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Empirical assessment of the tourism-led growth hypothesis: the case of the Tirol–Südtirol–Trentino Europaregion

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Cointegration tests have become very popular in empirical analyses of the tourism-led growth hypothesis (TLGH). They were first introduced into the literature on tourism economics by Balaguer and Cantavella-Jordá, and then were made popular by many researchers attempting to assess the causal long-run relationship between international tourism and economic growth. The vast majority of these studies analyse countries in which tourism is one of the most important sectors of the national economy and, in most cases, the TLGH is validated. With respect to previous contributions to the literature, this paper examines the TLGH in sub-national transfrontier economies, taking as its case the three administrative areas forming the region known as 'Tirol–Südtirol–Trentino Europaregion'. Direct comparisons with the results for across-the-border regions that have similar international tourism markets provide new insights for our understanding of the TLGH.

Keywords: economic growth; tourism development; Johansen cointegration test; Granger causality; tourism-led growth hypothesis

According to the widely accepted theoretical arguments supporting the so-called 'export-led growth hypothesis' (ELGH) (Balassa, 1985; Bhagwati, 1988), the idea that international tourism may be regarded as a form of invisible

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export, Balaguer and Cantavella-Jordá (2002) formulated the 'tourism-led growth hypothesis' (TLGH). The TLGH specifies 'the existence of various arguments for which tourism would become a main determinant of overall long-run economic growth' (Balaguer and Cantavella-Jordá, 2002). In its original formulation, the TLGH was supported by three main general arguments. The first refers to the fact that international tourism may significantly contribute to the financial resources that allow an economy to import more than to export (McKinnon, 1964). Second, international tourism may make local tourist firms more efficient, because of competition with counterparts operating in other international tourist areas (Bhagwati and Srinivasan, 1979; Krueger, 1980). Third, expansion of the tourism sector may increase the opportunities for local tourist firms to exploit economies of scale (Helpman and Krugman, 1985).

In more recent theoretical developments, other explanations for the TLGH have been suggested. One is that tourism may also play an important role in stimulating investment in new infrastructures and human capital. Physical capital functional to tourist activities such as airports, marinas, hotels and restaurants can also positively affect productivity and trade (Sakai, 2009). Human capital is one of the most important production factors in tourism, to the extent that this economic sector represents an important source of creation of new employment. Human capital also comprises knowledge, education and professional capabilities, all factors that can boost efficiency and competitiveness (Blake *et al*, 2006). Another important explanation relates to the propensity of tourism to stimulate other economic sectors by direct, indirect or induced effects. Increased tourism expenditure can produce an increase in the activities of related industries, and the resulting global variations will be greater than the injection of the initial expenditure (Spurr, 2006).

Enhanced by growing interest in the economic literature on the role played by tourism on economic growth, within the last decade there has been a proliferation of empirical studies, primarily based on linear models for time series data, aiming at validating the TLGH in many different economies. A comprehensive review of findings can be found in the work of Brida and Pulina (2010), who show that the TLGH has been validated in 7 out of 8 South American countries examined, 6 out of 8 European destinations, 8 out of 10 Asian and Pacific destinations, and 2 out of 3 African and Middle Eastern countries. Most of these studies used annual time series data at national level and analysed countries in which tourism is one of the most important sectors of the national economy.

In this paper, we assess the TLGH at Nomenclature of Territorial Units for Statistics-2 (NUTS-2) level for three across-the-border regions between Italy and Austria: the Italian Trentino, the Italian South Tyrol and the Austrian Tyrol (hereinafter Trentino, South Tyrol and Tyrol). These three neighbouring sub-national administrative units share several very similar cultural, social and economic characteristics and, above all, they all have a common mountain-based tourism sector. They have also stipulated an outline convention on trans-frontier cooperation called the 'Tirol–Südtirol–Trentino Europaregion' (TST Europaregion).

The contribution of this paper to the extensive literature about the TLGH lies in the fact that it is one of the few studies to analyse sub-national economies and, as far as we know, this is the first attempt to assess direct comparisons among trans-frontier regions. We argue that further comprehension of the phenomena characterizing the TLGH can be gained by examining the regional dimension: this is because, unlike other economic sectors, tourism has an impact that is relatively stronger on a local, rather than national, scale (Sgro and Hazari, 1995).

The structure of the paper is as follows: in the first section, we measure the relative size of the tourism market in the three regions of the TST Europaregion and identify the purpose of assessing the TLGH. The subsequent section presents the methodological econometric framework employed to validate the TLGH empirically. The penultimate section gives the empirical results for each of the three regions. Finally, the last section discusses the results, offers concluding remarks, and indicates directions for future developments in this field.

The tourism sector in the Tirol–Südtirol–Trentino Europaregion

Validating the TLGH for this region is important because, as we show here, the dimension of tourism in its three component areas is very large when compared with the corresponding national and international territorial contexts (Italy, Austria and the European Union). To prove this statement, we rely on the Eurostat regional tourism database[1] concerning the numbers of bed-places and nights spent by tourists in collective tourist accommodation establishments.[2]

The quantitative extent of the supply-side of a tourism market may be approximately measured by the number of tourist bed-places per inhabitant. Figure 1 shows that all the three administrative units of the TST Europaregion have a number of bed-places per 100 inhabitants that is much higher than in nearby national and supranational territories. In 2009, for example, Trentino, South Tyrol and Tyrol represented, respectively, about 32, 44 and 39 bed-places per 100 inhabitants, while Italy, Austria and the European Union only have about 8, 12 and 6, respectively.

In order to measure the demand of tourism in the area, we refer to the *tourist function rate* (Defert, 1967); that is, the ratio between tourist nights spent and number of inhabitants multiplied by 365 (the days of the year). When this statistical measure is multiplied by 100, it interprets the average number of tourists per 100 inhabitants residing in the area in the course of one year, and hence allows comparisons between tourist flows within differing territories. The values of the tourist function rate for the TST Europaregion and for Italy, Austria and the European Union are shown in Figure 2: even from the demand side of the tourism market, these three trans-frontier regions constitute an area of high tourist intensity.

In 2009, for example, the tourist flows within the three areas (with an annual average of 8–15 tourists per 100 inhabitants) were relatively more consistent than those within Italy, Austria and the EU (with an annual average of 1–3 tourists per 100 inhabitants).

From a temporal evolution perspective and in terms of territorial comparison, the tourism sector of this interregional area clearly has a significant impact on the local economy and, according to the TLGH, may represent a potential

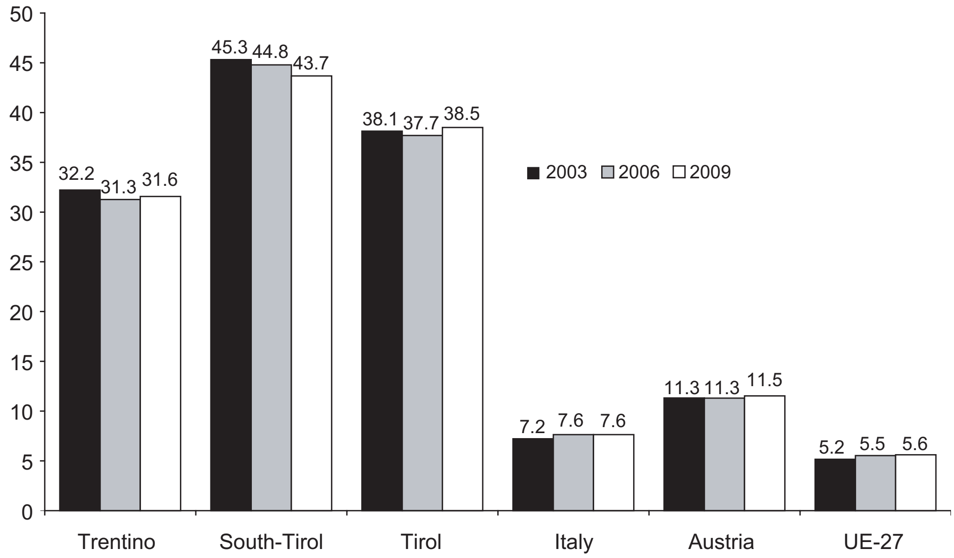

Figure 1. Numbers of tourist bed-places per 100 inhabitants in the regions of Tirol–Südtirol–Trentino Europaregion, and in Italy, Austria and the European Union for 2003, 2006 and 2009.

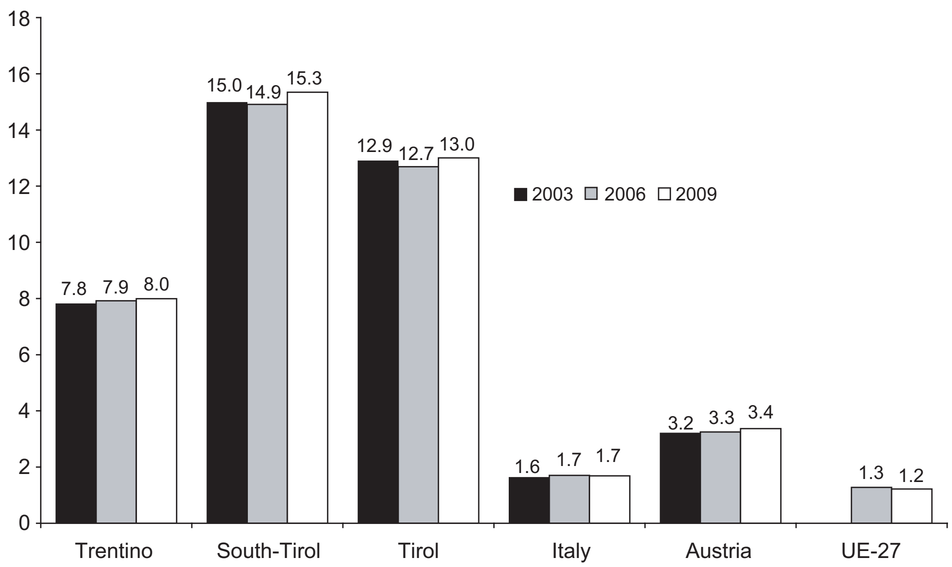

Figure 2. Tourist function rate for the regions of Tirol–Südtirol–Trentino Europaregion and for Italy, Austria, and the European Union for 2003, 2006 and 2009.

strategic factor for growth. The validity of the TLGH for these regions is examined in the next section.

Validating the TLGH for the Tirol–Südtirol–Trentino Europaregion

Validating the TLGH empirically – that is, measuring the strength of the causation relationship from tourism activity to economic growth – is not straightforward. There is a methodological problem, due to the fact that economic theory provides equally plausible justifications even for the opposite causation, which implies that tourism cannot be assumed as an exogenous variable. In other words, the presence of a statistically significant association between tourism and economic growth cannot just be interpreted as the existence of causality. To tackle this problem, many authors have relied on Granger's concept of causality in the context of linear time series analysis (see, among many others, Balaguer and Cantavella-Jordá, 2002; Dritsakis, 2004; Nowak *et al*, 2007; Brida and Monterubbianesi, 2010). The same methodological approach is used here to assess, individually, the impact of the tourism sector on the growth of the local economies of Trentino, South Tyrol and Tyrol.

Data

For all three regions, the data applied in this study are annual time series, from 1980 to 2009, of regional real gross domestic product (*GDP*), number of international tourists visiting the regions (*T*) and the relative price index (*RP*) between the regions and Germany. The first variable represents the economic growth that took place in the region, the second measures the volume of tourism activity, and the third mimics a sort of virtual regional exchange rate, which is included as a proxy variable of external competitiveness. Since, for all three regions, tourists from Germany are relatively the most numerous among foreign tourists, we use German tourist arrivals and *RP* between Germany and the regions as indicators of international tourism and external competitiveness. Variable *RP* properly approximates the virtual local exchange rate, provided that the law of one price and the Purchasing Power Parity theory both hold. Since the three regions and Germany have the same currency and are not subject to legal or fiscal barriers to the circulation of goods and individuals, it is reasonable to assume that, in the long run, changes in relative prices represent a change in competitiveness differentials.

The time series for South Tyrol and Trentino were constructed from data made available by the local official institute of statistics, respectively the Autonomous Province of South Tyrol Provincial Statistics Institute (ASTAT) and the Statistics Agency of the Province of Trento. For Tyrol, the source of data is Statistik Austria. Since the time series of price levels in Tyrol was not available, we used the price levels throughout Austria as a proxy.

Methodological framework

In order to detect causality between tourism and economic growth, we refer to the methodological framework of Granger (1988), which is based on a 'weak' concept of causality (Granger, 1969). According to this perspective, one variable causes a second variable if the second variable can be better predicted with all the available information on it and the past history of the first variable, than without using the past history of the first variable. Therefore, this particular notion of causality is related to prediction and not necessarily to actual predetermination (Ahmad, 2001).

In order to apply this framework to our problem, we model the relationship among the three variables of interest – *GDP*, *T* and *RP* – by means of a Vector Error Correction Model (VECM) specification:

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{i=k-1} \Gamma_i \Delta Y_{t-1} + \varepsilon_t, \tag{1}$$

where $Y = (\ln GDP, \ln T, \ln RP)$ is a vector containing the variables in their logarithmic transformation, so that the model coefficients can be interpreted as elasticities; μ is a vector of constant terms; and ε_t is the usual error term, which allows us to control for factors omitted by the deterministic part of the model. Matrix Π conveys information about the long-run relationship between the Y variables. The rank of Π expresses the number of cointegrating relations; that is, the number of linearly independent and stationary linear combinations of the variables. The presence of cointegration among the time series variables is due to common stochastic trends, which imply convergence to a long-run equilibrium state; that is, a stable long-run relationship exists among the variables (Banerjee *et al*, 1993).

It is well known that, in the context of time series analysis, a stationarity test is important to establish the estimation of the right model. The first step is therefore to apply unit root tests to study time series stationarity. In the case of non-stationarity, we apply the Johansen cointegration test (Johansen, 1988; Johansen and Juselius, 1990) to detect long-run relationships in the data. Weak exogeneity and a modified version of the Granger causality test are then applied to analyse causality between the variables.

Lastly, the robustness of the results with respect to the model assumptions – that is, autocorrelation, non-normality and conditional heteroscedasticity in residuals – is tested, to check whether the VECM is a proper representation of the phenomenon under study.

Empirical results

South Tyrol

In this section, in order to illustrate the estimation procedure in detail, we focus on the case of South Tyrol (for the other two regions, we only report empirical results in the next sections). First of all, to set the model as in Equation (1) and perform the cointegration test, we must study the stationarity of the time series and identify their order of integration by means of unit root tests, such as the augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1979) and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test (Kwiatkowski *et al*, 1992). These two tests are complementary: ADF has the null hypothesis of non-stationarity; KPSS has the null hypothesis of stationarity and is therefore more conservative. Tables 1, 2 and 3 show unit root tests for the variables in

Table 1. Unit root test results: levels (South Tyrol).

Variable	ln*GDP*		ln*T*		ln*RP*	
Unit root tests	ADF	KPSS	ADF	KPSS	ADF	KPSS
Trend, constant	– 0.03	0.34[a]	– 2.81	0.13[b]	– 5.38	0.24[a]
Constant	– 1.93	1.54[a]	– 0.65	1.42	– 3.81[a]	0.94[a]
Without trend, constant	4.33		2.26		0.32	

Note: [a]Rejection of null hypothesis at 5%; [b]rejection of null hypothesis at 10%.

Table 2. Unit root test results: first differences (South Tyrol).

Variable	Δ(ln*GDP*)		Δ(ln*T*)		Δ(ln*RP*)	
Unit root tests	ADF	KPSS	ADF	KPSS	ADF	KPSS
Trend, constant	– 3.92[a]	0.13[b]	– 4.29[a]	0.04	–2.22	0.31[a]
Constant	– 3.24[a]	0.31	– 4.32[a]	0.09	4.00[a]	1.10[a]
Without trend, constant	– 1.65[b]		– 3.51[a]		–4.21[a]	

Note: [a]Rejection of null hypothesis at 5%; [b]rejection of null hypothesis at 10%.

Table 3. Unit root tests results: second differences (South Tyrol).

Variable	Δ (Δ(ln*RP*))	
Unit root tests	ADF	KPSS
Trend, constant	– 5.28[a]	0.04
Constant	– 4.24[a]	0.27
Without trend, constant	– 3.66[a]	

Note: [a]Rejection of null hypothesis at 5%.

levels, first differences and second differences, respectively, for the case of South Tyrol.

According to the test results, ln*GDP* and ln*T* variables are first-order integrated processes $I(1)$, and ln*RP* is of $I(2)$ order. Therefore, we must detect the presence of a cointegrating relationship among ln*GDP*, ln*T* and Δ(ln*RP*), which may be interpreted as a sort of local relative inflation. Banerjee *et al* (1993) argue that testing for cointegration is searching for a statistical equilibrium between variables, which tends to grow over time. The discrepancy of this equilibrium can be modelled with the VECM specification (Equation (1)) where, rather than using ln*RP*, we employ Δ(ln*RP*).

The estimated coefficients of the VECM indicate how the variables come back to equilibrium after suffering a shock. In order to define the optimal VECM, we rely on the minimum AIC criterion, indicating a lag length of one. To determine the number of cointegrating equations, the Johansen maximum likelihood method provides both trace and maximum eigenvalue statistics. Table 4 shows that, for South Tyrol, both statistics can detect the existence of one significant cointegrating vector.

Table 4. Unrestricted cointegration rank test with no deterministic trend for ln*GDP*, ln*T* or Δ(ln*RP*) variables (South Tyrol).

Hypothesized number of CE	Eigenvalue	Trace statistics	5% Critical value	*p*-value**
None*	0.580	40.51	35.07	0.0109
At most 1	0.378	17.09	20.16	0.1304
At most 2	0.147	4.28	9.14	0.3839

Notes: *Rejection of null hypothesis at 0.05 level; **MacKinnon *et al* (1999) *p*-values. Trace test indicates 1 cointegrating equation at 0.05 level.

When a long-run equilibrium relationship among the variables is detected, exogeneity must be tested in order to avoid misinterpretation in the meaning of the estimated parameters (McCallum, 1984). Following Johansen and Juselius (1990) and Johansen (1995), weak exogeneity in the cointegrating equations can be tested by applying zero restrictions on the relative rows of *loading matrix* α, which is the matrix giving $\Pi = \alpha\beta'$ and which contains the weights attached to the cointegrating relationships in the single equations of the VECM (Lütkepohl, 2006). The null hypothesis of this test is of weak exogeneity, and hence the likelihood ratio test statistics on the single parameter associated with variable ln*T* of 1.9695, *p*-value 0.1605, indicates that ln*T* is exogenous. Similarly, a likelihood ratio test statistic on the single parameter associated with variable Δ(ln*RP*) of 0.4733, *p*-value 0.4915, indicates that Δ(ln*RP*) is also exogenous. Even the null hypothesis of joint weak exogeneity of ln*T* and Δ(ln*RP*) cannot be rejected, since the likelihood ratio test statistic is 3.0196, *p*-value 0.2210. These results allow us to infer the existence of a long-run equilibrium in South Tyrol after testing weak exogeneity of ln*T* and Δ(ln*RP*):

$$\ln GDP_t = 4.16 + 0.36\ln T_t - 3.31\Delta(\ln RP)_t. \qquad (2)$$

The elasticity of ln*GDP* with respect to international tourist arrivals is clearly positive, with a value of 0.36.

The existence of a significant stable long-run relation between ln*T* and ln*GDP* is a necessary but not sufficient condition for causality between the two variables. In other words, we still need to determine which variable is the cause and which is the effect. According to Granger (1988), we can state that ln*T* does not cause ln*GDP* if, in the VECM equation in which ln*GDP* is the response variable, the regression parameters associated with ln*T* are jointly insignificant. For further details about Granger causality in the context of cointegrated time series, see Lütkepohl (2006). Therefore, testing the proper zero restrictions on the parameters of the single equations of the estimated model of Equation (1) allows us to detect the direction of causality among the three variables; see Table 5 for the results in the case of South Tyrol.

Apparently, the null hypothesis that international tourism does not Granger-cause real *GDP* is definitely rejected; instead, the null hypothesis that the real *GDP* does not Granger-cause international tourism cannot be rejected. Thus, unidirectional Granger causality from international tourism to real *GDP* does exist. This may be interpreted as empirical evidence of the TLGH. Local relative

Table 5. Granger causality test (South Tyrol).

Null hypothesis	*F*-statistic	*p*-value
ln*T* does not Granger-cause ln*GDP*	16.702	0.0000[a]
ln*GDP* does not Granger-cause ln*T*	1.310	0.2891
Δ(ln*RP*) does not Granger-cause ln*GDP*	16.319	0.0000[a]
ln*GDP* does not Granger-cause Δ(ln*RP*)	1.430	0.2598
Δ(ln*RP*) does not Granger-cause ln*T*	0.634	0.5395
ln*T* does not Granger-cause Δ(ln*RP*)	0.126	0.8822

Note: [a]Rejection of null hypothesis at 5%.

inflation, Δ(*RP*), also has a significant impact on the real *GDP*, so that the estimated elasticity of real *GDP* with respect to ln*T*, 0.36, measures the net effect of international tourism on economic growth. More precisely, it means that an increase in tourism arrivals by 100% produces an increment of 36% in the real output of South Tyrol.[3]

To identify the ideal time-span of the impact of tourism, we also compute the impulse response function (see, for example, Lütkepohl, 2006), which shows, *ceteris paribus*, how *GDP* reacts over time after a positive shock in the number of foreign tourists (Figure 3). Figure 3 shows the cumulative effects of ln*T* on ln*GDP* over the years (1, 2, . . .) and hence the cumulative impact of a unit change in ln*T* on the variable ln*GDP* at each year. These results are in line with previous studies analysing the role of tourism in the local economy of South Tyrol (see Brida and Risso, 2010).

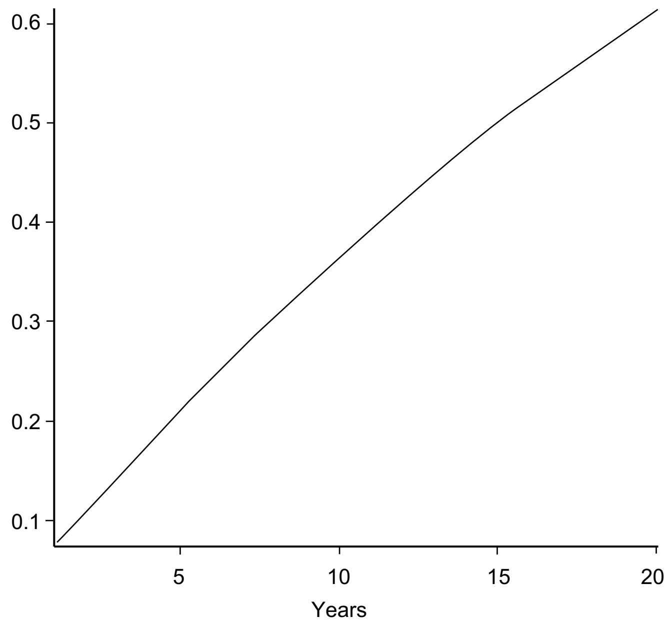

Figure 3. Impulse response function of ln*GDP* to ln*T*, South Tyrol.

Table 6. Diagnostic tests for estimated VECM (South Tyrol).

Test	*BG-LM*	LJB_L	KHB_{DH}	*ARCH-LM*
Test statistic	7.472	8.423	8.166	33.295
Distribution (approximated)	$\chi^2(9)$	$\chi^2(6)$	$\chi^2(6)$	$\chi^2(36)$
p-value	0.588	0.209	0.226	0.598

To check the adequacy of this modelling framework, we conducted some diagnostic tests for residual autocorrelation, non-normality and conditional heteroscedasticity. In particular, in order to check the first problematic effect, we performed the Breusch–Godfrey LM test (*BG-LM*) (see Lütkepohl, 2004). Non-normality is diagnosed by two multivariate Lomnicki–Jarque–Bera-based tests: those proposed by Lütkepohl (1991) (LJB_L) and Doornik and Hansen (1994) (LJB_{DH}). The third violation of assumption is detected by the *ARCH-LM* test (see Lütkepohl, 2004). The results are listed in Table 6, which shows that the null hypotheses of autocorrelation, non-normality and conditional heteroscedasticity are all rejected, thus implying that the model assumptions hold and that the VECM can properly represent the underlying data-generating process.

Trentino

This section briefly presents the results for Trentino. Tables 7, 8 and 9 show the results of the unit root tests, from which we see that ln*GDP* and ln*T* are *I*(1) and ln*RP* is *I*(2), in turn implying that a proper VECM to test cointegration should employ variables ln*GDP*, ln*T* and Δ(ln*RP*).

Turning now to the equilibrium relation among the variables, Table 10 lists the results of Johansen's cointegration tests, which provide evidence in favour of a stable long-run linear relationship.

The weak exogeneity of the variables is then tested: ln*T* and Δ(ln*RP*) can be considered as jointly exogenous, since the likelihood ratio test statistic is 2.95, *p*-value 0.2289. Therefore, the estimated long-run equilibrium in Trentino after testing weak exogeneity is the following:

$$\ln GDP_t = 5.94 + 0.\ 25 \ln T_t - 1.82\Delta(\ln RP)_t. \tag{3}$$

Table 7. Unit root test results: levels (Trentino).

Variable	ln*GDP*		ln*T*		ln*RP*	
Unit root tests	ADF	KPSS	ADF	KPSS	ADF	KPSS
Trend, constant	– 1.12	0.29[a]	– 1.78	0.14[b]	– 4.29[a]	0.25[a]
Constant	– 1.94	1.51[a]	– 1.03	1.54[a]	– 4.20[a]	0.92[a]
Without trend, constant	1.21		3.43		– 0.23	

Note: [a]Rejection of null hypothesis at 5%; [b] rejection of null hypothesis at 10%.

Table 8. Unit root test results: first differences (Trentino).

Variable	Δ(ln*GDP*)		Δ(ln*T*)		Δ(ln*RP*)	
Unit root tests	ADF	KPSS	ADF	KPSS	ADF	KPSS
Trend, constant	– 3.22[b]	0.08	– 3.69[a]	0.11	– 2.29	0.29[a]
Constant	– 2.40	0.29	– 3.74[a]	0.12	– 2.56	1.16[a]
Without trend, constant	– 1.60		– 2.53[a]		– 3.18[a]	

Note: [a]Rejection of null hypothesis at 5%; [b]rejection of null hypothesis at 10%.

Table 9. Unit root test results: second differences (Trentino).

Variable	Δ (Δ(ln*RP*))	
Unit root tests	ADF	KPSS
Trend, constant	– 4.80[a]	0.05
Constant	– 4.04[a]	0.25
Without trend, constant	– 3.38[a]	

Note: [a]Rejection of null hypothesis at 5%.

Table 10. Unrestricted cointegration rank test with no deterministic trend for ln*GDP*, ln*T* or Δ(ln*RP*) variables (Trentino).

Hypothesized number of CE	Eigenvalue	Trace statistics	5% Critical value	*p*-value**
None*	0.515	39.01	35.07	0.0169
At most 1	0.337	19.46	20.16	0.0629
At most 2	0.266	8.35	9.14	0.0717

Note: *Rejection of null hypothesis at 0.05 level; **MacKinnon *et al* (1999) *p*-values. Trace test indicates 1 cointegrating equation at 0.05 level.

Table 11. Granger causality test (Trentino).

Null hypothesis	*F*-statistic	*p*-value
ln*T* does not Granger-cause ln*GDP*	10.783	0.0005[a]
ln*GDP* does not Granger-cause ln*T*	2.298	0.1231
Δ(ln*RP*) does not Granger-cause ln*GDP*	11.662	0.0003[a]
ln*GDP* does not Granger-cause Δ(ln*RP*)	0.249	0.7815
Δ(ln*RP*) does not Granger-cause ln*T*	1.359	0.2768
ln*T* does not Granger-cause Δ(ln*RP*)	0.203	0.8176

Note: [a]Rejection of null hypothesis at 5%.

We are now in a position to test for Granger causality (Table 11). The null hypothesis that international tourism does not Granger-cause real *GDP* is rejected, thus validating the TLGH for Trentino. In particular, since the elasticity of ln*GDP* with respect to ln*T* is positive at 0.25, an increase in

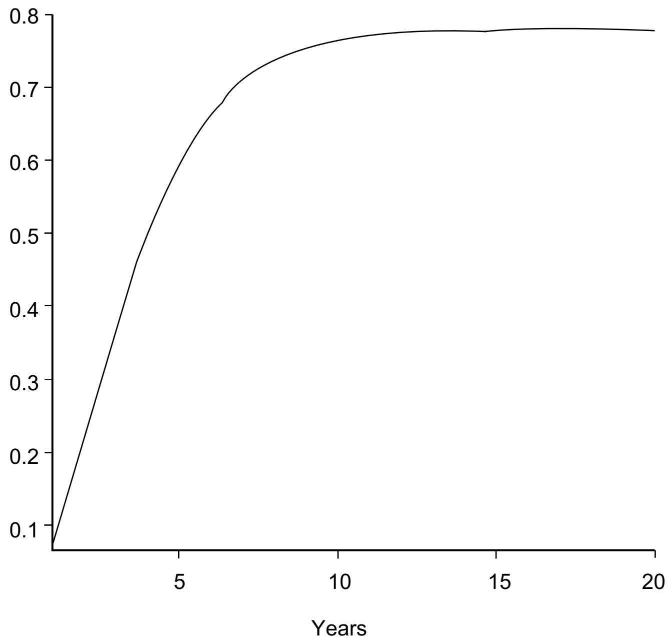

Figure 4. Impulse response function of ln*GDP* to ln*T*, Trentino.

tourism arrivals by 100% would potentially produce an increase of 25% in the total local output.

For more details of the temporal characteristics of this causal mechanism, the estimated impulse response function (Figure 4) shows that a positive shock in the number of foreign tourists induces *GDP* to grow for almost ten years, until the impact is absorbed. This temporal pattern is very different from that found for South Tyrol (Figure 3), in which a stimulus from the tourism sector has a lasting impact on the local economy. This evidence may be due to the fact that the South Tyrol tourism sector is more interdependent with the other sectors of economic activity than Trentino. However, our data do not allow us to prove this statement. More detailed data, such as input–output tables, are needed. We leave this interesting point to future research.

Lastly, the diagnostic statistics shown in Table 12 indicate that the results for Trentino are robust.

Table 12. Diagnostic tests for estimated VECM (Trentino).

Test	*BG-LM*	LJB_L	LJB_{DH}	*ARCH-LM*
Test statistic	8.254	5.650	7.730	48.178
Distribution (approximated)	$\chi^2(9)$	$\chi^2(6)$	$\chi^2(6)$	$\chi^2(36)$
p-value	0.509	0.464	0.259	0.084

Tyrol

The same methodological approach used to verify the validity of the TLGH for South Tyrol and Trentino is also applied here to the case of Tyrol. Tables 13, 14 and 15 show the results for the unit root tests; Table 16 lists the conclusion of the cointegration tests.

Table 13. Unit root test results: levels (Tyrol).

Variable	ln*GDP*		ln*T*		ln*RP*	
Unit root tests	ADF	KPSS	ADF	KPSS	ADF	KPSS
Trend, constant	– 2.10	0.16[a]	– 3.06	0.13[b]	– 3.34[b]	0.14[b]
Constant	– 0.72	1.35[a]	– 1.25	0.82[a]	– 2.21	1.01[a]
Without trend, constant	1.16		1.06		0.62	

Note: [a]Rejection of null hypothesis at 5%; [b]rejection of null hypothesis at 10%.

Table 14. Unit root tests results: first differences (Tyrol).

Variable	Δ(ln*GDP*)		Δ(ln*T*)		Δ(ln*RP*)	
Unit root tests	ADF	KPSS	ADF	KPSS	ADF	KPSS
Trend, constant	– 3.53[a]	0.09	– 3.40[a]	0.08	– 2.46	0.13[b]
Constant	– 3.62[a]	0.09	– 3.57[a]	0.10	– 2.32	0.25
Without trend, constant	– 3.34[a]		– 2.73[a]		– 2.00[a]	

Note: [a]Rejection of null hypothesis at 5%; [b]rejection of null hypothesis at 10%.

Table 15. Unit root tests results: second differences (Tyrol).

Variable	Δ (Δ(ln*RP*))	
Unit root tests	ADF	KPSS
Trend, constant	– 4.80[a]	0.05
Constant	– 4.04[a]	0.25
Without trend, constant	– 3.38[a]	

Note: [a]Rejection of null hypothesis at 5%.

Table 16. Unrestricted cointegration rank test with no deterministic trend for ln*GDP*, ln*T* and Δ(ln*RP*) variables (Tyrol).

Hypothesized number of CE	Eigenvalue	Trace statistics	5% Critical value	*p*-value**
None*	0.432	27.44	35.07	0.2707
At most 1	0.281	12.75	20.16	0.3927
At most 2	0.149	4.18	9.14	0.3975

Note: *denotes rejection of the hypothesis at the 0.05 level; **MacKinnon *et al* (1999) *p*-values.

Unlike the cases of South Tyrol and Trentino, the cointegration tests for Tyrol show that no cointegration exists between real *GDP*, international tourist arrivals and local relative inflation, since the null hypothesis of no cointegration relations cannot be rejected. Consequently, there is no convergence of the three variables to long-run equilibrium, and no causation exists between international tourist arrivals and real *GDP*, implying that the TLGH is not validated for the local economy of Tyrol.

Conclusion

This work validates the well known stylized assumption of the TLGH for Trentino, South Tyrol and Tyrol, three across-the-border regions located in Italy and Austria that have stipulated an outline convention on trans-frontier cooperation, the TST Europaregion. State-of-the-art time series econometric methods were applied for the purpose. The results indicate that the TLGH holds for South Tyrol and Trentino, since significant unidirectional causality exists between international tourism and the growth of their local economies. However, the impact of increases in tourism demand is stronger in South Tyrol (estimated elasticity of real output, 0.36) than in Trentino (estimated elasticity of real output, 0.25) and is also temporally more persistent in the former (as shown by analysis of the impulse response function). This empirical evidence is consistent with the fact that the tourism sector in South Tyrol is relatively larger than in Trentino. Quite surprisingly, in contrast, the TLGH was not validated for Tyrol, since no significant cointegrating relation was found between the time series of tourism demand and of local real *GDP*. This result is unexpected, because the Tyrol tourism sector is very similar (characterized by the same mountain-based tourist activities) to that of the other two regions and it is undeniably not much smaller (see section The tourism sector in the Tirol–Südtirol–Trentino Europaregion). An interesting problem therefore emerges for future studies.

We suggest two explanations for the lack of evidence in favour of the TLGH in Tyrol. Its economy is more complex and variegated, and is probably less dependent on tourism than that of Trentino and South Tyrol. Therefore, on one hand, the system of simultaneous linear equations we used may have been too simplified to represent the relationship between tourism and economic growth properly. On the other hand, the TLGH may not be valid for economies that are not strictly dependent on the tourism sector, even though it may be large. The vast majority of empirical studies that have confirmed the validity of the TLGH examined highly tourism-oriented economies. We therefore argue that advances in study of TLGH from both theoretical and methodological perspectives may be accomplished with non-linear cointegration methods (see, for example, Park and Phillips, 2001; de Jong, 2002) and analysing economies in which tourism, although important, does not necessarily represent the main strategic factor of growth.

Endnotes

1. http://epp.eurostat.ec.europa.eu
2. Hotels and similar establishments, tourist campsites, holiday dwellings and other collective accommodation.

3. However, the elasticity of variable Δ(*RP*) has no straightforward economic meaning. The purpose of introducing Δ(*RP*) in the model is merely to control for the effects of external competitiveness, to obtain valid inferences from our variable of interest, international tourist arrivals.

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