https://doi.org/10.1016/j.jairtraman.2021.102036

Hong Kong's Aviation and Tourism Growth - an empirical investigation

Wai Hong Kan Tsui[a], Xiaowen Fu[b], Chuanzhong Yin[c], Huaxin Zhang[d]*

[a]The School of Aviation, Massey University, New Zealand. E-mail: w.h.k.tsui@massey.ac.nz
[b]Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University, Hong Kong, China. Email: xiaowen.fu@polyu.edu.hk
[c]College of Transport & Communication, Shanghai Maritime University, Shanghai, China Email: czyin@shmtu.edu.cn
[d*]College of Transport & Communication, Shanghai Maritime University, Shanghai, China Email: hxzhang@shmtu.edu.cn, Corresponding author.

Abstract

This study investigates the critical link between aviation and tourism growth in Hong Kong, with a focus on the identification of causal relationships between scheduled capacity and visitor arrivals. This is achieved through the cointegration analysis and Granger causality test, using monthly data collected from Hong Kong's top 17 tourist source markets during 2008 to 2018. Our analysis finds clear evidence of an overall two-way causal relationship between airline scheduled capacity and tourist arrivals. The positive externalities between the two crucial sectors to the Hong Kong economy call for coordinated planning and policy design in the tourism and aviation sectors, and justify continued government support. On the other hand, market-specific features are evident in selected markets. Such heterogeneity is likely due to airline network effect and regulation in the international market. Therefore direct subsidy is not always an efficient support measure. A combination of liberalization policy and industry supports are preferred in views of the benefits to be achieved for the two sectors and the Hong Kong economy.

Keywords: Air Transport; Tourism; Causality; Aviation and Tourism; Tourist arrivals; Tourist source markets; Hong Kong

1. Introduction

The relationship between air transport and tourism has been an important topic in both air transport and tourism literatures. Many studies found supporting evidence that air transport and tourism are mutually dependent (Duval, 2013, 2020; Ivanova, 2017; Spasojevic, Lohmann & Scott, 2018). Tourism growth stimulates aviation operations, whereas transport services, notably aviation services, are clearly essential elements in the delivery of tourism (Lumsdon & Page, 2007). Hong Kong has many roles at the same time: an "international aviation hub", a "regional and international gateway", "the planet's most popular city destination", a "tourism destination", and a "shopping paradise" (Lew & McKercher, 2002; McKercher, 2008; Homsombat et al., 2011; Tsui, Yuen & Fung, 2018). Tourism is one of the pillar industries of Hong Kong[1] (Jin, 2011; Airport Authority Hong Kong, 2020; Tourism Commission, 2019). The city has broad tourist appeal, attracting more than 58.47 million and 65.15 million of overseas tourists in 2017 and 2018, respectively (Hong Kong Tourism Board, 2017; 2018) [2]. In 2017, Hong Kong's tourism sector employed around 257,100 persons, accounting for about 7% of the city's total employment (Tourism Commission, 2019). Total expenditure associated with inbound tourism (TEAIT) in 2017 and 2018 were approximately HK$296.70 million and HK$328.19 million, respectively (Hong Kong Tourism, 2017a, 2018a). The main arrival mode of Hong Kong's tourists is by land transport, which is the dominant transport mode for tourists from mainland China. However, regional and inter-continental travellers mostly arrive by air (Fung, Law & Ng, 2006; International Air Transport Association, 2014). Visitor arrivals by air to Hong Kong in 2017 and 2018 were approximately 23.4% and 22.08% of its total visitor arrivals (Hong Kong Tourism Board, 2017; 2018).

Despite the great success in the past decades, Hong Kong is facing many challenges in the years to come, notably high infrastructure and input costs in both the aviation and tourism sectors, limited potential of further capacity expansion in the long term, competition from the established network airlines and aggressive low-cost carriers (LCCs) in increasingly liberalized international market (Fu et al., 2010, 2015; Wang et al., 2017, 2020). It is important for stakeholders to have a good understanding of the key demand drivers for aviation and tourism, and how these two sectors influence each other. Hong Kong's aviation and tourism have to be aligned on the basis of sustainable development, thus that their interdependence are exploited for the benefits of the city's economy. This calls for well-defined empirical investigation to identify and quantify such interactions.

As discussed in more details in the literature review section, many studies have examined the relationship between aviation and tourism, which offer rich insight and practical findings across many markets. However, some research gaps remain. Importantly, Pacheco and Fernandes (2017) concluded that prior studies showed that there is no uniform relationship between air transport and tourism, or air transport and economic development. The causal relationships behave differently across countries and regions, and empirical estimation results can vary

[1] Hong Kong's four pillars are financial services, trading and logistics, tourism, and producer and professional services (Airport Authority Hong Kong, 2020).
[2] Visitor arrivals included visitors from Mainland China.

depending on the indicators and variable used. Therefore, the interactive relationship between aviation and tourism in Hong Kong shall not be taken for granted. Indeed, one would expect significant heterogeneity across the aviation markets linking Hong Kong to the rest of the world. Therefore, it is important to conduct empirical investigation using real market data. This study aims to complements previous studies by examining whether there is a significant long-term and causal relationship between airline seat capacity and inbound visitor arrivals in Hong Kong. By using data collected from Hong Kong's top 17 tourist source markets during the period of 2008–2018, robust inference can be made with a representative extensive dataset. More importantly, in the literature there has been a trade-off in sample size *vs*. market heterogeneity. To increase sample size, it is customary to pool the data from many markets to increase estimation efficiency. On the other hand, this could introduce significant heterogeneity in the sample. Our study restricts to the key tourist source markets to one single city (i.e. Hong Kong), so that destination market characteristics remained the same for all observations. On the other hand, a dataset over extended period means there are sufficient variation in the data which improves estimation accuracy. Our study is also among the first to use airline scheduled capacity in causality analysis. Previous studies have used indicators such as dummy variables of direct service availability (Duval and Schiff, 2011), flight frequency (Koo et al., 2017), actual passenger volume (Álvarez-Díaz et al., 2019), manager's score of airport performance (Castillo-Manzano et al., 2011). Because airlines schedules are mostly planned and released for booking in advance, they are more directly determined by airlines, and less dynamic compared to actual traffic volume that is jointly determined by supply and demand. Therefore, our approach enhances the robustness of estimation with very recent data, allowing us to provide reliable and timely findings to stakeholders in Hong Kong. Our analysis finds clear evidence of an overall two-way causal relationship between airline scheduled capacity and tourist arrivals. The positive externalities between the two crucial sectors to the Hong Kong economy call for coordinated planning and policy design in the tourism and aviation sectors, and justify continued government support. On the other hand, market-specific features are evident in selected markets. Such heterogeneity is likely due to airline network effect and regulation in the international market. Therefore direct subsidy is not always an efficient support measure. A combination of liberalization policy and industry supports are preferred in views of the benefits to be achieved for the two sectors and the Hong Kong economy. Because tourists tend to be more price sensitive than business travellers, promoting the growth of the LCC sector may facilitate the growth and recovery of the tourism sector in Hong Kong, which has been badly hit amid the COVID-19 pandemic.

This paper is structured as follows: Section 2 reviews the key findings and research methods in the relevant literature. Section 3 provides an overview of airline seat capacity and visitor arrivals to Hong Kong from the sampled markets. Section 4 describes the methodology and reports estimation results. Section 5 discusses key findings and policy implications of this study. The last section summarizes and explores possible future research opportunities.

2. Literature review

The relationship between aviation and tourism has been an important topic in the aviation and tourism literature, and a few prior studies investigated Hong Kong's tourism demand in different aspects (e.g. Hanqin & Lam, 1999; Law, 2001; Hiemstra & Wong, 2002; Song, Wong, & Chon, 2003; McKercher, 2008; Song et al., 2010; ; Lee, 2011a, 2011b; Ho & McKercher, 2014; Ahn & McKercher, 2015; Liu & McKercher, 2016; Tsui & Fung, 2016; Min Poon & McKercher, 2016; Tsui, Yuen & Fung, 2018). It is generally acknowledged that the availability of air services is necessary for tourism activity, and the quality aviation services stimulate tourism demand (e.g. Duval, 2013, 2020; Duval & Schiff, 2011; Ivanova, 2017; Koo, Lim & Dobruszkes, 2017; Spasojevic, Lohmann & Scott, 2018). These prior studies suggested the theoretical rationales of the causal connection between air transport and tourism. That is, aviation provides the essential accessibility to tourism market and services, and thus, the availability and quality of aviation services contribute significantly to the development in the tourism sector. Such a relationship is evident in geographically isolated markets such as New Zealand and Australia, where aviation is effectively the only viable transport mode for overseas visitors. In particular, Duval and Schiff (2011) is one of the few empirical studies on the impact of direct air services on tourist arrivals. The recent study of Koo, Lim and Dobruszkes (2017) also examined the causal relationship between direct air services and tourism demand.

Granger causality test has been extensively used for the identification of causality (Wooldridge, 2016), and has been adopted in the tourism investigations. Kulendran and Wilson (2000) found a positive relationship between international travel flows and international trade volume using the cointegration and Ganger causality approaches. Pulina and Cortés-Jiménez (2010) examined the relationship of LCCs and tourism activity in Alghero (Italy) using Granger causality test, and concluded that LCC services influenced both domestic and international tourism demand, albeit to differing degrees. Tsui and Fung (2016) analysed relationship between business travel and trade volumes between Hong Kong and its three key trading partners (i.e. Mainland China, Taiwan, and the US), and identified different patterns of casual relationships. Küçükönal and Sedefoğlu (2017) used panel Granger test to examine the causal relationships between air transport, tourism, employment rate and economic development for OECD countries. Results indicated that an uni-directional short-run causal relationship between economic growth, tourism, employment and air transport, and the aforementioned factors played important roles in the growth of air transport. More recently, Pisa (2018) investigated the causal relationship between air transport, tourism and economic growth in South Africa using cointegration, Granger causality test and the vector auto-regressive model (VAR). No evidence of causality and long-run relationships could be identified between air transport and gross domestic product (GDP), or between GDP and tourism. Álvarez-Díaz, González-Gómez and Otero-Giráldez (2019) studied the causal relationship between LCC and international tourism demand for North Portugal and Galica-Spain. They found that LCC passengers have a positive influence on the number of hotel nights spent by international guests.

In addition to studies on the causal relationship between air transport and tourism, many have used the Granger causality test to examine the relationship between air transport and economic development in different markets such as Australia (Baker, Merkert & Kamruzzaman, 2015), Brazil (Fernandes & Pacheco, 2010; Pacheco & Fernandes, 2017), mainland China (Hu et al., 2015), India (Mishra, Rout & Mohapatra, 2011), in Korea (Seo, Park & Boo, 2010), in Nigeria (Saheed & Iluno, 2015), Pakistan (Mehmood & Kiani, 2013), Taiwan (Chang & Chang, 2009), the US (Chi, 2014), the Asia-Pacific region (Van De Vijver, Derudder & Witlox, 2014), and South Asia (Hakim & Merkert, 2016).[3]

Although these studies offer rich insight and practical findings in selected markets, it is unclear to what extent the conclusions can be directly applied to Hong Kong. On the one hand, Hong Kong is one well-established tourist destination in the region. On the other hand, many tourists are from mainland China who have relied on ground transport. Business travel has always accounted for a very significant share of the city's aviation sector, with its local LCC development lagged behind compared to both developed and developing economies in the region (i.e. Singapore, Australia, Japan, Korea, Malaysia, Philippines). In addition, since Hong Kong is well connected to many destinations, there must be significant heterogeneity across the routes. Therefore, it is important to conduct empirical investigation using real market data. This study also complements previous studies by using data collected from Hong Kong's top 17 tourist source markets, so that destination market characteristics remained the same for all observations. The following section outlines the data sources and the background of the aviation market in Hong Kong.

3. Overview of Hong Kong's airline seat capacity and visitor arrivals by air

We compiled data for Hong Kong's 17 key tourist source markets during the period of January 2008–June 2018 from the Hong Kong Tourism board and the OAG database (Hong Kong Tourism Board, 2018; Official Airline Guide, 2020).[4] Available seat kilometre (ASK) represents the seat capacity scheduled by airlines, catering for travels of different purposes. Visitor arrivals (tourist) represent the total number of visitor arrivals by air from a country (tourist source market) visiting Hong Kong, irrespective of purposes of visit (including business, vacation, visiting friends and relatives, en route and others). Table 1 and Figure 1 provide descriptive statistics and time plots of available seat kilometres and visitor arrivals by air in logarithm form (i.e. ln(ASKs) and In(Tourist), respectively). As shown in the charts in Figure 1, both ASK and visitor arrivals for all markets were generally increasing during the sample period, although visitor arrivals from the UK and France presented a declining tendency and Germany presented a steady trend, respectively. ASK numbers experienced higher volatility, likely due to network effects. Scheduled seat capacities are used not only for passengers destined for Hong Kong, but also connecting passengers. For example, passengers may fly from Australia to London via Hong Kong. The consistent capacity increase between

[3] It should be noted that methods other than Granger causality have been used in the literature too, such as production function (Yao and Yang, 2015), augmented gravity models (Brugnoli et al., 2018) and dynamic common correlated effects estimator (Fu et al., 2021).

[4] The sampled 17 key tourist source markets are Hong Kong's key inbound tourist source markets that have already established stable direct flight services for tourists and passengers travelling to Hong Kong. The tourism data are reported by the Hong Kong Tourism Board and publically available.

Hong Kong and Australia reflects such a network effect. On the other hand, increased capacity and flight frequency often lead to higher service quality to consumers in terms of reduced schedule delay, which further stimulate traffic demand and extending network effects (Brueckner and Flores-Fillol, 2007; Pai, 2010; Pitfield et al., 2010; Wang et al., 2014; Fu et al., 2019). It is also clear that despite the traffic reduction caused by the global financial crisis (GFC) in 2008/09, Hong Kong has not suffered major or long-lasting losses during our sample period prior to the COVID-19 pandemic (Tsui and Fung, 2016).

[see Table 1 and Figure 1]

The total visitor arrivals to Hong Kong reached the record level of 1.29 million tourists in October 2017, and shortly after total ASK to Hong Kong reached a peak of 30.4 billion in January 2018. The markets included in our sample are Hong Kong's top tourism destinations, with their combined ASK and visitor arrivals accounted for 87.6% and 85.51% of Hong Kong's total volumes during the sample period, respectively. In most markets and also aggregation of all markets, the time series of ln(ASK) appear to follow those of ln(Tourist), which leads to *a priori* expectation that there is likely some causal relationship between air transport and tourism, although the cases for Australia, Japan, Philippines, Taiwan and the UK do not seem to provide strong support.

Regarding monthly average ln(ASK) of the sampled markets, the top two markets were the US and Australia, both are long-haul markets. They accounted for 17.97% and 11.15% of Hong Kong's total scheduled ASKs during the study period. Mainland China and Japan are Hong Kong's top aviation markets. Despite their geographic proximity, the related ASKs were also quite high. They are followed by another three long-haul markets (in descending order, Canada, the UK and New Zealand), which accounted for between 5.25% and 4.35% of Hong Kong's total ASK. The five proximate and short-haul Asian markets' shares were between 4.04% and 2.48%, which were Singapore, Indonesia, Malaysia, Taiwan and South Korea. The three markets with least scheduled capacity were South Africa, France and Philippines, with shares ranging from 2.30% to 1.17%.

In terms of average monthly visitor arrivals by air, the two largest markets were Mainland China and Taiwan, due to geographic proximity and close economic and cultural ties. They accounted for 33.69% and 10.42% of the total volume, respectively. This is followed by a mix of both long distance and regional markets, including the US, Japan, South Korea, Philippines, Australia, the UK and Singapore in descending order, with shares between 3.29% and 6.09% . Similar patterns had been identified earlier (see also McKercher, 2008), which remained stable for extended period of time. The following tourism markets for Hong Kong were Malaysia, Indonesia, Canada and France, which contributed between 2.84% and 1.32% of the total visitor arrivals by air. Despite their sizable markets in terms of scheduled ASKs, the two long distance markets, New Zealand and South Africa, accounted for less than 1% of visitor arrivals by air.

Overall, the markets included in our sample accounted for more than 80% of Hong Kong's total scheduled seat capacity and visitor arrivals by air. Therefore, empirical results in our study will be representative and characterize the overall market conditions. On the other hand, we need to pay attention to possible heterogeneity across ASK and visitor arrival numbers. Decision makers of the Hong Kong government, airline management, airport authority, as well as tourism authority and operators need to develop a good understanding route-specific characteristics for the design of appropriate air transport and tourism policies.

4. Methodology and Findings

This study uses a three-stage procedure to test the long-run relationship and causality between the time series of ln(ASK) and ln(Tourist) as follows: Stage 1: test the order of integration of ln(ASK) and ln(Tourist) with the Augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) unit root tests. Stage 2: test the existence of cointegration (a long-run relationship) between ln(ASK) and In(Tourist). Stage 3: construct Granger-causality tests where ln(ASK) and ln(Tourist) were cointegrated. The detailed analysis results are summarized as follows.

- ***Stage 1: Unit root tests***

Cointegration between the two time series variables implies a long-run relationship (Granger, 1981; Kulendran & Wilson, 2000; Khan, toh & Chua, 2005; Oh, 2005). To estimate the cointegration of ln(ASK) and ln(Tourist) in this study, these two time series variables need to be stationary so as to avoid the problem of spurious correlation (Tsui & Fung, 2016). The ADF and PP unit root tests were used to test the stationary of ln(ASK) and ln(Tourist) being investigated (Dicky & Fuller, 1976; Phillips & Perron, 1988; Wooldridge, 2016) (see Equation 1). Table 2 shows the unit root test results of ln(ASK) and ln(Tourist), and the results indicated that these two time series variables of all the sampled markets are stationary, which is at the 0.05 significance level and can be regarded as cointegration of order I(1).

$$\Delta x_t = \alpha + \beta x_{t-1} + \sum_{i=1}^{k} \delta \Delta x_{t-1} + \mu_i \qquad (1)$$

where x denotes the level of the variables of interest (ln(ASK) or ln(Tourist)), t denotes time period, α is a constant, β is the coefficient and μ_i is the error term, respectively.

[see Table 2]

- ***Stage 2: Cointegration test***

This stage tests the existence of cointegration (a long-run relationship) between ln(ASK) and ln(Tourist). Following the approach of Engle and Granger (1987), for ln(ASK) and ln(Tourist) to be cointegrated, both time series variables need to be integrated of the same order, e.g. I(1). The order of cointegration is determined by the ADF and PP unit root tests as discussed above. Investigating cointegration between ln(ASK) and ln(Tourist) in this study, the ordinary least square (OLS) model was estimated for both time series variables of all the sampled markets, and their residuals were tested for stationarity based on the ADF and PP tests (see Equations 2 and 3). Tables 3, 4 and 5 present three different scenarios (without constant, with constant only, and with constant and trend), which suggest a long-run relationship between ln(ASK) and ln(Tourist) for most of the sampled markets at the 0.10 significance level or above, except for Australia and Taiwan. Table 6 summarises the identified long-run relationship between ln(ASK) and ln(Tourist) for Hong Kong's key tourist source markets. Overall, the cointegration tests in this study lent support for the proposition that there is a long-run relationship between air transport and tourism in Hong Kong.

$$\ln(\text{ASK})_t = \alpha_0 + \alpha_1 \ln(\text{Tourist})_{t-i} + \mu_t \quad (2)$$

$$\ln(\text{Tourist})_t = \beta_0 + \beta_1 \ln(\text{ASK})_{t-i} + \varepsilon_t \quad (3)$$

where α and β are the coefficients, t denotes time periods, μ_t and ε_t are the error terms, respectively.

[see Tables 3, 4, 5 and 6]

- ***Stage 3: Granger causality test***

Granger (1988) suggested that if two time series variables are cointegrated, then there must be Granger causation in at least one direction. Cointegration between ln(ASK) and ln(Tourist) in Stage 2 implies long-term relationship but does not indicate the direction(s) of the causal relationship (Kulendran & Wilson, 2000). Following Granger (1988), Kulendran and Wilson (2000), Khan, Toh & Chua (2005), and Tsui and Fung (2016), the Granger causality test are used to investigate whether uni-directional (one-way) or bi-directional (two-way) Granger causation can be identified between ln(ASK) and ln(Tourist). The logic in conducting the Granger causality test is that prior literature provided evidence of different Granger causality directions between aviation and tourism/economic development. For example, empirical findings have suggested inter-linkage between air transport and tourism (Duval, 2013; Spasojevic et al., 2018), a bi-directional Granger causality between international travel and international trade (Shan & Wilson, 2001: Tsui & Fung, 2016), and an uni-directional Granger causality from tourism and economic growth to air transport (Fernandes & Pacheco, 2010; Küçükönal & Sedefoğlu, 2017). During the Granger causality test, the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) were used to select for the optimal lag lengths for both ln(ASK) and ln(Tourist). The optimum lag used for the Granger causality test were verified and checked by lags 12, 18 and 24, respectively. In examining the evidence of the direction(s) of Granger causation between ln(ASK) and ln(Tourist), the following hypotheses were established and tested with significance level chosen at 0.10 (see Equations 4 and 5). For example, a rejection of the null hypothesis in Equation (4), suggests that ln(ASK) (scheduled airline seat capacity) does not Granger-cause ln(Tourist) (visitor arrivals by air) for a market.

H_0: testing ln(ASK) does not Granger-cause ln(Tourist) for a market:

$$H_0: \alpha_{21} = \alpha_{22} \dots = \alpha_n = 0 \quad (4)$$

H_0: testing ln(Tourist) does not Granger-cause ln(ASK) for a market:

$$H_0: \beta_{21} = \beta_{22} \dots = \beta_n = 0 \quad (5)$$

Table 7 reports the results of Granger causality test for all of the sampled markets being studied, and Table 8 summarises the directions of Granger-causation relationship, respectively. The results indicated that the rejection of the null hypothesis for eight markets (the US, the UK, Germany, South Korea, Indonesia, Philippines, Singapore, and Mainland China), suggesting that airline seat capacity did Granger-cause (or increase) the number of tourists flying to Hong Kong for holidays and vacations or other purposes. The null hypothesis that ln(Tourist) does not Granger-cause ln(ASK) was also rejected for most of the sampled markets, except for three markets (Australia, South Korea, and Taiwan). That is, visitor arrivals by air from these three markets do not Granger-cause (or increase) seat capacity scheduled by airlines. Importantly, overall, (i.e. when all markets are considered), bi-directional Granger-causation between ln(ASK) and ln(Tourist) are statistically significant at 1%.

[see Tables 7 and 8]

5. Discussion and conclusions

Whereas the economic benefits of aviation has been one critical issue in the air transport literature, not many studies have examined the causal relationship between aviation and tourism. Most empirical findings support a positive relationship in place, albeit not always consistent and there is significant diversity across different markets. It has been concluded that there is no uniform relationship between air transport and tourism, or air transport and economic development. Despite Hong Kong's success in both the tourism and aviation sectors, the city faces significant challenges in terms of rising costs, capacity constraints and increased competition. It is important for stakeholders to have a good understanding of the key drivers for aviation and tourism, and how these two sectors influence each other. This study aims to provide timely analysis on this important topic, thus Hong Kong's aviation and tourism can be aligned on the basis of sustainable development. This is achieved by empirically analysing whether there is a long-run relationship between scheduled airline capacity and visitor by air, using monthly data from 2008 to 2018 for the city's key tourist source markets. Our cointegration and Granger-causality studies suggest the following: First, the cointegration tests found clear evidence of a long-run relationship between airline scheduled capacity and visitor arrivals in most markets (except Australia and Taiwan). Such a pattern is consistent and significant, but market-specific features should also be recognized. Second, the analysis of co-movement in air transport and international inbound tourism using the Granger causality tests concludes that overall there is bi-directional (two-way) Granger causality between airline seat capacity and visitor arrivals by air. Consistent pattern has been individually verified for the markets to US, the UK, Indonesia, Philippines, Singapore and mainland China. Uni-directional (one-way) Granger causality from airline seat capacity to visitor arrivals by air, or from visitor arrivals by air to airline seat capacity, can also be identified with statistical significance.

Despite the overall consistency of the key findings, variations in Granger-causality test results reflect the heterogeneity across different markets. Among others, this could be ascribed to airlines' network configurations, especially that Hong Kong is a major international aviation hub. For example, both Hong Kong and Australian airlines have been using the Hong Kong International Airport to offer connection services from Oceania to Europe (i.e. the so-called Kangaroo routes). Furthermore, air transport regulations and policies may also play important roles. The bilateral air service agreements (ASA) between Hong Kong and Australia remain fairly restrictive, with capacity limits on the Hong Kong-Australia routes (Australia Aviation, 2016). Higher restrictiveness in aviation policy leads to lower levels of movement of people between international cities, and tourism flows are highly sensitive to changes in bilateral aviation policy (Zhang and Findlay, 2014). In the Hong Kong−Australia market, it is important to remove various constraints on international airlines (Dresner and Oum, 1998; Clougherty et al., 2001; Intervistas, 2006; Li et al., 2010; Adler et al., 2014). For the case of Taiwan, no evidence of Granger-causality between airline seat capacity and visitor arrivals by air to Hong Kong could be identified. Historically, routes linking Hong Kong to Taiwan (especially the city of Taipei), were among the world's busiest routes. In 2008, Taiwan and Mainland China signed cross-Strait agreement which allows non-stop or direct flights, which effectively shifted Hong Kong's role of a transit hub in the related markets (Lau et al., 2012; Tsui et al., 2018; Wu, Jiang & Yang, 2018). On the other hand, such cross-Strait agreement between mainland China and Taiwan was accompanied by a time of increased economic integration, and increased tourist flows due to political good will established following the agreement. These effects are likely to be more significant than the casual relationships between aviation and tourism in Hong Kong, making it difficult to be identified statistically. In addition, it should be noted that our analysis used aggregated data at route level, which do not capture the important effects of airline networks and connecting passenger traffic. For example, airlines based in Singapore, such as Singapore Airlines and its subsidiaries, and Australian low cost carrier JetStar could have played important roles in the Hong Kong – Australia market. Such network effects are however not captured in our analysis on route (city-pair) based data. If passenger itinerary data can be obtained, it would be useful to extend our analysis by including all connecting passengers in the estimation. Such an analysis, together with a better control of other social - political factors, should more clearly model the transport markets.

Our study offers valuable findings and recommendations to stakeholders (e.g. the Hong Kong government, the Hong Kong Tourism Board, airline management, and tourism operators). On the one hand, Hong Kong's policy makers must appreciate the inter-dependence between the tourism and aviation sectors, as evidenced by the bi-directional causality empirically identified in our analysis. This calls for coordinated planning and policy design in the tourism and aviation sectors. Thanks to positive causality, any measure promoting the growth of one sector is expected to generate positive feedback effects, and thus justify government support measures. This implies that stakeholders in the tourism sector, or government economic agencies in general, may play more active roles in the formulation of aviation polices, such as those related to aviation infrastructure and air liberalization. In addition, since tourists tend to be price sensitive, the Hong Kong government and aviation policymakers may facilitate increased operations by LCCs, which provide no-frill services at low costs, often stimulating traffic growth (Dresner et al., 1996; Windle and Dresner, 1999; Fu et al. 2011). This will lead to increased market share of Hong Kong's tourism market (Lee et al., 2018; Wang et al., 2017), promoted by local carriers or overseas entrant airlines. On the other hand, our study found significant heterogeneity across different markets. For example, no significant causal relationship were found for Australia. This implies direct government support such as aviation subsidy will provide limited help to the aviation and tourism sectors. Instead, removing existing constraints via liberalization is probably more effective and of higher priority. The Hong Kong government should also consider fifth freedom negotiation with foreign governments, which would encourage Hong Kong-based carriers to expand their international networks, and prompt more international carriers to develop Hong Kong as their transit hub. The latter was a challenging plan due to airport capacity constraint. With the third runway to be added at the Hong Kong International Airport (HKIA) soon, it may become a feasible option in the future. The current LCC movements at HKIA are largely restricted by its capacity shortage and constraint (Wang et al., 2017). After the opening of third runway at HKIA in 2024, as expected, increased airport slots and capacities can allow more leading Asian LCCs to boost seat capacities serving the Hong Kong market (Hong Kong Airport Authority, 2019; Wang et al., 2017). Although the COVID-19 pandemic has brought catastrophic damage to the global and regional markets (Czerny et al. 2021), strong rebounds are expected post the crisis, when LCCs could play an even more important roles with their low cost and high capacity utilization rates. In general, stakeholders should consider individual markets' characteristics, and the possible network effects in airlines' operation and competition strategy. Finally, our study of the overall markets of Hong Kong found strong two-directional causal relationship between scheduled aviation services and tourist arrivals. This implies that there are significant positive externalities between the two crucial sectors to the Hong Kong economy. Unless this externality is formally recognized, the benefits of government supporting policy will be under-estimated. In plain words, air transport and tourism are mutually dependent, and stakeholders in the two sectors should work together to leverage on the synergies.

As discussed in details in previous sections, the data and empirical model in this study allow us to improve the estimation efficiency and robustness. Still, some potential limitations may call for further improvements. For example, additional tourism-demand factors such as airfares, exchange rates, tourism prices for inbound tourists to visit and stay at Hong Kong, the impact of LCCs, were not formally controlled. As a meaningful extension of this study, it would be valuable to investigate the air transport–tourism nexus in Hong Kong in consideration of additional tourism-related variables. Importantly, given the mutual relationship between air transport and tourism, it would very valuable to develop a more comprehensive theoretical framework to further explore the air transport–tourism relationship. This is a research agenda clearly worthy of further attention, given the rapid growth in international air transport and tourism in Hong Kong and the region.

References

Adler N., Fu X., Oum, T. H., & Yu, C. (2014), Air transport liberalization and airport slot allocation: The case of the Northeast Asian transport market. *Transportation Research Part A: Policy and Practice*, *62*, 3-19.

Ahn, M. J., & McKercher, B. (2015). The effect of cultural distance on tourism: A study of international visitors to Hong Kong. *Asia Pacific Journal of Tourism Research*, *20*(1), 94-113.

Airport Authority Hong Kong. (2020). *Economic contribution of HKIA*. Retrieved from https://www.hongkongairport.com/iwov-resources/html/sustainability_report/eng/SR1718/our-future-airport/economic-contribution/

Álvarez-Díaz, M., González-Gómez, M., & Otero-Giráldez, M. S. (2019). Low cost airlines and international tourism demand. The case of Porto's airport in the northwest of the Iberian Peninsula. *Journal of Air Transport Management*, *79*, 101689.

Australian Aviation. (2016). *Cathay to bring A350-900, 777-300ER to Melbourne in 2017*. Retrieved from http://australianaviation.com.au/2016/09/cathay-to-bring-a350-900-777-300er-to-melbourne-in-2017/

Baker, D., Merkert, R., & Kamruzzaman, M. (2015). Regional aviation and economic growth: cointegration and causality analysis in Australia. *Journal of Transport Geography*, *43*, 140-150.

Brueckner, J.K., & Flores-Fillol, R. (2007). Airline schedule competition: Product-quality choice in a duopoly model. *Review of Industrial Organization*, *30*, 161-177.

Brugnoli, A., Dal Bianco, A., Martini, G., & Scotti, D. (2018). The impact of air transportation on trade flows: A natural experiment on causality applied to Italy. *Transportation Research Part A: Policy and Practice*, *112*, 95–107.

Castillo-Manzano J., López-Valpuesta, L., o González-Laxe, F. (2011) The effects of the LCC boom on the urban tourism fabric: The viewpoint of tourism managers, *Tourism Management 32*, 1085-1095.

Chang, Y. H., & Chang, Y. W. (2009). Air cargo expansion and economic growth: Finding the empirical link. *Journal of Air Transport Management*, *15*(5), 264-265.

Chi, J. (2014). A cointegration analysis of bilateral air travel flows: The case of international travel to and from the United States. *Journal of Air Transport Management*, *39*, 41-47.

Clougherty, J. A., Dresner, M., & Oum, T. H. (2001). An empirical analysis of Canadian international air policy: effects of dual carrier designation and partial liberalization. *Transport Policy*, *8*(3), 219-230.

Czerny, A., Fu, X., Lei, Z., Oum, T.H. (2021). Post pandemic aviation market recovery: experience and lessons from China, *Journal of Air Transport Management*, 90, 101971.

Dicky, D. A., & Fuller, W. A. (1976). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, *74*(366a), 427-431.

Dresner, M., Lin, J.S.C. & Windle, R., (1996). The impacts of low-cost carriers on airport and route competition. *Journal of Transport Economics and Policy* 30, 309-328.

Dresner, M., & Oum, T. H. (1998). The effect of liberalized air transport bilaterals on foreign traffic diversion: the case of Canada. *Journal of Transport Economics and Policy*, *32*(3), 317–330.

Duval, D. T. (2013). Critical issues in air transport and tourism. *Tourism Geographies*, *15*(3), 494-510.

Duval, D. T. (2020). *Transport and tourism. Tourism Review, Vol. ahead-of-print No. ahead-of-print*. Retrieved from https://doi.org/10.1108/TR-06-2019-0280

Duval, D. T., & Schiff, A. (2011). Effect of air services availability on international visitors to New Zealand. *Journal of Air Transport Management*, *17*(3), 175-180.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, *55*(2), 251-276.

Fernandes, E., & Pacheco, R. R. (2010). The causal relationship between GDP and domestic air passenger traffic in Brazil. *Transportation Planning and Technology*, *33*(7), 569-581.

Fu, X., Dresner, M. & Oum, T.H. (2011). Effects of transport service differentiation in the U.S. domestic airline market, *Transportation Research – Part E* 47(3), 297-305.

Fu, X., Jin, H., Liu, S., Oum, T. H., & Yan, J. (2019). Exploring network effects of Point-to-Point networks: An investigation of the spatial patterns of Southwest airlines' network. *Transport Policy*, *76*, 36-45.

Fu X., Oum T. H. & Zhang A. (2010). Air transport liberalization and its impacts on airline competition and air passenger traffic. *Transportation Journal*, 49(4), 24-41.

Fu X., Oum T. H., Chen R., & Lei Z. (2015). Dominant carrier performance and international liberalization – the case of North East Asia, *Transport Policy*, 43, 61-75.

Fu, X., Tsui, K., Sampaio, B. & Tan, D. (2021), Do airport activities affect regional economies? - Regional analysis of New Zealand's airport system, *Regional Studies*, forthcoming

Fung, M. K. Y., Law, J. S., & Ng, L. W. K. (2006). Economic contribution to Hong Kong of the aviation sector: A value-added approach. *Chinese Economy*, *39*(6), 19-38.

Granger, C. W. J. (1981). Some properties of time series data and their use in econometric model specification. *Journal of Econometrics*, *16*(1), 121-130.

Granger, C. W. J. (1988). Some recent development in a concept of causality. *Journal of Econometrics*, *39*(1-2), 199-211.

Hakim, M. M., & Merkert, R. (2016). The causal relationship between air transport and economic growth: Empirical evidence from South Asia. *Journal of Transport Geography*, *56*, 120-127.

Hanqin, Z. Q., & Lam, T. (1999). An analysis of Mainland Chinese visitors' motivations to visit Hong Kong. *Tourism Management*, *20*(5), 587-594.

Hiemstra, S., & Wong, K. K. (2002). Factors affecting demand for tourism in Hong Kong. *Journal of Travel & Tourism Marketing*, *13*(1-2), 41-60.

Ho, G., & McKercher, B. (2014). A comparison of long-haul and short-haul business tourists of Hong Kong. *Asia Pacific Journal of Tourism Research*, *19*(3), 342-355.

Homsombat W., Lei, Z., & Fu, X. (2011). Development status and prospects for aviation hubs – A comparative study of the major airports in South-east Asia. *Singapore Economic Review*, *56*(4), 573-591.

Hong Kong Airport Authority. (2019). Airport authority's statement in response to media report about the progress of reclamation works of three-runway system. Retrieved from https://www.hongkongairport.com/en/media-centre/press-release/2019/pr_1326

Hong Kong Tourism Board. (2017, 2018). *Visitor arrival statistics*. Retrieved from https://securepartnernet.hktb.com/australia/en/research_statistics/research_publications/index.html?id=4109

Hong Kong Tourism. (2017a, 2018a). *A statistical review of Hong Kong Tourism*. Retrieved from https://securepartnernet.hktb.com/australia/en/research_statistics/research_publications/index.html?id=3632

Hu, Y., Xiao, J., Deng, Y., Xiao, Y., & Wang, S. (2015). Domestic air passenger traffic and economic growth in China: Evidence from heterogeneous panel models. *Journal of Air Transport Management*, *42*, 95-100.

International Air Transport Association. (2014). *Growing Hong Kong as an aviation economy*. Retrieved from https://airlines.iata.org/analysis/growing-hong-kong-as-an-aviation-economy
Intervistas. (2006). *The Economic Impact of Air Service Liberalisation*. Retrieved from http://www.intervistas.com/wp-content/uploads/2015/07/The_Economic_Impacts_of_Air_Liberalization_2015.pdf
Ivanova, M. G. (2017). *Air transport–tourism nexus: A destination management perspective*. Varna: Zangador
Jin, J. C. (2011). The effects of tourism on economic growth in Hong Kong. *Cornell Hospitality Quarterly*, *52*(3), 333-340.
Khan, H., Toh, R. S., & Chua, L. (2005). Tourism and trade: cointegration and Granger causality tests. *Journal of Travel Research*, *44(2*), 171-176.
Koo, T. T., Lim, C., & Dobruszkes, F. (2017). Causality in direct air services and tourism demand. *Annals of Tourism Research*, *67*, 67-77.
Küçükönal, H., & Sedefoğlu, G. (2017). The causality analysis of air transport and socio-economics factors: the case of OECD countries. *Transportation Research Procedia*, *28*, 16-26.
Kulendran, N., & Wilson, K. (2000). Is there a relationship between international trade and international travel?. *Applied Economics*, *32*(8), 1001-1009.
Lau, Y. Y., Lei, Z., Fu, X., & Ng, A. K. (2012). The implications of the re-establishment of direct links across the Taiwan Strait on the aviation industries in Greater China. *Research in Transportation Economics*, *35*(1), 3-12.
Law, R. (2001). The impact of the Asian financial crisis on Japanese demand for travel to Hong Kong: A study of various forecasting techniques. *Journal of Travel & Tourism Marketing*, *10*(2-3), 47-65.
Lew, A. A., & McKercher, B. (2002). Trip destinations, gateways and itineraries: The example of Hong Kong. *Tourism Management*, *23*(6), 609-621.
Lee, C. K., Ng, K. K. H., Chan, H. K., Choy, K. L., Tai, W. C., & Choi, L. S. (2018). A multi-group analysis of social media engagement and loyalty constructs between full-service and low-cost carriers in Hong Kong. *Journal of Air Transport Management*, *73*, 46-57.
Lee, K. N. (2011a). Forecasting long-haul tourism demand for Hong Kong using error correction models. *Applied Economics*, *43*(5), 527-549.
Lee, K. N. H. (2011b). Estimating demand elasticities for intra-regional tourist arrivals to Hong Kong–the 'bounds' testing approach. *Applied Economics Letters*, *18*(17), 1645-1654.
Li ZC., Lam H.K., Wong S.C. and Fu X (2010), Optimal route allocation in a liberalizing airline market. *Transportation Research Part B: Methodological*, *44*(7), 886-902.
Liu, A., & McKercher, B. (2016). The impact of visa liberalization on tourist behaviors –The case of China outbound market visiting Hong Kong. *Journal of Travel Research*, *55*(5), 603-611.
Lumsdon, L., & Page, S. J. (2007). Progress in transport and tourism research: reformulating the transport-tourism interface and future research agendas. In L. Lumsdon & S. J. Page (Eds.), *Tourism and Transport* (pp. 16-43). London: Routledge.
McKercher, B. (2008). The implicit effect of distance on tourist behavior: A comparison of short and long haul pleasure tourists to Hong Kong. *Journal of Travel & Tourism Marketing*, *25*(3-4), 367-381.
Mehmood, B., & Kiani, K. (2013). An inquiry into nexus between demand for aviation and economic growth in Pakistan. *ACADEMICIA: An International Multidisciplinary Research Journal*, *3*(10), 200-211.
Min Poon, P. C., & McKercher, B. (2016). The Transit Tourists in Hong Kong. In *Tourism and Hospitality Management* (pp. 31-46). Emerald Group Publishing Limited.

Mishra, P. K., Rout, H. B., & Mohapatra, S. S. (2011). Causality between tourism and economic growth: Empirical evidence from India. *European Journal of Social Sciences*, *18*(4), 518-527.

Official Airline Guide. (2020). *Schedules Analysis*. Retrieved from https://www.oag.com/analyser

Oh, C. O. (2005). The contribution of tourism development to economic growth in the Korean economy. *Tourism Management*, *26*(1), 39-44.

Pacheco, R. R., & Fernandes, E. (2017). International air passenger traffic, trade openness and exchange rate in Brazil: A Granger causality test. *Transportation Research Part A: Policy and Practice*, *101*, 22-29.

Pai, V., 2010. On the factors that affect airline flight frequency and aircraft size. *Journal of Air Transport Management*, *16*, 169-177.

Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Pisa, N. (2018). Causal Relationship between Air Transport, Tourism and Economic Growth: Joinpoint Regression and Granger Causality Analysis. *Euro Economica*, *37*(2), 164-176.

Pitfield, D. E., Caves, R. E., & Quddus, M. A. (2010). Airline strategies for aircraft size and airline frequency with changing demand and competition: A simultaneous-equations approach for traffic on the North Atlantic. *Journal of Air Transport Management*, *16*, 151-158.

Pulina, M., & Cortés-Jiménez, I. (2010). Have low-cost carriers influenced tourism demand and supply? The case of Alghero, Italy. *Tourism Analysis*, *15*(6), 617-635.

Saheed, A. A. A., & Iluno, S. Z. C. (2015). Air transportation development and economic growth in Nigeria. *Journal of Economics and Sustainable Development*, *6*(2), 1-11.

Seo, J. H., Park, S. Y., & Boo, S. (2010). Interrelationships among Korean outbound tourism demand: Granger causality analysis. *Tourism Economics*, *16*(3), 597-610.

Shan, J., & Wilson, K. (2001). Causality between trade and tourism: empirical evidence from China. *Applied Economics Letters*, *8*(4), 279-283.

Song, H., Lin, S., Zhang, X., & Gao, Z. (2010). Global financial/economic crisis and tourist arrival forecasts for Hong Kong. *Asia Pacific Journal of Tourism Research*, *15*(2), 223-242

Song, H., Wong, K. K., & Chon, K. K. (2003). Modelling and forecasting the demand for Hong Kong tourism. *International Journal of Hospitality Management*, *22*(4), 435-451.

Spasojevic, B., Lohmann, G., & Scott, N. (2018). Air transport and tourism–a systematic literature review (2000–2014). *Current Issues in Tourism*, *21*(9), 975-997.

Tourism Commission. (2019). *Hong Kong: The facts – Tourism*. Retrieved from https://www.gov.hk/en/about/abouthk/factsheets/docs/tourism.pdf

Tsui, W. H. K., & Fung, M. K. Y. (2016). Causality between business travel and trade volumes: Empirical evidence from Hong Kong. *Tourism Management*, *52*, 395-404.

Tsui, K. W. H., Yuen, A. C. L., & Fung, M. K. Y. (2018). Maintaining competitiveness of aviation hub: Empirical evidence of visitors to China via Hong Kong by air transport. *Current Issues in Tourism*, *21*(11), 1260-1284.

Van De Vijver, E., Derudder, B., & Witlox, F. (2014). Exploring causality in trade and air passenger travel relationships: the case of Asia-Pacific, 1980–2010. *Journal of Transport Geography*, *34*, 142-150.

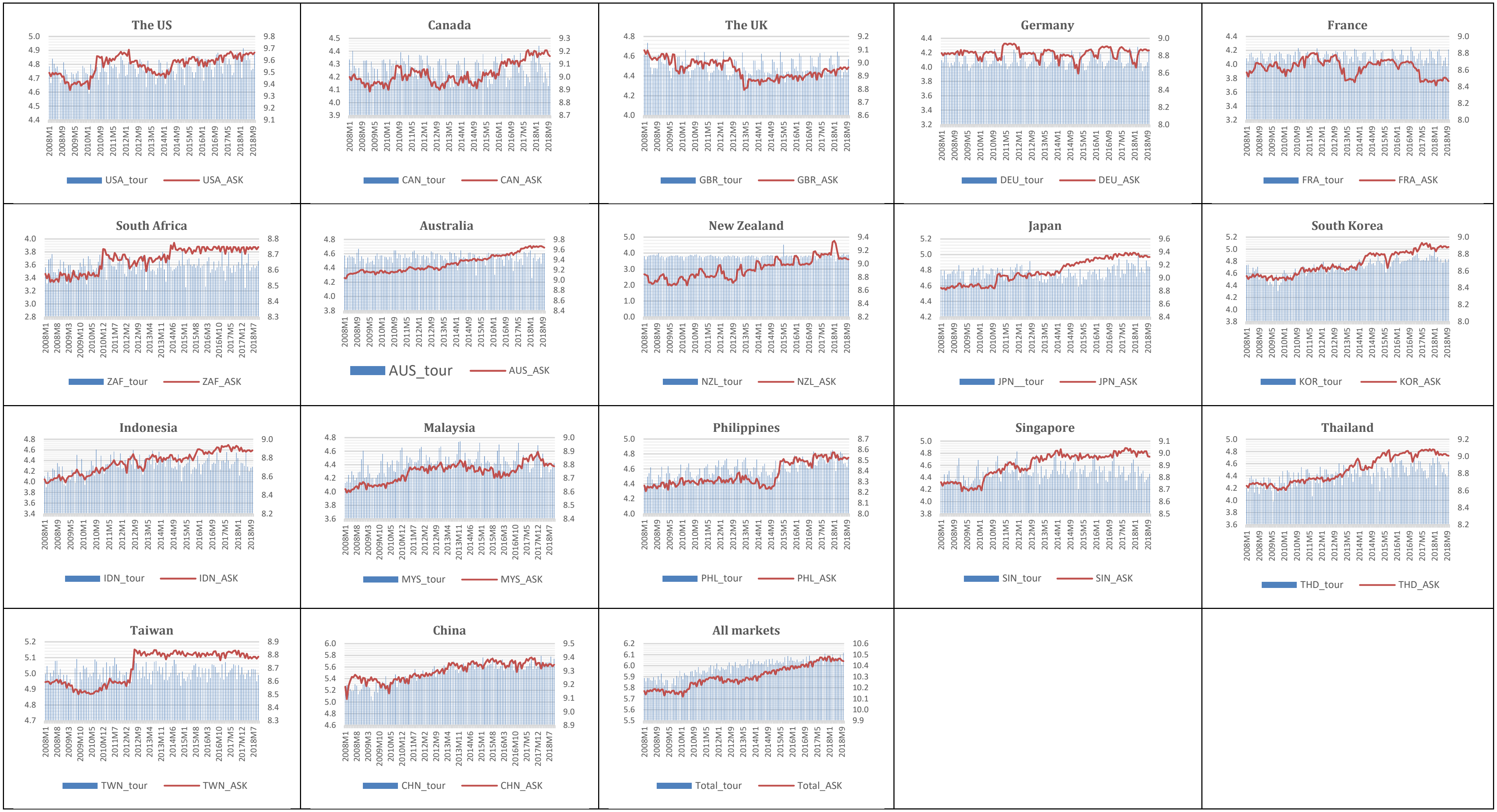
Wang, K., Fu, X., Czerny, A., Hua, G., & Lei, Z. (2020) Modeling the potential for aviation liberalization in Central Asia - Market analysis and implications for the Belt and Road initiative. *Transportation Research Part A: Policy and Practice*, *134*, 184-210.

Wang K., Gong Q., Fu, X., & Fan, X. (2014). Frequency and aircraft size dynamics in a concentrated growth market: The case of the Chinese domestic market. *Journal of Air Transport Management*, *36*, 50-58.
Wang, K., Tsui, K.W. H., Liang, L. & Fu, X. (2017). Entry patterns of low-cost carriers in Hong Kong and implications to the regional market, *Journal of Air Transport Management*, *64*(B), 101-112.
Windle, R. & Dresner, M., (1999). Competitive responses to low cost carrier entry. *Transportation Research Part E* 35, 59-75.
Wooldridge, J. M. (2016). *Introductory econometrics: A modern approach*. US: South-Western Cengage Learning.
Wu, C., Jiang, Q., & Yang, H. (2018). Changes in cross-strait aviation policies and their impact on tourism flows since 2009. *Transport Policy*, *63*, 61-72.
Yao, S., & Yang, X. (2012). Air transport and regional economic growth in China. *Asia-Pacific Journal of Accounting & Economics*, *19*(3), 318–329.Zhang, Y., & Findlay. C. (2014). Air transport policy and its impacts on passenger traffic and tourism flows. *Journal of Air Transport Management*, *34*, 42-48.

Table 1. Descriptive statistics for Hong Kong's key tourist source markets (January 2008–June 2018)

	ASK (million)	Visitor arrivals by air (number)	ASK (million)	Visitor arrivals by air (number)	ASK (million)	Visitor arrivals by air (number)	ASK (million)	Visitor arrivals by air (number)	ASK (million)	Visitor arrivals by air (number)	ASK (million)	Visitor arrivals by air (number)
	The US		Canada		The UK		Germany		France		South Africa	
Maximum	4886.87	82,305	1,615.53	27,664	1,245.69	54,360	868.24	19,063	634.50	17,818	596.02	6395
Minimum	2242.12	39,031	769.28	13,096	621.97	21,716	389.33	8791	258.96	9527	334.45	1645
Mean	3652.23	59,480	1067.50	18,486	898.22	32,188	674.00	12,728	438.78	12,922	470.95	3936
Standard deviation	661.54	8548.7	210.99	3252.4	143.80	6340.3	92.42	2628.4	92.44	2074.8	76.56	1046.4
No. of months	126	126	126	126	126	126	126	126	126	126	126	126
	Australia		New Zealand		Japan		South Korea		Indonesia		Malaysia	
Maximum	4713.82	46,639	2,210.56	33,589	2445.33	100,314	855.05	97,345	868.97	40,528	787.10	55,647
Minimum	1082.46	18,168	468.90	2935	657.45	37,462	306.05	20,312	338.25	7877	392.46	12,191
Mean	2267.18	34,907	884.72	6418	1368.44	58,843	503.83	52,566	582.01	21,629	559.11	27,729
Standard deviation	954.18	5711.8	340.24	2751.6	573.10	10,387.3	156.86	14864.6	147.78	7523.9	88.47	9245.0
No. of months	126	126	126	126	126	126	126	126	126	126	126	126
	Philippines		Singapore		Thailand		Taiwan		Mainland China		All markets	
Maximum	375.32	71,225	1103.33	67,444	1218.04	55,802	694.69	125,458	2503.34	619,029	30,431.73	1,288,583
Minimum	162.33	21,148	483.82	15,628	399.38	9622	317.17	77,762	1238.20	106,159	13,124.77	567,040
Mean	237.47	40,826	821.57	32,173	741.46	27,734	527.57	101,835	2003.66	329,083	20,324.52	976,873
Standard deviation	63.09	11,099.2	182.42	11,125.8	270.55	9501.2	138.19	10,871.7	290.06	114,457.1	4,690.61	161,259.2
No. of months	126	126	126	126	126	126	126	126	126	126	126	126

Figure 1. Time plots of ln(ASK) and ln(Tourist) by air of Hong Kong's key tourist source markets (January 2008–June 2018)



Remarks: ASK and Tour denote ln(ASK) and In(Tourist) in the time plots, respectively.

Table 2. ADF and PP unit root tests for the time series variables

Country	Unit root tests	ln(ASK)			ln(Tourist)		
		ln(ASK)	Δln(ASK)	Integration order	ln(Tourist)	Δln(Tourist)	Integration order
The US	ADF	0.881	-2.9935**	I(1)	1.651	-3.691***	I(1)
	PP	0.526	-17.798***		0.386	-30.068***	
Canada	ADF	1.181	-3.184***	I(1)	0.584	-3.780***	I(1)
	PP	0.959	-17.696***		-0.845	-47.354***	
The UK	ADF	-0.451	-3.273***	I(1)	-1.700*	-5.198***	I(1)
	PP	-0.790	-17.527***		-0.965	-28.480***	
Germany	ADF	-0.269	-2.768***	I(1)	0.180	-4.654***	I(1)
	PP	0.127	-17.100***		-0.443	-16.703***	
France	ADF	-0.247	2.840***	I(1)	0.013	-13.145***	I(1)
	PP	-0.262	-14.273***		-0.578	-34.061***	
South Africa	ADF	1.160	-2.863***	I(1)	0.266	-3.911***	I(1)
	PP	2.539	-23.556***		-0.066	-51.194***	
Australia	ADF	2.232	-2.172**	I(1)	-0.222	-4.589***	I(1)
	PP	3.171	-15.019***		-0.282	-56.219***	
New Zealand	ADF	1.584	-2.259**	I(1)	-0.148	-11.923***	I(1)
	PP	1.450	-14.661***		0.256	-42.015***	
Japan	ADF	-1.657	-2.254**	I(1)	0.635	-3.855***	I(1)
	PP	3.033	-13.940***		-0.105	-43.428***	
South Korea	ADF	1.631	-3.236***	I(1)	1.300	-3.094***	I(1)
	PP	2.219	-15.371***		0.095	-21.155***	
Indonesia	ADF	2.136	-3.950***	I(1)	1.513	-3.418***	I(1)
	PP	2.044	-10.092***		0.948	-42.682***	
Malaysia	ADF	0.750	-2.664***	I(1)	1.151	-3.406***	I(1)
	PP	0.958	-18.574***		0.751	-30.714***	
Philippines	ADF	0.711	-2.378**	I(1)	2.588	-3.100**	I(1)
	PP	1.138	-16.292***		1.209	-21.079***	
Singapore	ADF	1.253	-2.836***	I(1)	0.419	-3.413***	I(1)
	PP	1.354	-18.174***		0.371	-35.945***	
Thailand	ADF	1.897	-3.198***	I(1)	2.154	-4.017***	I(1)
	PP	1.694	-14.704***		0.708	-47.582***	
Taiwan	ADF	0.618	-2.514**	I(1)	0.078	-9.443***	I(1)
	PP	0.712	-16.387***		0.069	-65.065***	
Mainland China	ADF	0.933	-3.143***	I(1)	2.613	-2.532**	I(1)
	PP	1.541	-19.964***		2.340	-29.405***	
All markets	ADF	1.262	1.716*	I(1)	1.823	-2.478**	I(1)
	PP	3.049	-21.603***		0.564	-33.526***	

Remarks: *, **, and *** indicate that the time series variable is significant at the 0.10, 0.05, and 0.01 significance level, respectively. The ADF and PP unit root test results are without constant. The ADF and PP unit root results with constant only as well as constant and trend are unreported for the sake of brevity and contact the corresponding author for additional results. Δ represents first-order differencing of the time series variables.

Table 3. ADF and PP tests for hypothesis of cointegration of ln(ASK) and ln(Tourist) (without constant)

Country	ln(ASK) & ln(Tourist)			Countries	ln(ASK) & ln(Tourist)		
	ADF test (AIC / SIC)	PP test	Cointegration		ADF test (AIC / SIC)	PP test	Cointegration
The US	-2.445** -2.445**	3.669***	Yes	**South Korea**	-1.185 -5.312***	-5126***	Yes
Canada	-0.597 -1.799*	-1.590	Yes	**Indonesia**	-1.431 -1.392	-2.084**	Yes
The UK	-2.097** -2.097**	-2.683***	Yes	**Malaysia**	-1.344 -1.344	-3189***	Yes
Germany	-3.957*** -3.957***	-4.646***	Yes	**Philippines**	-1.514 -1.514	-4.836***	Yes
France	-2.414** -1.807*	-2.360**	Yes	**Singapore**	-0.925 -0.925	-2.411**	Yes
South Africa	-1.653* -1.715*	-1.951**	Yes	**Thailand**	-0.257 -0.041	-5060***	Yes
Australia	0.958 0.958	-0.305	No	**Taiwan**	-1.219 -1.049	-1.444	No
New Zealand	-0.583 -0.583	1.965	No	**Mainland China**	-1.915* -1.915*	-7.377***	Yes
Japan	-0.824 -0.862	-1.196	No	**All markets**	-1.531 -1.531	-6.123***	Yes

Remarks: The ADF and PP without constant tests the null hypothesis (H_0) of the non-stationary of the resulting residual time series of the regression of ln(ASK) and ln(Tourist). AIC and SIC results are based on lag 12. *, ** and *** indicate the rejection of the null hypothesis (H_0) at the 0.10, 0.05 and 0.01 significance level, respectively.

Table 4. ADF and PP tests for hypothesis of cointegration of ln(ASK) and ln(Tourist) (with constant)

Country	ln(ASK) & ln(Tourist)			Countries	ln(ASK) & ln(Tourist)		
	ADF test (AIC/SIC)	PP test	Cointegration		ADF test (AIC/SIC)	PP test	Cointegration
The US	-2.447 -2.447	-3.661***	Yes	**South Korea**	-1.215 -5.288***	-5.090***	Yes
Canada	-0.316 -1.784	-1.556	No	**Indonesia**	-1.366 -1.378	-2.072	No
The UK	-2.152 -2.152	-2.670*	Yes	**Malaysia**	-1.252 -1.252	-3.165**	Yes
Germany	-3.928*** -3.928***	-4.629***	Yes	**Philippines**	-1.495 -1.495	-4.822***	Yes
France	-2.400 -1.797	-2.348	No	**Singapore**	-0.951 -0.951	-2.389	No
South Africa	-1.670 -1.706	-1.925	No	**Thailand**	-0.154 0.057	-4.893***	Yes
Australia	2.478 2.478	-0.126	No	**Taiwan**	-1.219 -1.045	-1.420	No
New Zealand	-0.280 -0.280	-1.900	No	**Mainland China**	-1.905 -1.905	-7.350***	Yes
Japan	-0.851 -0.875	-1.145	No	**All markets**	1.495 -1.495	-6.1055***	Yes

Remarks: The ADF and PP with constant and trend tests the null hypothesis (H_0) of the non-stationary of the resulting residual time series of the regression of ln(ASK) and ln(Tourist). AIC and SIC results are based on lag 12. *, ** and *** indicate the rejection of the null hypothesis (H_0) at the 0.10, 0.05 and 0.01 significance level, respectively.

Table 5. ADF and PP tests for hypothesis of cointegration of ln(ASK) and ln(Tourist) (with constant and trend)

Country	ln(ASK) & ln(Tourist)			Countries	ln(ASK) & ln(Tourist)		
	ADF test (AIC/SIC)	PP test	Cointegration		ADF test (AIC/SIC)	PP test	Cointegration
The US	-2.680 -2.680	-4.309**	Yes	**South Korea**	-2.242 -6.263***	-60.78***	Yes
Canada	-1.398 -3.107	-2.993	No	**Indonesia**	-2.507 -3.360*	-4.525***	Yes
The UK	-2.067 -2.067	-3.032	No	**Malaysia**	-2.106 -2.106	-5.216***	Yes
Germany	-3.953** -3.953**	-4.620***	Yes	**Philippines**	-2.358 -2.358	-5.631***	Yes
France	-2.718 -2.236	-2.646	No	**Singapore**	-1.961 -1.961	-5.520***	Yes
South Africa	-2.456 -3.700**	-4.951***	Yes	**Thailand**	-2.291 -7.676***	-8.008***	Yes
Australia	-1.998 -1.998	-2.519	No	**Taiwan**	-1.913 -1.257	-2.781	No
New Zealand	-3.272* -3.272*	-4.845***	Yes	**Mainland China**	-2.383 -2.383	-7.585***	Yes
Japan	-3.048 -3.048	5.355***	Yes	**All markets**	-2.056 -2.056	-6.758***	Yes

Remarks: The ADF and PP with constant and trend tests the null hypothesis (H_0) of the non-stationary of the resulting residual time series of the regression of ln(ASK) and ln(Tourist). AIC and SIC results are based on lag 12. *, ** and *** indicate the rejection of the null hypothesis (H_0) at the 0.10, 0.05 and 0.01 significance level, respectively.

Table 6. Long-run equilibrium relationship between ln(ASK) and ln(Tourist)

Identified long-run relationship based on ADP and PP unit root tests	Tourist source markets
ln(ASK) ◄─► ln(Tourist) (*A long-run relationship existed*)	The US, Canada, The UK, Germany, France, South Africa, New Zealand Japan, South Korea, Indonesia, Malaysia, Philippines, Singapore, Thailand, Mainland China, All markets
ln(Tourist) —— ln(ASK) (*a long-run relationship did not exist*)	Australia, Taiwan

Table 7. Granger causality between ln(ASK) and ln(Tourist)

Country	Granger causality		Countries	Granger causality	
	H_0: ln(ASK) do not Ganger-cause ln(Tourist)	H_0: ln(Tourist) do not Granger-cause ln(ASK)		H_0: ln(ASK) do not Ganger-cause ln(Tourist)	H_0: ln(Tourist) do not Granger-cause ln(ASK)
The US	Rejected (0.0008)***	Rejected (9.E-07)***	**South Korea**	Rejected (0.0295)***	Fail to reject (0.0591)
Canada	Failed to reject (0.3548)	Rejected (0.0003)***	**Indonesia**	Rejected (0.0128)***	Rejected (7.E-08)***
The UK	Rejected (0.0017)***	Rejected (2.E-09)***	**Malaysia**	Fail to reject (0.0725)	Rejected (0.0025)***
Germany	Fail to reject (0.1555)	Rejected (6.E-16)***	**Philippines**	Rejected (0.0003)***	Rejected (0.0001)***
France	Fail to reject (0.4250)	Rejected (0.0002)***	**Singapore**	Rejected (8.E-05)***	Fail to reject (0.0189)
South Africa	Fail to reject (0.9763)	Rejected (0.0008)***	**Thailand**	Fail to reject (0.4610)	Rejected (0.0003)***
Australia	Fail to reject (0.0966)	Fail to reject (0.0535)	**Taiwan**	Fail to reject (0.1411)	Fail to reject (0.1598)
New Zealand	Fail to reject (0.0879)	Rejected (0.0099)***	**Mainland China**	Rejected (0.0007)***	Rejected (0.0004)***
Japan	Fail to reject (0.4702)	Rejected (8.E-07)***	**All markets**	Rejected (2.E-05)***	Rejected (6.E-06)***

Remarks: The parentheses indicate the *p*-values. *** indicate that the rejection of the null hypothesis (H_0) at the 0.01 significance level, respectively.

Table 8. Summary of Granger-causality test

Country	Identified Granger causation relationship	Significance level	Country	Identified Granger causation relationship	Significance level
The US	ln(ASK) ⇄ ln(Tourist)	1%	**South Korea**	ln(ASK) → ln(Tourist)	1%
Canada	ln(Tourist) → ln(ASK)	1%	**Indonesia**	ln(ASK) ⇄ ln(Tourist)	1%
The UK	ln(ASK) ⇄ ln(Tourist)	1%	**Malaysia**	ln(Tourist) → ln(ASK)	1%
Germany	ln(Tourist) → ln(ASK)	1%	**Philippines**	ln(ASK) ⇄ ln(Tourist)	1%
France	ln(Tourist) → ln(ASK	1%	**Singapore**	ln(ASK) → ln(Tourist)	1%
South Africa	ln(Tourist) → ln(ASK	1%	**Thailand**	ln(Tourist) → ln(ASK)	1%
Australia	*No Granger-causation relationship found*		**Taiwan**	*No Granger-causation relationship found*	
New Zealand	ln(Tourist) → ln(ASK	1%	**Mainland China**	ln(ASK) ⇄ ln(Tourist)	1%
Japan	ln(Tourist) → ln(ASK	1%	**All markets**	ln(ASK) ⇄ ln(Tourist)	1%

Remarks: Arrows indicate direction of Granger causation between ln(ASK) and ln(Tourist).