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A TIME SERIES ANALYSIS OF THE UNCERTAINTY IN INTERNATIONAL TOURIST ARRIVALS TO THE CANARY ISLANDS

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ABSTRACT

International tourism is an important source of service exports to Spain and its regions, particularly the Canary Islands. Tourism is the major industry in the Canary Islands, accounting for about 22% of GDP. This paper examines the time series properties of international tourism demand to the Canary Islands collected by the National Airport Administration (AENA) at airports from information regarding the number of tourist arrivals from abroad. The data set comprises monthly figures for the Canary Islands from 14 leading tourist source countries, as well as total tourist arrivals, from 1990(1)-2003(12). Tourist arrivals and the associated uncertainty of monthly tourist arrivals are estimated for the 15 data series. The univariate estimates suggest that conditional volatility (or uncertainty) models provide an accurate measure of uncertainty in monthly international tourist arrivals from the 14 leading source countries, and total monthly tourist arrivals. The estimated conditional correlations indicate whether there is specialization, diversification or independence in the international tourism demand shocks to the Canary Islands. At the multivariate level, the conditional correlations in the monthly tourist arrivals shocks are generally positive, varying from small negative to large positive correlations. These estimates suggest that the shocks from alternative tourist sources are independent or specialized rather than diversified. Therefore, the Canary Islands should specialize on tourist sources that provide the largest numbers and growth in tourist arrivals rather than diversify the tourism base.

1. INTRODUCTION

Tourism is a fast growing industry, attracting investment and scarce economic resources in different countries and destinations. This process is driven by a growing market which accommodates new destinations and transformations in the products offered by established destinations, both nationally and internationally. In this context, an understanding of tourism demand plays an important role in decisions regarding the management of tourist products and investment decisions that are necessary to accommodate the growing numbers of tourists.

Tourism demand has traditionally been modelled using a variety of approaches, including structural equations and time series techniques, which have been able to forecast changes in the number of tourists over time (see, for example, Martin and Witt (1989)). These models usually consider a random term which incorporates all the unknown effects on tourism demand over time. Until recently, the uncertainty in the random (or unpredictable) shocks to tourism demand, which can be modelled as heteroscedasticity in the shocks, had not been of major concern to tourism researchers. It is well known that the presence of heteroscedasticity can yield imprecise estimates of tourism demand, thereby reducing the forecasting performance of the models. However, it is only recently that time-varying models of heteroscedasticity have been applied to tourism research (see Chan, Lim and McAleer (2004)).

Volatility (or uncertainty) refers to the changes in the variability of shocks to tourism demand over time, and is defined as the squared deviation of each observation from the respective sample mean tourist arrivals or deseasonalized tourist arrivals. As a result of many factors that can affect the tourism market, it is clear that shocks to tourism demand may not have the same variability over time. In the case of tourism, uncertainty may be present due to various unexpected factors which can affect consumer decisions, such as changes in disposable income and wealth, advertising campaigns, and random events. Moreover, the uncertainty could also vary across different destinations and sources. For a single destination, changes in tourism demand could indicate uncertainty according to the various tourism sources, while a given tourism source may have uncertainty in tourist demand according to a wide range of possible tourist destinations.

In this paper we estimate univariate and multivariate (or systems) models of international tourist arrivals and uncertainty from a set of tourism sources for a particular tourist destination, the Canary Islands, Spain. Annual international tourist arrivals to the Canary Islands range from a minimum of 3.5 million to a maximum of 12.4 million over the sample period, namely January 1990 to December 2003. Tourism is the major industry in the Canary Islands, accounting for about 22% of GDP. This industry has grown rapidly over the last thirty years, with an average growth rate of 5.24% between 1990 and 2002. However, in the last few years, the rate of tourism growth has declined slightly as a result of saturation effects and the economic slowdown in the world economy.

The estimated correlation coefficients from the multivariate models of uncertainty provide useful information regarding the specialization, diversification or independence in the international tourism demand shocks to the Canary Islands. Variations in the degree of uncertainty across tourist source markets need to be appreciated in order to make optimal management and marketing decisions regarding particular markets. In addition, models of uncertainty permit a distinction to be made between the short and long run persistence of shocks to tourism demand, which provide useful information regarding the effects of shocks on uncertainty. Shocks in one market can affect tourism demand in other markets differently, depending on the degree of correlation in uncertainty across markets. The inter-relationship of the short and long run effects of shocks to uncertainty, and the correlation coefficients across different source markets, permit a classification of markets according to uncertainty.

With regard to the estimated correlations in the uncertainty of tourist arrivals shocks, tourist source countries with a high positive correlation are specialized markets, in which case the Canary Islands should concentrate on those tourism sources which provide the largest numbers and growth in tourist arrivals. On the other hand, tourist source countries with a high negative correlation are diversified markets, in which case the Canary Islands should concentrate on diversifying the tourism base. Correlations in tourist arrivals shocks that are close to zero indicate independent markets, so that neither specialization nor diversification in tourism source markets would be required. Such issues based on models of uncertainty have not previously been considered in the tourism demand literature.

The plan of the paper is as follows. Section 2 describes the data sources for the empirical analysis, and discusses the salient features of the monthly international tourist arrivals data for the Canary Islands from 14 leading tourist source countries, as well as total tourist arrivals. Seasonality in the tourist arrivals data from the various country sources, as well as total tourist arrivals, is also discussed. Univariate and multivariate models of uncertainty for monthly tourist arrivals are presented in Section 3. The empirical results for the models of uncertainty are analysed in Section 4. Some concluding comments are given in Section 5.

2. DATA SOURCE AND DESCRIPTION

The Canary Islands account for about 20% of total tourism in Spain, with a larger proportion in the winter season as compared with the summer season. The effect of seasonality varies significantly across the tourism source countries, showing the largest patterns for the Scandinavian countries. In particular, tourist arrivals from the Scandinavian countries to the Canary Islands drop dramatically during the period from May through to September, which includes the European summer.

Seasonality for the total number of tourists is inverted with respect to tourism demand in the rest of Spain, with the strong season for the Canary Islands being mid-November to mid-March. During this time of the year, the Canary Islands still enjoy pleasant weather. Moreover, the travel time to the Canary Islands from virtually any European tourism source country is relatively short. During the summer season, the Canary Islands compete in similar conditions with other leading tourist destinations, such as those in the Mediterranean.

This paper examines the time series properties of international tourism demand to the Canary Islands collected by the National Airport Administration (AENA) at airports from information regarding the number of tourist arrivals from abroad. The data set comprises monthly figures for different islands in the Canary Islands from 14 leading international tourist source countries, as well as total tourist arrivals, for the period 1990(1)-2003(12), thereby giving 15 separate data series.

Seven descriptive statistics, namely mean, maximum, minimum, standard deviation (SD), coefficient of variation (CoV), skewness and kurtosis have been calculated. While SD is frequently regarded as an adequate indicator of variability, the CoV enables a comparison between SD associated with different means. The mean tourist arrivals vary substantially across the 14 countries, ranging from 11,334 from

Austria to 241,739 from UK. Of the 14 leading international tourist source countries, Austria, Belgium, Denmark, Finland, France, Ireland, Italy, Norway, Other and Switzerland have means that are less than 20,000, while Holland and Sweden have means of 32,343 and 30,574, respectively. The means of German and UK monthly tourist arrivals, which are the two major tourist source countries for the Canary Islands, are both well above 200,000 tourists. Excluding total tourist arrivals, monthly tourist arrival figures from the 14 source countries vary from 0 for Finland and Norway to 389,803 for UK. Although SD has a wide range from 2,882 to 166,757, this primarily reflects differences in mean monthly tourist arrivals. In comparison, CoV does not vary as substantially across the 15 source countries, with the lowest CoV being observed for Germany at 0.220 and the highest for Finland at 0.982. Apart from monthly tourist arrivals from Germany, UK and Total, tourist arrivals to the Canary Islands are all positively skewed, with the kurtosis ranging from 1.690 for Finland to 4.555 for Other.

The descriptive statistics for the volatility (or uncertainty) in monthly international tourist arrivals show that the 15 means vary substantially across countries, ranging from 8,254,144 for Austria to 5,420,000,000 for UK. Apart from the uncertainty associated with total tourist arrivals, the two highest uncertainty means are for Germany and UK. Overall, the uncertainty associated with tourist arrivals from the 14 source countries vary from a minimum of 9 for Belgium to a maximum of 22,200,000,000 for UK. While the SD for all 15 tourist uncertainty has a wide range from 11,931,093 to 5,480,000,000, CoV does not vary substantially across the tourism source countries. The lowest CoV is observed for Finland at 0.832 and the highest is observed for Other at 1.888. There is positive skewness for the 14 countries and total, with the kurtosis ranging from 3.718 for Norway to 26.349 for France.

Descriptive statistics are also calculated for the uncertainty in deseasonalised monthly tourist arrivals. The 15 uncertainty means vary substantially across all countries, ranging from 6,719,253 for Austria to 5,210,000,000 for UK, with Germany and the UK having the two highest uncertainty means of the 14 source countries. Excluding the uncertainty in total tourist arrivals, the uncertainty associated with tourist arrivals from the 14 source countries varies from a minimum of 2 for Holland to 20,200,000,000 for UK. In terms of variability, SD for all 15 tourist uncertainty ranges from 10,037,994 for Austria to 23,400,000,000 for Total, while CoV varies from 0.910 for UK to 2.101 for Finland. There is positive skewness for all 14 countries and total, with the kurtosis ranging from 2.331 for UK to 21.472 for Other.

Finally, descriptive statistics are also obtained for the proportions of monthly tourist arrivals relative to monthly total tourist arrivals for the 14 country sources. UK and Germany jointly account for almost 68% of the total international tourist arrivals to the Canary Islands, with means of 35.580% and 31.719%, respectively. The mean proportions of the remaining 12 leading international tourist arrival countries are substantially lower than for UK and Germany. Moreover, the proportions vary only slightly, ranging from 1.717% for Austria to 4.737% for Holland. Overall, the tourist proportion figures for the 14 source countries vary from a minimum of 0% for Finland and Norway to a maximum of 48.555% for UK. Although SD has a range of 0.398 to 6.484, CoV is generally low and does not vary substantially across the 14 tourism sources and the total. The lowest CoV is observed for Germany at 0.099 and the highest is observed for Finland at 1.090. Apart from the tourist proportions for UK and Germany, the tourist proportions to the Canary Islands are positively skewed, with the kurtosis ranging from 1.536 for Sweden) to 6.714 for Belgium.

International monthly tourist arrivals, the uncertainty associated with monthly tourist arrivals and deseasonalised monthly tourist arrivals, and the proportions of tourist arrivals to the Canary Islands, for the 14 leading source countries and total, are also available. There is significant seasonal variation in the monthly international tourist arrivals for all 14 leading source countries and total tourist arrivals. The patterns in uncertainty are reasonably similar for nine of the tourist sources, and significantly different for six sources, namely Denmark, Finland, Germany, Norway, Other and Sweden. This makes it clear that the four Scandinavian countries have distinctive seasonal patterns, which distinguishes them from most of the other leading tourism sources for the Canary Islands. There is also distinctive seasonality in the proportions of the monthly tourist arrivals for all 14 leading source countries.

3. MODELS OF UNCERTAINTY FOR TOURIST ARRIVALS

The purpose of this section is to model the level and uncertainty in monthly international tourist arrivals from the 14 leading source countries, as well as total monthly international tourist arrivals, to the Canary 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 all pairs of tourist arrivals shocks, will be discussed briefly.

Consider the following specification:

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

where $y_t = (y_{1t},...,y_{mt})'$ measures the tourist arrivals from the 14 leading source countries and total tourist arrivals, $\eta_t = (\eta_{1t},...,\eta_{mt})'$ 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 $D_t = diag\left(h_{1t}^{1/2},...,h_{mt}^{1/2}\right)$, F_t is the past information available to time *t*, *m* (=15) is the number of tourism source countries, including total tourist arrivals, and *t* = 1,…,168 monthly observations for the period 1990(1) to 2003(12).

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

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

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 Chan, Hoti 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,…,*m*. When the correlation coefficient of tourism arrivals shocks, ρ_{ij}, is close to +1, the Canary 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, ρ_{ij}, is close to -1, the Canary 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, ρ_{ij}, 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:

$$\varepsilon_t = \eta_t \sqrt{h_t}$$
$$h_t = \omega + \sum_{j=1}^{r} \alpha_j \varepsilon_{t-j}^2 + \sum_{j=1}^{s} \beta_j h_{t-j}, \qquad (3)$$

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, so that a sensible empirical analysis can be conducted.

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:

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

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) using a joint normal density for the standardized tourist arrivals shocks, η_t, after uncertainty has been modelled. When η_t does not follow a joint multivariate normal distribution, the parameters are estimated by Quasi-MLE (QMLE). The conditional log-likelihood function is given as follows:

$$\sum_{t=1}^{n} l_t = -\frac{1}{2}\sum_{t=1}^{n}\left(\log h_t + \frac{\varepsilon_t^2}{h_t}\right).$$

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

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

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

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

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).

In empirical examples, the parameters in the regularity conditions (5) and (6) are replaced by their respective QMLE, the standardized residuals, η_t, are replaced by the estimated residuals from the GARCH and GJR models of uncertainty, respectively, for $t = 1,\ldots,n$, and the expected values in (5) and (6) are replaced by their respective sample means.

4. EMPIRICAL RESULTS

Using the monthly data on international tourist arrivals, univariate and multivariate uncertainty models are estimated for 14 tourism source countries, as well as total tourist arrivals, for the period 1990(1)-2003(12). There is a distinct seasonal pattern in each tourist arrivals series. Although there are several alternative methods for modelling seasonality, twelve seasonal dummy variables are included for simplicity in the respective tourist arrivals models of monthly international tourist arrivals from source $i = 1,\ldots,15$, TA_{it}, as follows:

$$TA_{it} = \sum_{j=1}^{12}\phi_{ij}D_{ijt} + \varepsilon_{it} \ ,$$

where D_{ijt} = 1 in month j = 1,..,12, and D_{ijt} = 0 elsewhere.

In addition to estimating the tourist arrivals for each source country, the univariate ARCH(1), ARCH(2), GARCH(1,1) and GJR(1,1) models of uncertainty are used to estimate the uncertainty associated with the 14 leading tourism source countries and total tourist arrivals. As the estimated GARCH(1,1) model was always found to be preferable to the ARCH(1) and ARCH(2) models, and also generally superior to the asymmetric GJR(1,1) model, in what follows the empirical results will be discussed only for the GARCH(1,1) model of uncertainty.

On the basis of the univariate estimates of the standardized tourist arrivals shocks, the CCC model is used to estimate the correlation coefficients of the monthly international tourist arrivals shocks between all pairs of tourism source countries. This can provide useful information on various source markets in terms of the international tourism arrivals shocks to determine if the Canary Islands should specialize on tourist sources that provide the largest numbers and growth in tourist arrivals or diversify the tourism base.

All the estimates in this paper are obtained using the Berndt, Hall, Hall and Hausman (BHHH) (1974) algorithm in the EViews 4 econometric software package. Virtually identical estimates are obtained from using the RATS 6 econometric software package. Several different sets of initial values have been used in each case, but do not lead to substantial differences in the estimates.

4.1 Univariate Models of Uncertainty

Estimates of the parameters of the tourist arrivals and uncertainty for the univariate GARCH(1,1) model are presented in Tables 1 and 2, respectively. The tourist arrivals estimates for GARCH(1,1) in Table 1 vary across the 14 tourism source countries, as well as total tourist arrivals. There is highly significant seasonality in tourist arrivals for each country and each month, except for Finland for the months of May-September inclusive.

Although not reported here, the univariate estimates of uncertainty generally suggest that there is little asymmetry, such that positive and negative monthly international tourist arrivals shocks have similar effects on the uncertainty in tourism arrivals. Table 2 reports the GARCH(1,1) estimates of the uncertainty in tourist arrivals by the 14 leading tourism source countries, as well as total tourist arrivals. Both the asymptotic and Bollerslev-Wooldridge (1992) robust t-ratios are reported to enable valid statistical inference. In general, the robust t-ratios are smaller in absolute value than their asymptotic counterparts.

The persistence of shocks to the uncertainty in monthly tourist arrivals shocks is an important aspect of modelling volatility. Total tourist arrivals, as well as tourist arrivals from UK, Ireland and Sweden, have only short run persistence in tourist arrivals shocks, that is, for about one month. On the other hand, Germany has only long run persistence in tourist arrivals shocks rather than short run persistence, which means that the tourist arrivals shocks from Germany do not have an immediate impact but tend to accumulate over several months.

Regarding the regularity conditions of the GARCH(1,1) model, both the log-moment and second moment conditions are satisfied for Austria, Belgium, France, Germany, Italy and Switzerland. Although the log-moment condition could not be calculated for Finland, Norway and Sweden, the second moment condition is satisfied, so that the QMLE are consistent and asymptotically normal. Such results suggest that the empirical estimates are statistically valid for these tourism source countries.

Three interesting results are found for Holland, Ireland and total tourist arrivals, in which the second moment regularity condition is not satisfied but the log-moment condition is satisfied, so that the QMLE are consistent and asymptotically normal. Only three sets of regularity conditions are not satisfied, namely Denmark, Other and UK, in which the log-moment regularity condition could not be calculated and the second moment condition was not satisfied.

Overall, these univariate results suggest that, in general, the GARCH(1,1) model provides an accurate measure of the uncertainty in international monthly tourist arrivals shocks for the 14 leading source countries, as well as total tourist arrivals, to the Canary Islands.

4.2 Multivariate Models of Uncertainty

Estimates of the constant conditional correlation coefficients for monthly international tourist arrivals shocks by source country, and total tourist arrivals, are given in Table 3. These correlation correlations are calculated using the estimated tourist arrivals shocks after modeling uncertainty for the 14 leading tourism source countries as well as total international tourist arrivals.

In Table 3, there are a number of high correlation coefficients in the tourist arrivals shocks, especially between total monthly tourist arrivals and some leading tourism source countries. Of the 14 conditional correlations with total tourist arrivals, of which two are negative, the range is from -0.119 to 0.859. The highest correlation coefficients for total tourist arrivals are with UK, Norway, Ireland, Sweden, Belgium, Denmark, Holland and Germany. With the exception of Finland, the Scandinavian countries have highly correlated tourist arrivals shocks with total tourist arrivals. It is surprising that Germany, which is the second most important source of tourist arrivals to the Canary Islands, has the eighth highest correlation coefficient in the tourist arrivals shocks with total tourist arrivals at 0.696. These results suggest that, in general, the shocks from alternative tourist sources are independent or specialized rather than diversified.

Of the 91 possible pairs of correlation coefficients between the 14 leading tourist source countries, of which 71 are positive, the ten highest conditional correlations in the standardized shocks hold between the following pairs of countries: (Norway, Sweden), (Denmark, Sweden), (Denmark, Norway), (Norway, UK), (Belgium, UK), (Ireland, UK), (Sweden, UK), (Belgium, Germany), (Ireland, Norway) and (Belgium, Norway), with the highest being 0.782 and the lowest being 0.648. The correlation coefficients vary from a low of -0.277 to a high of 0.782. The UK and three of the four Scandinavian countries have high correlation coefficients in the tourist arrivals shocks, with Belgium, Ireland and Germany also having some high correlation coefficients. This suggests that these tourism sources are similar, and hence specialized, in terms of tourist arrivals shocks. On the other hand, Italy and Finland have very low conditional correlations in the tourist arrivals shocks with all countries, which suggest that these two countries have independent shocks.

5. CONCLUSION

International tourism is an important source of service exports to Spain and its regions, particularly the Canary Islands. Tourism is the major industry in the Canary Islands, accounting for about 22% of GDP. This paper examined the time series properties of international monthly tourist arrivals to the Canary Islands collected by the National Airport Administration (AENA) at airports from information regarding the number of tourist arrivals from abroad. The data set comprised monthly figures for the Canary Islands from 14 leading tourist source countries, as well as total tourist arrivals, from 1990(1)-2003(12). Tourist arrivals and the associated uncertainty of monthly tourist arrivals are estimated for the 14 source countries, as well as total tourist arrivals, for the 15 data series.

The univariate estimates suggested that the GARCH(1,1) conditional volatility model provides an accurate measure of uncertainty in monthly international tourist arrivals from the 14 leading source countries, and total monthly tourist arrivals. The estimated conditional correlation coefficients indicated whether there is specialization, diversification or independence in the international tourism demand shocks to the Canary Islands. At the multivariate level, the conditional correlations in the monthly tourist arrivals shocks were generally positive, varying from small negative to large positive correlations. These estimates suggested that the shocks from alternative tourist sources are independent or specialized rather than diversified. Therefore, the Canary Islands should specialize on tourist sources that provide the largest numbers and growth in tourist arrivals rather than diversify the tourism base.

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Table 1: Estimates of Monthly Tourist Arrivals Models

Country	δ_1	δ_2	δ_3	δ_4	δ_5	δ_6	δ_7	δ_8	δ_9	δ_{10}	δ_{11}	δ_{12}
Austria	11004	12303	11550	10493	8182	8834	11465	10897	9278	10226	12633	10166
	28.94	28.70	28.28	26.69	29.38	14.61	33.34	16.87	16.34	29.23	35.93	39.24
	29.23	36.92	33.85	29.17	19.60	34.80	32.23	48.85	43.30	35.72	41.08	27.36
Belgium	19071	19716	19209	18553	13209	14156	23208	18926	13536	18346	17588	20871
	15.22	20.86	34.49	33.76	15.53	14.02	35.53	32.58	10.26	29.94	22.99	22.21
	47.60	39.75	23.46	21.65	23.31	30.42	32.59	23.95	38.75	25.75	18.46	43.13
Denmark	31719	27738	28742	10443	3992	4184	5346	5538	6855	19111	29759	30506
	44.43	39.16	38.07	31.12	9.47	5.31	8.47	10.86	19.14	45.02	48.70	41.77
	66.78	46.26	30.11	12.08	22.33	22.02	23.14	18.44	11.04	30.68	51.22	65.64
Finland	38708	35878	37847	12902	531	844	662	601	2251	18353	38735	38708
	52.54	32.57	118.66	58.71	0.73	1.44	0.58	1.20	8.42	80.74	95.31	33.26
	23.98	18.49	23.09	55.27	0.13	0.21	0.16	0.14	1.44	20.69	47.60	21.45
France	13212	18178	18092	23069	18416	12638	16954	18844	13830	15374	8946	11367
	22.01	32.31	28.36	42.17	35.38	8.02	24.92	26.36	9.14	18.93	13.74	18.86
	22.77	25.11	23.24	26.99	21.78	40.61	31.45	36.07	46.40	36.30	17.83	20.23
Germany	223546	242590	290652	247641	197014	178474	215557	207533	215241	243231	267604	234194
	43.97	30.85	53.98	66.99	26.12	34.26	44.74	50.16	31.71	38.13	49.87	63.75
	42.05	29.44	49.15	66.06	28.02	34.47	44.03	50.26	32.88	39.50	52.05	62.95
Holland	28450	31487	35292	26436	21289	21588	34449	24597	23424	28905	26946	28129
	38.84	233.16	72.14	29.32	33.19	50.86	50.79	26.18	47.81	32.97	68.29	54.59
	10.01	43.17	91.11	78.43	98.06	27.08	16.29	32.18	32.31	92.09	58.79	25.25
Ireland	7208	7153	8449	6272	11885	15229	13240	13076	12660	9525	6739	6108
	90.25	65.89	44.32	26.65	19.67	15.77	8.36	10.75	11.32	9.14	14.81	50.73
	85.38	39.06	25.51	11.80	26.75	60.93	10.11	17.76	59.48	11.36	5.01	19.57
Italy	19945	16933	15652	15367	9697	13026	16857	24513	12906	11353	10225	13039
	33.18	15.93	19.93	22.68	9.38	16.77	25.19	54.59	13.94	11.16	8.78	13.72
	22.22	36.31	25.60	20.87	20.35	21.30	24.40	21.17	22.68	23.30	24.58	27.09
Norway	32623	28412	30418	14012	4117	5503	8739	7204	7790	18453	32198	30910
	42.59	23.54	53.69	18.88	6.41	13.04	14.23	17.51	21.12	60.98	85.82	41.93
	19.16	14.42	18.01	7.29	2.07	3.16	5.47	4.21	4.36	18.00	31.84	17.46
Other	13213	12194	13839	14236	11179	13052	22108	29383	18632	11505	9704	13422
	21.66	17.07	26.35	27.11	27.06	39.09	53.00	47.06	20.78	27.04	28.68	25.49
	43.67	55.71	46.94	43.66	38.91	29.28	38.83	82.52	10.54	39.61	18.91	37.32
Sweden	57294	50730	52907	26248	5982	4949	6547	5879	4704	28506	56897	57139
	22.12	15.56	24.23	17.51	9.29	1.88	2.60	2.71	2.29	23.29	37.09	19.11
	26.73	20.39	33.81	66.65	5.55	2.43	3.57	3.06	3.37	32.57	47.92	20.43
Switzerland	14424	13863	15189	17616	14316	12430	17939	14560	15780	21330	16869	14390
	22.77	16.35	22.85	36.11	15.90	13.94	49.47	20.36	18.42	54.63	38.21	23.45
	31.53	35.69	34.00	32.03	42.05	41.66	33.06	33.43	47.31	37.81	22.67	27.93
UK	200207	204516	233394	220543	226325	232074	255844	256009	255104	247668	219422	209397
	45.37	46.38	39.28	68.57	31.75	26.23	57.30	21.95	48.24	56.90	59.95	34.54
	65.03	49.82	38.80	71.92	35.00	26.90	66.06	19.02	52.31	74.72	45.13	39.75
Total	733450	747693	840857	655027	555191	541943	669055	631615	607018	704174	748729	744782
	24.17	23.58	26.53	29.78	24.82	28.64	17.41	24.15	17.59	26.29	22.18	51.44
	41.73	28.31	80.86	64.80	39.36	47.89	85.50	66.40	51.85	11.58	91.97	27.64

Table 2: GARCH(1,1) Estimates of Uncertainty

Country	ω	α	β	Log-Moment	2nd Moment
Austria	69277	0.30	0.69	-0.06	0.99
	0.76	2.12	6.71		
	1.48	3.89	10.50		
Belgium	564564	0.06	0.84	-0.11	0.90
	1.40	0.80	7.28		
	2.13	1.57	1.36		
Denmark	2119905	1.34	-0.03	N.C.	1.30
	1.73	4.70	-0.71		
	5.24	41.12	-9.80		
Finland	11673741	0.93	-0.06	N.C.	0.87
	4.72	5.32	-21.87		
	3.86	2.70	-0.85		
France	688185	0.35	0.61	-0.13	0.96
	1.34	2.78	4.86		
	2.85	5.96	13.15		
Germany	17930932	0.16	0.78	-0.08	0.94
	0.87	1.76	5.29		
	0.93	1.17	5.35		
Holland	1864	1.21	0.22	-0.03	1.43
	0.38	4.09	2.03		
	1.83	9.81	14.80		
Ireland	2674	1.02	0.32	-0.01	1.33
	0.29	3.67	2.28		
	1.26	3.82	2.38		
Italy	269723	0.08	0.87	-0.06	0.95
	1.92	1.58	18.15		
	2.04	2.59	64.76		
Norway	14201937	0.94	-0.14	N.C.	0.80
	2.50	5.24	-1.01		
	3.26	2.49	-1.74		
Other	1733949	1.23	-0.03	N.C.	1.20
	3.12	4.24	-7.60		
	5.35	25.07	-1.18		
Sweden	18004013	1.04	-0.16	N.C.	0.88
	3.33	3.09	-2.11		
	3.85	3.84	-3.02		
Switzerland	381806	0.38	0.61	-0.09	0.99
	1.27	2.02	4.04		
	0.46	7.26	19.75		
UK	47863434	1.12	-0.08	N.C.	1.03
	1.60	2.88	-0.73		
	1.59	2.58	-0.47		
Total	187968694	1.10	0.06	-0.17	1.16
	2.17	2.47	2.95		
	1.13	3.04	0.38		

Note: The three entries corresponding to each parameter are their estimates, their asymptotic t-ratios, and the Bollerslev and Wooldridge (1992) robust t-ratios.

Table 3: Constant Conditional Correlations of Tourist Arrivals Shocks

Country	Austria	Belgium	Denmark	Finland	France	Germany	Holland	Ireland	Italy	Norway	Other	Sweden	Switzerland	UK	Total
Austria	1.000	0.335	0.252	0.146	0.606	0.506	0.364	0.280	0.180	0.279	0.337	0.217	0.463	0.233	0.327
Belgium		1.000	0.634	0.231	-0.041	0.656	0.589	0.577	-0.031	0.648	0.328	0.642	0.059	0.679	0.727
Denmark			1.000	0.372	-0.120	0.576	0.559	0.623	-0.214	0.773	0.335	0.779	0.039	0.646	0.722
Finland				1.000	-0.084	0.259	0.165	0.241	-0.248	0.241	-0.036	0.318	0.111	0.227	0.337
France					1.000	0.166	0.051	-0.075	0.238	-0.092	0.155	-0.103	0.469	-0.171	-0.086
Germany						1.000	0.475	0.537	0.023	0.515	0.454	0.578	0.237	0.552	0.696
Holland							1.000	0.627	-0.060	0.627	0.346	0.544	0.175	0.613	0.708
Ireland								1.000	-0.277	0.654	0.393	0.558	0.135	0.667	0.757
Italy									1.000	-0.250	-0.059	-0.196	0.139	-0.187	-0.199
Norway										1.000	0.295	0.782	-0.046	0.755	0.789
Other											1.000	0.281	0.204	0.410	0.462
Sweden												1.000	-0.053	0.661	0.735
Switzerland													1.000	-0.001	0.106
UK														1.000	0.859
Total															1.000