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Commentary

The Fundamental Equation in Tourism Finance

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Abstract: The purpose of the paper is to present the fundamental equation in tourism finance that connects tourism research to empirical finance and financial econometrics. The energy industry, which includes, oil, gas and bio-energy fuels, together with the tourism industry, are two of the most important industries in the world today in terms of employment and generating income. The primary purpose in attracting domestic and international tourists to a country, region or city is to maximize tourism expenditure. The paper will concentrate on daily tourism expenditure, regardless of whether such data might be readily available. If such data are not available, a practical method is presented to calculate the appropriate data.

Keywords: tourism research; tourism finance; growth in tourism; returns on tourism; volatility; fundamental equation; empirical finance; financial econometrics.

JEL Classification: C22; C32; C58; G32

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1. Introduction

The purpose of the paper is to present the fundamental equation in tourism finance that connects tourism research to empirical finance and financial econometrics.

In addition to the energy industry, which includes, oil, gas and bio-energy fuels, tourism is one of the most important industries in the world today in terms of generating employment and income. The primary purpose in attracting domestic and international tourists to a country, region or city is to maximize tourism expenditure. In this sense, tourism is a commodity that provides income and income growth. This association is the primary reason for tourism advertising and promotional expenditures that are intended to attract tourists from a source country, region or city.

The growth in income is essentially identical to the returns on financial assets, such as stocks, bonds and any associated financial derivatives. This parallel interpretation, which leads to returns and associated measures of financial risk, will be developed in the following section.

There has been substantial research in empirical finance and financial econometrics to analyze the high frequency returns financial assets, that is, returns on a weekly, daily, or hourly basis, and ultra-high frequency tick data that measures prices, returns and associated financial risk on a minute, second or nano-second basis. Such analysis has not generally been the case in tourism research, one reason being the lack of ultra-high frequency data.

Twelve papers that have addressed the modelling of tourism demand and the associated volatility (or uncertainty) include Chan, Lim and McAleer [1], Chang, Hsu and McAleer [2], Chang *et al.* [3], Chang, Lim and McAleer [4], Divino and McAleer [5,6], Hoti, McAleer and Shareef [7,8], McAleer and Shareef [9,10,11], and Medeiros *et al.* [12]. These papers have analyzed tourism demand and the associated risk in leading journals such as *Journal of Econometrics*, *Tourism Management*, *Tourism Economics*, *International Journal of Tourism Research*, *International Journal of Tourism Sciences*, *North American Journal of Economics and Finance*, *Environmental Modelling and Software*, and *Mathematics and Computers in Simulation*.

However, none of these interesting papers has sought to present tourism research in the same context as empirical finance and financial econometrics, or analyzed the fundamental equation in tourism finance that connects tourism research to empirical finance and financial econometrics. This lack of an obvious connection misses out on the overlap of tourism research with tourism finance, which therefore neglects the portability of the methods and techniques that are widely used in empirical finance and financial econometrics.

The paper concentrates on daily tourism expenditure, regardless of whether such data might be readily available. If such data are not available, a practical method is presented to calculate the appropriate data. One paper that has analysed daily tourism expenditure data and risk is Medeiros *et al.* [12], who used neural network regression with conditional volatility for ultra-high frequency air passenger arrivals to Mallorca in the Balearic Islands, Spain. Chang, Hsu and McAleer [2] analyzed the impact of China on the daily closing prices of tourism stock prices, returns and volatility in the Taiwan tourism industry, but they did not examine tourist expenditures or total tourism.

It is fair to say that high frequency data have typically not been analyzed widely in tourism research, which may well be a strong reason for the connection between tourism finance and tourism research not having been advocated. This paper seeks to emphasize the connection between the two topical areas of research to enable portability of research methods and techniques across the two research areas.

The remainder of the paper is as follows. Section 2 presents the fundamental equation, Section 3 develops a practical method to make the fundamental equation operational, and Section 4 provides some concluding comments.

2. Fundamental Equation

Consider the equation that relates total daily tourism expenditure, y_t, to the total number of tourists, x_t, and the average daily expenditure by tourists, z_t:

$$y_t = x_t \times z_t \tag{1}$$

As there is little evidence to suggest that the average daily expenditure by tourists, z_t, changes on a daily basis, z_t can be replaced by a constant, *c*, so that Equation (1) can be replaced by the following:

$$y_t = c \times x_t \tag{2}$$

It follows from Equation (2) that:

$$\Delta y_t = c \times \Delta x_t \tag{3}$$

where Δ is the first difference operator, namely $\Delta A_t = A_t - A_{t-1.}$ for a variable A_t, such that Δy_t is the change in total daily tourism expenditure, and Δx_t measures the net daily tourist arrivals, namely the total number of daily tourist arrivals minus daily tourist departures.

Using the lagged version of Equation (2) to divide the left-hand side of Equation (3) by y_{t-1} and the right-hand side of Equation (3) by $c \times x_{t-1}$, leads to:

$$\Delta y_t / y_{t-1} = \Delta x_t / x_{t-1} \tag{4}$$

which, in turn, leads to the following Proposition regarding the fundamental equation in tourism finance:

Proposition: Equation (4) gives the fundamental equation in tourism finance, and relates the growth in total daily tourism expenditure, or alternatively the daily returns on total tourism, $\Delta y_t / y_{t-1}$, to the net daily tourist arrivals divided by the previous day's total number of tourists, $\Delta x_t / x_{t-1}$.

The variable that can be observed on a daily basis in the fundamental Equation (4) is Δx_t, which is the change in the net daily tourist arrivals. The primary purpose of tourism authorities in the public and private sectors is to achieve high daily returns on total tourism, which can be accomplished by increasing Δx_t, that is, encouraging high net daily tourism. As x_{t-1} might not be available, the following section provides a method for calculating the variable to make the fundamental equation operational.

3. Operational Method

The daily returns on total tourism, $\Delta y_t / y_{t-1}$, are not observable, and similarly for daily total tourism, whereas net daily tourism, Δx_t, can be obtained from appropriate data sources. As monthly, quarterly or annual tourism are typically available from standard government data sources and tourism authorities, assuming a uniform rate of tourism arrivals, which may accommodate seasonal factors, x_{t-1} can be obtained as the average number of daily tourists, denoted x^*_{t-1}.

Rewriting Equation (4) as the following:

$$\Delta y_t / y_{t-1} = \Delta x_t / x^*_{t-1} \tag{5}$$

ensures that $\Delta x_t / x^*_{t-1}$ can be used to measure $\Delta y_t / y_{t-1}$, namely the growth in total daily tourism expenditure, or equivalently the daily returns on the total number of tourists, based on observable data.

As $\Delta y_t / y_{t-1}$ is the most widely used measure of financial returns in investment finance, with associated volatility to capture financial risk, it can be modelled as:

$$r_t = E(r_t \mid I_{t-1}) + \varepsilon_t \tag{6}$$

where r_t measures financial returns, and I_{t-1} captures the information set that is available at the end of the previous day in order to predict r_t and its associated volatility, which is a measure of financial risk.

Numerous alternative measures of volatility, such as historical, implied, expected, realized (such as range, namely, the highest minus the lowest daily price), optimal realized, conditional, and stochastic, are available to estimate the volatility associated with financial returns. In terms of tourism research and tourism finance, the daily returns on the total number of tourists is the financial variable based on interpreting the total number of tourists as a tourism stock index (see, for example, McAleer [13] for a comprehensive analysis of the alternative types of methods that can be used to estimate financial volatility for both univariate and multivariate processes).

Multivariate methods can be used to measure spillovers across alternative sources of tourism, such as from different countries, regions or cities. Spillovers can be calculated in many different ways, most of which are incorrect. A recent guide to calculating spillovers correctly across different financial markets, has been developed by Chang *et al.* [14], where three new definitions of volatility and covolatility spillovers are given, namely full volatility spillovers, partial volatility spillovers, and covolatility spillovers. The models and methods can easily be adapted to different tourist markets in tourism finance.

4. Concluding Comments

The energy industry, which includes, oil, gas and bio-energy fuels, together with the tourism industry, are two of the most important industries in the world today in terms of employment and generating income. The primary purpose in attracting domestic and international tourists to a country, region or city is to maximize tourism expenditure.

The purpose of the paper was to present the fundamental equation in tourism finance that connects tourism research to empirical finance and financial econometrics. It is fair to say that high frequency data have not been analyzed widely in tourism research, which may well be a strong reason for the connection between tourism finance and tourism research not yet having been advocated. This paper emphasized the connection between the two topical areas of research to enable portability of a wide range of research methods and techniques across the two research areas.

The paper concentrated on daily tourism expenditure, regardless of whether such data might be readily available. If such data are not available, a practical method was presented to calculate the appropriate data in order to calculate the growth in total daily tourism expenditure, or equivalently the daily returns on the total number of tourists.

The methods can easily be adapted to different high frequency data periods, such as monthly, weekly, daily, hourly, and ultra-high frequency minute, second and nano-second data measurements. The connection between daily returns on total tourism and the associated volatility to capture financial risk was also discussed.

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Conflicts of Interest

The authors declare no conflict of interest.

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