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TOURISM ACCOMODATION INDICATORS' IMPACT ON THE GDP – A GRANGER CAUSALITY APPROACH

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Abstract

In this paper, the authors study the impact of selected indicators of tourism accommodation on the Gross Domestic Product. The indicators are related to the number of nights spent, therefore they are not directly related to the GDP, thus justifying the choice of Granger causality as method to assess the impact. The fact that most of the variables are found to be not stationary leads to the application of a special technique, adapted to the dataset and software used. The VAR models used do not pass all the specification tests, the authors have chosen a conservative approach, considering the results achieved with caution. Following the application of the methodology, mixed results have been achieved, showing that there is some degree of causality, which cannot be, however, generalized.

Key Words: *granger causality, accommodation, GDP, model, specification*
JEL classification: *C52, O40, Z32*

Introduction

The subject of this paper is focused on outlining the existence and shape of Granger causality, if any, between some indicators characterizing the tourism activity and the Gross Domestic Product (considered as GDP per capita), in the European Union (27 countries, after 2020) Romania and the Republic of Serbia.

This article is a first approach of the authors on the behavior of the chosen indicators, as part of a "Granger causality environment". The tourism has

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a clear influence on the economic outcome and economic growth, through the income it generates, which can be linked directly or indirectly with the accommodation, therefore indicators of accommodation, other having no financial meaning can be studied in order to assert their influence on the Gross Domestic Product.

Studies on the influence of tourism on the economic growth have been capitalized widely in the literature. Antonakakis et al. (2015) have outlined the instability, over time, of the link between the tourism and economic growth. Păunică et al. (2021) have studied a set of factors of influence on the GDP by using the same method, outlining the impact of some factors on the economic growth. Manole and Buiga (2018) have approached on some up-to-date evolution in the sector of tourism. Udrescu and Buiga (2013) consider the importance of the brand, and particularly of the country brand, in the context of hospitality. Danish and Wong (2019) demonstrate that tourism is a positive factor when it comes to economic growth. The results of these authors encourage a study on the proposed indicators.

Research methodology

The following research hypothesis has been defined, according to the research objective:

> *H1. The indicator "Nights spent at tourist accommodation establishments" Granger causes the Gross Domestic Product in the European Union, Romania and Serbia.*

Since the authors have considered the GDP per capita as one of the variables in the study, and it can be reasonably expected that such variable is not stationary, the method chosen was the approach described by Giles (2011) for the Toda-Yamamoto method dedicated to Granger causality, adapted to the datasets described below.

All data have been extracted from the EUROSTAT database, therefore the quoted labels are the ones that accompany the source values. The datasets considered were chosen as such in order to describe the indicators approached in this study:

- GDP per capita (code GDPC), the dataset (last updated 25 February 2022) is named "Main GDP aggregates per capita", where the following coordinates have been selected:
    - Data are not adjusted;

- The indicator is "Gross Domestic Product at market prices";
- For enhanced comparability, the unit of measure is "Current prices, euro per capita";

- Nights spent. The dataset is "Nights spent at tourist accommodation establishments - monthly data" (most recent update 21 February 2022), and the data have the following characteristics:
  - "Country of residence" – "Reporting country", "Foreign country" and "Total";
  - Measurement unit – number of nights spent;
  - "Statistical classification of economic activities in the European Community (NACE rev. 2)" – the most comprehensive indicator, in the opinion of the authors, that is "Hotels; holiday and other short-stay accommodation; camping grounds, recreational vehicle parks and trailer parks".

The geographical coordinates selected indicate the European Union (27 countries, from 2020, that is post-BREXIT), Romania and Serbia, while the time interval covered is 2012 (Q1) – 2021 (Q3). Thus, the dataset encompasses 39 observations. All provisional or estimated data have been considered, for the purpose of this research, as they have been computed and presented at the timestamp the respective datasets were updated, according to the data source.

The following codes (abbreviations) are applied for the variables involved in this article:

Table 1: *Codes for variables*

Variable	**EU-27**	**Romania**	**Serbia**
GDP per capita	GDPCE	GDPCR	GDPCS
Nights spent, foreign country	NFE	NFR	NFS
Nights spent, reporting country	NRE	NRR	NRS
Nights spent, total	NTE	NTR	NTS

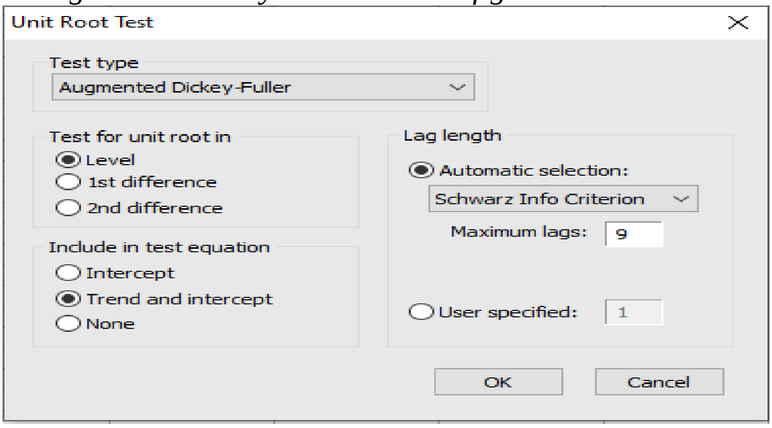
Source: *Authors' representation, labels according to the data source*

The methodology was implemented in EViews ® and involves the following steps:

1. Assessment of the order of integration for each variable, which involves the application of the unit root tests. For a more accurate and valid results, two tests have been used:

a. The Augmented Dickey-Fuller test (ADF), with the following structure (the maximum number of lags is the one specified by the software):

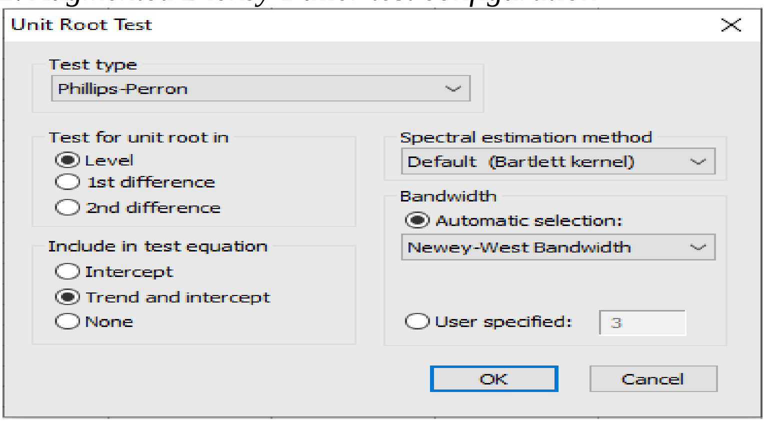
Figure 1: *Augmented Dickey-Fuller test configuration*



Source: *Authors' capture from Eviews® interface*

b. The Phillips-Perron test (PP), with the following configuration:

Figure 2: *Augmented Dickey-Fuller test configuration*



Source: *Authors' capture from Eviews® interface*

In case of conflicting results, the highest value is to be considered.

2. For each county, and for the respective pair of variables, the maximum order of integration is computed for later use.
3. For each county, and for the respective pair of variables, an unrestricted VAR model is defined between the variables included in the pair.

4. For each VAR model, the appropriate lag length is estimated and set. Following Chirila and Chirila (2017), the value presented by the Schwarz Info Criterion is to be chosen.
5. The updated VAR models will be tested against the four specification test: stability, serial correlation (LM test), normality (Cholesky of Covariance, Lutkepohl), heteroskedasticity().
    a. A model that fails the stability test or the autocorrelation one, the maximum number of lags is augmented by one lag (Giles, 2011) until the problem is solved;
    b. Hatemi-J (2004) quotes Hacker and Hatemi-j. (2003) on the possible biased results of Toda-Yamamoto procedure (modified Wald test) on models affected by lack of compliance with either normality or heteroskedasticity assumptions.

    The models that pass the autocorrelation tests will be "passed" for the next step, however, appropriate comments for their behavior against the other tests are inserted, because of the limited trust that the authors grant to the final results (of step 8).
6. For each models retained from the previous step, the lag length will be augmented with the number of lags corresponding to the maximum order of integration, set as exogenous variables – that is the method applicable in EViews ® in order to properly run the test (Giles, 2011).
7. The updated model is evaluated with the Granger causality test and the results are assessed.

Results and Discussion

The orders of integration

The structures of the hypothesis and of the datasets involves three separate tests, since there are three independent variables for each component of the geographical dimension. As stated above, the initial steps of the test procedure involves the assessment of the individual orders of integration (OI), and then the observation of the maximum one, for each pair of variables (maxOI). The results for the tests are presented in Tables 2 and 3.

Table 2: *Individual orders of integration – ADF test*

Variable	**GDPCE**	**GDPCR**	**GDPCS**	**NFE**	**NFR**	**NFS**
OI	0	2	2	3	**2**	**2**
Variable	**NRE**	**NRR**	**NRS**	**NTE**	**NTR**	**NTS**
OI	**2**	**3**	**2**	2	3	2

Source: *Authors' representation*

Table 3: *Individual orders of integration – PP test*

Variable	**GDPCE**	**GDPCR**	**GDPCS**	**NFE**	**NFR**	**NFS**
OI	0	0	0	**0**	**1**	**1**
Variable	**NRE**	**NRR**	**NRS**	**NTE**	**NTR**	**NTS**
OI	**0**	**0**	**0**	0	0	0

Source: *Authors' representation*

The majority of the PP test results testify for stationary variables, in the majority of cases, while the ADF-supported orders of integration, with one exception, lead to the fact that the variables are non-stationary. Also, it can be observed that in the majority of the cases, the behaviors of the Romanian and Serbian datasets is similar against the two tests. According to the provisions of the research methodology, the variables' orders of integration will be assessed according to the ADF test.

The VAR models. Optimum lags

The results of the VAR optimum lag testing (the maximum number of lags for which the tests are performed is the one suggested by the software, that is 3) are presented in the following table (the optimums are represented with italic characters):

Table 4: *Optimum lags*

Independent variable: NFE						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-1006.89	NA	7.54e+21	56.04985	56.13783	56.08056
1	-986.515	37.36732	3.04e+21	55.13973	55.40365	55.23185
2	*-969.876*	*28.65551*	*1.51e+21*	*54.43758*	*54.87745**	*54.59111*
3	-963.8512	9.707427*	1.36e+21*	54.32507*	54.94088	54.54000*
Independent variable: NFR						
0	-800.1621	NA	7.75e+16	44.56456	44.65253	44.59527
1	-779.4835	37.91084	3.07e+16	43.63797	43.90189	43.73009
2	-759.6598	34.14080	1.28e+16	42.75888	43.19874	42.91240
3	*-743.5075*	*26.02308**	*6.55e+15**	*42.08375**	*42.69956**	*42.29869**
Independent variable: NFS						
0	-749.0705	NA	4.53e+15	41.72614	41.81411	41.75685
1	-717.9665	57.02400	1.01e+15	40.22036	40.48428	40.31248
2	-699.7233	31.41897	4.58e+14	39.42907	39.86894	39.58260
3	*-691.6410*	*13.02137**	*3.67e+14**	*39.20228**	*39.81809**	*39.41721**
Independent variable: NRE						
0	-1008.371	NA	8.18e+21	56.13174	56.21972	56.16245
1	-981.6081	49.06592	2.31e+21	54.86712	55.13104	54.95923
2	*-959.8500*	*37.47236**	*8.64e+20**	*53.88056**	*54.32042**	*54.03408**

3	-956.4003	5.557892	8.97e+20	53.91113	54.52694	54.12606
Independent variable: NRR						
0	-859.2875	NA	2.07e+18	47.84930	47.93728	47.88001
1	-842.8165	30.19674	1.04e+18	47.15647	47.42039	47.24859
2	-802.6165	69.23335	1.39e+17	45.14536	45.58523	45.29889
3	*-785.5878*	*27.43518**	*6.78e+16**	*44.42154**	*45.03736**	*44.63648**
Independent variable: NRS						
0	-763.1501	NA	9.91e+15	42.50834	42.59631	42.53904
1	-724.9904	69.95944	1.49e+15	40.61058	40.87450	40.70269
2	-698.3471	45.88568	4.24e+14	39.35262	39.79248	39.50614
3	*-685.3985*	*20.86165**	*2.59e+14**	*38.85547**	*39.47129**	*39.07041**
Independent variable: NTE						
0	-1031.662	NA	2.98e+22	57.42568	57.51366	57.45639
1	-1008.975	41.59294	1.06e+22	56.38751	56.65143	56.47963
2	*-990.5367*	*31.75532**	*4.75e+21**	*55.58537**	*56.02524**	*55.73889**
3	-987.0307	5.648499	4.92e+21	55.61282	56.22863	55.82775
Independent variable: NTR						
0	-864.3591	NA	2.74e+18	48.13106	48.21903	48.16177
1	-849.8120	26.66963	1.53e+18	47.54511	47.80903	47.63723
2	-813.1493	63.14134	2.50e+17	45.73052	46.17038	45.88404
3	*-794.0045*	*30.84451**	*1.08e+17**	*44.88914**	*45.50495**	*45.10407**
Independent variable: NTS						
0	-778.3257	NA	2.30e+16	43.35143	43.43940	43.38213
1	-749.3312	53.15658	5.75e+15	41.96285	42.22677	42.05496
2	-722.2696	46.60612	1.60e+15	40.68164	41.12151	40.83517
3	*-713.9851*	*13.34721**	*1.27e+15**	*40.44362**	*41.05943**	*40.65855**

Source: *Authors' representation*

Before going to the next step, all models have been updated, if necessary, to the optimum lag (the default one, at the initial definition of the model is 2). The models are now ready to be tested for specification.

Specification tests

All tests are to be applied according to the proposed methodology. The stated decision rules will be followed in order to decide whether to proceed, with each model, to the next step.

VAR - independent variable: NFE

The model is stable in its initial configuration. There is serial correlation up to lag length (1, …, 5), however this model becomes unstable. Further attempts to increase lag length does not help in solving the lack of stability for the model. The model's residuals do not follow a normal distribution, but the heteroskedasticity test is passed with success.

The authors are in the presence of a model free from serial correlation (see Table 5), with no heteroskedasticity, but unstable and with improper distribution of the residuals. This model will be used for Granger Causality testing.

Table 5: *VAR (NFE, GDPCE) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	2.205865	4	0.6980	0.552752	(4, 40.0)	0.6981
2	3.301632	4	0.5087	0.838588	(4, 40.0)	0.5089
3	3.606329	4	0.4619	0.919436	(4, 40.0)	0.4622
4	7.545870	4	0.1097	2.020707	(4, 40.0)	0.1099
5	4.258425	4	0.3722	1.094496	(4, 40.0)	0.3724
6	5.924692	4	0.2048	1.554671	(4, 40.0)	0.2051

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	2.205865	4	0.6980	0.552752	(4, 40.0)	0.6981
2	10.27800	8	0.2461	1.356873	(8, 36.0)	0.2483
3	13.69575	12	0.3206	1.194559	(12, 32.0)	0.3283
4	20.68753	16	0.1908	1.410367	(16, 28.0)	0.2068
5	24.07355	20	0.2392	1.288855	(20, 24.0)	0.2741
6	33.14040	24	0.1011	1.593831	(24, 20.0)	0.1466

*Edgeworth expansion corrected likelihood ratio statistic.
Source: *Authors' representation based on EViews® test results*

VAR - independent variable: NFR

The Romanian VAR (NFR,GDPCR) behaves as the one tested in the previous section in the tests and corrections related to serial correlation (see Table 6 below). However, the model is also unstable and there are issues with the normality test. The proposed White Heteroskedasticity test (no cross terms) satisfies the criteria for a good behavior. The conclusion regarding the specification of this model is thus identical to the one defined for the European Union, the model will be capitalized in the next stages of analysis.

Table 6: *VAR (NFR, GDPCR) Residual Serial Correlation Tests results*

Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	4.084577	4	0.3947	1.047553	(4, 40.0)	0.3950
2	2.669111	4	0.6146	0.672660	(4, 40.0)	0.6148
3	2.049467	4	0.7267	0.512574	(4, 40.0)	0.7268
4	2.025268	4	0.7311	0.506371	(4, 40.0)	0.7313
5	2.440012	4	0.6554	0.613190	(4, 40.0)	0.6556
6	1.203005	4	0.8776	0.297763	(4, 40.0)	0.8777

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	4.084577	4	0.3947	1.047553	(4, 40.0)	0.3950
2	8.268734	8	0.4077	1.062770	(8, 36.0)	0.4100
3	10.21306	12	0.5973	0.847695	(12, 32.0)	0.6039
4	11.38550	16	0.7851	0.672780	(16, 28.0)	0.7954
5	15.53111	20	0.7453	0.721222	(20, 24.0)	0.7692
6	16.42155	24	0.8723	0.582058	(24, 20.0)	0.8971

*Edgeworth expansion corrected likelihood ratio statistic.

Source: *Authors' representation based on EViews® test results*

VAR - independent variable: NFS

The application and interpretation of the specification tests leads to observations similar to the previous cases based on the same topic variable (NF).

The model is affected by the presence of serial correlation in the residuals, which imposed the extension of the lag length to (1, …, 5). The stability test fails to offer a proper result, with the same conclusion drawn in the case of normality of residuals. However, there is no heteroskedasticity present.

Table 7: *VAR (NFS, GDPCS) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	4.726373	4	0.3165	1.221847	(4, 40.0)	0.3168
2	1.490325	4	0.8284	0.370181	(4, 40.0)	0.8285
3	4.439578	4	0.3498	1.143624	(4, 40.0)	0.3500
4	3.524031	4	0.4742	0.897540	(4, 40.0)	0.4745
5	6.762378	4	0.1490	1.793177	(4, 40.0)	0.1492
6	6.516938	4	0.1637	1.722790	(4, 40.0)	0.1640

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	4.726373	4	0.3165	1.221847	(4, 40.0)	0.3168
2	5.297086	8	0.7254	0.654655	(8, 36.0)	0.7269
3	7.495537	12	0.8232	0.598828	(12, 32.0)	0.8268
4	13.63759	16	0.6257	0.833800	(16, 28.0)	0.6410
5	18.96348	20	0.5242	0.931812	(20, 24.0)	0.5595
6	24.05384	24	0.4585	0.977177	(24, 20.0)	0.5265

*Edgeworth expansion corrected likelihood ratio statistic.
Source: *Authors' representation based on EViews® test results*

Overall conclusion for the models tested in this stage: similar behavior, all models can be used for the subsequent steps, but final results are to be interpreted with caution.

VAR - independent variable: NRE

This model cannot be used for testing against Granger causality, as there serial correlation was present up until lag length (1, …, 10), as seen in table 8.

Table 8: *VAR (NRE, GDPCE) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 29

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	10.80615	4	0.0288	4.176992	(4, 10.0)	0.0304
2	3.819375	4	0.4310	1.037806	(4, 10.0)	0.4347
3	3.222484	4	0.5213	0.850950	(4, 10.0)	0.5246
4	6.276873	4	0.1794	1.923431	(4, 10.0)	0.1830
5	10.29866	4	0.0357	3.875945	(4, 10.0)	0.0374
6	1.986781	4	0.7382	0.494889	(4, 10.0)	0.7402
7	3.436914	4	0.4875	0.916913	(4, 10.0)	0.4910
8	7.153416	4	0.1280	2.290339	(4, 10.0)	0.1313
9	5.384344	4	0.2501	1.578693	(4, 10.0)	0.2539
10	5.352828	4	0.2530	1.567024	(4, 10.0)	0.2568
11	4.824716	4	0.3058	1.376378	(4, 10.0)	0.3097

Source: *Authors' representation based on EViews® test results*

VAR - independent variable: NRR

The model displays proper "no serial correlation" results when the lag length is expanded by two units (1,..., 5, see Table 9). Given the high number of lags, the model becomes, as in the previous cases, unstable. The results are not multivariate normal, but there is no heteroskedasticity.

Table 9: *VAR(NRR, GDPCR) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	5.322210	4	0.2558	1.386120	(4, 40.0)	0.2561
2	0.428871	4	0.9800	0.105152	(4, 40.0)	0.9801
3	5.714377	4	0.2215	1.495551	(4, 40.0)	0.2218
4	8.775756	4	0.0670	2.386757	(4, 40.0)	0.0671
5	1.867866	4	0.7600	0.466114	(4, 40.0)	0.7602
6	0.750933	4	0.9449	0.184842	(4, 40.0)	0.9449

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	5.322210	4	0.2558	1.386120	(4, 40.0)	0.2561
2	9.519687	8	0.3004	1.244092	(8, 36.0)	0.3027
3	19.87673	12	0.0695	1.896597	(12, 32.0)	0.0736
4	19.72367	16	0.2329	1.324521	(16, 28.0)	0.2500
5	21.35527	20	0.3765	1.092060	(20, 24.0)	0.4142
6	23.15094	24	0.5109	0.925205	(24, 20.0)	0.5764

*Edgeworth expansion corrected likelihood ratio statistic.
Source: *Authors' representation based on EViews® test results*

Unlike the model designed for EU, this model can be used, under the restrictions described, for testing Granger causality according to the research hypothesis.

VAR - independent variable: NRS

The model can be corrected from the autocorrelation issue by raising the maximum lag to 5 (Table 10). This model is not stable and there is no normal distribution of residuals, while the heteroskedasticity test is compliant with the proper results.

Table 10: *VAR(NRS, GDPCS) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	9.247218	4	0.0552	2.530015	(4, 40.0)	0.0554
2	7.030699	4	0.1343	1.870609	(4, 40.0)	0.1345
3	2.713362	4	0.6069	0.684186	(4, 40.0)	0.6071
4	5.742966	4	0.2192	1.503570	(4, 40.0)	0.2195
5	5.938845	4	0.2038	1.558660	(4, 40.0)	0.2040
6	0.795495	4	0.9391	0.195918	(4, 40.0)	0.9391

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	9.247218	4	0.0552	2.530015	(4, 40.0)	0.0554
2	13.74781	8	0.0886	1.901839	(8, 36.0)	0.0901
3	16.63549	12	0.1638	1.513859	(12, 32.0)	0.1702
4	17.53883	16	0.3516	1.138465	(16, 28.0)	0.3702
5	20.53430	20	0.4250	1.035742	(20, 24.0)	0.4625
6	21.25295	24	0.6238	0.820767	(24, 20.0)	0.6809

*Edgeworth expansion corrected likelihood ratio statistic.
Source: *Authors' representation based on EViews® test results*

VAR - independent variable: NTE

This model can be used for further testing, as the serial correlation has been "cleaned" when the maximum lag has been updated to 5 (Table 11). The results that are to be achieved in the last step will be interpreted with due caution.

Table 11: *VAR(NTE, GDPE) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	2.774101	4	0.5963	0.700025	(4, 40.0)	0.5965
2	5.037601	4	0.2835	1.307355	(4, 40.0)	0.2837
3	3.045338	4	0.5503	0.771046	(4, 40.0)	0.5505
4	7.011791	4	0.1353	1.865136	(4, 40.0)	0.1355
5	3.519453	4	0.4749	0.896323	(4, 40.0)	0.4752
6	6.601520	4	0.1585	1.746999	(4, 40.0)	0.1588

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	2.774101	4	0.5963	0.700025	(4, 40.0)	0.5965
2	10.42211	8	0.2366	1.378554	(8, 36.0)	0.2389
3	17.27135	12	0.1397	1.586324	(12, 32.0)	0.1456
4	21.09508	16	0.1749	1.447382	(16, 28.0)	0.1903
5	26.30784	20	0.1559	1.463201	(20, 24.0)	0.1856
6	33.48786	24	0.0942	1.621188	(24, 20.0)	0.1380

*Edgeworth expansion corrected likelihood ratio statistic.
Source: *Authors' representation based on EViews® test results*

VAR - independent variable: NTR

This model offered the best responses to the test procedures. As in the previous cases, the serial correlation was eliminated at lag length (1, …, 5, see Table 12), the model is not stable, the "normality of residuals" is not demonstrated (even if the test produced the best results), and there is no heteroskedasticity.

Table 12: *VAR(NTR, GDPR) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	1.858342	4	0.7618	0.463683	(4, 40.0)	0.7619
2	1.457881	4	0.8341	0.361978	(4, 40.0)	0.8342
3	5.251190	4	0.2625	1.366414	(4, 40.0)	0.2628
4	4.893148	4	0.2984	1.267587	(4, 40.0)	0.2987
5	1.465984	4	0.8326	0.364026	(4, 40.0)	0.8327
6	0.994227	4	0.9107	0.245459	(4, 40.0)	0.9107

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	1.858342	4	0.7618	0.463683	(4, 40.0)	0.7619
2	7.559162	8	0.4777	0.962475	(8, 36.0)	0.4799
3	15.56592	12	0.2119	1.394741	(12, 32.0)	0.2190
4	15.54292	16	0.4853	0.978356	(16, 28.0)	0.5033
5	19.58667	20	0.4840	0.972453	(20, 24.0)	0.5205
6	26.50761	24	0.3279	1.126310	(24, 20.0)	0.3970

*Edgeworth expansion corrected likelihood ratio statistic.
Source: *Authors' representation based on EViews® test results*

VAR - independent variable: NTS

The VAR defined for Serbia (total nights of accommodation) has the same behavior: no the serial correlation for lag length (1, …, 5, see Table 13), no stability or normal distribution for the residuals, and a good response to heteroskedasticity tests.

Table 13: *VAR(NTR, GDPR) Residual Serial Correlation Tests results*
Sample: 2012Q1 2021Q3
Included observations: 34

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	0.820881	4	0.9356	0.202233	(4, 40.0)	0.9357
2	7.219303	4	0.1247	1.925341	(4, 40.0)	0.1250
3	1.465262	4	0.8328	0.363844	(4, 40.0)	0.8329
4	3.389208	4	0.4949	0.861764	(4, 40.0)	0.4952
5	6.624925	4	0.1571	1.753707	(4, 40.0)	0.1573
6	2.084164	4	0.7203	0.521475	(4, 40.0)	0.7204

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	0.820881	4	0.9356	0.202233	(4, 40.0)	0.9357
2	7.092406	8	0.5267	0.897490	(8, 36.0)	0.5288
3	8.447956	12	0.7492	0.683977	(12, 32.0)	0.7540
4	10.20852	16	0.8555	0.592662	(16, 28.0)	0.8629
5	15.97242	20	0.7183	0.747087	(20, 24.0)	0.7441
6	17.84384	24	0.8105	0.648509	(24, 20.0)	0.8451

*Edgeworth expansion corrected likelihood ratio statistic.
Source: *Authors' representation based on EViews® test results*

Testing for Granger causality

The models have been augmented with the additional number of lags identified as the maximum order of integration, and then the Modified Wald test has been applied. The results are presented in Table 14.

Table 14: *Granger causality test*

Independent variable	Initial lag length	Additional number of lags	MWald test	p-value
NFE	2	3	6.036985	0.3026
NFR	3	2	34.92839	0.0000
NFS	3	2	15.32871	0.0090
NRE	2	-	-	-
NRR	3	3	5.865899	0.3195
NRS	3	2	8.871376	0.1143
NTE	2	2	12.21014	0.0320
NTR	3	3	6.967829	0.2230
NTS	3	2	11.81688	0.0374

Source: *Authors' representation, based on the Wald test results*

For the NFE case, it is found that the reverse of the research hypothesis is demonstrated, that is GDPCE Granger causes the said variable, while the result expected according to the hypothesis is not found, the same conclusion is found in the case of Romania (GDPCR Granger causes NRR). No causality is originating from the variables NRS, NTR).

When the model based on the NFS is tested, the causality is demonstrated to be reciprocal, the same applies for NTE and NTS. The hypothesis is validated (one-way causality) for Romania (NFR independent variable).

Conclusions

The tests for Granger causality produced mixed results, no general conclusion can be drawn. The outputs are to be considered with proper reserve, as the authors have chosen to pursue the opinions of the literature that recommends caution when testing with models that do not behave properly against the specification criteria. Some of the causalities were even bidirectional. Undoubtedly, the values in the datasets have contributed to the achievement of such results. A further direction of research of the authors will be the study of the pre-pandemic period, and the comparison with the outcomes of this paper. As more data become available, these can be capitalized in order to drawn more secure conclusion on the behavior of the variables.

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