



Flights and Variations: Understanding the Dynamics of Elasticity in Air Transportation

Vuelos y variaciones: comprensión de la dinámica de la elasticidad en Transporte Aéreo

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Resumen

El crecimiento económico de un país, reflejado en sus principales indicadores, actúa como motor de desarrollo en sectores como el comercio, la industria, la movilidad, el turismo y la infraestructura. Los estudios econométricos permiten cuantificar las interacciones en este entorno mediante el análisis de datos y la elaboración de modelos estadísticos que ofrecen soluciones óptimas a problemas complejos de las ciudades. La elasticidad precio de la demanda es una medida econométrica que determina cómo los cambios en el precio afectan el consumo de productos o servicios; de acuerdo con la teoría, la demanda es elástica si su valor es mayor que 1 e inelástica si es menor que 1. En este contexto, la presente investigación realiza una revisión del Estado del Arte de los principales estudios sobre la elasticidad precio de la demanda del transporte aéreo, parámetro que mide el impacto de una variación en el precio sobre la cantidad de boletos adquiridos. En el mercado aéreo, diversas investigaciones han buscado modelar de manera óptima la relación entre el precio y la demanda, evidenciando que la elasticidad presenta alta sensibilidad a factores como las variables empleadas en su medición y las metodologías utilizadas, hallazgos que pueden guiar decisiones estratégicas en la fijación de precios.

Palabras clave: Crecimiento económico; Elasticidad precio de la demanda; Transporte aéreo; Modelos econométricos; Fijación de precios.

Abstract

A country's economic growth, reflected in its main indicators, acts as a generator of development in sectors such as commerce, industry, mobility, tourism, and infrastructure. Econometric studies allow for the quantification of interactions within this environment through data analysis and the construction of statistical models that provide optimal solutions to the complex problems of cities. Price elasticity of demand is an econometric measure indicating how changes in price affect the demand for products or services. Theory indicates that demand is elastic if the price elasticity of demand is greater than 1 and inelastic if it is less than 1. This research conducts a State of the Art review of the principal studies related to the price elasticity of air transport demand, a parameter that measures the effect on the quantity of tickets purchased in response to a price variation. In the air transportation market, various investigations seek to optimally model the relationship between the variables of price and demand, revealing a high sensitivity of elasticity to two determining factors: the variables involved in its measurement and the methodologies used for its determination. The findings can contribute to optimal decision-making in the pricing of services offered by associated institutions and companies.

Keywords: Economic growth; Price elasticity of demand; Air transport; Econometric models; Pricing.



1. Introducción

Passenger demand is one of the most notable variables in the air transportation market, a condition that has led to multiple studies analyzing its correlation and causality with other related economic, social, and political variables. Air transport substantially contributes to a country's economic development by fostering trade and investment. As of December of this year, approximately 5.5 million passengers and 339,000 metric tons (TM) of cargo were transported by air in Ecuador, both domestically and internationally.

Table 1

Passenger and Cargo (MT) Relationship

	PASSENGERS	CARGO (MT)
INTERNATIONAL	2.513.279	333.048
DOMESTIC	2.975.796	5.926
TOTAL 2023	5.489.075	338.974

Therefore, it is necessary to have research that contributes to a better understanding of the airport sector. The information contained in this state of the art review (2000–2022) has been developed by compiling and analyzing several relevant global investigations, selected for their pertinence, complexity, and the advancements shown in the research topic. It is now up to the reader to delve into a critical analysis of this study in search of methodological optimization and the construction of minimum technical agreements on which variables, instruments, and analysis methods will best meet goals and ensure quality in the airport sector.

Development of Topics

Sources and Types of Variables

The inclusion or omission of variables in a study is a key factor in estimating a reliable elasticity model. This information can be found in various available sources, such as

government agencies, travel agencies, airlines, and websites. The study by Perera (2019), for instance, used a database compiled from three individual databases of a specific airline over a 12-month period, containing information on reservations, ticket issuance, and accounting data like flight times, commissions, and fares. Escañuela (2018) employed a mix of variables, compiling information from national agency sources (domestic passengers, population, travel prices, per capita expenses, fuel prices) and data on passengers and prices from the U.S. aviation division since 1993. In Granados (2012), data from an international airline was collected over two years, amassing over two million reservation records for forty city pairs. Other available sources include freely accessible official sites, as seen in a study of the low-cost air market that consulted data from the airline easyJet over a 7-month period, along with two additional sources for airlines operating on the same routes.

Endogeneity and Instrumental Variables

Once the variables for demand analysis are selected, it is important to analyze whether endogeneity exists in the model. This condition arises when observed variables are correlated with unobserved factors. To address this problem, "instrumental" or "control" variables are



introduced to capture the conditional mean of these factors and thus control the correlation. Instrumental variables applied in these studies include: weekly demand for non-promotional fare tickets, the airline's average price in all other markets with similar-length flights, the price of oil, passenger flow, and the offer price, which refers to the marginal cost of offering a seat. However, control variables do not always succeed in correcting endogeneity, as they may still exhibit autocorrelation with the estimated regression model, as observed with the variables of oil price and passenger flow.

2. Metodología

Researchers use different methods to estimate elasticity. The table below summarizes the most frequent ones, along with their main advantages and disadvantages.

Table 2

Comparative Methodology Chart

METHODOLOGY	MODEL	ADVANTAGES	DISADVANTAGES
Qualitative Methods	Market Research	Speed and ease of obtaining information	Subjectivity
Extrapolation	Time Series	Considers variability	Difficulty in obtaining
		over time	complete databases
Causal Models	Regression Models	Reliability and ease of processing	Modeling errors and complex databases
Optimization Models	Linear and Non-linear Programming	A viable alternative when regression models are insufficient	Complex programming and extensive processing

When a relationship exists between variables, linear regression does not provide optimal model estimates; to address this, a two-stage regression is performed using instrumental variables. This is observed in Mumbower et al. (2014), which initially uses an ordinary least squares regression model and, upon finding endogeneity, implements a two-stage instrumental variable model to correct the condition. The study by Perera (2019) demonstrates how a regression analysis can be applied comprehensively; however, after initial models failed to yield expected results, endogeneity tests showed the instrumental variables were ineffective. Consequently, a sample with high passenger demand was selected, and with this data, the two-stage regression model achieved a value consistent with expectations.



3. Resultados

The effects obtained in the analyses depend directly on the variation factors applied in the models:

- **User Behavior and Seasonality:** Elasticity is affected by user purchasing behavior and the travel season, with elasticity being higher in the high season than in the low season. Different demand models for each selected route also yield varying elasticity values.
- **Flight Type:** The price-demand relationship differs considerably between domestic and international flights.
- **Market Competition:** The exit of a major airline caused the market to become elastic, a change attributed to the significant growth of low-cost carriers in the Indian domestic market.
- **Route Type:** Results show a variation in elasticity depending on the type of route, with inelastic demand for business routes and elastic demand for leisure routes.
- **Distance:** Elasticity shows significant differences based on the distance traveled on routes⁴³. One study obtained a price elasticity of demand at the national market level of -1.11, while a harmonic analysis showed a value of -0.71 for the entire market.
- **Passenger Flow:** In one model, after selecting a high-passenger-flow sample, only a 2-stage least squares model resulted in an elastic demand of -1.157, which the author indicates is the most consistent with expected industry results.
- **Endogeneity Correction:** An initial price elasticity estimate was 0.75 (inelastic), but after correcting for endogeneity, the elasticity became 1.97 (elastic).
- **Geography and Aggregation Level:** The IATA (2007) report indicates that airfares vary according to geography, distance, and level of aggregation (Route, National, and Pan-National).

Table 3

Variation of Fares According to Geography, Distance, and Aggregation Level

	Route/Market Level	National Level	Pan-National Level
	Short-haul	Long-haul	Short-haul
Intra North America¹	-1.54 ²	-1.40 ³	-0.88 ⁴
Intra Europe⁵	-1.96* ⁶	-1.96 ⁷	-1.23 ⁸
Intra Asia⁹	-1.46 ¹⁰	-1.33 ¹¹	-0.84 ¹²



Intra Sub-Sahara Africa ¹³	-0.92 ¹⁴	-0.84 ¹⁵	-0.53 ¹⁶
Intra South America ¹⁷	-1.93 ¹⁸	-1.75 ¹⁹	-1.10 ²⁰
Trans Atlantic (North America – Europe) ²¹	-1.85 ²²	-1.68 ²³	-1.06 ²⁴
Trans Pacific (North America – Asia) ²⁵	-0.92 ²⁶	-0.84 ²⁷	-0.53 ²⁸
Europe-Asia ²⁹	-1.39 ³⁰	-1.26 ³¹	-0.79 ³²

The short-haul adjustor has not been applied to the Intra Europe short-haul elasticity in order to maintain elasticities below 2.0

Source: IATA (2017)

4. Discusión

Investigations are conducted within a specific scope, and their application is generally limited to that context. For example, one must consider whether analyses account for competition, refer to a domestic or international market, involve passenger segmentation, calculate booking time, or include price variations and other related factors. Competition is a factor some studies consider to determine elasticity, showing the effects of the entry or exit of competing airlines, while others analyze the behavior of a single airline across different routes. The content of variables is influenced by their source; in some cases, the price variable refers to the average airfare without considering market fluctuations, while in others it refers to the minimum price for each day. Data from freely accessible websites offer a large amount of information on routes, airlines, and travel agencies and are generally more accessible than data from airlines or government agencies, which may not always be available or may be confidential. Databases may present problems, such as a high percentage of missing information in registered observations. To correct this, an inverse probability weighting methodology and a sensitivity analysis have been used.

Within the framework of theoretical considerations, it is pertinent to incorporate a Keynesian perspective to deepen our understanding of aggregate demand for air transport. Following the reinterpretation of Keynes proposed by Kicillof and Odriozola (2017), demand for services such as air travel does not respond solely to microeconomic optimization by consumers, but is

intrinsically linked to fluctuations in the economy as a whole. Uncertainty about the economic future, a pillar of Keynesian analysis, directly impacts leisure and business spending decisions,



altering apparent elasticity. Thus, an airline pricing policy that ignores the state of overall effective demand—and the public policies that seek to manage it—risks making elasticity estimates that, although econometrically sophisticated, are insufficient to capture the true dynamics of the market.

In order to complement the analysis of the factors that determine pricing and elasticity, it is crucial to consider the public policymaking process, as described by Vásquez, Córdoba, and Muñoz (2005). Airfares and sector regulation are not the result of an isolated technical calculation but rather of complex negotiations among actors with varying degrees of power and influence, including government agencies, airlines, tourism associations, and consumer organizations. "Policymaking" in this area means that variables such as competition, route allocation, and fuel taxes are not merely input data for an econometric model but rather the result of political disputes and strategic agreements. Therefore, a comprehensive analysis of elasticity must consider how this political arena shapes the structural conditions of the airline market.

Future Studies

The studies themselves suggest the need to incorporate new variables and use innovative methodologies like optimization models and game theory to achieve a better approximation of the price elasticity of demand. Specifically, researchers propose calculating cross-price elasticity using data not only from one airline but also from its competitors to observe intergroup interactions. Other authors see a need to extend the data collection period to observe seasonal variations over time and to test passenger demand elasticity in relation to variations in GDP and income. A lack of generality is a noted weakness in existing studies; proposed prediction models often work only at the flight or route level but not at both simultaneously. Thus, there is room for improvement in areas such as predicting the exact value of ticket prices/demand, addressing dataset issues, and enhancing prediction techniques.

5. Conclusión

The research process begins with the search for representative model variables and the application of method validity tests, continues with the analysis of result consistency with the studied market, and ends with the development of alternative methodologies to support the obtained effects. Measuring elasticity via regression requires systematizing factors like the type and quantity of available variables, the existence of endogeneity, the validity of selected instrumental variables, and the number of application stages; the reliability of the results

depends on these factors. Other statistical methodologies, such as optimization algorithms, segmentation and harmonization techniques, and game theory, present competent alternatives for calculating this metric.

In most analyzed models, demand is more elastic under conditions of high season, markets with strong competition, leisure travel, domestic or short-haul routes, and high passenger flow; these segments share a common feature of high demand for air tickets. Conversely, demand is generally inelastic in scenarios of low season, markets with balanced competition, business travel, and long-haul routes; these segments are related to low demand for tickets. In scenarios with high ticket demand, there is greater elasticity, meaning the quantity demanded responds significantly to a price variation. In scenarios with low ticket demand, the opposite occurs, where price does not have a significant influence on the quantity demanded. This serves as a guide for establishing pricing policies for airfares.

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Conflicto de Intereses: Los autores declaran que no tienen conflictos de intereses relacionados con este estudio y que todos los procedimientos seguidos cumplen con los estándares éticos establecidos por la revista. Asimismo, confirman que este trabajo es inédito y no ha sido publicado, ni parcial ni totalmente, en ninguna otra publicación.