumer price index is the cause in Granger sense for consumption volume per Uruguayan.

After the estimation of the models and to compare the results obtained with critical values can be assumed that all explanatory variables that were selected for this project are the cause in Granger sense for consumption volume per capita in Uruguay. It can therefore be concluded that the amount of consumption of each Uruguayan depends on the size of government spending, exports, imports, investments and the level of consumer prices.

5. CONCLUSIONS

The results of estimation VAR models indicate the presence of causal relationships in the sense of Granger. Audit of Granger causality indicates that the inclusion of the individual regression equations delayed variables can better explain and predict the evolution of the size of consumption in Uruguay. This means that increases the size of the consumption of the residents of Uruguay can be better predicted in terms of fit to the actual data, if you take into account the corresponding delay increases the size of government spending, exports and imports, investments and the level of consumer prices.

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