

# Forecasting Tourist Arrivals in Greece and the Impact of Macroeconomic Shocks from the Countries of Tourists' Origin

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**Abstract:** This paper generates short-term forecasts on tourist arrivals in Greece and performs impulse response analysis to measure the impact of macroeconomic shocks from the origin country on future tourism demand. We find the ARIMA (1, 1, 1) model outperforms exponential smoothing models in forecasting the direction of one year out of sample forecasts. However, this does not translate into point forecasting accuracy. Impulse response analysis on the impact of unemployment and tourists' cost of living shocks shows that the source of downside risk to future tourism numbers is limited in scope, magnitude, and duration. Shocks to consumer confidence from the origin countries have no impact on future tourism demand. Our results offer important insights and implications for policymakers and tourist operators.

**Keywords:** Tourist Arrivals, Macroeconomic Shocks, ARIMA, Holt's Exponential Model With Trend, Double Exponential Smoothing, Impulse Response Function

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## INTRODUCTION

The tourism industry is one of the most crucial sectors for a thriving economy as it accounts for a large part of some countries' Growth Domestic Product (GDP) and employment figures. Tourism is characterized by large variations in numbers on a yearly basis and, as a result, predicting future arrivals is a very difficult task. Forecasts of tourist arrivals are essential for planning, policy making and budgeting purposes by tourism operators (Uysal and O'Leary (1986)).

In response to this, a growing body of literature has focused on tourism demand and arrivals' forecasts in several countries (for instance, Law (2000) for Taiwan and Hong Kong, Burger et al. for South Africa, Chu (2008) for nine major tourist destinations in the Asian-Pacific region, Dharmaratne (1995) and Dalrymple and Greenidge (1999) for Barbados, González and Moral (1996) for Spain, Chu (2004), Song and Witt (2006), Chu (2009) for Asian-Pacific countries, Lim and McAleer (2001), Athanasopoulos and Hyndman (2008) for Australia, Smeral and Weber (2000) and Papatheodorou and Song (2005) for international tourism trends and Shen et al. (2010) for the United Kingdom outbound tourism demand) under the research framework that the tourism industry is a key sector in the economic development strategy of many developing countries.

A second strand of literature that has emerged in recent years is the use of macroeconomic factors to explain tourism demand using structural time series models. For instance, Metzgen-Quemarez (1990) used real GDP figures from the United States, amongst other factors; Var et al. (1990) and Icoz et al. (1998) employed Turkish Consumer Price Index (CPI) figures and the Turkish Lira currency exchange rate against the currency units from the tourists' country of origin, respectively; Greenidge (2001), used real GDP and CPI of the country of origin as well as the price index of tourism in Barbados and finally, Song et al. (2010) employed GDP data of the country of origin and CPI in Hong Kong relative to the country of origin adjusted by the exchange rate.

This paper seeks to break new ground by analyzing, for first time in the literature, the impact of macroeconomic shocks from the country of origin on future short term tourism demand to Greece. We examine the effect of tourists' cost of living, unemployment and consumer confidence in the country of origin as the source of macroeconomic shocks.

Particularly, the two latter variables have not been considered in the prior related literature. Tourists' cost of living is used as a measure of price competitiveness of the destination and, as such, has a major impact on tourism demand. Unemployment and the consumer confidence indicator serve as useful proxies for the state of the economy in the origin country, which implies an impact to future demand for tourism. The intuition behind unemployment lies in two avenues of research which have focused on the wage curve hypothesis and the psychological impact on the level of happiness. Both explanations imply a negative impact on future tourism numbers in periods of high unemployment. The consumer confidence indicator reflects the level of economic uncertainty and/or expectations on future income and the level of precautionary savings. The build up of precautionary savings feeds into falling levels in tourism demand as consumers postpone or cancel vacations.

Additionally, no study to our knowledge has attempted to forecast future arrivals in Greece, which is one of the most popular tourist destinations worldwide. According to the National Statistical Service of Greece, in 2002 the country welcomed 14.9 million international tourists placing Greece the 12$^{th}$ place most visited destination internationally. This yielded an income of $9.74 billion, boosting Greece in the top ten in the world. It is therefore of paramount importance for policy makers and industry that forecasting models are developed and tested to provide an accurate and reliable picture of future tourism arrivals in Greece. As a result, unlike previous studies, we use an array of forecasting models to generate short term predictions on tourism arrivals in Greece.

The identification and analysis of the impact of macroeconomic shocks from the country of origin on tourism flows in Greece introduces an added dimension by recognizing the main source of risk to future arrivals. In this paper, we identify the potential risk coming from unemployment, tourists' cost of living, defined as the CPI of Greece relative to the CPI of the country of origin, and the consumer confidence indicator.[1] Although relative CPI has been used

[1] Although we recognize the importance of the CPI of other major competitors in determining tourism flows to Greece, the underlying assumption in this paper is that travelling to domestic destinations is a viable substitute. The intuition behind this notion lies in the countries of origin used in this study (U.K., France, Germany, Italy, the Netherlands, Japan and the U.S.) which account for 510 million domestic trips per annum in the E.U. (Peeters et al. (2007). Furthermore, according to the WTO (2005), domestic tourism in the U.S. amounted to more than a billion trips per year. As a consequence, the CPI of the origin country is viewed as the CPI of potential competitors that is incorporated into the tourists' cost of living used in this paper.

in past papers as a driver of tourism demand (Song et al. (2010) and Abbas and Ibrahim (2011)), no study has considered the impact of unemployment and consumer confidence as macroeconomic inputs. Macroeconomic shocks from these factors are introduced into a Vector Autoregressive (VAR) system of equations from which one can gauge the reaction and time it takes to impact on future arrivals.

Apart from investigating the impact of random macroeconomic shocks on future tourism arrivals, this paper also provides a methodological contribution by utilizing impulse response function within a VAR framework. This involves simulating impulse responses from the macroeconomic shock to provide information on the size of the reaction and the duration of the effects on future arrivals. Confidence bands are computed using Monte Carlo Simulation to determine the statistical reliability of the response.

Our results reveal a number of interesting observations. First, preliminary analysis reveals that the ARIMA (1, 1, 1) model outperforms the double exponential smoothing and the Holt's exponential smoothing model with trend as a short-term directional forecasting tool. However, the success rate of the ARIMA model in capturing long term trends does not translate into forecasting accuracy. Instead, based on the Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) measures, the Holt's exponential smoothing approach is the best performing model as point forecasting tool.

The next set of results focused on how random macroeconomic shocks, introduced into a system of equations, could impact on future tourism demand in the short term. Initial findings show that random unemployment shocks, as well as shocks to the tourists' cost of living, have profound, yet time varying, effects on short term tourism demand in Greece. In contrast, shocks to consumer confidence from the country of origin have a benign impact on tourism demand. Closer inspection of the results indicate that despite the lack of diversification in the sources of tourism demand to Greece, downside risk in the two main countries of origin, the United Kingdom and Germany, is limited.

To sum up, this paper has two main contributions to the literature. First, we consider tourist arrivals in Greece and provide a preliminary analysis on initial short term forecasts in future tourism demand. Given the importance of the tourism industry in Greece and the level of tourism demand, this addresses a major gap in the literature. The second contribution, and one

that forms the overriding objective of this paper, is that it explores the impact of macroeconomic shocks of various sources from the country of origin on future tourism demand.

The rest of the paper is structured as follows. Section 1 reviews the related literature on the importance of the macroeconomic variables used in this study. Section 2 discusses the data used and provides descriptive statistics. Section 3 presents the methodology. Section 4 analyses the empirical results, followed by a discussion of the findings in Section 5. Section 6 discusses the implications of this study. Finally, Section 7 summarises and concludes the paper.

## 1. RELATED LITERATURE

Although no studies have yet to document the impact of macroeconomic shocks on future tourists' arrivals, reviewing the wider literature on the impact of unemployment, changes in the tourists' cost of living, and consumer confidence could provide useful inferences on potential effects to international tourism flows.[2]

### 1.1. Unemployment

In this paper, unemployment is defined as a proxy used for the state of the economy in the origin country which might have a potential impact on future arrivals. The intuition behind this partially lies in the literature on "the wage curve" hypothesis. This theorem is based on the relationship between unemployment in the local labour market and the level of pay, where real wages are suggested to be negatively related to the unemployment rate. Lower real wages imply falling numbers going abroad. Early studies have reported convincing evidence that the level of pay is lower in areas of high unemployment across different countries (Blanchflower and Oswald ((19/90), (1994) and (2006)) based on the unemployment elasticity of wages measure.[3] On the

[2] We recognize the use of GDP used in previous studies as a determinant of tourism demand. However, we have restricted our database to include macroeconomic variables available monthly to maximize the number of data observations used when generating short to medium term impulse responses on future tourism demand. As a result, GDP figures, only released on a quarterly basis, would lead to meaningless results in generating one year ahead impulse response paths that would ensure consistency with short term forecasts analyzed later in the paper. Moreover, although tourists' cost of living is a variable used in previous studies, an important innovation of this paper is the use of unemployment and consumer confidence as alternative proxies for the state of the economy in the country of origin.

[3] Further support is provided from studies that examine European countries which document an elasticity of approximately -0.01 (Wagner (1994), Estevao and Nargis (2002) and Montuenga, Garcia and Fernandez (2003), and Sanz de Galdeano and Turunen (2005)). Similarly, Deller and Tsai (1998) reach the same conclusion for the United States.

other hand, Malley and Moutos (1996) provided another angle by analyzing unemployment as a measure of aggregate income uncertainty. Using quarterly data from the United States, they find an inverse relationship between the level of consumption and unemployment that is attributable to an increase in precautionary savings during periods of high unemployment.

Further intuition behind the use of unemployment as a proxy lies in the growing body of work on the psychological effect of unemployment on the level of happiness and well being. One conclusive finding that was held relatively unchallenged is that the level of unemployment reduces the level of happiness and well being significantly. For instance, Blanchflower ((1996), (2001)), amongst others, reaches this conclusion after investigating twenty-three different countries. Further support for this finding is provided by Ahn et al. (2004) who examine this effect for all countries in the European Community. They find evidence that unemployment reduces the level of satisfaction both in financial terms and vocational activity. This finding varies across countries, with unemployment in Denmark and the Netherlands having the least sensitive impact on well being.

### 1.2. Cost of Living-Consumer Price Index (CPI)

The only variable considered in this study that has been used in the international tourism literature is the tourists' cost of living (or relative CPI) defined as the CPI for the destination country relative to the origin country (Habibi and Rahim (2009), Arsad and Johor (2010), Song et al. (2010) and Abbas and Ibrahim (2011) among others). There is recognition amongst academics and the tourism industry on the relevance of price competitiveness of the destination country (Dwyer et al. ((2000a), (2000b), (2002)). Theoretically, a proxy for the tourists' cost of living should include travel cost to and from the destination, in addition to the cost of accommodation, tour services and restaurants. However, due to a lack of data, most studies have omitted travel costs. Hence, the question mark posed by previous studies is whether the CPI in the destination country is a reasonable proxy for tourism prices.

Morley (1994) investigated the reliability of the CPI as a proxy for tourism prices for 10 major destinations. Tourist expenditures estimated were found to correlate with the CPI in the country of destination, a finding that was found to be robust to the removal of linear time trends

from the series. A similar conclusion was reported in a more recent study by Salman et al. (2007) in relation to formulating and testing the demand function for tourism in Sweden. In view of the importance of price competitiveness in the country of destination, shocks to relative CPI could have profound implications for future tourism arrivals.

### 1.3. Consumer Confidence

The final macroeconomic variable considered in this study is the consumer confidence indicator as providing inferences on the degree of uncertainty associated with future economic conditions in the country of origin. According to Ludvigson (2004), high consumer confidence reflects reduced uncertainty on future economic conditions, which translates into reduced precautionary savings and increased present consumption at the expense of future consumption. However, economic theory surrounding consumer confidence extends beyond precautionary savings and current consumption. Theory also judges consumer confidence as a means of capturing expectation on future income and wealth and, as such, it could impact on future consumption (Ludvigson (2004)).

In this paper, the consumer confidence indicator is used as a second proxy for the state of the wider economy. The intuition behind this notion is provided by Matsusaka and Sbordone (1995), who report evidence that consumer confidence has a statistically significant impact on macroeconomic fluctuations. Based on the above analysis, we argue that high consumer confidence in the country of origin implies a fall in the level of precautionary savings and therefore may feed into increased tourism flows from that country; whether it has an immediate impact depends on which theoretical explanation holds.

The implication of past studies considering the role of consumer confidence was to examine whether the indicator merely serves as a proxy for a broader economic cycle (Matsusaka and Sbordone (1995)). Doms and Morin (2004) added to this notion by reporting evidence that the consumer confidence indicator is more volatile in times during and after recessions, when news coverage is greater coinciding with a willingness to adjust expectations. However, the vast majority of studies have investigated whether consumer confidence can be used to forecast future household spending and consumption. The general consensus formed is that it adds predictive power to short term forecasts (Carroll et al. (1994), Bram and Ludvigson

(1998) and Howrey (2001)). Eppright et al. (1998) find negative shocks have an adverse impact on consumer confidence that in turn translates into lower consumption.

Taken together, it is plausible to argue that unemployment levels, having a major effect on real wages, as well as people's level of happiness and well being, could affect the level of tourism activity. Additionally, the notion that tourists' cost of living as a reflection of price competitiveness of the destination country, in addition to consumer confidence proxies for economic uncertainty and future income, could have far reaching implications on future tourism arrivals to Greece. With no evidence available from previous studies, this will provide a more complete picture for policymakers on future arrivals especially in times of recession when poor economic fundamentals could feed into short to medium term forecasts. As a matter of fact, this study is of particular interest, given that Greece has been in a recession recently.

## 2. DATA

### 2.1. Sample

To conduct this study, our database consists of monthly data on tourist numbers to Greece as well as unemployment levels, Consumer Price Indices (CPI) and Consumer Confidence Indicators from the country of origin for the period January 1977 to December 2009. Macroeconomic variables for the United Kingdom, United States, France, Germany, Italy and the Netherlands were downloaded from Datastream. In addition to the countries of origin, we also collected CPI data for Greece to compute relative CPI as a proxy for tourists' cost of living. Consistent with previous studies,[4] the relative CPI (CP) is defined as:

$$CP_t = \frac{CPI_{i,t}}{CPI_{j,t}}$$

where $CPI_{i,t}$ and $CPI_{j,t}$ are the consumer price indexes of Greece (the destination country i) and the countries of origin j, respectively.

Tourism data was collected from a variety of different sources. First, data regarding the arrivals in Greece and countries of tourists' origin were obtained from the Hellenic Statistical Authority. Cross checks and additional information were extracted from airlines, cruise

[4] See Daniel and Ramos (2002), Garin-Munoz (2006) and Garin-Munoz and Montero-Martin (2007), among others, in relation to Portugal and Spain respectively.

companies, travel industry sources, big tourism operators, such as the Association of British Travel Agents (ABTA), the International Air Transport Association (IATA), the Greek National Tourism Organisation (GNTO), the Association of Greek Tourist Enterprises (SETE), the Hellenic Association of Travel & Tourist Agencies, the European Travel Commission (ETC), the General Secretariat of National Statistical Service of Greece (NSSG) – Ministry of Economy and Finance, Athens International Airport (Eleftherios Venizelos), Mediterranean Cruise Ports (MedCruise), Piraeus Port Authority and the United Kingdom Office for National Statistics.

Figure 1 illustrates the importance of the origin countries chosen in this paper as the source of tourism demand in Greece. These countries are: France, Germany, the United Kingdom, Italy, the Netherlands, and the United States. The countries selected make up on average more than 50% of the total arrivals in Greece throughout the entire sample period.

[Please Insert Figure 1 About Here]

## 2.2. Descriptive Statistics

### 2.2.1. Tourist Arrivals

The total number of tourist arrivals in Greece from 1977-2009 are presented in Table 1. The table considers tourist arrivals from the countries of origin considered in the paper. The statistics generally indicate a rapidly increasing trend that began in the 1980's and reached a peak of 17.2 million tourists in 2006. It is worth mentioning that Greek tourism underwent much development during this period in which increases in tourism arrivals were registered for twelve out of the thirteen years mostly due to spatial polarization, the intensification of seasonality, and the production and distribution of tourism consumption (Galani-Moutafi (2004)). The two years that followed (2008 – 2009) clearly showed a decline due to the global financial crisis and increased competition from newer holiday hot spots, such as Montenegro, Croatia and Turkey offering similar attractions. Greece has a high percentage of repeat customers, but as a member of the Eurozone, it is more expensive than some of the up-and-coming destinations and less appealing to those on a fixed income (retirees for instance) or families seeking a budget holiday (Alegre et al. (2010)).

Table 1 also reveals that tourist arrivals from Europe comprise the majority of foreign

tourists in Greece. For instance, Germany and the United Kingdom, two important sources of tourism, reported an average annual growth rate of approximately six percent. Arrivals from the United Kingdom peaked at over three million in 2003. However, since then, there has been a steady drop of over 100,000 arrivals per year mainly due to intense competition from other destinations, including domestic, offered by tour operators as well as the internet (Miller, Rathouse, Scarles, Holmes, and Tribe (2010)).

However, further analysis of Table 1 reveals clear evidence that the source of tourism arrivals is undiversified and heavily reliant on the United Kingdom, followed by Germany. Both countries contribute, on average. 16.5% and 15.2% respectively, to total tourism demand between 1977 and 2009.[5] As a result, establishing the United Kingdom and Germany as the main source of tourism demand has implications in identifying the greatest source of risk when impulse response analysis is performed later in the study.

[Please Insert Table 1 About Here]

### 2.2.2. Macroeconomic Factors

Table 2 provides descriptive statistics on the macroeconomic variables for the country of origin from 1977 to 2009. Relative CPI, from a low of about five percent in Italy to almost nine percent in Germany, indicates that the cost of living in Greece has increased significantly relative to all countries of origin over the sample period. As a result, high inflation in Greece relative to other countries seems as a potential source of risk to future arrivals. Unemployment appears to be the most volatile macroeconomic factor considered even though it has increased over the period, from just over one percent in Italy to around five percent in Germany, thus suggesting another potential source of risk to future tourism demand in the short term. On the other hand, despite showing greater variability, as implied by the minimum and maximum values, the consumer confidence indicator has remained relatively stable over the sample period.

[5] Further evidence of a lack of diversification in the source of tourism demand is provided when we performed the same analysis (not reported for space purposes) to non-EU countries and regions. Non-EU countries such as Russia, Turkey and Japan contributed only 0.9%, 0.8% and 0.9%, respectively, over the same period. For regions, we looked at the E.U. block, Asia, Africa and Oceania zones, only to find unequivocal evidence that the source of tourism demand is undiversified with 66.3% arrivals coming from E.U. block countries, 4.2% from Asia, 0.9% from Africa and 1.1% from the Oceania zone.

2.2.2.1 Unemployment Trends

Table 2 also provides inferences on annual trends in the macroeconomic factors by taking the year on year percentage change as of December of each year. Focusing on unemployment trends in relation to table 1, the United Kingdom, regarded as the most important source of tourism, appears to be insensitive to increases in annual unemployment except during 2008 – 2009. Contrary to the general conclusions of Malley and Moutos (1996), significant increases in unemployment between 1980–1982 and 1990–1992 were associated with increases in tourists' numbers. According to unreported data from Laborsta organisation, this may be attributable to the upward trend in employment levels over the past three decades, as from approximately 24.8 million people being employed in 1977, the number increased to around 30.8 million people by 2005. However, the significant fall in unemployment between 1993 and 2000 was associated with the largest increase in tourist numbers in Greece over the same period. The increase in unemployment during 2008–2009 coincided with a 19.26% reduction of British tourists who visited Greece.

Germany, the second most important source of tourism demand, experienced the highest unemployment increases during 1981 – 1983, 1990 – 1993 and 2003 – 2005. Despite this, table 1 shows that tourism from Germany increased during the first period and little changed in the second period; this was followed by a fall of 10% in 2003 relative to the previous year. Tourism flow appears to be insensitive to upward trends in unemployment in Italy between 1978 and 1987. According to Table 1, the greatest increase in tourism numbers coincided with a sustainable period of declining unemployment from 1999 to 2007. Similar patterns occur in relation to France and the Netherlands whereby tourist arrivals from both countries appear to be relatively insensitive to increases in unemployment.

2.2.2.2 Relative CPI Trend – *Tourists' Cost of Living*

Table 2 provides also information on the trend in the tourists' cost of living defined as the CPI in Greece relative to the countries of origin. Double digit increases in the cost of living in Greece was observed relative to the countries of origin between 1980 and 1992. Interestingly, the rate of increase declined quite dramatically later in the sample to the extent that, in some cases, the cost of living in the country of origin increased relative to Greece (United Kingdom, United

States, Italy and the Netherlands). Despite this, tourism demand to Greece increased dramatically over the same period. Germany, the second most important source of tourism, increased tourist arrivals in Greece by 106%, followed by 99% from the Netherlands, 80% from Italy, 57% from France, 56% from the United Kingdom and, finally, 25% from the United States.

On the other hand, the declining rate of increase in the relative CPI from 1993 has been associated with marked shifts in the tourism arrivals. For instance, tourism arrivals from the United States increased by 103% due to a major surge in numbers in 2005. Tourism arrivals from Italy increased by 81% followed by 75% from France and 57% the Netherlands. Tourism arrivals from the largest contributor, the United Kingdom, only increased by 36% over the same period.

#### 2.2.2.3 Consumer Confidence Indicator

One of the key characteristics of the consumer confidence indicator is the stability and lack of trend. However, closer inspection of the results, in relation to Table 1, reveals some interesting findings. The largest year on year increases in tourism arrivals between 1984 and 1985, followed by 1998 and 2000, coincided with little or no increase in the consumer confidence indicator. Evidence of declining consumer confidence, translating into declining tourism arrivals, is restricted to Italy and the Netherlands at the height of the financial crisis in 2008, as shown in table 2. On the other hand, the same period was related with similar falls in consumer confidence in France and Germany, and tourism arrivals increased by 20% and 9%, respectively.

[Please Insert Table 2 About Here]

## 3. METHODOLOGY

In this paper we use the impulse response function to measure the impact of macroeconomic shocks on future tourism demand. The implication of generating impulse responses is to identify the source of risk to future tourism numbers due to the arrival of macroeconomic shocks. There is a body of work in the tourism literature which uses macroeconomic inputs into structural time series models to explain future tourism demand. For instance, Metzgen-Quemarez (1990) used real Growth Domestic Product figures from the United

States, amongst other factors; Var et al. (1990) and Icoz et al. (1998) employed Turkish CPI figures and the Turkish Lira currency exchange rate against the currency units from the tourist's country of origin, respectively; Greenidge (2001), used real Growth Domestic Product and CPI of the country of origin as well as the price index of tourism in Barbados and finally, Song et al. (2010) employed Growth Domestic Product data of the country of origin and CPI in Hong Kong relative to the country of origin adjusted by the exchange rate.

However, unlike previous studies, we do not use macroeconomic inputs to explain the demand function of tourism arrivals. Instead, we generate macroeconomic shocks from these variables through the impulse response function by utilizing the Vector Autoregressive (VAR) Model, first introduced by Sims (1980). Since its introduction, it has been widely used in the economics literature in the use of macroeconomic variables. For instance, within the unemployment literature, the VAR has been used extensively to generate forecasts of the natural rate (Groenewold and Hagger (2000) and King and Morley (2007)) and turning points in the rate of unemployment (Edlund and Karlsson, (2002)), just to list a few.

However, in the context of this paper, the VAR approach is only used to set up a system by which one would introduce random macroeconomic shocks and analyze its impact on future tourism demand. To determine the statistical reliability of the response, Monte Carlo Simulation is used to construct confidence bands around the impulse response. This is of paramount importance to policy makers and industry, as it provides useful inferences on the sensitivity of future tourism arrivals to macroeconomic shocks and the potential source of risk from the country of origin.

### 3.1. The Impulse Response Function

The impulse response function is a valuable tool that can be used to isolate the impact of a macroeconomic shock from the country of origin on future tourists' arrivals to Greece, assuming other variables are held constant. For the purpose of this study, consider the simple VAR model consisting of tourism demand in destination i denoted as $Y_{i,t}$ and macroeconomic inputs $X_{j,t}$ from the country of origin j at time t:

$$\begin{aligned} Y_{i,t} &= \eta_{10} + \Phi_{11} Y_{i,t-n} + \Phi_{12} X_{j,t-n} + u_{i,t} \\ X_{j,t} &= \eta_{20} + \Phi_{21} X_{j,t-n} + \Phi_{22} Y_{i,t-n} + u_{j,t} \end{aligned} \tag{1}$$

in which,

$$X_{j,t} = f\left(UN_j, CP_{ij}, CON_j\right)$$

where $UN_j$, $CP_{ij}$ and $CON_j$ represent unemployment, tourists' cost of living and consumer confidence indicators from each country of origin, respectively. The term $\Phi$ denotes the vector of coefficients that represent the effect of $X_{j,t-n}$ and $Y_{i,t-n}$ on $Y_{i,t}$ and vice versa, and n is the number of lags in the system.

The model of equation (1) is a VAR(n) specification given that the variables in the system have a lag of n. A change in the innovation $u_{i,t}$ will immediately change all future values of Y and X, since lagged Y appears in both equations. Assuming that the innovations $u_{i,t}$ and $u_{j,t}$ are uncorrelated, the interpretation of the impulse response is straightforward. The $u_{i,t}$ is the innovation for Y and $u_{j,t}$ is the innovation for X. The impulse response functions for $u_{j,t}$ measure the impact of a random macroeconomic shock on future tourism demand.

The innovations $u_{i,t}$ and $u_{j,t}$ are, however, usually correlated, so that they have a common component that cannot be associated with a specific variable. A common, but arbitrary, method of dealing with this issue is to attribute the full impact of any common component to the variable that comes first in the VAR system. In this case, the common component of $u_{i,t}$ and $u_{j,t}$ is $u_{i,t}$ given that the innovation $u_{i,t}$ precedes $u_{j,t}$. Hence, $u_{i,t}$ becomes the Y and X innovations, which are transformed to remove the common component. We transform the innovations by orthogonalising the errors using the Cholesky factorisation. This is a popular method of transforming the covariance matrix of the resulting innovations in the VAR residuals into a vector of orthogonal innovations defined as $e_t$.

$$E\left(e_{i,t}e_{j,t}\right) = 0 \qquad \text{where} \quad i \neq j \tag{2}$$

To transform the error terms, a $(N \times N)$ lower matrix defined as V is chosen and the orthogonalised innovations $e_t$ are obtained to satisfy the following equation:

$$e = uV^{-1} \tag{3}$$

where, the innovation $u_t$ has an identity covariance matrix $\Omega$ such that:

$$Eee^{T} = \Omega \tag{4}$$

and

$$VV^{T} = \Omega \tag{5}$$

Upon making the transformation of the orthogonalised innovation and replacing the $u_t$ with $e_t V$, the VAR model, expressed as a moving average representation, can be rewritten as follows:

$$Y_t = \sum_{n=0}^{\infty} A_n V e_{t-n} \tag{6}$$

By defining $B_n = A_n V$, equation (7) becomes:

$$Y_t = \sum_{n=0}^{\infty} B_n e_{t-n} \tag{7}$$

where, $B_n$ represents the impulse response of the market in the future to a shock of one standard deviation in time t. Hence, the elements of $B_n$ are the impact multipliers. Assuming that tourism demand $Y$ is stationary, the impulse response should tend towards zero as n increases.

## 4. EMPIRICAL RESULTS

### 4.1. Preliminary Analysis – Forecasting Tourism Arrivals

Table 3 presents the performance of one year out of sample forecasts for tourism demand Y in Greece using the ARIMA (1, 1, 1), double exponential smoothing, and the Holt's exponential smoothing model with trend.[6] The statistics relate to the performance of all models since the estimation period expands when the model forecasts are updated as new data becomes available. This includes statistics on the success rate at which the model captures the directional forecasts and measures of forecasting accuracy using the Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE).[7] Intuitively, this

[6] Before implementing the forecasting models, we tested annual total arrivals series for a unit root using the Phillips-Perron (1988) test. The results are not reported in the paper, but are available upon request. We find the null hypothesis of a unit root accepted in the log levels $Y$ but rejected after taking the first differences $\Delta Y$. Therefore, we uncover stationarity in the transformed series $\Delta Y$.

[7] The Mean Absolute Error (MAE) measures the degree to which forecasts and the outcomes are close together. The Mean Absolute Percentage Error (MAPE) is similar except that it presents a measure of forecasting accuracy relative to the eventual outcome in terms of a percentage, whereas, the Root Mean Square Error (RMSE) is a measure of precision based on the residuals aggregated over the back-test period. All three measures of accuracy are frequently used in the literature (for instance, Preez and Witt (2003), Song et al (2003) and Chu (2009) to list a few).

would enable one to identify the forecastability of tourism demand to Greece in light of the potential risks to future numbers.

[Please Insert Table 3 About Here]

In general, the ARIMA (1, 1, 1) model outperforms other exponential smoothing models as a directional forecasting tool over an expanding estimation period. The performance is most impressive when it forecasts an increase in tourists' numbers in one year's time. The success rate ranges from 79% to 68%. Despite this, the directional forecasting performance of the ARIMA model does not translate into superior accurate forecasts. Based on the Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Root Mean Square Error (RMSE) measures, the most consistent performing model as a point forecasting tool is the Holt's exponential smoothing model with trend.

On the other hand, the worst performing model based on these criteria is the ARIMA (1, 1, 1) model, a finding that is robust as the estimation period expands. These findings are consistent with the results of Smeral and Wuger (2005) who reported that the naïve model outperformed the ARIMA model. On the other hand, our results contrasts with the early findings of Chu (1998), followed by Preez and Witt (2003), in which the superior performance of the ARIMA model in relation to other approaches was highlighted. Finding differences in model performance using different approaches is also not surprising. For instance, Clements and Hendry (1998) argue that the performance of econometric models is determined by the methodology used to generate forecasts.

### 4.2. The Impact of Macroeconomic Shocks on Future Tourism Arrivals

#### 4.2.1. The VAR Model

In this section, we address the impact of macroeconomic shocks on future tourism demand for Greece. Firstly, we utilize the VAR (n) model on monthly data of tourists' arrivals to Greece, unemployment, tourists' cost of living, and consumer confidence from the countries of origin from 1977 to 2009. Given that VAR models are modelled on a stationary time series, the first step requires the implementation of unit root tests on each series. Instead of using the

Augmented Dickey-Fuller (ADF) test, we employ the Phillips-Perron (1988) approach on the level series first followed by the transformed series.

The intuition behind the use of the Phillips-Perron (1988) approach is that it has more power than the Augmented Dickey-Fuller test. One issue that arises with the Augmented Dickey-Fuller is the selection of the number of lags that could lead to a bias towards rejection of the null hypothesis of a unit root in the event of selecting too few lags. Conversely, bias towards accepting the null hypothesis tends to arise in the event of selecting too many lags. This problem has been overcome by this approach, as it applies a non-parametric correction to deal with any serial dependencies in the dataset. Table 4 presents the Phillips-Perron (1988) test results for each series. As expected, rejection of the null hypothesis of a unit root is reported when the series is differenced.[8]

[Please Insert Table 4 About Here]

With the detection of stationarity in the transformed series ($\Delta Y$ and $\Delta X$), the following VAR model, used as the system of equations from equation (1), is estimated:

$$\begin{aligned}
\Delta ARR_t &= a_1 + \sum_{i=1,\ldots,n} b_i \Delta ARR_{t-i} + \sum_{i=1,\ldots,n} c_i \Delta UN_{t-i} + \sum_{i=1,\ldots,n} d_i \Delta CP_{t-i} + \sum_{i=1,\ldots,n} e_i \Delta CON_{t-i} + u_{i,t} \\
\Delta UN_t &= a_2 + \sum_{j=1,\ldots,n} bj \Delta ARR_{t-j} + \sum_{j=1,\ldots,n} c_j \Delta UN_{t-j} + \sum_{j=1,\ldots,n} d_j \Delta CP_{t-j} + \sum_{j=1,\ldots,n} e_j \Delta CON_{t-j} + u_{j,t} \\
\Delta CP_t &= a_3 + \sum_{k=1,\ldots,n} b_k \Delta ARR_{t-k} + \sum_{k=1,\ldots,n} c_k \Delta UN_{t-k} + \sum_{k=1,\ldots,n} d_k \Delta CP_{t-k} + \sum_{k=1,\ldots,n} e_k \Delta CON_{t-k} + u_{k,t} \\
\Delta CON_t &= a_4 + \sum_{l=1,\ldots,n} b_l \Delta ARR_{t-l} + \sum_{l=1,\ldots,n} c_l \Delta UN_{t-l} + \sum_{l=1,\ldots,n} d_l \Delta CP_{t-l} + \sum_{l=1,\ldots,n} e_l \Delta CON_{t-l} + u_{l,t}
\end{aligned} \tag{8}$$

where, $\Delta ARR$ is the change in total tourism arrivals to Greece and a, b, c, d, e are coefficients to be estimated within the VAR system. Before estimating equation (8), we performed the Akaike (1974). Information Criterion test to determine the optimal number of lags (n) used in each

[8] Given the finding of non-stationarity in the log series and stationarity in the transformed series, we tested whether there exist a long run equilibrium relationship between tourism flows to Greece and the macroeconomic factors from the country of origin using the Johansen (1988) and Johansen and Juselius (1990) maximum likelihood approaches. The test results report overwhelming evidence of multiple co-integrating relationships between tourism flows and macroeconomic variables as implied by theory discussed earlier. Owing to the volume of results generated, our findings are not presented, but are available upon request.

model system. We find that lag 5 is the optimal number of lags chosen for each system.[9] Table 5 presents the VAR estimations for the total number of arrivals to Greece. Only coefficients that are statistically significant at the five per cent level are reported given the volume of output. In brief, the results suggest that changes in tourism demand are sensitive to changes in unemployment (UN) in the origin country, and tourists' cost of living relative to the country of origin (CP), but least sensitive to changes in the consumer confidence indicator (CON). The United Kingdom, being one of the important sources of tourism flows, is most sensitive to changes in the tourists' cost of living. On the other hand, Germany, with the second highest number of arrivals, is subject to changes in unemployment and tourists' cost of living. Tourism flows appear to be most sensitive to changes in macroeconomic factors in the Netherlands.

[Please Insert Table 5 About Here]

4.2.2. Impulse Response Results

An issue with the VAR system estimations of Table 5 are the difficulties associated in interpreting the coefficients owing to complications arising from correlation feedbacks in addition to fluctuations of estimations at different lags. Following the estimation of the VAR, the next step is to consider the system's response to shocks originating from macroeconomic surprises and the extent to which these shocks continue to have an impact on future tourism arrivals. To be consistent with the one year forecasts in tourism arrivals analyzed earlier, we focus on impulse responses for the next twelve months. In undertaking such an exercise, we could identify the potential source of risk to future tourists' arrivals. To this effect, impulse responses take into account the variations in the velocity to which the effects of macroeconomic shocks are transmitted, as well as the duration and rate of decay.

In order to determine the robustness and reliability of the response, we compute confidence bands using Monte Carlo Simulation that is simulated 5000 times as a robustness test of the impulse response. Large confidence intervals around the impulse response call into question the credibility of the measurement information, and as such, the robustness of the

[9] The results from the Akaike (1974) Information Criterion test are not presented in this paper for brevity; however, they are available upon request.

response. In Figure 2 we generate time paths of impulse responses on future arrivals in each destination to a one standard deviation unemployment shock in the country of origin. To ensure consistency with the annual forecasts reported earlier, we generate impulse responses in future tourists' arrivals twelve months ahead.

The results provide a clear picture on the impact of macroeconomic shocks on future tourism demand to Greece. Consistent with the conclusions implied by previous studies, a one standard deviation unemployment shock originating from France and the Netherlands has an immediate negative impact on future tourists' arrivals although its duration is very temporary. However, more interestingly future tourists' arrivals appear to react positively after a delay of four to six months following the unemployment shock from the country of origin (Germany, France and the Netherlands). Tourists' arrivals are forecasted to return to pre-shock levels around ten months after the shock. In the case of Germany, the impulse response does become negative ten months after the unemployment shock to continue beyond the twelve month horizon period.

The impulse response results show that tourists' cost of living have a consistent impact on future short term tourists' arrivals with varying degrees of velocity and rate of decay. Closer inspection of the results reveals that the response is asymmetric and differs in magnitude across countries of origin. For instance, future tourists' arrivals respond to a shock in relative CPI in a positive manner subject to a lag of three to four months. However, in some cases the initial positive response of future arrivals does become negative on average around five months after the introduction of the shock only for arrivals to return to their pre-shock levels two months later. The positioning of the confidence bands suggests that the impulse response is reliable and robust. The results on unemployment and tourist's cost of living are in marked contrast to the consumer confidence indicator. Shocks to consumer confidence in the origin country appear to have no impact on future tourism demand, although the positioning of the bands raises questions on the reliability of the response.

[Please Insert Figure 2 About Here]

## 5. FURTHER DISCUSSION OF THE RESULTS

The combination of one year ahead forecast and measurement of the duration, at which future tourism arrivals return to pre-shock levels in the twelve month horizon, provide important information to policy makers for short term planning and budgeting purposes. We find all forecasting models being useful short term directional forecasting tools as long as the models forecast a year on year increase in arrivals. In combining the impulse response of an unemployment shock into the VAR system, the delayed positive response in future tourist numbers is consistent to the success rate in forecasting an increase in tourists' arrivals in Table 3.

For Germany, being the second most important source of tourism demand, the unemployment shock appears to have the greatest positive response. The finding of a delayed positive response could be attributed to tourists deeming Greece as a relatively cheap destination that people travel at a time when economic fundamentals are deteriorating in the origin country. The immediate negative response to an unemployment shock, whilst consistent with the conclusions inferred by the wage curve hypothesis and the psychological aspects of unemployment (Blanchflower ((1996), (2001)) and Ahn, Garcia and Jimeno (2004)), is a major source of downside risk to forecasting future projections of tourism arrivals. Despite this, when combined with the delayed positive response, downside risk from an unemployment shock appears to be limited.

Another source of risk to future tourism demand is the delayed negative response recorded following the introduction of a shock to the tourists' cost of living. This source of risk tends to materialize six months after the introduction of the shock in France, Italy and the Netherlands. However, the risk from this source appears to be limited due to the positive response from shocks originating from the United Kingdom, and Germany that are not forecasted to be reversed at least in the short run.

The impulse response analysis reports evidence that shocks to consumer confidence have no bearing on future tourists' arrivals. This finding has major implications in the light of previous studies which have tested the theory surrounding the importance of the consumer confidence indicator. Theory implies that falls in consumer confidence from the viewpoint of increased uncertainty of future economic conditions or pessimism regarding future income leads to an increase in precautionary savings and hence, negative reaction in future tourism arrivals.

According to our results, this hypothesis is rejected. Furthermore, the implication of our impulse response results is to question the empirical finding that the predictive power of consumption and household expenditure models is improved by the information contained in the consumer confidence indicator (Carroll et al. (1994), Bram and Ludvigson (1998), and Howrey (2001)). Such a conclusion is reached by the inference that a high reading on the consumer confidence index should translate into increased expenditure and a willingness to go on vacation. This also appears to be rejected by our results.

Taken together, finding limited downside risk to future demand from shocks to tourists' cost of living and unemployment is indicative of customer loyalty irrespective of macroeconomic shocks in the tourists' country of origin and is consistent with the results reported by Garin-Munoz (2006) and later, by Garin-Munoz and Montero-Martin (2007). Using lagged consumption in the destination country as a dependent variable, both studies found compelling evidence of high customer loyalty that is attributable to "word of mouth" effect in relation to the Canary and Balearic Islands. Overall, our analysis provides an added dimension, not considered in prior studies that unforeseen macroeconomic shocks from the origin country play an important role in understanding potential risks to future tourism arrivals. Our results highlight the need for third parties to perform impulse response analysis on total tourists' arrivals to Greece as the size of the response, the rate of decay and velocity and the duration of the response, vary considerably.

## 6. IMPLICATIONS ON TOURIST ARRIVALS

The above analysis has a number of implications. Table 1 highlights the lack of diversification in the sources of tourism in Greece since 1977. Negative macroeconomic shocks to the United Kingdom and Germany pose major risks to the Greek tourism industry. Although the impulse response results suggest that future tourism numbers may increase following macroeconomic shocks, there is downside risk that could coincide with the peak times of the year. With the source of potential risk confined to countries in the European Union, the results suggest that the Greek authorities would be benefited by diversifying the sources of tourism as

means of reducing the risk of global macroeconomic shocks from the countries of origin.[10] This involves attracting a greater number of tourists from countries outside the European Union, such as China, India, Russia and the United States. For instance, indications on arrivals from China are very positive as over the studied period there is an average annual growth rate of 19.22%.[11]

As a result of the impact of macroeconomic shocks in the countries of origin, a potential source of risk to future tourists' arrivals has been identified by our findings. Safeguarding the Greek tourism industry requires short, medium and long term planning and investment on the brand itself, in addition to promoting Greece to countries beyond the European Union as a means of diversifying away global economic risk. The results in this paper should provide important insights that will be useful to short and medium term planning process. A similar exercise for longer term planning will provide inferences on where to target future additional investment in promoting the brand to new countries and/or regions in addition to its traditional sources of tourism.

## 7. CONCLUSION

This paper opens a new avenue of research in tourism forecasting by investigating the impact of random macroeconomic shocks on short term forecasts for tourist arrivals. This approach differs from the established literature of investigating the demand function for tourists. Our study addresses a major gap in the literature by forecasting tourism arrivals in Greece. Forecasting tourists' arrivals comes in two levels; first, we utilize an array of forecasting models, firmly established in the literature, to generate one year out of sample forecasts. Secondly, we estimate a VAR system from which we introduce random macroeconomic shocks to gauge the reaction of future tourism arrivals in terms of the sign, magnitude and duration. Macroeconomic factors used include unemployment, tourists' cost of living, and finally, the consumer confidence indicator with the latter two variables acting as proxies for the state of the economy in the origin country. Undertaking such an exercise breaks new ground by identifying the greatest source of the risk to future tourism demand, both in terms of the variable and location.

[10] This view is given added importance given additional analysis reported earlier in footnote 4, where 66.3% of tourists over the 1977 to 2009 period arrive from E.U. countries. This contrasts with 4.1% from Asia, 0.9% from Africa and 1.1% from the Oceania region.

[11] Source: Hellenic Association of Travel and Tourist Agencies (2010).

To begin with, our forecasting results were mixed. According to the preliminary analysis, the ARIMA (1, 1, 1) model outperforms other exponential smoothing models as a directional forecasting tool. This finding is robust on an ever expanding estimation period. However, the directional forecasting performance of the ARIMA fails to translate into forecasting accuracy. Instead, the Holt's exponential smoothing model with trend generates the most accurate forecasts.

In identifying the source of risk, we established that the source of tourists' arrivals to Greece is undiversified and heavily over-weighted towards the United Kingdom and Germany. Despite this, the impulse response analysis yielded some interesting results. Consistent with the implications of previous studies on unemployment, there is some evidence that shocks have an immediate temporary negative impact on future tourists' arrivals that is reversed four to six months after the shock. Furthermore, future tourists' arrivals appear to react to shocks on the tourists' cost of living, regardless of the country of origin, subject to a lag of three to four months. This contrasts with the lack of response in future tourism demand to a shock in consumer confidence index in the origin country. Taken together, despite the undiversified nature in the source of tourism flow to Greece, the impulse response results suggest that downside risk to future arrivals is limited, at least in the short term.

The impulse response results presented in this study open a new dimension in the type of macroeconomic factors used and how these shocks impact on tourism demand in the future. As a result, our comprehensive evidence offers important implications and insights to policymakers and tourist operators regarding future tourism demand.

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## Table 1. Total Arrivals and Origin of Tourist Arrivals in Greece

| Year | Total | France | Germany | United Kingdom | Italy | Netherlands | United States |
|---|---|---|---|---|---|---|---|
| **1977** | 3961112 | 276468 | 489522 | 384076 | 164631 | 106448 | 598470 |
| **1978** | 4532411 | 347627 | 520547 | 514485 | 214678 | 122054 | 513181 |
| **1979** | 5798360 | 319483 | 555171 | 559657 | 264646 | 141089 | 601456 |
| **1980** | 5271115 | 299791 | 692961 | 768215 | 197006 | 179842 | 288647 |
| **1981** | 5577109 | 298499 | 625121 | 964707 | 225479 | 170002 | 321081 |
| **1982** | 5463860 | 335366 | 606046 | 1022692 | 223922 | 139286 | 333080 |
| **1983** | 5258372 | 299506 | 728478 | 888991 | 327610 | 153672 | 406887 |
| **1984** | 6027266 | 405907 | 864000 | 1043363 | 328598 | 192879 | 474845 |
| **1985** | 7039428 | 441141 | 1050000 | 1329259 | 364177 | 280309 | 466155 |
| **1986** | 7339015 | 462898 | 1148728 | 1354742 | 377873 | 302850 | 483620 |
| **1987** | 8053052 | 471113 | 1302781 | 1412474 | 393117 | 336890 | 514835 |
| **1988** | 8351182 | 476631 | 1367348 | 1435855 | 414843 | 348002 | 274720 |
| **1989** | 8540962 | 480983 | 1438592 | 1449347 | 421929 | 356219 | 278856 |
| **1990** | 9310492 | 487290 | 1564289 | 1500428 | 447192 | 374413 | 273849 |
| **1991** | 8271258 | 485627 | 1544312 | 1503271 | 445720 | 369418 | 180429 |
| **1992** | 9765012 | 494572 | 1674200 | 1583508 | 457134 | 396010 | 278941 |
| **1993** | 9913267 | 491567 | 1604829 | 1599478 | 461849 | 407720 | 256719 |
| **1994** | 11230854 | 502837 | 1785401 | 1673820 | 485303 | 442260 | 270777 |
| **1995** | 10712145 | 484621 | 1830378 | 1704620 | 497837 | 466276 | 239684 |
| **1996** | 9782061 | 462732 | 1907863 | 1687999 | 491081 | 452179 | 222130 |
| **1997** | 10588489 | 426678 | 1994670 | 1711942 | 533303 | 464144 | 240555 |
| **1998** | 11363822 | 486201 | 2136515 | 2044243 | 659688 | 548339 | 219362 |
| **1999** | 12605928 | 545981 | 2450137 | 2433033 | 745915 | 616807 | 229314 |
| **2000** | 13567453 | 602353 | 2395185 | 2772256 | 823245 | 655285 | 218731 |
| **2001** | 14678688 | 726816 | 2345440 | 2932342 | 889925 | 715926 | 164689 |
| **2002** | 14918177 | 735568 | 2510849 | 2858360 | 805008 | 721413 | 146754 |
| **2003** | 14784560 | 714821 | 2267063 | 3008382 | 865730 | 635882 | 148751 |
| **2004** | 14267420 | 621407 | 2189222 | 2869737 | 898208 | 611990 | 161398 |
| **2005** | 16938131 | 676658 | 2241942 | 2718721 | 1128506 | 666287 | 305840 |
| **2006** | 17283910 | 712131 | 2267961 | 2615836 | 1187598 | 782154 | 358624 |
| **2007** | 17165265 | 756105 | 2264332 | 2508651 | 1157081 | 828185 | 380611 |
| **2008** | 16938806 | 910023 | 2469152 | 2554943 | 1099981 | 756939 | 404384 |
| **2009** | 15914534 | 962433 | 2364488 | 2112151 | 935009 | 651437 | 531276 |

**Note:** The unemployment figures are expressed in thousands (000's) and were downloaded from Datastream.

## Table 2. Descriptive Statistics on Macroeconomic Factors from Country of Origin

| | U.K | | | U.S. | | | Germany | | | France | | | Italy | | | Netherlands | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Relative CPI | Unemployed | Consumer Confidence | Relative CPI | Unemployed | Consumer Confidence | Relative CPI | Unemployed | Consumer Confidence | Relative CPI | Unemployed | Consumer Confidence | Relative CPI | Unemployed | Consumer Confidence | Relative CPI | Unemployed | Consumer Confidence |
| **1977** | | | | | | | | | | | | | | | | | | |
| **1978** | 3.1% | -8.3% | -4.1% | 2.5% | -11.2% | | 9.0% | -3.9% | 2.8% | 1.9% | 1.9% | -0.5% | 0.2% | 4.5% | 3.9% | 7.6% | 7.6% | -0.7% |
| **1979** | 6.4% | -3.7% | -2.4% | 10.2% | -0.8% | -1.7% | 18.4% | -12.0% | -4.2% | 11.6% | 11.6% | -1.4% | 5.0% | 3.9% | -4.9% | 19.0% | 19.0% | -0.9% |
| **1980** | 9.6% | 70.2% | -2.3% | 12.1% | 25.0% | 1.5% | 19.5% | 3.3% | -5.0% | 10.9% | 10.9% | -0.9% | 5.5% | 1.3% | 1.1% | 18.2% | 18.2% | -3.3% |
| **1981** | 9.3% | 33.5% | 0.2% | 12.5% | 7.9% | -1.0% | 14.8% | 44.1% | -4.6% | 7.5% | 7.5% | 1.2% | 3.7% | 13.7% | 1.4% | 14.1% | 14.1% | 0.1% |
| **1982** | 13.0% | 12.7% | 4.9% | 14.5% | 29.5% | 1.4% | 13.9% | 43.1% | 0.9% | 8.5% | 8.5% | -0.7% | 2.2% | 0.5% | -3.8% | 14.2% | 14.2% | -1.0% |
| **1983** | 14.1% | 5.2% | 1.9% | 15.8% | -0.2% | 5.3% | 17.0% | 22.0% | 7.5% | 10.0% | 10.0% | -2.9% | 7.0% | 14.2% | 2.8% | 16.7% | 16.7% | 1.6% |
| **1984** | 12.9% | 5.0% | -3.3% | 13.7% | -20.2% | 0.0% | 15.8% | 0.1% | 0.3% | 10.6% | 10.6% | -2.6% | 7.9% | 2.9% | 4.5% | 14.8% | 14.8% | 2.4% |
| **1985** | 18.1% | 2.6% | -1.3% | 20.1% | -2.5% | -0.3% | 22.9% | 1.8% | 1.2% | 19.2% | 19.2% | 2.0% | 14.6% | 8.4% | -2.7% | 22.8% | 22.8% | 3.5% |
| **1986** | 12.8% | -0.4% | 1.3% | 15.8% | -0.8% | -0.6% | 18.2% | -3.6% | 2.3% | 14.6% | 14.6% | -0.3% | 12.3% | 11.0% | 4.5% | 17.4% | 17.4% | -0.1% |
| **1987** | 11.6% | -16.1% | 2.5% | 10.9% | -10.1% | -0.7% | 14.6% | 0.4% | -4.7% | 12.3% | 12.3% | 1.0% | 10.1% | 5.9% | -2.3% | 16.4% | 16.4% | -1.4% |
| **1988** | 8.8% | -20.9% | -1.6% | 9.1% | -9.7% | 1.5% | 11.8% | 0.2% | 2.9% | 10.5% | 10.5% | 1.7% | 8.1% | -1.4% | 2.4% | 12.6% | 12.6% | 1.8% |
| **1989** | 9.0% | -18.8% | -2.8% | 9.7% | -2.6% | -0.6% | 11.5% | -9.1% | 0.7% | 10.9% | 10.9% | -0.1% | 8.1% | -2.2% | -0.1% | 13.4% | 13.4% | 1.2% |
| **1990** | 14.2% | 13.3% | -1.1% | 15.9% | 8.2% | -5.7% | 19.6% | 1.2% | -1.5% | 19.2% | 19.2% | -2.8% | 15.3% | -2.4% | -4.3% | 19.7% | 19.7% | -3.6% |
| **1991** | 10.1% | 37.3% | 2.0% | 14.5% | 22.4% | 0.7% | 11.6% | 27.2% | -1.9% | 14.6% | 14.6% | -1.5% | 11.5% | -2.6% | 0.2% | 13.8% | 13.8% | -0.2% |
| **1992** | 11.6% | 16.7% | -3.2% | 11.1% | 11.2% | 4.4% | 10.7% | 14.4% | -5.5% | 12.2% | 12.2% | 0.4% | 9.1% | -22.6% | -7.0% | 11.8% | 11.8% | -0.4% |
| **1993** | 9.3% | -6.6% | 2.5% | 9.0% | -7.1% | 0.1% | 7.5% | 15.0% | -0.8% | 9.7% | 9.7% | 0.4% | 7.3% | 14.2% | 0.6% | 9.1% | 9.1% | -0.7% |
| **1994** | 8.5% | -12.9% | 1.0% | 7.8% | -10.7% | 1.5% | 8.0% | 7.3% | 9.2% | 8.9% | 8.9% | 3.9% | 6.4% | 6.1% | 12.3% | 7.8% | 7.8% | 3.0% |
| **1995** | 4.8% | -7.7% | 1.8% | 5.3% | -7.1% | -1.2% | 6.3% | -1.9% | -3.9% | 5.8% | 5.8% | -3.2% | 2.2% | 1.4% | -0.6% | 6.1% | 6.1% | 1.5% |
| **1996** | 4.9% | -15.7% | 1.3% | 3.9% | -2.4% | 1.8% | 5.7% | 9.9% | -2.4% | 5.4% | 5.4% | -0.6% | 4.3% | 1.5% | -3.3% | 4.9% | 4.9% | 0.1% |
| **1997** | 3.0% | -24.7% | 1.4% | 2.9% | -6.9% | 1.6% | 2.6% | 10.6% | 2.3% | 3.6% | 3.6% | 3.4% | 2.8% | 1.0% | 3.4% | 2.3% | 2.3% | 1.6% |
| **1998** | 2.3% | -6.8% | -3.2% | 2.3% | -7.8% | -0.7% | 3.4% | -3.0% | 6.4% | 3.7% | 3.7% | 1.8% | 2.2% | 1.9% | 0.5% | 2.1% | 2.1% | -1.7% |
| **1999** | 1.5% | -11.8% | 2.2% | 0.0% | -5.2% | 1.2% | 1.6% | -4.1% | -1.6% | 1.4% | 1.4% | 1.1% | 0.6% | -5.7% | -1.6% | 0.6% | 0.6% | 2.5% |
| **2000** | 3.1% | -11.2% | -0.2% | 0.5% | -3.3% | -1.7% | 1.8% | -5.2% | 1.3% | 2.3% | 2.3% | 1.2% | 1.2% | -8.8% | 1.5% | 1.3% | 1.3% | -1.3% |
| **2001** | 2.0% | -6.2% | -1.9% | 1.4% | 20.1% | -2.5% | 1.4% | -0.5% | -5.4% | 1.7% | 1.7% | -5.1% | 0.7% | -7.2% | 0.7% | -1.1% | -1.1% | -3.4% |
| **2002** | 1.7% | -3.2% | 0.7% | 1.0% | 22.6% | -1.0% | 2.2% | 5.5% | -2.1% | 1.1% | 1.1% | 0.2% | 0.6% | -2.5% | -4.7% | 0.6% | 0.6% | -1.5% |
| **2003** | 1.8% | -3.1% | 0.6% | 1.1% | 4.7% | 2.6% | 2.0% | 7.6% | 1.2% | 0.9% | 0.9% | -0.8% | 0.6% | -2.7% | -0.6% | 1.4% | 1.4% | -0.1% |
| **2004** | 1.4% | -8.8% | 0.8% | -0.1% | -7.2% | -0.1% | 0.8% | 0.2% | -0.3% | 1.0% | 1.0% | 1.9% | 1.0% | -3.5% | -0.4% | 2.0% | 2.0% | 0.8% |
| **2005** | 1.7% | 9.9% | -1.0% | 0.1% | -6.9% | -1.8% | 2.2% | 10.8% | 2.7% | 2.1% | 2.1% | -0.1% | 1.6% | -4.4% | -0.4% | 1.5% | 1.5% | 1.4% |
| **2006** | -0.1% | 3.5% | -0.5% | 0.4% | -7.7% | 1.4% | 1.5% | -7.7% | 2.3% | 1.4% | 1.4% | 1.3% | 1.0% | -14.4% | 0.9% | 1.9% | 1.9% | 2.6% |
| **2007** | 1.7% | -13.3% | 0.1% | -0.2% | 1.2% | -3.7% | 0.7% | -15.8% | 1.2% | 1.3% | 1.3% | -0.4% | 1.2% | -0.9% | -3.0% | 2.0% | 2.0% | -1.4% |
| **2008** | -1.1% | 45.2% | -7.0% | 1.9% | 26.7% | -4.1% | 0.8% | -13.5% | -8.2% | 1.0% | 1.0% | -5.9% | -0.3% | 11.2% | -2.9% | 0.0% | 0.0% | -4.5% |
| **2009** | -0.2% | 35.2% | 6.9% | -0.1% | 59.8% | 3.2% | 1.7% | 4.8% | 2.1% | 1.7% | 1.7% | 4.6% | 1.6% | 17.6% | 5.7% | 1.5% | 1.5% | 2.9% |
| Mean | 6.59% | 2.83% | -0.11% | 7.05% | 3.40% | 0.03% | 8.74% | 4.65% | -0.15% | 7.10% | 3.08% | -0.11% | 4.86% | 1.24% | 0.12% | 8.64% | 2.85% | 0.02% |
| Standard deviation | 0.0522 | 0.2136 | 0.0275 | 0.0625 | 0.1644 | 0.0236 | 0.0700 | 0.1400 | 0.0394 | 0.0557 | 0.0836 | 0.0234 | 0.0446 | 0.0851 | 0.0379 | 0.0728 | 0.1958 | 0.0207 |
| Minimum | -1.11% | -24.66% | -6.98% | -0.17% | -20.24% | -5.72% | 0.74% | -15.84% | -8.17% | 0.89% | -13.38% | -5.89% | -0.27% | -22.60% | -6.99% | -1.06% | -23.82% | -4.53% |
| Maximum | 18.15% | 70.23% | 6.93% | 20.13% | 59.75% | 5.34% | 22.87% | 44.09% | 9.25% | 19.20% | 23.33% | 4.61% | 15.26% | 17.62% | 12.30% | 22.81% | 47.63% | 3.47% |

**Table 3. Forecasting Tourism Arrivals – Model Performance**

| Period Estimated | | Directional Success (%) Increase* | Directional Success (%) Decline* | MAE | MAPE | RMSE |
|---|---|---|---|---|---|---|
| 1977 - 2005 | ARIMA(1,1,1) | 0.79 | 0.75 | 0.02986 | 1.05656 | 0.00528 |
| | Double ES | 0.68 | 0.17 | 0.01018 | 1.01460 | 0.00180 |
| | Holt-Winter's | 0.69 | 0.00 | 0.01513 | 0.91509 | 0.00267 |
| 1977 - 2006 | ARIMA(1,1,1) | 0.74 | 0.50 | 0.04047 | 1.02714 | 0.00715 |
| | Double ES | 0.68 | 0.14 | 0.01056 | 1.08054 | 0.00187 |
| | Holt-Winter's | 0.71 | 0.00 | 0.00759 | 0.86517 | 0.00134 |
| 1977 - 2007 | ARIMA(1,1,1) | 0.74 | 0.43 | 0.04301 | 1.27458 | 0.00760 |
| | Double ES | 0.65 | 0.14 | 0.00935 | 1.15094 | 0.00165 |
| | Holt-Winter's | 0.69 | 0.00 | 0.00702 | 0.97420 | 0.00124 |
| 1977 - 2008 | ARIMA(1,1,1) | 0.71 | 0.43 | 0.04274 | 1.42699 | 0.00756 |
| | Double ES | 0.63 | 0.14 | 0.00881 | 1.24417 | 0.00156 |
| | Holt-Winter's | 0.67 | 0.00 | 0.00764 | 1.06173 | 0.00135 |
| 1977 - 2009 | ARIMA(1,1,1) | 0.68 | 0.43 | 0.04257 | 1.43372 | 0.00753 |
| | Double ES | 0.68 | 0.40 | 0.00665 | 1.22910 | 0.00118 |
| | Holt-Winter's | 0.66 | 0.00 | 0.00454 | 1.06338 | 0.00080 |

**Note:** * The terms "Increase" and "Decline" refers to a model forecast of an increase and decrease in tourism arrival in one year.

**Table 4. Phillips-Peron Tests for Unit Root on Each Series**

| **Destination** | **Levels** | | | **First Difference** | | |
|---|---|---|---|---|---|---|
| **Greece** | -3.0306 | | | -12.619* | | |
| | UNEM | Relative CPI | Consumer Confidence | UNEM | Relative CPI | Consumer Confidence |
| **U.K.** | -1.4380 | -3.4086 | -3.4163 | -5.5869* | -17.499* | -4.4346* |
| **U.S.** | -1.0629 | -3.3826 | -2.1215 | -22.126* | -16.493* | -4.5822* |
| **Germany** | -1.5379 | -3.0981 | -3.1272 | -10.481* | -16.596* | -4.8583* |
| **France** | -3.0583 | -2.9607 | -3.1206 | -9.9413* | -17.318* | -3.6119* |
| **Italy** | -2.1862 | -2.2698 | -3.2743 | -20.886* | -19.312* | -4.0020* |
| **Netherlands** | -2.1583 | -3.3330 | -2.1500 | -21.101* | -16.163* | -4.4719* |

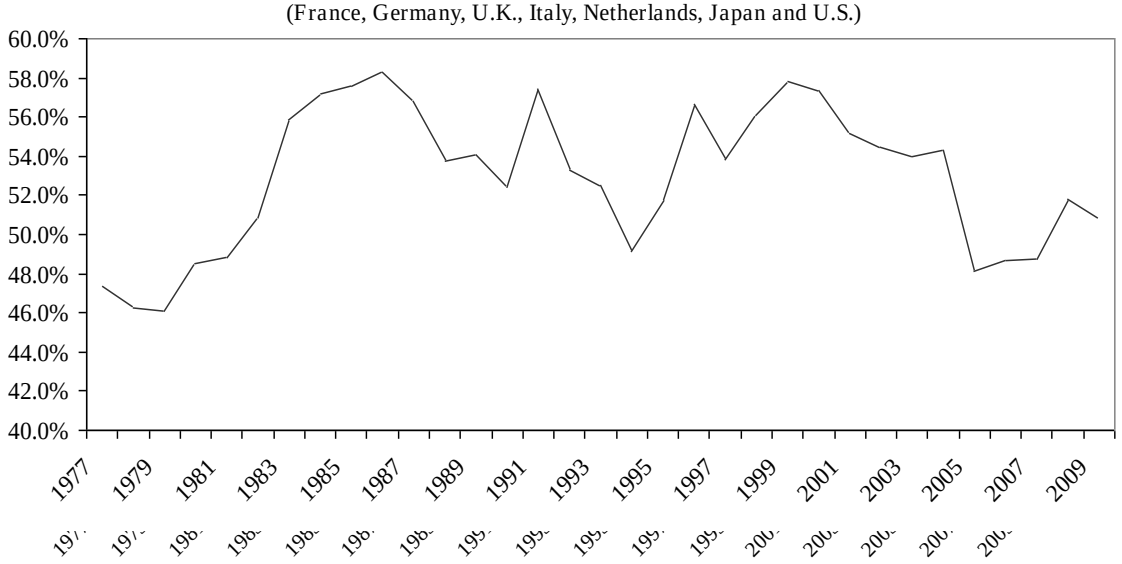
**Note:** The asterisk * implies rejection of the null hypothesis of a unit root $\delta_1 = 0$ at the 1% level of significance.

## Table 5. VAR System Estimations

| | Lag | ΔARR | ΔUN | ΔRCPI | ΔCON | a | | ΔARR | ΔUN | ΔRCPI | ΔCON | a |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| United Kingdom | n = 1 | 0.4275 | | -0.1835 | | | United States | 0.4352 | | | | |
| | | [ 9.40] | | [-3.13] | | | | [ 9.34] | | | | |
| | n = 2 | | | 0.1910 | | | | | | 0.1291 | | |
| | | | | [ 3.29] | | | | | | [ 2.15] | | |
| | n = 3 | | | 0.2528 | | | | | | 0.2078 | | |
| | | | | [ 4.49] | | | | | | [ 3.53] | | |
| | n = 4 | | | 0.1974 | | | | | | 0.1978 | | |
| | | | | [ 3.34] | | | | | | [ 3.28] | | |
| | n = 5 | -0.3571 | | -0.4835 | | | | -0.3401 | | -0.4386 | -0.1747 | |
| | | [-8.01] | | [-8.14] | | | | [-7.32] | | [-7.46] | [-2.02] | |
| Germany | n = 1 | 0.3240 | -0.0101 | -0.2420 | | | France | 0.2349 | -0.0502 | | | |
| | | [ 7.30] | [-2.04] | [-4.12] | | | | [ 4.60] | [-6.23] | | | |
| | n = 2 | | | | | | | | | | | |
| | n = 3 | | | | | | | | -0.0370 | 0.1184 | | |
| | | | | | | | | | [-4.33] | [ 2.07] | | |
| | n = 4 | | 0.0138 | 0.4659 | | | | | 0.0194 | 0.2357 | | |
| | | | [ 2.50] | [ 8.48] | | | | | [ 2.23] | [ 4.10] | | |
| | n = 5 | -0.3144 | 0.0245 | -0.3964 | | | | -0.2218 | | -0.2886 | | |
| | | [-7.01] | [ 4.73] | [-7.03] | | | | [-4.78] | | [-4.65] | | |
| Italy | n = 1 | 0.4409 | | | | | Netherlands | 0.2733 | -0.0208 | | | |
| | | [ 9.56] | | | | | | [ 5.34] | [-6.37] | | | |
| | n = 2 | | | | | | | 0.1480 | | | | |
| | | | | | | | | [ 3.23] | | | | |
| | n = 3 | | | 0.1742 | | | | | 0.0134 | 0.1470 | | |
| | | | | [ 3.10] | | | | | [ 4.31] | [ 3.09] | | |
| | n = 4 | | | 0.1664 | | | | -0.1056 | 0.0282 | 0.2114 | | |
| | | | | [ 2.95] | | | | [-2.18] | [ 9.51] | [ 4.31] | | |
| | n = 5 | -0.3481 | | -0.4243 | | | | -0.3795 | -0.0140 | -0.3865 | | |
| | | [-7.52] | | [-7.44] | | | | [-8.64] | [-4.60] | [-8.05] | | |

## Figure 1

**Percentage of Total Arrivals to Greece**
**From the Country's of Origin: 1977 - 2009**
(France, Germany, U.K., Italy, Netherlands, Japan and U.S.)



# Figure 2

## Impulse Response Analysis