Article

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Measuring hidden demand and price behavior from US outbound health tourism spending

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Abstract

The health tourism literature has covered several topics, but studies on the workings of health tourism demand and prices are still under-highlighted. This study investigates US outbound health tourism demand and price developments (real exchange rates) for 50 destinations, using outbound health tourism spending as a reference variable. The study applies the dynamic time warping approach, a sophisticated technique to assess similarities between time series, specifically, the outbound health spending with demand and prices. The results show that demand developments have similarities with US outbound health tourism spending in the short-run, with about 1.2% of all US outbound travelers being health tourists. Price developments have both long- and short-term similarities with outbound health tourism spending. The findings could help policy-makers in better managing the health tourism industry.

Keywords

health tourism, tourism demand, prices, real exchange rate, dynamic time warping, United States

Introduction

According to the United Nations' World Tourism Organization (UNWTO), health tourism has become one of the most established businesses in many destinations (UNWTO, 2018). The UNWTO defines it as "[…] tourism which ha[s] as a primary motivation, the contribution to physical, mental, and/or spiritual health through medical and wellness-based activities which increase the capacity of individuals to satisfy their own needs and function better as individuals in their environment and society." (UNWTO, 2018: 63). In other words, tourists will only be considered health tourists if they have medical and/or wellness treatment as their primary goal for traveling abroad. This definition considers health tourism an umbrella concept of both medical and

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wellness tourism, an approach followed by multiple studies in the literature (e.g., Aydin and Karamehmet, 2017; Loh, 2014; and Ridderstaat et al., 2019).

Over the last three decades, many authors have studied health tourism (e.g., Beladi et al., 2019; Choi et al., 2018; Hiemstra and Wong, 2008; Ile and Tigu, 2017; Loh, 2014; Ridderstaat et al., 2019; Salehi-Esfahani et al., 2021; Taheri et al., 2021; Tang and Abdullah, 2018). Despite the abundant studies, there is still a lack of reliable and comparable data and evidence-based health tourism information (UNWTO, 2018). One reason for the latter is that the background of health tourism studies is likely to be contextual, hindering the research findings from having implications beyond the conducted study. Context denotes a set of circumstances or unique factors (e.g., time, country, history, and culture) that affect an evidence-based practice, and failure to account for these factors may limit the generalizability of study findings to different backgrounds (Nilsen and Bernhardsson, 2019). The context may also hinder the theorization process if not properly considered (Zahra, 2007). With their in-depth approach, case studies can help shed light on the various contextual features that define the research scene (Poulis et al., 2013).

This study uses health tourism spending to understand outbound health tourism travel from the United States (US) to 50 global destinations. The US is a key sending country for health tourism (Sandberg, 2017), making it adequate for this investigation. The study aims to answer four key questions: (i) How strong is the connection between US outbound health tourism spending and its volume (number of health tourists) and price components (prices and exchange rates) for each investigated destination? (ii) Do decomposed data increase the strength of the connection between US outbound health tourism spending and the volume and price components for each of the investigated destinations? (iii) What is the rate of health tourists in the overall outbound tourism numbers per destination? (iv) What is the annual range in outbound health tourism travelers for each investigated destination? The tourism (and health tourism) product is unique, indivisible, and partially intangible. It is a bundle of goods and services (e.g., transport, accommodation, food, etc.) (Morley, 1992) that travelers need to consume at the destination (Schulmeister, 1979). It is impossible to consider the tourism product as a single product, and the conventional product-price relationship discussed in the microeconomic literature does not work for tourism (or health tourism). The latter may explain why tourist arrivals (or departures from the perspective of the sending country) are commonly used as a measure of tourism demand in empirical research, as discussed by Song et al. (2010). The implications are that our concept of volume and price developments in this study has to consider the number of arrivals at the destination as volume and average spending at the destination as price elements. Overall, health tourism spending is ultimately a function of these volume and price components, and understanding the relationship's intricacies aligns with Issenberg's (2016) notion that health tourism is a movement of both capital and people.

The study answers the above questions using the Dynamic Time Warping distance measure technique. This robust similarity computation method differs from the conventional Euclidean distance measure because it replaces one-to-one point evaluations with many-to-one comparisons (Cassisi et al., 2012).

The case-study nature of the investigation requires consideration of the results not as statistical generalizations (finding abstraction) (Veal, 2006; Yin, 2014) but as a way to articulate new ideas from the collected evidence (Smith, 2010). Following this line of thinking, the study contributes in several ways to advance the literature on health tourism. First, the study considers the influences of volume (number of outbound health tourists) and price elements (prices and exchange rates) on US outbound health tourism spending for 50 destinations. While Salehi-Esfahani et al. (2021) and Ridderstaat et al. (2019) investigated these effects on inbound health tourism, this study expands this research line by focusing on US outbound health tourism. Second, the study expands the notion of short- and long-run effects proposed by Ridderstaat et al. (2019) by analyzing the decomposed volume and price values against decomposed outbound health tourism spending data (i.e., short with short and long with long), rather than with the complete health tourism spending information. The more specific approach improves our understanding of the existing connection between outbound health tourism spending and its volume and price elements. Third, the study also expands the short-term view on health tourism data proposed by Ridderstaat et al. (2019) by including the irregular or shock factors in the short-run analyses (in addition to cyclical factors), a novel approach that further helps to explain the link between outbound health tourism spending and its volume and price elements. Fourth, the study proposes a methodology that could assist in estimating the size of both inbound and outbound health tourism demand for other source countries, which could improve our understanding of the health tourism industry.

The remainder of this paper is as follows. The literature on health tourism is evaluated in section two. Section three discusses the data and applied methodology, while section four analyzes and discusses the empirical findings. The last section discusses the study's implications, limitations, and suggestions for future research.

Literature review

Health, medical, and wellness tourism

Health is a holistic concept. The 1946 Constitution of the United Nations' World Health Organization (UNWHO, 1946: (1) considers health as a state of complete physical, mental, and social well-being and not solely related to a disease or infirmity. Therefore, health-oriented services providing treatment and rehabilitation may be medical or wellness of nature (Aydin and Karamehmet, 2017), which explains the all-inclusive health tourism approach adopted by the UNWTO (2018). This overarching formulation of health tourism has previously received support from several studies, that is , Aydin and Karamehmet (2017), De Arellano (2007), Loh (2014), Ridderstaat et al. (2019), Salehi-Esfahani et al. (2021), Turner (2007, 2011), and Voigt and Laing (2013). The UNWTO defines medical tourism as "[…] a type of tourism activity which involves the use of evidence-based medical healing resources and service […]." (UNWTO, 2018: 64). Medical tourism is associated with curing an illness (Pessot et al., 2021), where tourists often have to involuntarily travel to distant destinations to receive medical treatment (Puczkó and Stackpole, 2021). Wellness tourism is a "[…] tourism activity which aims to improve and balance all of the main domains of human life including physical, mental, emotional, occupational, intellectual and spiritual." (UNWTO, 2018: 64). The focus of wellness tourism is on relaxation, recuperation, and holistic means of health promotion (Kemppianen et al., 2021), and the goal is to improve the health and well-being of travelers (Puczkó and Stackpole, 2021).

According to the Patients Beyond Borders (2021), the market size of the global medical tourism market is between \$74 and \$92 billion, with about 21–26 million people spending an average of \$3,550 per visit on medically related costs, cross-border and local transport, inpatient stay, and accommodations. Estimates of the magnitude of wellness tourism indicate that this activity is even bigger than medical tourism. The Global Wellness Institute estimated the size of wellness tourism to be around \$639 billion in 2017 (Global Wellness Institute, 2021). The SRI International (formerly: Stanford Research Institute) estimated the magnitude of wellness tourism in 2013 at around \$438.6 billion (SRI, 2017). These are all global estimations, and data on national quantifications are scarce, missing or rely predominantly on health tourism spending.

Quantifying health tourism demand

We know little about the number of health tourists because it is often not recorded. One possible explanation for this missing information is because there are many ways for a tourist to be associated with health-related activities. The UNWTO (2018), for example, distinguishes between (i) accidental health tourists (i.e., those having a medical check-up or using emergency services while on holiday), (ii) the health-aware tourist (i.e., those who use a hotel gym or who visit a day spa), and (iii) core health tourists (i.e., those who have an operation or stay in a destination spa). Cohen (2008) proposes an alternative typology of health tourists, that is, medicated tourists (i.e., those who receive medical treatment for accidents and unexpected health problems during their stay at a destination), (ii) the medical tourists proper (those who visit a destination for both tourism and medical treatment purposes, with plans to receive treatment during their vacation), (iii) the vacationing patients (those who visit the host country mainly for medical treatment but also use the opportunity for vacationing during the post-operation or -treatment period (iv) the mere patients (those who visit the host country solely for medical treatment purposes, without vacationing).

Quantifying the demand for health tourism matters partly because the consumption pattern of a health tourist could be different from that of standard tourists. The number of health tourists to a destination could provide information on the relevance of this niche market and whether destination marketing organizations should exert extra efforts to cater to these travelers' needs (Puckzó & Stackpole, 2021). Also, from the sending country's perspective, the number of health tourists matters because health tourism may pose health risks for tourists. Some surgery procedures, such as sex reassignment, stem-cell, and organ transplant, are considered high-risk interventions (Mason and Spencer, 2017) and could endanger human health, with potentially fatal consequences if not adequately performed. Similar consequences could arise from prescribed medication (e.g., poor quality, harmful content, or counterfeit) (Centers for Disease Control and Prevention, 2021).

Price and other motivating factors

With medical tourism, price or affordability seems to be a key element of people's decisions to become health tourists (Aydin and Karamehmet, 2017; Dalen and Alpert, 2019; De Arellano, 2007; Horowitz et al., 2007; Puczkó and Stackpole, 2021; Reisman, 2010; Taheri et al., 2021; UNWTO, 2018). Prices of health care services, transportation and accommodation, and the general price level, together with favorable exchange rates, are among the key factors influencing health tourism choices (Aydin and Karahmehmet, 2017; Cohen, 2008), and ultimately a country's health tourism spending. However, there are also other appealing factors. As with health tourism demand, not much is known about destinations' health price developments. Some studies have provided static pictures of prices for specific health treatments abroad (e.g., Aydin and Karamehmet, 2017; Herrick, 2007; Lunt et al., 2011), which are only indicative prices because not every treatment plan is the same and may depend on the patient's health status (UNWTO, 2018). Other studies have used average health-related spending per visitor (Ridderstaat et al., 2019) or the destination's health consumer price index (Salehi-Esfahani et al., 2021) as a proxy for estimating the price elasticity of health tourism spending.

Besides price, other motivational factors include skipping long waiting lines (Aydin and Karamehmet, 2017; Carrera and Lunt, 2010; De Arellano, 2007), the advanced medical care and/or technology (Choi et al., 2015; Cohen, 2008), and inadequate or non-existent insurance or privacy, cultural affinity and ancestral background, and mistrust of the domestic health care systems (Mathijsen, 2019; UNWTO, 2018). Also, proximity, treatment availability elsewhere, medical personnel's reputations are considered key influences conducive to health tourism (Lu et al., 2016; UNWTO, 2018). Some key reasons for wellness tourism are stress reduction (Hudson et al., 2017), indulgence, escape and relaxation, improved physical health and appearance, transcendence, and re-establishment of self-esteem (Cohen et al., 2017).

Treatments types

Health tourism treatments may be curative (medical) or preventive (wellness-oriented) (Aydin and Karamehmet, 2017). The treatments sought abroad may include life-saving interventions (e.g., open-heart surgery), procedures forbidden in the tourists' home country (e.g., stem-cell therapies, reproductive treatment, and euthanasia) (Beladi et al., 2019), but also regular and elective procedures such as cosmetic surgery, dentistry, and experimental drug/surgical treatments (Puczkó and Stackpole, 2021). Wellness treatments include holistic therapies and wellness retreats (Cohen et al., 2017).

The treatments are particularly short-term of nature (either recurring or ad-hoc). However, some countries offer longer-term care services to foreign citizens through the establishment of retirement villages (e.g., My Second Home in Malaysia), where people could commute to and from their permanent homes (UNWTO, 2018) or by offering more affordable nursing home care in, for example, Mexico (Herrick, 2007). These treatments and therapies indicate that health tourism can have long- and short-term implications that may cause periodical variations in health tourism demand.

Context in health tourism studies

Studies on health and health care are likely to be affected by contextual factors (Tomoaia-Cotisel et al., 2013), and the circumstantial features may also influence health tourism studies. Health tourism research involves, for example, divergent groups of health tourists, types of treatments, prices, and destinations offering specific treatments, all of which could influence the research findings. Failure to account for these different circumstances and factors may limit study findings generalizability to different backgrounds (Nilsen and Bernhardsson, 2019) and may cause failure to replicate research (Tomoaia-Cotisel et al., 2013). Context fuels the need to have more health tourism studies, considering different perspectives, such as the tourists' country of origin, outbound destinations, exchange rates, and prices, to understand this study field better.

There is a decent amount of observations- or experience-based studies conducted on health tourism in the last three decades, with increased research speed. However, according to the UNWTO, the health tourism field still lacks adequate reliable and comparable data and evidence-based information (UNWTO, 2018), which hinders a proper understanding of this niche form of tourism (Salehi-Esfahani et al., 2021). Most of the existing studies have emphasized medical tourism (e.g., Aydin and Karamehmet, 2017; Lu et al., 2016; Taheri et al., 2021; Wang, 2012), but wellness tourism is not lagging far behind (e.g., Cohen et al., 2017; Dillette et al., 2020; Hudson et al., 2017).

The literature has covered both sporadic and recurring research topics. Intermittent health tourism topics include, for example, the dimensions of wellness tourism experience (Dillette et al., 2020), influences on the perceived value of medical tourism (Lu et al., 2016), the diasporic medical tourism behavior (Mathijsen, 2019), and customers' perceived value as a driver of medical tourism (Wang, 2012). Recurring health tourism research topics include word-of-mouth effects (Choi et al., 2018; Taheri et al., 2021), demand effects (Hiemstra and Wong, 2008; Ridderstaat et al., 2019; Salehi-Esfahani et al., 2021), trends (Ile and Tigu, 2017; Loh, 2014), and economic impacts

(Beladi et al., 2019; Tang and Abdullah, 2018). Another set of studies have looked at volume and price effects on health tourism spending, both in the long- and short-run (e.g., Loh, 2014; Ridderstaat et al., 2019; Salehi-Esfahani et al., 2021). For example, studies by Salehi-Esfahani et al. (2021) and Ridderstaat et al. (2019) indicate that the volume component has a relatively more significant influence on health tourism spending than the price component. Interestingly, the study by Ridderstaat et al. (2019) also considered dynamic effects by looking at both the relationships' long- and short-term perspectives. Although the latter study findings were related to inbound health tourism, their focus can also be deployed to outbound health tourism expenditures, which leads to the first two hypotheses of this study:

H_1: US outbound health tourism spending is more aligned with demand than with price developments in the long run.
H_2: US outbound health tourism spending is more aligned with demand than with price developments in the short-run.

The US health care system and outbound health tourism

Health care in the US is costly because profit-making is central (Rosenthal, 2017). The country spends close to 18% of its gross domestic product on health care, more than any other country, with a total health care waste estimated between $760 - $935 billion (or about 25% of overall health care spending) (Shrank et al., 2019). Nevertheless, many US residents cannot afford healthcare insurance, and those with insurance may face substantial cost-related barriers to care (Crowley et al., 2020). Health tourism may offer, in some instances, an alternative to uninsured or underinsured residents.

More US residents seek affordable care abroad and are willing to pay for their expenses out of pocket (Chambers, 2015), a development that may have been paralyzed partly by the COVID-19 pandemic. However, even with the COVID-19 impediment, a growing number of people are still traveling to Mexico to address their urgent health needs (Yeginsu, 2021). Cost-saving seems to be a key reason why Americans become health tourists (Chambers, 2015; Dalen and Alpert, 2019; Herrick, 2007), in part stimulated by insurance providers to reduce costs (Kumar et al., 2012). The Covid-19 pandemic has also deprived millions of Americans of their health insurance following job losses, inducing a growing number of people to seek health care treatment in, particularly, Mexico (Yeginsu, 2021). Health tourism destinations for US citizens mentioned in the literature include Canada, the United Kingdom, Germany, Sweden, France, Brazil, Costa Rica, Hong Kong, India, Korea, Mexico, South Africa, Thailand (Salehi-Esfahani et al., 2021; Herrick, 2007; Hiemstra and Wong, 2008; Kumar et al., 2012; Sandberg, 2017), but the relevance of each destination is unclear. Besides medical tourism, there is also a potential for wellness tourism abroad, as there is a promising trend in the US where more and more people focus on personal responsibility and holistic approaches to health and well-being (Hudson et al., 2017).

Estimations of the number of US outbound health tourists vary widely and are often unsubstantiated (Turner, 2012). According to Adabi et al. (2017), an estimated 15 million US patients seeks medical treatment each year. A study by Baliga (2006), subsequently mentioned by Horowitz et al. (2007), projected that about 750,000 Americans would travel abroad in 2007 for medical treatment, and this number will continue to increase up to six million by 2010. Deloitte LLP (2009) used the estimation by Baliga (2006) and Horowitz et al. (2007) as the basis for 2007 and estimated that US outbound medical tourism could reach 1.621 million by 2012. Chambers (2015) estimated that between 150,000 and 320,000 US travelers are healthcare tourists. Dalen and Alpert (2019) mention that about 1.4 million American patients traveled to many countries worldwide in 2017.

The Patients Without Borders organization estimated that about 2.2 million Americans would have traveled abroad in 2020 for medical treatment (Patients Beyond Borders, 2021), although the COVID-19 pandemic may have dampened this estimation. The US National Travel and Tourism Office (NTTO) provides perhaps the most methodologically substantiated estimate of US health tourism numbers. According to the NTTO's Survey of International Air Travelers (SIAT), an average of 0.5% of all surveyed people (median = 0.5%) traveled abroad primarily for health-related purposes between 2000–2019, with the lowest rate in 2000 (0.2%) and the highest in 2015 (0.6%) (National Travel and Tourism Office, 2021). However, the NTTO's survey does not include travel by US residents to Canada, the second-largest outbound destination for US residents, and the survey sample considers only people traveling by plane (National Travel and Tourism Office, 2021a). For a country such as Mexico (the largest outbound destination), this approach excludes those US residents who travel by bus or car. The NTTO implicitly indicates on their site that their survey is not perfect, citing, for example, problems of under- or over-surveyed gateways (National Travel and Tourism Office, 2021b). These findings serve for formulating the third hypothesis of the study:

H_3: On average, about 0.5% of all outbound US travelers are health tourists.

The testing of the three hypotheses will occur in the following sections.

Study overview, data, and methods

Study overview and data

Figure 1 presents the study overview. The study goal is to (1) determine the relevance of volume and price developments in determining health tourism spending by looking at their similarities, (2) determine the relevance of decomposed developments in volume and price factors (trends, cycles, and irregular elements) in determining health tourism spending, again by looking at their similarities, and (3) estimate rates and numbers of health tourists. *Methodology* will discuss the methodology to achieve the study goal. The study relied on the NTTO for the data on outbound health tourism spending. This information is similar to the data reported by the International Monetary Fund (IMF) in its International Financial Statistics database. According to the IMF's balance of payments manual, health tourism spending covers "medical services, other health care, food, accommodations, local transport acquired by those who travel for medical reasons" (IMF, 2009: 167). Although the IMF considers multiple elements of health tourism spending, countries collect the data almost solely in aggregate form. In the case of the US, outbound health tourism spending increased progressively in the analysis period, that is, 1999–2019, from $233 million (1999) to $717 million (2019), an almost 308% increase (Figure 2).

The investigation considers health tourism spending as a function of both volume and price elements, where the volume component is based on US tourist departures to 50 destinations, accounting for about 65% of all US outbound travel. These destinations were selected using online information on health tourism destinations and available data for the analysis period. Using outbound tourists as a volume element requires further explanation. The tourism product is indivisible and, in part, also intangible. The product demanded by tourists and (primarily) consumed at the destination (Schulmeister, 1979) is a bundle of goods and services (e.g., transport, accommodation, food, etc.) (Morley, 1992), which makes it an aggregated and unique product. The tourism product also has partial intangible characteristics in the services rendered to tourists at the destination (e.g., service at a restaurant). Given these considerations, it is impossible to consider

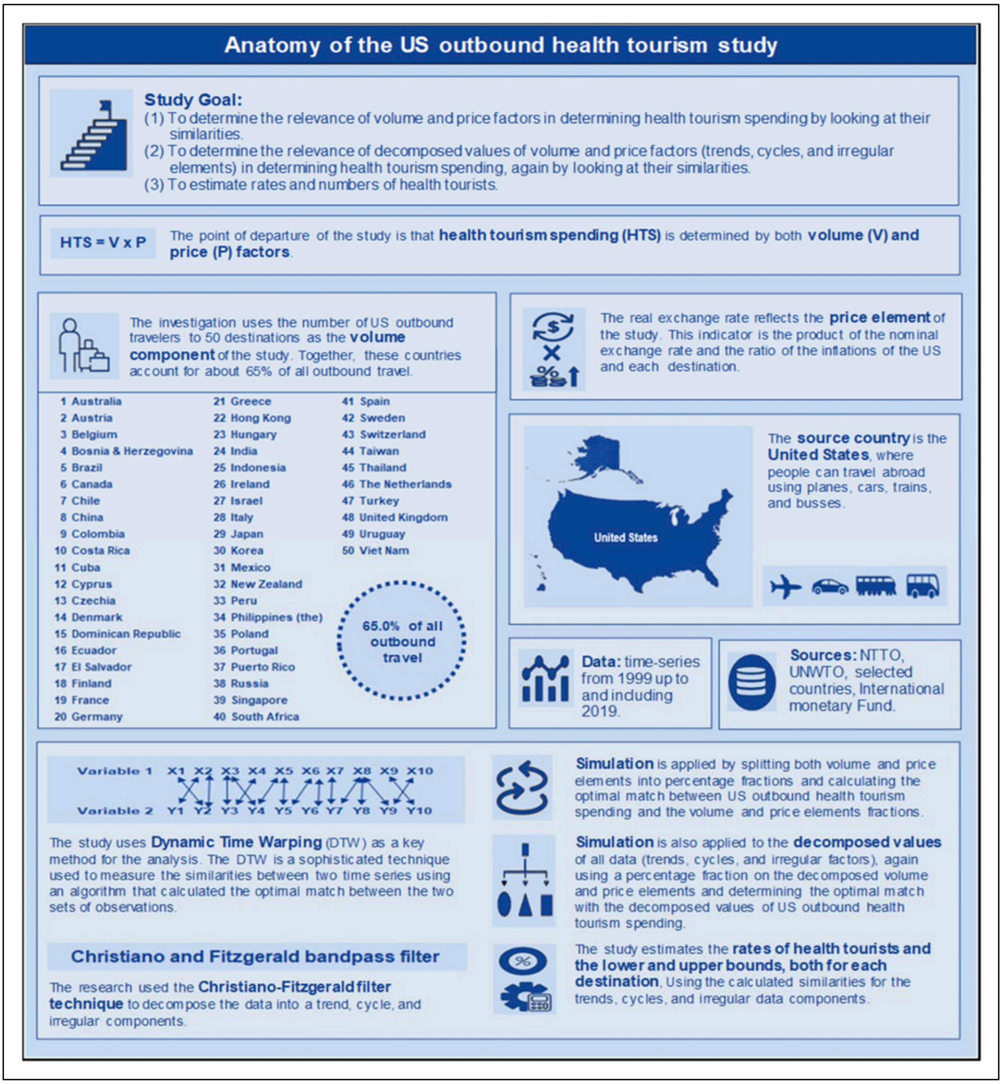

Figure 1. Anatomy of the US outbound health tourism.

the tourism product as a single product, and the conventional product-price relationship discussed in the microeconomic literature does not apply for tourism (or health tourism). The latter may explain why tourist arrivals (or departures from the perspective of the sending country) are commonly used as a measure of tourism demand in empirical research, as discussed by Song et al. (2010). In the absence of actual outbound health tourism numbers, the study will use the developments of total outbound tourists to understand the patterns of outbound health tourists, as will be explained in the next section. The annual tourist departure data were collected primarily from the NTTO and the UNWTO and from the selected destinations when unavailable from the other two sources.

The consequence of using outbound tourists in the volume approach is that the price component does not measure a price specifically but reflects an average spending per tourist on the (health)

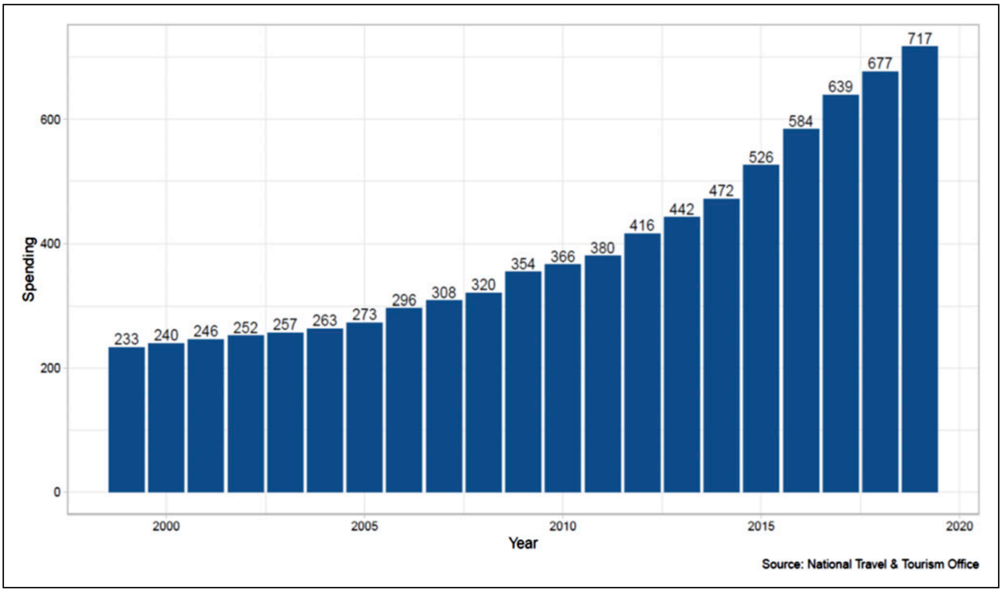

Figure 2. Health tourism spending by US outbound travelers.

tourism product. Similar to the volume element, this investigation does not consider the magnitude of this average but only its progress over time. That is why the study uses the real exchange rate as a proxy indicator for this development. The latter reflects changes in general price levels vis-à-vis the US (relative inflation) and the US's nominal exchange rates against the selected destinations. Thus, the real exchange rate measures the value of a country's good or service versus another country's prevailing nominal exchange rate (Catão, 2020) and indicates how many goods and services one country can trade with those of another country. The source for the data on inflation and exchange rates of the US and selected destinations is the International Monetary Fund.

Methodology

The study calculated the similarity between health tourism spending and the respective volume and price elements to determine their connection. The similarity determination process is often referred to as time-series data mining, which aims to extract meaningful knowledge from the data's shape (Esling and Agon, 2012). Here, the process implies comparing US outbound health tourism spending with each of the selected destinations' demand and price components. In this way, we can assess each destination's relevance in the US outbound health tourism spending.

The challenge here is that we do not explicitly know the volume and price elements of US outbound health tourism. Consequently, the application of regression-based models is difficult, if not impossible. Therefore, the study uses the Dynamic Time Warping (DTW) distance measure approach to overcome the limitations of not having explicit information on the volume and price elements. The DTW is a robust similarity computation method that distinguishes itself from conventional calculations of the Euclidean distance measure because it replaces one-to-one point evaluation (sequence alignment) with many-to-one comparisons (Cassisi et al., 2012). The DTW is based on an algorithm that calculates an optimal match between two time series using a local resealing method (warping curves), allowing two time series to achieve an equal length of time (Ferrante et al., 2019). It uses a series of restrictions and rules to determine the optimal alignment between two series (Huang et al., 2019):

- Every observation in one series must match one or more observations in the other series.
- The first and last observations of both series must match.
- The mapping of the observations in the two series must be monotonically increasing.

If we have two time series, a query series X (= $x_1 \ldots x_n$) and a reference series Y (= $y_1 \ldots y_m$), we can define a non-negative local dissimilarity function f between any pair of x_i and y_j as follows (Giorgino, 2009)

$$d(i,j) = f\left(x_i,y_j\right) \geq 0 \tag{1}$$

where

i = The elements of vector X (i = 1…n).
j = The elements of vector Y (j = 1…m).
d = A cross-distance matrix between vectors X and Y.

The objective of the DTW is to minimize (Cassisi et al., 2012; Li et al., 2010)

$$\mathrm{DTW}(X,Y) = \min\left(\sum_{k=1}^{K} d_K, W = \langle w_1, w_2, \ldots w_K \rangle\right) \tag{2}$$

where

$d_k = d(x_i,y_i)$, or the distance represented as $w_k = d(i,j)$ on path W (= w_1, $w_2, \ldots, w_K$).

The calculated DTW distances need further transformation for adequacy interpretation. For this purpose, the study calculated similarity measures from the DTW distance outcomes, along the lines of Li et al. (2010)

$$\mathrm{Sim}(X,Y) = 1 - \frac{\text{DTW distance}(X,Y)}{\text{Max. DTW distance}(X,Y)} \tag{3}$$

The similarity outcome (Sim(X, Y)) indicates how closely aligned the demand and price variables are with the outbound health tourism spending variable and can vary between zero (no similarity) and one (maximum or perfect similarity). The maximum DTW distance is calculated using a variable containing only the maximum values for each outbound destination. So, if the highest observation for a destination were 50,000, all the variable observations would be equal to 50,000 (D.W, 2016).

The DTW offers additional benefits in that it can overcome limitations with conventional methods such as correlation analysis and the Euclidean distance measure. The correlation indicator is, for example, sensitive to outlier values and to not exactly aligned time series (Raihan, 2017). Similarly, the Euclidean distance measure can only compare time series with equal timing (X_t versus Y_t and not, for example, X_t versus Y_{t-1} or Y_{t+1}), while it does not handle well outliers and shifting time series (e.g., amplitude changes) (Cassisi et al., 2012). According to the latter authors, the DTW approach offers more robustness to the similarity calculation since it allows for many-to-one point comparisons (and vice versa) rather than one-on-one comparisons in the case of the Euclidean distance measure (and its variants). The latter means that the DTW can consider timing differences between time series, which can occur in one or a few years only and is, thus, more flexible in considering possible lag situations. Correlation analysis and the Euclidean distance measure can handle lag situations by considering a lag for all observations (rather than one or a few in the DTW approach), leading to less robust outcomes. The robustness of the DTW approach has also been signaled by other studies, for example, Alaee et al. (2021), Ding et al. (2008), and Sharbiani et al. (2017). Several researchers in the tourism field have already used the DTW approach (e.g., Ferrant et al., 2019; Pranama et al., 2021; Zhang et al., 2020; and Zheng et al., 2019). For instance, Ferrante et al. (2019) studied the behavior of cruise passengers at a destination in Italy. Pranama et al. (2021) used the DTW approach to study the different impacts of COVID-19 on Indonesia's tourism industry.

This study looks first for the smallest distance between the US outbound health tourism spending and the selected demand and price variables by simulating one hundred different fragments of each of the last two data sets. Each fragment reflects a specific percentage and is part of a larger aggregate

$$X = \sum_{f=1\%}^{100\%} (X \times f) = \sum_{f=1\%}^{100\%} x_f \tag{4}$$

where

X = The query series (either the demand or the price variables).
x = A fraction of the query series ($x_f = X \times f$) ($f = 1\%, \ldots, 100\%$))
f = Percentage fraction.

Once these fractions have been defined, the study determined the percentage where the DTW distance of these respective fractions with the overall US outbound health tourism spending is minimized

$$\%\mathrm{Min}_f = \mathrm{Min}\left[\mathrm{DTW}\left(x_f, y\right)\right] \tag{5}$$

where

$\%\mathrm{Min}_f$ = Minimum percentage fraction resulting from minimizing the DTW distance.

Next, the study uses the demand and price variables, adjusted by their respective minimum percentages, to determine whether US outbound health tourism is a steady or unstable business. For this purpose, the study decomposed the adjusted variables into their respective trend (T), cycle (C), and irregular elements (I), using the widely applied Christiano and Fitzgerald bandpass filter technique (Christiano and Fitzgerald, 2003). The three decomposition elements (T, C, I) are common when using annual data (Bails and Peppers, 1993). The trend element echoes the data's long-term component (Makridakis et al., 1998). The cycle element reflects unpredictable recurring wavelike fluctuations of the data (Makridakis et al., 1998), and the irregular element is the residual after eliminating the trend and cycle components from the data and reflects multiple unforeseeable events such as strikes, hurricanes, wars, infectious diseases, etc. (Bails and Peppers, 1993). The COVID-19 pandemic is a vivid example of such an irregular element. While the trend is considered the long-term pattern of the data, the cycle and irregular components are deemed the short-term influences. The distinction here between short and long is not one based on sequence (i.e., first short and then long), but one based on synchronicity, that is, both long- and short-term movements occurring at the same time, with the short-term fluctuations moving along the long-term patters (Ridderstaat et al., 2016). The decomposition can be summarized in the following equations, for, respectively, the query series (demand and price variables) and the reference series (outbound health tourism spending)

$$X_{adj} = X_{adj,T} + X_{adj,C} + X_{adj,I} \tag{6}$$

$$Y = Y_T + Y_C + Y_I \tag{7}$$

The DTW distance between the decomposed elements can be determined as follows

$$\mathrm{Min}\left(X_{adj,T}, Y_T\right) = \mathrm{Min}\left[\mathrm{DTW}\left(X_{adj,T}, Y_T\right)\right] \tag{8}$$

$$\mathrm{Min}\left(X_{adj,C}, Y_C\right) = \mathrm{Min}\left[\mathrm{DTW}\left(X_{adj,C}, Y_C\right)\right] \tag{9}$$

$$\mathrm{Min}\left(X_{adj,I}, Y_I\right) = \mathrm{Min}\left[\mathrm{DTW}\left(X_{adj,I}, Y_I\right)\right] \tag{10}$$

The similarities of these minimum DTW distances were subsequently calculated, based again on equation (3).

For the last estimation, the study used the calculated minimum percentages of demand to determine the percentage and volumes of health tourism travelers from the entire outbound tourism series. Since the estimated percentages are in logarithm, they need to be converted first to the percent of the original (untransformed) arrival data by taking the calculated minimum percent's natural exponent. The calculated outcome is, subsequently, multiplied by the geometric mean of the trend, cycle, and irregular factor similarities of equations (8–10)

$$\%ARR = e^{\left(\frac{\%MinX_D}{100}\right)} \times \left[\mathrm{Sim}\left(X_{adj,DT}, Y_T\right) \times \mathrm{Sim}\left(X_{adj,DC}, Y_C\right) \times \mathrm{Sim}\left(X_{adj,DI}, Y_I\right)\right]^{\frac{1}{3}} \tag{11}$$

where

%ARR = Percentage fraction for actual arrivals.
$Xadj,_D$ = Adjusted demand variable.
E = Natural exponent (e ≈ 2.7,182,818,284).

The geographic means is a central tendency measure calculated by taking the product of several observations (n) and, subsequently, taking the n^{th} squared root of the product. When working with small samples and summarizing ratios or percentages, the geometric mean is considered a better measure of central tendency than the conventional arithmetic mean (Roenfeldt, 2018). As will be seen later, both features are present in this study.

The study also used the calculated percentage fractions to estimate, respectively, the lower and upper bounds for the number of health tourists per destination, again corrected for the geometric mean of the trend, cycle, and irregular component similarities

$$ARR_{Lower} = \%ARR \times \mathrm{Min}(X_D) \tag{12}$$

Table 1. Mean, median, minimum, maximum, and average shares of selected countries in total US outbound tourism.

Country	Mean	Median	Minimum	Maximum	Average share in total outbound (in %)
Australia	527,673	462,940	417,049	789,380	0.45
Austria	610,796	580,916	441,848	858,134	0.52
Belgium	304,706	297,777	245,609	447,788	0.26
Bosnia and Herzegovina	12,447	8,537	6,546	33,960	0.01
Brazil	622,394	603,674	475,232	793,559	0.53
Canada	13,609,666	13,891,800	11,477,624	16,167,219	11.58
Chile	170,663	162,693	124,259	224,741	0.15
China	1,729,812	1,901,221	736,386	2,483,554	1.47
Colombia	390,008	338,000	242,000	705,400	0.33
Costa Rica	824,855	807,162	392,556	1,334,777	0.7
Cuba	155,134	77,646	36,808	637,907	0.13
Cyprus	23,284	21,928	15,847	47,513	0.02
Czechia	357,285	314,950	190,357	584,627	0.3
Denmark	425,118	505,805	65,582	849,843	0.36
Dominican Republic	1,325,221	1,150,875	530,352	2,334,987	1.13
Ecuador	227,770	242,096	124,526	365,836	0.19
El Salvador	324,222	320,737	130,128	600,254	0.28
Finland	97,100	93,469	68,853	142,512	0.08
France	3,407,907	3,208,279	2,447,000	4,770,628	2.9
Germany	2,244,446	2,163,759	1,678,135	3,057,411	1.91
Greece	655,885	603,903	318,251	1,208,419	0.56
Hong Kong	1,098,808	1,143,089	683,791	1,304,232	0.94
Hungary	205,790	177,981	133,873	370,551	0.18
India	853,833	827,140	251,926	1,476,600	0.73
Indonesia	223,706	196,625	129,152	457,832	0.19
Ireland	1,010,762	867,000	759,000	1,739,000	0.86
Israel	574,162	617,933	206,195	966,000	0.49
Italy	4,415,210	4,442,549	3,289,349	6,092,754	3.76
Japan	894,673	768,345	565,887	1,723,861	0.76
Korea	647,077	611,327	396,286	1,044,038	0.55
Mexico	22,917,719	19,658,687	17,154,718	39,942,348	19.5
New Zealand	229,731	212,410	177,680	367,958	0.2
Peru	395,244	417,232	166,932	656,991	0.34
Philippines (the)	637,033	582,537	387,879	1,064,440	0.54
Poland	369,143	300,000	230,000	654,000	0.31
Portugal	396,033	267,433	219,499	1,195,918	0.34
Puerto Rico	2,727,101	2,702,677	2,212,900	3,241,800	2.32
Russia	268,862	280,848	184,043	351,261	0.23
Singapore	438,366	408,885	250,678	729,409	0.37
South Africa	295,077	292,884	173,533	427,504	0.25
Spain	2,024,922	1,741,346	1,442,151	3,684,376	1.72
Sweden	238,863	207,122	124,446	576,721	0.2

(continued)

Table 1. (continued)

Country	Mean	Median	Minimum	Maximum	Average share in total outbound (in %)
Switzerland	774,892	726,035	598,046	1,154,155	0.66
Taiwan	421,037	395,729	272,858	605,054	0.36
Thailand	731,244	681,748	461,671	1,168,000	0.62
The Netherlands	1,008,190	967,200	761,500	1,469,000	0.86
Turkey	544,482	532,404	222,918	798,787	0.46
United Kingdom	3,431,408	3,455,483	2,711,000	4,498,754	2.92
Uruguay	54,002	57,552	25,809	84,399	0.05
Viet Nam	410,714	414,800	208,642	746,171	0.35

$$\mathrm{ARR_{Upper}} = \%\mathrm{ARR} \times \mathrm{Max}(\mathrm{X_D}) \tag{13}$$

where

ARR = Arrivals.
Min = Minimum.
Max = Maximum.

The next chapter will present the results of the discussed methodology in this section.

Empirical findings and discussion

The study used R software to conduct the calculations. Table 1 shows some general characteristics of US outbound travel per destination. The most prominent two destinations for US travelers are Mexico and Canada, accounting, on average, for respectively 19.5% and 11.6% of all US outbound travel. Some other significant destinations for US travelers include Italy (3.8%), France (2.9%), the United Kingdom (2.9%), Puerto Rico (2.3%), Germany (1.9%), China (1.5%), and the Dominican Republic (1.1%). The table shows some variability in the data when considering the differences between the mean and median and the minimum and maximum US outbound tourism per country.

Table 2 shows the results of the DTW distance simulations and their respective similarities and minimum percentages. The adjusted demand distances ranged between 1.4 and 7.2, which may suggest a high degree of similarity. However, the latter is not everywhere the case. The results show that Bosnia & Herzegovina had the highest similarity with outbound health tourism spending (88.7%), while Canada had the lowest similarity (1.8%). Canada and Mexico's outcomes were disappointing at first sight, considering both countries' relative importance in overall outbound health tourism demand. The estimated minimum percentages of the demand data varied between 35% (Canada) and 62% (Bosnia & Herzegovina). Please bear in mind that these percentages are large because the data is in logarithm, so the original data's actual percentage still needs to be calculated (see Table 5). The price distance results ranged between 63.0–237.1, that is, about 33–45 times larger than those of demand. The percentages of the price simulation show some peculiar results, as they reveal two specific percent scenarios where the DTW price distance is minimized, that is, when we have 100% (21 cases) and 1% (29 cases) of the data. These outcomes initially

Table 2. Minimum DTW distances (demand and price elements).

Country (I)	Adjusted Distance (Demand)	Similarity (Demand)	Minimum % of Data (Demand)	Country (II)	Adjusted Distance (Price)	Similarity (Price)	Minimum % of Data (Price)
Bosnia and Herzegovina	1.3905	0.88652	62	India	63.0185	0.19222	100
India	1.7472	0.8464	45	Uruguay	93.5217	0.28756	100
Peru	2.0848	0.74545	46	United Kingdom	217.0195	0.02398	100
Sweden	2.0849	0.78066	47	Hungary	225.3727	0.037	100
El Salvador	2.1641	0.76821	47	Poland	225.8933	0.04051	100
Portugal	2.2687	0.77956	45	Czechia	225.9081	0.04173	100
Dominican Republic	2.2819	0.71794	42	The Netherlands	226.0806	0.04032	100
Viet Nam	2.4212	0.74865	46	Austria	226.1638	0.04448	100
Costa Rica	2.6896	0.65477	43	Belgium	226.1867	0.04417	100
Ecuador	2.7868	0.65713	48	Spain	226.2461	0.04205	100
Uruguay	3.06	0.67679	55	France	226.2843	0.04481	100
China	3.0985	0.65159	42	Germany	226.2909	0.04458	100
Israel	3.1394	0.66655	45	Finland	226.2995	0.04332	100
South Africa	3.1815	0.577	47	Portugal	226.334	0.04037	100
Korea	3.226	0.57744	44	Greece	226.3447	0.04155	100
Colombia	3.3158	0.57555	45	Italy	226.3587	0.04362	100
Hungary	3.3881	0.5216	47	Ireland	226.3794	0.04085	100
Cuba	3.4198	0.8145	50	Cyprus	226.3835	0.04406	100
Greece	3.5013	0.57286	44	Ecuador	229.8869	0.01411	100
Indonesia	3.5236	0.53306	46	Cuba	231.3458	0.01418	100
Thailand	3.5271	0.567	44	Puerto Rico	232.6778	0.00307	100
Czechia	3.5505	0.55266	46	Switzerland	233.1106	0.0008	1
Philippines (the)	3.6468	0.49724	43	El Salvador	233.1242	0.00363	1
Japan	3.7752	0.46353	42	Canada	233.1778	0.00036	1
Spain	3.9074	0.47801	40	Australia	233.2079	0.00056	1
Singapore	3.9854	0.47962	45	Singapore	233.2257	0.00043	1

(continued)

Table 2. (continued)

Country (I)	Adjusted Distance (Demand)	Similarity (Demand)	Minimum % of Data (Demand)	Country (II)	Adjusted Distance (Price)	Similarity (Price)	Minimum % of Data (Price)
New Zealand	4.0241	0.43573	47	New Zealand	233.2511	0.00077	1
Denmark	4.0383	0.78426	49	Bosnia and Herzegovina	233.2967	0.00041	1
Cyprus	4.1869	0.40399	56	Turkey	233.4835	0.00109	1
Mexico	4.2335	0.3811	34	Brazil	233.5261	0.00046	1
Australia	4.3027	0.42125	44	Peru	233.5584	0.00018	1
Ireland	4.3156	0.39525	42	Israel	233.6239	0.00034	1
Poland	4.3336	0.46664	46	Denmark	233.8457	0.00043	1
Taiwan	4.4511	0.41581	45	China	233.8769	0.00035	1
Chile	4.517	0.37464	49	Hong Kong	233.92	0.0001	1
Finland	5.1483	0.22948	50	Sweden	233.9612	0.0003	1
Russia	5.3149	0.36292	48	South Africa	234.0594	0.00045	1
The Netherlands	5.3396	0.25491	42	Mexico	234.1927	0.00039	1
Italy	5.3777	0.18895	38	Taiwan	234.4949	0.00019	1
Belgium	5.4449	0.18912	45	Thailand	234.5169	0.0005	1
Germany	5.4457	0.26372	40	Dominican Republic	234.5902	0.00044	1
Turkey	5.5396	0.32106	45	Russia	234.6324	0.00064	1
Switzerland	5.6194	0.1436	42	Philippines (the)	234.6731	0.00017	1
Hong Kong	5.8232	0.13347	42	Japan	235.0025	0.00029	1
France	5.8343	0.16205	38	Costa Rica	235.635	0.00024	1
Puerto Rico	5.863	0.22165	40	Chile	235.7212	0.00018	1
Austria	5.9369	0.09236	43	Korea	235.9676	0.00017	1
United Kingdom	6.6973	0.09871	38	Colombia	236.3137	0.00033	1
Brazil	6.9505	0.07234	44	Indonesia	236.9168	0.00032	1
Canada	7.1726	0.01833	35	Viet Nam	237.1347	0.00025	1

Table 3. Estimated long- and short-term distances (Demand element).

Country (I)	Trend Distances	Trend Similarities	Country (II)	Cycle Distances	Cycle Similarities	Country (III)	Irregular Factor Distances	Irregular Factor Similarities
Australia	206.952	0.57717	Australia	15.517	0.92989	Australia	18.7965	0.92201
Austria	209.0077	0.57492	Austria	15.4876	0.93	Austria	18.7737	0.92214
Belgium	208.0733	0.57615	Belgium	15.4664	0.93003	Belgium	18.7819	0.92211
Bosnia and Herzegovina	207.0041	0.57603	Bosnia and Herzegovina	15.5014	0.92958	Bosnia and Herzegovina	18.8233	0.92177
Brazil	200.2603	0.58535	Brazil	15.4923	0.92996	Brazil	18.7738	0.92215
Canada	206.4412	0.57796	Canada	15.5182	0.92996	Canada	18.7798	0.92213
Chile	202.1302	0.58302	Chile	15.5292	0.92976	Chile	18.7923	0.92202
China	196.3464	0.5899	China	15.5158	0.92979	China	18.808	0.92191
Colombia	205.275	0.57916	Colombia	15.4603	0.93002	Colombia	18.8049	0.92194
Costa Rica	198.2807	0.58741	Costa Rica	15.5083	0.92981	Costa Rica	18.8045	0.92195
Cuba	210.8427	0.57125	Cuba	15.5386	0.92976	Cuba	18.8626	0.92146
Cyprus	218.1094	0.56482	Cyprus	15.4536	0.92994	Cyprus	18.8027	0.92193
Czechia	200.7227	0.58434	Czechia	15.4807	0.92989	Czechia	18.7942	0.922
Denmark	178.1934	0.61239	Denmark	15.4046	0.92986	Denmark	18.8139	0.92178
Dominican Republic	196.2156	0.58974	Dominican Republic	15.4951	0.92988	Dominican Republic	18.812	0.9219
Ecuador	200.3648	0.58509	Ecuador	15.472	0.9299	Ecuador	18.8094	0.9219
El Salvador	195.8284	0.59021	El Salvador	15.4373	0.92998	El Salvador	18.8094	0.92189
Finland	209.6314	0.5742	Finland	15.4919	0.92997	Finland	18.7894	0.92204
France	209.5031	0.57443	France	15.4962	0.93003	France	18.7815	0.92211
Germany	206.1293	0.57832	Germany	15.486	0.92998	Germany	18.7829	0.92207
Greece	206.7454	0.57722	Greece	15.4592	0.93002	Greece	18.7935	0.92199
Hong Kong	202.5097	0.58277	Hong Kong	15.4853	0.93012	Hong Kong	18.7823	0.9221
Hungary	205.9702	0.57813	Hungary	15.4788	0.92994	Hungary	18.7933	0.92202
India	192.4049	0.59441	India	15.4933	0.92973	India	18.8248	0.92178
Indonesia	210.642	0.57269	Indonesia	15.4812	0.92996	Indonesia	18.8058	0.92195
Ireland	208.1791	0.57571	Ireland	15.4856	0.92998	Ireland	18.7929	0.92201

(continued)

Table 3. (continued)

Country (I)	Trend Distances	Trend Similarities	Country (II)	Cycle Distances	Cycle Similarities	Country (III)	Irregular Factor Distances	Irregular Factor Similarities
Israel	205.714	0.57853	Israel	15.3805	0.93028	Israel	18.7722	0.92207
Italy	204.5962	0.58026	Italy	15.4906	0.92993	Italy	18.7832	0.92208
Japan	207.9899	0.57586	Japan	15.5253	0.92975	Japan	18.798	0.92199
Korea	202.5376	0.58238	Korea	15.5043	0.92981	Korea	18.8041	0.92194
Mexico	206.5368	0.5777	Mexico	15.5075	0.9299	Mexico	18.7962	0.92201
New Zealand	206.9336	0.57723	New Zealand	15.5058	0.92989	New Zealand	18.8025	0.92196
Peru	197.0033	0.58883	Peru	15.4954	0.92984	Peru	18.812	0.92189
Philippines (the)	204.9452	0.57946	Philippines (the)	15.5019	0.92991	Philippines (the)	18.7941	0.92202
Poland	202.7384	0.58176	Poland	15.4865	0.92997	Poland	18.788	0.92204
Portugal	213.5467	0.56898	Portugal	15.5259	0.92958	Portugal	18.8146	0.92184
Puerto Rico	201.9728	0.58339	Puerto Rico	15.5218	0.92982	Puerto Rico	18.7798	0.9221
Russia	197.5948	0.58883	Russia	15.479	0.93012	Russia	18.796	0.922
Singapore	206.1444	0.57815	Singapore	15.5154	0.92973	Singapore	18.7904	0.92202
South Africa	199.6159	0.58587	South Africa	15.5403	0.92968	South Africa	18.8034	0.92194
Spain	207.3545	0.57669	Spain	15.5164	0.92978	Spain	18.8002	0.92197
Sweden	207.4438	0.57654	Sweden	15.5129	0.92962	Sweden	18.824	0.9218
Switzerland	211.268	0.57237	Switzerland	15.5232	0.92985	Switzerland	18.7786	0.92212
Taiwan	205.0057	0.57956	Taiwan	15.4992	0.92992	Taiwan	18.7954	0.92201
Thailand	202.329	0.5826	Thailand	15.5334	0.92967	Thailand	18.8044	0.92193
The Netherlands	207.2079	0.57703	The Netherlands	15.5294	0.92985	The Netherlands	18.7888	0.92204
Turkey	197.9378	0.58834	Turkey	15.4345	0.92997	Turkey	18.7478	0.9222
United Kingdom	208.2477	0.57604	United Kingdom	15.5222	0.92987	United Kingdom	18.7766	0.92214
Uruguay	196.598	0.58978	Uruguay	15.4678	0.92975	Uruguay	18.799	0.92195
Viet Nam	200.7819	0.58437	Viet Nam	15.5373	0.9296	Viet Nam	18.8143	0.92186

Table 4. Estimated long- and short-term distances (Price element).

Country (I)	Trend Distances	Trend Similarities	Country (II)	Cycle Distances	Cycle Similarities	Country (III)	Irregular Factor Distances	Irregular Factor Similarities
Australia	84.75601	0.76541	Australia	11.8051	0.93867	Australia	15.5207	0.93213
Austria	84.51921	0.76591	Austria	11.8038	0.93865	Austria	15.5034	0.93219
Belgium	84.52984	0.76589	Belgium	11.8035	0.93865	Belgium	15.5031	0.9322
Bosnia and Herzegovina	85.19385	0.76451	Bosnia and Herzegovina	11.8193	0.93861	Bosnia and Herzegovina	15.5252	0.93212
Brazil	85.83002	0.76308	Brazil	11.821	0.93862	Brazil	15.5291	0.9321
Canada	84.83222	0.76526	Canada	11.8074	0.93867	Canada	15.5165	0.93215
Chile	91.68973	0.75127	Chile	12.0213	0.93804	Chile	15.7288	0.93142
China	86.82929	0.76107	China	11.8724	0.93847	China	15.5724	0.93196
Colombia	93.36418	0.74784	Colombia	12.0876	0.9378	Colombia	15.7775	0.93125
Costa Rica	92.05913	0.75012	Costa Rica	12.0269	0.93797	Costa Rica	15.7101	0.93148
Cuba	84.99385	0.76489	Cuba	11.8114	0.93863	Cuba	15.5034	0.9322
Cyprus	84.54053	0.76587	Cyprus	11.8023	0.93865	Cyprus	15.5032	0.9322
Czechia	84.55636	0.76583	Czechia	11.8034	0.93865	Czechia	15.5027	0.9322
Denmark	86.5008	0.76181	Denmark	11.8671	0.93847	Denmark	15.5713	0.93196
Dominican Republic	89.39171	0.75528	Dominican Republic	11.9217	0.93829	Dominican Republic	15.607	0.93182
Ecuador	85.5671	0.76356	Ecuador	11.7945	0.93872	Ecuador	15.4915	0.93223
El Salvador	82.87412	0.76938	El Salvador	11.9857	0.93775	El Salvador	15.5479	0.93198
Finland	84.54041	0.76587	Finland	11.8045	0.93864	Finland	15.5031	0.9322
France	84.52657	0.7659	France	11.8035	0.93865	France	15.5035	0.93219
Germany	84.52438	0.7659	Germany	11.8038	0.93864	Germany	15.5035	0.93219
Greece	84.54395	0.76587	Greece	11.8051	0.93864	Greece	15.503	0.9322
Hong Kong	87.04396	0.76066	Hong Kong	11.8779	0.93845	Hong Kong	15.5737	0.93196
Hungary	84.59081	0.76577	Hungary	11.8021	0.93865	Hungary	15.5012	0.9322
India	84.06147	0.76682	India	11.7871	0.93867	India	15.4734	0.9323
Indonesia	95.19965	0.74401	Indonesia	12.154	0.93758	Indonesia	15.8375	0.93105
Ireland	84.54031	0.76587	Ireland	11.801	0.93866	Ireland	15.5031	0.9322

(continued)

Table 4. (continued)

Country (I)	Trend Distances	Trend Similarities	Country (II)	Cycle Distances	Cycle Similarities	Country (III)	Irregular Factor Distances	Irregular Factor Similarities
Israel	86.6073	0.76153	Israel	11.851	0.93853	Israel	15.5467	0.93205
Italy	84.5244	0.7659	Italy	11.8039	0.93864	Italy	15.5034	0.9322
Japan	89.81468	0.75504	Japan	11.9778	0.93815	Japan	15.6709	0.93162
Korea	92.35051	0.74992	Korea	12.0503	0.93799	Korea	15.7569	0.93133
Mexico	87.57919	0.75925	Mexico	11.8728	0.93847	Mexico	15.5864	0.9319
New Zealand	84.79946	0.76529	New Zealand	11.8132	0.93864	New Zealand	15.5276	0.93211
Peru	85.96833	0.76289	Peru	11.8458	0.93854	Peru	15.5442	0.93206
Philippines (the)	89.11844	0.75642	Philippines (the)	11.9287	0.9383	Philippines (the)	15.6332	0.93174
Poland	84.61222	0.76572	Poland	11.8027	0.93865	Poland	15.5016	0.9322
Portugal	84.52816	0.7659	Portugal	11.8027	0.93865	Portugal	15.5032	0.9322
Puerto Rico	85.05743	0.76477	Puerto Rico	11.8119	0.93863	Puerto Rico	15.5028	0.9322
Russia	88.56345	0.75715	Russia	11.8994	0.9383	Russia	15.6199	0.93177
Singapore	85.27539	0.76429	Singapore	11.8135	0.93864	Singapore	15.5189	0.93214
South Africa	86.98307	0.76055	South Africa	11.8544	0.9385	South Africa	15.5792	0.93192
Spain	84.52894	0.76589	Spain	11.8028	0.93865	Spain	15.5032	0.9322
Sweden	86.5991	0.76161	Sweden	11.8638	0.9385	Sweden	15.5803	0.93193
Switzerland	84.76578	0.76533	Switzerland	11.8139	0.93862	Switzerland	15.5151	0.93215
Taiwan	88.60419	0.75746	Taiwan	11.9168	0.93836	Taiwan	15.6232	0.93178
Thailand	88.64565	0.75737	Thailand	11.9144	0.93836	Thailand	15.6287	0.93176
The Netherlands	84.5476	0.76585	The Netherlands	11.8056	0.93863	The Netherlands	15.5031	0.9322
Turkey	86.25841	0.76161	Turkey	11.7883	0.93858	Turkey	15.5012	0.93215
United Kingdom	84.29513	0.76634	United Kingdom	11.7797	0.93875	United Kingdom	15.4934	0.93223
Uruguay	83.58448	0.76782	Uruguay	11.7851	0.93866	Uruguay	15.4717	0.93229
Viet Nam	96.13825	0.7422	Viet Nam	12.2098	0.9374	Viet Nam	15.8543	0.931

Table 5. Estimated health tourism demand (sorted by adjusted distance).

Country	Estimated percentage of country-specific arrivals	Health tourists (lower bound)	Health tourists (upper bound)
Bosnia and Herzegovina	1.47	96	499
India	1.25	3,155	18,495
Peru	1.26	2105	8286
Sweden	1.26	1574	7295
El Salvador	1.27	1659	7653
Portugal	1.23	2,709	14,762
Dominican Republic	1.21	6,430	28,311
Viet Nam	1.26	2625	9386
Costa Rica	1.22	4,801	16,324
Ecuador	1.28	1599	4697
Uruguay	1.38	356	1165
China	1.21	8,929	30,114
Israel	1.24	2,560	11,994
South Africa	1.27	2207	5437
Korea	1.23	4,881	12,860
Colombia	1.24	3005	8761
Hungary	1.27	1695	4692
Cuba	1.3	478	8288
Greece	1.23	3,909	14,842
Indonesia	1.25	1614	5721
Thailand	1.23	5,687	14,388
Czechia	1.26	2395	7355
Philippines (the)	1.22	4,723	12,960
Japan	1.2	6,807	20,736
Spain	1.18	17,011	43,460
Singapore	1.24	3111	9052
New Zealand	1.27	2249	4656
Denmark	1.32	864	11,190
Cyprus	1.37	218	653
Mexico	1.11	190,694	444,003
Australia	1.23	5122	9695
Ireland	1.2	9,130	20,918
Poland	1.26	2889	8216
Taiwan	1.24	3389	7516
Chile	1.3	1609	2911
Finland	1.3	896	1856
Russia	1.29	2368	4521
The Netherlands	1.2	9,167	17,683
Italy	1.16	38,115	70,598
Belgium	1.24	3045	5552
Germany	1.18	19,816	36,103
Turkey	1.25	2783	9973
Switzerland	1.2	7,180	13,856

(continued)

Table 5. (continued)

Country	Estimated percentage of country-specific arrivals	Health tourists (lower bound)	Health tourists (upper bound)
Hong Kong	1.21	8,259	15,753
France	1.15	28,260	55,095
Puerto Rico	1.18	26,206	38,390
Austria	1.21	5,366	10,422
United Kingdom	1.16	31,337	52,002
Brazil	1.23	5864	9793
Canada	1.12	128,896	181,562

suggest that price development (real exchange rate) either fully mattered or was almost completely irrelevant for the connection with US outbound health tourism spending.

Table 3 shows the DTW distance analysis with the decomposed data stemming from the adjusted demand series. The long-run (trend) similarities were overall weak, generally hovering around 58%. The latter means that the long-term alignment of demand with outbound health tourism spending was poor. The respective similarities were much higher with the cyclical and irregular factors, averaging between 93% (cycles) and 92% (irregular elements). The latter results indicate a strong resemblance when considering the short-term elements of both variables. Since the short-term developments synchronously hover around the data's long-term patterns, the short-run results suggest that US outbound health tourism demand is likely to be dynamic, with extended variability, probably reflecting the absence of a standard patient and the treatment differences.

The price similarity comparisons in Table 4 show a relatively strong trend similitude compared to the demand one in the previous table. There was an average 76% similarity, which is about 1.3 times stronger than the demand case. However, the most considerable similarities still come from the short-term comparisons, with average similarities between 94% (cycles) and 93% (irregular components). These findings show that the price element has a more structural (or long-term) bond with health tourism spending than the demand component, but the short-term connections are virtually equal between demand and price elements. Bear in mind that the price component included in this study only covers the real exchange rate and does not include developments in individual expenses, which could go beyond the health care spending, and may include additional costs for accommodation, airline tickets, gas prices (for those traveling by car to Canada or Mexico), food, local transportation, etc. As per the IMF's balance of payments manual (IMF, 2009).

Table 5 provides a quantification of the demand for health tourism, considering the outcomes of Tables 2 and 3. The results reveal that US outbound tourism rates vary per destination, with the lowest rate for Mexico (1.11%) and the highest for Bosnia and Herzegovina (1.47%). The average rate is (1.24%) was about 0.74 percentage points higher than the average reported by the NTTO for health tourism as the main reason for travel (0.5%). The NTTO's percentage, of course, has some issues, as discussed in section two. Between 629,843 and 1,360,450 persons (lower and upper bounds) travel each year to the selected destinations for health care purposes, which are lower than all the relevant estimations presented in *Treatments types*. Country-wise evaluation of the study's results with actual data is difficult because the data does not exist. The destination survey results are also difficult because health statistics are often presented with other travel reasons, such as education and personal motivations. Nevertheless, some specific comparisons could be made with destination-based survey results. Noree et al. (2016) estimated the number of medical tourists from the US to Thailand at 7,855, which is within the range of the study under review for this destination (5,687–14,388). The annual statistical report of the Ministry of Tourism in India indicates that 1.1% of all US visitors to India in 2018 reported that their primary travel purpose was medical (Ministry of Tourism Government of India, 2019). This percentage is reasonably close to the study under review's estimation (1.25%). Data from the Costa Rican Institute of Tourism (Instituto Costarricense de Turismo) indicates that an average of 0.43% (median = 0.4%) of all international tourists indicated that health and medical treatment was the key reason for traveling to that country, equivalent to between 15,901 and 19,769 health tourists for 2017–2019 (Instituto Costarricense de Turismo, 2021). While they do not report the specific percentage for US visitors, they indicate that the US accounts for about 40% of all visitors to Costa Rica. Using the latter percentage, the array of US health tourists to Costa Rica would then be between 6,873 and 8,500, which is within the range of the study under review (4,801–16,324). The Salvadoran Tourism Corporation (La Corporación Salvadoreña de Turismo) reported that an average of 1.2% (median = 1.2%) of international tourists indicated that health treatment was the main reason for traveling to El Salvador between 2009–2015 (Salvadoran Tourism Corporation, 2016). While we do not know the specific response percentage of US tourists, the average is close to what the study under review has reported for El Salvador (1.27%). The Tourist Information Center of Colombia (Centro de Informacion Turistica de Colombia) reports an average of 0.55% (median = 1.24%) of all international travelers reported health and medical treatment as the main reason for traveling to that destination for the period 2012–2019 (Tourist Information Center of Colombia, 2021). The statistics do not report the US % motivation, but the difference with the study under review is only 0.7 percentage points.

The top countries for US outbound health tourism travel are Mexico, Canada, Italy, United Kingdom, France, and Puerto Rico, which essentially counters Chambers (2015), who indicated that US outbound travelers are likely to travel to South America, Central America, and the Caribbean for health care purposes. Canada's outcome may also indicate that the US may be a dominant market for Canada, as Salehi-Esfahani et al. (2021) suggested.

The results indicate that the rate of health tourists in the overall number of US outbound travelers was 0.74 percentage points higher than the 0.5% average of the NTTO's SIAT. The difference could signal in part the limitations of the SIAT, discussed in *The US health care system and outbound health tourism*. The study findings also did not validate the other hypotheses presented in this study, implying that demand does not appear to have a stronger bond with outbound health tourism spending than price developments.

Conclusion

Summary of the findings

Health tourism is a growing niche tourism segment with a strong dose of research. Despite the many studies in this field, there is still an unsettled comprehension of the health tourism system and its workings, mirrored by a lack of reliable and comparable data and evidence-based information (UNWTO, 2018). The probable reason lies in the context-specific background of health tourism, mainly due to health and health care activities' circumstantial nature, possibly compromising study findings' generalizability. This study found that the similarity of outbound health tourism spending with outbound health tourism demand and destination-specific price developments is more compelling when separately considering intra-data elements (trends, cycles, and irregular elements). While on the demand side, the similarity with outbound health tourism spending is strong in the short but weak in the long run, the similarity with the price elements is more likely to be strong both in the long- and short-term. Additionally, between 1.1% and 1.5% of all US outbound travelers are health tourists, with Mexico, Canada, Italy, the United Kingdom, France, and Puerto Rico being the most prominent health tourism destinations.

Theoretical implications

This study contributes in several ways to advance the relevant tourism literature. First, the study looks at how volume (number of outbound health tourists) and price elements (prices and exchange rates) influence US outbound health tourism spending, considering 50 different destinations. Studies by Salehi-Esfahani et al. (2021) and Ridderstaat et al. (2019) have looked at similar influences but focused on inbound health tourism. This study expands this research line by emphasizing US outbound health tourism to multiple destinations. Second, the study expands the notion of short- and long-run effects proposed by Ridderstaat et al. (2019) in two ways. While the latter study analyzed the short- and long-run volume and price effects on overall health tourism spending, this study did the same analysis but now on decomposed outbound health tourism spending data. In this way, the approach offers a deeper understanding of the connections between outbound health tourism spending and its volume and price elements, considering the same data level (i.e., short with short and long with long). Additionally, this study considered the irregular or shock factors in the analysis, a novel approach for the health tourism literature. The results show that US outbound tourism is particularly a short-term activity (rather than a long-term one), where incidentals (irregular factors) also matter.

Managerial implications

The findings have managerial inference for several reasons. First, while the literature review section already hinted at an understatement of the NTTO survey estimations, this study has quantified the possible error margin of said survey (about 0.7 percentage points). The latter could be significant, and NTTO policy-makers and researchers could reduce this margin by including US travelers to Canada and US travel by bus and car in their survey. Second, the presented results offer a more expanded view on the travel destinations by health tourists, which could help policy-makers disseminate more accurate magnitude estimations of US outbound health tourism. For example, the Centers for Disease Control and Prevention (CDC) reports on its site (Centers for Disease Control, 2021) that each year "[…] millions of US residents participate in medical tourism […]," and US medical tourists "[…] commonly travel to Mexico and Canada, as well as countries in Central America, South America, and the Caribbean […]." The results of this study indicate that about 1.2% of all outbound travelers is health tourist (or about 1.2 million, using the 2019 total outbound travel data reported by the NTTO), countering the assumption of millions of health tourists. Moreover, the study shows a more specific and broader indication of the destination-wise spread of health tourism than what the CDC is reporting, which could help this organization improve its messaging to the public. Third, the study findings could help destinations better understand the US market's potential demand and become more informed about the pool of competitors. In this way, they could target their information and marketing strategy more effectively and make potential health care tourists aware of their services' quality and prices vis-à-vis their main (regional) competitors. Fourth, the methodology presented in this study could assist policy-makers in other source countries (e.g., Canada) in estimating the size of their outbound health tourism demand but could also be tweaked to estimate inbound health tourism demand, allowing for more reliable and comparable data, as petitioned by the UNWTO (2018).

Study limitations

Data on outbound health tourism spending was only available annually (rather than monthly) for about 20 years. The lack of more frequent data beyond annual observations impeded a more in-depth analysis to look for other issues, such as health tourism seasonality. The data were also only available as an aggregate of both medical and wellness tourism, preventing separate analyses of these two activities. Moreover, data on demand for some countries known to offer health tourism services, for example, Argentina, were not fully available to include them in the study.

Recommendations for future research

Future investigations will consider other countries known for being health tourist senders, such as Canada and the United Kingdom, to assess similar connections as those included in this study. Future research will also consider applying this study's methodologies from the perspective of a health tourism destination. Studies in the future will also aim to quantify the weights of medical and wellness tourism and the spending of health tourists on specific goods and services using other research techniques (e.g., surveys or interviews). The ultimate goal of these plans is to get a firm knowledge grip on the health tourism industry.

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