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Demand for International Tourism in Sri Lanka: Almost Ideal Demand System

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Abstract

The paper analyses the tourism demand and its economic determinants for effective management within the tourism sector. Utilising the Almost Ideal Demand System (AIDS), the study aims to estimate tourism expenditure and price responsiveness elasticities. The model employs data from 1995 to 2019, focusing on total share, total expenditure share, and total expenditure share per item. The findings reveal that Sri Lanka emerges as a destination with typical demand characteristics, showcasing a notably higher demand for tourism. Analysis of spending elasticities, both in terms of own and cross prices, underscores the country's favourable position within the tourism market. Specifically, the results indicate that the demand for tourism in Sri Lanka is sensitive to pricing dynamics, with elasticity values suggesting a significant response of tourist demand to price fluctuations. Understanding Sri Lanka's competitive position relative to other destinations underscores the importance of tailoring management strategies to suit the unique demand characteristics of each country. Given the price sensitivity observed within Sri Lanka's tourism demand, careful attention to pricing mechanisms is imperative for sustaining and enhancing the country's tourism sector.

Keywords: AIDS, Tourism demand, Elasticity estimation, Sri Lanka

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INTRODUCTION

Tourism stands as one of the most pervasive and rapidly expanding industries globally. Sri Lanka entered the international tourism in the 1960s (SLTDA, 2020). However, the tourism industry's growth trajectory has been dynamic and diverse. Following the cessation of the war in Sri Lanka, the tourism sector experienced a period of flourishing and prosperity until recent setbacks, such as terrorist attacks and the COVID-19 pandemic. Tourism remains a critical income-generating sector, with Sri Lanka consistently ranking among the top tourist destinations worldwide in recent years. Consequently, the principal economic ramifications of this industry include its contributions to government revenues, foreign exchange earnings, employment generation, and the facilitation of business opportunities, particularly for small and medium enterprises (SMEs) within the country.

Despite fluctuations, tourism has sustained its significance, contributing approximately 12.5 per cent to the GDP in 2020. This marks a notable increase from the 6.7 per cent recorded in 2001, reflecting an average annual growth rate of 3.61 per cent (World Travel and Tourism Council, 2020). Figure 1 illustrates the percentage of GDP contribution attributed to the tourism sector in Sri Lanka. Consequently, the economic growth of Sri Lanka is heavily reliant on the tourism sector, with significant potential for further expansion. Despite enduring substantial challenges such as periods of war, terrorist attacks, violence, and natural disasters, the tourism industry has demonstrated remarkable resilience. Even in the face of such adversities, the sector has managed to sustain operations for short-term periods. However, the cessation of hostilities following the war's end created an environment conducive to tourism. Despite the fluctuating fortunes experienced within the tourism industry, Sri Lanka boasts a rich history as a tourist destination and has consistently ranked among the top destinations globally in recent years. Identifying the determinants of international tourism demand is crucial for informed policy decisions. Although the pivotal role tourism demand plays in the economy, scant attention has been devoted to assessing international tourism demand until recently, with limited empirical research available (Gamage et al., 1997, 1998; Gamage and King, 1999). Hence, this research endeavour is motivated by the imperative to examine the causal relationships between economic

determinants and tourism demand.

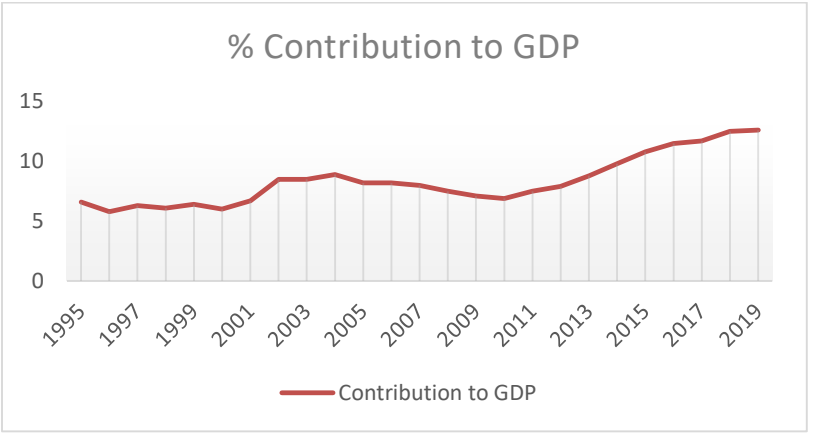

Figure 1: Contribution of tourism to the percentage of GDP in Sri Lanka
Source: World Travel and Tourism Council

Figure 2 depicts tourist arrivals in Sri Lanka from 1995 to 2019. Although data on other exploratory variables are available from 1995 onwards, the study's scope is constrained to this timeframe due to this limitation. It is evident from the figure that tourist arrivals witnessed a substantial surge post-2009, following the conclusion of the civil war. This period saw heightened demand for tourism in Sri Lanka from numerous countries, leading to a dramatic increase in tourist arrivals.

Figure 2: Tourist arrivals in Sri Lanka
Source: World Development Indicators, WB

The primary motivation behind this research is to delineate policy solutions to bolster tourism demand within Sri Lanka. Despite the acknowledged significance of

tourism demand, the theoretical framework governing international tourism demand still needs to be explored within the existing literature. Consequently, this study evaluates tourism demand to furnish robust empirical estimations. Such empirical analysis is imperative given the inherent variability of the tourism sector, which is susceptible to unforeseen disruptions such as terrorism and pandemics like COVID-19.

Forecasting international tourism demand using appropriate techniques becomes essential under such circumstances. These estimation techniques serve as vital tools for addressing econometric challenges inherent in conventional applications while facilitating the development of consistent and accurate predictions regarding future demand. This research provides an innovative platform for understanding tourism demand and sector performance, furnishing essential insights for strategic planning within the tourism industry. By bridging existing knowledge gaps in empirical demand analysis through econometric applications, this study aims to inform policymaking processes effectively.

The tourism sector is Sri Lanka's primary income generator. Nonetheless, achieving improved performance and bolstering demand for international tourism necessitates establishing a robust policy framework. While existing literature offers numerous methodologies for estimating tourism demand, a significant gap remains in validating these approaches for demand estimation and forecasting. Moreover, the tourism sector in Sri Lanka has experienced exponential growth following the post-civil war period, resulting in both an increase in tourist numbers and enhancements in the quality and facilities within the industry.

The overarching objective of this study is to empirically analyse international tourism demand to inform policy formulation in Sri Lanka. They employ three distinct empirical approaches. The study endeavours to yield robust and consistent outcomes for tourism demand estimation and forecasting. To address potential endogeneity issues, the Almost Ideal Demand System (AIDS) model is employed to estimate tourism demand and elasticities of determinants. The structure of this paper is as follows: The second section offers a succinct review of existing studies about the

effects of tourism demand and the AIDS model. Section three outlines the research methodology and data employed in the study. Section four presents and discusses the results obtained. Finally, the fifth section concludes the study and outlines its policy implications.

LITERATURE REVIEW

Despite the inherent advantages of the AIDS model, a dearth of literature focuses on measuring elasticities within the realm of tourism demand analysis. Consequently, the literature review on tourism demand is inadequate in research papers, highlighting one of the merits of employing the AIDS model for such analyses. Koike and Yoshino (2014) studied inbound and outbound tourism markets to gain insights into tourism demand and interregional relationships. Their primary objective was to assess the suitability of the AIDS model in estimating tourism demand in Japan. Utilising a dynamic AIDS model, they aimed to derive elasticities for destination activities. Their findings revealed the proactive influence of economic factors on changes in tourism demand, underscoring the significance of adopting strategies to promote tourism. Moreover, they calculated long-run elasticities while considering policies to alter tourism demand.

Singagerda et al. (2020) studied Indonesian tourism price competitiveness utilising the AIDS model. They argued that a low price level does not guarantee high foreign exchange earnings for a tourism destination. Furthermore, they contended that price reduction strategies may not effectively increase income earnings if demand is price-inelastic. Consequently, they advocated for applying the AIDS model, an appropriate demand elastic approach, to measure competitiveness. Their findings revealed that the price of tourism significantly influences the allocation of tourist spending. As a result, they emphasised the importance of implementing diverse strategies to enhance the tourism sector in Indonesia, considering demand characteristics and competitiveness. The study proposed various measures, including pricing strategies, ensuring domestic inflation stability, monitoring the monetary price trend of competitor countries, and fostering cooperation within the tourism industry for development. However, it is noted that the study did not adequately address the

endogeneity of the AIDS model, potentially impacting the robustness of elasticity estimations.

Altayeb and Daoud (2022) conducted a study in Jordan; the demand for food and housing is not affected much by changes in price or income, meaning it is inelastic. On the other hand, the demand for all other types of goods is elastic, meaning it is more sensitive to price and income changes. Among the different goods, food and clothing items have the highest own-price elasticity. This study estimates the Almost Ideal Demand System (AIDS) for Jordan. They analysed the demand for various goods using free, homogeneous, symmetric and restricted AIDS models. The results show that the demand for food and housing is inelastic about total expenditure or income. However, the demand for other types of goods is elastic. Specifically, the demand for food and clothing items is relatively inelastic, while the demand for other goods is also inelastic. It is interesting to note that the own-price elasticity for food is exceptionally high compared to other countries. Furthermore, based on the log-likelihood ratios, we found that the assumption of homogeneity and symmetry for the entire system was rejected. This suggests that the demand for aggregate goods in Jordan does not align with the demand theory.

Ito, Maruyama, and Wakamatsu (2022) conducted research in Japan. The COVID-19 pandemic in Japan significantly impacted food consumption patterns, resulting in increased home cooking and a decrease in eating out. The researchers used the Almost Ideal Demand System (AIDS) to analyse whether consumers changed their food preferences between 2019 and 2020. It's worth noting that Japan did not implement legal restrictions on consumer behaviour during this time. By analysing home scan data for 25 food items, including eating out and food delivery, the study found that COVID-19 led to a shift in expenditure towards home cooking in 2020 while eating out experienced a significant decrease. Moreover, the researchers calculated their own price elasticity and expenditure elasticity of demand, revealing that ingredients for home cooking became more substitutive with eating out and more complementary with other ingredients in 2020.

In their 2021 study, Duan, Yu, and Chen use the age structure of Beijing's

population as a significant factor in food consumption. Commodity prices and income play crucial roles, highlighting the need for policies to increase farmers' income and stabilise prices to achieve optimal consumption. They utilise Beijing panel data from 1990 to 2019 to expand upon the traditional Almost Ideal Demand System (AIDS) model. They introduce nutritional needs indicators based on age structure and conduct a quantitative analysis of household food consumption in Beijing. The study estimates and compares the income, price, and nutritional demand elasticity of the food consumption structure. Additionally, the study predicts per capita food consumption in Beijing. The findings demonstrate that commodity prices and income influence consumer demand. Furthermore, changes in the population's age structure have a corresponding impact on consumption structure. Beijing's consumption structure is currently optimising, calling for relevant departments to develop policies focusing on increasing farmers' income and stabilising prices.

Gostkowski (2018) analysed consumer demand using the Quadratic Almost Ideal Demand System (QUAIDS), an extension of the Almost Ideal Demand System. Notably, the QUAIDS model allowed for exploring inaccessible relationships through single equation models and accommodated non-linear Engel curves. Utilising household microeconomic data from 1999 to 2015, Gostkowski extended the QUAIDS model with demographic variables in the analysis. The results indicated that the QUAIDS model was not reducible to the AIDS model and was an adequate tool for consumer demand analysis. However, it is essential to note that the QUAIDS model may encounter singularity issues, which this research needed to elucidate. Additionally, the study should have addressed the concern of endogeneity, potentially affecting the reliability of the findings.

In Pakistan, Iqbal et al. (2023) studied the demand for most fruits as inelastic, meaning they are considered necessities. However, a few notable substitutes exist, such as apples, grapes, and almonds. This research paper aims to analyse the demand elasticities of fruits in Pakistan using the Linear, Approximate, Almost Ideal Demand System (LA/AIDS). The data used for this study is from the Household Integrated Economic Survey (HIES) 2018-2019, which is part of the Pakistan Living Standard and Measurement. The analysis results show that the estimated expenditure elasticities

for the selected fruits in Pakistan are positive. The expenditure elasticities for bananas, malta, apples, grapes, watermelon, plum, and almonds is less than one, classifying them as everyday food items. The estimated uncompensated own price demand elasticities for all fruits in Pakistan are also less than one, indicating that they are inelastic and classified as necessities. Based on the cross-price uncompensated demand elasticities, eighteen fruits are considered gross complements, while three are gross substitutes. Most fruits are considered neutral, as their estimated elasticities are closer to zero, meaning they have no significant cross-price effect on each other's demand. Only apples, grapes, and almonds are found to be notable substitutes. Due to the inelastic nature of the price elasticities of fruits, any price changes would significantly increase expenditure on these fruits. Therefore, the government may consider implementing policies to stabilise fruit prices to ensure that the basic daily food requirements of the lower segments of society are met. This study is unique in that it focuses on estimating demand elasticities for individual fruits, as there is limited research available on this topic in the study area.

Rusli and Kamu (2020) investigated changes in Malaysians' food preferences, explicitly focusing on fresh meat such as poultry, beef, mutton, and other varieties. Their study aimed to explore shifts in consumer preferences within this domain. Employing the Linear Approximate Almost Ideal Demand System (LA-AIDS), they assessed the demand elasticity of fresh meat among households in Malaysia. Utilising data from the Household Expenditure Survey (HES) conducted in 2014, they constructed a model to estimate demand elasticities. Despite applying a linear approximation of the AIDS model, they did not address the issue of endogeneity within the system equations.

Sacli and Ozer (2017) conducted a study investigating the socio-demographic and economic factors influencing expenditure on red and chicken meat and eggs based on a household survey conducted in Turkey. Employing the Ideal Demand System (LA/AIDS), they identified significant determinants such as gender, education level, income, and birthplace for veal and beef demand. Notably, they found that none of these variables significantly influenced mutton consumption, except for being born in an urban area. Additionally, after estimating cross-price elasticities for veal, beef, and

goat meat, they observed negative values, indicating complementarity between these meats, while other product groups exhibited positive values, suggesting competition. However, they should have noticed the endogeneity of covariates, potentially compromising the robustness of the elasticity estimates in their model.

Rahmani et al. (2019) conducted a study on the impact of travel distance on domestic tourism demand in Mashhad. They collected cross-sectional data from domestic tourists using a randomised stratified sampling method. The study employed the AIDS model to estimate income and price elasticities for six items: food, accommodation, transportation, entertainment, shopping, and souvenirs. Additionally, the study examined the influence of travel distance on tourism demand. However, the study overlooked the endogeneity issue in the AIDS model, potentially affecting the reliability of the findings.

Li et al. (2004) investigated tourism demand modelling using the dynamic linear AIDS method. In this study, both static and dynamic forms of LAIDS were estimated for international tourism demand. The dominance of the dynamic error correction LAIDS over its static counterpart was applied for theoretical restriction and forecasting accuracy. The study calculated short-run and long-run elasticities using expenditure data from UK tourists. The findings indicated that travelling to Western Europe was considered luxurious for UK tourists in the long run, making demand for these destinations price elastic over time. Moreover, the study proposed that the effects of substitution or complementarity varied across different destinations. However, one limitation of this study was its failure to address the issue of endogeneity in the equations.

Li et al. (2018) studied the demand for organic fluid milk using the AIDS model based on retail data from 2008 to 2010. Their research examined consumer demand for organic fluid milk products distributed through conventional and natural marketing channels. The study's findings revealed asymmetric cross-price elasticities, indicating a relative reluctance among consumers to switch from organic milk to traditional milk. Moreover, the authors explained that shifts in demand towards products with higher expenditure elasticities in a differentiated market could be

attributed to relative budget shares and expenditure elasticities. However, the study neglected to extend its analysis to address endogeneity within the AIDS model.

Vu (2020) investigated the food consumption patterns of households in Vietnam in 2006, considering a comprehensive demand system alongside socio-demographic factors. Employing a modified AIDS model, the study estimated demand elasticities. The findings highlighted the influence of income, price, socio-economic status, and geographic factors on food consumption patterns in Vietnam. Notably, all food items exhibited positive expenditure elasticities and negative own-price elasticities. The study indicated that middle-income households benefited the most, while the poorest households gained the least from higher rice prices. This underscores the importance of targeted support programs, particularly for the poorest quintile, especially in regions disproportionately affected by price increases. The study emphasised the need for tailored food policies based on specific demand patterns within different demographic groups.

RESEARCH METHODOLOGY

A panel dataset primarily comprises tourist arrivals from 1994 to 2019 across 32 countries because of the data availability. Secondary data is obtained from annual reports issued by the Sri Lanka Tourist Development Authority (SLTDA). Annual data are derived from various years of the World Development Indicators from the World Bank, with all nominal values being adjusted to constant 2015 U.S. dollars utilising the Consumer Price Index (CPI). Although the study encompasses 32 countries, particular focus is placed on the twelve most significant countries in terms of tourism demand, including India, China, the UK, Germany, Australia, France, the Maldives, Russia, the USA, The Netherlands, Canada, and Japan, for elasticity estimation.

Variables measuring tourism demand

As presented in Table 2, numerous variables have been identified in the literature to gauge tourism demand. A defining characteristic of tourism is its consumption of a bundle of goods and services (Copeland, 1991). Thus, for analytical purposes, tourism can be conceptualised as a composite of commodities, encompassing

all goods and services that a tourist or visitor consumes at a destination (Divisekera, 1995; 2003). Consequently, demand is measured concerning all commodities consumed by tourists or the aggregate value of those commodities.

Price: Typically, literature considers two types of prices: the cost of travel to the destination and the cost of living for tourists within the destination country. However, due to the challenges associated with measuring these prices or fees and the unavailability of transport costs, the Consumer Price Index (CPI) is employed as a proxy for the price of tourism. Moreover, the CPI is adjusted for the exchange rate between the origin and destination currencies. The price variable is anticipated to exert a negative influence on tourism demand.

Relative Price: Given the difficulty in directly measuring the actual expenditure on tourism prices, such as the cost of living in the destination country, the Consumer Price Index (CPI) is a proxy for tourism prices at the destination (Morley, 1994). Nonetheless, the following formula is utilised to account for fluctuations in exchange rates.

$$RP_{it} = \left(\frac{CPI_{it}}{CPI_{jt}}\right) ER_{it}$$

Where $RPit$ is the relative price in the destination, $CPIit$ is the consumer price index in destination country i, $CPIjt$ is the consumer price index in origin country j; it is an index of the price of origin country currency in terms of destination country i currency (Lim, 1997).

Tourism Expenditure: The expenditure of tourists also significantly influences tourism demand. Increasing the tourism expenditure within a country can hurt tourism demand. Several studies argue that an increase in the expenditure of the destination country may reduce the demand for that particular destination.

Expenditure Share: Typically, actual expenditure data spent in each country are required to calculate expenditure shares. However, such data are often not readily available. Instead, the total tourism expenditure for each destination is determined by

multiplying the total tourism receipts in country i by the fraction of tourist arrivals from the source country's overall tourist arrivals in country i.

Empirical Method

In empirical methodology, the AIDS (Almost Ideal Demand System) model presents an econometric framework for analysing tourism demand. Despite the multifaceted nature of tourism demand, wherein various key variables are discussed, the relative importance of these variables still needs to be fully integrated into the planning of the tourism sector. The AIDS approach offers a robust economic theoretical foundation and is more potent than single-equation models in analysing elasticity within tourism demand.

While the AIDS model made its debut in tourism literature during the 1980s, its application has remained sparse in studies. Nevertheless, Fujii et al. (1985), O'Hagan and Harrison (1984), Papatheodorou (1999), Syriopoulos and Sinclair (1993), and White (1985) have applied the AIDS model in its original static version. Moreover, some studies have employed the AIDS model to model and forecast tourism demand dynamics. Examples include Papatheodorou (1999), Lyssiotou (2000), De Mello, Pack, and Sinclair (2002), Divisekera (2003), Durbarry and Sinclair (2003), Li, Song, and Witt (2004), De Mello and Fortuna (2005), and Han, Durbarry, and Sinclair (2006).

Linear AIDS models have been applied by De Mello and Fortuna (2005), Durbarry and Sinclair (2003), Li et al. (2004), and Mangion et al. (2005), often combined with error correction models. Additionally, Li et al. (2004) conducted demand elasticity analysis and forecasting, demonstrating the superior forecasting performance of EC-LAIDS models over their static counterparts. Li et al. (2006a) further showed that TVP-LR-AIDS and TVP-EC-LAIDS models outperformed fixed-parameter counterparts in demand-level forecasts. De Mello and Nell (2005) examined the forecasting performance of static AIDS against three VAR models. However, this study employs a different analytical framework using a cointegrated VAR approach in dynamic LAIDS models.

Given the theoretical advantages of AIDS in examining substitution effects, this method is particularly well-suited for analysing destination competitiveness. Developed by Deaton and Muellbauer in 1980, the Almost Ideal Demand System (AIDS) model presents a novel technique for analysing tourism demand. Unlike single-equation econometric models, AIDS employs a system-of-equations approach, utilising neighbouring destinations as source markets and tourism expenditure shares as dependent variables.

Almost Ideal Demand System (AIDS) Model

The Almost Ideal Demand System drives from a utility function specified as a second-order approximation to any utility function. The demand functions are derived in budget share form as:

$$\frac{p_i q_i}{y} \equiv w_i = a_i + \sum_j b_{ij} \ln p_i + c_i \, ln \, \frac{y}{P}$$

Where w_i is the budget share, P is a price index defined as:

$$\ln P = a_0 + \sum_k a_k \ln p_k + \frac{1}{2} \sum_j \sum_k b_{jk} \; ln \, p_k \, lnp_j$$
$$i$$

The parameters are subjected to the following restrictions:

$\sum_i a_i = 1; \sum_i b_{ij} = 0; \sum_i c_i = 0; \sum_j b_{ij} = 0$ and $b_{ij} = b_{ji}$

Deaton and Muellbauer (1980) suggest approximating the price index P by the Stone geometric price index:

$$\ln P^* = \sum_i w_i \ln p_i$$

This linear approximation is all the better if there is collinearity in the prices over time. The equation to be estimated is thus:

$$w_i = a^* + \sum_j b_{ij} \ln p_j + c_i \, ln \, \frac{y}{P^*}$$

Where $a_i^* = a_i - c_i \ln \emptyset$ and $P = \emptyset P^*$is the approximation to P. The linear approximate AIDS should be estimated as a system of equations with the abovementioned restrictions on the parameter estimates. The price and income elasticities can be derived from the parameter estimates as:

$$E_{ii} = -1 + \frac{b_{ii}}{w_i} - c_i$$

$$E_{ij} = \frac{b_{ij}}{w_i} - \frac{c_i}{w_i} w_j$$

$$\eta_i = 1 + \frac{c_i}{w_i}$$

The AIDS implies a money flexibility value of minus one (Blanciforti et al., 1986)

Estimating Almost-Ideal Demand System with Endogenous Regressors

Considering the quadratic extension of Deaton and Muellbauer's (1980) AIDS. The QUAIDS, which was introduced by the Banks, Blundell, and Lewbel (1997), the budget share on good $i = 1, \ldots, N$ for household $h = 1, \ldots, H$ with log total expenditure x^h and the log price $N - vector\ p^h$ is given by,

$$w_i^h = \propto_i + \gamma_i' p^h + \beta_i \{x^h - a(p^h, \theta)\} + \lambda_i \frac{\{x^h - a(p^h, \theta)\}^2}{b(p^h, \theta)} + u_i^h$$

With the non-linear price aggregators

$$a(p^h, \theta) = \alpha_0 + \alpha' p^h + \frac{1}{2} p^{h\prime} \Gamma p^h$$

$$b(p^h, \theta) = \exp(\beta' p^h)$$

Where $\alpha = (\alpha_1 \ldots\ldots, \alpha_N)'$, $\beta = (\beta_1 \ldots\ldots, \beta_N)', \Gamma = (\gamma_1 \ldots\ldots, \gamma_N)'$, θ is the set of all parameters, and u_i^h is an error term. These parameters should satisfy three sets of theoretical restrictions: additivity - all must sum to zero overall equations except the constant term, which must sum to one; homogeneity - log price parameters must sum to zero within each equation; and symmetry - the effect of log price I on the budget share j must equal the impact of log price j on budget share i.

Several ways can be observed to introduce demographic variables in the demand system. The households' heterogeneity is applied in the demand system through the α's, which are modelled as linear combinations of a set of socio-

demographic variables (s^h) observed in the data.

$$\alpha^h = \mathrm{A}s^h, A = (\alpha_i')$$

This is known as the translating approach proposed by Pollak and Wales (1981). It allows to depend on the level of demand on the demographic variables. Modelling heterogeneity like this does not mean heterogeneity leads to model linearity. Then, the heterogeneity appears linearly in the intercept and nonlinearly in the expenditure terms. Even though this method is more restrictive than the scaling approach used by Poi (2012), which allows the level and total expenditure terms to depend upon demographic variables, it preserves the conditional linearity in the model.

Elasticities

The main purpose of estimating the demand system is to derive expenditure and price elasticities. These estimates can be derived by omitting h superscripts, differentiating the equation (1) concerning x and p_j. These results, respectively,

$$\mu_i = \beta_i + 2\tau_i \frac{\{x - a(p,\theta)\}}{b(p,\theta)}$$

$$\mu_{ij} = \gamma_{ij} - \mu_i(\alpha_j + \gamma_j p) - \lambda_i \beta_j \frac{\{x - a(p,\theta)\}^2}{b(p,\theta)}$$

Expenditure elasticities are then given by

$e_i = \mu_{ij}/w_i + 1$; uncompensated price elasticities by

$e_i = \mu_{ij}/w_i - \delta_{ij}$, where δ_{ij} is the Kronecker delta, and compensated price elasticities by

$e_{ij}^c = e_{ij}^u + e_i w_j$.

Based on the above empirical framework of the AIDS model, the following sections explain the results of the Almost Ideal Demand System estimates with endogenous regressors.

FINDINGS AND DISCUSSION

Table 1 provides the summary statistics of the variables used in the model. It encompasses the number of observations, mean, standard deviation, and minimum and maximum values of the variables.

Table 1: Summary statistics of the variables

Variable	Obs	Mean	Std. Dev.	Min	Max
year	832	2006	7.504	1994	2019
tourist	820	24843.340	45293.550	86	424887
price	832	8.256	4.615	2.135	22.564
tourexpen	665	123.92	2.671	4.107	180.11
texptrvitem	799	103.92	2.938	3.257	298.51
gdppc	831	29692.23	23289.700	396.122	92556.300
cpij	806	5.946	36.692	-1.401	891.188
trend	800	2006	7.215	1994	2018

Source: Authors' own

Almost Ideal Demand System (AIDS)

This section presents the analytical findings derived from the AIDS model for forecasting tourism demand in Sri Lanka. The primary objective of this chapter is to estimate the potential increase in tourism demand when the determinants experience an increase while addressing the issue of endogeneity through the utilisation of the Almost Ideal Demand System (AIDS) model analysis. Many previous studies applying the AIDS model have not adequately addressed the singularity of the matrix of determinants, which act as endogenous regressors. In contrast, this study addresses the concern of endogeneity by incorporating demographic variables into the model estimation. In addition to demographic variables, three key variables are considered: total share (to share), total expenditure share (the share), and total expenditure share per item (to items). The analytical results for these variables are presented below.

Table 2: Homogeneity and symmetry-constrained estimates

Equation	Obs	Parms	RMSE	R-sq	F (4 798)	Prob >F
toshare	803	4	0.083	0.808	1126.13	0.000
toexshare	803	4	0.213	0.095	28.22	0.000
toitemShare	803	4	0.208	0.195	64.79	0.000

Variables	Coefficient	Std. Err.	z	P>z
to share				
gamma_lnprice	-0.083***	0.009	-9.11	0.000
gamma_lnrelprice	0.051***	0.005	10.26	0.000
gamma_lncpij	0.032***	0.005	6.39	0.000
beta_lnx	-0.058***	0.001	-55.86	0.000
alpha_cons	0.485***	0.013	36.03	0.000
toexshare				
gamma_lnprice	0.051**	0.022	2.29	0.022
gamma_lnrelprice	-0.026**	0.011	-2.29	0.022
gamma_lncpij	-0.024**	0.012	-2.08	0.038
beta_lnx	0.023***	0.002	8.74	0.000
alpha_cons	0.265***	0.033	8.08	0.000
toitemshare				
gamma_lnprice	0.032*	0.018	1.73	0.084
gamma_lnrelprice	-0.024**	0.009	-2.48	0.013
gamma_lncpij	-0.007	0.009	-0.8	0.425
beta_lnx	0.034***	0.002	13.48	0.000
alpha_cons	0.249***	0.029	8.36	0.000

Source: Authors' own

According to the data presented in Table 2, estimates under homogeneity and symmetry constraints are provided. The estimated coefficients for the three price variables are significant at the 5% level, except for gamma_lnprice and gamma_lncpij. Therefore, it can be concluded that the price variables and their distributions are homogeneous and symmetric within the model. This model is constructed without demographic variables and assumes homogeneity for all regressors. The symmetry-constrained estimates and elasticities obtained are identical in both models. Upon comparing the elasticities at the sample mean point, it is observed that the values calculated from the two models, "QUAIDS" and "AIDSILLS," are very close. Subsequently, predicted shares, budget, price elasticities, and standard errors can be obtained after running the latter model.

Expenditure elasticity and own price elasticity

The expenditure elasticity remains positive across all regions, indicating that expanding Sri Lankan outbound tourist' expenditure stimulates tourism demand. In this table, the elasticity score is less than 1 in the short run, implying that a 1% increase in tourist' expenditure results in less than a 1% increase in Sri Lankan tourist demand to these countries. Moreover, the long-run values in these countries are also below 1, suggesting that a 1% increase in Sri Lankan tourist expenditure leads to a change in demand by less than 1%.

Table 3: Predicted shares, budget and (un)compensated own-price elasticities

	shares	**budget**	**u_price**	**c_price**
	b/se	b/se	b/se	b/se
to share	0.037***	-0.578***	-2.258***	-2.279***
	(-0.003)	(-0.13)	(-0.239)	(-0.24)
the share	0.436***	1.054***	-1.071***	-0.612***
	(-0.008)	(-0.006)	(-0.026)	(-0.026)
to items are	0.527***	1.066***	-1.026***	-0.464***
	(-0.007)	(-0.005)	(-0.021)	(-0.022)

*** indicates that the elasticities are significant at a 1% level

Source: Authors' own

In terms of budget, except for total share, which is harmful, both total expenditure share (the share) and total expenditure share per item (to items are) exhibit positive values that are more significant than one. In the short run, a 1% increase in tourist expenditure leads to a more important than a 1% increase in Sri Lankan tourist demand to the original countries.

The price elasticity of the expenditure side is negative across all regions, indicating that an increase in prices and the exchange rate will decrease demand from Sri Lankan tourists. The interpretation of the elasticities mirrors that of expenditure, as a 1% increase in the relative prices of the countries results in a decrease in Sri Lankan short-term demand for tourism. These countries under consideration are less susceptible to changes in their price. Due to the dollar's impact, the number of Sri Lankans travelling abroad has increased. Consequently, although price changes have a more significant impact in the short run, they are expected to decrease in the long run.

Cross price elasticities

In Tables 4 and 5, cross-price values are presented, indicating the sensitivity of demand for each destination country to an increase in price relative to competitors. For example, in the long run, the results suggest that a 1% increase in price in the destination countries results in a decrease in demand for Sri Lankan tourism in those destination countries.

Table 4: Uncompensated cross-price elasticities

	price b/se	reprice b/se	cpi b/se
toshare	-2.258***	1.692***	1.143***
	(-0.239)	(-0.179)	(-0.15)
toexshare	0.083	-1.071***	-0.065*
	(-0.047)	(-0.026)	(-0.026)
to items are	0.019	-0.060**	-1.026***
	(-0.038)	(-0.021)	(-0.021)

Source: Authors' own

The differences in the signs of elasticity between the short and long run suggest that a decrease in prices in the destination countries reduces Sri Lankan tourism demand in the short run. However, this relationship changes in the long run, as almost all cross-price elasticities become positive, indicating that increasing prices will increase tourism in Sri Lanka for nearly all regions.

Table 5: Compensated cross-price elasticities

	price b/se	reprice b/se	cpi b/se
toshare	-2.279***	1.440***	0.839***
	(-0.24)	(-0.137)	(-0.118)
toexshare	0.122*	-0.612***	0.490***
	(-0.047)	(-0.026)	(-0.026)
to items are	0.059	0.406***	-0.464***
	(-0.038)	(-0.021)	(-0.022)

Source: Authors' own

Comparing short and long-run elasticities reveals that the long-run values are higher than the short-run values, indicating that the impact of changing prices in other

regions will increase year by year. Additionally, some regions exhibit different signs in the short and long run. Table 6 below presents the alpha, beta, and gamma distribution of the three price level variables in the model. According to the results shown, all the distributional values are significant, indicating that the distributions are symmetric.

Table 6: Alpha, beta, and gamma distribution of the variables

	Coef.	Std. Err.	z	P>z
alpha				
alpha_1	0.485	0.013	37.79	0.000
alpha_2	0.268	0.026	10.26	0.000
alpha_3	0.246	0.025	9.73	0.000
beta				
beta_1	-0.058	0.001	-55.93	0.000
beta_2	0.023	0.002	9.31	0.000
beta_3	0.034	0.002	14.1	0.000
gamma				
gamma_1_1	-0.082	0.008	-9.73	0.000
gamma_2_1	0.051	0.004	10.62	0.000
gamma_3_1	0.032	0.004	6.88	0.000
gamma_2_2	-0.027	0.004	-6.09	0.000
gamma_3_2	-0.023	0.003	-6.52	0.000
gamma_3_3	-0.008	0.003	-2.24	0.025

Source: Authors' own

When prices are not exogenous, each log price is regressed on exogenous variables (such as total expenditure and demographic variables) and identifying Instrumental Variables (IV). There are at least four IVs in the prices – price, relative price, CPI and income. The Results from these first-stage regressions are reported in tables preceding the demand-system estimates. Residuals are then predicted and added to the set of regressors in each demand equation. Notably, all the variables are significant at a 5% significance level. Further, coefficients of relative prices and CPI of the country of origin are negatively substantial.

Table 7: Instrumental Regression

in tourists	Coef.	Std. Err.	z	P>z
price	2.004**	0.722	2.77	0.006
lnrelprice	-1.718**	0.690	-2.49	0.013
lncpij	-2.231***	0.692	-3.22	0.001
lninc	0.058***	0.015	3.79	0.000
exchrate	-0.007**	0.003	-2.44	0.015
exchrateisl	0.018**	0.007	2.57	0.010
_cons	15.026***	2.325	6.46	0.000

Number of observations: 673; adj R2=0.278; F (6,666) = 44.28***
*,**,*** are shown at 10%, 5%, and 1% levels of statistical significance respectively.

Source: Authors' own

Table 8 shows the homogeneity and symmetry of three expenditure variables with the log variables of the demographic determinants. These variables include total share (toshare): gamma_lnrelprice, beta_lnx, rho_vgdppc, alpha_exchrateisl, and alpha_cons, total expenditure share (toexshare): gamma_lnprice, gamma_lnrelprice, rho_vgdppc, alpha_exchrateisl, alpha_cons, and total expenditure share per item (toitemshare): gamma_lncpij, beta_lnx, rho_vgdppc, alpha_exchrateisl, alpha_cons are significantly determined the tourism demand in Sri Lanka.

Table 8: Homogeneity and symmetry-constrained estimates

Equation	Obs	Parms	RMSE	R-sq	F (7, 665)	Prob > F
to share	673	7	0.164	0.248	36.76	0.000
toexshare	673	7	0.218	0.041	4.79	0.000
to items are	673	7	0.221	0.092	11.31	0.000

Parameters	Coef.	Std. Err.	z	P>z
toshare				
gamma_lnprice	0.011	0.105	0.11	0.914
gamma_lnrelprice	0.110	0.035	3.11	0.002
gamma_lncpij	-0.121	0.075	-1.61	0.107
beta_lnx	-0.235	0.049	-4.78	to share
rho_vgdppc	0.271	0.048	5.63	0.000
alpha_exchrate	0.000	0.001	0.04	0.972
alpha_exchrateisl	-0.003	0.001	-3.21	0.001
alpha_cons	-0.978	0.256	-3.82	0.000

toexshare				
gamma_lnprice	0.109	0.051	2.15	0.032
gamma_lnrelprice	-0.074	0.022	-3.33	0.001
gamma_lncpij	-0.035	0.042	-0.84	0.401
beta_lnx	0.053	0.042	1.27	0.204
rho_vgdppc	-0.086	0.043	-1.98	0.047
alpha_exchrate	-0.000	0.000	-0.66	0.510
alpha_exchrateisl	0.001	0.000	1.99	0.047
alpha_cons	0.761	0.216	3.52	0.000
toitemshare				
gamma_lnprice	-0.121	0.074	-1.62	0.106
gamma_lnrelprice	-0.035	0.037	-0.95	0.343
gamma_lncpij	0.157	0.041	3.74	0.000
beta_lnx	0.181	0.017	10.64	0.000
rho_vgdppc	-0.185	0.020	-9.09	0.000
alpha_exchrate	0.000	0.000	0.65	0.517
alpha_exchrateisl	0.002	0.000	4.00	0.000
alpha_cons	1.217	0.120	10.06	0.000

Source: Authors' own

Table 9: AIDS – linearised with price index unconstrained estimates

Equation	Obs	Parms	RMSE	R-sq	F (6, 666)	Prob > F
toshare	673	6	0.068	0.869	741.3	0.000
toexshare	673	6	0.207	0.139	17.97	0.000
to items are	673	6	0.208	0.194	26.8	0.000

	Coef.	Std. Err.	z	P>z
to share				
gamma_lnprice	0.165	0.048	3.43	0.001
gamma_lnrelprice	-0.185	0.046	-4.03	0.000
gamma_lncpij	-0.177	0.046	-3.83	0.000
beta_lnx	-0.058	0.001	-56.51	0.000
alpha_exchrate	0.000	0.000	3.98	0.000
alpha_exchrateisl	0.002	0.000	4.39	0.000
alpha_cons	1.833	0.156	11.74	0.000
toexshare				
gamma_lnprice	-0.076	0.146	-0.52	0.600
gamma_lnrelprice	0.089	0.139	0.64	0.522
gamma_lncpij	0.075	0.139	0.54	0.592

beta_lnx	0.028	0.003	9.04	0.000
alpha_exchrate	-0.000	0.000	-1.06	0.287
alpha_exchrateisl	-0.001	0.001	-1.27	0.205
alpha_cons	-0.328	0.471	-0.7	0.487
toitemshare				
gamma_lnprice	-0.089	0.147	-0.61	0.544
gamma_lnrelprice	0.096	0.140	0.69	0.491
gamma_lncpij	0.102	0.141	0.73	0.468
beta_lnx	0.030	0.003	9.59	0.000
alpha_exchrate	-0.000	0.000	-0.25	0.802
alpha_exchrateisl	-0.000	0.001	-0.19	0.853
alpha_cons	-0.505	0.475	-1.06	0.288

Source: Authors' own

As the next step of determining the tourism demand through three expenditure variables, AIDS linearised with price index unconstrained estimates are obtained in Table 9. Three price categories are analysed using the linearised model of AIDS to obtain unconstrained estimates. Notably, the total share is significant at a 5% significance, though the other two price indexes are not significant under the linearised form.

Table 10: Homogeneity constrained estimates

Equation	Obs	Parms	RMSE	R-sq	F (6, 666)	Prob > F
toshare	673	6	0.070	0.863	846.24	0.000
toexshare	673	6	0.207	0.136	21.08	0.000
toitemshare	673	6	0.208	0.195	32.38	0.000
	Coef.	Std. Err.	z	P>z		
toshare						
gamma_lnprice	-0.109	0.012	-8.45	0.000		
gamma_lnrelprice	0.062	0.006	9.38	0.000		
gamma_lncpij	0.046	0.007	6.38	0.000		
beta_lnx	-0.060	0.001	-60.48	0.000		
alpha_exchrate	0.001	0.000	4.09	0.000		
alpha_exchrateisl	0.000	0.000	0.44	0.657		
alpha_cons	0.408	0.030	13.43	0.000		
toexshare						
gamma_lnprice	0.047	0.037	1.27	0.206		
gamma_lnrelprice	-0.022	0.018	-1.21	0.226		
gamma_lncpij	-0.024	0.019	-1.27	0.205		

beta_lnx	0.028	0.002	9.82	0.000
alpha_exchrate	-0.001	0.001	-1.15	0.252
alpha_exchrateisl	-0.001	0.000	-1.90	0.057
alpha_cons	0.333	0.076	4.34	0.000
toitemshare				
gamma_lnprice	0.061	0.033	1.86	0.063
gamma_lnrelprice	-0.040	0.017	-2.28	0.023
gamma_lncpij	-0.021	0.016	-1.32	0.187
beta_lnx	0.031	0.002	10.83	0.000
alpha_exchrate	-0.000	0.000	-0.56	0.579
alpha_exchrateisl	0.000	0.000	2.39	0.017
alpha_cons	0.257	0.063	4.03	0.000

Source: Authors' own

Table 10 presents the homogeneity-constrained estimates of the three concerned price variables, including other sociodemographic variables in the AIDS model. Tables 11 and 12 in the annexe present expenditure, own-price, and cross-price elasticities by significant countries in the short and long run.

Analysis of Price Competitiveness of Tourism

This study utilises the AIDS method to model the competitiveness of foreign tourist prices for Sri Lanka, the destination country. Various factors drive the attractiveness of Sri Lanka as a tourist destination. From a tourism perspective, tourists who are satisfied with a particular destination are more likely to revisit it, making the demand for that destination less sensitive to fluctuations in tourists' total budget (income) and prices.

The value of price elasticity indicates that tourists' sensitivity to price changes varies depending on their country of origin. Moreover, the value of cross-price elasticity reveals significant competition between the countries of origin and the destination country. When tourism prices decrease in both countries by the same percentage, the resulting decline in demand for both tourists is more pronounced in competitor countries. However, according to tourists, the value of cross-price elasticity between the two countries shows no significant difference. The high values of both cross-price elasticities among tourists indicate a solid tendency to alter their tourism

preferences in response to price fluctuations in competitors' countries. Thus, the determinants of tourism demand can be influenced by the level of competitiveness between the country of origin and the country of destination (Sri Lanka).

CONCLUSIONS AND POLICY IMPLICATIONS

Tourism has become a significant contributor to the economies of countries like Sri Lanka, which is renowned for its captivating landscapes and island allure. However, the tourism industry can achieve higher growth objectives with proper planning and encouragement for sectoral growth. This dissertation addresses three objectives using different econometric and data science applications to recommend solutions for these pitfalls.

The study employs a complete demand system estimation using the AIDS model to analyse the tourism demand for Sri Lanka from various countries of origin. Price emerges as the primary determinant influencing the allocation of tourist spending in destination countries. Results indicate that Sri Lanka is a regular destination with a higher demand for tourism, implying that tourist demand for these destinations will increase alongside the rise in tourists' total budget.

The value of spending elasticities of own price and cross prices suggests that the demand for tourists is sensitive to price changes. Specifically, price elasticity indicates that tourist demand is elastic or sensitive to price fluctuations. In general, price elasticity holds greater significance than output elasticity, signifying that tourist demand tends to be more responsive to price changes than changes in the tourists' total income. Understanding Sri Lanka's competitiveness in the tourism market relative to competitor countries is essential for devising effective promotion strategies tailored to the characteristics of each country's tourist demand. Several tourism policy recommendations need implementation to enhance the income of Sri Lanka's tourism sector. Precise pricing strategies that maintain domestic inflation stability are crucial, as tourism demand from countries of origin in Sri Lanka proves to be price-sensitive. These strategies can significantly improve Sri Lanka's appeal to tourists, with elasticities as vital considerations to understand the tourism sector's competitiveness.

LIMITATIONS AND FUTURE DIRECTIONS

The research underscores the implementation of the AIDS model into the tourism sector in Sri Lanka. However, there are limitations in the study, which can be highlighted as more advanced AIDS models, such as integrating deep learning models in data science, can be implemented to understand the more accurate elasticities of tourism demand. Furthermore, the research can be extended to the comparison of elasticities to manage the tourism sector properly in the country.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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Elasticities:

Appendix 01: Expenditure, own-price, and cross-price elasticities in Short Run

Short run													
Destination	**Expenditure elasticity**	**Price elasticity**											
		India	China	UK	Germany	Australia	France	Maldives	Russia	USA	Netherlands	Canada	Japan
India	0.786	0.239	0.883	0.739	0.900	0.111	0.888	-0.120	0.101	-0.632	0.201	0.523	0.110
China	0.285	0.832	0.543	0.312	-1.003	0.164	-1.998	0.734	-0.456	0.802	0.403	-0.901	0.794
UK	1.492	0.873	-0.043	-0.773	0.062	0.375	0.109	0.787	0.555	0.090	-0.800	0.223	-0.934
Germany	0.235	0.234	0.023	0.909	0.231	-0.397	0.208	-0.333	0.878	-0.126	0.265	-0.222	0.451
Australia	0.837	0.793	0.084	-0.125	0.799	0.765	0.466	0.092	0.763	0.945	0.675	0.900	0.093
France	0.763	-1.823	0.620	0.903	-0.537	0.456	0.121	0.126	-0.230	0.234	0.345	0.898	-0.253
Maldives	0.238	0.723	0.172	-0.007	0.191	0.232	0.264	0.733	0.909	0.786	-0.856	0.763	0.834
Russia	1.342	0.645	-0.905	0.356	0.901	0.234	-0.093	0.110	0.122	0.345	0.854	-0.945	0.128
USA	0.945	0.854	-0.125	0.360	-0.542	0.754	0.623	0.800	0.011	-0.045	0.034	0.374	0.347
Netherlands	0.873	-1.782	0.734	0.083	0.002	-0.532	0.623	-0.732	0.700	0.567	0.342	0.965	0.192
Canada	0.124	0.882	0.708	0.902	0.426	0.347	0.734	0.734	-0.834	0.978	0.743	0.595	-0.943
Japan	0.239	0.723	0.744	0.101	-0.262	0.908	0.965	0.733	0.464	0.324	-0.745	0.378	0.873

Source: Authors' own

Appendix 02: Expenditure, own-price, and cross-price elasticities in Long Run

Long run													
Destination	**Expenditure elasticity**	**Price elasticity**											
		India	China	UK	Germany	Australia	France	Maldives	Russia	USA	Netherlands	Canada	Japan
India	0.112	0.201	0.293	0.294	0.101	0.192	0.119	1.114	0.902	0.221	0.762	0.200	0.119
China	0.423	-0.844	0.442	0.568	0.209	0.731	-0.763	0.843	-0.734	0.809	0.800	0.252	0.839
UK	0.732	0.722	0.333	0.925	-0.382	0.329	0.530	0.543	0.632	0.876	0.953	-0.087	0.262
Germany	1.932	0.249	-1.005	0.335	0.575	-0.879	0.569	0.685	0.990	-1.240	0.200	0.244	0.363
Australia	0.877	0.072	0.762	0.909	0.579	0.777	0.728	-0.434	0.702	0.070	0.438	0.657	0.770
France	0.901	0.475	0.018	0.682	0.483	0.283	0.800	0.657	0.093	0.811	-0.276	0.237	0.812
Maldives	0.004	-0.383	0.812	0.630	0.772	0.782	0.226	0.954	-0.504	0.744	0.483	0.870	-0.904
Russia	0.893	0.066	0.108	-0.908	0.881	0.902	0.856	0.345	0.398	0.904	0.783	0.622	0.663
USA	1.576	0.569	0.283	0.888	0.854	0.739	-0.237	0.880	0.008	0.822	0.289	0.346	0.802
Netherlands	1.822	0.420	0.804	0.127	-0.700	0.567	0.954	0.354	0.700	0.716	0.439	0.213	0.634
Canada	0.104	-0.722	0.662	0.387	0.392	0.298	0.348	0.345	0.888	-0.076	0.125	0.566	-0.902
Japan	0.584	0.700	0.810	0.592	0.438	0.005	0.674	-0.085	0.741	0.037	0.123	0.348	0.701
Own price elasticity	In red, negative price elasticities are presented.												

Source: Authors' own