Tourism as a long-run **economic growth** factor in Portugal: Evidence from **causality analysis**

JOÃO PAULO CERDEIRA BENTO * [jpbento@ua.pt]
MADALENA SANTOS ** [psantos@iscac.pt]

Abstract | This paper investigates empirically the role of tourism in the Portuguese long-run economic output growth on quarterly data (1997:1 to 2010:4). The augmented Granger causality test approach developed by Toda and Yamamoto (1995) is employed to ascertain the direction of causality between variables in a bi-variate vector autoregressions (VAR) system using the Seemingly Unrelated Regression (SUR) method. The results provide evidence of a strong one-way directional causality between tourism and economic growth and the necessary argument to support the tourism led growth hypothesis. This result has important policy implications for where government investments should be targeted giving a further catalyst to economic growth.

Keywords | economic growth, international tourism, causality analysis.

Resumo | Este artigo faz uma investigação empírica sobre o papel do turismo no crescimento económico de longo prazo em Portugal. Para tal, foram utilizados os dados disponíveis: valores trimestrais de 1997 a 2010. Foi utilizada a análise de causalidade de Granger desenvolvida por Toda e Yamamoto (1995), para verificar a direção da causalidade entre as variáveis, num sistema VAR (" bi-variate vector autoregression") utilizando o método SUR ("Seemingly Unrelated Regression"). Os resultados evidenciaram uma importante causalidade unidireccional entre o turismo e o crescimento económico, confirmando a hipótese do setor do turismo gerar crescimento. Este resultado revela-se assim importante em termos de políticas públicas de investimento, mostrando como o turismo pode ser catalisador de crescimento económico.

Palavras-chave | crescimento económico, turismo internacional, análise de causalidade.

* **PhD in Economics** by the University of Reading, United Kingdom, **Member** of the Research Unit in Governance, Competitiveness and Public Policy (GOVCOOP) and **Assistant Professor** at the Department of Economics, Management and Industrial Engineering (DEGEI), University of Aveiro, Portugal.
** **PhD candidate** in Tourism, **Member** of the Research Unit in Governance, Competitiveness and Public Policy (GOVCOOP) at the University of Aveiro, and **Assistant Professor** at Instituto Politécnico de Coimbra (ISCAC), Coimbra, Portugal.

1. Introduction

The tourism sector has begun to have a high relevance in the national economy only in the sixties. Tourism is an important economic activity that has not only allowed for the creation of numerous direct and indirect jobs, but has also become the country's largest domestic exporter. In 2009, tourism expenditure accounted for about 14.6% of total Portuguese exports of goods and services. Statistics have revealed that tourism has contributed about 5% of the country's Gross Domestic Product. Tourism brings in about approximately 12 million visitors every year.

According to empirical evidence from single-country studies, the relationship of long-run economic growth and tourism can run strongly in one-way (Balaguer and Cantavella, 2002; Brida, Carrera and Risso, 2008), but is also present in two-ways (Dritsakis, 2004). These authors have assessed the so-called Tourism Led Growth Hypothesis (TLGH), which views international tourism as a key strategic factor for economic growth, mainly through cointegration and error correction techniques (Johansen, 1995) and causality testing (Granger, 1988).

The present study contributes to the previous empirical literature. The main contribution is in *growth accounting*, which attempts to quantify the contribution of different determinants of output growth, by analysing the role of tourism for economic growth in Portugal. The rationale behind is that tourism is an important source and integral part of economic growth for any country. This study investigates causal relationships between economic growth, proxied by the gross domestic product, and the aggregate expenditure by international tourist arrivals, a proxy for the tourism variable, using quarterly data that span from 1997:1 to 2010:4. This research is conducted with the augmented causality testing procedure proposed by Toda and Yamamoto (1995) to test the hypothesis that tourism is an important determinant of long-run output growth. A bi-variate VAR model is employed to pose the research questions or the following causal hypothesis: do international tourism expenditure cause economic growth and does economic growth cause international tourism expenditure?

Another equally important contribution is the extension of the econometric methodologies employed so far in this kind of studies to improve the power of the Granger causality test. The main interest of this study is not in the co-integrating relationship, but in the hypothesis test or the significance of coefficients of a VAR model formulated in levels to test general restrictions on the parameter matrices. Toda and Yamamoto procedure is a methodology of statistical inference, which makes parameter estimation valid even when the VAR system is not cointegrated. This method does not require whether the series are stationary or not, and it takes account of the fact that the included variables are integrated of an arbitrary order. Furthermore, Toda and Phillips (1993) have claimed that testing for causality with error correction models still contains the possibility of incorrect inference, because the models depend on a number of nuisance parameters and their non standard nature (Zapata and Rambaldi, 1997).

The paper is organized in the following way: section 1 reports a survey of the existing literature including empirical evidence on the nature of the causal relationship between economic growth and tourism. Section 2 presents the variables and data descriptions, and discusses the econometric methodology to be employed. The empirical results are presented in section 3. Finally, section 4 reports the conclusions and policy implications.

2. Data, model specification and econometric methodology

This study employs the Toda and Yamamoto (1995) augmented Granger causality procedure, where an n-vector time series $\{y_t\}$ sequence is generated by the following linear function:

$$y_t = \beta_0 + \beta_1 t + \dots + \beta_q t^q + \eta_t \qquad (1)$$

Let $\{\eta_t\}$ sequence be a vector autoregression with k, the optimal lag length, and ε_t, a random vector, such as

$$\eta_t = J_1\eta_{t-1} + \dots + J_k\eta_{t-k} + \varepsilon_t \qquad (2)$$

Transforming (1) into $\eta_t = y_t - \beta_0 + \beta_1 t + ... + \beta_q^{t^q}$ and then substituting it into (2), we obtain the following equation:

$$y_t = \gamma_0 + \gamma_1 t + \dots + \gamma_q t^q + J_1 y_{t-1} + \dots + J_k y_{t-k} + \varepsilon_t \qquad (3)$$

If the order of integration $d > 0$, then the order of polynomial trend γ in equation (3) might be lower than order q of the polynomial in (1). Let's assume, for $\gamma_{s+1} = \dots = \gamma_q = 0$ for some $s > q$, depending on the structure of β_i's and J_h's, that for illustrative purposes d=1 and q=1, i.e. $\gamma_2 = \gamma_3 = \gamma_q = 0$in equation (3), then equation (1) becomes:

$$y_t = \gamma_0 + \gamma_1 t + J_1 y_{t-1} + \dots + J_k y_{t-k} + \varepsilon_t \qquad (4)$$

The interest of the Toda and Yamamoto approach is not in the VAR's stationary position, that is, whether the process $\{y_t\}$ is integrated, cointegrated or stationary, but instead in testing the significance of coefficients of lagged y in equation (4). The null hypothesis is to jointly test vector J:

$$H_0 : J_1 = J_1 = \dots = J_k = 0$$

To test the above hypothesis, we consider estimating the following levels VAR:

$$y_t = \hat{\gamma}_0 + \hat{\gamma}_1 t + ... + \hat{\gamma}_q t^q + \hat{J}_1 y_{t-1} + ... + \hat{J}_k y_{t-k} + ... + \hat{J}_p y_{t-p} + \hat{\varepsilon}_t \quad (5)$$

Where circumflex above coefficients represent estimated value by ordinary least squares (OLS), $t = 1,\dots T$ and $p \geq k+d$. Equation (5) includes at least d more lags than the true lag length k in equation (4). Because k is assumed to be the optimal lag length, the coefficients of additional lag are indifferent from zero. Hence, the null hypothesis remains unchanged. The authors have established the statistical proprieties of the null hypothesis through the estimation of equation (5). They constructed a standard Wald statistic to test the null hypothesis and proved that it has an asymptotic chi-square distribution with m degrees of freedom if $p \geq k+d$. More importantly, this asymptotic propriety does not depend on whether equation (5) is integrated or cointegrated.

This implies that a $(k + d_{max})$ th order VAR model can be estimated, where d_{max} is the maximal order of integration, and then jointly test k order lagged coefficients. Little attention has to be paid to integration and cointegration proprieties, so we do not have to test for cointegration rank or transform a VAR into a vector error correction model (VECM) since tests involved with testing for cointegration are known to have low power. The Toda and Yamamoto approach is not without drawbacks, since it intentionally over-fits VAR's. The relative inefficiency depends on the model employed. If the VAR system has a small number of variables and the true lag length is one, then the inefficiency caused by adding one extra lag might be relatively big. Thus, if the VAR system has a small number of variables, which is the case in this study, and possess long lag length, as it is often the case in practice, then the inefficiency caused by adding a few more lags might be relatively small. For instance, if the latter is the case, the preset biases associated with the unit root and cointegration tests, could become more serious.

The advantage of the Toda and Yamamoto is that it is a simple procedure enabling the estimation of an augmented VAR $(k + d_{max})$ model, even where there is cointegration, which assures that the modified Wald (MWald) statistic is asymptotically distributed as chi-square with usual degrees of freedom and this does not depend on whether y_t is stationary, integrated of order one or two, or on whether y_t is cointegrated or not.

Prior to causality testing, we take on in determining the optimal lag length k in the original

VAR system and the maximal order of integration of the variables d_{max} which is expected to occur in the VAR model. The procedure then employs a MWald statistic for zero restrictions on the parameters of the original VAR(k) model. The coefficient of the last lagged d_{max} vectors is ignored in the VAR system. The MWald statistic has, as mentioned earlier, an asymptotic chi-square distribution when the augmented VAR ($k + d_{max}$) model is estimated. For $d = 1$, the lag selection procedure is always asymptotically valid since $k \geq 1 = d$. If $d = 2$, then the procedure is valid unless $k = 1$.

This study adopts Rambaldi and Doran (1996) in formulating the Toda and Yamamoto test of Granger causality into a seemingly unrelated regression (SUR) form. Let variables entering the model, GDP and ITE, be denoted by X and Y respectively. Employing the SUR framework, a bi-variate VAR model is estimated as follows:

$$\begin{bmatrix} \ln X_t \\ \ln Y_t \end{bmatrix} = A_0 + A_1 \begin{bmatrix} \ln X_{t-1} \\ \ln Y_{t-1} \end{bmatrix} + \ldots + A_k \begin{bmatrix} \ln X_{t-k} \\ \ln Y_{t-k} \end{bmatrix} + \\ + A_{k+1} \begin{bmatrix} \ln X_{t-k-1} \\ \ln Y_{t-k-1} \end{bmatrix} + \ldots + \\ + A_{k+d} \begin{bmatrix} \ln X_{t-k-d} \\ \ln Y_{t-k-d} \end{bmatrix} + \begin{bmatrix} \varepsilon_X \\ \varepsilon_Y \end{bmatrix} \quad (6)$$

In the above system of equations, A's are the two by two matrices of coefficients with A_0 as an identity matrix.

The causal relationship between the two variables can be investigated with equation 6. To test the hypothesis that there is "no Granger causality from Y to X", the null hypothesis is stated $H_0 : \alpha_{12}^{(1)} = \alpha_{12}^{(2)} = \ldots = \alpha_{12}^{(k)} = 0$, where the coefficients of Y are $\alpha_{12}^{(k)}$ in the first equation of the system. If the null hypothesis is rejected, then there is a one-way causality running from Y to X, so one can infer that Y affects X. The alternative null hypothesis that reverses the causal direction is $H_0 : \alpha_{12}^{(1)} = \alpha_{12}^{(2)} = \ldots = \alpha_{21}^{(k)} = 0$, where the coefficients of X in the second equation of the system are $\alpha_{21}^{(k)}$. Similarly, if the null hypothesis is rejected, there is a one-way directional causality of X to Y. If both null hypotheses are rejected, X and Y have a causal relationship in both directions. In all cases, rejecting the above null hypothesis requires finding the significance of the MWald statistic for the group of the lagged variables.

Before testing for Granger causality, centring on the unit root null hypothesis and model selection criteria are necessary to choose appropriately *dmax* and k, respectively. The augmented Dickey-Fuller (ADF) stationary test, proposed by Dickey and Fuller (1979), is employed to find the order of integration of the time series. The Dickey and Pantula (1987) procedure is used to test for the order of integration against higher order of integration. The test results are cross checked by computing the Phillips-Perron (PP) test for the null hypothesis that the time series have a unit root. The Phillips-Perron (1988) test is robust to general forms of heteroskedasticity, accommodates a possible fitted drift and time trend and corrects for any serial correlation in the errors of the regression.

The selection of an optimal value for k the unknown lag length of the VAR model is done with traditional information criteria for lag length selection, such as the Akaike information criterion (AIC), Bayesian information criterion, also known as Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ). A model with a smaller information criterion is ranked as a better model.

This study uses quarterly GDP and ITE data (1997:1 to 2010:4). The selection of the data periodicity has been dictated by data availability and compatibility rather than by other choice. GDP is gross domestic product and ITE is seasonally adjusted international tourism expenditure. Both variables are expressed in constant prices (2000=100) and in logarithmic form prior to estimations. The data has been compiled from two data sources on the internet. Data series of international tourism expenditure is from EUROSTAT Statistics Database (2012) and data series of GDP is from the *BPStat – Online Statistics* service developed by the Bank of Portugal (2012).

3. Empirical results

To determine the order of integration between variables, denoted I(d), the Philips-Perron (PP) unit root test is computed on both the levels and the first differences of the series with the null hypothesis that one variable has a unit root against a stationary alternative. Table 1 shows the stationary status of the series on their level and first difference forms, reports the unit root test results and the critical values, when the unit-root test equation only includes an intercept term and then both a time trend and a constant.

The results show that the null hypothesis of a unit root can be rejected when the PP test is applied to first differences of all variables. Thus, the null hypothesis of a unit root can only be rejected in the case of ITE in level form. Hence, ITE is integrated of order zero. Both ADF and PP test statistics report that the level of GDP is not stationary indicating that this variable is in fact integrated of order one.

Lag order selection criteria such as the sequential modified LR test statistic (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC), Hannan-Quinn information criterion (HQ) are used to determine the appropriate maximum lag length of the variables in the VAR. Table 2 reports the results of the optimal lag length search among lags from zero up to eight. LE, FPE, AIC, SC and HQ information criterion indicate that the appropriate lag order of the bi-variate VAR(k) is four.

The Granger causality procedure developed by Toda and Yamamoto (1995) is used to establish the direction of causality between the variables used in this study. Table 3 reports the optimal lag length (k), the VAR order ($k + d_{max}$), the MWald statistics, the p-values and direction of causality for the bi-variate VAR model. The Granger causality tests results reported in Table 3 suggest that the null hypothesis of "Granger no-causality from International Tourism

Table 1 | Unit root test results

Variable	ADF test: With intercept term	ADF test: With trend and intercept	PP Test: With intercept term	PP Test: With trend and intercept	Integration order I(d)
GDP	-2.64 *	-2.99	-2.97 **	-2.37	1
ΔGDP	-2.21	-2.39	-10.75 ***	-14.91 ***	
ITE	-2.07	-2.26	-7.71 ***	-10.43 ***	0
ΔITE	-24.75 ***	-24.76 ***	-39.56 ***	-41.66 ***	
CV 1%	-3.56	-4.14	-3.55	-4.13	
CV 5%	-2.91	-3.50	-2.91	-3.49	
CV 10%	-2.59	-3.17	-2.59	-3.17	

Note: ***, **, * denotes 1%, 5% and 10% significance level, respectively.
Source: own construction.

Table 2 | Optimal lag length selection test results

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.000335	-2.32	-2.24	-2.29
1	66.14	9.11e-05	-3.62	-3.39	-3.54
2	77.32	1.78e-05	-5.26	-4.87	-5.11
3	15.24	1.46e-05	-5.46	-4.91	-5.25
4	19.67*	1.04e-05*	-5.80*	-5.11*	-5.53*
5	5.63	1.07e-05	-5.78	-4.93	-5.46
6	2.54	1.19e-05	-5.69	-4.68	-5.31
7	4.08	1.26e-05	-5.65	-4.48	-5.21
8	7.25	1.20e-05	-5.71	-4.39	-5.21

Notes: * indicates lag order selection by the criterion LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterionSource: Own construction
Source: own construction.

Table 3 | Toda and Yamamoto causality test results

Null hypothesis	Lag (k)	$k + d_{\max}$	MWald statistics	p- values	Direction of causality
ITE does not Granger cause GDP	4	$4 + 1 = 5$	12.99 ***	0.01	ITE $\longrightarrow$ GDP
GDP does not Granger cause ITE	4	$4 + 1 = 5$	6.51	0.16	No causality

Notes: The (k+$d_{\max}$) denotes the *th*-order VAR, where $d_{\max}$ is the maximal order of integration of variables. The order of integration $m = 1$ and does not exceed the true lag length of the VAR model. ***, **, * denotes 1%, 5% and 10% significance level, respectively. The lag length selection results are reported in Table 2. The symbol $\longrightarrow$ relates to one-way causality and the symbol $\longleftrightarrow$ refers to two-way causality.
Source: own construction.

Expenditure to GDP" can be rejected at the one, five and ten percent significance level, respectively. Thus, the test result fails to reject the null hypothesis of "Granger no-causality from GDP to International Tourism Expenditure".

These results indicate that there is unidirectional causality between ITE and GDP. Furthermore, the causality between ITE and GDP is strong at one, five or ten percent significance level. This confirms earlier findings on the Tourism Led Growth Hypothesis and prior beliefs that GDP is boosted by some internal factors. The implication here is that policy makers can use ITE as a leading indicator for future growth in GDP.

4. Conclusions

The test results obtained from the Toda and Yamamoto (1995) procedure to test for Granger causality, based upon quarterly data in a bi-variate VAR system, point to a statistically significant one-way directional causality from tourism to economic growth. This means that sustainable tourism growth would boost the sector's contribution to economic growth. Moreover, the results do not support any feedback causality relationships, so only tourism seems to affect economic growth in Portugal.

If we take dim view of *previous* empirical research or *earlier* articles in the domain, the current research has shown comparable and similar results, because it can be inferred that international tourism expenditure affects economic growth in a unidirectional way. For that reason, the tourism-led growth hypothesis is confirmed suggesting that tourism is an important factor of long-run economic growth.

Finally, the findings of this study have important policy implications while designing and implementing public interventions in future. Economic growth performance can be improved in Portugal by harnessing the contribution of the tourism sector, and even if some public intervention is desirable, it is highly recommended in the promotion and development of a country as a tourism destination, but also to identify factors likely to be of importance in tourism supply.

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