An Unobserved Component Model to evaluate the
determinants of demand for exports of tourism

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Abstract

The present paper analyses the dynamic behaviours of the main determinants of tourism demand
for France, Greece, Spain and Australia. In addition to the traditional variables affecting the
demand for exports of tourism, namely price and foreign income, an unobserved component in the
form of time varying trend enters the tourism equations to capture underlying competitiveness. The
structural modelling approach within an error correction framework allows us to isolate the different
sources of tourism fluctuations and to better assess the contribution of each set of variables to
export flows. The findings confirm that stochastic trends are present as result of consumer tastes,
technical change and other exogenous factors driving tourism flows, and that a failure to account
for these trends will lead to biased estimates of long-run price and income elasticities.

Keywords: tourism exports, stochastic trends, price elasticities, ECM

1 Introduction

This paper investigates the demand for exports of international tourism of a group of
economies within a structural time series framework. The traditional models of tourism
demand specify two key determinants of tourism receipts and, in general, tourism
performance, price competitiveness and income. Empirical evidence suggests that the two
components alone do not explain entirely tourism flows, factors such as changes in tastes
and preferences (i.e. non-price competitiveness component) may also play a crucial role.
The work, therefore, introduces an unobserved component in the form of time-varying
trend in the considered tourism demand equation to pick up stochastic unmodelled
behaviours of the series and to avoid spurious regressions.

In the field of international tourism economics the unobserved component model has
not been adopted yet. Most of empirical trade works has been, in fact, confined to the
estimation of demand functions for tourism that resemble the imperfect substitute model,
i.e. regressing exports of tourism on the level of economic activity at home or abroad and
on relative travel prices and cost of living, with attention closely focused on the estimated
income and price elasticities. The novelty of this work consists in applying for the first time
the technique to a set of countries in order to have a more precise estimation of factors
influencing tourism exports and to extract all the possible information from the time series
by isolating the regularities and “laws” governing tourism fluctuations.

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We thank seminar participants at the 1st QATEM Workshop on quantitative approaches in tourism economics and
management (Perpignan, 27 June 2008) for useful comments.
The analysis is conducted for four countries with strong tourism tradition, namely Australia, France, Greece and Spain and covers the period going from 1985:1 to 2006:1. Quarterly data are used.

The paper is organised as follows: Section 2 presents the economic literature on tourism. Section 3 outlines the theoretical framework to assess tourism demand equations and sets out the model. Section 4 provides the empirical results and discusses the findings. Section 5 concludes.

2 Literature Review

Tourism’s growing contribution to national economies has been accompanied by the need to understand the main factors that can determine demand levels. Tourism demand can be assessed by a host of variables including tourist arrivals, overnight stays, real revenues, real expenditures and visits per head of the origin’s population. In the literature, most studies have attempted to model tourism demand within a time series framework using single equation models or equation system models.

Single equation models have been adopted by Loeb (1982), Uysal and Crompton (1984), Martin and Witt (1989), Crouch et al (1992), Chan (1993), Morley (1994), Morris (1995) and Walsh (1996). These authors have used least square regression to compute the level of tourist arrivals in a particular country as a linear function of the factors (such as income, price and special events) that influence arrivals. Remaining autocorrelations have been corrected using the Cochrane-Orcutt procedure. Shortcomings of these studies are embedded in the stationary paradigm they adopt: in fact, if variables are not stationary results will be spurious and estimates will be biased. Put differently, these works fail to quantify the changes in demand behaviour that occur over time. The considerable advances in econometric methodology during recent years have brought many authors to adopt more sophisticated approaches – see, for example, Gonzales and Moral (1995), Kulendran (1996), Kulendran and King (1997), Chu (1998), Lathiras and Siriopoulos (1998), Vogt and Wittayakorn (1998), Lim et. al. (2001), Payne and Mervar (2002), Hellström (2002), and Ferro Luzzi and Flückiger (2003), Vogt (2008). All these works operate within the framework of structural models and have the advantage of clear treatment of the time dimension of tourism demand\(^1\). Systems of equations were based on the Almost Ideal Demand System (AIDS) as developed by Deaton and Muellbauer (1980). Pioneering studies to extend the approach to tourism demand were those of O’Hagan and Harrison (1984) and Syriopoulos and Sinclair (1993). The first two authors gauged the US tourism demand in several destinations between 1964 and 1981. Syriopoulos and Sinclair estimated an Almost Ideal Demand System model for a group of European and Mediterranean countries. Later on, Papatheodorou (1999) conducted a parallel study to the one of Syriopoulos and Sinclair (1993) using the AIDS model with the addition of a time trend to analyse the demand for international tourism in the Mediterranean regions. Lyssiotou (2001) specified a non-linear dynamic AIDS model to examine the British demand for tourism. De Mello et al. (2002) applied the Almost Ideal Demand System to the UK demand for tourism in the neighbouring destinations, France, Spain and Portugal. Divisekera (2003) adopted the same structure to Japan, New Zealand, UK and US demands for tourism to Australia and other selected destinations. More recently, Han et al. (2006) have adopted the AIDS model, in conjunction with a cointegration analysis, to provide estimates of price and income elasticity of the US tourism demand.

\(^1\) For a comprehensive literature review see Lim (1999) and Li, Song and Witt (2005).
As noted by Gonzales and Moral (1995) and Li, Song and Witt (2005), a problem linked to such analyses is the difficulty to measure a variety of socio-economic factors, namely the preferences of tourists and the popularity of tourism destinations. These variables are either not considered in the analytical works or a deterministic trend is used to proxy their effect. It should be noted that the use of a deterministic trend seems not reasonable as it would imply that the variables that represents i.e. preferences, popularity of the destination, evolve at an unchanging rate over time. In this paper an unobserved component (UC) model, in the form of time stochastic trend, is adopted to overcome such a drawback. The unobserved component, in fact, will capture any unobserved behaviour of the tourism demand series.

3 Econometric methodology

3.1 An Unobserved component model for trade

The basic structure of the unobserved component model was developed by Harvey (1989), Harvey and Shephard (1993) and Harvey and Scott (1994) with the purpose to build an approach in which the concept of equilibrium could have been interpreted in a more dynamic perspective. The framework starts with the following equation:

\[ y_t = \alpha + \pi x_t + \mu_t + \varepsilon_t \] (1)

Where \( \alpha \) is a constant, \( x_t \) is a kx1 vector of exogenous regressors, \( \pi_t \) is a kx1 vector of coefficients, \( \mu_t \) is the time-varying trend or unobserved component, \( \varepsilon_t \) is an irregular or transient component normally distributed with zero mean and constant variance. The \( x_t \) vector includes lagged values of the dependent variable as well lagged values of exogenous variables.

In general, the trend component \( \mu_t \) assumes the local linear specification as reported below:

\[ \mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \quad \eta_t \approx NID(0, \sigma^2_\eta) \] (2)

\[ \beta_t = \beta_{t-1} + \xi_t \quad \xi_t \approx NID(0, \sigma^2_\xi) \] (3)

where equation (2) defines the level of the trend and equation (3) its slope (\( \beta \)), i.e. its growth rate. \( \eta_t, \xi_t \) and \( \varepsilon_t \) are normally distributed stochastic error terms independent from each other in all time period. The local linear trend specifies both the level and the slope to be stochastic, but the trend can also be a random walk with drift (local level with drift) when \( \sigma^2_\xi = 0 \) or random walk without drift (local level) when \( \sigma^2_\xi = 0 \) and \( \beta=0 \). The model collapses to a global or deterministic trend when \( \sigma^2_\eta = \sigma^2_\xi = 0 \). It is important noting that to have a stationary disturbance term it is necessary differencing twice in the case of local linear trend, it is instead necessary to difference once in the case of local level with or without drift and deterministic trend (Harvey and Scott, 1994). In the latter case, equation (1) becomes:

\[ \Delta y_t = \alpha + \pi \Delta x_t + \delta \Delta x_{t-1} + \mu_t + \varepsilon_t \] (4)

Where the lagged variables constitute the long run dynamics and the differenced ones (\( \Delta \)) represent the short run dynamics.
3.2 The ECM specification

A generalised formulation of our error correction model for tourism exports incorporating an unobserved component and allowing for relative price fluctuation can be expressed as follows:

\[
\begin{align*}
\Delta \log \text{rev}_t &= \delta_1 \Delta \log \text{cl}_t + \delta_2 \Delta \log \text{ct}_t + \delta_3 \Delta \log \text{gdp}_t - \gamma_1 \log \text{rev}_{t-1} + \gamma_2 \log \text{cl}_{t-1} + \gamma_3 \log \text{ct}_{t-1} + \gamma_4 \log \text{gdp}_{t-1} + \mu_t + \epsilon_t
\end{align*}
\]

(5)

\[
\begin{align*}
\mu_t &= \mu_{t-1} + \beta_{\mu-1} + \eta_t, \quad \eta_t \approx \text{NID}(0, \sigma_\eta^2) \quad (6)
\end{align*}
\]

\[
\begin{align*}
\beta_t &= \beta_{t-1} + \xi_t, \quad \xi_t \approx \text{NID}(0, \sigma_\xi^2) \quad (7)
\end{align*}
\]

In our tourism model, the dependent variable is country \(i\)'s international tourism receipts\(^3\) (\(\text{rev}_t\)), the chosen explanatory variables include income and prices variables. The international tourism receipts in dollar at constant prices (2000=100) are taken by OECD, Balance of Payments statistics (2007). Income is expressed in terms of real world GDP (\(\text{gdp}_t\)). Figures have been taken from OECD data stream. The price variable is broken down into two additional series: the cost of living for tourists in the chosen destination (\(\text{cl}_t\)) and the cost of travel to the destination (\(\text{ct}_t\)). The cost of living index is constructed as the ratio between country \(i\)'s CPI and an aggregate of CPI of the client countries\(^4\) adjusted by the nominal effective exchange rate.

An increase in country \(i\)'s CPI or real effective exchange rate implies a reduced competitiveness of that tourist destinations. The considered costs of travel are oil prices based 2000 and they have been collected from the Energy Information Administrator (see Appendix for a complete list overview of the series).

In equation 5, \(\Delta\) is the difference operator, \(\log\) is logarithm; \(\mu\), the latent component, mirrors different phenomena, namely the changes in tourism tastes, the political environment, globalisation of tourism destination, and the requests for increasing quality standards on tourism demand side. \(\epsilon\), \(\xi\) and \(\eta\) are stochastic error terms, normally and identically distributed. The lagged variables represent the long-run equilibrium equation, while the differenced variables define the short run equilibrium.

4. Econometric Analysis

4.1 Variable Analysis

The order of integration in each series has been tested using the adjusted Dickey Fuller (ADF) (Dickey and Fuller, 1979) and the Phillips-Perron (PP) (Phillips and Perron, 1988) tests. The results for the individual time series are reported in Table 1. The critical values

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\(^2\) According to the ECM

\[
\begin{align*}
\Delta \log \text{rev}_t &= \delta_1 \Delta \log \text{cl}_t + \delta_2 \Delta \log \text{ct}_t + \delta_3 \Delta \log \text{gdp}_t - \lambda (\alpha_1 \log \text{rev}_{t-1} - \alpha_2 \log \text{cl}_{t-1} - \alpha_3 \log \text{ct}_{t-1} - \alpha_4 \log \text{gdp}_{t-1} - \alpha_5 \mu_t) + \epsilon_t
\end{align*}
\]

which is the expression formulated by Harvey (1989). Equation (1) is obtained by defining \(\alpha_1=1, \lambda=\gamma_1; \quad \alpha_2=\gamma_2, \alpha_3=\gamma_3, \alpha_4=1/\lambda\).

\(^3\) Following the UN and UNWTO (1994) definitions, international tourism receipts are tourism exports. They are obtained from the item “travel, credits” of the Balance of Payments of each country and correspond to the “expenditure of non-resident visitors (tourists and same-day visitors)” within the economic territory of the country of reference.

\(^4\) The set of client countries considered are those countries, which represent more than 70% of tourist visits to country \(i\). The weighting system reflects the relative importance of each country as far as number of tourists is concerned.
are those computed by McKinnon, the tests include an intercept since this specification is a plausible description of the considered data. The proper lag length has been selected on the basis of the Schwarz Bayesian Criterion (SBC), which chooses the appropriate lag length by trading off parsimony against reduction in the sum of squares. As the fit of the model increases, the SBC will approach to $-\infty$. The PP test uses instead the Newey-West bandwidth to select the proper lag structure.

**Table 1 Unit Root Test**

Null Hypothesis: there is a unit root

<table>
<thead>
<tr>
<th></th>
<th>Augmented Dickey-Fuller test statistic**</th>
<th>Phillip-Perron test statistic***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADF Level</td>
<td>ADF 1st difference</td>
</tr>
<tr>
<td>lg ct</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lg gdp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lg rev</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>0.457140</td>
<td>0.8111</td>
</tr>
<tr>
<td>Greece</td>
<td>-1.392765</td>
<td>0.9582</td>
</tr>
<tr>
<td>Spain</td>
<td>-0.544395</td>
<td>0.8760</td>
</tr>
<tr>
<td>Australia</td>
<td>-0.676150</td>
<td>0.8463</td>
</tr>
<tr>
<td>lg cl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>-0.425602</td>
<td>0.8990</td>
</tr>
<tr>
<td>Greece</td>
<td>-1.762885</td>
<td>0.3962</td>
</tr>
<tr>
<td>Spain</td>
<td>-1.125348</td>
<td>0.7023</td>
</tr>
<tr>
<td>Australia</td>
<td>-1.899035</td>
<td>0.9858</td>
</tr>
</tbody>
</table>

**Lag Length:** Automatic based Schwarz Information Criterion

**Note:** *MacKinnon (1996) one-sided p-values.

The tourism receipts, the relative cost of living price, the cost of travel and the income series for each considered country are integrated of order one I(1), i.e. the series become stationary after the first differentiation. A divergent result between the two tests was found for Greece regarding the cost of living (Table 1). Following the ADF test, in fact the series is integrated of order two, whilst according the PP test the series is an I(1) process (Table 1).

We decide to follow the PP results because the test is considered more powerful than the ADF, as the former uses consistent estimators of the variance. We can therefore conclude that all the series are random walk processes.

### 4.2 Estimates of Export equations with unobserved components

Being all the variables I (1), the appropriate specification of the model is a local level with or without drift. All estimations and test statistics were produced with the econometric software STAMP 7 (Koopmans and al.2006), which maximises a likelihood function using the Kalman Filter with diffuse initial conditions.

The estimation report of equations 5-7 and the diagnostic summary concerning the setting with stochastic trend (stochastic level, fixed slope) for the four countries are displayed in Table 2.
### Table 2 - Export equations of Tourism estimated with fixed slope

<table>
<thead>
<tr>
<th>1985:1-2006:1</th>
<th>France</th>
<th>Greece</th>
<th>Spain</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fundamental Part</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagged export tourism revenues</td>
<td>-0.13 (0.039)</td>
<td>-0.35 (0.078)</td>
<td>-0.22 (0.066)</td>
<td>-0.164 (0.016)</td>
</tr>
<tr>
<td>Lagged cost of living</td>
<td>-0.13 (0.536)</td>
<td>-0.31 (0.139)</td>
<td>-0.23 (0.528)</td>
<td>-0.84 (0.112)</td>
</tr>
<tr>
<td>Lagged cost of travel</td>
<td>-0.015 (0.008)</td>
<td>-0.043 (0.636)</td>
<td>-0.034 (0.400)</td>
<td>-0.51 (0.213)</td>
</tr>
<tr>
<td>Lagged income</td>
<td>0.59 (0.136)</td>
<td>1.22 (0.636)</td>
<td>0.88 (0.400)</td>
<td>1.17 (0.213)</td>
</tr>
<tr>
<td>Different variables D_rev_1</td>
<td>D_rev_1</td>
<td>D_rev_1</td>
<td>D_rev_1</td>
<td>D_rev_1</td>
</tr>
<tr>
<td>D_income_2</td>
<td>D_cost of travel_3</td>
<td>D_cost of travel_1</td>
<td>D_cost of travel_4</td>
<td>D_cost of travel_4</td>
</tr>
<tr>
<td>D_income_4</td>
<td>D_cost of living_4</td>
<td>D_cost of living_4</td>
<td>D_cost of living_4</td>
<td>D_cost of living_4</td>
</tr>
<tr>
<td><strong>Trend decomposition, standard deviations of disturbances (10^2)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>σε Irregular</td>
<td>0.27</td>
<td>0.50</td>
<td>0.24</td>
<td>1.3</td>
</tr>
<tr>
<td>σε trend</td>
<td>0.96</td>
<td>1.63</td>
<td>1.11</td>
<td>0.15</td>
</tr>
<tr>
<td>q ratio</td>
<td>0.28</td>
<td>0.31</td>
<td>0.22</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Trend Analysis at end of period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>0.21</td>
<td>0.11</td>
<td>2.68</td>
<td>1.78</td>
</tr>
<tr>
<td>Growth rate per year</td>
<td>-1.04%</td>
<td>1.36%</td>
<td>-1.11%</td>
<td>1.57%</td>
</tr>
</tbody>
</table>

**Residuals tests**

| Std error (10^2) | 0.94 | 1.58 | 1.06 | 1.27 |
| Normality | 3.49 | 1.67 | 1.31 | 5.0 |
| H(h) | 0.72 H(26) | 0.31 H(24) | 0.85 H(25) | 0.93 H(25) |
| r(1) (10^2) | -4.5 | -0.1 | -0.7 | -4.6 |
| r(7) (10^2) | 18.9 | 2.59 | 12.4 | 11.5 |
| DW | 1.94 | 1.95 | 1.96 | 1.74 |
| Q(8.7) | 8.31 | 8.26 | 13.57 | 2.78 |
| Rd^2(10^2) | 63.8 | 62.9 | 53.0 | 69.5 |

**Goodness of fit results for residuals**

| Prediction error variance (p.e.v.) | 0.000090 | 0.000253 | 0.000114 | 0.000161 |
| Ratio p.e.v./prediction error mean deviation | 1.2 | 1.2 | 1.2 | 1.4 |
| AIC | -8.97 | -7.86 | -8.68 | -8.31 |

**Convergence**

| Very strong | yes | yes | yes | yes |

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1. The method of estimation is Maximum Log-likelihood. The State is estimated through a Kalman filter.
2. Outliers relative to 1988:1 and 1999:1 were added to the export equation for Australia. Three outliers relative to 1989:1 1993:1 and 1997:1 were introduced in the export equation for France. Two outliers relative to 1991:4 and 1998:4 were introduced in the export equation for Greece. Three outliers relative to 1988:4, 1993:1 and 2002:4 were added to Spain.
3. The level p-values are equal to 0.0%.
4. Normality is tested according to the Jarque-Bera statistic. The latter has a Chi-Square distribution with two degrees of freedom under the null hypothesis of normally distributed errors. We reject the null if the calculated probability exceeds the tabulated ones equal to 5.99 at 5% significance level and 9.21% at 1% significance level. H(h) is the heteroskedasticity test statistics distributed as a F(h,h) with (h,h) degrees of freedom. Under the null of no heteroskedasticity and for h=26, the 5% critical value is 1.93; for h=25 the 5% critical value is 1.96 and for h=24 the 5% critical value is 1.98. r(1) and r(7) are the serial correlation coefficients at the 1st and 7th distributed as a N(0;1/T), T being the number of observations. Rho < 0.02 at 5%. DW is the classical Durbin Watson test distributed as N(2, 4/T). Q(P,d) is the Ljung Box statistics based on the sum of the first P autocorrelations and it is tested against a Chi- Square distribution with d degrees of freedom. The null hypothesis of no autocorrelation is tested against the alternative of autocorrelation. The critical value for 7 degrees of freedom is 14.07 at 5% significance level.
5. The prediction error variance (p.e.v) is the variance of the one-step ahead prediction errors in the steady state. It gives a measure of the precision of a model's predictions. A low p.e.v. (tending to zero) means that good predictions are obtained at that point. A ratio p.e.v./ prediction error mean deviation in squares near to 1 means that the model is correctly specified. AIC is the Akaike Information criterion used to select the proper model estimation.
Interventions, in the form of irregular and level components were introduced where residuals of tourism exports exhibited an outlier. More clearly, irregular interventions are like dummy variables, they correct for transitory, non typical observations. Level interventions accommodate permanent step shift in the series; they resemble structural breaks. The estimation reports (Table 2) give information about convergence (i.e., strong or weak convergence), the maximized value of the log-likelihood function, the prediction error variance and a set of summary statistics for the estimated residuals, such as a normality test, the Box-Ljung and Durbin-Watson tests for absence of serial correlation and a test for the absence of heteroskedasticity.

More specifically, normality is tested according to the Doornik-Hansen correction to the Bowman-Shenton statistic. The latter has a Chi-Square distribution with two degrees of freedom under the null hypothesis of normally distributed errors. We reject the null if the calculated probability exceeds the tabulated ones equal to 5.99 at 5% significance level and 9.21% at 1% significance level. The heteroskedasticity test statistics (H(h)) is distributed as a F(h,h) with (h,h) degrees of freedom. Under the null of no heteroskedasticity and for h=24-26, the 5% critical value ranges between 1.93 and 1.98. The serial correlation coefficients (r) at the 1st and 7th lag are distributed as a N(0;1/T), T being the number of observations. Rho < 0.02 at 5%. The classical Durbin Watson test is distributed as N(2,4/T). The Ljung Box statistics (Q(P,d)) is based on the sum of the first P autocorrelations and it is tested against a Chi-Square distribution with d degrees of freedom. The null hypothesis of no autocorrelation is tested against the alternative of autocorrelation. The critical value for 7 degrees of freedom is 14.07 at 5% significance level.

Table 2 shows that the estimated coefficient display the expected signs. The diagnostic checking rejects the presence of serial correlation, heteroskedasticity and non-normality. The estimates show good explanatory power for all countries as highlighted by the R² values. The correct specification of the model is testified by the low values of the prediction error variance, i.e. the variance of the one-step ahead prediction errors in the steady state, and by the ratio of the prediction error variance and the mean deviation in squares near to 1. Finally, the model strongly converged in few iterations which is generally an indication of good results (Koopman et al. 1995, p. 222).

The long run relationship implied by this setting is:

$$\text{lg } \text{rev}_{it} = \gamma_2 \text{ cl}_{it} + \gamma_3 \text{ gdp}_{it} + \gamma_4 \text{ gdp}_{it} + \frac{1}{\gamma_1} \mu_{it+1}$$

where the stochastic trend $\mu_{it+1}$ is given by

$$\mu_{it+1} = \mu_{it} + \beta + \eta_{it+1}$$

Table 3 reports the long run tourism export equations, given the estimates of coefficients and the hyper-parameters, $\sigma^{2}_{\eta}$ and $\sigma^{2}_{\xi}$.

In line with the literature, cost of living, cost of travel and world industrial output are highly significant and enter the final equation with the expected signs. An upsurge in the cost of living causes a consistent drop in tourism revenue, whilst a rise in world output may give rise to higher tourism receipts. The coefficient of world output is positive, highlighting that tourism revenues are very sensitive to changes in world output. The estimated income elasticities, since exceed unity, show that foreign tourism is regarded as a ‘luxury’. Economic theory, in fact, considers foreign holidays ‘superior’ goods, and thus an increase
in income is expected to increase demand. The elasticity of Greece, Spain and Australia are within the range of income measures (i.e., 0.4–6.6) reported in the survey by Witt and Witt (1995). The elasticity of France instead falls outside. The values of estimated elasticities vary considerably, because low figures refer to travel within a country. In this case, ‘domestic tourism’ is more a necessity than a ‘luxury’, whereas overseas travel is seen as a ‘luxury’ and shows high income elasticities.

Here, income is the main determinant of tourism exports for Greece and Australia, but not for France and Spain where the costs of living are the major factor that drives tourism revenues. The coefficient of the price variable should be interpreted as an indicator of competitiveness, such that if strong competition from alternative destinations is overcome, the payoff can be significant. A real appreciation makes country i destinations less competitive and attractive for tourists. The impact is quite significant: in particular, a 1% increase in the index induces a fall in revenues by 7.9%, 1.02%, 5.6% and 5.2% in France, Greece, Spain and Australia.

An increase in oil price of 1% reduces revenues by 0.38% in France, 0.12% in Greece, 0.15% in Spain and 3.1% in Australia; this impact is not as relevant with the exception of Australia, likely due to the fact that higher oil prices experienced in recent years have been absorbed by the European markets and have had only a marginal effect on tourism demand. This is in line with a recent work conducted by UNWTO (UNWTO, WTB vol. 5 no. 2 June 2007).

Finally, Table 3 shows that the stochastic trends are all statistically significant and they have a long-run elasticity greater than one for all the considered countries, with France and Australia having the largest values. This implies the presence of substantial unobserved long-run effects, which are effectively captured by the stochastic trend.

<table>
<thead>
<tr>
<th>Table 3 Long-run export volumes relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \lg \ rev_t = \frac{\gamma_2}{\gamma_1} \ cl_t + \frac{\gamma_3}{\gamma_1} \ lg \ ct_t + \frac{\gamma_4}{\gamma_1} \ lg \ gdp_t + \frac{1}{\gamma_1} \mu_{t+1} )</td>
</tr>
</tbody>
</table>

**France**
\[
\lg \ rev_t = -7.91 \ lg \ cl_t - 0.38 \ lg \ ct_t + 4.5 \ lg \ gdp_t + 7.6 \mu_{t+1}
\]
\( \mu_{t+1} = \mu_t + \beta + \eta_{t+1} \)
\( t \)-values in parentheses:
- \( \mu_{t+1} \): (4.38)
- \( \beta \): (1.87)
- \( \eta_{t+1} \): (-1.92)

**Greece**
\[
\lg \ rev_t = -1.02 \ lg \ cl_t - 0.12 \ lg \ ct_t + 3.51 \ lg \ gdp_t + 2.9 \mu_{t+1}
\]
\( \mu_{t+1} = \mu_t + \beta + \eta_{t+1} \)
\( t \)-values in parentheses:
- \( \mu_{t+1} \): (1.92)
- \( \beta \): (1.95)
- \( \eta_{t+1} \): (-2.23)

**Spain**
\[
\lg \ rev_t = -5.61 \ lg \ cl_t - 0.15 \ lg \ ct_t + 4.1 \ lg \ gdp_t + 4.5 \mu_{t+1}
\]
\( \mu_{t+1} = \mu_t - \beta + \eta_{t+1} \)
\( t \)-values in parentheses:
- \( \mu_{t+1} \): (2.20)
- \( \beta \): (3.78)
- \( \eta_{t+1} \): (-3.33)

**Australia**
\[
\lg \ rev_t = -5.21 \ lg \ cl_t - 3.11 \ lg \ ct_t + 7.21 \ lg \ gdp_t + 6.1 \mu_{t+1}
\]
\( \mu_{t+1} = \mu_t + \beta + \eta_{t+1} \)
\( t \)-values in parentheses:
- \( \mu_{t+1} \): (5.49)
- \( \beta \): (6.37)
- \( \eta_{t+1} \): (-7.5)

Notation: \( rev \) = tourism revenue (or tourism exports), \( cl \) = cost of living, \( ct \) = cost of travel, \( gdp \) = income. \( T \)-values in brackets.
It should be noted that the trend is the long-run component in the series and indicates the general direction in which the series is moving. The extent to which trend component evolves over time depends on the parameters $\sigma^2_\eta$ and $\sigma^2_\varepsilon$ which have been estimated by maximum likelihood in the time domain. Table 2 reports the estimated standard deviations and the signal-to-noise ratio of the residuals driving the unobserved component.

Being the signal-to-noise ratio different from zero, the permanent component is confirmed to be stochastic. If the signal-to-noise ratio were equal to zero, the time-series model representing a decomposition into permanent plus transient components would have contained a deterministic trend. Moreover, since the proportion that is not explained by the model, i.e., the transitory noise, is minimised, this model is well specified. The contribution of the trend component to the annual rate of tourism export growth within sample is positive for all the countries with the exception of France and Spain. The trend term reduces tourism export performance by 1.04% and 1.11% per year in the two countries (Table 2). The negative trend effect could be imputed to a change in the attractiveness of a destination country as a result of changing tastes of tourists. Moreover, France and Spain are more mature market than Australia and Greece. From the estimated long-run elasticities, the following conclusions can be drawn. For the growth and development of their tourism industry, the considered countries need to maintain price and non-price competitiveness. To be price- and non-price competitive in the long run, policy makers should make concerted efforts to diversify tourism offers, in order to reduce tourism seasonality, attract tourists throughout the year and satisfy different tourist tastes. This will help to contain prices and make better use of the great variety of possibilities that tourism can offer. A better policy of price discrimination would thus help the tourism industry grow stronger.

5 Conclusions

This paper has investigated the long-run determinants of tourism demand of France, Greece, Spain and Australia, using a structural time series approach based on an unobserved component model. In the traditional models of tourism exports, price competitiveness and income are the main variables which influence export performance. This paper introduces a non-price dimension of competitiveness to model tourism export equation. This methodology allows us to pick up underlying changes in tourism export performance after controlling for the impact of price competitiveness and income. If the non price information were in fact overlooked, the long-run export equations would be misspecified and spurious regressions would have occurred. The adopted approach therefore overcomes any misspecification by proxying any long-run variation with a latent component in the form of time-varying trend.

The results indicate that cost of living is the main significant factor to push tourism revenues in France and Spain, while income is the main driver for Greece and Australia. Additionally, oil price changes do not have a considerable impact on tourism exports with the exception of Australia. The model shows also how significant are time stochastic trends in explaining the core performance of tourism exports. Using a set of diagnostic checking we fail to detect any misspecification. Besides, the signal-to-noise testifies that the model is well specified since the transitory noise is minimized.

The estimated stochastic trend elasticities are well above the unity showing how they effectively capture the changes that occurred during the years in the four countries. The estimated price and income elasticities are all elastic.
References


Appendix

Data Sources and Definitions

<table>
<thead>
<tr>
<th>Series</th>
<th>Source and Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real revenue from international visitors</td>
<td>Data refer to “travel” (credit), a the component of services in the current account the balance of payments. Data were supplied by Main Economic Indicators OECD (2008). To control for seasonal changes data were seasonally adjusted.</td>
</tr>
<tr>
<td>Real World Production (2000=100)</td>
<td>GDP data have been taken from the OECD Main Economic Indicators (2007). To control for seasonal changes data were seasonally adjusted.</td>
</tr>
<tr>
<td>Cost of living index (2000=100)</td>
<td>The cost of living was computed as follows:</td>
</tr>
<tr>
<td></td>
<td>[ CL_i = \left( \frac{\sum_{j=1}^{N} CPI_{service}^j \cdot E}{\sum_{j=1}^{N} CPI_{service}^j} \right) ]</td>
</tr>
<tr>
<td></td>
<td>Where the service CPI excludes housing and ( i \neq j ); ( j ) stands for the group of client countries (namely Germany, the USA, the UK, France, Austria and Spain); ( E ) is the nominal effective exchange rate. CPI data have been collected from the Statistics Warehouse published by the European Central Bank. The exchange rate values were extracted from OECD Main Economic Indicators.</td>
</tr>
<tr>
<td>Cost of travel</td>
<td>The Europe Brent spot price taken from the Energy Information Administration (2007) was used for the cost of travel</td>
</tr>
</tbody>
</table>
|                                             | http://tonto.eia.doc.gov/dnav/pet/hist/rbrteM.htm