

Modelling tourism demand elasticities for South Africa using demand systems

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ABSTRACT

International tourism to South Africa has increased steadily from 1994 to 2008. The year 2009 saw international arrivals to South Africa decline significantly and it became evident that the worldwide recession impacted not only on tourism arrivals in other countries, but also in South Africa. This sudden drop in international tourism sparked renewed interest into the demand for South Africa as a destination. It became evident that understanding the factors that influence foreign countries' demand for South Africa as a tourism destination is crucial to anticipating future changes and formulating policy.

Of particular importance are South Africa's main tourism markets. From an intercontinental perspective, the United Kingdom is the most important market with 15 per cent of intercontinental tourists stemming from the UK in 2009 (Government Communications of South Africa, 2012). The UK is followed by Germany with 8 per cent, with the USA taking third position with 7 per cent in terms of intercontinental arrivals. As a market that grew substantially in importance over the past decade (moving from fifth position in 1994 to third position in 2009), and due to the size of the potential market, the USA is another market that warrants investigation.

An Almost Ideal Demand System (AIDS) and a Rotterdam model is used to examine tourism demand for South Africa by UK and USA tourists. This is done to quantify UK and USA tourism demand for South Africa, specifically the elasticities associated with tourism demand. Five other destinations were included along with South Africa (Italy, Malaysia, New Zealand, Spain and USA in the case of UK tourists) to examine the substitute and complementary effects that a change in tourism price brings forth. For the USA case, five destinations were chosen (Italy, Spain, New Zealand, Spain and the UK). The two models are compared to establish whether one model can better explain tourism demand from the UK and the USA to South Africa than the other model.

The models provide policy makers with useful information on the sensitivity of tourism demand to changes in relative prices, exchange rates, expenditure, seasonality and the global recession of 2008. Short-term elasticities, that are critical when focusing on policies regarding own-price, cross-price and expenditure elasticities, were derived from both models.

The results for the Rotterdam model show that price competitiveness is important for UK and USA demand for all the countries in the study but, in particular, the long haul destinations – South Africa and Malaysia. This was expected as these two destinations are seen as ‘luxury’ destinations for both UK and USA tourists. In the South African case, Malaysia, Italy and the UK are seen as substitutes by US tourists and Malaysia, Spain and USA seen as complementary destinations for South Africa by UK tourists.

The results for the EC-AIDS model show that, in terms of expenditure elasticities, almost all of the countries are close to unity, which can be attributed to the dynamic nature of the EC-AIDS model, in that tourists’ choices are taken in account. It was also shown that, in terms of price competitiveness for the UK and the USA, demand in South Africa is relatively unimportant. This means that tourists are not discouraged from visiting South Africa when prices increase. South Africa is viewed as a substitute destination for Italy, Spain and the USA for UK tourists but as a complement to Malaysia. USA tourists view South Africa as a substitute for Italy, Malaysia and the UK but as a complement to Spain.

The two models were compared using a J-test and it was found that the EC-AIDS model dominates the Rotterdam model for UK tourists in the South African case but is indifferent for USA tourists when choosing a model.

Keywords: tourism demand, Almost Ideal Demand System (AIDS), error correction mechanism, South Africa, Rotterdam model, J-Test

OPSOMMING

Internasionale toerisme na Suid-Afrika het geleidelik vermeerder van 1994 tot 2008. In 2009 was daar 'n merkbare afname in internasionale toeriste na Suid-Afrika en dit was duidelik dat die wereldwye resessie nie net 'n impak op ander lande se toerisme gehad het nie, maar ook in Suid-Afrika. Die merkbare afname in internasionale toerisme het belangstelling aangewakker na die vraag na Suid-Afrika as 'n toeriste bestemming. Dit het duidelik geword om die faktore wat lande se vraag na Suid-Afrika as bestemming te verstaan, sodat dit kan gebruik word veranderinge in vraag te kan voorspel en die nodige beleid in plek te stel.

Van besondere belang is Suid-Afrika se grootste toeriste market. As daar gefokus word op die interkontinentale perspektief, is die Verenigde Koningryk (VK) die mees belangrikste mark vir Suid-Afrika, met 15 persent van die interkontinentale toeriste afkomstig van die VK in 2009 (Government Communications of South Africa, 2012). Die VK word gevolg deur Duitsland met 8 persent met die Verenigde State van Amerika (VSA) in die derde plek met 7 persent in terme van interkontinentale toeriste na Suid-Afrika. Die VSA is mark wat merkbaar gegroei het in die afgelope dekade (van vyfde in 1994 tot derde in 2009) en die grootte van die potensiële VSA mark, moet die mark geondersoek word.

'n Byna Ideale Vraag Sisteem (Almost Ideal Demand System (AIDS)) en 'n Rotterdam-model was aangewend om die toerisme vraag na Suid Afrika van die VK en VSA te ondersoek spesifiek die elasticiteite wat bereken word. Om die toerisme vraag na Suid-Afrika te kwantifiseer vir VK toeriste is vyf ander bestemmings saam Suid-Afrika gebruik. Die bestemmings was Italië, Maleisië, Nieu-Seeland, Spanje en die VSA. Die laasgenoemde bestemmings was gebruik, sodat die substituu en komplementere effekte tussen die lande ondersoek kan word at deur 'n verandering in toerisme prys voortgebring word. Die VSA studie gebruik vyf van dieselfde bestemmings (Italië, Maleisië, Nieu-Seeland, Spanje an Suid-Afrika) as die VK studie, maar gebruik ook die VK as 'n bestemming. Substituut en komplementêre effekte tussen die lande word ook bereken soos die VK studie. Die twee modelle is ook vergelykbaar en dus kan daar ook vasgestel word of een model toerisme vraag meer volledig kan verduidelik as die ander model.

Die modelle bied beleidmakers nuttige inligting met betrekking tot die sensitiviteit van die toerisme-vraag veranderinge in die relatiewe pryse, wisselkoerse, uitgawes, die seisoen en die wêreldwye resessie van 2008. Korttermyn elastisiteite is van kritieke belang wanneer die fokus op beleid is met betrekking tot eie-prys, kruis-prys en uitgawes elastisiteite. Die elastisiteite is afgelei uit beide modelle uit.

Die resultate toon dat vir die Rotterdam-model, prys mededinging belangrik is vir die Verenigde Koninkryk en die VSA se toerisme vraag na al die lande in die studie, maar in die besonder die lang afstand bestemmings: Suid-Afrika en Maleisië. Dit is te verwagte omdat hierdie twee bestemmings gesien word as "luukse" bestemmings vir beide die Verenigde Koninkryk en die VSA toeriste. In die Suid-Afrikaanse geval word Maleisië, Italië en die Verenigde Koninkryk gesien as substitute en deur die Amerikaanse toeriste. Maleisië, Spanje en die VSA word as komplementere bestemmings vir Suid-Afrika deur die Britse toeriste waargeneem.

Die resultate vir die Fout-Regmakende – Byna Ideale Vraag Sisteem (EC-AIDS) model toon dat in terme van uitgawes elastisiteite, byna al die lande naby aan eenheid is, wat die dinamiese aard van die EC-AIDS-model ondersteun, deur dat toeriste keuse in ag geneem. Daar is ook getoon dat in terme van prys mededinging vir die Verenigde Koninkryk en die VSA toerisme vraag na Suid-Afrika, is relatief onbelangrik, wat beteken dat toeriste nie afgeskrik word Suid-Afrika te besoek as pryse verhoog nie. Suid-Afrika word beskou as 'n substituuat bestemming vir Italië, Spanje en die VSA vir Britse toeriste., maar as 'n komplementere bestemming vir Maleisië. VSA toeriste beskou Suid-Afrika as 'n substituuat bestemming vir Italië, Maleisië en die Verenigde Koninkryk, maar as 'n komplementere bestemming vir Spanje.

Die twee modelle is in vergelyking met mekaar met behulp van 'n J-toets. Daar is bevind dat die EC-AIDS model is 'n beter model as die Rotterdam-model vir Britse toeriste in die Suid-Afrikaanse studie. Daar is geen voorkeur vir enige van die modelle vir VSA toeriste nie, wanneer dit getoets word in die Suid Afrikaanse studie.

Sleutelwoorde: toerisme vraag, Byna Ideale Vraag Sisteem (AIDS), fout korrigerende meganisme, Suid Afrika, Rotterdam model, J-Toets

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CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

1.1 INTRODUCTION

In recent times, tourism has become a very important sector in countries' economies – partly due to the impact of tourism on a country's gross domestic product (GDP) and the employment opportunities that tourism can offer. The figures over the past few years make for interesting reading. From 2005 to 2007, international tourist arrivals grew by nine per cent, from 800 million to 900 million, according to the World Trade & Tourism Council (WTTC). Since 2007, however, much has changed in the economic environment, with North America experiencing a financial crisis that led to the global economic recession. Because of this, the global tourism industry suffered as a result of tourists' reluctance to travel due to tighter budgets and lack of disposable income. Almost all destinations saw a decline in arrivals, and South Africa was no exception.

According to the WTTC summary of the Tourism industry in 2010 (WTTC, 2010), the recession of 2009 effected a drop of 2.1 per cent in real World GDP. The recession mainly affected developed countries, which is the most important source for travel and tourism demand in the world. In terms of tourism, the global contribution of the tourism economy to the world economy fell by 4.8 per cent, which, in turn, resulted in more than four and a half million jobs being lost. After the boom that 2007 represented in international tourist arrivals, the recession caused a decline in arrivals from 901 million in 2007 to 877 million tourists in 2009. However, even with the effect of the recession, in the global economy tourism still employs, direct and indirectly, 235 million people across the world and accounts for 9.4 per cent of the World GDP, making it a sector to be reckoned with worldwide (WTTC, 2010).

The WTTC (2010) forecasts that Travel and Tourism will, in the long run, be a main role player in supporting and encouraging global growth and employment opportunities. They expect developing countries to be the drivers of this increase of growth with the main focus being on international travel. This represents a shift in focus from developed to developing nations as the source of tourism.

In addition to its positive influence on income and employment, tourism also has a significant effect on the Balance of Payments in the sense those international

transactions in a given period influence the foreign exchange position of a country. According to Smith (2006:31), tourism is the main source of foreign exchange for countries like the USA, Spain and France and is the fourth highest earner of foreign exchange in South Africa.

According to the Minister of Tourism of South Africa, Marthinus van Schalkwyk, (Anon, 2011) South Africa's arrival of international tourists grew from one million arrivals in 1990 to almost 10 million in 2010 which equates to a 13 per cent compound growth over the last 20 years. South Africa is currently the most popular destination on the African continent and the twenty-sixth most visited destination worldwide (UNWTO, 2010). However, the economic recession of 2009 also negatively influenced international arrivals to South Africa, which necessitates an in-depth review of the demand for South Africa as a tourist destination.

1.2 PROBLEM STATEMENT

The focus of this study is on tourism demand and, specifically, the demand for South Africa by tourists from the United States of America (USA) and the United Kingdom (UK). From the introduction it could be ascertained that tourism is an important part of South Africa's economy and, indeed, of the world economy. The competitive nature of the tourism industry makes it imperative for a country to keep its foreign demand high and therefore requires demand that is inelastic to changes in prices and income for tourists coming to South African shores.

From 2002 to 2008 the growth rate of South Africa's largest long haul markets, – the UK, France, Germany, the USA, the Netherlands and Australia (in that order) only grew by 2.5 per cent in six years, which, according to Mr Van Schalkwyk (Anon,2009), is worrisome. This would suggest that competition for long haul destinations is fierce and that tourist demand is relatively elastic when it comes to choosing a destination.

The following questions can therefore be asked when it comes to tourism demand: How sensitive are tourists to price increases? Are tourists more prone to react to income changes than price changes or *vice versa*? Or are they indifferent to both these changes? How does the economic climate affect tourist demand? What can South Africa do to ensure a consistent flow of international tourists?

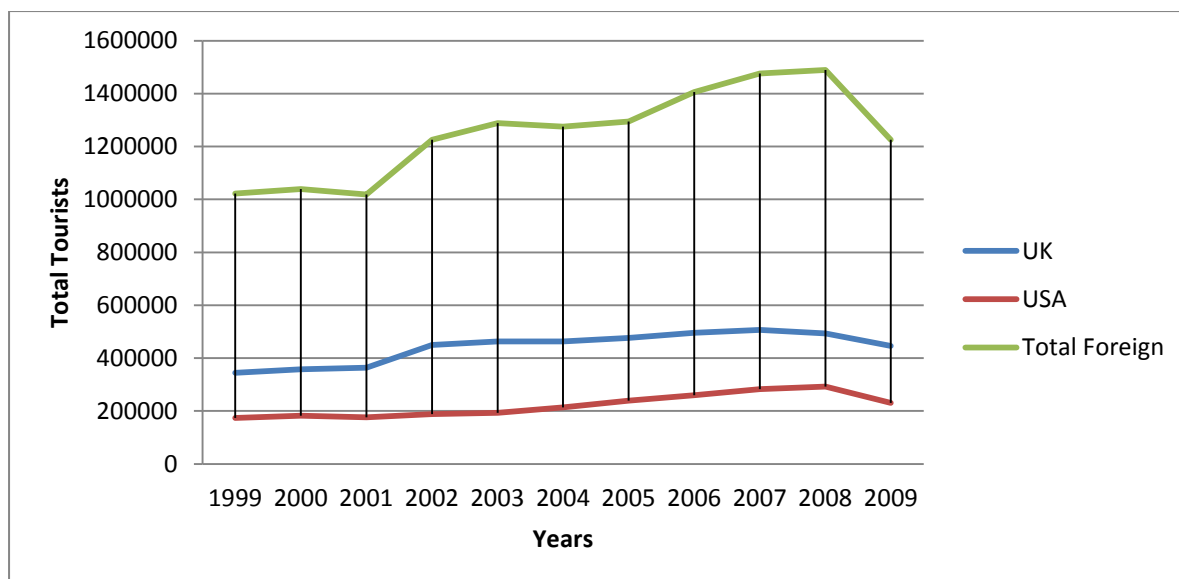


Figure 1: Foreign Tourist Arrivals

(Source of data: Statistics South Africa)

From the above graph, the problem underlying this research becomes evident in that the growth of tourists from abroad to South Africa showed a steady increase from 1999 to the end 2007 but declined sharply with the financial crisis starting at the end of 2008. This shows that tourists to South Africa are susceptible to changes in price and/or income. The question to answer is: how sensitive are they to price and/or income changes? International price changes influence the competitiveness of South Africa as a destination and could either stimulate or deter tourism flows to the country. Prices changes in South Africa also influence the country's competitiveness and therefore the number of tourist arrivals. However, tourists' incomes are determined in their own countries and therefore international income changes have an effect on tourism to South Africa.

To ascertain the reasons for the declining growth in these markets, an investigation into the income and price elasticity of foreign tourist demand is warranted. The purpose of this research is to provide some answers to the questions above. More specifically, to investigate the income and price elasticities of tourist demand from South Africa's largest European market – the UK – and largest North American market – the USA.

The UK is an important market to focus on as it is South Africa's largest international market, not only from all the European countries, but it also tops the list when all intercontinental arrivals are considered. This is evident from Figure 1.

The reasons for focusing on the USA is that, according to Han, Durbarry and Sinclair (2006), the USA is the world's highest international travel spender. Almost 40 per cent of US tourists prefer European destinations. This would suggest that the USA is an untapped market for South Africa and luring tourists to South Africa could be an alternative that policy-makers should investigate to grow tourism revenue. Currently the USA is the third most important long haul market for international visitors to South Africa.

The USA's foreign tourism demand is a relatively uncovered field in studies with only a few scholarly articles having been published. In addition to Han *et al.* (2006) who studied USA tourism demand for European destinations, White (1985) studied the USA's demand for a group of European countries and Stronge and Redman (1982) studied US tourism demand in Mexico.

1.3 METHOD

To address the problem of measuring income and price elasticity, various methods have been used internationally. In general, some tourism demand functions are estimated and elasticities and cross elasticities are derived from these functions.

The subject of estimating tourism demand has engendered many debates and scholarly articles in the past two decades. According to Lim (1999), there have been 420 articles published focusing on tourism demand from 1960 to 1999. Most of these articles focused on explaining tourism demand through different methods.

In a more recent study, Song and Li (2008) reviewed studies from 2000 to 2007 and divided tourism demand into two broad categories. These two categories being: quantitative and qualitative, with quantitative being the most popular with researchers. Song and Turner (2006) stated that the majority of studies in modelling tourism demand have been quantitative and that the quantitative studies can be placed into two categories. These are (i) non-causal time series models and (ii) causal econometric approaches. The difference between the two models is whether or not the model recognises any causal relationship between the tourism demand variable and its independent variables. Song and Li (2008) also weighed up the different approaches to measuring tourism demand and found five broad approaches that have been used. The following approaches have been identified by them, (i)

Time series methods, (ii) Econometric models, (iii) Panel Data methods, (iv) Demand Systems and (v) Other quantitative models. These are subsequently reviewed.

1.3.1 Time series methods

The basis of a time series model is the explanation of a variable with regard to its own past values and a random error term. These methods are particularly useful when focusing on historic trends such as seasonality and in predicting future trends. The data that is used for time series models are historical observations of a variable which ensures that data collection is simpler and more cost effective. Time series models have been the most popular tool for tourism demand forecasting for four decades Song and Li (2008). The various models that have been used in time series are the summarised in Table 1.

Table 1: Time series models used in tourism demand

Model	Discussion
Auto-regressive moving average models (ARIMA) Seasonal Auto-regressive moving average models (SARIMA)	Two thirds of all research done on tourism demand uses this model and its variations. Different variations of the ARIMA are used, most notably the SARIMA which include seasonal data due to the seasonality aspect of tourism. Both these models have shown contradicting evidence when measured against one another in terms of which model is a better fit for the study.(Song and Li, 2008).
Multivariate models (MARIMA)	A new model was introduced by Goh and Law (2002) called the multivariate SARIMA (MARIMA) which includes a function to capture potential spillover effects of two demand series. Du Preez and Witt (2003) found that the multivariate ARIMA model can

	be outperformed by a simple ARIMA model in certain situations when the two demand series have many cross-correlations.
Generalised Autoregressive Conditional Heteroskedastic (GARCH)	This model is normally used in a financial modelling context to determine the volatility of a time series. In a tourism demand sense, the model is used to focus on the volatility of demand and the effects of shocks on tourism demand. Although this model is successful in explaining that demand is affected by conditional variances, it is not assessed as a forecasting device.(Song and Li, 2008).

1.3.2 Econometric Models

An advantage of econometric models over time series models is the ability of econometric models to examine the connecting interactions between the dependent tourism demand variable and the influencing independent variables. This is a helpful tool in forecasting tourism demand or to influence policy, since these models can be backed by economic theory. Tourism demand, on aggregate, is useful from an economic viewpoint because interpretation of the data can lead to policy recommendations and can also be used as a yardstick to measure the effect of current policies. This further makes it evident that time-series models have a major drawback in explaining and determining the linkages of different factors in the economy when it comes to tourism demand (Song and Li, 2008). According to Li, Song and Witt (2004) the most common factors that influence tourism demand in recent econometric studies are tourism price, income, substitute prices and exchange rates. Some of the most popular autoregressive methods used in tourism demand studies are described in Table 2.

Table 2: Econometric models used in tourism demand

Model	Discussion
Vector Auto regressive (VAR)	Differs from the single equation models in that the VAR model treats every variable as endogenous and each variable is specified as having a linear relationship with the other variables. The classic VAR does not perform well in tourism prediction studies (Song and Li, 2008).
Error Correction Model (ECM) Time-Varying Parameter (TVP)	On their own, both models outperform the time series models but, in recent years, a more integrated model has been used – the TVP-ECM. This integrated model performs well in the tourism demand function. By combining the two methods, the merit of this method is well warranted (Song and Li, 2008). Song, Witt and Jensen (2003) state that the TVP-ECM model is mostly used for forecasting, and this is not applicable to this study.

1.3.3 Panel Data methods

The advantages of panel data analysis over time series models are that the data is more comprehensive because it uses cross-sectional and time series data which, in turn, reduces the problem of multicollinearity and provides more degrees of freedom. Taking these factors into account, it seems that panel data would lend itself perfectly to demand estimation although this approach has rarely been used and the forecasting ability of this method has not been tested in tourism literature.(Song and Li, 2008). This study is geared towards finding elasticities for tourism demand but panel data only supplies averages of the data, which would provide limited information on elasticities.

1.3.4 Demand Systems

Demand systems differ from the single equation methods due to their systems of equations approach, with tourism expenditure shares as dependent variables. The most popular demand system used in tourism demand research is the Almost Ideal Demand System (AIDS) as described by Deaton and Muellbauer (1980a). The major advantage of the AIDS model is in its strong economic theory base, since demand systems satisfy the properties of demand, and allow an elasticity analysis with regards to substitution, complementary and income effects (See Chapter 2 for detailed discussion) (Song and Li, 2008). An alternative demand system is the Rotterdam model, first used by Theil (1965) and Barten (1966). This model shares a number of similarities with the AIDS model but has been relatively unexplored in tourism demand studies. The differences and the similarities of the models will be discussed in depth in Chapter 2.

1.3.5 Other quantitative models

Over the last decade, a number of new quantitative measures for measuring tourism demand have been used. These new models have predominantly been AI (Artificial Intelligence) models. One major advantage of these techniques is that no secondary information, such as distribution or probability, is needed in applying these techniques. It is therefore not surprising that these techniques have become more and more prominent in tourism demand studies in recent years. However, there are very pertinent limitations on AI models in the sense that they are not backed by economic theory and can therefore assist very little with policy recommendations (Song and Li, 2008).

Table 3: Other quantitative models used tourism demand

Model	Discussion
Artificial Neural Network (ANN)	This approach is unique in that it tries to mirror the learning process of the human brain, where it adapts to imperfect data non-linearity. This approach has the ability to adapt to imperfect data and can be used as an alternative to static regression models (Law, 2000).

Rough Set Approach	This is different from classical regression analysis, in that this approach pays a lot of attention to categorical variables; for example in a tourism demand equation it would predict tourist demand for one geographical area in relation to another geographical area within the study and the relationships of the variables. This is helpful in that it can complement the original regression model (Song and Li, 2008).
Fuzzy Time Series Model	The strength of this approach is that it analyses short-time series with incomplete past observations. The criticism of the method is that, due to the limited data, consistency becomes an issue (Wang, 2004).
Genetic Algorithms (GA)	This approach works on the premise of the evolutionary thinking of natural selection and genetics; therefore it is regarded as an optimisation approach. This characteristic gives this approach the ability to capture the changing composition of tourism demand (Song and Li, 2008).

1.3.6 Methods used in this study

From the discussion above, it can be observed that Demand Systems, such as the Almost Ideal Demand System, are the most suitable methods for calculating a variety of tourism demand elasticities. In addition, they are also the most comprehensive methods for testing tourism demand hypotheses against microeconomic theory.

In this study, the two methods that will be used are the Almost Ideal Demand System (AIDS) model and the Rotterdam model. Both models deal with consumer demand, but with different restrictions in the model. Deaton and Muellbauer's (1980a) introduction of the AIDS model made it possible to accurately measure tourism demand as it dealt with the criticism voiced against the single equation models which were that they lacked the ability to show how other variables affect the single

equation method or the single equation methods' inability to calculate cross-price elasticities.

According to Durbarry and Sinclair (2003), the AIDS model is useful in tourism economics as it allows assessments of the entire set of price and expenditure elasticities, given the sensitivities of tourism demand to changes in comparative prices and expenditure. Cortés-Jiménez, Durbarry and Paulina (2009) suggested that the AIDS model works well in determining tourism demand with the restriction that consumers make informed budgeting choices. According to Song *et al.* (2008) the key determinants of tourism demand are tourists' income, tourism prices in the country visited relative to the country of origin, tourism prices in competing destinations and exchange rates. These components are all included in AIDS model. The other model that will be used to focus on the elasticities of demand is the Rotterdam model. According to Faroque (2008) both models are attractive to use in aggregate demand studies because both are flexible, easy to estimate and consumer behaviour can be tested. The fundamental reason for including this model is that, based on the fact that both models are roughly similar, it would be able to establish which model is a better fit for tourist arrivals in South Africa with the available data.

Due to nature of the Rotterdam model, in terms of being used for various different demand studies, it will be used as an alternative demand system in this study. Faroque (2008) used the Rotterdam model to estimate the demand for alcoholic beverages in Canada. Brown and Lee (2002) used the Rotterdam model to focus on demand between female labour participation rate and its impact on the purchasing of fruits. The flexibility of the Rotterdam Model lends itself to tourism demand due to the ever changing nature of tourism, although it has not previously been used in tourism demand studies.

In the literature, there has been some discussion about which of the two models is more useful in determining demand. According to Barnett and Seck (2007) both models perform well when substitutions between goods are low and moderate but the AIDS model performs better when substitutions between goods are high. This study therefore aims to contribute towards this debate and find the most suitable demand model for UK and USA tourists in South Africa, by comparing the models with one another. This study is restricted to tourists from the UK and the USA visiting

South Africa (for reasons explained in Section 1.2) and does not cover domestic tourism or tourists from other nations.

This study employs quarterly time series data for the period 1999 to 2009 since it is a period in which all the countries under consideration have complete data sets. All the data is secondary data from, amongst others, Statistics South Africa, the International Monetary Fund (IMF) and the World Travel and Tourism Council.

1.4 Objectives

From the introduction and problem statement, it can be deduced that tourism is an important sector and there has been a steady growth in tourism to South Africa. However, the sector must be managed in such a way that the growth in tourists from developed countries, such as the UK and USA is consistent. Understanding these tourists' choices and reactions to changes in income and prices for long haul destinations such as South Africa is paramount. The main objective of this research is therefore to determine the expenditure, price and cross-price elasticities of demand of tourists from the UK and the USA for South Africa as a tourist destination, with the aim of assessing the price competitiveness of South Africa as a tourism destination for these countries.

In addition, the following objectives of this study can be identified:

- To explore the origins of tourism demand in microeconomic theory using a comprehensive literature review of tourism demand methods and relevant models.
- To determine the demand elasticities of USA and UK tourists travelling to South Africa using the AIDS model.
- To determine the demand elasticities of USA and UK tourists travelling to South Africa using the Rotterdam model.
- To compare the AIDS and Rotterdam models, thereby identifying the model best suited for tourism demand modelling in South Africa.

1.5 Layout of study

This study will be divided into five chapters. The five chapters are:

- Chapter 1: Introduction – This chapter introduces the tourism sector as an important part of the World economy. Furthermore, this chapter discusses the

problem underlying the study provides an overview of methods used in modelling tourism demand and the objectives of the study.

- Chapter 2: Literature Review – This chapter will focus on the microeconomics of tourism demand. The two models that will be used in this study will be discussed extensively and this will provide the framework for the empirical analyses for Chapters 3 and 4.
- Chapter 3: Rotterdam Model – This empirical chapter will model tourism demand for South Africa using the Rotterdam model and the data collected. Subsequently, the various demand elasticities will be determined.
- Chapter 4: AIDS Model and Comparison – This empirical chapter will make use of the AIDS model to model tourism demand for South Africa using the data collected. Subsequently, the various demand elasticities will be determined. Both models will be compared with each other to identify the model that best describes tourism demand for South Africa.
- Chapter 5: Conclusion – This chapter will contain a conclusion concerning modelling tourism demand elasticities and make policy recommendations as well as methodological recommendations.

Chapter 2: Literature review

2.1 Introduction

Tourism demand has been a well-researched topic with various studies aiming to explain tourism demand. From Chapter 1, it is evident that tourism is a highly lucrative industry and has a major role to play in countries' economies. The question that arises when dealing with tourism demand is: What are the factors that influence tourism demand and how are they used and interpreted in the system of equation models?

This chapter will begin with the relevant economic theory that supports demand with specific attention to income and substitution effects and elasticities. Once the demand functions have been explored, this chapter will continue by exploring the theoretical framework of both the AIDS and Rotterdam models as prominent demand systems, and criticisms that have been levelled against both systems. The conclusion at the end of the chapter will provide a succinct review of tourism demand.

As has been discussed in the previous chapter, most of the initial studies that have focused on tourism demand used single equations. Some of the criticisms levelled against these studies include the interdependencies between variables and competing tourism destinations that are not taken into account, which is an important factor influencing the demand for a particular destination. Further criticisms include that these studies are not credible in terms of theoretical and technical issues, chief among which is the uniformity with the basic axioms of utility and demand theory.

Over the past decade, single equation models have made way for the systems approach in tourism demand research. This approach models tourism demand for a particular destination concurrently, whereas, with the single equation models, the effects of different equations of demand were negated. As was seen in the method Section (1.3.6) of the introduction, the two system modelling approaches are the AIDS and Rotterdam models. This study will make use of both these modelling approaches to determine which approach is superior in estimating tourism demand for South Africa.

2.2 Theory of demand

Modelling tourism demand has been a well-discussed topic as was illustrated in Chapter 1, with numerous papers published and various methods, that include ARIMA, GARCH, VAR, and AIDS (Section 1.3), being used. As was discussed in the introduction (Section 1.3.2), the choice of models depends on the available data, the objectives of the study, and the theory that supports the study (Section 1.3.6). This study will make use of the AIDS and Rotterdam models specifically as they measure consumer behaviour which is the basis of microeconomics and thus economic theory will be able to support the empirical results of this study.

Before discussing the theoretical basis of the models in their entirety, it would be helpful to focus on the microeconomic theory surrounding the two main demand functions, the Hicksian and Marshallian, the accompanying elasticities, the income and substitution effect, and the two (Compensated and Uncompensated) responses that these effects have on demand.

2.2.1 Marshallian demand

Alfred Marshall was the first economist to make use of the supply and demand curves. The Marshallian demand curves are used to show an uncomplicated market or individual demand curves (Friedman, 1949).

The Marshallian demand function has its roots in utility maximisation (Varian, 1992), thus the properties of consumer preferences must be satisfied. The consumer is assumed to have preferences on the consumption bundle in X . $x \succsim y$ means that the consumer believes that bundle x is as good as bundle y . These preferences are assumed to satisfy certain properties (Varian, 1992).

- Complete: For any two bundles in the choice set x and y either $x \succsim y$ or $y \succsim x$. The consumer prefers one or the other.
- Reflexive: each bundle is as good as itself. For all x and X , either $x \succsim x$.
- Transitive: If the consumer has three bundle sets to choose from if $x \succsim y$ and $y \succsim z$ then it can be assumed that $x \succsim z$. Choices are rational and consistent.

- Continuous: This property is useful when ruling out certain discontinuous behaviour. This means that if a certain number consumption bundle (x^i) is at least as good as bundle y and some bundle x converges to y then x is as good as y .
- Non-satiation: The utility function $v(q)$ is non-decreasing in each of its arguments and for all q in the choice set increasing in at least one of its arguments. It states that a consumer can always do a little better and also rules out thick indifference curves.
- Convexity: The indifference curves are convex so that two bundles that yield the same utility can be chosen by a consumer according to their preference.

Taking these properties into consideration, if consumer choices are all of the above then there has to be a utility function where preferences are maximised. Varian (1992) continues by saying that, assuming that a consumer acts rationally, he will always choose the most desirable bundle from the affordable bundles offered to him. Thus preference can be defined as:

$$\max u(x) \text{ such that } px \leq m \text{ and } x \text{ is in } X \quad (2.1)$$

With bundle set:

$$B = \{ x \text{ in } X : px \leq m \}$$

Where:

- X = is the possible bundle sets.
- $p = (p_1, \dots, p_k)$ = is the vector of prices of a good.
- m = fixed amount of money available to consumer.

Varian (1992) noted three problems with the utility function, the first being that an objective function is continuous and that the constraint set is closed and bounded. The utility function is continuous, by assumption, and closed in terms of the constraint set. A problem occurs when, for instance, some price is zero. The consumer might then want an unlimited amount of the good. This problem is rectified by giving the constraints $p_i > 0$ for $i = 1, \dots, k$ and $m \geq 0$.

The second problem deals with the representation of preferences, where the choice of maximising x will be independent of the utility function. This is because the optimal

x^* must have the property that $x^* \succsim x$ for all x in B . So any utility function that represents the preference $\succ$ must pick out x as a constrained maximum.

Thirdly, if all prices and income are multiplied by some positive constant, the budget set cannot be changed. In other words, the optimal set is homogenous of degree zero in prices and income.

Following the local nonsatiation property, a bundle x^* that maximises utility must meet the budget constraint with equality. The consumer problem of maximum utility can be restated as the following.

$$v(p, m) = \max u(x) \text{ such that } px = m \quad (2.2)$$

This function $v(p, m)$ shows the maximum utility achievable, given prices and income. This utility function is called the indirect utility function. The function that relates p and m to the bundle x demanded is the demand function. The notation for the demand function is $v(p, m)$. This is also called the Marshallian demand function and is an observable demand function because its variables, price and income, are observable.

Zaratiegui (2003) stated that the use of the Marshallian demand function can be said to answer the question as to how does the effect of a change in price (p_x) of a good influence the quantity demanded of a good when holding income and all other prices constant? Using Figure 2.1 and 2.2 from Snyder and Nicholson (2008), it can be observed that Marshallian demand curves absolutely combine income and substitution effects, thus they are net demands that add up over these two theoretically different behavioural reactions to price changes.

Figure 2.1 shows an individual's utility maximisation choice bundles of x and y at three different prices of good x (p'_x, p''_x and p'''_x). Figure 2.2 shows this relationship between p_x (price) and x (quantity demanded) in a single demand curve. This represents a Marshallian demand curve and shows both income and substitution effects due to the assumption that p_y and I (budget constraint) remain constant and only p_x varies.

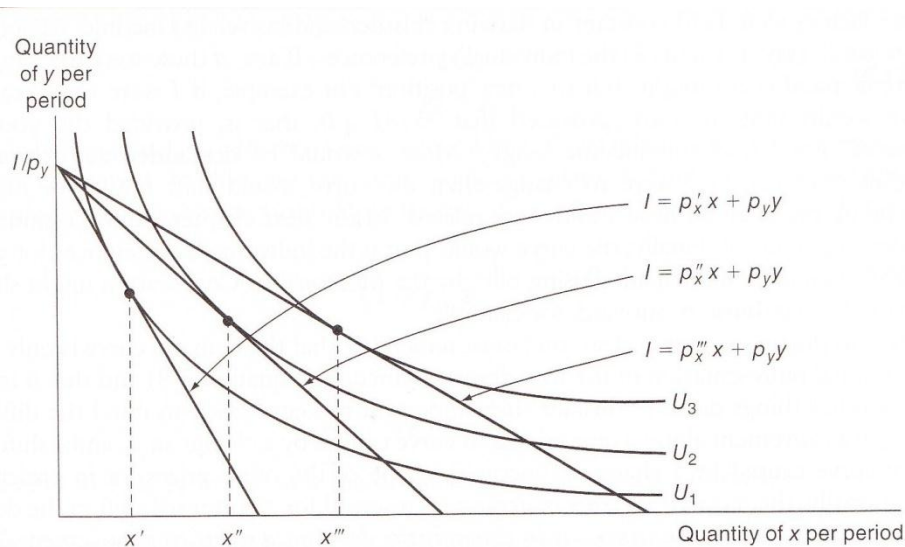


Figure 2.1: Indifference curves

Source: Snyder and Nicholson, 2008

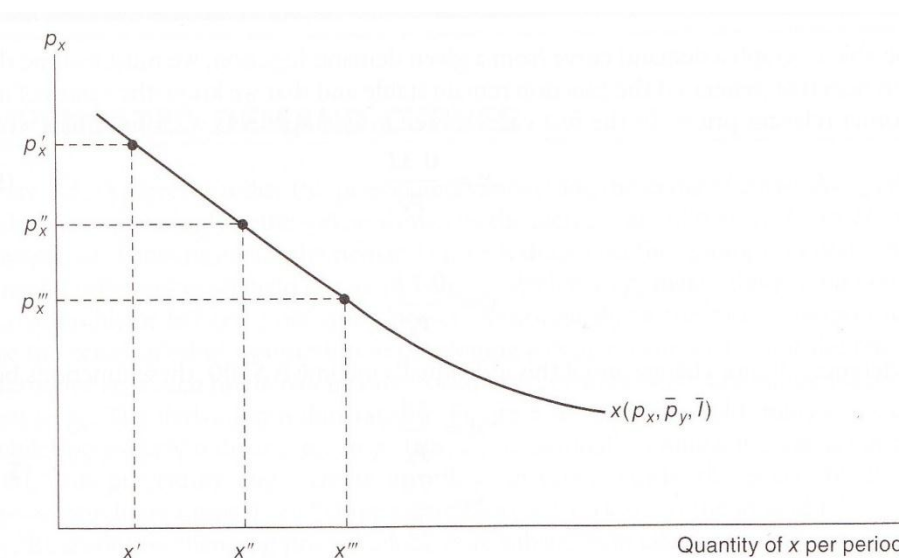


Figure 2.2: Marshallian Demand Curve

Source: Snyder and Nicholson, 2008

2.2.2 Hicksian demand

Another important demand function is the Hicksian demand function, which was introduced into economics by economist J.R. Hicks. This demand function was conceived using substitution effects alone (Diewert and Wales, 1993).

Varian (1992) shows that the Hicksian demand function has its roots in the indirect utility function $v(p, m)$, where under the local nonsatiation property the indirect utility function will be strictly increasing in m when preferences are satisfied. The indirect

utility function can be inverted to solve m as a function of utility. This function is known as the expenditure function and shows the minimal expenditure needed to achieve utility at prices p . The expenditure function is notated as follows:

$$e(p, u^*) = \min px \text{ such that } u(x) \geq u^* \quad (2.3)$$

It is also important to note that the expenditure function is equivalent to the cost function.

The expenditure function has an important property that ties the Hicksian demand to it. This property states that if the Hicksian demand notated $(h(p, u))$ is the expenditure-minimising bundle necessary to achieve utility (u) at prices (p) then $h_i(p, u) = \frac{\partial e(p, u)}{\partial (p_i)}$ for $i = 1, \dots, k$ assuming that the derivative exists and $p_i > 0$.

The rationale for this demand function is derived by keeping consumer utility constant and determines the effect of a change in price (p_x) and how it affects the quantity demanded of a good. The parameter (u) in the demand equation shows that consumer utility is held constant on the same indifference curve as the price changes. The Hicksian demand function shows how a demanded good achieves a target level of utility and minimises total expenditure.

The Hicksian demand function is also called the compensated demand function, Varian (1992) states that this terminology comes into being due to demand functions being constructed by varying prices and income with the aim of keeping the consumer at a fixed level of utility. This means that income changes are arranged to compensate for the price changes. For comparable reasons the Marshallian demand function is called the uncompensated model. Hicksian demand functions are not directly observable, because they depend on utility, which is not directly observable. Figures 2.3 and 2.4 show the effect of Hicksian demand graphically.

The curve x^c shows the quantity of good x that is demanded when price (p_x) changes, while holding p_y and utility constant. This shows that the individual's income is compensated to keep utility constant. Thus, x^c shows only the substitution effects of price changes.

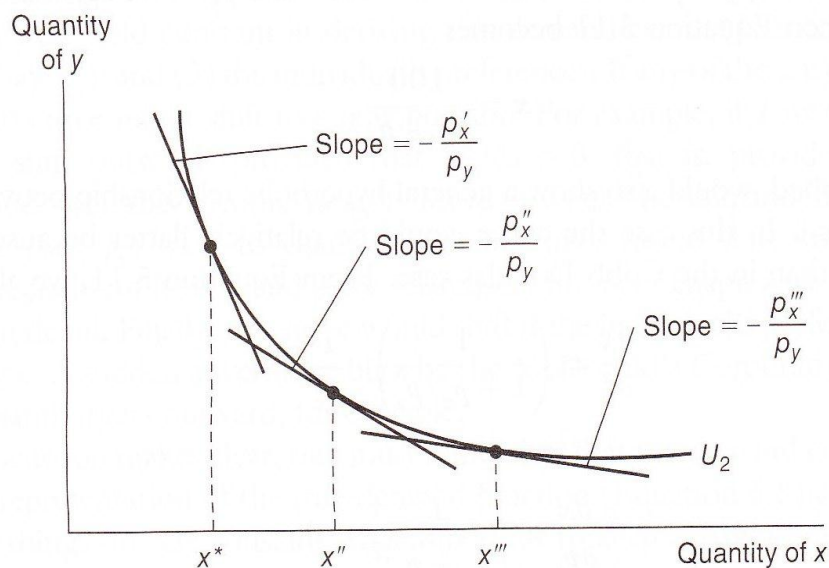


Figure 2.3 Indifference curves, Hicksian demand

Source: Snyder and Nicholson, 2008

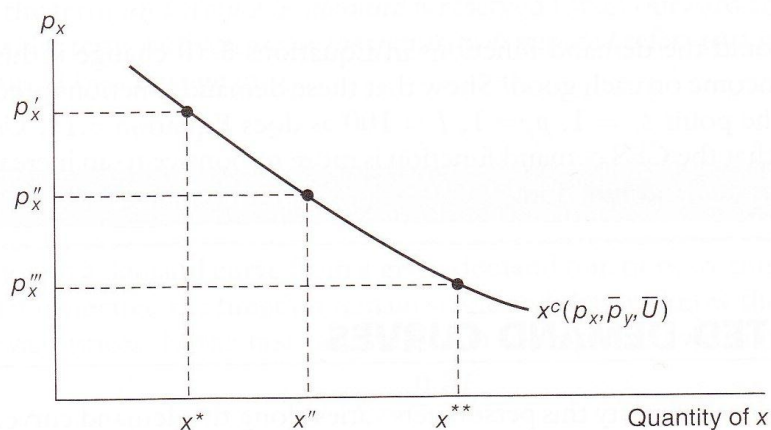


Figure 2.4 Hicksian demand curves

Source: Snyder and Nicholson, 2008

Figure 2.5 shows the Hicksian demand curve x^c and the Marshallian demand curve x . Both demand curves intersect at point p''_x because x'' is demanded by both demand curves. Prices above p''_x show that an individual's income increased with the Hicksian demand curve so that x is demanded more than with the Marshallian demand curve. When prices are below p''_x income is reduced for the Hicksian demand curve, and more of x is demanded with the Marshallian demand curve. The Marshallian demand curve is flatter than the Hicksian demand curve due to the curve

incorporating income and substitution effects whereas the Hicksian demand curve only reflects substitution effects.

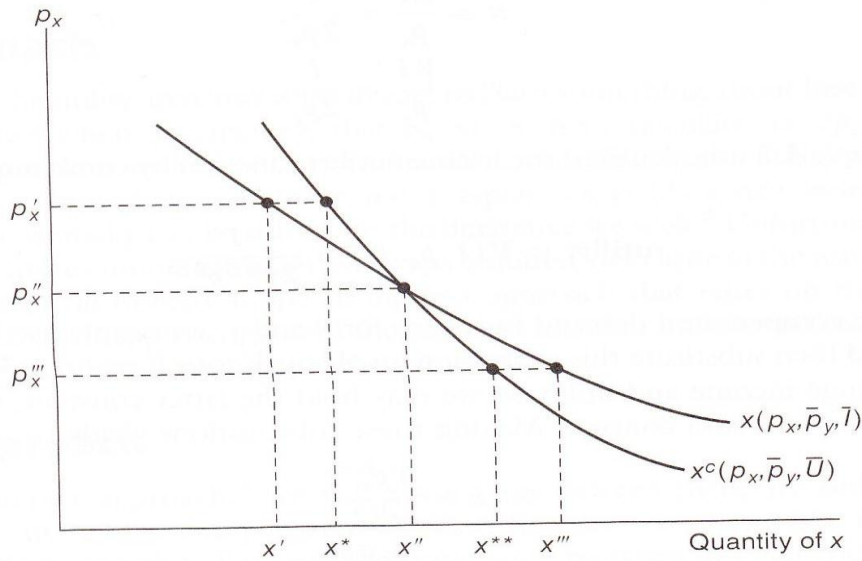


Figure 2.5 Hicksian and Marshallian demand curves

Source: Snyder and Nicholson, 2008

Varian (1992) also added that there are some important identities that tie together the expenditure function, the indirect utility function, the Marshallian demand function and the Hicksian demand function. By taking both the utility maximisation problem (2.1) and the expenditure minimisation problem (2.3) into account, it is evident that there are four important identities:

- $e(p, v(p, m)) \equiv m$. The minimum expenditure necessary to reach utility $v(p, m)$ is m .
- $v(p, e(p, u)) \equiv u$. The maximum utility from $e(p, u)$ is u .
- $x_i(p, m) \equiv h_i(p, v(p, m))$. The Marshallian demand at income m is the same as the Hicksian demand at utility $v(p, m)$.
- $h_i(p, u) \equiv x_i(p, e(p, u))$. The Hicksian demand at utility u is the same as the Marshallian demand at income $e(p, u)$.

The last identity ties together the unobservable Hicksian demand function and the observable Marshallian demand. The identity shows that expenditure minimisation, the Hicksian demand, is equal to the Marshallian demand at an appropriate level of income to achieve the desired level of utility.

2.2.3 Properties of demand

With regards to demand functions, microeconomics dictates that there are four properties that a properly-defined demand function must satisfy. These properties are general characterisation of the Hicksian and Marshallian demand functions (Snyder and Nicholson, 2008):

- *Property 1: Adding up:* The total value of both Hicksian and Marshallian demand indicates total expenditure,

$$\sum p_k h_k(u, p) = \sum p_k g_k(x, p)$$

According to microeconomic theory, the adding up restriction implies that the sum of all expenditures weighted by prices should equal unity. Simply put, it means that expenditure cannot exceed the budget constraint of an individual.

- *Property 2: Homogeneity:* The Hicksian demand is homogeneous of degree zero in prices, which means that a proportional change in all prices and real expenditure will not affect the quantities purchased. The Marshallian demand is homogenous in total expenditure and prices together for scalar $\theta > 0$.

$$h_i(u, \theta p) = h_i(u, p) = g_i(\theta x, \theta p) = g_i(x, p)$$

In terms of homogeneity, microeconomic theory states that the homogeneity of demand assumes that all households face the same prices so that differences in household consumption are based on expenditure patterns and family composition.

- *Property 3: Symmetry:* The cross-price derivatives of the Hicksian demands are symmetric for all $i \neq j$.

$$\frac{d h_i(u, p)}{d p_j} = \frac{d h_j(u, p)}{d p_i} \quad \forall i \neq j$$

Symmetry applies to the consistency of consumer choice with regards to spending patterns because, without these restrictions, consumers make inconsistent choices. Negativity comes from the concave nature of cost functions due to costs being minimised and utility maximised.

- *Property 4: Negativity:* The $n \times n$ matrix formed by the elements $\delta h_i / \delta p_j$ is negative semi-definite, for any n vector ξ : This means that a rise in prices results in a fall in demand as required when the commodities under analysis are considered normal goods. The quadratic form then becomes:

$$\frac{\sum_i \sum_j \xi_i \xi_j \delta h_i}{\delta p_j} \leq 0$$

In summary, there are four general properties of demand functions: They add up, they are homogenous to the degree zero in terms of prices and expenditure, compensated prices respond symmetrically and they form a negative semi-definite matrix.

2.2.4 Income and substitution effects

Snyder and Nicholson (2008) focused on the two effects that are brought about by price changes in the Hicksian and Marshallian demand functions, the income and substitution effects. The substitution effect is given by the slope of the Hicksian demand curve since the slope represents movement along a single indifference curve (see Figure 2.3). The income effect reflects the way price affects the demand of a product through purchasing power. An increase in price would increase the expenditure level that is needed to keep utility at a constant level. One important factor of the Marshallian demand is that nominal income is constant so there must be a downward shift in the indifference curve to allow for this shortfall in the event of an increase in prices (see Figure 2.1).

Han *et al.* (2006) explained the effects of Figure 2.6 as the effect of relative changes in price on the consumer's budget and how consumers react to the price changes. They state that a price change has two very clear effects, these being the income and substitution effects.

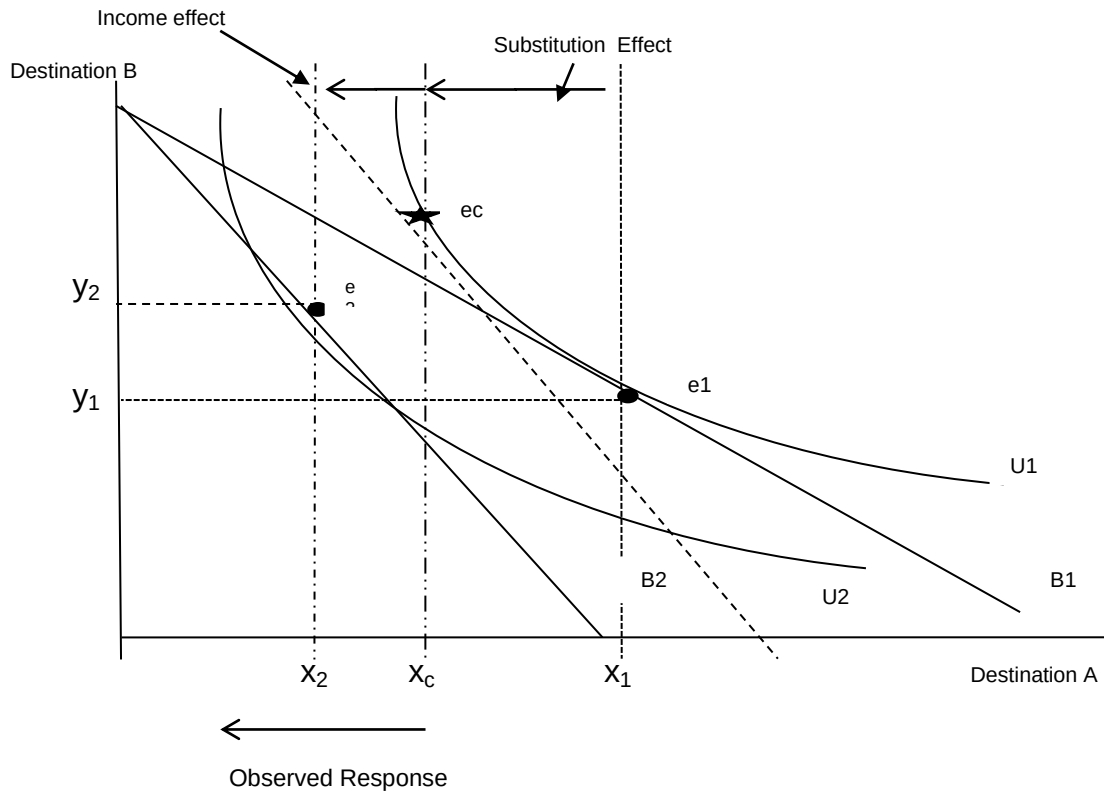


Figure 2.6 Income and Substitution effects

Source: Han, Durbarry and Sinclair 2006

Han *et al.* (2006) explain Figure 2.6 as the effect of a price change on the demand for a destination. The initial position of the budget constraint is given by B_1 with the indifference curve u_1 . The first effect that can be observed when prices in destination A rise, is the substitution effect which is indicated as a movement from e_1 to e_c : When the economic theory of demand and supply is used, it can be interpreted that when the price of a destination changes, the consumer normally tends to decrease their demand for the destination. The overall effect of a price increase is negative according to the substitution effect. This shows that x_c is consumed instead of x_1 . This is also observable in Figure 2.3 (Hicksian demand).

The movement from e_1 to e_2 in Figure 2.6 is the change in demand for destination A because of a fall in income with the assumption the relative prices stay the same. This can also be observed in the Marshallian demand curves (Figure 2.1). From figure 2.6, the effects of both income and substitution can be ascertained, when $x_1 > x_c > x_2$ then the income and substitution effects strengthen each other, but if $x_2 > x_1 > x_c$ then the income effect of an inferior destination is larger than the

substitution effect. In the latter case, the increase in price of an inferior destination results in an increase in demand for that destination. This can be partly due to consumers' perception that the destination is changing and partly due to the attraction of wealthier consumers.

Accounting for the change in quantity demanded from both a change in price and a change in real income is known as a compensated response. This is indicated by the movement from e_1 to e_2 in Figure 2.6. Accounting for the change in quantity demanded in response to price change, not including the effects of real income forced by price changes, is known as uncompensated response (the movement from e_1 to e_c). These responses are relevant to this study since uncompensated price elasticities are more often than not more appropriate for price sensitivity analysis as consumers may not be aware of changes in their real income.

The next part of the chapter will deal with putting the theory explained above into a framework from where it can be applied in models. This will show how the theory can be made specific to tourism and observe the usefulness of the theory in the empirical work. The first model that will be discussed is the Rotterdam model.

2.3 The Rotterdam model

2.3.1 Background

One of the most popular methods for estimating demand was put forward by Thiel (1965) and Barten (1966) and is known as the Rotterdam model. As will be seen in the theoretical framework, this model implies an adaptation of Stone's equation. One of the advantages of this demand system is its ease of use and the theoretical background embedded within this demand system.

The first pilot study done using the Rotterdam model was by Barten (1967), testing data from the Netherlands over the pre- and post-war periods for four broad groups of products. The finding was that there was little conflict between the results and economic theory. When Barten (1969) expanded his study by introducing 16 groups of products into his equation and including an intercept term to allow for changes in taste of the consumers, he found that the adding up restriction was satisfied.

One disadvantage Barten (1969) observed was that the homogeneity restriction caused a very large drop in maximum likelihood. The drop was, in fact, much larger

than if the data satisfied the homogeneity by chance. He also found that, with testing the symmetry restriction that is in conflict with theory and results, there was evidence that a proportional change in prices and aggregate expenditure will not leave the pattern of demand unchanged.

Deaton (1974) also observed this disadvantage when he estimated the Rotterdam model using a nine-product model of British data from 1900 to 1970. He found that, in terms of homogeneity, there was a stark contrast between economic theory and the results. The symmetry restriction was found to be an additional restriction, although not damaging if it was not satisfied.

Deaton and Muellbauer (1980a) identified the Rotterdam model as the first model that incorporates a substitution matrix where substitution and complementary products can be identified from the estimation alone. Therefore it remains a key model for estimating demand and income and substitution effects even today.

2.3.2 Setting up the Model

Deaton and Muellbauer (1980a) stated that the Rotterdam model has its roots in Stone's analysis, which came into being from the Marshallian demand function. This indicates that the Rotterdam model followed from the Marshallian demand function.

Stone (1954) proposed the following demand equation after he focused on estimating demand for 48 categories of food consumption for Britain in the years 1920-1938. The demand equation he used was the following:

$$\log q_i = \alpha_i + e_i \log x + \sum_{k=1}^n e_{ik} \log p_k \quad (2.4)$$

Where:

- q_i is the quantity of good i demanded.
- e_i is the elasticity of expenditure.
- e_{ik} is the cross-price elasticity of the k^{th} price on the i^{th} demand.
- x total expenditure (same as Marshallian demand function).
- p_k price of k^{th} good

Deaton and Muellbauer (1980a) state that where the quantity of observations is small, the number of explanatory variables should be kept to a minimum. For this demand equation to be estimated, some restrictions are required. The first procedure they envisioned was that of setting most of the cross-price elasticities to zero, but admitted that this approach would be ineffective as price elasticities include income as well as substitution effects and, while the effect for substitution might be zero in terms of 'unrelated' goods, there is enough evidence to suggest that the same cannot be said for the income effects.

The solution Stone used to solve this problem was to estimate cross-elasticities by using the Slutsky equation in elasticity form:

$$e_{ik} = e_{ik}^* - e_i w_k \quad (2.5)$$

Where:

- e_{ik}^* is the compensated cross-price elasticity.
- w_k is the budget share.

By substituting the Slutsky (2.5) equation into the original Stone's analysis (2.4) the new equation is (2.6):

$$\log q_i = \alpha_i + e_i \{ \log x - \sum_k w_k \log p_k \} + \sum_{k=1}^n e_{ik}^* \log p_k \quad (2.6)$$

The expression $\sum_k w_k \log p_k$ can be seen as the logarithm of a general price index ($\log P$) and thus equation (2.6) becomes:

$$\log q_i = \alpha_i + e_i \log\left(\frac{x}{P}\right) + \sum_{k=1}^n e_{ik}^* \log p_k \quad (2.7)$$

This gives the demand in terms of total real expenditure as well as compensated prices. The same transformation from Marshallian to Hicksian demand functions is observed in the general specification of the Rotterdam Model.

Furthermore the homogeneity restriction that can be gathered from Stone's analysis, that the sum of the compensated cross-price elasticities is zero and can be shown as follows:

$$\sum_k e_{ik}^* = 0 \quad (2.8)$$

This equation (2.8) can be used to allow deflation in prices in (2.7) by the general price index ($\log P$). The range of substitution is restricted to some set (k) of close substitutes and complements. This is done to ensure that there is no reason not to rule out zero substitution between unrelated goods. Equation (2.9) below is the basis

for Stone's analysis. The equation of Stone's analysis conserves degrees of freedom. After the analysis, the elasticities are estimated from budget studies and the values used as prior information in the estimation. This equation is approximately equivalent to (2.7) only in relative prices.

$$\log q_i = \alpha_i + e_i \log(x/P) + \sum_{k \in K} e_{ik}^* \log(p_k/P) \quad (2.9)$$

Stone also put in a time trend variable ($\theta_i t$) to accommodate the changes in consumer tastes and used first differences to account for the effects of serial correlation in the residuals. Thus the final equation (2.10) is:

$$d [\log q_i - e_i \log(\frac{x}{P})] = \theta_i t + \sum_{k \in K} e_{ik}^* \Delta \log(p_k/P) \quad (2.10)$$

- where e_i , is the expenditure elasticity is estimated from the budget studies

According to Deaton and Muellbauer (1980a) the Rotterdam model is very similar to Stone's analysis but, instead of working in levels of logarithms, the Rotterdam model uses differentials. First differentiate Stone's equation (2.4):

$$d \log q_i = e_i d \log x + \sum_j e_{ij} d \log p_j \quad (2.11)$$

Unlike Stone's analysis, there is no assumption made that the elasticities e_i and e_{ij} are constant. As in Stone's analysis, the Slutsky breakdown (2.4) is used to write (2.5) for compensated cross-price elasticity e_{ij}^* , which means (2.11) becomes the following:

$$d \log q_i = e_i (d \log x - \sum w_k d \log p_k) + \sum_j e_{ij}^* d \log p_j \quad (2.12)$$

Deaton and Muellbauer (1980a) also state that equation (2.12) is a full differential of Stone's equation (2.7), but the disadvantage of this equation is that it does not adhere to the restriction of symmetry because of (2.11) where there is also a restriction on consumers' variable budget share. This is rectified by multiplying the equation (2.12) by budget share w_i . This leads to the following equation that can be estimated:

$$w_i d \log q_i = b_i d \log \bar{x} + \sum_{j=1}^n c_{ij} d \log p_j \quad (2.13)$$

Where:

$$d \log \bar{x} = d \log x - \sum w_k d \log p_k = \sum w_k d \log q_k \quad (2.14)$$

$$b_i = w_i e_i = p_i \frac{\partial q_i}{\partial x} \quad (2.15)$$

$$c_{ij} = w_i e_{ij}^* = \frac{p_i p_j s_{ij}}{x} \quad (2.16)$$

With s_{ij} is the (i,j) th term of the Slutsky substitution matrix. The first equality in equation (2.14) is the definition of $d \log \bar{x}$. The second equality in the equation is the budget constraint. The measure of $d \log \bar{x}$ is regarded as an index that represents the change in real total expenditure. This can be seen as a measure of the change in utility, to illustrate that (2.13) represents Marshallian demands like the Stone equation. Equation (2.15) shows that $b_i = w_i e_i$ is the marginal propensity to spend on the i th good.

Adding up requires that the marginal propensities to spend on goods sum to one and that the net effect of a price change on the budget is zero.

$$\sum_k b_k = 1; \sum_k c_{kj} = 0 \quad (2.17)$$

Equation (2.14) will hold so that sum of the dependent variables in equation (2.13) will equal the first independent variable. OLS estimation should not be a problem as the adding up equations place no restriction on the explanatory power of the equation and the parameters will automatically satisfy (2.17) because of the budget constraint.

Homogeneity can well be tested and the Rotterdam model would be homogenous, if for all j .

$$\sum_k c_{jk} = 0 \quad (2.18)$$

This can be enforced and tested equation by equation.

The final restriction would be true, since all prices are positive, then c will be negative semi-definite when s is negative semi-definite. c is the marginal propensity to spend and s the Slutsky matrix. Both symmetry and negativity can be tested using the same restrictions on c . It should be noted that symmetry, adding up, and homogeneity are not independent. The symmetry of the substitution matrix implies that matrix c be symmetric for all i and j , thus:

$$c_{ij} = c_{ji} \quad (2.19)$$

Deaton and Muellbauer (1980a) showed the basic form of the Rotterdam model but, in this study, the absolute price version of the Rotterdam model proposed by Barnett and Serletis (2008) will be used. This model is chosen because, like the AIDS model (see Section 2.4), this model incorporates the utility function of the representative consumer. Another major advantage according to Barnett and Serletis (2008) is that

no other model has the same connection with demand theory after aggregation over consumers under weak assumptions. The model uses the following equation:

$$w_{it}^* \Delta \log x_{it} = \theta_t d \log Q_t + \sum_{j=1}^n \pi_{ij} \Delta \log p_{jt} + u_t \quad (2.20)$$

Where:

- w_{it}^* = two period average weight.
- $\log x_{it}$ = quantity of good i demanded = $\Delta \ln x_i = \Delta \ln y - \Delta \ln p_i$.
- DQ_t = Tornqvist-Theil Divisia index = $d \log Q_t = \sum_{j=1}^n w_{jt} d \log x_{jt}$.
- p_{jt} = tourism price.
- Δ = first difference operator.

The reason that the Rotterdam model is considered static is because the θ_t and π_{ij} coefficients are treated as constants. The above equation is known as the absolute version of the Rotterdam model. The same restrictions apply to this Rotterdam model as to the basic Rotterdam model proposed by Deaton and Muellbauer (1980a).

It is important to note that the Rotterdam model proposed by Barnett and Serletis (2008) does not use a price index like the Stones' price index, which will be discussed in detail later along with the AIDS model, but uses a Divisia index. This specification consists of the Divisia price and quantity indices respectively.

Barnett and Serletis (2008) evolved their Rotterdam model from equation (2.13) by incorporating (2.16) where $\sum_{j=1}^n c_{ij} d \log p_j$ is the budget share that is weighted by the n logged price changes. This defines the Divisia price index:

$$d \log P = \sum_{j=1}^n w_j d \log p_k \quad (2.21)$$

Also from equation (2.13) the Divisia quantity index can be derived:

$$d \log Q = \sum_{j=1}^n w_j d \log x_j \quad (2.22)$$

Where:

- y = equals the nominal income/expenditure.

By obtaining the price and quantity indices it is now possible to calculate the income or expenditure variable. The formula is:

$$d \log P + d \log Q = d \log y \quad (2.23)$$

When rewriting

$$d \log Q = d \log y - d \log P \quad (2.24)$$

It can be said that the Divisia Price index transforms the change in money income (expenditure) into a change in real income (expenditure).

Furthermore, in this study, the absolute price version of the Rotterdam model needs to be converted to a finite change form as economic data is in finite form. (Barnett and Serletis, 2008). This means that the Divisia quantity index must be recalculated in finite change form. This is done by adding a time subscript. This leads to the variable being calculated as:

$$d \log Q_t = \sum_{j=1}^n w_{jt} d \log x_{jt} \quad (2.25)$$

From this demand system, elasticities can be derived – the elasticities being the expenditure, own-price and cross-price elasticities. The equations are as follows:

Expenditure Elasticity:

$$\eta_i = \frac{1}{w_i} \frac{dw_i}{d \ln x} = \frac{\beta_i}{w_i} \quad (2.26)$$

Uncompensated own-prices elasticities:

$$\varepsilon_{ij} = \frac{1}{w_i} \frac{dw_i}{d \ln p_i} - 1 = \frac{\gamma_{ii}}{w_i} - \beta_i \frac{w_i^\beta}{w_i} - 1 \quad (2.27)$$

Uncompensated cross-price elasticities:

$$\varepsilon_{ij} = \frac{1}{w_i} \frac{dw_i}{d \ln p_i} = \frac{\gamma_{ii}}{w_i} - \beta_i \frac{w_i^\beta}{w_i} \quad (2.28)$$

Only the formulas for the expenditure and uncompensated elasticities are shown as these will be the elasticities that will be estimated. The reason for this will become apparent later on in the study (See Section 3.7).

2.3.3 Applications of the Rotterdam model

The Rotterdam model has gone through some improvements and evolutions since its first inceptions. According to Barnett (1979) the most widespread criticism levelled at the Rotterdam model is that the model only correctly observes known properties and theoretical implications, when the model is highly restrictive and in uninteresting special cases. This means that the model can only be applied to known theory when this highly restrictive special case is maintained. Barnett (1979) concludes by saying

that a discrete Rotterdam model is consistent with utility maximisation only when the utility function is in a linear logarithmic form.

With the level of criticism that the Rotterdam model received, Mountain (1988) showed that a discrete Rotterdam model was possible with the approximation at the disaggregate level in the space of variables. The unique nature of the discrete model in using approximation variables means that estimated elasticities are also approximations. He concluded that the discrete Rotterdam model in variable space is an alternative approach that can be used in place of the normal discrete Rotterdam model.

Notwithstanding these criticisms, the main purpose of a complete demand system is to estimate elasticities and the Rotterdam model is no different. Therefore it has been widely applied.

Clements and Selvanathan (1988) analysed the Rotterdam model in the application of marketing. They used the model to analyse the effect of marketing in the consumption of alcohol (wine, beer and spirits). They found that, although the Rotterdam model is mainly a theoretical system, it works well when applied to aggregate data. They stated that the block independence¹ feature of the Rotterdam model makes it easy to calculate the factors that will have an impact on the dependent variable, such as market structure and advertising.

Seale, Sparks and Buxton (1992) completed a study using the differential approach Rotterdam model in the market for fresh apple importing by four major markets that are important to USA exporters. They found that the restrictions of homogeneity and symmetry could not be rejected using nested tests among import suppliers. This means that price changes had an effect on household consumption and there is no consistency in spending.

Kinnucan, Xiao, Hsia and Jackson (1997) studied the pattern of meat consumption in the USA from 1976 to 1993 using the Rotterdam model with specific model specifications where the effects of advertising and nutritional information were used as variables to determine whether they had an effect on the USA meat demand. An interesting feature of this model was that there was an intercept term to test whether meat demand is affected by trend related changes or demographics of meat

¹ block independence refers to the situation where the consumer's preferences for consumer goods can be expressed by a utility function which is additive in the groups of goods.

demand. This is interesting in the fact that this intercept was used as a definite indicator of whether the decline in meat demand was trend-based or demand-based. Xiao, Kinnucan and Kaiser (1999) used the two-stage Rotterdam model to determine the effects of advertising on the demand for non-alcoholic beverages in the USA from 1970 to 1994. Five types of beverage were analysed in the study. The study revealed that advertising appears to play a minor role in explaining the beverage consumption pattern in the USA. Also, the study found that demand for non-alcoholic beverages was inelastic. In addition, income elasticities were between 0 and 1, which suggests that the beverages were normal goods.

Neves (1993) states that both the AIDS model and the Rotterdam model correspond to different parameterisations of the budget differential equation, where 'parameterisation' refers to the assumptions made concerning the constancy of the relevant parameters. In this way, the parameters b_i and c_{ij} are treated as constants in the Rotterdam model, in the same way as the parameters α_i and γ_{ij} are taken to be constant in the AIDS model. (See Sections 2.3.2 and 2.4.2).

This approach to the Rotterdam model was used by Ben Kaabia, Angulo and Gil (2001), where they used a modification of the Rotterdam model to establish whether increasing information had an effect on demand for different types of meat in Spain.

Even though the Rotterdam model has never been used in measuring tourism demand, it shares many similarities to the AIDS demand function which makes it a viable alternative for measuring tourism demand. It will also be interesting to compare the Rotterdam model to the AIDS model and to establish whether one of the models dominates the other.

2.4 The Almost Ideal Demand System (AIDS)

2.4.1 Background

In 1980, Deaton and Muellbauer devised a model of multiple equations which rests upon a class of preferences, the PIGLOG class. This class of model is represented by a cost or expenditure function that defines the minimum expenditure necessary to attain a certain level of utility. This model uses the value shares to the logarithm of total expenditure to model demand. In time series analysis, it is a necessity for the model to include the effects of prices.

Deaton and Muellbauer (1980a) state that the AIDS model preserves the generality of the Rotterdam model and the translog model. This implies that the AIDS model is comparable to the Rotterdam model.

A major advantage of using the AIDS model, according to Li, Song and Witt (2004), apart from it being the most used method in the attempt to analyse consumer behaviour, is that it gives random first order approximation to any demand system. The AIDS model also has a very flexible form and does not impose any prior restrictions on elasticities. The model also allows for easy estimation and mostly avoids non-linear estimation. The restrictions on homogeneity and symmetry can be tested through linear restrictions on the parameters. The model is a sensible representation of a consumer that is assumed to make a sensible budgeting allocation. Therefore the AIDS model has its base in microeconomic theory and can be generalised.

2.4.2 Setup of the AIDS model and variations

As indicated in (2.4.1), the foundation of the AIDS model is the PIGLOG class of preferences. To fully explain the setup of the AIDS model, there will be a focus on the PIGLOG model first and the way that Deaton and Muellbauer derived the AIDS model from it. De Mello, Pack and Sinclair (1999) derive the AIDS model by Deaton and Muellbauer (1980b) in the following way.

Let x be the total expenditure which is to be spent, within a given time, on some or all of n products. The products must be bought in non-negative quantities such that $q_i, i=1, \dots, n$ at given prices p_i . Let $q = (q_1, q_2, \dots, q_n)$ be the quantities vector of the n products purchased, and let $p = (p_1, p_2, \dots, p_n)$ be the price vector.

From this the budget constraint can be calculated. The budget constraint of the representative consumer is the following:

$$\sum_{i=1}^n p_i q_i = x \quad (2.29)$$

Defining the utility function as $u(q)$ the consumer strives for utility maximisation subject to a budget constraint.

$$\max u(q) \text{ subject to } \sum_{i=1}^n p_i q_i = x \quad (2.30)$$

This leads to the uncompensated (Marshallian) demand function:

$$q_i = g_i(p, x) \quad (2.31)$$

(which is the same as $x = v(p, m)$ in Section 2.2.1)

On the other hand, the consumer's problem can be defined as total expenditure minimisation to achieve utility u^* at given prices:

$$\min \sum_{i=1}^n p_i q_i = x \text{ subject to } u(q) = u^* \quad (2.32)$$

Solving equation (2.32) will lead to the compensated (Hicksian) demand function

$$q_i = h_i(p, u) \quad (2.33)$$

This leads to the cost function that can be defined as:

$$C(p, u) = \sum_{i=1}^n p_i h_i(p, u) = x \quad (2.34)$$

Given the total expenditure x and prices p , the level of utility is derived from the solution of equation (2.30). Solving equation (2.34) in terms of u an indirect utility function is derived such that:

$$u = v(p, x) \quad (2.35)$$

This is the basis of the AIDS model in that the AIDS model specifies a cost function which is used to derive the demand functions for the destinations under analysis.

The derivation process can be divided into three steps:

- $\frac{\partial C(p, u)}{\partial p_i} = h_i(p, u)$ which are Hicksian demand functions.
- The indirect utility function is obtained such that $u = v(p, x)$.
- $h_i[p, v(p, x)] = g_i(p, x)$ that state that the Hicksian and Marshallian demands are equal.

The same properties of demand apply here that were discussed in Section 2.2.3.

The cost function of the AIDS model is defined by:

$$\log c(u, p) = a(p) + ub(p) \quad (2.36)$$

Where:

- $a(p)$ and $b(p)$ are functions of prices and give rise to the demands of equation (2.36).

From equation (2.36), Deaton and Muellbauer (1980b) discuss the functional form of the AIDS model. The next step is to take the specific functional forms for $a(p)$ and $b(p)$.

$$a(p) = a_0 \sum_k a_k \log p_k + \frac{1}{2} \sum_k \sum_l \gamma_{kl}^* \log p_k \log p_l \quad (2.37)$$

$$b(p) = \beta_0 \prod p_k^{\beta_k} \quad (2.38)$$

Where:

- α, β , and γ^* are parameters.
- $c(u, p)$ is homogenous in p .

The cost function of equation (2.36) can be rewritten as the AIDS cost function by substituting equation (2.37) and (2.38) into equation (2.36).

$$\log c(u, p) = a_0 \sum_k a_k \log p_k + \frac{1}{2} \sum_k \sum_l \gamma_{kl}^* \log p_k \log p_l + \beta_0 \prod p_k^{\beta_k} \quad (2.39)$$

To establish whether $c(u, p)$ is homogenous in p , it must be a valid representation of preferences. The following restrictions apply:

$$\sum_1^n \alpha_k = 1, \sum_k \gamma_{kl}^* = \sum_l \gamma_{kl}^* = \sum_1^n \beta_k = 0 \quad (2.40)$$

Deaton and Muellbauer (1980b) state that the demand functions of the AIDS model can be directly derived for equation (2.39) as the authors explained it is the fundamental property of the cost function that its price derivatives are the quantities demanded. This means that $\frac{\partial c(u, p)}{\partial p_i} = q_i$ and multiplying on both sides by $p_i/c(u, p)$ gives:

$$\partial \log c(u, p) / \partial \log p_i = \frac{p_i q_i}{c(u, p)} = w_i \quad (2.41)$$

Where:

- w_i is the budget share of good i .

The next step is to differentiate equation (2.39) and this gives us budget shares as a function of prices and utility:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i u \beta_0 \prod p_k^{\beta_k} \quad (2.42)$$

Where:

$$\gamma_{ij} = \frac{1}{2} (\gamma_{ij}^* + \gamma_{ji}^*) \quad (2.43)$$

For a consumer that wants to maximise their utility, their total expenditure (x) will be equal to $c(u, p)$ and this can be inverted to give utility (u) as a function of p and x (indirect utility function). This can be done to equation (2.39) and, by substituting the result into equation (2.42), the budget shares as a function of p and x will be

calculated. The function for the AIDS demand functions in budget share form have the following equation:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{x}{P}\right) \quad (2.44)$$

and where:

- w_i is the budget (expenditure) share of the i^{th} product.
- p_j is the nominal price of the j^{th} good.
- x is total expenditure that is to be spent on n products within a given period.
- P is the price index of the group defined as $\log P = a_0 \sum_k a_k \log p_k + \frac{1}{2} \sum_k \sum_l \gamma_{kl}^* \log p_k \log p_l$.

In the model's simplest form of equation, it shows that the size of the consumer's budget that is spent on a particular product (i) (destination) is dependent on the consumer's budget and the price of the product (destination) relative to the price of competing products (destinations).

The restrictions α and γ ensure that P is a linearly homogenous function of the individual prices. The β parameters of the AIDS model determine whether goods are luxuries or necessities. Changes in expenditure function through the β_i coefficients, which add up to zero and are positive for luxuries and negative for necessities.

The restrictions on the parameters of equation (2.39) plus equation (2.43) imply restrictions on the parameters of the AIDS equation (2.44). This equation also has a number of restrictions that apply to the parameters of the equation that are in accordance with the basic axioms of consumer demand theory (see Section 2.2.3).

- The adding up restriction that all budget shares add up to unity routinely holds and implies that the marginal propensities to spend on each good sum to unity and the net effect of a price change on the budget is zero.

$$\sum_{k=1}^n a_k = 1, \sum_{k=1}^n \gamma_{kj} \text{ and } \sum_{k=1}^n \beta_k = 0$$

- Homogeneity means that a proportionate change in all prices and expenditure has no effect on the quantities acquired: $\sum_{j=0}^n \gamma_{kj} = 0$
- Symmetry requires the matrix to be symmetric and this is given by:

$$\gamma_{ij} = \gamma_{ji}$$

The equation of the AIDS model is very close to being linear apart from the expression P which entails parameters. Deaton and Muellbauer (1980a) explain that, to linearise the equation, one needs to use Stone's (1954) price index, which takes the form

$$\log P^* = \sum_i w_i \log p_i \quad (2.45)$$

This linear form of the AIDS equation using the Stone price index is called the LAIDS. This slight alteration of the model that uses Stone's index is called the 'linear approximate AIDS' or LA/AIDS. If prices are highly collinear, P might be roughly proportional to p^* : $P \cong \gamma p^*$. There is also an extreme case when P is linearly proportional to p^* , then the LA/AIDS model can estimate the parameters of the AIDS model because the LA/AIDS model can be written in terms of the AIDS model.

$$w_i = (\alpha_i - \beta_i \ln \lambda) + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{x}{p^*}\right) \quad (2.46)$$

Green and Alston (1990) state that it is not known whether the LA/AIDS model has satisfactory theoretical properties. They also state that both models are non-nested systems, which means that the various factors in the model are not shared and not on a specific hierarchical order, but as the Stone index becomes a better proxy for the price index, the estimates for the LA/AIDS would approach the estimates for the AIDS except for the intercept term. They ultimately found that, when the study uses the LA/AIDS model, the formula that they proposed (2.26) should be used but, when specifically working with the AIDS model, the price elasticity for the AIDS model should be used. There was also very little difference in both systems when empirical studies were completed and elasticities were compared.

Equation 2.26 indicates a log-linear functional form and, through this equation, the relevant elasticities cannot be specified and assessed from the parameter estimates. These values must therefore be calculated as follows:

Expenditure elasticity:

$$\eta_i = \frac{1}{w_i} \frac{dw_i}{d \ln x} + 1 = \frac{\beta_i}{w_i} + 1 \quad (2.47)$$

Uncompensated own-prices elasticities:

$$\varepsilon_{ij} = \frac{1}{w_i} \frac{dw_i}{d \ln p_i} - 1 = \frac{\gamma_{ii}}{w_i} - \beta_i \frac{w_i^\beta}{w_i} - 1 \quad (2.48)$$

Uncompensated cross-price elasticities:

$$\varepsilon_{ij} = \frac{1}{w_i} \frac{dw_i}{d \ln p_i} = \frac{\gamma_{ii}}{w_i} - \beta_i \frac{w_i^\beta}{w_i} \quad (2.49)$$

Compensated own-price elasticities:

$$\varepsilon_{ij}^* = \varepsilon_{ii} + w_i^\beta \varepsilon_i = \frac{\gamma_{ii}}{w_i} + w_i^\beta - 1 \quad (2.50)$$

Compensated cross-prices elasticities:

$$\varepsilon_{ij}^* = \varepsilon_{ii} + w_i^\beta \varepsilon_i = \frac{\gamma_{ii}}{w_i} + w_i^\beta - 1 \quad (2.51)$$

Where:

- w_i represents the sample average share of destination i .
- w_j^β represents the share of destination j in the base year.

In the case where the variables in the system are non-stationary and co-integration may be present, the LA/AIDS can be expanded as the EC-AIDS model. This equation takes into account all the errors that occur from consumers and corrects them until they are in equilibrium. The basic equation of the EC-AIDS model according to Cortés-Jiménez, Durbarry and Paulina (2009) is the following:

$$\Delta w_{it} = \delta_i \Delta w_{it-1} + \sum_j c_{ij} \Delta \ln p_{jt} + b_i d \ln \left(\frac{x}{p} \right)_t - \lambda \{ECT_{t-1}\} + \gamma_i T + u_{it} \quad (2.52)$$

Where:

- i indicates the country destination, j refers to all the country destinations.
- t indicates time.
- Δ Indicates that the variable is first differenced and $\ln$ that the variable is transformed into a natural logarithm.

The variables are the following:

- w is the share of tourism expenditure and i total expenditure in j destination.
- p is the relative price of tourism in the destination.
- $\left(\frac{x}{p} \right)_t$ is the ratio of tourist expenditure and the Stone index.
- ECT_{t-1} is the error correction term.

The error correction term is obtained when estimating the equation:

$$w_{it} = \alpha + \sum_j \gamma_{ij} \ln p_{jt} + \beta_i \ln\left(\frac{x}{p}\right)_t \quad (2.53)$$

According to Cortés-Jiménez *et al* (2009) the EC-LAIDS performs better than the LA/AIDS in determining income elasticities, cross-price elasticities and own-price elasticities. This is because the EC-LAIDS incorporates a dynamic error correction mechanism which catches short-term variations. This allows for better predictions to be made using more accurate data than long-run models.

2.4.3 Applications of the AIDS model

One of the advantages of the AIDS model is that it is a useful framework for modelling demand due to its flexibility and ease of calculation. In terms of demand theory, the AIDS automatically satisfies the adding up restriction. By imposing parameter restrictions, the homogeneity and symmetry restrictions can be satisfied (Li, Song and Witt, 2004). According to Fujii, Khaled and Mak (1985), the negativity restriction cannot be satisfied by parameters alone but is likely to be satisfied by any data set created by utility-maximising behaviour.

Due to this model's ease of use and its flexibility, the linear AIDS model is very popular for empirical studies. Apart from testing tourism demand, the AIDS model has been used in various other demand studies such as the demand for meat supply in South Africa (Taljaard, Alemu and van Schalkwyk, 2004), food demand systems (Kastens and Brester, 1996) and household expenditures (Blundell, Browning and Meghir, 1994)

Numerous academic studies have used the AIDS model to determine and analyse tourism demand and used the model to assess tourism expenditures from one or more base markets for a particular destination. After Deaton and Muellbauer introduced the AIDS model in 1980, the first pilot studies using the model for tourism demand were done by White (1982) who analysed USA's tourism expenditures in Europe from 1960-1981, with White (1985) furthering his study by grouping countries under seven regions and adding a transportation equation into the demand system.

A study that used Deaton and Muellbauer's AIDS model without any alterations was Fujii, Khaled and Mark (1985) who assessed the demand for foreign tourists visiting

Hawaii, paying special attention to the price of lodging, food and drink, recreation and entertainment, local transport, clothing and other. This was one of the first studies that used the AIDS model with the focus on how tourists react to policy changes.

Sinclair and Syriopoulos (1993) determined how tourists from the UK, Germany, France and Sweden allocate their expenditure among groups of Mediterranean countries. Papatheodorou (1999) focused on the demand for international tourism in the Mediterranean from three developed countries (UK, West Germany and France) and their demand for six Mediterranean countries from 1957-1989. He also provided a detailed discussion on the various variables in the AIDS model. These being:

- Dependent variable: The dependent variable is the tourism expenditure from the origin country in the destination country as part of the aggregate tourism expenditure of the origin country in the destination country.
- Explanatory variables: The set of explanatory variables included prices, total tourist expenditures and a time trend. A problem was encountered in finding data for advertising expenditure and dummy variables for seasonal trends proved to be not significant and were dropped from the study.

De Mello, Pack and Sinclair (2002) constructed an AIDS model of the UK demand for neighbouring counties (France, Spain and Portugal). The focus of this study was to establish whether or not countries that were considered developing countries (in the case Spain and Portugal, who only moved into the developed country category in the mid 1980s) had an increase in tourism demand since their 'status' changed and how they compare to a developed country like France. They found that, for the most part, poorer countries can catch up to their richer neighbours but, in the case of Portugal, it was not as instantaneous as with Spain and this holds valuable information for policy makers in attracting foreign tourists.

Han, Durberry and Sinclair (2006) studied USA's tourism demand for European destinations using a static AIDS model and showed that price competitiveness is important for USA's demand for France, Italy and Spain but not as important for the UK. There is also an argument for France and Italy being substitutes for one another and the same goes for Italy and Spain. As USA's tourism expenditure increases, the

market for Spain and the UK decline while France and Italy benefit from this increase in expenditure.

According to Anderson and Blundell (1983), the basic AIDS model by Deaton and Muellbauer assumes that there is no difference in consumers' short-run and long-run behaviour. This implies that the consumer is always in balance. However, there are a few factors that cause the consumer to be out of balance before full correction takes place which include habit persistence, imperfect information and incorrect expectation.

According to Chambers and Nowman (1997), the assumptions of the static AIDS model are unrealistic, the reasons for this being that there is no attention paid to the data in terms of its statistical properties and the dynamic nature of time series analysis. This has a particular effect on the OLS estimation due to the non-stationary nature of many economic series. This is due to the incidence of unit roots and this may cause spurious results when estimating.

Since the few early studies using the AIDS model and the criticism levelled against it regarding the lack of ability of the long-run specification to comprehend the dynamic adjustment of tourism demand, AIDS modelling has evolved with more recent studies focusing on a more dynamic framework with the use of different approaches. Popular among these are co-integration and the use of an error correction mechanism (ECM) (explained above – see equation (2.30)).

Lyssiotou (2001) was the first to use a nonlinear AIDS model. In doing this, he made use of a lagged dependent variable. This was done to capture habit persistence while measuring UK demand for tourism to North America excluding Mexico and 16 other European destinations. One flaw in this study was that neighbouring destinations were aggregated and thus no substitution and complementary effects could be witnessed between these countries.

Durbarry and Sinclair (2003) studied tourism demand from France for three markets, Italy, Spain and the UK for 1968-1999, using an error correction AIDS model. The author indicated that lagged endogenous variables could be omitted from the model as they violate the restriction of homogeneity. This can be rectified by having a constant term and first-order differencing. Using the long-run model it was found that the homogeneity and symmetry restrictions were valid. The elasticities that were derived showed that tourism demand to these destinations was very sensitive to

price changes, which again indicates a level of price competitiveness between the three countries.

With regards to long-run implementation of the EC-AIDS model, there have been studies that incorporated the ECM specification into the linear AIDS model and therefore can analyse both the long-run and short-run dynamics.

Li, Song and Witt (2004) used a dynamic linear AIDS model to estimate the UK tourism demand to 22 Western European Countries. While comparing the static AIDS model with the dynamic AIDS model they found that the EC-AIDS model was superior to the other models with regards to properties of a demand function (Homogeneity and Symmetry) and better with forecasting accuracy. They also found that tourists travelling to Western Europe from the UK can be deemed as a luxury good in the long run, hence more of a price elasticity in the long run than in the short run.

Cortés-Jiménez, Durbarry and Paulina (2009) used monthly data from 1996-2005 to evaluate Italian tourism demand in four main European destinations France, Germany, the UK and Spain, in both the short run and long run, as well as cross-price and expenditure elasticities derived from the dynamic model. They found that the dynamic model outperformed the long-run model in forecasting accuracy. Their study is unique in nature because they measure monthly LAIDS and EC-AIDS models and thus get more accurate results than previous studies.

Wu, Li and Song (2008) took a different take on the EC-AIDS model in that instead of measuring tourism demand for Hong Kong they measured tourism expenditure patterns. The four main categories by which they measured tourism expenditure were shopping, hotel accommodation, meals outside the hotel and other expenses. Using the ECM term they tested both long-run and short-run models and found that they satisfy the homogeneity and symmetry restrictions. Their findings were that shopping had the highest elasticities in the short and long run and that short-run expenditure elasticities are, for most cases, lower than in the long run.

Other extensions of the AIDS-model can be found in research by Li, Song and Witt (2004). Their study introduced a time varying parameter (henceforth, TVP) to the Linear AIDS model (LAIDS) in both the long-run and short-run error correction (EC) forms. They were particularly interested in the structural instabilities in data brought about by high rates of inflation changing consumer expectations. They conclude that

an EC-LAIDS equation is the most appropriate form but, in terms of forecasting the TVP models for both the short run and the long run, it outperforms any of the other AIDS models. They further state that their model has forecasting abilities that are superior to the normal fixed parameter EC-LAIDS, but that the predictive ability of the TVP needs further investigation.

Empirical studies of international tourism demand using econometric models are limited in terms of South Africa. As previous literature has suggested, modelling AIDS for tourism demand is helpful with regards to elasticities and tourism competitiveness. This study will be specifically geared to the demand for South Africa by UK and USA tourists.

2.5 Comparison of the two models

The question that is often raised is which one of the two demand systems is the better one? According to Taljaard *et al.* (2006), the Rotterdam model and AIDS model display many parallels. Both these equations use the same data sets, have very flexible functional forms, both are very frugal with respect to number of parameters and both are linear in parameters. He further states that, because these two models share so many characteristics, it will be more productive to compare the Rotterdam and AIDS models than other demand models.

Barnett and Seck (2006) used Monte Carlo techniques to determine which of the two demand systems was the best. They made four findings from their study:

- Both models perform well when substitution between goods is low. The higher the level of aggregation, the lower the substituting elasticity.
- Both models perform equally well when substitution between goods is moderately high.
- When substitution between goods is high, the AIDS model performs better.
- The Rotterdam model appears to be better at realising true elasticities.

They were very critical of both models when using different price indices and the results yielded from this were not satisfactory according to the authors.

Paraguas and Kamil (2005) explained that the AIDS model derives a demand function for each consumption item in the budget share form. This model is first differenced in time series analysis to reduce the auto-correlation problem. To make it consistent with the Rotterdam form, the first differenced AIDS model is the same as equation (2.13), the only difference being the variable w that is an actual expenditure share weight at time t rather than a two-period average in the Rotterdam model. They continue by stating that both the Rotterdam and the LA-AIDS models are non-nested models. Therefore they are not directly comparable since they have different dependent variables, but the right side of both equations show similarity, hence the need for a Box-Cox transformation to compare the results from both models.

Since the right hand sides of the two models that will be presented later in this study (Chapter 5) differ, an alternative approach is necessary. According to Alston and Chalfant (1993), non-nested models such as the AIDS and Rotterdam models, cannot normally be nested and a non-nested hypothesis would be sufficient. This approach works well with models where the right hand sides of the models are different.

The approach that will be followed in this paper is the J-test by Davidson and MacKinnon (1981) where predicted values (weights) are generated and plugged into the other equation.

Edgerton (1996) stated that there is a need to establish whether the differences between models are statistically significant. In the study that will be done between the Rotterdam model and the EC-AIDS model. The two models are non-nested and a J-test needs to be applied to be able to compare them.

Edgerton (1996) stated that the J-test is a method that can be used when testing a static model versus a dynamic model. The hypothesis test has the following parameters $H_f: E(y|x) = f(x, \beta)$ against $H_g: E(y|x) = f(x, \gamma)$. This is the single equation test and comprises three steps:

- Estimate β and γ from the two models and form two predictions (variables) $\widehat{y}_f$ and $\widehat{y}_g$.
- Estimate the models $E(y|x) = f(x, \beta) + \alpha_f \widehat{y}_g$ and $E(y|x) = f(x, \gamma) + \alpha_g \widehat{y}_f$.
- Test $\alpha_f = 0$ and $\alpha_g = 0$ in the two models above.

The result is when $\alpha_f = 0$ the $f(x, \beta)$ is sufficient to explain y and $\alpha_g = 0$ is sufficient to explain $f(x, \gamma)$.

In this study, the method of estimation is systemic and Edgerton (1996) states that in a system all the predictions should be entered into the system and the same hypothesis would suffice for the system as for the single equation.

According to Wooldridge (2005) the J-test has four possible outcomes, these being none, one, or two rejections. If neither hypothesis is rejected then the equations cannot be ranked and neither is superior, if both equations are rejected it is an indication that both models are inadequate. If one rejection is evident then it shows that one equation dominates the other and the J-test is definitive. Wooldridge (2006) further adds that this test does not imply that the preferred model is well specified as this test is only against a very specific alternative and does not emphatically state that the chosen model is the best possible model of all the other alternatives.

2.6 Conclusion

The chapter began by stating that tourism demand is a well-researched topic and that various approaches exist to analyse demand. In this study, the two approaches that will be used are the AIDS model introduced by Deaton and Muellbauer (1980) and the Rotterdam model introduced by Theil (1965) and Barten (1966). The literature starts by focusing on the microeconomic theory and, in particular, demand theory. Two demand theories from which the Rotterdam and AIDS models were derived are the Marshallian and Hicksian demand theories. The properties of demand are the same in the AIDS and Rotterdam models as in the Marshallian and Hicksian demand functions. Another important part of economic theory that was discussed is income and substitution effects (elasticities) and in, particular, how this applies to demand theory. In particular, the focus was on tourism demand and how tourists change their demand according to the change in expenditure and price changes.

Both the AIDS and Rotterdam models were further discussed on the basis of a background to the models. This describes how the models came into being, and the first pilot studies done by the pioneers of the demand models such as Theil and Barten for the Rotterdam model and Deaton and Muellbauer for the AIDS model. The review also focuses on the mathematical approach of setting up the models and

various approaches that have been taken in the past decades of both models as well as how to calculate the various elasticities that show how tourism is affected.

In the case of the Rotterdam model, the model was discussed as to how it was first used by the pioneers and how it subsequently evolved from the early studies. It was also shown how the Rotterdam model was used for a wide variety of studies. Evidence of this can be seen in Section 2.3.3.

In the case of the AIDS model, various approaches have been introduced like LA-AIDS, EC-AIDS. The applications of the models show that both models are very flexible and easy to calculate and that many studies have used these approaches (See Section 2.4.3).

Finally a comparison was drawn between the AIDS and Rotterdam models and the major difference that was found was that the weight in the Rotterdam model is a two-period average weight, whereas the AIDS model uses a first differenced weight. The procedure to compare the two models was discussed as the non-nested nature of the two models makes it impossible to compare them at face value. Two options were discussed, the Box-Cox transformation and the J-test. The Box-Cox transformation can be used when the right hand sides of the equations are the same. The transformation is not applicable to this study due to the differing right hand sides and thus the J-test was chosen as it can cope with equations where the two right hand sides are different.

The following two chapters will cover the empirical analysis of tourism demand for South Africa using the AIDS and Rotterdam models.

Chapter 3: Rotterdam Model of tourism demand for South Africa

3.1 Introduction

As was discussed in Chapter 2, the Rotterdam model is one of the most popular methods for estimating demand and was put forward by Thiel (1965) and Barten (1966). This model is also a system of equations model and, in its most basic form, an adaptation of Stone's equation. Two major advantages of the Rotterdam model are the ease of estimating and the theoretical background embedded within this system. The main purpose of a complete demand system is to estimate elasticities and the Rotterdam model is no different, therefore its application has been used extensively.

Deaton and Muellbauer (1980) stated that the Rotterdam model was the first model that incorporated a substitution matrix where substitution and complementary products can be identified from the estimation alone.

One key feature of the Rotterdam model is the model's versatility, as is evident from the various studies that have used with the Rotterdam models. The Rotterdam model has seen extensive use, especially in demand studies where food consumption and demand needs to be estimated. Section 2.3.3 shows the versatility of the Rotterdam model in modelling demand for various goods.

The purpose of this chapter is to model tourism demand using the Rotterdam model and to calculate elasticities from the model. This is an integral part of the study as the Rotterdam model and elasticities are the key to understanding the behaviour of UK and USA tourists in choosing destinations, their income, tourism prices and exchange rate.

This study will incorporate the Rotterdam model in the study of tourism demand and is different than most Rotterdam studies in that this study focuses on tourism demand, an area of study not renowned for using the Rotterdam model.

The chapter will proceed as follows: Firstly, the Rotterdam model will be discussed, outlining the variables that will be used as well as the model specification itself. Secondly, the pre-modelling analyses are explained, which include unit roots. Thirdly, the unrestricted model will be estimated, after which a Wald-test will be performed to test the homogeneity and symmetry restrictions. If the restrictions hold, it will be unnecessary to estimate the restricted model, otherwise the restricted

model needs to be estimated. Finally, after the final model has been estimated, the elasticities will be calculated and a detailed description of them will be given before a conclusion is reached.

3.2 Model Specification

The purpose of this study is to investigate demand elasticities for South Africa as a tourist destination by calculating elasticities and using the AIDS and Rotterdam models. The first model that will be discussed is the Rotterdam model. Equation (2.20) in Chapter 2 will be used as the basis for the Rotterdam model in this study.

$$w_{it}^* \Delta \log x_{it} = \theta_t d \log Q_t + \sum_{j=1}^n \pi_{ij} \Delta \log p_{jt} + u_t \quad (3.1)$$

Where:

- w_{it}^* = two-period average weight.
- $\log x_{it}$ = quantity of good i demanded = $\Delta \ln x_i = \Delta \ln y - \Delta \ln p_i$.
- DQ_t = Tornqvist-Theil Divisia index = $d \log Q_t = \sum_{j=1}^n w_{jt} d \log x_{jt}$.
- p_{jt} = tourism price.
- Δ = first difference operator.

As was discussed in Chapter 2, the Rotterdam model uses a different price index – the Divisia Price Index (2.21) – to the Stone's Price Index (2.45) used by the AIDS model.

One challenge Eilat and Einav (2004) foresaw in the determination of tourism demand is the necessity for variables that represent tourism prices. The problem being, according to them, that indices for tourism prices are not always readily available. The common cure for researchers facing this problem was to use exchange rate variables to substitute for tourism prices. One popular measure used was the use of nominal exchange rates, measured as an index relative to a base year. This was done on the assumption that tourists are aware of changes in exchange rates but do not have the information regarding nominal price changes in the destination country. They dismiss the argument if some of the costs of tourism are paid in advance which is normally true in the case of hotels, rentals and car hire.

Another measure that can be used is using real exchange rates instead of nominal exchange rates where the exchange rate is adjusted to inflation of both origin and destination countries. One advantage of this is an improved account of the actual cost of living in both countries and both indices have a common denominator in being measured relative to a base year. This adjustment can track the changes in costs over time, but cannot capture the real differences in cost of living between the two destinations.

An interesting study was done by Divisekera (2009), where the author developed different tourism price indices to White (1985) and Papatheodorou (1999), where the consumer price index (CPI) was used as a substitute for tourism price. In the study, Divisekera (2009) used a variable for tourism price that encapsulates the relative cost levels between destinations.

In this study, the tourism price is calculated using the formula proposed by Cortés-Jiménez *et al.* (2009). The formula for the UK being:

$$\ln p_{it} = \ln \left[\frac{CPI_{it} * E_{it}}{CPI_{iUK} * E_{ibase}} \right] \quad (3.2)$$

And for the USA:

$$\ln p_{it} = \ln \left[\frac{CPI_{it} * E_{it}}{CPI_{iUSA} * E_{ibase}} \right] \quad (3.3)$$

Where:

- $\ln p_{it}$ = effective tourism price.
- CPI_{it} = Inflation of the destination country at time t .
- E_{it} = Exchange rate of destination country at time t .
- CPI_{iUK} and CPI_{iUSA} = Inflation of countries the tourists come from.
- E_{ibase} = Base exchange rate of Pounds Sterling for the UK and US Dollars for the USA in 2005.

Price data was obtained from the International Monetary Fund's (IMF) *Yearbook of International Financial Statistics*. The base year was 2005. The same source was used to obtain the various exchange rate data for the countries.

The Rotterdam model was estimated using quarterly data covering the period from the first quarter of 1999 to the fourth quarter of 2008. The reasons this period was

chosen are because of the increase in tourism to South Africa in the past decade and the incorporation of the initial period of the financial crisis and the effect it had on tourism as well as the availability of the data. The sources of the data for the Tourism expenditure and arrival data for the countries are Tourism New Zealand for New Zealand, the Office of Travel & Tourism Industries for USA arrivals, Tourism Malaysia Corporation for Malaysia, Statistics UK for the UK, Eurostat for Spain and Italy tourist arrivals and the World Bank for their expenditure data and Stats SA for the South African data.

One assumption that is made is that the tourists from the UK and the USA allocate their budget expenditure between six main destinations. According to Cortés-Jiménez (2009), this is done because it is assumed that preferences in each group are not influenced by the demand in other groups. The empirical analysis will examine the interrelationships in the budgeting processes of UK and USA's tourists and the demand for j destinations. These destinations are – for the UK – South Africa, Italy, Spain, New Zealand, Malaysia and the USA and – for the USA – the destinations are: South Africa, Italy, Spain, New Zealand, Malaysia and the UK.

The reason these destinations were chosen was because of their geographical importance. South Africa is the destination that is focused on, and New Zealand was chosen as another long haul destination in the Southern Hemisphere. The choice of Italy and Spain is based on the fact that they are the two countries in Europe that attract a lot of tourists from both the UK and USA. Malaysia was chosen as a representative destination in the East and, because of its similarity to South Africa, it is experiencing growth in tourism. The other two countries – the UK and the USA – were chosen as they are popular destinations for USA and UK tourists respectively

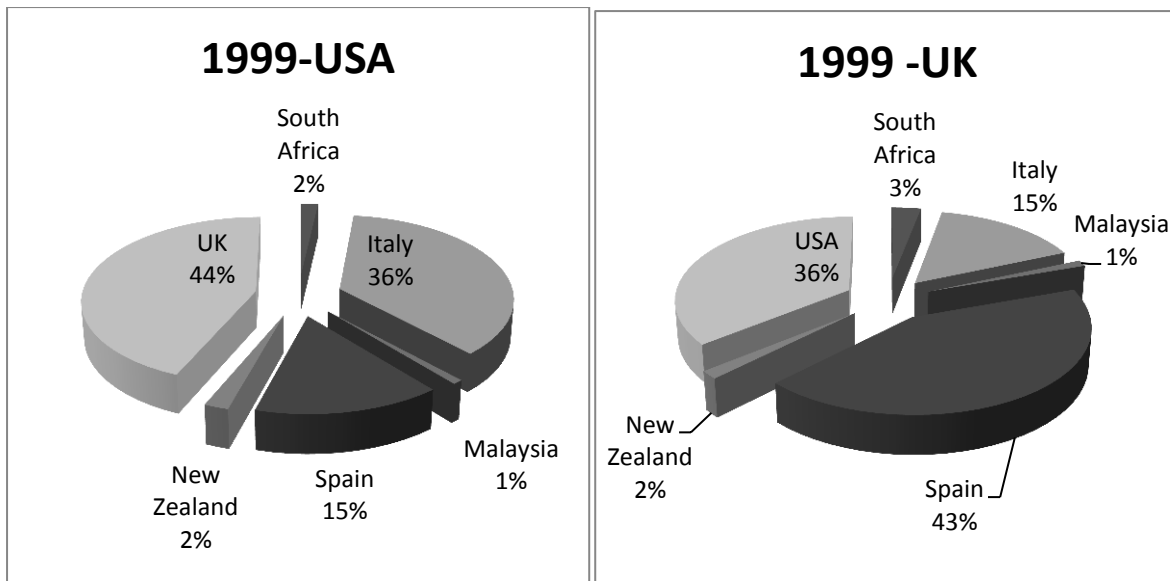


Figure 3.1 and 3.2 Budget shares allocated in 1999 to a destination by tourists from the USA (Fig 3.1) and UK (Fig 3.2)

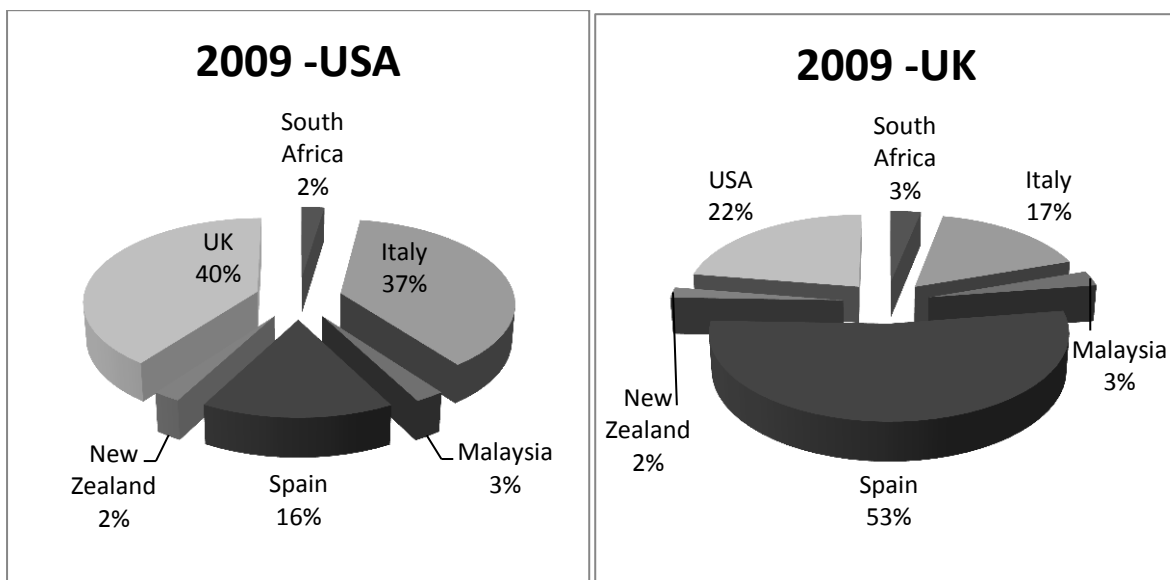


Figure 3.3 and 3.4 Budget shares allocated in 2009 to a destination by tourists from the USA (Fig 3.3) and UK (Fig 3.4)

Figures 3.1 to 3.4 illustrate the relative budget shares allocated to destinations by UK and USA tourists. This shows how tourism spending has been allocated as well as the change in tourism trends in the past ten years.

In 1999, USA tourists (Fig. 3.1) allocated 44 per cent of their budget for the six destinations to the UK, with Italy at 37 per cent and South Africa at two per cent and Malaysia one per cent. In 2009 (Fig. 3.3), the situation differs only slightly with the UK losing four per cent, Italy gaining one per cent, South Africa staying the same and Malaysia gaining two per cent. This shows that tourists from the USA have changed their preferences very little with regards to the six destinations in the past ten years and only small changes in their budget allocation can be observed.

In 1999 UK tourists (Fig. 3.2) allocated 43 per cent of their budget to Spain, 36 per cent to the USA, three per cent to South Africa and one per cent to Malaysia. In 2009 (Fig. 3.4) Spain gained ten per cent, the USA lost 14 per cent, South Africa was unchanged and Malaysia gained two per cent. The figures show that UK tourists are more variable in their choice of destination particularly in terms of going to the USA and Spain. This means that UK tourists are not visiting USA as frequently as before and more tourists are visiting the Spain.

Given the data for expenditure and numbers of tourists, a weight variable could be generated. This was done by calculating a country's portion of expenditure between the six countries for the UK or USA tourists' visits. The Rotterdam model takes a two-period average of the weights. To be consistent, the averages were taken not on consecutive quarters but on the corresponding quarters of the current year and the following year. This can also be seen in Table 3.1.

Table 3.1 shows a detailed breakdown and summary of the variables used in the Rotterdam model as well as its description, data used and the source of the data.

Table 3.1 Summary of variables used in the Rotterdam model

Variable	Description	Data Used	Source
$avg\ w$ [$wita, wmal, wsa, wspa, wuk, wusa$]	Average weight of tourists' expenditure for each country over a two-period average of the total expenditure for the six countries.	Quarterly Arrival data from countries.	Tourism New Zealand. Stats SA. Office of Travel & Tourism Industries for the USA. Tourism Malaysia Corporation. Statistics UK.
$\Delta \log q_{it}$	Quantity demanded of one destination i in terms of its tourism price. As equated in Section 2.3.2 and as explained in equation (2.20).	The first difference of tourism price and first difference of quantity demanded.	Tourism New Zealand Stats SA. Office of Travel & Tourism Industries for the USA. Tourism Malaysia Corporation. Statistics UK.
$\Delta \ln p_{jt}$	Tourism Prices calculated from equation (3.1) and (3.2).	Inflation of the all the countries. Base year: 2005.	IMF: <i>Yearbook of International Financial Statistics</i> .

		Exchange rate of all the countries: Base year 2005.	
<i>expenditure</i>	The sum of how much tourists spend in a destination multiplied by the weight of the destination. Tornqvist-Theil Divisia quantity index Calculated by equation (2.25) in Section 2.3.2.	Summation of the weight of a country over time multiplied by the first difference of the logarithm of expenditure/income.	Tourism New Zealand. Stats SA. Office of Travel & Tourism Industries for the USA. Tourism Malaysia Corporation. Statistics UK.
<i>Db</i>	Structure dummy – to see the effect before the financial crisis.	1 = for the four quarters of 2007. 0 = all the other years.	
<i>Dst</i>	Seasonal dummy – second quarter effects.	1 = for second quarter. 0 = for all the other quarters.	
<i>Dsd</i>	Seasonal dummy – third quarter effects.	1 = for third quarter. 0 = for all the other quarters.	
<i>Dsf</i>	Seasonal dummy – fourth quarter effects.	1 = for fourth quarter. 0 = for all the other quarters.	

As was previously stated, the Rotterdam model shares a multi-stage budgeting approach, and consists of explaining variations in the shares of budget expenditure for a designated good or destination. In this research, a proxied variable is used that was constructed using the total tourist receipts for the two countries in question, the UK and the USA, and dividing this total by the total number of tourists from the respective countries and then multiplying it by the number of tourists that went to the destinations in this study to obtain an average expenditure per capita as done by Papatheodorou (2002).

The basis of the model that was used by Paraguas and Kamil (2005), where they stated that the difference between the AIDS model and the Rotterdam model is the way the weights are calculated, and similar specifications that will be used in the AIDS model will also be used in the Rotterdam except for the change in the weight variable. The calculation of the Rotterdam weight variable was discussed in this

chapter as well as illustrated in Table 3.1. The Rotterdam model will be estimated from the basis of equation (2.20) and evolving it to fit the data using the following equation:

$$avg\ w\ \Delta \log q_{it} = \sum_j c_{ij} \Delta \ln p_{jt} + b_{ij} Expenditure_t + \theta_{1i} Db + \theta_{2i} Dst + \theta_{3i} Dsd + \theta_{4i} Dsf + c_{it} \quad (3.4)$$

where i represents the country destination, j denotes all the country destinations, t signifies time with the time being from 1999Q1 to 2009Q4 (Q meaning quarter). For the variables that have been first-differenced the delta (Δ) is used and $\ln$ implies that the variable is transformed into natural logarithms. Natural logarithms are taken to eliminate measurement problems encountered due to different measuring units used, to simplify the equation and also linearise the equation.

As for the description of the variables, *avg w* indicates the average expenditure shares between two periods t and $t - 1$ in destination i (these destinations being Italy, Malaysia, South Africa, Spain, the UK and the USA respectively) to total tourism expenditure in j destinations. The variable $\log q_{it}$ is the quantity demanded of one destination i in terms of its tourism price ($\Delta \ln q_i = \Delta \ln y - \Delta \ln p_i$). The effective relative price of tourism in each destination (the same destinations that were used in i subscript) is denoted by $\Delta \ln p_{it}$. The *expenditure* variable (calculated as the finite change version of the Divisia quantity index known as the Tornqvist-Theil Divisia quantity index) is generated by $\Delta \ln y - \Delta \ln P$ where y (also x : see Section 2.3.2) is the total expenditure and P the Divisia price index, furthermore D shows the dummy variables. In this research, there are four dummy variables that are taken into account. The first dummy variable is *Db* (see Table 3.1 for notation) that attempts to capture the effect of the lead up to the recession of 2008, which is defined as 1 for the four quarters of 2007, which had abnormally high tourist figures, and 0 for all the other periods. The other three dummies, *Dst*, *Dsd* and *Dsf* (see Table 3.1 for notation) are seasonal dummies to observe whether there are any noticeable seasonal noticeable trends by tourists from the UK and the USA.

The steps that will be followed regarding the empirical analysis are as follows: The pre-modelling analysis will be discussed first and this encompasses the study of the presence of unit roots in the data and the co-integration relationship among the variables. Secondly, the Rotterdam model is estimated for both USA and UK tourists.

Thirdly, the theoretical restrictions of homogeneity and symmetry are examined in terms of their application to the Rotterdam models. If these restrictions are found to be acceptable, the restricted Rotterdam model will be estimated. Fourthly, the expenditure, price and cross-price elasticities are estimated as they are highly pertinent in policy application. In the next chapter, the AIDS model will be estimated and compared to the Rotterdam model.

3.3 Pre-modelling analysis

Before the model can be estimated, an analysis of the data needs to be carried out to ensure that all data is stationary. According to Asteriou and Hall (2007:231), a time series can be said to be weakly stationary when it adheres to the following three characteristics:

- Displays mean reversion in that it varies around a constant long-run average.
- Shows limited variance that is time-invariant.
- Contains a theoretical correlogram that reduces as the lag length increases.

In the simplest mathematical form, a time series can be said to be weakly stationary when: (Asteriou and Hall, 2007:231)

- $E(Y_t) = \text{constant for all } t$.
- $Var(Y_t) = \text{constant for all } t$.
- $Cov(Y_t, Y_{t+k}) = \text{constant for all } t \text{ and all } k \neq 0$, or if the mean, variances or covariances remain constant over time.

Asteriou and Hall (2007:231) explain that stationarity is important because a non-stationary series, when used in regression analysis, will lead to spurious results and therefore the results are not valid. They also added that, with a stationary time series, shocks will be temporary over time, which means that the effect of the shock will diminish in the long run. This would not be the case if the time series is not stationary.

A unit root can be eliminated from a time series by first differencing a time series and test for stationarity in the first difference. A series is said to be integrated of the order 1 or I(1) if it is stationary after being first differenced. If the time series is still not

stationary it should be differenced again and if it is then found to be stationary it is said to be integrated of order 2 or I(2).

To test for unit roots, a variety of tests is available. One of the most common tests is the Augmented Dickey Fuller (ADF) test and it will also be used in this analysis. The null hypothesis of the ADF is that the time series has a unit root A rejection of the null hypothesis means that the time series is stationary.

The test was applied to the weights of tourists' expenditure for the USA and the UK, the logarithm of the tourism price and the logarithm of the overall expenditure variable of USA tourists in the countries. Table 3.2 and 3.3 show the ADF test results with the test assumptions of no intercept and with an intercept in both level and first difference form. Table 3.2 reports the results for USA tourists and Table 3.3 reports the results for UK tourists.

Table 3.2 ADF results for countries' weight, logarithm of the price and logarithm of expenditure – USA tourists

Weight	ADF(level) No Intercept	ADF(level) Intercept	ADF(1 st difference) No Intercept	ADF(first difference) Intercept
	Probability	Probability	Probability	Probability
Wita	0.0000**	0.0004**	-<0.0001**	-<0.0001**
Lnnpita	0.7072	0.9308	<0.0001**	0.0016**
Wmal	0.0000**	0.0007**	-<0.0001**	-<0.0001**
Lnpmal	0.2301	0.7079	<0.0001**	<0.0001**
Wnz	0.0000**	0.0009**	-<0.0001**	-<0.0001**
Lnnpnz	0.2879	0.5276	<0.0001**	0.0026**
Wsa	0.0000**	0.0009**	-<0.0001**	--<0.0001**
Lnpsa	0.8838	0.0406**	<0.0001**	-<0.0001**
Wspa	0.0000**	0.0004**	-<0.0001**	-<0.0001**
Lnpspa				

	0.7623	0.9060	<0.0001**	<0.0001**
Wuk	0.0000**	0.0003**	-<0.0001**	-<0.0001**
LnpuK	0.6187	0.5379	<0.0001**	<0.0001**
Expenditure	0.0000**	0.0002**	-	-

** indicates the series as stationary at the 5 % level. The bold values are for the variables that is used in the equation(3.4).

Table 3.3 ADF results for countries' weight, logarithm of the price and logarithm of expenditure – UK tourists

Weight	ADF(level) No Intercept	ADF(level) Intercept	ADF(1 st difference) No Intercept	ADF(first difference) Intercept
	Probability	Probability	Probability	Probability
Wita	0.0542	0.0749	<0.0001**	<0.0001**
Lnnpita	0.3245	0.9979	<0.0001**	0.0004**
Wmal	0.0564	0.2087	<0.0001**	<0.0001**
Lnpmal	0.5661	0.5163	0.0061**	0.0694
Wnz	0.0965	0.0920	<0.0001**	<0.0001**
Lnnpnz	0.3326	0.8911	0.0000**	0.0006**
Wsa	0.0000**	0.0000**	-<0.0001**	-<0.0001**
Lnpsa	0.9447	0.2851	<0.0001**	0.0005**
Wspa	0.0323**	0.0922	-<0.0001**	<0.0001**
Lnpspa	0.4133	0.9884	<0.0001**	0.0004**
Wusa	0.0000**	0.0000**	-<0.0001**	-<0.0001**
Lnpusa	0.6182	0.6382	<0.0001**	0.0002**

Expenditure	0.0647	0.0680	<0.0001**	<0.0001**
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** indicates the series as stationary at the 5 % level. The bold values are for the variables that is used in the equation(3.4).

As stated above, the null hypothesis of the ADF test is that the variable has a unit root. In this study, a five per cent significance level will be used, which means that the unit root cannot be rejected if the probability (p) > 0.05. The ADF test shows most of the weights as reported in Table 3.2 and Table 3.3 are stationary at a five per cent level with the weights of New Zealand and Malaysia and Italy being the exceptions in Table 3.3. The expenditure variable is stationary at a five per cent level for USA tourists but not for UK tourists, even though the margin is very close. Thus it can be said that these variables are integrated of order zero ($I(0)$). All the logarithm of price data as reported in Table 3.2 and Table 3.3 are non-stationary, when assuming there are no intercepts. When first differences are taken, the null hypothesis can be rejected, indicating stationarity in the first differences, meaning that the variables are integrated of order one ($I(1)$). After first differencing the two non-stationary time series indicated in Tables 3.2 and 3.3, it shows that the data in Table 3.2 is stationary ($I(1)$) for both the models using no intercept and an intercept. Table 3.3, when first differenced shows that all the variables that were not stationary of order $I(0)$ are stationary of order $I(1)$ when using the ADF test without an intercept and with an intercept.

With the dependent and expenditure variables being integrated of order zero $I(0)$, and the logarithm of price variables being integrated of order one ($I(1)$), it is not applicable to test for co-integration and therefore this will not be discussed further in the Rotterdam model part of the study².

Due to the data properties of the dependent variable being stationary in $I(0)$, the unrestricted Rotterdam model can now be estimated for both USA and UK tourists.

²Since all variables are not integrated of the same order, the possibility of co-integration amongst the variables was explored using the bound test procedure. The results of this procedure were unsatisfactory.

3.4 Unrestricted Rotterdam models

As previously mentioned, the Rotterdam model is a system of equations model. The method that is used to obtain the estimates is the seemingly unrelated regression (SUR). According to Moon and Perron (2006) the SUR can be used when a system of equations contains several individual relationships because their disturbance term is correlated. According to the authors, there are two main advantages in using the SUR method. The first is to gain efficiency in estimation by combining information in different equations and, secondly, the equation can impose/test restrictions that involve parameters in different equations. This method is preferred over the ordinary least squares method (OLS), because according to Cortés-Jiménez *et al* (2009) the SUR is more efficient at estimating a system of equations model than OLS because of the property of the SUR in estimating individual relationships between variables.

The estimated results are obtained using EViews 7 econometric software and are shown in Table 3.4 for UK tourists and Table 3.5 for USA tourists respectively. The t-statistic is the value in parentheses.

Table 3.4 Unrestricted Rotterdam model for UK tourists

	Italy	Malaysia	South Africa	Spain	USA
C	-0.002395 (-1.287832)	0.000474 (2.101155)	0.000501 (0.844466)	-0.008545 (-1.328312)	0.004211 (1.577097)
$\Delta \ln P$ Italy	0.304662*** (3.336118)	0.013721 (1.238174)	0.036645 (1.256944)	1.258148*** (3.981823)	0.159720 (1.217949)
$\Delta \ln P$ Mal	-0.014150 (-0.450010)	-0.015680*** (-4.109468)	-0.006378 (-0.635363)	0.009188 (0.084454)	0.019578 (0.433581)
$\Delta \ln P$ SA	-0.004844 (-0.646813)	0.002715*** (2.987435)	-0.030625*** (-12.80981)	-0.003125 (-0.120597)	0.006805 (0.632798)
$\Delta \ln P$ SPA	-0.321084*** (-3.532990)	-0.003180 (-0.288400)	-0.015182 (-0.523279)	-1.319131*** (-4.195068)	0.047419 (0.363350)
$\Delta \ln P$ USA	0.044908 (1.637842)	0.002733 (0.821292)	0.021795** (2.489879)	0.114813 (1.210222)	-0.193001*** (-4.901740)
$\Delta \ln P$ NZ	0.005351 (0.401611)	0.001062 (0.656826)	0.008390* (1.972450)	-0.012161 (-0.263775)	-0.013736 (-0.717886)
Expenditure	0.150212*** (11.19493)	0.016358*** (10.04676)	0.035712*** (8.337162)	0.529834*** (11.41260)	0.223793*** (11.61471)
Db	0.001018 (0.610302)	0.000272 (1.340802)	0.000408 (0.765119)	0.001286 (0.222779)	0.000191 (0.079503)
Dst	0.006322* (1.936948)	-1.88E-05 (-0.047567)	0.001485 (1.425085)	0.021190* (1.876306)	-0.003237 (-0.690572)
Dsd	0.001170 (0.785428)	-0.001088*** (-6.021572)	-0.002068*** (-4.349848)	0.003018 (0.585663)	-0.006048*** (-2.828043)
Dsf	0.007065** (2.478280)	-0.000257 (-0.742621)	-0.000160 (-0.176189)	0.019087* (1.935132)	-0.003573 (-0.872896)
R ²	.952265	0.944917	0.926688	0.958532	0.963171

R ² -adjusted	0.935327	0.925371	0.900674	0.943817	0.950102
DW-Stat	2.678807	2.813017	2.356195	2.768456	3.115586

*** = 1% significance level; ** = 5% significance level; * = 10% significance level.

From Table 3.4, it is evident that the expenditure variable is positive and significant for the countries, which is as expected since, if income increases, expenditure would also increase. This, is a normal good according to economic theory. It is also evident that, in all the countries, their own-price variable is significant, which is also to be expected since an increase in prices would lead to a decrease in demand according to demand theory. In all cases except Italy, the own-price variable is negative which indicates whether if the price increases, the demand decreases. In the Italian case, the price variable is positive which might indicate a substitution effect between Italy and Spain. This will be examined when the elasticities are calculated (See Section 3.7.3). Other variables that are significant include some of the seasonal dummies which is to be expected since the countries that were chosen are in different hemispheres and climates. The dummy variable that was inserted was inserted to account for the abnormal year that was 2007 in terms of abnormally high travel and was not significant for any country. This dummy variable also accounts for the start of the recession of 2008. The insignificance of the dummy variable could be attributed to the data that ends in 2009 as the full effect of the shock had not been realised by then. Further investigation is needed to confirm this hypothesis. The models all show a very high R-squared statistic and the Durbin-Watson statistics are within the acceptable level.

Table 3.5 Unrestricted Rotterdam model for USA tourists

	Italy	Malaysia	South Africa	Spain	UK
C	-0.000927 (-0.841833)	2.11E-05 (0.245157)	-8.42E-05 (-0.628747)	0.000463 (1.132916)	1.23E-05 (0.009928)
$\Delta \ln P$ Italy	-0.207238** (-2.338905)	-0.001144 (-0.165266)	0.002173 (0.201720)	-0.044375 (-1.350451)	0.210563** (2.109388)
$\Delta \ln P$ Mal	0.022554 (0.707406)	-0.019093*** (-7.663150)	-0.007110* (-1.834320)	0.007758 (0.656145)	-0.009837 (-0.276524)
$\Delta \ln P$ SA	0.011306 (1.505064)	0.001029* (1.752060)	-0.020370*** (-22.30532)	0.007734*** (2.776341)	0.003021 (0.357000)
$\Delta \ln P$ SPA	0.005444 (0.062254)	0.012289* (1.798087)	0.007520 (0.707239)	-0.048808 (-1.504857)	0.026099 (0.264886)

$\Delta \ln P_{UK}$	0.094381*** (5.734095)	0.011382*** (8.848544)	0.008401*** (4.198338)	0.050221*** (8.227565)	-0.195136*** (-10.52329)
$\Delta \ln P_{NZ}$	0.013813 (1.123901)	0.000111 (0.115467)	-0.000158 (-0.106027)	0.001913 (0.419670)	0.006824 (0.492827)
Expenditure	0.291072*** (12.74639)	0.025160*** (14.09869)	0.019936*** (7.180675)	0.119326*** (14.09038)	0.480032*** (18.65903)
Db	0.001881 (1.163214)	-3.13E-05 (-0.247384)	-8.81E-05 (-0.448439)	-0.000202 (-0.336806)	-0.001242 (-0.682129)
Dst	0.003548* (1.947666)	-0.000265* (-1.862662)	-7.55E-05 (-0.340805)	-0.001533** (-2.269685)	-0.001812 (-0.883140)
Dsd	0.001381 (1.046883)	3.39E-05 (0.328857)	0.000168 (1.0499726)	0.000135 (0.276524)	-0.001433 (-0.964079)
Dsf	0.000964 (0.577202)	-0.000111 (-0.850253)	5.30E-05 (0.261050)	-0.001061* (-1.712837)	0.000385 (0.204292)
R ²	0.973801	0.926166	0.966069	0.979791	0.984300
R ² -adjusted	0.964505	0.899967	0.954029	0.972621	0.978730
DW-Stat	1.428681	2.604040	1.731174	2.120348	1.553747

*** = 1% significance level; ** = 5% significance level; * = 10% significance level.

The findings of Table 3.5, i.e. the demand of USA tourists for destinations are very similar to those found in Table 3.4. The expenditure variable is significant for all the countries. It is interesting to note that the price variable of the UK is significant for all countries; the model shows that the UK is a substitute for all the destinations visited by USA tourists. As in Table 3.4, the own-price variables are also significant except for Spain. Some of the seasonal dummies are also significant and negative as expected showing the seasonal aspect of travelling to different countries in different hemispheres. The models all have a very high R-squared statistic and the Durbin-Watson statistics are mixed with some models being in the acceptable level above 2 and the countries below 2 being in the inconclusive zone, which is around 1.4 and 1.5.

3.5 Testing model restrictions

In the previous chapter, the properties of demand were explained, two of those properties, homogeneity and symmetry, can be imposed in the models if it can be ascertained that the restrictions fail to satisfy the null hypothesis. This means that, if the null hypothesis is satisfied, the data is homogenous and symmetric. The Wald-test is used to establish whether the restrictions satisfied the null hypothesis. The results are presented in Tables 3.6 and 3.7 respectively. The significance determines whether the restrictions are adhered to or violated. A five per cent level of significance is used in the null hypothesis: If $p \leq 0.05$ the null hypothesis can be rejected that the variables are homogenous and symmetric, and if $p > 0.05$ the null hypothesis cannot be rejected that the variables are homogenous and symmetric. If the null hypothesis can be rejected, the restricted version of the model must be estimated to conform to microeconomic theory.

Table 3.6 Wald test for Homogeneity, Symmetry and Combined for UK tourists – Rotterdam model

	Homogeneity	Symmetry	Combined
Chi-Squared (probability)	4.8597 (0.433)	27.9678*** (0.002)	39.1707*** (0.001)

***: Indicates 5% significance level.

Table 3.7 Wald test for Homogeneity, Symmetry and Combined for USA tourists – Rotterdam model

	Homogeneity	Symmetry	Combined
Chi-Squared (probability)	33.8425*** (0.000)	197.3086*** (0.000)	247.0907*** (0.000)

***: Indicates 5% significance level.

From Table 3.6 one cannot reject the null hypothesis that homogeneity is present, but can reject the null hypothesis in symmetry and combined. Table 3.7 shows that the null hypothesis can be rejected for homogeneity, symmetry and both. Following from theory (See Section 2.3.2) the homogeneity and symmetry restrictions are imposed and the models are re-estimated. This means that a restricted Rotterdam model is estimated for both UK and USA tourism demand.

3.6 Restricted Rotterdam models

The estimates of the UK and USA restricted models are presented in Tables 3.8 and 3.9 respectively. The estimations were obtained using the econometric software MICRO-FIT 4.1. The estimated parameters, the R-squared and Durbin-Watson statistics (DW) for the restricted models imposing homogeneity and symmetry simultaneously, are given in Tables 3.8 and 3.9, with t-statistics shown in parentheses.

Table 3.8 Restricted Rotterdam model UK Tourists

	Italy	Malaysia	South Africa	Spain	USA
C	-0.3293E-3 (-0.16777)	0.5172E-3** (2.3476)	0.9730E-3 (1.6582)	-0.2946E-3 (-0.042320)	0.0055111** (2.1484)
$\Delta \ln P$ Italy	-0.017194*** (-5.3087)	0.0092621 (1.1237)	0.0032930 (0.73489)	-0.0082664 (-1.4280)	0.010964 (1.4393)
$\Delta \ln P$ Mal	-0.023315** (-2.1029)	-0.017194*** (-5.3087)	0.0021600* (1.7901)	0.0020195** (2.4105)	0.4752E-3 (0.058033)
$\Delta \ln P$ SA	-0.0082664 (-1.4280)	0.0020195** (2.4105)	-0.030855*** (-12.9359)	-0.011441 (-0.59078)	-0.0060516 (-0.73839)
$\Delta \ln P$ SPA	0.010964 (1.4393)	0.4752E-3 (0.058033)	0.0060071 (1.0942)	-0.0060516 (-0.73839)	0.18069*** (11.9905)
$\Delta \ln P$ USA	0.034518** (2.7104)	0.0032770 (1.1267)	0.012987*** (3.5899)	0.054595* (1.7877)	-0.19208*** (-12.8785)
$\Delta \ln P$ NZ	0.0032930 (0.73489)	0.0021600* (1.7901)	0.0064079* (1.7987)	-0.030855** (-12.9359)	0.0060071 (1.0942)
Expenditure	0.15081*** (10.5068)	0.016335*** (10.5230)	0.031647*** (7.4711)	0.53074*** (10.4111)	0.22266*** (11.9423)
Db	0.3843E-3 (0.20796)	0.2506E-3 (1.2353)	0.5066E-3 (0.92652)	0.8024E-3 (-0.12256)	-0.1717E-3 (-0.071429)
Dst	0.0011275 (0.34055)	-0.1075E-3 (-0.28709)	0.5147E-3 (0.52209)	0.6820E-3 (0.057905)	-0.0059648 (-1.3800)
Dsd	0.8024E-3 (0.48598)	-0.0010957*** (-6.0503)	-0.0021646*** (-4.4024)	0.0013467 (0.22994)	-0.0063927*** (-2.9719)
Dsf	0.0030016 (1.0686)	-0.3157E-3 (-0.97367)	-0.0011518 (-1.3837)	0.0027536 (0.27649)	-0.0056364 (-1.5418)
R ²	0.93419	0.94250	0.91333	0.93926	0.95821
DW-Stat	2.8972	2.7013	2.2074	2.9616	2.9796

*** = 1% significance level; ** = 5% significance level; * = 10% significance level.

From Table 3.8, it can be seen that the own-price of every country is negative and significant except for Spain. This is in line with economic theory that when the price increases, demand decreases. The coefficients of the price variables ($d \ln P = c_{ij}$) are as follows: c_{ij} measures the absolute change in the i^{th} expenditure share following a unit proportional change in the price of the destination country with

everything else constant. For illustrative purposes, if the USA increased its effective price by 1%, it will decrease the USA's budget share by 0.19 percentage points, keeping everything else constant. The USA is also a substitute for UK tourists for all countries except Malaysia.

The expenditure variable is also positive and significant for all the countries, which means that these countries have all seen that a rise in income/expenditure from UK tourists increases the demand for the destinations. Tourism is therefore a normal good. From the dummies, the only significant dummy is the season dummy (Dsd) which is the dummy for the third quarter of the year. This variable is significant for Malaysia, South Africa and United States, and in all three instances negative, which shows the seasonal aspect of tourism. The seasonal aspect can be explained due to the third quarter coinciding with the end of South Africa's winter, the tropical storm season in Malaysia and the summer in Europe and North America. The Durbin-Watson statistics fall in the acceptable level which means no serial correlation in the residuals (De Mello *et al.* 2002).

Table 3.9 Restricted Rotterdam model

	Italy	Malaysia	South Africa	Spain	UK
C	-0.3259E-4 (-0.023869)	0.1519E-3 (1.3113)	0.6989E-4 (0.49168)	0.0022394** (2.2383)	-0.6324E-3 (-0.39214)
Δ In P Italy	-0.024200*** (-20.4557)	0.0047144 (1.2494)	-0.0010081 (-0.12781)	0.0042181 (.44700)	-0.064161*** (-4.4981)
Δ In P Mal	0.022609** (2.5960)	-0.024200*** (-20.4557)	-0.0016379*** (-2.7518)	0.9923E-3 (1.2342)	0.014124*** (3.8377)
Δ In P SA	0.0042181 (0.44700)	0.9923E-3 (1.2342)	-0.020796*** (-21.9663)	0.0031161 (0.45070)	0.0085384 (0.77872)
Δ In P SPA	-0.064161*** (-4.4981)	0.014124*** (3.8377)	0.018049** (2.3903)	0.0085384 (0.77872)	0.17323*** (6.0462)
Δ In P UK	0.062542*** (4.3156)	0.0060081*** (5.1211)	0.0067422*** (4.4976)	0.0039314 (0.55596)	-0.14978*** (-9.9269)
Δ In P NZ	-0.0010081 (-0.12781)	-0.0016379*** (-2.7518)	-0.0013490 (-0.99006)	-0.020796*** (-21.9663)	0.018049** (2.3903)
Expenditure	0.32523*** (23.1000)	0.022524*** (17.1963)	0.023422*** (17.0189)	0.12333*** (12.8426)	0.44764*** (29.1914)
Db	0.0035958 (1.6757)	0.3212E-4 (0.17608)	0.7023E-4 (0.33437)	0.0012189 (0.75615)	-0.0031048 (-1.2452)
Dst	0.0025755 (1.3792)	-0.5320E-3*** (-3.2838)	-0.3212E-3 (-1.4923)	-0.0046832*** (-3.4707)	-0.0013977 (-0.62355)
Dsd	0.7479E-3 (0.41909)	-0.1497E-4 (-0.098988)	0.6402E-4 (0.36414)	-0.7588E-3 (-0.56966)	-0.8686E-3 (-0.41811)

Dsf	0.9361E-3 (0.51737)	-0.2101E-3 (-1.3308)	-0.1524E-3 (-0.76466)	-0.0027576** (-2.0454)	-0.4102E-3 (-0.19172)
R ²	0.94706	0.82432	0.95573	0.82968	0.96592
DW-Stat	2.0717	1.4326	2.0204	1.5985	2.1365

*** = 1% significance level; ** = 5% significance level; * = 10% significance level.

In Table 3.9, it is shown that the own-price coefficients are negative and significant in line with demand theory for all countries except for Spain where it is positive again and insignificant. This might be attributed to Spain being a substitute destination for other European countries. The coefficients of the price variables ($d \ln P = c_{ij}$) are as follows: c_{ij} measures the absolute change in the i^{th} expenditure share following a unit proportional change in the price of the destination country with everything else constant. For illustrative purposes, if the UK increased its effective price by 1%, it will decrease the UK's budget share by 0.15 percentage points, keeping everything else constant. The UK is, as in the unrestricted model, a substitute for the USA tourists for most of the destinations except Spain.

As with Table 3.8, the expenditure coefficients are all positive and significant indicating that an increase in income/expenditure will lead to an increase in demand, which shows that the destinations are normal goods. The only dummy that is significant is the seasonal dummy for the second quarter of the year. This shows that USA tourists have a significant negative reaction to visiting Spain and Malaysia during the second quarter of the year, relative to the first quarter. There is mixed evidence in the Durbin-Watson statistics with the statistics ranging between the inconclusive and acceptable range which shows no signs of serial correlation between the residuals.

The next section turns to determining elasticities based on p expenditure, uncompensated own- and cross-price elasticities.

3.7 Calculation of Elasticities

According to De Mello *et al.* (2002), the reason for estimating elasticities is to quantify the sensitivity of tourism demand to changes in expenditure or income (expenditure elasticities), prices in the country the tourist wants to visit (own-price

elasticities) and prices in alternative destinations under consideration (cross-price elasticities).

3.7.1 Expenditure Elasticities

Firstly, the expenditure elasticity is calculated using the results of the estimation that was provided by the restricted Rotterdam model (See Section 2.3.2 for the equations to calculate the elasticities). Both the expenditure elasticities for UK and USA tourists are shown in Tables 3.10 and 3.11 respectively. The expenditure elasticity is calculated as was explained in Chapter 2. The equation is the same as (2.26).

$$\eta_i = \frac{1}{w_i} \frac{dw_i}{d \ln x} = \frac{\beta_i}{w_i} \quad (3.5)$$

Table 3.10 Expenditure elasticities for UK tourists – Rotterdam model

Country	Italy	Malaysia	South Africa	Spain	USA
η	0.979613**	1.076875**	1.119309**	0.979892**	0.913749**

** = indicates significant at 0.05 per cent level.

Table 3.11 Expenditure elasticities for USA tourists – Rotterdam model

Country	Italy	Malaysia	South Africa	Spain	UK
η	0.868391**	1.373636**	1.081613**	0.828916**	1.07483**

** = indicates significant at 0.05 per cent level.

From the above tables, it is evident that the expenditure elasticities are all positive. This means that, for UK and USA tourists, none of the destinations is 'inferior' because the shares increase with the real expenditure per capita. They are therefore all normal destinations.

From Table 3.10, it is evident that all of the elasticities are close to unity, but some distinctions can be made. For UK tourists it shows that Italy, Spain and the USA are slightly less than unity which describes 'necessary' goods in terms of tourist vacations. It can be concluded that these destinations are relatively close to the UK and less expensive than other long haul destinations. Thus if there is an increase in income there would be a decrease in demand.

In the case of South Africa and Malaysia, the elasticity is greater than 1 which indicates that they are 'luxury' destinations. This claim can be substantiated by these two countries being long haul destinations and the cost would be more to get to

these destinations. A decrease in the UK tourist budget would mean that these destinations would be given up to be used for other purposes.

In Table 3.11 is evident that all of the elasticities are close to unity but, as with Table 3.10, some distinctions can be made. For USA tourists it is evident that Italy and Spain are 'necessities' in terms of tourist destinations. This can be due to the natural tourist attractions that these countries offer.

In terms of South Africa, Malaysia and the UK, it can be said that these destinations are 'luxury' destinations. The same long haul argument can be put forward in the case of South Africa and Malaysia as with Table 3.10, but the elasticity of the UK is surprising. This can be ascribed to the UK being an expensive destination or it could be ascribed to the preference of the tourists.

3.7.2 Uncompensated Own- and Cross-Price Elasticities

Demand theory suggests that own-price elasticities should be negative as this will indicate that increases in price will lead to a reduction in demand. In this study, only the uncompensated elasticities are estimated since De Mello *et al.* (2002) state that uncompensated elasticities focus on the real reaction of the dependent variable to changes in prices. This is useful, because it supplies more clear and direct information about the behaviour of demand. This feature of the uncompensated elasticities makes it more viable for policy purposes. The difference between compensated and uncompensated elasticities was discussed when comparing the Hicksian and Marshallian demand functions. (Sections 2.2.1 and 2.2.2).

The Hicksian demand is called the compensated demand due to it being constructed by varying prices and income with the aim of keeping the consumer at a fixed level of utility. The Marshallian demand is called the uncompensated demand because of its observable variables price and income. The utility that destination will offer a person is directly observable by price and income/expenditure.

With regard to cross-price elasticities, positive and negative signs show substitutability and complementarity between the tourism destinations considered, respectively. The cross-price elasticities indicate the competitor's position regarding price changes in a destination.

The own-price elasticities were calculated using the following equation, the same as (2.27):

$$\varepsilon_{ij} = \frac{1}{w_i} \frac{dw_i}{d \ln p_i} - 1 = \frac{\gamma_{ii}}{w_i} - \beta_i \frac{w_i^\beta}{w_i} - 1 \quad (3.6)$$

The cross-price elasticities were calculated using the following equation, the same as (2.28):

Table 3.12 Uncompensated Own- and Cross-Price elasticities for UK tourists – Rotterdam model

	Italy	Malaysia	South Africa	Spain	USA
Italy	-1.2625**	-0.16631**	-0.08139**	0.043521**	-0.01449
Malaysia	0.444815**	-2.14984**	0.102687**	0.00088	-0.04638**
South Africa	-0.05585**	0.059417**	-2.12294**	0.180816**	0.186581**
Spain	-3.18222**	-0.21332**	-0.93539**	-1.54191**	-2.64325**
USA	-0.09568**	-0.01191	-0.05067**	0.715678**	-2.01092**

** = indicates significant at 0.05 per cent level.

The UK tourists' own-price elasticities show that they are sensitive to price change. For example, the figures show that a one per cent increase in prices in Italy will lead to a decrease of 1.26 per cent in UK tourism demand for Italy. In terms of South Africa, a one per cent increase will lead to a 2.13 per cent decrease in tourism demand from the UK.

In terms of cross-price elasticities, it can be seen that most of the countries compete on prices. Positive signs mean that a country is a substitute for another country. For example, if South Africa's tourism price increases by one per cent, the USA gains 0.18 per cent in demand. On the other hand, it seems that South Africa and Italy are complementary destinations with an increase of one per cent in the tourism price of South Africa being consistent with a 0.05 per cent decrease in tourist demand to Italy. It is also interesting to note that a one per cent increase in the tourism price in

Spain is associated with a 3.18 per cent decrease in tourism demand for Italy by UK tourists, and the same increase in prices by the USA would be consistent with a 0.71 per cent increase in demand for Spain as a tourism demand from UK tourists. These increases and decreases in demand can be attributed to economic conditions and personal preferences, as the elasticities are statistically significant but no economic reason can be given for the said elasticities. According to De Mello *et al.* (1999) the interpretation of the elasticities on their own does provide some information on tourist behaviour but in order to estimate more accurate elasticities more should be done, in terms of, provision of further information both economic and non-economic. With more information more accurate elasticities would be able to be estimated.

Table 3.13 Uncompensated Own- and Cross-Price elasticities for USA tourists – Rotterdam model

	Italy	Malaysia	South Africa	Spain	UK
Italy	-1.38985**	0.046129	-0.00754	-0.30052**	-0.19497**
Malaysia	-0.22694**	-2.49837**	0.03077**	0.656982**	-0.20568**
South Africa	-0.45164**	-0.09337**	-1.98377**	0.672564**	-0.13911**
Spain	-0.2821**	-0.00692	0.02994	-1.06594**	-0.3188**
UK	-0.5566**	0.016289**	-0.00277	0.256025**	-1.80728**

** = indicates significant at 0.05 per cent level.

The USA tourists' own-price elasticities show that they are also sensitive to price change similar to UK tourists. For example, the numbers show that a one per cent increase in prices in Italy is associated with a decrease of 1.39 per cent in USA tourism demand for Italy. In terms of South Africa, a one per cent increase is consistent with a 1.98 per cent decrease in tourism demand from the UK.

In terms of cross-price elasticities, it can be seen that most of the countries compete on price. Positive signs mean that a country is a substitute for another country. For example, if South Africa's tourism price increases by one per cent, it is associated with a 0.45 per cent decrease in demand in Italy and a 0.67 increase in tourism to Spain from the USA. Quite significant is that a one per cent increase in the tourism price in Italy is consistent with a 0.31 per cent decrease in demand for Spain from USA tourists. In terms of complementary destinations, if the UK prices increase by one per cent it is associated with a 0.25 per cent increase in demand for Spain as a tourist destination by USA tourists. These increases and decreases in demand can be attributed to economic conditions and personal preferences, as the elasticities are statistically significant but no economic reason can be given for the said elasticities. According to De Mello *et al.* (1999) the interpretation of the elasticities on their own does provide some information on tourist behaviour but in order to estimate more accurate elasticities more should be done, in terms of, provision of further information both economic and non-economic. With more information more accurate elasticities would be able to be estimated.

There are several implications for South Africa that can be observed from the introduction (Chapter 1). It was said that South Africa increased tourism by ten per cent every year. From Figures 3.1 to 3.4 it can be seen that South Africa has not had the same increase from long haul tourists (UK and USA). The expenditure elasticities show that South Africa is bordering on being a 'luxury' destination for UK and USA tourists. According to the own-price elasticities, South Africa can expect a two per cent decrease in tourism should the South African price rise by one per cent. This is significant in that, if South Africa cannot manage its inflation, many tourists will not come to South Africa according to the elasticities derived from the Rotterdam model. The elasticities suggest that South Africa should keep its prices stable in order for tourists to come to South Africa. This is also significant in that tourism price inflation may be higher than average South African inflation and thus have a bigger impact on the tourism market.

It is important in a South African context to understand the effect that price changes have on the demand for South Africa by the UK and the USA. With the tourism

industry playing an important role in South Africa's economy, it can explain the effect on tourism when prices change.

3.8 Conclusion

In this chapter, the focus was on the Rotterdam model and the way it is used to estimate tourism demand and elasticities. The chapter started with an introduction discussing why the Rotterdam model was chosen to estimate tourism demand. The model specification was discussed with the Rotterdam model that was used in this study evolving from equation 2.20 in Chapter 2

The variables that were used were introduced as well as the way they were calculated and the countries that were used in the study. The data was also tested for unit roots and it was found that the data was stationary and the unrestricted Rotterdam model was estimated for both UK and USA tourists. It was also found that the own-price elasticities were negative in most cases which are supported by economic theory.

To establish whether the unrestricted Rotterdam model violates any of the properties of demand a Wald-test was done. This found that the model violated the homogeneity and symmetry restrictions of the properties of demand. These restrictions were imposed on the model and a new restricted model was estimated. With the restrictions being imposed, elasticities were estimated. The elasticities that were estimated were the expenditure, own-price and cross-price elasticities.

Chapter 4: Empirical Analysis of AIDS Model

4.1 Introduction

As was indicated in Chapter 1, the AIDS model with its system of equations has an advantage over single equation models because it can analyse the interaction of budget allocations for different groups or services. The AIDS model is also unique in that it has its basis in microeconomic consumer expenditure theory. Therefore it shows how demand is quantified as a function of consumers' expenditure budget and the relative prices of a set of goods and services they can purchase. In the case of tourism, it shows how tourists choose between alternative destinations based on their budget and the relative prices of destinations.

According to Chang, Khamkaew and McAleer (2010), the AIDS model is preferred to most demand models because the AIDS model includes a group of consumer goods. Estimating all the consumer goods at once allows this model to interpret tourists' allocation of expenditure on alternative destinations. This allows the AIDS model to potentially provide useful information about the sensitivity of tourism demand to changes in comparative prices and expenditure as well as interaction for competing destinations.

As was seen from Chapter 2, the AIDS model with its system of equations approach focuses on clarifying the changes in tourism expenditure, rather than changes in the levels of tourism demand. Han *et al.* (2006) state that the model assumes that consumption and labour supply are not linked. This is done to ensure that consumers' tourism budget shares do not fluctuate in accordance with their work time and effort. Section 2.4.3 reviewed the various applications of the AIDS model that have evolved over time.

The purpose of this chapter is to model tourism demand for South Africa for the UK and USA using the AIDS model, and to calculate the relevant elasticities from the model. While Chapter 3 was dedicated to the Rotterdam model, this chapter focuses on the AIDS model applied to tourism demand for South Africa. The elasticities derived from this model are the key to understanding how UK and USA tourists decide upon which destinations they are going to visit, based on their expenditure/income, exchange rate and tourism prices.

The chapter will proceed as follows: Firstly, the AIDS model will be reviewed outlining the variables that will be used as well as the model specification itself of the LA/AIDS. Secondly, the pre-modelling analyses are explained, which include unit root tests. If the data has unit roots present, a Johansen Co-integration Test will be performed to identify the presence of co-integration. If co-integration is present the LA/AIDS is not the correct model and the EC-AIDS model will have to be estimated. Thirdly, the unrestricted model will be estimated after which a Wald-test will be performed to test the homogeneity and symmetry restrictions. If the restrictions hold, it will be unnecessary to estimate the restricted model, otherwise the restricted model needs to be estimated. Finally, after the final model has been estimated, the elasticities will be calculated and a detailed description of them given before a conclusion is reached.

4.2 Model Specification

This model was estimated using quarterly data covering the period from the first quarter of 1999 to the fourth quarter of 2008. Tourism expenditure and arrivals for the countries in the model was obtained through Tourism New Zealand for New Zealand, the Office of Travel & Tourism Industries for USA arrivals, Tourism Malaysia Corporation for Malaysia, Statistics UK for the UK, Eurostat for Spain and Italy tourist arrivals and the World Bank for their expenditure data and Stats SA for the South African data.

Price data was obtained from the International Monetary Fund's (IMF) *Yearbook of International Financial Statistics*. The base year was 2000. The same source was used to obtain the various real exchange rate data for the countries.

One assumption that is made is that tourists from the UK and the USA allocate their budget expenditure between six main destinations. According to Cortés-Jiménez (2009) this is done because it is assumed that preferences in each group are not influenced by the demand in other groups. The empirical analysis will examine the interrelationships in the budgeting processes of the UK and USA's tourists and the demand for j destinations. These destinations are – for the UK – South Africa, Italy, Spain, New Zealand, Malaysia and the USA and – for the USA – South Africa, Italy, Spain, New Zealand, Malaysia and the UK.

The reason these destinations were chosen was because of their geographical importance. South Africa is the destination that is focused on, and New Zealand was chosen as another long haul destination in the Southern Hemisphere. The choice of Italy and Spain is based on the fact that they are the two countries in Europe that attract a lot of tourists from both the UK and the USA. Malaysia was chosen as a representative destination in the East and because, similarly to South Africa, it is experiencing growth in tourism. The other two countries – the UK and the USA – were chosen as they are popular destinations for USA and UK tourists respectively.

In Section 2.4.2 (equation 2.46), the basic AIDS model was described. It was indicated the LA/AIDS is the most popular demand system used in tourism demand and that it has the following functional form:

$$w_{it} = \sum_j c_{ij} \ln p_{jt} + b_i \ln \text{RexP} + \theta_{1i} Db + \theta_{2i} Dst + \theta_{3i} Dsd + \theta_{4i} Dsf + c_{it} \quad (4.1)$$

Where i represents the destination country, j denotes all the country destinations, t signifies time with the time being from 1999Q1 to 2008Q4 (Q meaning quarter). $\ln$ indicates that the variable is transformed in natural logarithms. Natural logarithms were taken to eliminate measurement problems.

As for the description of the variables, w_{it} shows the share of tourism expenditure assigned in destination i to total tourism expenditure in j destinations. The effective relative price of tourism in each destination is denoted by $\ln p_{jt}$ respectively. The ratio between UK and USA tourist expenditure and the Stone price index is given by (x/P^*) , and D shows the dummy variables. In this study, there are four dummy variables that are taken into account. The first dummy variable is Db that attempts to capture the lead up to the recession of 2008, which is defined as 1 for the four quarters of 2007, which had abnormally high tourist figures, and 0 for all the other periods. The other three dummies, Dst , Dsd , Dsf , are seasonal dummies to observe whether there are any noticeable trends by tourists from the UK and USA.

The rationale behind the tourism price was discussed and shown in Section 3.2 and the same principles apply to the AIDS model.

In this study, the real exchange rate, as tourism price index, is used, because the exchange rates are adjusted for inflation and this gives a better indication of how tourism is affected by the exchange rate than the nominal exchange rate (Chang *et al.*, 2010). The price index is the Stone Price index and is defined by:

$$\ln p^* = \sum_i w_{it} \ln p_{it} \quad (4.2)$$

This Stone price index is calculated from the sum of the weight of country i at time t , multiplied by the logarithm of the price (see equation 3.2).

Table 4.1 is a breakdown and summary of the all the variables that are in the AIDS model as well as a description of the variable, the data used and the source of the data.

Table 4.1 Summary of variables

Variable	Description	Data Used	Source
w_{it} [wita, wmal, wsa, wspa, wuk, wusa]	Shows share of tourism expenditure assigned in destination i to total tourism expenditure in j destinations.	Quarterly Arrival data from countries.	Tourism New Zealand. Stats SA. Office of Travel & Tourism Industries for the USA. Tourism Malaysia Corporation. Statistics UK.
$\Delta \ln p_{jt}$	Tourism Prices calculated by equation (3.1) and (3.2).	Inflation of the all the countries. Base year: 2005. Exchange rate of all the countries: Base year 2005.	IMF: <i>Yearbook of International Financial Statistics</i> .
$\ln RexP$	The natural logarithm of ratio between the UK and USA tourist expenditure and the Stone price index is given by (x/P^*) . The tourist expenditure is given by $\ln(\frac{\sum EXP_{it}}{POP_t^*})$, where $\sum EXP$ is the sum of total expenditure by USA (UK) tourists in the six destinations, POP is total number of tourists from USA (UK) and P^* is the Stone price index.	Sum of Expenditure by USA (UK) tourists. Total departures USA (UK) and the Stone Price index given by (4.1).	Tourism New Zealand. Stats SA. Office of Travel & Tourism Industries for the USA. Tourism Malaysia Corporation. Statistics UK.
Db	Structure dummy – to see the effect before the financial crisis.	1 = for the four quarters of 2007. 0 = all the other years.	
Dst	Seasonal dummy – second quarter effects.	1 = for second quarter. 0 = for all the other quarters.	
Dsd	Seasonal dummy – third quarter effects.	1 = for third quarter. 0 = for all the other	

		quarters.	
<i>Dsf</i>	Seasonal dummy – fourth quarter effects.	1 = for fourth quarter. 0 = for all the other quarters.	

The AIDS model shares a multi-stage budgeting approach, and consists of explaining variations in the shares of budget expenditure. In this research, a proxied variable is used to show budget shares which was constructed using total tourist expenditure of the two countries in question, the UK and the USA, dividing it by the total tourist receipts of the two countries in question, the UK and the USA, and then dividing this result by the total number of tourists from the respective countries and multiplying it by the number of tourists that went to the destinations in this study to obtain an average expenditure per capita on travels as done by Papatheodorou (2002). Paptheodorou (1999) states the AIDS model assumes the presence of a representative consumer. This study only uses aggregate data and, because the aggregate expenditure data is divided by a specific population, the average consumer expenditure is acquired.

The steps that will be followed in the empirical analysis are as follows: The data and pre-modelling analysis will be discussed first and it encompasses unit root analysis and co-integration. Secondly, the unrestricted model is estimated for both USA and UK tourists. Thirdly, the theoretical restrictions of homogeneity and symmetry are examined in terms of their application to the estimated models. If the models do not adhere to the restrictions, the restricted models will be estimated. Fourthly, the expenditure, price and cross-price elasticities will be calculated as they are highly pertinent in policy application. Finally, the AIDS and Rotterdam models (previous chapter) will be compared. This will be done to find out which model explains tourism demand more completely.

4.3 Pre-Modelling Analysis

In Section 3.3 the importance of testing for unit roots was discussed. If the time series is non-stationary, the shocks to the series will be permanent. Furthermore, the variance will depend on time and will go to infinity as time goes to infinity. As stated in Section 3.3 this leads to spurious results when estimating models with non-stationary data.

The Augmented Dickey Fuller test (See Section 3.3) is used to assess stationarity. All data series (as explained in Table 4.1) are subjected to the ADF test and the results are indicated in Tables 4.2 and 4.3 respectively.

Table 4.2 ADF results for countries' weight, logarithm of the price and logarithm of expenditure – USA tourists

Weight	ADF(level) No Intercept	ADF(level) Intercept	ADF(1 st difference) No Intercept	ADF(1 st difference) Intercept
	Probability	Probability	Probability	Probability
Wita	0.8026	0.0957	0.0005**	0.0085**
Lnrita	0.7072	0.9308	<0.0001**	0.0016**
Wmal	0.8787	0.9232	<0.0001**	0.0005**
Lnpmal	0.2301	0.7079	<0.0001**	<0.0001**
Wnz	0.8234	0.3506	0.0001**	0.0001**
Lnpsz	0.2879	0.5276	0.0001**	0.0026**
Wsa	0.9939	0.5268	0.0104**	0.0015**
Lnpsa	0.8838	0.0406**	<0.0001**	-
Wspa	0.6815	0.2461	<0.0001**	<0.0001**
Lnpspa	0.7623	0.9060	<0.0001**	<0.0001**
Wuk	0.3294	0.1056	0.0018**	0.0206**
Lnpuke	0.6187	0.5379	<0.0001**	0.0001**
InrexpUSA	0.0859	0.2394	<0.0001**	<0.0001**

** = indicates significant at 0.05 per cent level.

Table 4.3 ADF results for countries' weight, logarithm of the price and logarithm of expenditure – UK tourists

Weight	ADF(level) No Intercept	ADF(level) Intercept	ADF(1 st difference) No Intercept	ADF(1 st difference) Intercept
	Probability	Probability	Probability	Probability
Wita	0.9107	0.2076	0.0004**	0.0052**
Lnrita	0.3245	0.9979	0.0000**	0.0004**
Wmal	0.8946	0.9736	0.0098**	0.0752
Lnpmal	0.5661	0.5163	0.0061**	0.0694
Wnz	0.9627	0.7361	0.2374	0.0180**
Lnnpnz	0.3326	0.8911	<0.0001**	0.0006**
Wsa	0.8841	0.6120	<0.0001**	0.0003**
Lnpsa	0.9447	0.2851	<0.0001**	0.0005**
Wspa	0.6210	0.0214**	0.0018**	-
Lnpspa	0.4133	0.9884	<0.0001**	0.0004**
Wusa	0.3125	0.0091**	<0.0001**	-
Lnpusa	0.6182	0.6382	<0.0001**	0.0002**
InrexpUK	0.7504	0.0345**	0.0346**	-

** = indicates significant at the 5% level.

As stated in 3.3 the null hypothesis of the ADF test is that the variable contains a unit root. In this stud, a five per cent significance level will be used. This means that the unit root cannot be rejected if the probability (P) > 0.05, but it can be rejected if P < 0.05. Tables 4.2 and 4.3 show the probabilities that the weights, logarithm of price

and logarithm of expenditure data is non-stationary. The ADF test shows all of the weights in Tables 4.2 and Table 4.3 are non-stationary. All the logarithm of price data in Tables 4.2 and Table 4.3 are non-stationary, when assuming there are no intercepts. A co-integration test can be performed on this data to test for a long-run relationship between the data.

After first differencing the non-stationary time series indicated in Tables 4.2 and 4.3, it can be seen that the data is stationary. Therefore all variables are $I(1)$. Table 4.3, when first differenced shows that all the variables are stationary when using the ADF test without an intercept, the exception being the weight variable for New Zealand. The test was also run using an intercept and mixed results were found with the logarithm of price for Malaysia and the logarithm of expenditure for UK tourists where the probability was greater than 0.05.

Given the unit root results, the following step is to conduct a co-integration analysis. This is done to test whether the time series show a consistent long-run relationship between the variables or, in other words, whether they are jointly co-integrated. Asteriou and Hall (2007:319) indicate that the Johansen Co-integration Test must be used when there are more than two variables.

The statistics that are generated by the Johansen test are the trace and the maximal eigenvalue respectively. The aim of these statistics is to determine the number of co-integrating vectors. To interpret the model the use of ' r ' is important because it determines the number of co-integrating vectors. For example, if $r = 0$ then there are no co-integrating vectors. It is important to note that the two test statistics sometimes have conflicting results and do not always indicate the same number of co-integrating vectors.

Table 4.4 and 4.5 shows the co-integration results for both USA tourists and UK tourists where $r = 0$ means no integrating vectors, $r \leq 1$ means at least one co-integrating vector.

To select the appropriate number of lags to ensure white noise residuals, the Schwartz criterion was used and the appropriate lag length is 1 for all models.

Table 4.4 Johansen Co-integration Test results for the USA

Model 1: Italy = wita = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln pspa, \ln puk, \ln rexp)$ – 1 lag

Hypothesis	$r=0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	353.3254**	169.5991	230.8436**	134.6780
π max test	122.4818**	53.18784	70.07863**	47.07897

$$ECT_i = WITA - (1.88)*LNPITA + (0.09)*LNPMAL + (0.09)*LNPNZ - (0.08)*LNPSA + (1.98)*LNPSPA - (0.12)*LNPUK - (0.001)*LNREPUSA + 0.3452$$

(-1.57) (0.19) (0.38) (-1.08) (1.57) (-0.50) (-0.62) (0.45)

Model 2: Malaysia = wmal = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln pspa, \ln puk, \ln rexp)$ – 1 lag

Hypothesis	$r=0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	298.7817**	169.5991	214.7541**	134.6780
π max test	84.02755**	53.1874	68.3217**	47.07897

$$ECT_{mal} = WMAL - (0.02)*LNPITA - (0.02)*LNPMAL - (0.003)*LNPNZ + (0.004)*LNPSA + (0.01)*LNPSPA + (0.02)*LNPUK + (2.17e-06)*LNREPUSA + 0.0508$$

(-0.22) (-0.63) (-0.14) (0.61) (0.11) (1.03) (0.48) (0.80)

Model 3: South Africa = wsa = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln pspa, \ln puk, \ln rexp)$ – 1 lag

Hypothesis	$r=0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	304.7966**	169.5991	83.74930**	53.18784
π max test	221.0473**	134.6780	70.7892**	7.07897

$$ECT_{sa} = WSA + (0.02)*LNPITA + (0.003)*LNPMAL - (0.007)*LNPNZ + (0.007)*LNPSA - (0.03)*LNPSPA - (0.0004)*LNPUK + (1.1e-06)*LNREPUSA + 0.0028$$

(0.43) (0.17) (-0.56) (1.95) (-0.57) (-0.03) (0.42) (0.07)

Model 4: Spain = wspa = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln pspa, \ln puk, \ln rexp)$ – 1 lag

Hypothesis	$r=0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	330.2352**	169.5991	219.8799**	134.6780
π max test	110.3552**	53.18784	63.78611**	47.07897

$$ECT_{spa} = WSPA + (0.26)*LNPITA - (0.18)*LNPMAL - (0.005)*LNPNZ + (0.001)*LNPSA - (0.24)*LNPSPA + (0.05)*LNPUK - (2.31e-07)*LNREPUSA + 0.4198$$

(1.13) (-2.04) (-0.10) (0.07) (-0.99) (1.17) (-0.02) (2.81)

Model 5: UK = wuk = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln pspa, \ln puk, \ln rexp)$ – 1 lag

Hypothesis	$r=0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	358.2321**	169.5991	231.6262**	134.6780
π max test	126.6059**	53.18784	68.52285**	47.07897

$$ECT_u = WUK + (1.4138)*LNPITA + (0.0931)*LNPMAL - (0.0583)*LNPNZ + (0.0560)*LNPSA - (1.5226)*LNPSPA + (0.04)*LNPUK + (2.1e-05)*LNREPUSA + 0.20$$

(1.34) (0.23) (-0.25) (0.78) (-1.37) (0.20) (0.45) (0.31)

** signifies that a test statistic is statistically significant at the 5% level. Cointegrating vector lags were chosen on the basis of SC, criteria by employing EViews 7. Tests are run employing EViews 7, 2010. c.v. indicates critical value.

Table 4.5 Johansen Co-integration Test – UK

Model 1: Italy = wita = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln ps pa, \ln pusa, \ln rexp) - 1$ la

Hypothesis	$r = 0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	398.6884**	169.5991	208.2042**	134.6780
π max test	190.4841**	53.18784	73.86753**	47.07897

ECTi = WITA + (0.17)*LNIPITALUK + (0.07)*LNPMALUK + (0.0004)*LNPNZUK + (0.01)*LNPSAUK - (0.06)*LNPSPAUK + (0.06)*LNPUA + (0.007)*LNREPUK - 0.21
(0.70) (0.79) (0.008) (1.03) (-0.25) (5.63) (0.81) (-1.26)

Model 2: Malaysia = wmal = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln ps pa, \ln pusa, \ln rexp) - 1$ lag

Hypothesis	$r = 0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	375.5843**	169.5991	227.5308**	134 6780
π max test	148.0535**	53.18784	91.59444**	47.07897

ECTmal = WMAL - (0.14)*LNIPITALUK + (0.0005)*LNPNZUK - (0.03)*LNPMALUK - (0.003)*LNPSAUK + (0.04)*LNPSPAUK - (0.01)*LNPUA - (0.002)*LNREPUK + 0.17
(-1.83) (0.029) (-1.13) (-0.72) (0.56) (-0.40) (-6.74) (3.14)

Model 3: South Africa = wsa = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln ps pa, \ln pusa, \ln rexp) - 1$ lag

Hypothesis	$r = 0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	473.3056**	169.5991	284.7124**	134.6780
π max test	188.5932**	53.18784	117.0271**	47.07897

ECTsa = WSA - (0.01)*LNIPITALUK + (0.04)*LNPMALUK - (0.01)*LNPNZUK + (0.008)*LNPSAUK - (0.17)*LNPSPAUK - (0.07)*LNPUA - (0.007)*LNREPUK + 0.15
(-0.16) (1.07) (-0.45) (1.12) (-1.58) (-2.01) (-12.60) (2.09)

Model 4: Spain = wspa = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln ps pa, \ln pusa, \ln rexp) - 1$ lag

Hypothesis	$r = 0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	375.8566**	169.5991	205.5345**	134.6780
π max test	170.3221**	53.18784	73.73402**	47.07897

ECTspa = WSPA - (0.79)*LNIPITALUK + (0.07)*LNPMALUK - (0.15)*LNPNZUK + (1.54)*LNPSAUK + (0.10)*LNPSPAUK - (0.18)*LNPUA + (0.01)*LNREPUK - 0.1163
(-1.68) (0.42) (-1.45) (3.11) (3.20) (-1.14) (6.34) (-0.35)

Model 5: USA = wusa = $f(\ln pita, \ln pmal, \ln pnz, \ln psa, \ln ps pa, \ln puusa, \ln rexp) - 1$ lag

Hypothesis	$r = 0$	0.05 c.v	$r \leq 1$	0.05 c.v
Trace	372.8839	169.5991	206.4663	134.6780
π max test	166.4177	53.18784	64.96202	47.07897

ECUsa = WUSA + (0.79)*LNIPITALUK - (0.18)*LNPMALUK + (0.1762)*LNPNZUK + (0.13)*LNPSAUK - (1.201)*LNPSPAUK + (0.25)*LNPUA - (0.007)*LNREPUK + 0.87
(2.05) (-1.29) (2.06) (-5.06) (-2.97) (1.92) (-3.64) (3.27)

** signifies that a test statistic is statistically significant at the 5% level. (2) Co-integrating vector lags were chosen on the basis of SC criteria by employing EViews 7. (3) Tests are run employing EViews 7, 2010. c.v. indicates critical value.

The Johansen Co-integration Test shows multiple co-integrating relationships for each country. According to the maximum eigenvalue and trace statistics, four co-integrating vectors are detected in each model of Table 4.4 and the same number of co-integrating vectors for Table 4.5. This is an indication of the long-term relationships between the various countries when it comes to tourism. Although there are multiple co-integrating vectors for the purpose of this study, only the first co-integrating vector is used. This was suggested by the research of Cortés-Jiménez *et al.* (2009).

From the co-integrating ³vectors, an error correction term is derived. The equation to obtain the error correction term is equation 2.53 in Section 2.4.2 and the individual equations to determine the error correction term of individual countries are found underneath the country models in Tables 4.4 and 4.5. The t-statistics are in parentheses.

Since all the variables are integrated of order one (I(1)), and the Johansen test indicates there is a long-run relationship between the variables, the EC-AIDS model has to be estimated.

As was stated in Section 2.4.2, when the variables are non-stationary and co-integrated, the LA/AIDS can be expanded as the EC-AIDS model. This equation takes in all the errors that occur from consumers and corrects them until they are in equilibrium.

According to Khamkaew and Leerattanakorn (2010), the short-run AIDS model includes an error correction term because it implies that the present change in budget shares does not exclusively depend on the current change in the relative price of tourism and real total expenditure per tourist, but also on the degree of disequilibrium in the previous period.

This chapter therefore follows the work of Durbarry, Li *et al.* (2006) and Cortés-Jiménez *et al.* (2009) as the model that will be estimated will be an error correction model of tourism demand for South Africa by the UK and the USA. Using the basis of the model that was used by Cortés-Jiménez *et al.* (2009), EC-LAIDS model, and similar specifications, the following econometric model for both UK and USA tourist demand was estimated:

³ The ADF test was done on the residuals and showed that they are stationary of order I(0), which was the expected result.

$$\Delta sdw_{it} = \sum_j c_{ij} \Delta \ln p_{jt} + b_i \Delta \ln(x/P^*) - \gamma[ECT_{t-1}] + \delta \Delta sdw_{it-1} + \theta_{1i} Db + \theta_{2i} Dst + \theta_{3i} Dsd + \theta_{4i} Dsf + c_{it} \quad (4.3)$$

Where i represents the country destination, j denotes all the country destinations, t signifies time with the time being from 1999Q1 to 2008Q4 (Q meaning quarter). For the variables that have been first-differenced, the delta (Δ) is used and $\ln$ implies that the variable is transformed in natural logarithms. Natural logarithms were taken to eliminate measurement problems.

As for the description of the variables, sdw shows the seasonal differenced share of tourism expenditure assigned in destination i to total tourism expenditure in j destinations. The effective relative price of tourism in each destination is denoted by $\Delta \ln p_{jt}$. The ratio between the UK and USA tourist expenditure and the Stone price index is given by $\Delta \ln(RexP)$. The error correction term is also called the lagged co-integrating vector, and is represented by ECT_{t-1} , sdw_{it-1} is the lagged dependent variable and indicates whether the previous year had an effect on tourist arrivals the following year and D shows the dummy variables. As indicated in Section 3.3, there are four dummy variables that are taken into account. The first dummy variable is Db that attempts to capture the lead up to the recession of 2008, which is defined as 1 for the four quarters of 2007, which had abnormally high tourist figures, and 0 for all the other periods. The other three dummies, Dst , Dsd , Dsf , are seasonal dummies to observe whether there are any noticeable trends that can be observed.

By establishing that the model was co-integrated and deriving an error-correction term, the next part of the study is to model the EC-AIDS model. For more information on the EC-AIDS model refer to Sections 2.4.2 and 2.4.3.

4.4 Unrestricted AIDS models

In this study, the EC-AIDS is estimated and, according to Cortés-Jiménez *et al.* (2009), the three most common estimation methods for AIDS models are: ordinary least squares (OLS), maximum likelihood (ML) and seemingly unrelated regression (SUR) estimation. This study will use the iterative SUR estimation method as Cortés-Jiménez *et al.* (2009) explain that the SUR method is the most widely-used method when estimating a system of equations and provides residuals that are normally distributed. The SUR method was discussed in detail in Section 3.4.

The estimated results are obtained using EViews 7 econometric software and are shown in Table 4.6 (for UK tourists) and Table 4.7 (for USA tourists) respectively.

Table 4.6 Unrestricted AIDS model for UK tourists

	Italy	Malaysia	South Africa	Spain	USA
C	0.004660 (1.477051)	-0.000699 (-0.448560)	0.000384 (0.376761)	-0.005343 (-0.625428)	-1.89E-05 (-0.002252)
$\Delta \ln P$ Italy	-0.019291 (-0.081057)	0.075158 (0.668927)	-0.005088 (-0.062404)	0.443094 (0.670309)	-0.511288 (-0.783768)
$\Delta \ln P$ Mal	0.211254*** (2.974755)	-0.004818 (-0.136326)	0.013271 (0.541246)	-0.148140 (-0.749241)	-0.086879 (-0.449598)
$\Delta \ln P$ SA	-0.005153 (-0.296537)	-0.002562 (-0.315333)	0.010242* (1.751246)	0.056272 (1.164765)	-0.062059 (-1.306522)
$\Delta \ln P$ SPA	0.001676 (0.006971)	-0.081833 (-0.721865)	-0.005528 (-0.067053)	-0.341659 (-0.511164)	0.434720 (0.658078)
$\Delta \ln P$ USA	-0.191509*** (-3.095871)	-0.002356 (-0.079408)	-0.012111 (-0.571012)	0.085922 (0.500543)	0.141765 (0.842976)
$\Delta \ln P$ NZ	-0.034161 (-1.116962)	0.015508 (1.094561)	-0.023544** (-2.193069)	0.105670 (1.266825)	-0.049120 (-0.599188)
$\Delta \ln RPEX$	-0.001591 (-1.196831)	-5.46E-05 (-0.081319)	-0.000495 (0.935542)	0.008709** (2.555663)	-0.006255* (-1.860722)
EC(-1)	-0.094300 (-1.150446)	0.029039 (0.170167)	-0.181271** (-2.083346)	-0.077328 (-1.096035)	-0.066034 (-0.87910)
SDW(-1)	0.611222*** (8.392196)	0.543724*** (4.616016)	0.428014*** (4.054982)	0.552550*** (8.694622)	0.549488*** (7.942800)
<i>Db</i>	0.009117** (2.502268)	0.000974 (0.565409)	0.001172 (0.942796)	0.000831 (0.081406)	-0.012562 (-1.252020)
<i>Dst</i>	0.001120 (0. 688 7)	0.001896 (0.512787)	0.002110 (0.820925)	-0.012291 (-0.652937)	0.006736 (0.367888)
<i>Dsd</i>	-0.005495 (-1.610322)	0.001106 (0.640999)	-0.001026 (-0.893034)	0.001440 (0.152600)	0.004856 (0.526956)
<i>Dsf</i>	-0.009624 (-1.631442)	0.002971 (1.199976)	-0.002479 (-1.227602)	0.035701** (2.484901)	-0.024813* (-1.749509)
R^2	0.685495	0.498722	0.408452	0.668346	0. 76643
R^2 -adjusted	0.521952	0.238057	0.100847	0.495885	0.356498
DW-Stat	1.908108	1.972335	2.173765	1.746857	1.645919

*** = 1% significance level; ** = 5% significance level; * = 10% significance level.

Table 4.7 Unrestricted AIDS model for USA tourists

	Italy	Malaysia	South Africa	Spain	UK
C	-0.001334 (-0.150263)	0.001195 (1.123775)	-0.000199 (-0.298227)	-0.003242 (-0.839009)	0.004387 (0.405726)
$\Delta \ln P$ Italy	-0.556621 (-0.838777)	0.070097 (0.768719)	-0.018477 (-0.336000)	0.070794 (0.275369)	0.484150 (0.740535)
$\Delta \ln P$ Mal	0.028855 (0.156733)	-0.054256** (-2.142971)	-0.006482 (-0.418105)	-0.161836** (-2.192329)	0.194356 (1.068826)
$\Delta \ln P$ SA	-0.010479 (-0.227347)	-0.022097*** (-3.654828)	0.010487*** (2.857075)	-0.043275** (-2.570638)	0.055332 (1.174841)
$\Delta \ln P$ SPA	0.565440 (0.828773)	-0.026420 (-0.283423)	0.02276 (0.405260)	-0.004719 (-0.017861)	-0.612940 (-0.916398)
$\Delta \ln P$ USA	0.117894 (1.328178)	-0.007872 (-0.658163)	-0.006113 (-0.859416)	-0.018830 (-0.574138)	-0.087840 (-0.994961)
$\Delta \ln P$ NZ	0.033041 (0.452139)	0.015999 (1.622968)	-0.007948 (-1.279610)	0.010838 (0.402059)	-0.040225 (-0.549873)
$\Delta \ln RPEX$	7.59E-06 (0.896089)	-2.07E-06* (-1.765002)	-4.35E-09 (-0.006425)	-2.50E-06 (-0.766360)	-6.00E-06 (-0.707243)
EC(-1)	-0.285292** (-2.238776)	0.076351 (0.472632)	-0.447335** (-2.154648)	-0.343145** (-2.473922)	-0.334758** (-2.134341)
SDW(-1)	0.578774*** (5.966587)	0.371585*** (3.495458)	0.814197*** (5.947657)	0.734039*** (7.384007)	0.642555*** (5.753802)
<i>Db</i>	-0.036930*** (-3.234293)	0.003681** (2.365027)	0.001714* (1.908678)	0.003531 (0.829981)	0.025711** (2.217986)
<i>Dst</i>	-0.019681 (-1.249818)	-0.002146 (-0.951184)	0.001636 (1.037393)	-0.002659 (-0.466938)	0.019375 (1.381996)
<i>Dsd</i>	0.028225* (1.819569)	0.000138 (0.109344)	-0.001339 (-1.417824)	0.011974** (2.209738)	-0.038731* (-1.923137)
<i>Dsf</i>	0.015027 (0.937761)	0.001050 (0.578730)	-0.000626 (-0.613705)	0.005745 (1.000947)	-0.018654 (-1.032049)
R ²	0.497246	0.625207	0.562218	0.626087	.493998
R ² -adjusted	0.235814	0.430315	0.334571	0.431652	0.230877
DW-Stat	2.437307	1.382026	1.967177	1.573946	2.452673

*** = 1% significance level; ** = 5% significance level; * = 10% significance level.

In both Table 4.6 and Table 4.7, it can be observed that there are many variables that are insignificant but they are estimated for the requirements of the AIDS model. In both Table 4.6 and Table 4.7, the lagged dependent variable (SDW(-1)) is significant for all the countries, which is expected as this shows that tourist expenditure is affected by previous years. Furthermore, the results in Tables 4.6 and 4.7 are mixed, with own-price variable and error correction terms only significant for some countries. The dummy that was inserted for the recession is significant for most countries as indicated in Tables 4.6 and 4.7, which indicate that 2007 was an abnormal year in terms of tourism. There are also some seasonal dummies that are significant and this captures the seasonal effect of tourism from the UK and the USA. The R-squared statistics compared to the Rotterdam model are significantly lower, which is not surprising since a number of variables are insignificant.

The two unrestricted models have some similarities with similar models that were estimated by Cortés-Jiménez *et al.* (2009) in that the expenditure variable is not very significant in most countries. The lagged dependent variable is significant for all the countries, which is in contrast to the results found by Cortés-Jiménez *et al.* (2009).

4.5 Model Restrictions

As explained in the previous chapter (see Section 3.5), the properties of demand can be imposed in the form of restrictions; the restrictions being homogeneity and symmetry (see Chapter 2.2). The Wald-test is used to establish whether the restrictions satisfied the null hypothesis of homogeneity and symmetry. The results are presented in Tables 4.8 and 4.9 respectively. A five per cent level of significance is used in the null hypothesis: $P < 0.05$ can reject the null hypothesis that the variables are homogenous and symmetric.

Table 4.8 Wald test for Homogeneity, Symmetry and Combined for UK tourists – AIDS model

	Homogeneity	Symmetry	Combined
Chi-Squared	6.3236	4.9690	13.5533
(probability)	(0.276)	(0.893)	(0.560)

Table 4.9 Wald test for Homogeneity, Symmetry and Combined for USA tourists – AIDS model

	Homogeneity	Symmetry	Combined
Chi-Squared (probability)	4.1342 (0.530)	7.3643 (0.691)	12.3701 (0.651)

For the UK tourists (Table 4.8), one cannot reject the null hypothesis of homogeneity and symmetry. Table 4.9 shows that the null hypothesis for homogeneity and symmetry cannot be rejected for USA tourists. The models therefore satisfy the restrictions of homogeneity and symmetry and the unrestricted EC-AIDS model will suffice when calculating the elasticities.

4.6 Calculating Elasticities

The value of calculating elasticities was discussed in the previous chapter and the same process applies when calculating the elasticities for the EC-AIDS model. The equations of the elasticities are in Section 2.4.2.

4.6.1 Expenditure Elasticities

Firstly the expenditure elasticity is calculated using the results of the estimation that was provided by the unrestricted AIDS model. The expenditure elasticities for both UK and USA tourists are shown in Tables 4.10 and 4.11 respectively. The formula for the expenditure elasticity was given by equation (2.47).

Table 4.10 Expenditure Elasticities for UK tourists – AIDS model

Country	Italy	Malaysia	South Africa	Spain	USA
η	0.989667**	0.996556**	0.982888**	0.999995**	0.752415**

** = indicates significant at 0.05 per cent level.

Table 4.11 Expenditure Elasticities for USA tourists – AIDS model

Country	Italy	Malaysia	South Africa	Spain	UK
η	1.00002**	0.999874**	1.000000**	0.999983**	0.999986**

** = indicates significant at 0.05 per cent level.

From the above tables, it is evident that the expenditure elasticities are all positive. This means that for UK and USA tourism none of the destinations is 'inferior' because the shares increase with the real expenditure per capita.

In Table 4.10, it is evident that all of the elasticities are close to unity. This, in part, can be due to the dynamic nature of the model and the preferences of tourists that no discernable difference can be made between the countries in terms of their expenditure elasticities. The USA's expenditure elasticity is the only one that is not close to unity and shows that the UK tourists have a preference for the USA.

In Table 4.11, it is evident that all of the elasticities are close to unity but, as was seen in Table 4.10, the factors that could possibly have an influence on the elasticities being so close to unity can be due to the dynamic nature of the model. This allows for the preferences of tourists which is not possible with the static Rotterdam model.

4.6.2 Uncompensated Own and Cross-price elasticities

As was stated in the previous chapter, demand theory dictates that own-price elasticities should be negative. Theoretically, if the price of a product/destination increases, then demand should decrease (*ceteris paribus*). In this study, only the uncompensated own- and cross-price elasticities are calculated, since De Mello *et al.* (2002) state that uncompensated elasticities focus on the real reaction of the dependent variable to changes in prices. This is useful, because it supplies more clear and direct information about the behaviour of demand. This feature of the uncompensated elasticities makes them more viable for policy purposes.

Positive and negative signs for cross-price elasticities indicate whether countries are substitute or complementary destinations. In the AIDS context, De Mello *et al.* (2002) state that concise deductions about the substitute and complementary effects are not always possible because, in previous studies, the models have not produced distinct cross-price effects. They also add that the results of the substitute and complementary effects should not distract from their importance as far as the relative magnitudes and the direction of change in demand goes. The equations for the own- and cross-price elasticities were discussed earlier with equations (2.48) and (2.49).

Table 4.12 Uncompensated Own and Cross-price elasticities for UK tourists – AIDS model

	Italy	Malaysia	South Africa	Spain	USA
Italy	-2.48839**	1.372973**	-0.03317	0.016394	-1.24137**
Malaysia	4.742454**	-4.30649**	-0.16153	-5.16129**	0.14778**
South Africa	-0.17341**	0.459414**	-0.51455**	-0.18213**	-0.41472**
Spain	0.831246	-0.27791	0.105567**	-1.03159**	0.161192
USA	-0.51129**	-0.08688	-0.24043**	1.866288**	-1.21087**

** = indicates significant at the 5% level.

Table 4.12 shows that, in terms of UK tourists' own-price elasticities, they are in some cases sensitive to price change and in others not so sensitive. For example, the figures show that a one per cent increase in prices in Italy will lead to a decrease of 2.49 per cent in UK tourism demand for Italy. In terms of South Africa, a one per cent increase will lead to a 0.51 per cent decrease in tourism demand from the UK. One of the possible reasons that the elasticity for South Africa is quite low can be put down to the Pound Sterling/SA Rand exchange rate, where UK tourists do not see an increase in prices as a deterrent to come to South Africa. This shows that UK tourists are price-insensitive when travelling to South Africa. These increases and decreases in demand can be attributed to economic conditions and personal preferences, as the elasticities are statistically significant but no economic reason can be given for the said elasticities. Similar criticism levied by De Mello *et al.* (1999) against the calculated cross-elasticities discussed earlier, applies here as well.

In terms of cross-price elasticities, it can be seen that most of the countries compete on prices. Positive signs mean that a country is a substitute for another country. For example, if South Africa's tourism price increases by one per cent, Malaysia gains

0.45 per cent in demand. On the other hand, it seems that South Africa and Italy are complementary destinations with an increase of one per cent in the tourism price of South Africa being associated with a 0.41 per cent decrease in tourist demand to the USA. It is also interesting to note that a one per cent increase in the tourism price in Italy is associated with a 1.24 per cent decrease in tourism demand for the USA by UK tourists, and the same increase in prices by the USA is consistent with a 1.87 per cent increase in demand for Spain as a tourism demand from UK tourists.

Table 4.13 Uncompensated Own and Cross-price elasticities for USA tourists – AIDS model

	Italy	Malaysia	South Africa	Spain	UK
Italy	-1.12525**	0.077156	-0.02802**	1.511959**	0.315235**
Malaysia	4.271947**	-1.30349**	-1.34666**	-1.6101**	-0.47969**
South Africa	-0.85534**	-0.30004**	-0.64567**	1.053899**	-0.28297**
Spain	0.473969	-1.08348**	-0.28972**	-0.94679**	0.12606**
UK	1.162318	0.466597	0.132838	-1.4715	-0.43443**

** = indicates significant at 0.05 per cent level.

Table 4.13 shows that, in terms of USA tourists' own-price elasticities, they are not as sensitive to price change as UK tourists. For example, the numbers show that a one per cent increase in prices in Italy is associated with a decrease of 1.12 per cent of USA tourism demand for Italy. In terms of South Africa, a one per cent increase is consistent with a 0.64 per cent decrease in tourism demand from the UK. As in the previous model of UK tourists, the US Dollar/SA Rand exchange rate is favourable for USA tourists and a one per cent price change would not lead to a demand change greater than one per cent. It can be said that USA tourists are also price insensitive when it comes to the SA Rand in that the tourists do not seem to be discouraged by a stronger Rand. The currency, although a factor, should not be

regarded as the only reason why the own price elasticity is lower than one. Some other factors could include personal preference and repeat visitation. An argument can also be formed that South Africa may still be seen as a value for money destination, since an increase in price does not necessarily cause tourists to view South Africa as an expensive destination.

In terms of cross-prices elasticities, it can be seen that most of the countries compete on prices. Positive signs mean that a country is a substitute for another country. For example, if South Africa's tourism price increases by one per cent, it is associated with a 1.05 per cent increase in demand in Spain. This substitute effect can possibly be put down to the two countries having the same climate. Furthermore, it shows that a one per cent increase in the tourism price in South Africa is associated with a 0.85 per cent decrease in tourism to Italy from the USA and a decrease of 0.3 per cent in demand for Malaysia. Quite significant is that a one per cent increase in the tourism price in Italy is consistent with a 1.51 per cent increase in demand for Spain from USA tourists. It is significant to note that none of the UK cross-price elasticities with the other countries is significant even though they have large percentage changes.

In Chapter 1, it was stated that South Africa experiences an annual growth in tourism of ten per cent. Figures (3.1 to 3.4) from long haul destinations (UK and USA) do not show the same percentages. Both the expenditure elasticities show that South Africa is a normal good for the UK and USA. The own-price elasticities derived from the EC-AIDS model show that one per cent change in South African prices will not have a serious effect on UK and USA tourists coming to South Africa and that could be put down to the favourable exchange rates. If this is the case, then there must be other factors that influence their decisions, such as political problems or crime.

It is important in a South African context to understand the effect that price changes have in demand for South Africa by the UK and the USA. With the tourism industry playing a massive role in South Africa's economy, it can explain the effect on tourism when prices change. With the dynamic EC-AIDS model, the effect was seen to be a lot less the static Rotterdam model.

The effects explained by the Rotterdam model could be exaggerated, but the opposite could also be true in that the EC-AIDS model underestimated the elasticities and is not a true reflection of tourism demand elasticities for UK and USA

tourists. In the light of this, in the next Section, the Rotterdam and the EC-AIDS models will be compared to establish whether one model dominates the other.

4.7 Comparing the AIDS and Rotterdam models

From the literature (see Section 2.6), it is evident that it is not possible to compare the AIDS and Rotterdam models just on face value. If that was the case, it would be easy to look at the models' R-squared statistics and other information criteria and conclude that the Rotterdam model is superior. This can, however, not be done because of the differing nature of each model. In this study, that Rotterdam model is a static model while the EC-AIDS is a dynamic model.

In Chapter 2, it was indicated that there are two possibilities for comparing the models: by performing a Box-Cox transformation or the J-test. In this study the J-test will be used as it can be implemented for equations with different right hand sides (different independent variables) as is the case with this study. The Box-Cox transformation requires the right hand side to be parsimonious and, for that, an LA-AIDS needed to be estimated which would be counterproductive as the dynamic nature of the EC-AIDS would be lost.

To determine whether one model is superior to another with the J-test, there needs to be evidence that the fitted variable has no power to improve the model. In other words the fitted variable should be insignificant in the equation that it is plugged into. It was also clear from the literature review that there are four possible outcomes – both equations could be adequate, one of the two equations could be superior or both equations could be rejected.

The J-test was performed by calculating a variable from each Rotterdam model for the UK and the USA and plugging that variable into the corresponding EC-AIDS model and vice versa. Table 4.14 shows the coefficient of the EC-AIDS fitted variable in the Rotterdam model for UK tourists. Table 4.15 shows the coefficient of the Rotterdam fitted variable in the EC-AIDS model for UK tourists. The t-statistics are in parentheses.

Table 4.14 Rotterdam model with EC-AIDS fitted variable – UK Tourists

	Italy	Malaysia	South Africa	Spain	USA
Fitted variable	0.013845 (1.330174)	-0.001999 (-1.726960)	0.000425 (1.844737)	-9.52E-07 (-0.182538)	-1.44E-05 (-1.113734)

Table 4.15 EC-AIDS model with the Rotterdam fitted variable – UK Tourists

	Italy	Malaysia	South Africa	Spain	USA
Fitted Variable	-0.705786 (-1.326799)	-1.267198 (-1.226775)	1.503582** (1.990153)	-0.576458 (-0.978424)	0.577925 (1.705612)

** = indicates significant at 0.05 per cent level.

If the criterion of the J-test is followed, both fitted values seem to have little impact on the overall equations, but the Rotterdam fitted variable is significant in the South African equation in the system. This leads to the conclusion that, for South Africa, the EC-AIDS model is superior to the Rotterdam model with regards to UK tourists.

For the USA tourist models, the same variable as above was generated for the different equations. Table 4.16 shows the coefficient of the EC-AIDS fitted variable in the Rotterdam model for USA tourists. Table 4.17 shows the coefficient of the Rotterdam fitted variable in the EC-AIDS model for USA tourists. The t-statistics are in parentheses.

Table 4.16 Rotterdam model with EC-AIDS fitted variable – USA Tourists

	Italy	Malaysia	South Africa	Spain	USK
Fitted Variable	0.009147 (0.997700)	0.001816 (0.339653)	0.014989 (1.199691)	7.36E-05 (0.111994)	-0.003530 (-1.079047)

Table 4.17 EC-AIDS model with the Rotterdam fitted variable –USA Tourists

	Italy	Malaysia	South Africa	Spain	UK
Fitted Variable	0.255218 (1.526046)	-0.857486** (-2.615256)	-0.107832 (-1.832307)	0.210950** (2.782710)	-0.214371** (-3.067186)

** = indicates significant at 0.05 per cent level.

If the criterion of the J-test is followed, one of the fitted values seem to have a lot of impact on the overall equations with the Rotterdam fitted variable being significant in three equations in the system and the EC-AIDS variable is not significant for any. This leads to the conclusion that, for this study, the EC-AIDS model is superior to the Rotterdam model. With no variable being significant in the South African case, it can be stated that, for USA tourists, South Africa is indifferent to either model.

Due to the non-nested feature of the EC-AIDS and the Rotterdam models, it is impossible to compare the models at face value. If this was possible, the Rotterdam model would have been superior to the AIDS-model when looking only at R-squared values and Durbin-Watson statistics. The models were tested by using Davidson and Mackinnon's (1981) J-test and it was found that the EC-AIDS is superior to the Rotterdam model.

4.8 Conclusion

In this chapter, the focus was on the AIDS model and how it is used to estimate tourism demand and elasticities. The chapter started with an introduction discussing why the AIDS model was chosen to estimate tourism demand. The model specification was discussed with the Rotterdam model that was used in this study evolving from equation 2.46 in Chapter 2.

The variables that were used were introduced as well as the way they were calculated together with the countries that were used in the study. The data was also tested for unit roots and it was found that the data was non-stationary and a Johansen Co-integration Test was used. With the co-integrating vectors evident, the use of an error-correction term was needed and was duly calculated. The unrestricted EC-AIDS model was estimated for both UK and USA tourists. It was found that the own-price elasticities were negative in most cases, which is supported by economic theory.

To establish whether the unrestricted EC-AIDS model violates any of the properties of demand, a Wald-test was done. This found that the model did not violate the homogeneity and symmetry restrictions of the properties of demand. Therefore the unrestricted model was found to be sufficient and thus the elasticities were calculated from the unrestricted EC-AIDS model. The elasticities that were estimated were the expenditure, own-price and cross-price elasticities.

Chapter 5: Conclusions and Recommendations

5.1 Introduction

The role played by tourism in the past decade cannot be overstated. This was seen in the value of the tourism industry in general, in terms of size, contribution to world GDP and employment. Tourism was shown as a significant industry when looking at its the share of the world GDP. International tourism to South Africa has increased steadily from 1994 to 2008. The year 2009 saw international arrivals to South Africa decline significantly and it became evident that the worldwide recession not only impacted on tourism arrivals in other countries, but also in South Africa. This sudden drop in international tourism sparked renewed interest into the demand for South Africa as a destination. It became evident that understanding the factors that influence foreign countries' demand for South Africa as a destination is crucial to anticipating future changes and formulating policy.

Of particular importance are the South Africa's main tourism markets. From an intercontinental perspective, the United Kingdom is the most important market with 15 per cent of intercontinental tourists stemming from the UK in 2009 (Government Communications of South Africa, 2012). The UK is followed by Germany 8 per cent, with the USA taking third position with 7 per cent in terms of intercontinental arrivals. As a market that grew substantially in importance over the past decade (moving from fifth position in 1994 to third position in 2009), and due to the size of the potential market, the USA is another market that warrants investigation.

Given the recent fall in tourism arrivals worldwide, as well as in South Africa, some questions can be asked such as: How sensitive are tourists to price increases? Are tourists more prone to react to income changes than price changes or *vice versa*? Or are they indifferent to both these changes? How does the economic climate affect tourist demand? What can South Africa do to ensure a consistent flow of international tourists?

The recent economic recession, sparked by the financial crisis, showed that tourism to South Africa is susceptible to changes in price and/or income. The question to answer is: how sensitive are they to price and/or income changes?

To ascertain the reasons for the declining growth in these markets, an investigation into the income and price elasticities of foreign tourists is needed. The purpose of

this research was to provide some answers to the questions above. More specifically, to investigate the income and price elasticities of tourists from South Africa's largest European market – the UK – and largest North-American market – the USA.

To answer these questions, it became evident that an investigation into the drivers of tourism demand is necessary and that demand systems would be able to provide answers to the questions investigated in this research. The models that were used in this study were the Almost Ideal Demand System (AIDS) and the Rotterdam model. The former is the most extensively used demand system when tourism demand has been estimated and the latter was used as it shares a lot of similarities of the AIDS model and have never been used in determining tourism demand. The comparison between the two models also established which one of the models is more dominant when testing tourism demand.

In the context of South African literature this study is important as it uses advanced econometric analysis to model tourism demand for South Africa. Furthermore this study aimed to establish whether the Rotterdam model could be a better model to use for modelling tourism demand than the widely-used AIDS model. The research showed that while the Rotterdam model is a good substitute for the AIDS model in many instances, the AIDS model is still outperforming the Rotterdam model in some cases, making it the best to use in estimate tourism demand.

5.2 Conclusions

To answer the questions pertinent to this study, the following objectives were set:

The main objective of this research was to determine the expenditure, own-price and cross-price elasticities of demand of tourists from the UK and the USA for South Africa as a tourist destination, with the aim of assessing the price competitiveness of South Africa as a tourism destination for these countries.

In addition, the following objectives of this study were identified:

- To explore tourism demand in microeconomic theory using a comprehensive literature review of the tourism demand models used in this study.
- To model the elasticities of USA and UK tourists travelling to South Africa using the AIDS model.

- To model the elasticities of USA and UK tourists travelling to South Africa using the Rotterdam model.
- To compare the AIDS and Rotterdam models, thereby identifying the model best suited for tourism demand modelling in South Africa.

To reach these objectives, the study was divided into 5 chapters. Chapter 2 addressed the second objective, Chapter 3 addressed the third objective and Chapter 4 addressed the last two objectives. Conclusions with respect to each of the objectives are subsequently discussed.

5.2.1 Conclusions with regards to the differences between the AIDS and Rotterdam models

A complete literature review on the two models found that both models had their origin in the Marshallian and Hicksian demand functions. Important to both the AIDS and Rotterdam models are the properties of demand that they both must satisfy, this being, adding up, homogeneity, symmetry and non-negativity.

While very similar at face value with most of the variables being the same, the biggest difference between the two models is in the way weights are calculated. In the Rotterdam model the weight is a two-period average weight, where the weight is calculated by the amount of budget share a particular destination enjoys of tourists from the UK and USA. The AIDS models' weight is calculated by taking the differences between the weights of corresponding quarters. One of the features of this study was to incorporate an error-correction term in the AIDS model. This is beneficial because an error correction term is a dynamic term with the characteristic that the deviation of the current state from its long-run relationship will be fed into its short-run dynamics.

The Rotterdam model was shown as one of the earliest models to use a system of equations approach and was used initially in consumer demand; examples of these would be food and beverage demand studies. The Rotterdam model was also found to be a very static model that did not allow for consumer preferences. While it has been applied widely in consumer studies, the Rotterdam model has not been used in tourism demand studies. The model allows estimated elasticities to be calculated,

which is instrumental to answering the questions that were asked in the problem statement of this study.

The AIDS model shares many similarities with the Rotterdam model and many of the variables are exactly the same for both models. As the literature showed, the AIDS model had its origins in the Rotterdam model and has been the most popular demand system to be used for tourism demand in the past two decades. The AIDS model has been modified significantly from the original model proposed by Deaton and Muellbauer (1980). The model used in the study is the error-correction model (EC-AIDS) that incorporates a dynamic element to the model that takes consumer preferences into account. As with the Rotterdam model, elasticities can be calculated to determine the effect of price and income changes on tourism demand.

Furthermore, the literature review revealed that comparing the two models is more complicated than merely focusing on the R-squared and Durbin-Watson statistics as the models are both non-nested with the left-hand side of the equations being different. The AIDS model uses a first differenced weight variable and the Rotterdam model a two-period average weight variable. It is also worth noting that the AIDS model uses a Stone price index while the Rotterdam model uses the Divisia price index. To compare the two models, the J-test was identified in the literature, since this test is specifically used to compare the two models and establishing which of the models dominates the other. Both these models are suitable for answering the problems that were stated in the problem statement.

5.2.2 Conclusions with regards to the Rotterdam Model estimates

This study provided a comprehension on the outbound tourism demand of the UK and the USA to some major destinations from 1999 to 2009 using quarterly data. This was done to determine how the economic climate affected tourism demand and the data showed that the recession of 2008 had a large negative impact on tourism arrivals in general. Since this study uses the Rotterdam and AIDS models in a tourism demand setting, it stands out from previous studies.

With the Rotterdam model, it was found that the properties of demand were not satisfied and a restricted model was estimated. The model itself had a very good fit in terms of the R-squared and Durbin-Watson statistics. This may be attributed to the model being static i.e. not incorporating consumer preferences. The restricted model

was also used to determine expenditure and uncompensated own-price and cross-price elasticities.

The expenditure elasticities of the Rotterdam model for both the UK and the USA show that South Africa is seen as a luxury destination, which indicates that, when expenditure (disposable income) diminishes, South Africa would be given up as a destination. Own-price elasticities show the extent of an increase in tourism prices in a destination on a destination's competitiveness. In general, a price increase in long haul destinations leads to a decrease in demand in long haul destinations (Malaysia and South Africa). These two destinations were the destinations where the UK and USA tourists were more sensitive to price changes than the other countries. In terms of cross-price elasticities, it can be seen that most of the countries compete on prices. For example, if South Africa's tourism price increases, the USA gains in demand. In terms of cross-price elasticities the criticism that was launched by De Mello *et al.* (1999) is also warranted in this study in that more information provision is needed to be able to estimate more accurate elasticities and in doing so better information can be gathered by policy makers.

To answer the questions set out in the introduction and problem statement, the Rotterdam model shows that tourists are sensitive to price changes and are prone to react to both expenditure and price changes equally. This would show that South Africa should keep prices at a constant level to ensure that tourists come to South Africa regularly, and that South Africa must be vigilant of other long haul destinations with UK and USA tourists.

5.2.3 Conclusions with regards to the AIDS model estimations

The unrestricted model of the AIDS was sufficient, as it satisfied all the criteria set by the properties of demand. The fit (R-Squared) of the model was not as significant as the Rotterdam model, but this may be attributed to the dynamic nature of the model.

The expenditure elasticities of both the UK and the USA in the AIDS model show that South Africa is not seen as either a luxury or as a necessity, with the demand being nearly unity, which indicates that when expenditure (disposable income) diminishes or increases, demand to South Africa would increase and decrease in the same proportion. Own-price elasticities are, in some cases, sensitive to price changes and, in other cases, not so sensitive. In terms of South Africa, an increase

in local prices will lead to small decreases in tourism demand from the UK and the USA i.e. relatively inelastic demand. One of the possible reasons that the elasticity for South Africa is quite low can be attributed to the Pound Sterling/SA Rand and US Dollar/SA Rand exchange rates since the exchange rate is still favourable, where UK and USA tourists do not see an increase in prices as a deterrent to come to South Africa. In terms of cross-prices elasticities, the model concludes that most of the countries compete on prices. When South Africa's tourism price increases, Malaysia gains UK tourists. An increase in the tourism price of South Africa is consistent with a decrease in USA and UK tourists. If South Africa's tourism price has an increase it is associated with an increase in demand for Spain by USA tourists but, in contrast, it shows that an increase in the tourism price in South Africa is associated with a decrease in tourism to Italy from the USA.

To answer the questions set out in the introduction and problem statement, the AIDS model shows that tourists are not as sensitive to expenditure changes as they are to price changes. This shows that South African prices do not seem to bother UK and USA tourists that much when focusing on the own-price elasticity. This means that South Africa can raise its prices without losing too many tourists due to the favourable exchange rates and that tourists do not mind the prices in South Africa. Possible deterrents to South Africa are factors that are not taken into account in this study.

5.2.4 Conclusions with regards to the most suitable model

The two models were also tested against one another using the J-test and it was found that the AIDS model dominates the Rotterdam model and is thus the better model for estimating demand for South Africa when only focusing on UK tourists. For USA tourists, the J-test found that South Africa is indifferent between the two models. This indicates that the Rotterdam model can also be used as an alternative specification to model tourism demand from USA tourists for South Africa. One of the key differences between the two models is that the AIDS model is a dynamic model which captures short-term variations. The error-correction specification also allows for short-run adjustment from long-term equilibrium, which is not captured by static long-run models. It seems that the Rotterdam models elasticities were exaggerated and thus the AIDS model should represent a more correct elasticity.

5.2.5 Conclusions with regards to demand elasticities of UK and USA tourists

The price competitiveness that was discussed in Chapter 1 can be determined by focusing on the own-price elasticities. In the Rotterdam model, South Africa is shown as being very price sensitive. This means that an increase in price will lead to a more than proportional decrease in UK and USA demand for South Africa. With regards to the EC-AIDS model, the elasticities show that South Africa is not price sensitive since there is only a moderate decline in UK and USA tourists to South Africa should the price increase. This might indicate that South Africa is still viewed as a destination that offers value for money. This study compared the short run elasticities between the models, but the error correction term in the AIDS specification also confirms that tourism demand for South Africa is still relatively price-insensitive, even in the long run. Since the AIDS model outperformed the Rotterdam model, policy-makers would be better advised by the AIDS model's elasticities.

5.3 Recommendations

Since this research focussed on modelling tourism demand using the Rotterdam and the EC-AIDS models, policy recommendations can be identified. In addition, further research recommendations follow.

5.3.1 Policy recommendations

In light of different results that were found with the Rotterdam and EC-AIDS models, no clear policy recommendations can be drawn from both models but rather a different set of recommendations for each model. In a South African context, it can be advised that South Africa is a luxury destination (income elastic) for UK and USA tourists, and with UK and USA tourists not being price sensitive, more needs to be done to attract tourists to South Africa. According to the Rotterdam model, policy makers should try and keep prices constant as increased prices can lead to a huge decrease in demand for South Africa. The study also showed that South Africa's competitors for the USA and UK markets are other long haul destinations like Malaysia. Shares to South Africa can be increased by understanding how competitors lure tourists to their countries and improving on their marketing techniques. The increase in South Africa as a tourist destination for USA tourists

should prompt policy makers to make concerted efforts to ensure the trend of an increase in tourists from the USA as the USA was shown by Han *et al.* (2006) as the leading country in tourism spending. For policymakers it is important to understand that the AIDS model is a dynamic model and was shown in the study to be superior to the Rotterdam model in estimating tourism demand to South Africa. In light of this, the results found in the AIDS model should be the focus of policymakers. One of the key factors influencing UK and USA tourists' decision to visit South Africa is the tourists' income. Since South Africa is a long-haul destination for both of these countries, it is expensive to travel to the country, which adds substantial cost to the tourists' holidays. This attribute of South Africa means that South Africa is more exposed to the state of the world economy in attracting foreign tourists. This unfortunate situation ties the hands of policymakers in designing policies to attract tourists to South Africa, but it is one of which policymakers should take cognisance. One area of interest for policymakers could be countries where income is still experiencing rapid growth, such as the BRIC countries. Policymakers can design policies to lure tourists from these countries to South Africa. Another possible avenue for policymakers is to gear more effort in the African markets, especially those economies that are growing at a faster rate than the South African economy.

5.3.2 Further research recommendations

For further study, there is scope to test these models of demand for South Africa as a tourist destination for African countries, since Africa is the main source of tourism to South Africa. Other alternatives are to estimate similar models using different variables, different price indices and to compare the different studies with each other and, in so doing, determining which model and variables are the most suitable for South African tourism demand. Modelling could be undertaken on other destinations, this would provide more information about the relative importance of price competitiveness and the growth of tourists' expenditure budgets for destination choice and related policy making. Researchers would also benefit in using the different AIDS models that was discussed in Chapter 2 in estimating tourism demand for South Africa and comparing it to this study.

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