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Tourism foreign direct investment led tourism gross value added: a co-integration and causality analysis of Croatian tourism

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ABSTRACT

The purpose of this study was to investigate the causal relationship between foreign direct investment in tourism and tourism gross value added in Croatia. The study employed econometric techniques, such as the unit root test, Johansen co-integration, and the Granger causality test, in a vector error correction model (V.E.C. model), and the Toda–Yamamoto causality test in a vector autoregressive model (V.A.R. model), using quarterly time-series data from 2000(1) to 2012(4). The results confirm the existence of a stable co-integrated relationship between variables in the long term. A short-term relationship was also proved between foreign direct investment in tourism and gross value added, using the Toda–Yamamoto causality test. By including control variables, the two-way causality between the subject variables was proven using the Granger causality test.

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JEL CLASSIFICATIONS

F21; L83; C22

Introduction

Despite the volatility of the tourism sector, Croatia is among those countries the economies of which are extremely dependent on tourism. Given the World Travel and Tourism Council's (W.T.T.C., 2011) forecasts, the situation will not change significantly in the future¹ Due to the non-investment activity in the Croatian economy since the onset of the global financial crisis, which refers to the lack of domestic capital, but also the reluctance of foreign investors, it seems logical to assume that further development of Croatian tourism needs foreign direct investment (F.D.I.).

The above-mentioned situation is consistent with The Master Plan and Strategy for the Development of Croatia's Tourism by 2020 (Institut za turizam, 2012), which states that tourism will be recognised as a priority economic activity by 2020. In that study, several possible scenarios for the development of Croatian tourism by 2020 are elaborated. A scenario that it is important to address, bearing in mind the topic of this paper, is that of major development investments. This scenario puts emphasis on the construction of new

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accommodation and other tourism capacity, especially in major cities along the coast, but also in larger complexes outside existing urban centres, or within defined development zones. Croatia needs to be more open to foreign investors and to increasing construction of new, large hotels and other big tourist facilities.

Given the importance of tourism to the Croatian economy, the authors recognised the necessity for testing the F.D.I.-led tourism growth hypothesis on the example of Croatia. Although there are a plethora of papers that have examined the effects of F.D.I. on the Croatian economy (Babić, Pufnik, & Stučka, 2001; Hunya & Škudar, 2006; Jovančević, 2007; Kersan-Škabić & Zubin, 2009; Lovrinčević, Butorac, & Marić, 2004; Lovrinčević, Mikulić, & Marić, 2004; Sisek, 2005), only a small number of papers deal with the topic of F.D.I. in Croatian tourism (Bezić, Nikšić Radić, & Kandžija, 2010; Kunst, 2011; Perić & Nikšić Radić, 2011). This clearly indicates that it is important to investigate the effects of F.D.I. on tourism, and particularly the long- and short-term relationships between F.D.I. in tourism and tourism gross value added.

It should be emphasised that each country has its own particularities, which should be acknowledged, and integrated into a wider socio-economic context (Surugiu & Surugiu, 2013). In addition, it cannot be claimed that the F.D.I.-led tourism growth hypothesis is valid for each every country. Although there are contradictions when testing the hypothesis, it should be borne in mind that any such research enriches the literature of regarding the potential contribution of F.D.I. in tourism. It is also necessary to mention that, given the fact that the effects of investment differ depending on the sector, the authors recognise the need to research the impact of F.D.I. on tourism productivity.

The aim of this paper is to explore the causal relationship between the F.D.I. stock in tourism and tourism gross value added in the Republic of Croatia from 2000 to 2012. The study is limited to an analysis of data in the stated period, due to the lack of data for the period prior to 2000. It is also necessary to point out that short time sequences are characteristic of research related to the region of south-eastern Europe. This paper will examine the co-integration and causality between F.D.I. in tourism and tourism gross value added by employing the Johansen co-integration test, and the Granger causality test, in the vector error correction (V.E.C.) model, and the Toda–Yamamoto causality test in the vector autoregressive (V.A.R.) model. Also, to ensure the reliability of our results, Granger and Toda–Yamamoto causality will be tested by including specific control variables, such as the index of corruption control, the index of political stability, the exchange rate, and education.

Causality testing between selected variables has not been carried out on the example of Croatia, which is one of the main contributions of this work. Another contribution of this paper is that, according to the authors, there is also, at the global level, no research based on the causality of F.D.I. stock in tourism and the tourism gross value added. The majority of research conventionally uses the inflows of F.D.I. in tourism. Even though the use of data in the form of flows can result in empirical estimates that are accurate (given the sign and significance that flows have in building the F.D.I. stock), the use of data in the form of flows is not consistent with the F.D.I. theory, and it is not likely that the coefficients will be of appropriate size (Ford, Rork, & Elmslie, 2008). Additionally, growth-enhancing spillover should not just occur from recent F.D.I. inflows, but also from F.D.I. established much earlier (Nunnenkamp & Spatz, 2004). There is also no research related to F.D.I.-led tourism growth hypothesis, based on the Toda–Yamamoto causality test, and so this is a third contribution of this paper. Lastly, considering the importance given to F.D.I.

in tourism, and expectations of the Croatian government for further entry of foreign capital into the Croatian tourism sector, research findings have significant, wide-ranging socio-economic implications. The fact that there are no uniform results from previous research on causality between F.D.I. and tourism growth clearly points out the need for analysis of such on a concrete example. In order to establish such effects, this study is based on the example of Croatia.

The rest of the study is organised as follows: Section 2 describes the literature review on the subject topic; data and the methodological framework are described in Section 3; section 4 concerns interpretation of results; and, finally, conclusions and policy implications are drawn in Section 5.

Review of literature

A large body of literature is related to the general effects of F.D.I. on economic growth. Despite that, research results are still unclear and, thus, open to further research. It is possible to substantiate the positive results of this research (Asteriou, Dassiou, & Glycopantis, 2005; Borensztein, De Gregorio, & Lee, 1998; Mlinarević, 2004), but there are also negative results (Mencinger, 2003). The situation is even more complicated if the research is brought to the level of the sector, because the effects can vary, depending on whether this is a primary, secondary, or tertiary sector (UNCTAD, 2001, p. 138). In 1958, Hirschman concluded that not all sectors have the same potential to absorb foreign technology and connectivity as the rest of the economy (Hirschman, 1958, p. 109). Numerous recent studies have proven the different impacts of F.D.I. on the productivity of each sector (Alfaro, 2003; Cipollina, Giovannetti, Pietrovito, & Pozzolo, 2012; Tondl & Fornero, 2010).

With respect to tourism as a part of the tertiary sector, and despite the continuing increase in the volume of tourist travel (increase in the number of tourists, growth rates, and growth in tourism revenues), and the growth of F.D.I. over the past 20 years, the area relating to F.D.I. in the tourism sector remains practically unstudied. The initial research on the effects of transnational corporations on tourism is the work of Dunning and McQueen (1982). They concluded that the effects of foreign-owned hotels varied, depending on the type of tourism, the transnational corporations' country of origin, the host country, and the advantages and objectives of individual transnational corporations. Sinclair and Stabler (1991) argued that F.D.I. in tourism is a neglected area in studies related to tourism. Zhang (1999), who is considered a pioneer in the field of research on F.D.I. in tourism, believed that his research would be significant enough to spur further research in this area. The World Tourism Organisation (W.T.O.) has stressed that F.D.I. and tourism have only recently been defined and explained, so F.D.I. in tourism is considered a new, and little explored, area (U.N.W.T.O., 1999).

Recent research regarding the impact of F.D.I. on tourism is based on testing the so-called F.D.I.-led tourism growth hypothesis (Salleh, Othman, & Sarmidi, 2011, p. 251). This may indicate that F.D.I. preceding tourism growth is in some way associated with F.D.I., and not only that the change in the tourism growth is a result of changes in the level of F.D.I. Study of the long- and short-term relationships between F.D.I. and tourism growth could be conducted using the co-integration and causality tests. Such research methodology is very common in papers dealing with the tourism-led growth hypothesis, with respect to the issue of causality tests between tourism development and economic

growth, exemplified by particular destination (Arslanturk, Balcilar, & Ozdemir, 2011; Belloumi, 2010; Bouzahzah & El Menyari, 2013; Schubert, Brida, & Risso, 2011; Surugiu & Surugiu, 2013), or a panel of countries (Aslan, 2014; Caglayan, Sak, & Karymshakov, 2012; Fourie & Santana-Gallego, 2011; Mello-Sampayo & Sousa-Vale, 2012). As far as papers related to F.D.I.-led tourism growth hypothesis are concerned (Salleh et al., 2011), with respect to the issue of causality tests between F.D.I. and tourism development, the same research methodology is used. Nevertheless, this represents a significantly smaller number of studies. Existing studies indicate different results for the association of tourism development and F.D.I., those in total and those aimed at tourism. Most of the research has proved a one-way causal relationship between F.D.I. and tourism growth (Bezić et al., 2010; Samimi, Sadeghi, & Sadeghi, 2013; Selvanathan, Selvanathan, & Viswanathan, 2012; Tang, Selvanathan, & Selvanathan, 2007). There is also one-way causality running from tourism growth to F.D.I. (Katircioglu, 2011; Khoshnevis Yazdi, Homa Salehi, & Soheilzad, 2015), as well as evidence of a two-way link between the observed variables (Othman, Salleh, & Sarmidi, 2012; Salleh et al., 2011).

Even though the amount of scientific papers that explore the relationship between tourism growth and F.D.I. in tourism have increased in the last few years, that number is still relatively small. Given the diversity of research results, and the fact that, according to the authors' knowledge, testing causality between selected variables in the case of Croatia has not been carried out so far, stated justified the purpose of research.

Data and methodological framework

This research employs quarterly time-series data from 2000(1) to 2012(4) in order to investigate the causal relationship between F.D.I. in tourism and tourism gross value added in Croatia. A variable for F.D.I. stock in tourism (F.D.I.-T) was obtained from the Croatian National Bank. The variable is deflated by the implicit deflator of gross investment, and reduced to the base year 2005. A variable for tourism gross value added (T.G.V.A.) was also obtained from the Croatian National Bank. This variable is deflated by the implicit GDP deflator, and reduced the base year 2005, and is seasonally adjusted (Census X-12). The productivity of the tourism sector is seen through the level of gross value added in the tourism sector² Both variables are in logarithm form.

As a first step of empirical analysis, a unit root test is conducted to determine the stationarity of the time-series data. Most of the time-series variables are non-stationary, and the use of such data leads to spurious regression, which cannot be used to get objective and accurate results from. The order of integration of the variables included in the model is determined by using the Augmented Dickey–Fuller (A.D.F.) test.

If the first step indicates that both variables are non-stationary, it is possible that there are short- and long-term relationships between the variables, so the second step examines their co-integration, using the Johansen co-integration test. The important pre-condition that needs to be fulfilled in applying the Johansen co-integration test is that the data must be of the same stationarity order. The V.A.R. model should also be very well specified before it approaches testing the co-integration. This requires selection of the optimal lag length through the usual information criteria, and evaluation of the quality of the model itself. Selection of the optimal lag length is crucial for the reliability of V.A.R. models (Liu, 2005).

The quality of the V.A.R. model will be verified by testing the normality of the distribution (Jarque-Bera test), the serial correlation (Lagrange multiplier [L.M.] test), and the heteroscedasticity (White's test) of the residuals.

Thirdly, if variables are integrated of order one, $I(1)$, and there is no stable co-integration relationship between them, the V.A.R. model is built. Studies using a V.A.R. model in a situation where there is co-integration between the variables in the model are actually incorrectly specified. This is also the reason why this study first tests whether there is co-integration between the variables. If the variables have the same order of integration, and if the co-integration is established between them, the V.E.C. model will be assessed. The V.E.C. model is also called a restricted V.A.R. model. The V.E.C. model shows the long- and short-term relationships between the variables. The main purpose of the V.E.C. model is to emphasise the speed of adjustment of a short-term balance to a long-term equilibrium. Economic theory assumes that there is a tendency towards equilibrium that prevents the individual time-series to stray too far. Such a co-integration provides a so-called error correction model (E.C.M.). A lagged error correction term (ECT_{t-1}) should have a negative value, indicating the return to the equilibrium state, and have a value ranging from 0 to 1, where 0 indicates no adjustments, while 1 indicates the total adjustment after a period of time.

As part of the evaluation of the V.E.C. model, the following models are specified:

$$\begin{aligned} \Delta \log b dv_{-t} = & a_0 + a_1 \Delta \log b dv_{-t-1} + \dots + a_p \Delta \log b dv_{-t-p} \\ & + b_1 \Delta \log f di_{-t-1} + \dots + b_p \Delta \log f di_{-t-p} + \lambda_1 ECT_{t-1} + u_t \end{aligned} \quad (1)$$

$$\begin{aligned} \Delta \log f di_{-t} = & c_0 + c_1 \Delta \log f di_{-t-1} + \dots + c_p \Delta \log f di_{-t-p} \\ & + d_1 \Delta \log b dv_{-t-1} + \dots + d_p \Delta \log b dv_{-t-p} + \lambda_2 ECT_{t-1} + v_t. \end{aligned} \quad (2)$$

where $\log f di_{-t}$ and $\log b dv_{-t}$ are, respectively, the logarithmic form of the F.D.I. in tourism and tourism gross value added in Croatia, Δ is the sign of differentiation, p is the optimal lag length, and ECT_{t-1} is a lagged error correction term.

A small number of observations, usually no more than 40 per country, are a common feature of empirical studies involving causality testing (Zachariadis, 2006), especially in the case of south-eastern Europe. This is also the case in this study. So, finally, in order to reach more reliable conclusions, the authors used two methods of determining causality, regarding a small number of observations. Respectively, the Granger and Toda–Yamamoto causality tests were applied.

Granger causality is possible to express within the set V.E.C. model. Causality in co-integrated systems can be established if, and only if, the ECT_{t-1} , which takes into account long-term dynamics, and the sum of the coefficients of the lagged variables, which takes into account short-term dynamics, are both significant (Asghar, Awan, & Ur Rehman, 2012, p. 139).

The majority of existing papers researching the causality between variables use the standard Granger causality test. The classic Granger causality test is a way to implement the Wald test for the first parameters (p) of other variables in the V.E.C. model, and, if the Wald test is significant, it rejects the null hypothesis of no causality.

This study, as well as the Granger causality test, also uses the modified Granger causality test, or the Toda–Yamamoto causality test (Toda & Yamamoto, 1995). The Toda–Yamamoto

causality test enables a more reliable conclusion to be drawn (Magnus & Fosu, 2008, p. 106). The Toda–Yamamoto test ignores any possible non-stationarity or co-integration between series, when testing for causality and fitting a standard V.A.R. in the levels of the variables (rather than first differences, as is the case with the Granger causality test) (Mavrotas & Kelly, 2001, p. 100). In this way, the risks associated with possibly incorrectly identifying the orders of integration of the series, or the presence of co-integration, are minimised and it also minimises the distortion of the tests' sizes, as a result of pre-testing (Chowdhury & Mavrotas, 2006, p. 4). The Toda–Yamamoto causality test involves estimation of an augmented V.A.R. ($p + m$) model, where p is the optimal lag length in the original V.A.R. system, and m is the maximal order of integration of the variables in the V.A.R. system. When a V.A.R. model is used for purposes other than testing for Granger non-causality, and the series are found to be co-integrated, a V.E.C. model should be used (Giles, 2011).

The Toda–Yamamoto causality test was applied in assessing the following pairs of bi-V.A.R. system:

$$\begin{aligned} \log bdv_{-t} = & a_0 + a_1 \log bdv_{-t-1} + \dots + a_p \log bdv_{-t-(p+m)} + b_1 \log fdi_{-t-1} + \dots \\ & + b_p \log fdi_{-t-(p+m)} + u_t \end{aligned} \quad (3)$$

$$\begin{aligned} \log fdi_{-t} = & c_0 + c_1 \log fdi_{-t-1} + \dots + c_p \log fdi_{-t-(p+m)} + d_1 \log bdv_{-t-1} \\ & + \dots + d_p \log bdv_{-t-(p+m)} + v_t \end{aligned} \quad (4)$$

where $\log fdi_{-t}$ and $\log bdv_{-t}$ are, respectively, logarithmic forms of the F.D.I. in tourism and tourism gross value added in Croatia, p is the optimal lag length, and m is maximal order of integration of the variables in the V.A.R. system.

In order to ensure the reliability of the results herein, Granger and Toda–Yamamoto causality were tested in the V.A.R. by including specific control variables: good governance is measured by the Control of Corruption ($\log cc$) and the Political Stability indices ($\log pol-stab$), which were taken from the World Bank. The value of annual data in both variables is attributed to the respective quarters. Furthermore, an educational variable is measured by the number of highly educated workers in the activity I ($\log skill$), and was obtained from the Croatian Bureau of Statistics. Finally, movement of the exchange rate is measured by the movement of kuna in relation to euro ($\log exrt$), and the variable is obtained from Eurostat. For the last two variables, the quarterly time-series were used, and these variables are seasonally adjusted (CENSUS X-12). All the control variables are in logarithmic form.

The Granger causality test was applied in assessing the following pairs in the V.A.R. system:

$$\begin{aligned} \log bdv_{-t} = & a_0 + a_1 \log bdv_{-t-1} + \dots + a_p \log bdv_{-t-p} + b_1 \log fdi_{-t-1} + \dots + b_p \log fdi_{-t-p} \\ & + c_1 CV_{t-1} + \dots + c_p CV_{t-p} + u_t \end{aligned} \quad (5)$$

$$\begin{aligned} \log fdi_{-t} = & d_0 + c_1 \log fdi_{-t-1} + \dots + d_p \log fdi_{-t-p} + e_1 \log bdv_{-t-1} \\ & + \dots + e_p \log bdv_{-t-p} + f_1 CV_{t-1} + \dots + f_p CV_{t-p} + v_t \end{aligned} \quad (6)$$

where $\log fdi_{-t}$ and $\log bdv_{-t}$ are, respectively, logarithmic forms of the F.D.I. in tourism and tourism gross value added in Croatia, CV is control variables, and p is the optimal lag length.

The Toda–Yamamoto causality test was applied in assessing the following pairs in the V.A.R. system:

$$\begin{aligned} \log bdv_{-t} = & a_0 + a_1 \log bdv_{-t-1} + \dots + a_p \log bdv_{-t-(p+m)} + b_1 \log fdi_{-t-1} \\ & + \dots + b_p \log fdi_{-t-(p+m)} + c_1 CV_{t-1} + \dots + c_p CV_{t-(p+m)} + u_t \end{aligned} \quad (7)$$

$$\begin{aligned} \log fdi_{-t} = & d_0 + c_1 \log fdi_{-t-1} + \dots + d_p \log fdi_{-t-(p+m)} + e_1 \log bdv_{-t-1} \\ & + \dots + e_p \log bdv_{-t-(p+m)} + f_1 CV_{t-1} + \dots + f_p CV_{t-(p+m)} + v_t \end{aligned} \quad (8)$$

where $\log fdi_{-t}$ and $\log bdv_{-t}$ are, respectively, logarithmic forms of the F.D.I. in tourism and tourism gross value added in Croatia, CV is control variables, p is the optimal lag length, and m is that maximal order of integration of the variables in the V.A.R. system.

Research results

Stationarity of the variables was tested for both time-series, and the results of the unit root test (A.D.F. test) indicate that both series are stationary after the first difference, which is evident from Table 1.

Therefore, both of the time-series are integrated in the same order, and denoted as I (1). The V.A.R. model must be extremely well specified before testing for co-integration. This requires the selection of the optimal lag length for the variables in the V.A.R. model, using the usual information criteria, and the evaluation of the quality of the model itself. Standard information criteria indicate the selection of different optimal lag lengths of each variable, from 1 to 4 (see Appendix). The quality of the V.A.R. model - testing the normality of the distribution (Jarque–Bera test), the serial correlation (LM test) and the heteroscedasticity (White's test) of the residuals – is satisfied if the maximum lag length is $p = 4$. It is also necessary to check whether the model is 'dynamically stable'.

As can be seen from Figure 1, none of the roots is outside the circle, which proves that the V.A.R. model is stable (stationary). The obtained result is very favourable, because the stability of the V.A.R. model means that the results and conclusions following from further analysis are not questionable. Since both the time-series are of the same order of integration I (1), the Johansen co-integration was tested. It was found that co-integration is present; one co-integration equation is observed.

The estimated co-integration equation, i.e., the long-term equation, is:

$$\begin{aligned} \log bdv_{-t} = & 0.096 \log fdi_{-t} + 17.676 \\ & (-0.96863) \end{aligned} \quad (9)$$

Table 1. ADF test result.

Variable	Level			First difference		
	Constant	Constant and trend	None	Constant	Constant and trend	None
LOGBDV_T	-5.19***	-1.65	4.39	-2.89*	-7.64***	-1.73*
LOGFDI_T	-2.91**	-1.59	1.66	-6.16***	-6.75***	-5.94***

Note: The significance of p-value:

*** $p < 0.01$,

** $p < 0.05$,

* $p < 0.1$.

Lag length in the model is based on the Schwarz information criterion.

Source: Author's calculations.

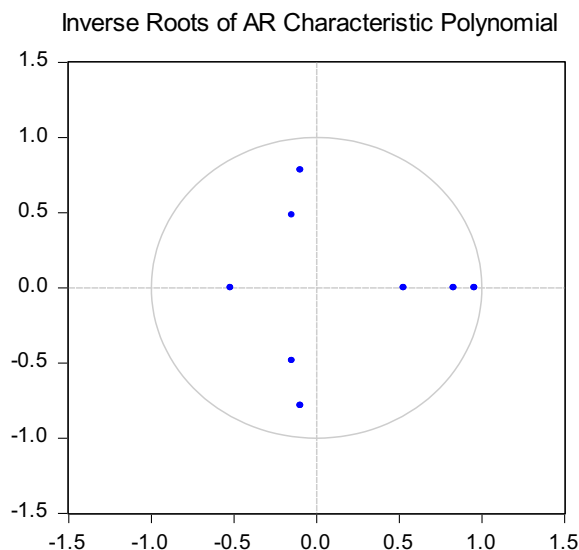


Figure 1. Stability of the V.A.R. model. Source: Author's calculations.

Table 2. V.E.C. model estimation.

	Equation 1 (dlogbdv_t)
ECT_{t-1}	-0.110644*** [0.0002]

Note: The significance of p-value:

***p<0.01,

**p<0.05,

*p<0.1.

Source: Author's calculations.

The co-integration equation suggests that there is a long-term equilibrium between gross value added and F.D.I. in the tourism industry.

The same order of integration I (1), the underlying time-series, and one co-integrating vector are in the background of choosing the V.E.C. model. Table 2 shows the V.E.C. model result.

The lagged ECT (ECT_{t-1}) of equation (1) is negative and significant, which is an indicator of a stable long-term relationship between F.D.I. and gross value added in tourism. The coefficient of -0.11 indicates that about 11% of the imbalance is corrected in the next quarter.

Proven co-integration is an indication of Granger causality. The results of the test are shown in Table 3.

The test results indicate that the causality among variables has not been proven in either direction. Given the proven co-integration, the presence of a causal link is expected, so the Toda–Yamamoto causality test will also be applied. Although the testing of co-integration does not affect the further procedure of Toda–Yamamoto's causality test, it is very useful for evaluating the validity of the final result. If the variables are co-integrated, but the causality has not been proven, it is possible that the sample size is too small. As already stated, this test allows for reliable conclusions.

Table 3. Granger causality test.

Dependent variable	Independent variable	
	dlogfdi_t	dlogbdv_t
	$X^2 (b_i = 0; d_i = 0)$	
dlogbdv_t	3.228786	-
dlogfdi_t	-	3.639948
Critical values for X^2		
$X^2 (3)$: na 1% = 11.34, na 5% = 7.81, na 10% = 6.25		
Note: The significance of p-value:		
***p<0.01,		
**p<0.05,		
*p<0.1.		
Source: Author's calculations.		

Table 4. Toda–Yamamoto Causality Test.

Dependent variable	Independent variable	
	logfdi_t	logbdv_t
	$X^2 (b_i = 0; d_i = 0)$	
logbdv_t	8.646045*	-
logfdi_t	-	6.085130
Critical values for X^2		
$X^2 (4)$: na 1% = 13.28, na 5% = 9.49, na 10% = 7.78		
Note: The significance of p-value:		
***p<0.01,		
**p<0.05,		
*p<0.1.		
Source: Author's calculations.		

Lastly, Toda–Yamamoto causality is tested by adding extra $m = 1$ lags; the results of the test are shown in Table 4.

The results of the research indicate that, in the case of the first dependent variable (*logbdv_t*), there is the presence of short-term causality running from total F.D.I. in tourism to tourism gross value added in Croatia. Therefore, the first null hypothesis of Granger non-causality, *logfdi_t non cause logbdv_t*, could be rejected. In other words, the short-term causality running from F.D.I. in tourism to tourism gross value added in Croatia has been confirmed at the 10% level of significance.

Regarding the other dependent variables, the second null hypothesis, *logbdv_t non-cause logfdi_t*, could not be rejected; the results of this study indicate that, in the case of the second dependent variable (*logfdi_t*), there is the absence of short-term causality running from tourism gross value added to F.D.I. in tourism.

Finally, by including the control variables, the Granger and Toda–Yamamoto causality testing was conducted. Stationarity of the variables was tested for all control variables, and the results of the unit root test (A.D.F. test) indicate that all series are stationary after the first difference, which is evident from Table 5, below.

Therefore, all the respective time-series are integrated in the same order and denoted as I (1). The quality of the V.A.R. model – testing normality of distribution (Jarque-Bera test), serial correlation (L.M. test), and heteroscedasticity (White's test) of their residuals

Table 5. ADF test results.

Variable	Level			First difference		
	Constant	Constant and trend	None	Constant	Constant and trend	None
LOGPOLSTAB	−2.35*	−2.50	0.36	−6.98***	6.93***	−7.00***
LOGCORR	−1.14	−1.44	2.01	−7.21***	−7.23***	−6.56***
LOGSKILL	−0.14	−3.52*	1.96	−3.50**	−2.62	−1.69*
LOGEXRT	−2.31	−1.84	−0.34	−7.72***	−8.11***	−7.77***

Note: The significance of p-value:

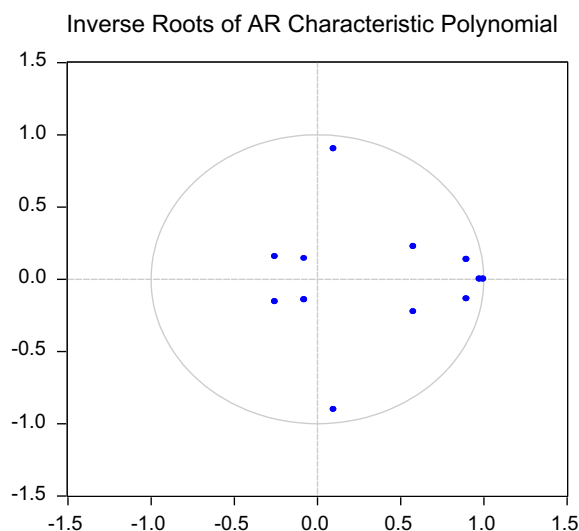
***p<0.01,

**p<0.05,

*p<0.1.

Lag length in the model is based on the Schwarz information criterion.

Source: Author's calculations.

**Figure 2.** Stability of the V.A.R. model. Source: Author's calculations.

– is satisfied if the maximum lag length is $p = 2$. It is also necessary to check whether the model is 'dynamically stable'.

As can be seen from Figure 2, none of the roots is outside the circle, which proves that the V.A.R. model is stable (stationary).

The results of the Granger causality test are shown in Ttable 6.

The null hypothesis of Granger non-causality, *logfdi_t non cause logbdv_t*, could be rejected at the 5% level of significance. If we take into consideration the influence of the control variables, the null hypothesis of Granger non-causality, *all variables non cause logbdv_t*, could be rejected at the 1% level of significance.

Regarding the other dependent variables, the null hypothesis, *logbdv_t non-cause logfdi_t*, could not be rejected; however, taking into consideration the influence of control variables, the null hypothesis of Granger non-causality, *all variables non cause logfdi_t*, could also be rejected at the 1% level of significance.

Lastly, Toda–Yamamoto causality test results are shown in Table 7.

Table 6. Granger causality test.

Dependent variable	Independent variable		
	logfdi_t	logbdv_t	all variables
	$X^2 (b_i = 0; d_i = 0)$		
logbdv_t	5.245320**	-	28.71239***
logfdi_t	-	1.39045	23.17893***
Critical values for X^2			
$X^2 (2)$: na 1% = 9.21, na 5% = 5.99, na 10% = 4.61			
Note: The significance of p-value:			
***p<0.01,			
**p<0.05,			
*p<0.1.			
Source: Author's calculations.			

Table 7. Toda–Yamamoto Causality Test.

Dependent variable	Independent variable		
	logfdi_t	logbdv_t	all variables
	$X^2 (b_i = 0; d_i = 0)$		
logbdv_t	16.52092***	-	31.49524***
logfdi_t	-	0.255122	14.74096
Critical values for X^2			
$X^2 (2)$: na 1% = 9.21, na 5% = 5.99, na 10% = 4.61			
Note: The significance of p-value:			
***p<0.01,			
**p<0.05,			
*p<0.1.			
Source: Author's calculations.			

The short-term causality running from F.D.I. in tourism to tourism gross value added in Croatia has been confirmed at the 1% level of significance. If we take into consideration the influence of control variables, the null hypothesis of Granger non-causality, *all variables non cause logbdv_t*, could be rejected at the 1% level of significance.

Regarding the other dependent variables, the null hypothesis, *logbdv_t non-cause logfdi_t*, could not be rejected; the results indicate that, in the case of the second dependent variable (*logfdi_t*), there is the absence of short-term causality running from tourism gross value added to F.D.I. in tourism. Moreover, the results remain the same, if we take into consideration the influence of control variables.

Conclusion

The results of the existing body of literature that deals with the issue of F.D.I.-led tourism growth hypothesis are rather diversified. The effects of F.D.I. in any sector, including the tourism sector, depend on the degree of development of a country (for example, the level of training of tourism staff), the legislation in the country, the stage of the life cycle of a tourist destination, *etc.* Given the mentioned particularities, research should be conducted for each individual country.

In this study, empirical research on long- and short-term causal links between F.D.I. in tourism and tourism gross value added in Croatia, using quarterly time-series data from 2000(1) to 2012(4), has been conducted. The study employed econometric techniques, such

as the unit root test, Johansen co-integration, and the Granger causality test in a V.E.C. model, and the Toda–Yamamoto causality test in a V.A.R. model. The results indicate that, in the case of Croatia, it is possible to discuss the F.D.I.-led tourism growth hypothesis. Both long- and short-term causal relationships between F.D.I. in tourism and tourism gross value added has been proven. Established long- and short-term causal relationships between variables are in line with the F.D.I.-led tourism growth hypothesis. Since the diagnostic tests are satisfied, and the stability of the V.A.R. model is confirmed, it is possible to conclude that the results obtained are reliable. The inclusion of certain control variables, such as index of corruption control, index of political stability, the exchange rate, and the educational variable, also contribute to the reliability of these results. By testing short-term causality using the Granger and Toda–Yamamoto tests, it is also confirmed that, with the inclusion of control variables in the case of Croatia, it is possible to discuss the F.D.I.-led tourism growth hypothesis.

These results confirm the importance of attracting F.D.I. in tourism, since it has the potential to stimulate sustainable tourism growth, and, thus, given the significance of tourism to the Croatian economy, it also has the potential to stimulate sustainable economic growth. The most important thing is to highlight that Croatian tourism is seriously lacking large hotel capacity that is necessary to ensure its viability, and the presence of established hotel chains could definitely help in providing that. These results are also in line with certain previous research related to the F.D.I.-led tourism growth hypothesis (Samini et al., 2013; Zhang, Ebberts, & Zhou, 2011).

Our results also confirm the necessity to create favourable conditions to attract F.D.I. The Granger causality test has proven that political stability, the level of corruption, the movement of the exchange rate, and education, along with the gross value added in tourism, are having a significant impact on F.D.I. attraction in tourism in the short term. As some research suggests, and according to our results, the political authorities should seriously approach the process of attracting foreign investors to establish incentivised macroeconomic business conditions, which require a good credit rating, quality infrastructure, a realistic exchange rate, competitive tax incentives, and favourable interest rates, to ensure political stability and eliminate the administrative and legislative barriers, and the image of the country as a ‘corrupt destination’ (Alfaro, 2003; Khoshnevis Yazdi et al., 2015; Perić & Nikšić Radić, 2015).

The significant impact of F.D.I. in tourism on tourism gross value added in Croatia validates the necessity of public intervention by implementing various policies, including the government providing incentives to foreign investors in tourism. On the other hand, given the importance of the control variables on the inflow of F.D.I. in tourism, the study results suggest an improved regulatory framework to make Croatia more attractive to F.D.I. inflow in tourism.

Among issues for future research, the authors could broaden this research to include testing the F.D.I.-led tourism growth hypothesis on whether it attracts greenfield or brown-field investment.

Notes

1. According to W.T.T.C.s’ (2011) estimates from 2011, the total tourism contribution to gross domestic product (GDP), in the case of Croatia, was 27.6%, while, at the European level,

that contribution was only 7.7%. Forecasts for 2021 are not very different – the total tourism contribution to GDP, in the case of Croatia, will amount to 30.7%, and, at the European level, 7.8%.

2. Several authors use the gross value added as a proxy for the level of productivity when measuring the effects of F.D.I. in particular sectors (Alfaro, 2003; Cipollina, Giovannetti, Pietrovito & Pozzolo, 2011; Tondl & Fornero, 2008).

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References

- Alfaro, L. (2003). *Foreign direct investment and growth: Does the sector matter?* (Working Paper). Retrieved from <http://www.grips.ac.jp/teacher/oono/hp/docu01/paper14.pdf>
- Arslanturk, Y., Balcilar, M., & Ozdemir, Z. A. (2011). Time-varying linkages between tourism receipts and economic growth in a small open economy. *Economic Modelling*, 28, 664–671. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0264999310001008>
- Asghar, N., Awan, A., & Ur Rehman, H. (2012). Human capital and economic growth in Pakistan: A cointegration and causality analysis. *International Journal of Economics and Finance*, 4, 135–147. doi:10.5539/ijef.v4n4p135
- Aslan, A. (2014). Tourism development and economic growth in the Mediterranean countries: Evidence from panel Granger causality tests. *Current Issues in Tourism*, 17, 363–372. doi:10.1080/013683500.2013.768607
- Asteriou, D., Dassiou, X., & Glycopantis, D. (2005). FDI and growth: Evidence from a panel of European Transition Countries. *Spoudai. Journal of Economics and Business*, 55, 9–30. Retrieved from <http://spoudai.unipi.gr/index.php/spoudai/article/view/1229/1308>
- Babić, A., Pufnik, A., & Stučka, T. (2001). *Teorija i stvarnost inozemnih izravnih ulaganja u svijetu i u tranzicijskim zemljama s posebnim osvrtom na Hrvatsku* [Theory and reality of FDI in the world and in transition countries with special reference to Croatia] (Discussion Paper No. 9). Retrieved from <http://www.hnb.hr/documents/20182/121897/p-009.pdf/3f1c8c9e-8483-4dd1-9b03-74ad98e3785b>
- Belloumi, M. (2010). The relationship between tourism receipts, real effective exchange rate and economic growth in Tunisia. *International Journal of Tourism Research*, 12, 550–560. doi:10.1002/jtr.774
- Bezić, H., Nikšić Radić, M., & Kandžija, T. (2010). Foreign direct investments in the tourism sector of the Republic of Croatia. *Valahian Journal of Economic Studies - an international review of theories and applied studies in performance management*, 1, 21–28. Retrieved from <http://www.vjes.eu/>
- Borensztein, E., De Gregorio, J., & Lee, J. (1998). How does foreign direct investment affect economic growth? *Journal of International Economics*, 45, 115–135. Retrieved from <http://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FS0022-1996%2897%2900033-0;h=repec:eee:inecon:v:45:y:1998:i:1:p:115-135>
- Bouzahzah, M., & El Menyari, Y. (2013). *The relationship between international tourism and economic growth: The case of Morocco and Tunisia* (Working Paper No. 44102). Retrieved from http://mpra.ub.uni-muenchen.de/44102/1/MPra_paper_44102.pdf, MPRA Munich Personal RePEc Archive
- Caglayan, E., Sak, N., & Karymshakov, K. (2012). Relationship between tourism and economic growth: A panel Granger causality approach. *Asian Economic and Financial Review*, 2, 591–602. Retrieved from <http://www.aessweb.com/pdf-files/591-602.pdf>

- Chowdhury, A., & Mavrotas, G. (2006). FDI and growth: What causes what? *World Economy*, 29, 9–19. doi:10.1111/j.1467-9701.2006.00755.x
- Cipollina, M., Giovannetti, G., Pietrovito, F., & Pozzolo, A. F. (2011). *FDI and growth: What cross-country industry data say* (Development Working Papers 313). Centro Studi Luca d'Agliano, University of Milano. Retrieved from http://www.dt.tesoro.it/export/sites/sitodt/modules/documenti_it/analisi_programmazione/working_papers/WP_N_10-2011.pdf
- Cipollina, M., Giovannetti, G., Pietrovito, F., & Pozzolo, A. F. (2012). FDI and growth: What cross-country industry data say. *World Economy*, 35, 1599–1629. doi:10.1111/j.1467-9701.2012.01478.x
- Dunning, J. H., & McQueen, M. (1982). Multinational corporations in the international hotel industry. *Annals of Tourism Research*, 9, 69–90. doi:10.1016/0160-7383(82)90035-4
- Ford, T. C., Rork, J. C., & Elmslie, B. T. (2008). Foreign direct investment, economic growth, and the human capital threshold: Evidence from US states. *Review of International Economics*, 16, 96–113.
- Fourie, J., & Santana-Gallego, M. (2011). The impact of mega-events on tourist arrivals. *Tourism Management*, 32, 1364–1370. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0261517711000148>
- Giles, D. (2011). *Testing for granger causality*. Retrieved from <http://davegiles.blogspot.com/2011/04/testing-for-granger-causality.html>
- Hirschman, A. (1958). *The strategy of economic development*. New Haven, CT: Yale University Press.
- Hunya, G., & Škudar, A. (2006). *The role of foreign direct investments in the Croatian economy*. Retrieved from <http://doi.org/10.1787/9789264034013-en>. OECD Publishing
- Institut za turizam. (2012). *Glavni plan i strategija razvoja turizma Republike Hrvatske, SWOT i PEST analiza i razvojni scenariji* [The master plan and development strategy of Croatian tourism, SWOT and PEST analysis and development scenarios] (Report No. 7). Retrieved from Institut za turizam: <http://iztztg.hr/UserFiles/Pdf/Izvjestaj-07-Strategija-razvoja-turizma-RH.pdf>
- Jovančević, R. (2007). The impact of foreign investment flows on Croatian economy - a comparative analysis. *Ekonomski pregled*, 58, 826–850. Retrieved from hrcak.srce.hr/file/30388
- Katircioglu, S. T. (2011). The bounds test to the level relationship and causality between foreign direct investment and international tourism: The case of Turkey. *E & M Economie and Management* [Economics and Management], XIV, 6–13.
- Kersan-Škabić, I., & Zubin, C. (2009). The influence of foreign direct investment on the growth of GDP, on employment and on export in Croatia. *Ekonomski pregled*, 60, 119–151. Retrieved from <http://hrcak.srce.hr/36848>
- Khoshnevis Yazdi, S., Homa Salehi, K., & Soheilzad, M. (2015). The relationship between tourism, foreign direct investment and economic growth: Evidence from Iran. *Current Issues in Tourism*, 19, 1–11. doi:10.1080/13683500.2015.1046820.
- Kunst, I. (2011). Direktna strana ulaganja u hrvatski turizam: stanje i ograničenja [Foreign direct investment in Croatian tourism: state and restrictions], *Turizam*, 59, 225–241. Retrieved from http://www.iztztg.hr/hr/publikacije/turizam/najnoviji_broj/?clanakId=319&brojId=23
- Liu, W. (2005). Determinants of semiconductor industry cycles. *Journal of Policy Modelling*, 27, 853–866. Retrieved from <http://doi.org/10.1016/j.jpolmod.2005.05.009>
- Lovrinčević, Ž., Butora, G., & Marić, Z. (2004). Foreign capital inflows – influence on domestic investment and trade structure. *Ekonomski pregled*, 55, 894–934. Retrieved from: <http://hrcak.srce.hr/16321>
- Lovrinčević, Ž., Mikulić, D., & Marić, Z. (2004). Investment efficiency and FDI - old story, new circumstances. *Ekonomski pregled*, 55, 3–43. Retrieved from <http://hrcak.srce.hr/14800>
- Magnus, J. F., & Fosu, O. E. (2008). Bivariate causality analysis between FDI inflows and economic growth in Ghana. *International Research Journal of Finance and Economics*, 15, 103–112. Retrieved from <http://connection.ebscohost.com/c/articles/32926489/bivariate-causality-analysis-between-fdi-inflows-economic-growth-ghana>
- Mavrotas, G., & Kelly, R. (2001). Old wine in new bottles: Testing causality between savings and growth. *The Manchester School*, 69, 97–105. doi:10.1111/1467-9957.69.s1.6
- Mello-Sampayo, F. D., & Sousa-Vale, S. D. (2012). *Tourism and growth in European countries: An application of likelihood-based panel cointegration* (Working Paper No. 2012/17). Retrieved from

- <http://pascal.iseg.utl.pt/~depeco/wp/wp172012.pdf>. ISEG - School of Economics and Management, Department of Economics, University of Lisbon
- Mencinger, J. (2003). Does foreign direct investment always enhance economic growth? *Kyklos*, 56, 491–508. Retrieved from <http://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fwww.blackwell-synergy.com%2Flinks%2Fdoi%2F10.1046%2Fj.0023-5962.2003.00235.x;h=repec:bla:kyklos:v:56:y:2003:i:4:p:491-508>
- Mlinarević, K. (2004). *Utjecaj izravnih stranih ulaganja na gospodarski rast - slučaj skupine tranzicijskih gospodarstava središnje i istočne Europe* [Effects of foreign direct investments on economic growth – the case of a group of transition economies in Central and Eastern Europe] (Unpublished master's thesis). Zagreb: Sveučilište u Zagrebu.
- Nunnenkamp, P., & Spatz, J. (2004). FDI and economic growth in developing economies: How relevant are host-economy and industry characteristics? *Transnational Corporations*, 13, 53–86.
- Othman, R., Salleh, N. H. M., & Sarmidi, T. (2012). Analysis of causal relationship between tourism development, economic growth and foreign direct investment: An ARDL Approach. *Journal of Applied Sciences*, 12, 1245–1254. doi:10.3923/jas.2012.1245.1254
- Perić, J., & Nikšić Radić, M. (2011). Sustainable foreign direct investment in tourism sector of developing countries. *Sustainable Tourism: Socio-Cultural, Environmental and Economics Impact*, 263–278. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2166480
- Perić, J., & Nikšić Radić, M. (2015). Tourism productivity and tourism FDI in Croatia. *Mediterranean Journal of Social Sciences*, 6, 425–433. doi:10.5901/mjss.2015.v6n5s2p425
- Salleh, N. H. M., Othman, R., & Sarmidi, T. (2011). An analysis of the relationships between tourism development and foreign direct investment: An empirical study in selected major Asian countries. *International Journal of Business Social Science*, 3, 250–257. Retrieved from <http://connection.ebscohost.com/c/articles/66502360/analysis-relationships-between-tourism-development-foreign-direct-investment-empirical-study-selected-major-asian-countries>
- Samimi, A. J., Sadeghi, S., & Sadeghi, S. (2013). The relationship between foreign direct investment and tourism development: Evidence from developing countries. *International Journal of Institutions and Economics*, 5, 59–68. Retrieved from <http://repository.um.edu.my/1031/1/Fulltext%203.pdf>
- Schubert, S. F., Brida, J. G., & Risso, W. A. (2011). The impacts of international tourism demand on economic growth of small economies dependent on tourism. *Tourism Management*, 32, 377–385. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0261517710000543>
- Selvanathan, S., Selvanathan, E. A., & Viswanathan, B. (2012). Causality between foreign direct investment and tourism: Empirical evidence from India. *Tourism Analysis*, 17, 91–98. Retrieved from <http://doi.org/10.3727/108354212X13330406124296>
- Sinclair, M. T., & Stabler, M. J. (1991). *The tourism industry: An international analysis*. Oxford: C.A.B. International.
- Sisek, B. (2005). Strane izravne investicije u Hrvatskoj - uzroci neuspjeha [Foreign direct investment in Croatia - causes of failure]. *Zbornik Ekonomskog fakulteta u Zagrebu*, 3, 89–108. Retrieved from <http://hrcak.srce.hr/26215>
- Surugiu, C., & Surugiu, M. R. (2013). Is the tourism sector supportive of economic growth? Empirical evidence on Romanian tourism. *Tourism Economics*, 19, 115–132. doi:10.5367/te.2013.0196
- Tang, S., Selvanathan, E. A., & Selvanathan, S. (2007). The relationship between foreign direct investment and tourism: Empirical evidence from China. *Tourism Economics*, 13, 25–39. doi:10.5367/000000007779784498
- Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics*, 66, 225–250. Retrieved from <http://www.sciencedirect.com/science/article/pii/0304407694016168>
- Tondl, G., & Fornero, J. A. (2008). *Sectoral productivity and spillover effects on FDI in Latin America*. Sidney: European Trade Study Group. Retrieved from http://fiw.wsr.ac.at/fileadmin/Documents/FOKO_II/TondlFornero.pdf
- Tondl, G., & Fornero, J. (2010). *Sectoral productivity and spillover effects of FDI in Latin America* (Working Paper No. 53). Retrieved from http://www.fiw.ac.at/fileadmin/Documents/Publikationen/Working_Paper/N_053-Tondl_Fornero.pdf FIW

UNCTAD. (2001). *World investment report 2001: Promoting linkages*. New York and Geneva: United Nations.

UNWTO. (1999). *Enzo Paci papers on measuring the economic significance of tourism*. Madrid: UNWTO.

W.T.T.C. (2011). *Croatia: Travel & tourism economic impact 2011*. W.T.T.C. Retrieved from http://www.tourism-generis.com/_res/file/3687/49/0/Croatia.pdf

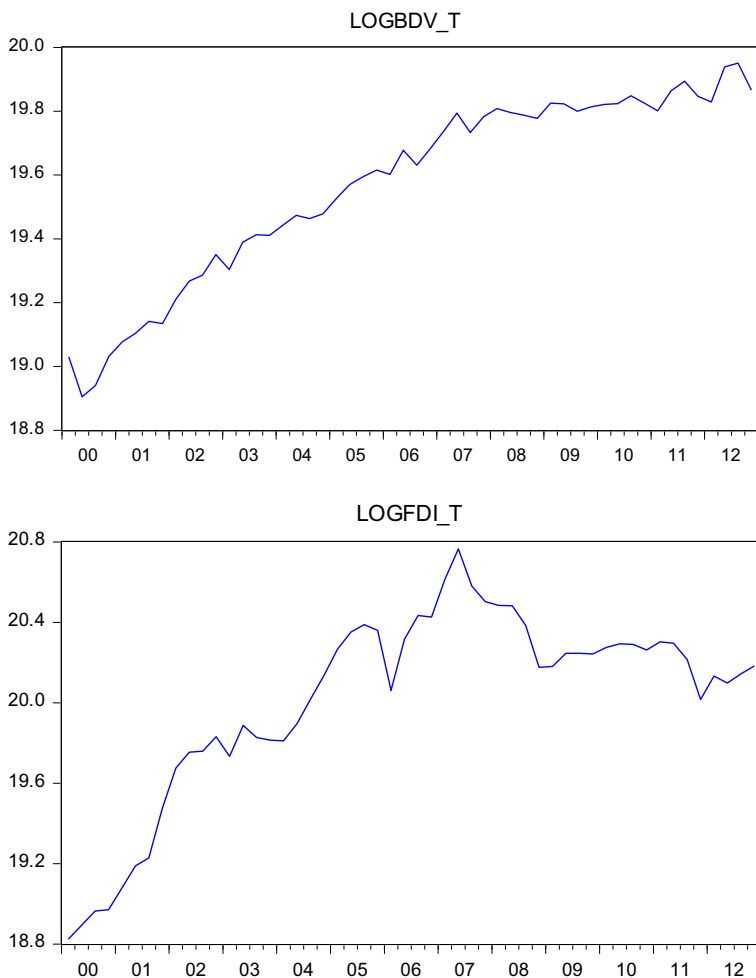
Zachariadis, T. (2006). *On the exploration of causal relationships between energy and the economy* (Discussion Paper No. 5). Department of Economics, University of Cyprus. Retrieved from <http://papers.econ.ucy.ac.cy/RePEc/papers/5-2006.pdf>

Zhang, G. (1999). *A comparative study of the economic impact of tourism investment on selected economies of APEC region* (Unpublished master's thesis). Hong Kong: The Hong Kong Polytechnic University.

Zhang, J., Ebbers, H., & Zhou, C. (2011). Flows of tourists, commodities and investment: The case of China. In Á. Matias, P. Nijkamp, & M. Sarmento (Eds.), *Tourism economics impact analysis* (pp. 43–63). Lisboa: Springer.

Appendix

Time trends of the selected variables



Source: Authors' calculation.

V.A.R. Lag Order Selection Criteria

Endogenous variables: LOGBDV_T LOGFD.I._T

Exogenous variables: C

Date: 03/06/14 Time: 09:12

Sample: 2000Q1 2012Q4

Included observations: 48

Lag	LogL	LR	FPE	AIC	SC	HQ
0	5.738807	NA	0.002934	-0.155784	-0.077817	-0.126320
1	135.2718	242.8744	1.57e-05	-5.386325	-5.152425*	-5.297934
2	138.1615	5.177444	1.65e-05	-5.340064	-4.950230	-5.192745
3	146.6000	14.41573*	1.37e-05	-5.525000	-4.979233	-5.318754*
4	151.0458	7.224377	1.35e-05*	-5.543574*	-4.841874	-5.278401

* Indicates lag order selected 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 criterion

Source: Authors' calculation.

Diagnostic tests

V.A.R. Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 03/11/14 Time: 10:41

Sample: 2000Q1 2012Q4

Included observations: 48

Lags	LM-Stat	Prob
1	3.786718	0.4356
2	2.999068	0.5580
3	1.457214	0.8342
4	2.289459	0.6827
5	3.823441	0.4304
6	1.451788	0.8351
7	1.952132	0.7446
8	1.941573	0.7465
9	1.651003	0.7996
10	4.308441	0.3659
11	2.039702	0.7285
12	4.270071	0.3707

Probs from chi-square with 4 df

Source: Authors' calculation.

V.A.R. Residual Normality Tests

Orthogonalisation: Residual Correlation (Doornik-Hansen)

Null Hypothesis: residuals are multivariate normal

Date: 03/11/14 Time: 10:42

Sample: 2000Q1 2012Q4

Included observations: 48

Component	Skewness	Chi-sq	df	Prob.
1	0.413833	1.625771	1	0.2023
2	-0.177358	0.311777	1	0.5766
Joint		1.937547	2	0.3795
Component	Kurtosis	Chi-sq	df	Prob.
1	3.271256	0.366598	1	0.5449
2	3.635279	2.945279	1	0.0861
Joint		3.311877	2	0.1909
Component	Jarque-Bera	df	Prob.	
1	1.992369	2	0.3693	
2	3.257056	2	0.1962	
Joint	5.249425	4	0.2626	

V.A.R. Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 03/11/14 Time: 10:42

Sample: 2000Q1 2012Q4

Included observations: 48

Joint test:					
Chi-sq	df	Prob.			
50.18190	48	0.3870			
Individual components:					
Dependent	R-squared	F(16,31)	Prob.	Chi-sq(16)	Prob.
res1*res1	0.263116	0.691814	0.7801	12.62956	0.6996
res2*res2	0.248415	0.640386	0.8262	11.92394	0.7492
res2*res1	0.404739	1.317373	0.2479	19.42746	0.2471

Source: Authors' calculation.