Journal of Air Transport Management 39 (2014) 41–47

Contents lists available at ScienceDirect

Journal of Air Transport Management

journal homepage: www.elsevier.com/locate/jairtraman

A cointegration analysis of bilateral air travel flows: The case of international travel to and from the United States

Junwook Chi*

School of Travel Industry Management, University of Hawaii at Manoa, 2560 Campus Road, George Hall 346, Honolulu, HI 96822, USA

ARTICLE INFO

Article history:
Available online 19 April 2014

Keywords:
Bilateral travel flows
Cointegration analysis
Error correction model
International air travel demand

ABSTRACT

Demand for international air travel has risen over the past decade causing international visitation to the US to reach a record high in 2012. This paper assesses the dynamic impacts of GDP, exchange rate, and the 9/11 terrorist attacks on bilateral air travel flows between the US and its 11 major travel and trading partners. An autoregressive distributed lag modeling approach is employed to estimate short- and long-run relationships between variables. Long-run results demonstrate foreign GDP as the major determinant of demand for inbound travel to the US and US GDP is a crucial factor affecting demand for outbound travel from the US. These findings support a strong linkage between economic growth and demand for international air travel. The real exchange rate has relatively little impact on the bilateral air travel flows. The US dollar appreciation against foreign currencies is found to reduce demand for inbound travel to the US, while having mixed effects on outbound travel from the US. In the short-run, economic growth tends to be a primary factor influencing international travel flows to and from the US. The 9/11 market shock has a detrimental short- and long-run effect on the bilateral air travel flows, implying that the impact of 9/11 is prolonged in international air travel markets.

1. Introduction

Travel and tourism is one of the largest industries in the United States (US) and an important contributor to the balance of international trade. In 2010, US travel exports and imports reached $134 billion and $103 billion, respectively, which resulted in approximately $32 billion in balance of travel trade surplus (USTA, 2013a). Over the past decade, the US has witnessed a rapid increase in demand for international air travel. According to the Bureau of Transportation Statistics (2012), enplaned international air-passengers to the US have increased by more than 35% from 64.2 million in 2001 to 86.8 million in 2012. For outbound travel from the US, enplaned international air-passengers have grown from 63.9 million to 86.4 million during the same period. The US Department of Commerce (2013) announced that international visitation to the US reached a record high and December 2012 marked the 20th straight month of increases. OTTI (2013) and Boeing (2013) data also support a continued upward trend in international travel. Since demand for international air travel has risen and is expected to grow in the future, it is important to investigate the major factors driving the recent demand.

International travel demand is a popular topic in travel research and a large number of studies have explored the determinants of demand for international air travel (Graham, 2000; Kulendran and Wilson, 2000; Song et al., 2000; Button and Taylor, 2000; Abed et al., 2001; Webber, 2001; Daniel and Ramos, 2002; Lim, 2004; Seetaram, 2012; Hsu et al., 2013). Many past studies examine the impact of economic and social factors on air travel demand between selected countries. For example, Kulendran and Wilson (2000) employ cointegration and Granger-causality approaches to examine the relationship between international trade and international travel flows. Their results support evidence that there is two-way Granger-causality between international travel and international trade. Webber (2001) uses the Johansen and Engle and Granger procedures to analyze the leisure travel demand from Australia to nine major tourism destinations. The results show that the variance of exchange rate has a significant long-run impact on Australian outbound travel. Daniel and Ramos (2002) investigates demand for Portuguese inbound tourism travel from five countries. They found the cost of living and income to be a significant factor affecting the tourism demand. Lim (2004) adopts an OLS model to assess the demand determinants of international travel from Korea to Australia; the findings show that gross national product and relative prices are important demand determinants of Korean outbound travel to Australia.

* Tel.: +1 808 956 2229; fax: +1 808 956 5378.

http://dx.doi.org/10.1016/j.jairtraman.2014.03.007
0969-6997/

Although past studies have improved fundamental understanding of international travel demand, there are important limitations found in the existing literature. First, previous research related to international air travel demand focuses on estimating either inbound or outbound travel flows, instead of bilateral flows. Seetaram (2012), Kim and Song (1998) and Webber (2001) analyze inbound flows of international travelers, while Song et al. (2000), Lim (2004), Coshall (2006), and Halicioglu (2010) investigate outbound traveler flows of selected countries. The lack of bidirectional traffic flow research has both policy and managerial effects. From a policy perspective, a unidirectional analysis does not provide information on the response of bidirectional traffic flows and more specifically – how trading and travel partners' macroeconomic variables (e.g., exchange rates and market shocks) affect bidirectional traffic flows. For example, an analysis using unidirectional flow data does not detect whether inbound travel flows are more responsive to a change in bilateral exchange rate than outbound travel flows. To improve understanding of the effectiveness of currency devaluation in increasing travel inflows and reducing travel outflows, it is necessary to investigate elasticities of demand at a bilateral level. From a managerial perspective, the sensitivity of inbound and outbound travel flows to a change in exchange rate can be an important management consideration regarding airline planning. One example would be airline scheduling and fleet assignment between countries. If exchange rate changes affect inbound and outbound travel flows differently, this unbalanced demand can be a significant constraint to maximize the average load factor in a fleet assignment model.

Second, relatively little attention has been paid to the estimation of both the short- and long-run dynamics of international air travel. Many dynamic model studies identify the existence of the long-run equilibrium and examine the long-run causal relationship between variables. These studies focus on only long-run rather than short- and long-run dynamics simultaneously (e.g., Kulendran and Wilson, 2000; Webber, 2001; Lee, 2012). It can be argued that, since a long-run adjustment of impact of a macroeconomic change on traffic flows may differ from its short-run effect, it is necessary to conduct a simultaneous analysis of short- and long-run dynamics. Furthermore, this analysis can provide information to help US policymakers develop short- and long-term investment plans for transportation and tourism development.

Finally, existing literature using aggregate data provides controversial empirical findings of the short- and long-run effects of the 9/11 terrorist attacks on air travel demand. For example, a group of studies (e.g., Ito and Lee, 2005; Blunk et al., 2006) supported that the market shock of the 9/11 attacks had a short-run and prolonged impact on air travel demand; however, in contradiction another group of studies (e.g., Lee et al., 2005; Lai and Lu, 2005) concluded that the 9/11 market shock was only transitory. In the case of international air travel, the mixed results of previous studies may be derived from an aggregation bias problem. That is, a significant elasticity of demand with one country could be offset by an insignificant elasticity of demand with another country, causing an insignificant result (Bahmani-Oskooee and Goswami, 2004). Furthermore, none of the previous research has investigated the presence of a structural break at 9/11 in the airline industry as well as the extent of dynamic impacts of the 9/11 market shock on air travel flows at a bilateral level.

The purpose of this paper is to advance earlier research on air travel demand by assessing the determinants of bilateral international air travel flows in a dynamic framework. For this purpose, an autoregressive distributed lag (ARDL) approach to cointegration, proposed by Pesaran et al. (2001) is employed. The main advantage of the ARDL model is that it applies an error-correction model estimating short-run coefficients through a simple linear transformation and therefore, can estimate the short- and long-run dynamics simultaneously. This paper focuses on the short- and long-run impacts of the three market factors – gross domestic product (GDP), exchange rate, and the 9/11 terrorist attacks – on demand for international travel to and from the US. Empirical results are derived from bilateral travel flow data[1] between the US and its 12 major travel and trading partners for the period of 1996:Q1-2012:Q4. This paper examines the impacts of the 9/11 market shock on international air travel at a bilateral country-level. The results can be used to determine whether 1) there is a structural break of the 9/11 attacks in the airline industry; 2) the dynamic impacts of the 9/11 on air travel flows vary by country; and 3) different responsiveness between US inbound and outbound air travel flows in correlation to the 9/11 attacks.

The remainder of this paper is organized as follows; Section 2 contains the ARDL procedure, the error-correction model, and data and variable descriptions. Section 3 presents the empirical results of short- and long-run coefficients of US inbound and outbound travel demand models. Then, the last section provides concluding remarks including policy and management implications of the findings.

2. The model

2.1. ARDL procedure

In examining bilateral international air travel flows, this paper follows the multi-step ARDL procedure developed by Pesaran et al. (2001). The first step is to estimate the long-run dynamics, a log-linear form of demand equations for inbound travel to the US and outbound travel from the US is specified as follows:

$$\ln D_{\mathrm{ius},t} = \alpha_0 + \alpha_1 \ln \mathrm{GDP}_{i,t} + \alpha_2 \ln \mathrm{ER}_{\mathrm{usi},t} + \alpha_3 \mathrm{DUM} + \varepsilon_t, \quad (1)$$

$$\ln D_{\mathrm{usi},t} = \beta_0 + \beta_1 \ln \mathrm{GDP}_{\mathrm{us},t} + \beta_2 \ln \mathrm{ER}_{\mathrm{usi},t} + \beta_3 \mathrm{DUM} + \mu_t, \quad (2)$$

where $D_{\mathrm{ius},t}$ ($D_{\mathrm{usi},t}$) is the number of enplaned air passengers from country i (the US) to the US (country i); $\mathrm{GDP}_{i,t}$($\mathrm{GDP}_{\mathrm{us},t}$) is the gross domestic product of country i (the US); $\mathrm{ER}_{\mathrm{usi},t}$ is the bilateral real exchange rate of the currency of country i against the US dollar; and DUM is a dummy of the 9/11 terrorist attacks in 2001. $\mathrm{ER}_{\mathrm{usi},t}$ is computed by multiplying the nominal exchange rate of the currency of country i against the US ($\mathrm{ER}^{*}_{\mathrm{usi},t}$) by the ratio of the consumer price indices (CPI) of country i to the US ($\mathrm{ER}_{\mathrm{usi},t} = \mathrm{ER}^{*}_{\mathrm{usi},t} \times (\mathrm{CPI}_{i,t}/\mathrm{CPI}_{\mathrm{us},t})$).

With regards to the signs of coefficients in Eqs. (1) and (2), it is assumed that $\alpha_1 > 0$ and $\beta_1 > 0$, since a rise in national income of the country i (the US) can increase demand for international travel to the US (country i). For inbound travel to the US, an appreciation of the US dollar against foreign currencies increases the cost of international travel to the US and reduces foreign traveler's purchasing power. Therefore, the real exchange rate is expected to have a negative impact on demand for US inbound travel ($\alpha_2 < 0$). On the other hand, the US dollar appreciation lowers the cost of international travel for US consumers and encourages US travelers to visit international destinations; thus, it is assumed to have a positive effect on demand for outbound travel from the US ($\beta_2 > 0$).

[1] To avoid an aggregation data bias, this paper uses the bilateral travel flow data between the US and its main travel and trading partners, instead of aggregate travel data (i.e., the US and the rest of the world).