Modelling The Predictable Uncertainty In British And German Tourist Arrivals To The Balearic Islands

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EXTENDED ABSTRACT

International tourism is an important source of service exports to Spain and its regions, particularly the Balearic Islands. Tourism is the major industry in the Balearic Islands, accounting for about 85% of GDP (see Riera, 2003). This paper examines the time series properties of international tourism demand to the Balearic Islands. The data set comprises monthly figures from two leading tourist source countries, namely UK and Germany, for the period January 1987 to October 2003. Tourist arrivals and the associated volatility (or uncertainty) of monthly tourist arrivals are estimated for the two data series. The univariate models estimates suggest that (log) British tourist arrivals are stationary around a linear trend with stable seasonal patterns whereas (log) German arrivals are non-stationary, both in the trend and in the seasonal pattern. Moreover, conditional volatility models provide an accurate measure of uncertainty in monthly tourist arrivals from the UK and Germany. The estimated conditional correlations indicate that the two markets were segmented, so that (the logarithm of) tourist arrivals from both the UK and Germany should be considered in any tourism marketing and management plans for the Balearic Islands.

The region of the Balearic Islands is a leading tourist destination in Spain, and also one of the most important tourist destinations in the Mediterranean Sea. Located in the Mediterranean, off the north-east coast of mainland Spain, and close to Barcelona and Valencia, the region comprises three main islands, namely Ibiza, Mallorca and Menorca, and two tiny and unspoilt islands, namely Formentera (south of Ibiza) and Cabrera (off the southern coast of Mallorca).

In the last 40 years, the Balearic Islands have changed from a quiet and rural area into one of Spain's richest regions, with GDP per capita on a par with the EU average, and well above the Spanish average. Such a transformation has been predominantly due to the boom in tourism, which now contributes around 85% of regional GDP. The Balearic Islands have one of the highest tourist rates per capita in the world, with an average of 10 million tourists a year for a population of less than 1 million (see Riera (2003)).

The traditional tourism source market for the Balearic Islands has been Northern Europe, in particular, the UK and Germany. More than 95% of the international tourists to the Balearic Islands arrive by air. The main characteristics of tourism to these Islands have been discussed in Capó et al. (2003) and Riera, Rosselló and Sansó (2004). A brief account of the characteristics discussed in these studies is as follows.

(i) Predominance of "sun and sand" mass tourism

Tourists usually visit Mallorca on a package tour, which includes transport, accommodation and some board, and remain in the island for about 10.5 days. However, the yearly tourist expenditure survey (see Aguiló et al. for different years) reflects a downward trend of the length of stay length. A new feature of tourism to the Balearic Islands is the German tourists having bought second residences in Mallorca over the past decade.

(ii) High repeat rate

Only 25% of tourists who visit Mallorca are doing so for the first time (see the annual tourist expenditure survey; Aguiló et al. for different years).

(iii) High degree of seasonality

Tourists visit Mallorca mainly for its beaches and pleasant climate. The vast majority of tourists visit during the spring and autumn months, and especially during the summer months. The months from May to September attract about 80% of the total number of tourist arrivals.

(iv) Predominance of international tourists

Domestic tourism from Spain represents less than 15% of the total tourist arrivals. Within international tourism, British and German tourists jointly represent more than 80% of total tourist arrivals.

1. INTRODUCTION

The overwhelming dependence on tourism represents a great challenge for the Balearic Islands. Tourism revenues are seasonal, create uneven demands on infrastructure, cause concerns about environmental issues, and fluctuate according to global trends (for further details, see Riera 2003). As such, tourism shocks do not have the same variability over time. Uncertainty may be due to various unexpected factors, such as changes in disposable income and wealth, advertising campaigns, random events, and social factors.

To sum up, monthly tourist arrivals data show the predominance of "sun and sand" tourism in the passenger data for total international tourist arrivals, as well as tourist arrivals from the UK and Germany (see Figures 1-3). It is clear that, during July and August, the relative importance of tourist arrivals is about 14%, but during December or January the importance virtually disappears, and is less than 3%.

The data set comprises monthly figures from two leading tourist source countries, namely UK and Germany for the period January 1987 to October 2003. This paper is to examine the time series properties of international tourism demand to the Balearic Islands.

The plan of the paper is as follows. Section 2 discusses the seasonality in tourism arrivals. Univariate and multivariate models of conditional volatility for monthly tourist arrivals are presented in Section 3. The empirical results for the models and some concluding remarks are presented and discussed in Section 4.

2. SEASONALITY IN TOURISM ARRIVALS

To test whether the seasonal pattern is constant or not over time, the HEGY test can be used. See Hylleberg et al (2000) and Haldrup, Montañés and Sansó (2005) for more details. To illustrate how the HEGY test works, consider the annual difference operator $\Delta_{12} \equiv (1-L^{12})$, where L is the lag operator, and that $\Delta_{12}y_t = (1-L^{12})y_t = y_t - L^{12}y_t = y_t - y_{t-12}$, that is, the annual change in variable y_t. The seasonal difference operator is commonly used when modeling time series with seasonality. This operator can be factorized according to its twelve roots as

$$\left(1-L^{12}\right)=\left(1-L\right)\left(1+L\right)\prod_{j=1}^{5}\left(1-2\cos\left(j\pi/6\right)L+L^{2}\right)$$

That is, the roots 1, -1 and five pairs of complex unit roots, each pair associated to a binomial such as $\left(1-2\cos\left(j\pi/6\right)L+L^{2}\right)$. Note that all roots have modulus one and, in this sense, are called unit roots. The first unit root, that is 1, is associated with the trend (also known as zero frequency) whereas the other eleven (that is, -1 and the ten complex unit roots) so are with the seasonality. Specifically, root -1 is related to the π frequency (a cycle of period two months) and the pairs of complex unit roots so are to the $j\pi/6$ $(j=1,...,5)$ frequencies, which imply cycles of period $12/j$ $(j=1,...,5)$ months. The presence of seasonal unit roots implies that the seasonal pattern is changing over time whereas their rejection implies that the seasonal pattern is constant

The HEGY test consists in checking whether each of these unit roots is present in a given time series. The auxiliary regression of the test is given by:

$$\begin{aligned}\Delta_{12}y_t &= \rho_0 y_{t-1}^{(0)} + \rho_\pi y_{t-1}^{(\pi)} + \rho_{\pi/6,1}y_{t-1}^{(\pi/6)} + \rho_{\pi/6,2}y_{t-2}^{(\pi/6)} \\ &+\rho_{\pi/3,1}y_{t-1}^{(\pi/3)} + \rho_{\pi/3,2}y_{t-2}^{(\pi/3)} + \rho_{\pi/2,1}y_{t-1}^{(\pi/2)} + \rho_{\pi/2,2}y_{t-2}^{(\pi/2)} \\ &+\rho_{2\pi/3,1}y_{t-1}^{(2\pi/3)} + \rho_{2\pi/3,2}y_{t-2}^{(2\pi/3)} \\ &+\rho_{5\pi/6,1}y_{t-1}^{(5\pi/6)} + \rho_{5\pi/6,2}y_{t-2}^{(5\pi/6)} + \varepsilon_t\end{aligned} \tag{1}$$

where ε_t is an error tern and $y_t^{(j)}$ are transformations of y_t such that all but one of the frequencies are filtered out. For instance, in

$$y_t^{(\pi/6)} = \left[\left(1-L\right)\left(1+L\right)\prod_{j=2}^{5}\left(1-2\cos\left(j\pi/6\right)L+L^{2}\right)\right]y_t,$$

all the unit roots but those related to $(1-2\cos(\pi/6)L+L^2)$ are filtered out, and in

$$y_t^{(\pi)} = \left[\left(1-L\right)\prod_{j=1}^{5}\left(1-2\cos\left(j\pi/6\right)L+L^{2}\right)\right]y_t$$

all the root but -1 are eliminated. Actually, in our empirical application we used a slightly different filtration for $y_t^{(j\pi/6)}$ $(j=1,...,5)$, suggested by Beaulieu and Miron (1993), in order to obtain uncorrelated regressors. Nevertheless, this does not affect our reasoning. The superscript of each transformed variable indicates the frequency which is led out. The presence of a unit root in a given frequency implies the non-significance of the related transformed variables. For instance, if $\rho_0 = 0$ then there is a unit root in the zero frequency (the trend), and if $\rho_{\pi/6,1} = \rho_{\pi/6,2} = 0$ that means that the (complex) unit root of frequency $\pi/6$ is also present, implying that the seasonal pattern of one cycle per year is changing continuously. Note that complex unit roots are tested with a (pseudo) F-test, because they imply the nullity of two parameters, whereas the presence of roots in frequencies 0 and π can be tested using a (pseudo) *t*-ratio.

The presence of all the roots implies that neither the trend nor the seasonality of y_t is stable and that the variable has to be differentiated, $\Delta_{12} y_t$, in order to get a stationary variable. If no unit roots are present, both the trend and the seasonal pattern of y_t are stable.

The auxiliary regression (1) can be generalized to include deterministic terms to allow a more general model under the alternative hypothesis of stationarity. In the empirical application below we specify a deterministic trend and a set of seasonal dummy variables. The (asymptotic) distribution of the tests, which is not standard, can be found in Hylleberg et al. (2000) and Haldrup et al. (2005), and the finite sample critical values can be found in Franses and Hobijn (1997). The autocorrelation of ε_t in (1) distorts the distribution of the test. To avoid this autocorrelation, additional lags of $\Delta_{12} y_t$ can be introduced.

3. CONDITIONAL VOLATILITY MODELS FOR TOURIST ARRIVALS

The purpose of this section is to model the level and conditional volatility (or uncertainty) in monthly international tourist arrivals from the 2 leading source countries, namely UK and Germany, to the Balearic Islands. The specification and properties of the Constant Conditional Correlation (CCC) GARCH model of Bollerslev (1990), which will be used to estimate the correlations between the tourist arrivals shocks, will be discussed briefly.

Consider the following specification:

$$\begin{aligned} y_t &= E\left(y_t \mid F_{t-1}\right) + \varepsilon_t \\ \varepsilon_t &= D_t \eta_t , \end{aligned} \tag{1}$$

where $y_t = \left(y_{1t}, y_{2t}\right)'$ measures the tourist arrivals from the 2 leading source countries, $\eta_t = (\eta_{1t}, \eta_{2t})'$ is a sequence of independently and identically distributed (*iid*) random vectors that is obtained from standardizing the tourist arrivals shocks, ε_t, using the standardization $D = diag(h_{1t}^{1/2}, h_{2t}^{1/2})'$, F_t is the past information available to time *t*, and $t = 1,...,202$ monthly observations for the period January 1987 to October 2003.

The CCC model assumes the uncertainty in tourist arrivals shocks from source *i*, h_{it}, *i* = 1,2, follows a univariate GARCH process, that is,

$$h_{it} = \omega_i + \sum_{j=1}^{r} \alpha_{ij} \varepsilon_{i,t-j}^2 + \sum_{j=1}^{s} \beta_{ij} h_{i,t-j} \tag{2}$$

where α_{ij} represents the ARCH effects, or the short-run persistence of shocks to tourist source *i*, and β_{ij} represents the GARCH effects, or the contribution of shocks to tourist source *i* to long-run persistence. Although the CCC specification in (2) has a computational advantage over other multivariate GARCH models with constant conditional correlations, such as the Vector Autoregressive Moving Average GARCH (VARMA-GARCH) model of Ling and McAleer (2003) and VARMA Asymmetric GARCH (VARMA-AGARCH) model of Hoti, Chan and McAleer (2002), it assumes independence of uncertainty across tourism sources, and hence no spillovers in uncertainty across different tourism sources, and does not accommodate the asymmetric effects on uncertainty of positive and negative shocks.

It is important to note that the conditional correlation matrix for the CCC model, Γ, is assumed to be constant, with the typical element of Γ being given by $\rho_{ij} = \rho_{ji}$ for *i*, *j* = 1,2. When the correlation coefficient of tourism arrivals shocks, ρ_{ij}, is close to +1, the Balearic Islands should specialize on tourist sources that provide the largest numbers and growth in tourist arrivals. However, when the correlation coefficient of tourism arrivals shocks is close to -1, the Balearic Islands should concentrate on diversifying the tourism base rather than concentrating on sources with the largest numbers and growth in tourist arrivals. Independent tourism sources are those pairs of countries with a correlation coefficient close to zero, in which case neither specialization nor diversification in tourism source markets would be required for optimal management of tourism arrivals.

When the number of tourism source countries is set to *m* = 1, such that a univariate model is specified rather than a multivariate model, equations (1)-(2) become:

$$\begin{aligned} \varepsilon_t &= \eta_t \sqrt{h_t} \\ h_t &= \omega + \sum_{j=1}^{r} \alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^{s} \beta_j h_{t-j} , \end{aligned} \tag{3}$$

and $\omega > 0$, $\alpha_j \geq 0$ for *j* = 1,…,*r* and $\beta_j \geq 0$ for *j* = 1,…,*s* are sufficient regularity conditions to ensure that uncertainty is defined sensibly, namely $h_t > 0$. The decomposition in (3) permits the uncertainty in the tourist arrivals shocks, ε_t, to be modelled by h_t, on the basis of historical data. Using results from Nelson (1990), Ling and Li (1997) and Ling and McAleer (2002a, 2002b), the necessary and sufficient regularity condition for the existence of the second moment of tourist arrivals shocks, ε_t, for the case *r* = *s* = 1 is given by $\alpha_1 + \beta_1 < 1$. This result ensures that the estimates are statistically adequate, for a sensible empirical analysis.

Equation (3) assumes that a positive shock ($\varepsilon_t > 0$) to monthly tourist arrivals has the same impact on uncertainty, h_t , as a negative tourist arrivals shock ($\varepsilon_t < 0$), but this assumption is typically violated in practice. In order to accommodate the possible differential impact on uncertainty from positive and negative tourist arrivals shocks, Glosten, Jagannathan and Runkle (1992) proposed the following specification for h_t :

$$h_t = \omega + \sum_{j=1}^{r} \left(\alpha_j + \gamma_j I\left(\varepsilon_{t-j}\right) \right) \varepsilon_{t-j}^2 + \sum_{j=1}^{s} \beta_j h_{t-j} \ . \tag{4}$$

When $r = s = 1$, $\omega > 0$, $\alpha_1 \geq 0, \alpha_1 + \gamma_1 \geq 0$ and $\beta_1 \geq 0$ are sufficient conditions to ensure that uncertainty is positive, namely $h_t > 0$. The short-run persistence of positive (negative) monthly tourist arrivals shocks is given by α_1 ($\alpha_1 + \gamma_1$). Under the assumption that the standardized shocks, η_t , follow a symmetric distribution, the average short-run persistence of tourist arrivals shocks is $\alpha_1 + \gamma_1/2$, and the contribution of tourist arrivals shocks to average long-run persistence is $\alpha_1 + \gamma_1/2 + \beta_1$. Ling and McAleer (2002a) showed that the necessary and sufficient regularity condition for the second moment of tourist arrivals shocks to be finite, and hence for sensible statistical analysis, is $\alpha_1 + \gamma_1/2 + \beta_1 < 1$.

The parameters in equations (1), (3) and (4) are typically obtained by Maximum Likelihood Estimation (MLE). When η_t does not follow a joint multivariate normal distribution, the parameters are estimated by Quasi-MLE (QMLE).

Ling and McAleer (2003) showed that the QMLE for GARCH(r,s) is consistent if the second moment regularity condition is finite. Jeantheau (1998) showed that the log-moment regularity condition given by

$$E\left(\log\left(\alpha_1 \eta_t^2 + \beta_1\right)\right) < 0 \tag{5}$$

is sufficient for the QMLE to be consistent for the GARCH(1,1) model of uncertainty, while Boussama (2000) showed that the QMLE is asymptotically normal for GARCH(1,1) under the same condition. It is important to note that (5) is a weaker regularity condition than the second moment condition, namely $\alpha_1 + \beta_1 < 1$. However, the log-moment condition is more difficult to compute in practice as it is the expected value of a function of an unknown random variable and unknown parameters.

McAleer, Chan and Marinova (2002) established the log-moment regularity condition for the GJR(1,1) model of uncertainty, namely

$$E\left(\log\left(\left(\alpha_1 + \gamma_1 I\left(\eta_t\right)\right)\eta_t^2 + \beta_1\right)\right) < 0, \tag{6}$$

and showed that it is sufficient for the consistency and asymptotic normality of the QMLE for GJR(1,1). Moreover, the second moment regularity condition, namely $\alpha_1 + \gamma_1/2 + \beta_1 < 1$, is also sufficient for consistency and asymptotic normality of the QMLE for GJR(1,1).

4. EMPIRICAL RESULTS

Univariate and multivariate uncertainty models are estimated for the two tourism source countries for the period 1987(1)-2003(10). All the estimates are obtained using GAUSS and EViews 4 software packages. Virtually identical results were obtained by using the RATS 6 econometric software package.

Using the monthly data, we first consider the stationarity of the (logs of) two series. Table 1 shows the results of the HEGY seasonal unit root test for both series. The HEGY test was performed by pretesting for the presence of additive outliers, as considered in Haldrup, Montañés and Sansó (2005), and dropping the insignificant lags in the auxiliary regression. A deterministic trend and a set of seasonal dummies were included in the auxiliary regression.

As shown in Table 1, we cannot reject some of the seasonal and non-seasonal unit roots for German tourist arrivals, whereas for British arrivals all the seasonal and non-seasonal unit roots are rejected. Hence, seasonality for the British data is stable, while seasonality for the German data is not. This is consistent with the fact that German tourists changed their travel patterns in visiting Mallorca over the last decade. In particular, German tourists have purchased numerous second residence houses in Mallorca, and also spread their visits throughout all the months of the year (see Riera, Rosselló and Sansó (2004)).

Given these results, the dependent variables are defined as the logarithm of the level of British tourist arrivals and the seasonally and regularly differenced logarithms of the German tourist arrivals. The conditional mean for British arrivals is given by:

$$\begin{aligned} \ln y_t &= \delta_0 + \phi_1 \ln y_{t-1} + \phi_2 \ln y_{t-2} + \phi_{12} \ln y_{t-12} \\ &+ \delta_1 t + \sum_{j=1}^{5} \left(\beta_{j,1} \cos\left(j\pi t/6 \right) + \beta_{j,2} \sin\left(j\pi t/6 \right) \right) \\ &+ \beta_{6,1} \cos\left(\pi t/6 \right) + \delta_E East_t + \varepsilon_t \end{aligned} \tag{7}$$

where the trigonometric terms capture the deterministic seasonality, and East is a dummy variable for the Easter period. These trigonometric terms are the discrete Fourier transformation of a set of seasonal dummy variables, so that they expand into the same space and are, in this sense, equivalent.

However, this representation identifies better the seasonal cycles which are present in the data.

Table 2 reports the estimated results for the British data, while Figure 4 plots the recursive OLS parameter estimates. The British estimates show stability. This is consistent with the findings regarding the seasonal unit roots reported in Table 1.

Figure 5 shows the recursive OLS estimates of equation (7) for German tourist arrivals. These estimates show a lack of stability implying that the seasonal pattern of German tourist arrivals is not constant and confirming the previous findings of seasonal unit roots in the German data.

Given the results of Table 1 and the recursive estimations concerning German tourist arrivals data, we impose the presence of all seasonal and non-seasonal unit roots, and estimate the following model for the conditional mean, for which the estimates are shown in Table 3:

$$\Delta\Delta_{12} \ln y_t = \delta_0 + \delta_E East_t + \left(1-\theta_1 L\right)\left(1-\theta_{12} L^{12}\right)\varepsilon_t$$

The estimated conditional means for the British and German tourist arrivals imply that these two variables have a completely different long-run behavior. British tourist arrivals can be considered stationary around a deterministic trend, while German tourist arrivals are non-stationary, neither in the trend nor in the seasonal frequencies. This implies that the two series are uncorrelated in the long-run.

The GARCH(1,1) estimates suggest that the conditional variance for British tourists is effectively constant (with the ARCH estimate close to 0 and the GARCH estimate close to 1), whereas there is only a one-period short run effect for German tourists. The GJR(1,1) model leads to completely different results. The GARCH effect disappears for British tourists, while the GJR (or asymmetry) effect, though significant for German tourists, is negative. This result would be regarded as being contrary to expectations.

As reported in Table 4, the conditional correlation between shocks to tourist arrivals from the UK and Germany (0.14) is very low. However, the Granger causality hypothesis for German tourist arrivals causing British tourist arrivals is not rejected (with a p-value of 0.373 for two lags), but it is rejected for British tourist arrivals causing German tourist arrivals (with a p-value of 0.022 for two lags).

Given that the shocks to both series are practically independent and that both series are asymptotically uncorrelated, the two markets are segmented, so that (the logarithm of) tourist arrivals from both the UK and Germany should be considered in tourism marketing and management plans for the Balearic Islands.

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Table 1: Seasonal Unit Root Tests (HEGY)

Frequency	0	π/6	π/3	π/2	2π/3	5π/6	π
British Tourists	-4.5**	21.0**	27.7**	6.45*	37.4**	11.8**	-5.41**
German Tourists	-1.75	1.79	6.49*	6.77*	6.20†	1.51	-5.49**

Note: †, * and ** refer to 10%, 5% and 1% significance levels, respectively, using the critical values given in Franses and Hobijn (1997).

Table 2: Conditional Mean Estimates

Parameters	British Tourists	Germans Tourists
δ_0	3.045 (4.87)	0.002 (1.03)
ϕ_1	0.377 (5.44)	
ϕ_2	0.224 (4.02)	
ϕ_{12}	0.159 (4.14)	
δ_1	0.001 (3.68)	
δ_E	0.318 (4.64)	-0.036 (-2.14)
$\beta_{1,1}$	-0.572 (-1.75)	
$\beta_{2,1}$	-0.035 (-1.65)	
$\beta_{3,1}$	0.288 (11.66)	
$\beta_{4,1}$	0.012 (0.77)	
$\beta_{5,1}$	-0.140 (-7.79)	
$\beta_{6,1}$	-0.010 (-0.99)	
$\beta_{1,2}$	0.331 (5.81)	
$\beta_{2,2}$	0.136 (7.47)	
$\beta_{3,2}$	0.039 (2.02)	
$\beta_{4,2}$	-0.040 (-3.12)	
$\beta_{5,2}$	-0.231 (-11.75)	
MA(1)		-0.794 (-24.19)
MA(12)		-0.426 (-7.03)
SE	0.129	0.132
Q(12)	15.533 (0.21)	11.162 (0.35)

Notes:
(1) t-ratios are given in parentheses; (2) SE is the standard error of the residuals; (3) Q(12) is the Ljung-Box test for non-autocorrelation in the first twelve lags; and (4) The entries in parantheses for Q(12) are p-values.

Table 3: Conditional Volatility Models: GARCH(1,1) and GJR(1,1)

	British Tourists		German Tourists	
Parameters	GARCH(1,)	GJR(1,1)	GARCH(1,)	GJR(1,1)
ω	1.2E-04	0.005	0.012	0.008
	1.08	4.00	3.88	2.06
α	-0.020	0.331	0.343	0.179
	-0.88	1.88	2.72	10.50
γ		1.032		-0.255
		2.08		-3.90
β	0.995	0.02	-0.047	0.397
	60.63	0.31	-0.31	1.40

Note: The two entries for each parameter are their respective estimate and the asymptotic t-ratio.

Table 4: Correlations Between the Squared Errors

Lags, Leads	-3	-2	-1	0	1	2	3
Correlations	-0.0251	-0.0402	0.0987	0.1411	0.1622	0.1822	0.0129

Note: Leads (+) and lags (-) are taken with respect to British tourists.

Figure 1: Monthly International Tourist Arrivals

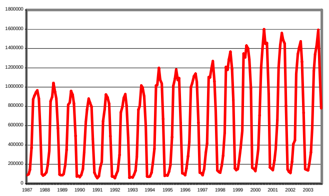

Figure 2: Monthly British Tourist Arrivals

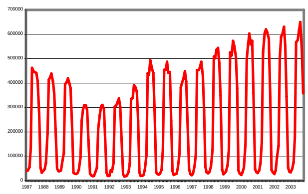

Figure 3: Monthly German Tourist Arrivals

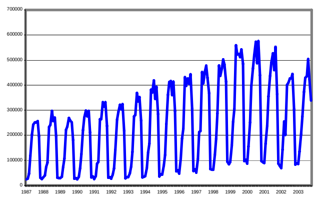

Figure 4: Recursive Coefficients Estimates of British Tourists (Equation (7)).

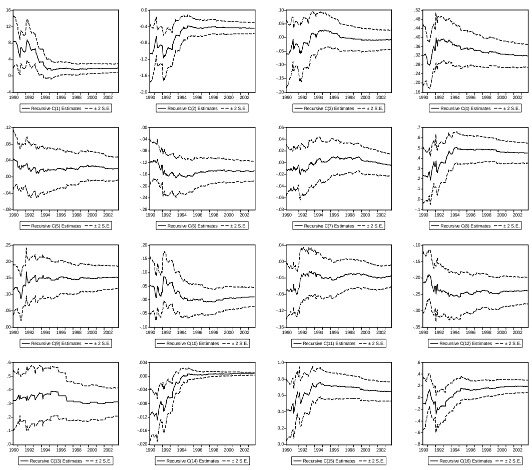

Figure 5: Recursive Coefficients Estimates of German Tourists (Equation (7)).