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Entry pattern of low-cost carriers in New Zealand

- The impact of domestic and trans-Tasman market factors

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Abstract

This study empirically examines the route entry decision of Jetstar NZ, a low-cost carrier (LCC), in New Zealand's duopolistic domestic aviation market between 2009 and 2016. The estimation controls for route characteristics, airline spatial network, and airline competition variables in both New Zealand's domestic market and the adjacent trans-Tasman markets linking Australia and New Zealand. The empirical results suggest that the favorable regional socioeconomic and tourism factors helped Jetstar NZ launch its service into a route. The LCC's entry decisions on domestic routes are not sensitive to airline competition within the same market but are influenced by the carrier's own operation and airline competition in the international Tasman market. Our study suggests that there are different sources of network effects for LCCs operating point-to-point travel demands. The Airline-in-Airline (AinA) strategy allows airlines within the same group to achieve certain synergy and competition benefits, but certain network effects can only be obtained between the same types of carriers. We also find preliminary evidence of spill-over effects, through which international liberalization influences competition in the domestic market.

Keywords: LCC's route entry decision; route- and market-pair characteristics; airline spatial network; airline competition; policy implication

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1. Introduction

Air transport has a significant influence on a region's economy, notably the sectors of tourism, logistics and high value added manufacturing (see, e.g., Lawton & Solomko, 2005; Mason & Alamdari, 2007; Spasojevic, Lohmann, & Scott, 2018; Tsui, 2017; Zhang & Lu, 2013; Gong et al. 2018). Low-cost carriers (LCCs) typically provide no-frill services at much lower airfares than traditional full service airlines (FSAs), which often allows them to substantially increase traffic volume after entering a route (Dresner et al. 1996; Fu et al., 2011; Windle & Dresner 1995, 1999). As a result, LCCs bring significant benefits to tourism destinations (Graham & Dennis, 2010; Chung & Whang, 2011) and short-haul regional markets (Whyte & Lohmann, 2015a). Regions with smaller airports have actively lobbied for LCC service, which is seen as a vehicle for promoting regional economic development (Oliveira & Huse, 2009; Müller-Rostin et al., 2010; Chung & Whang, 2011; Fu et al., 2015).

In New Zealand, the domestic aviation market has recently experienced strong growth after the LCC entry of Jetstar Airways into the country (hereafter Jetstar NZ). This was made possible by the 'open skies' agreement signed between the New Zealand and Australian governments in 2000 (New Zealand Government, 2000), which permits Australian airlines to operate domestic flights in New Zealand. Jetstar NZ offers point-to-point (i.e., no connection arrangements provided) low-fare services within New Zealand and across the Tasman Sea to Australian destinations. The airline has successfully broken the monopoly of Air New Zealand and its subsidiaries (e.g., Air Nelson and Mount Cook Airlines) in New Zealand's domestic market, emerging as a key competitor to challenge Air New Zealand's dominance. This has transformed New Zealand's domestic market into a duopolistic structure, with Air New Zealand seen as the full service airline (FSA)/legacy carrier/national carrier and Jetstar NZ as the LCC alternative (Henderson et al., 2019). This significant change in the aviation market is expected to have major impacts on other sectors, such as the tourism industry in New Zealand, as New Zealand is a tourism-oriented country, with tourism revenues having already become the largest revenue source in the economy (Tourism New Zealand, 2016; Balli, Tsui & Balli, 2019).

Although a number of studies have investigated LCCs' entry decisions in relatively large markets in Asia, Australia, the US, and Europe (see, e.g., Sinclair, 1995; Gil-Moltó & Piga, 2008; Homsombat, Lei & Fu, 2014; Fu et al., 2015; Wang, Xia & Zhang, 2017), few have examined the case of New Zealand. This leaves gaps and opportunities for research because New Zealand's aviation market possesses some distinctive features. (a) Except for Australia across the Tasman Sea, New Zealand is geographically isolated from other major aviation markets. The domestic surface transport network is not extensive. This makes New Zealand an ideal 'clean' case study for analyzing the effects of LCC entry that is free from complicating factors including the effects of other low-cost substitutes, such as high-speed rail, rail and coach services (Givoni & Dobruszkes 2013; Fu et al., 2012, 2014; Wang et al., 2017). (b) The trans-Tasman Single Aviation Market covering Australia and New Zealand is one of the very few markets in which foreign airlines are allowed to serve different countries' domestic markets (i.e., cabotage). This provides an excellent opportunity to examine the effects of airlines' international operations on domestic market performance. Such an analysis would have significant value, particularly for liberalization literature and related government policy. (c) Although it is well known that the "network effect" plays an important role in the aviation industry, until very recently, the effect has been studied for full service airlines that utilize the so-called "hub-and-spoke" network because LCCs typically operate point-to-point networks without offering connection/transfer services. However, a recent study on Southwest Airlines in the US domestic market suggests that even an LCC may explore network effects (Fu et al., 2019). Jetstar NZ is LCC that has limited network coverage in New Zealand's domestic market but has extensive trans-Tasman services. A study on Jetstar NZ's operation will therefore reveal to what extent and under what conditions the LCC can leverage the (possible) network effects.

Our study aims to explore these research opportunities by analyzing Jetstar NZ's spatial entry patterns. In addition to the issues discussed above, our study will examine the implications of the so-called "airline-in-airline" strategy (AinA) when an airline group operates an FSA and an LCC at the same time. Such a strategy was first introduced in the US and Europe, but the first successful case was in Australia, when the FSA (Qantas Airways) established its own LCC subsidiary (Jetstar Airways). As discussed in the Literature Review section, such a strategy is expected to introduce complex market dynamics in airline price competition, yet few studies have examined its implications in airline network development. Finally, our empirical investigation controls the effects of tourism and other social-economic factors and thus allows us to provide insights and policy recommendations for the country's aviation and tourism sector.

The remainder of this paper is structured as follows. Section 2 reviews the background of air transport development across the trans-Tasman market, as well as Jetstar's services across the Tasman and within New Zealand; Section 3 provides an overview of the determinants of the entry of LCCs into airline markets; Section 4 describes the methodology used in this study; Section 5 presents the dataset for analysis; Section 6 reports the results and discusses the results in terms of policy implications for regional development; and finally, the study concludes its key findings and indicates a direction for future research.

2. Backgrounds

2.1 Air transport development across the trans-Tasman market

In 1993, New Zealand and Australia signed the Closer Economic Relations Trade (CER) Agreement. Since then, both economies have progressively integrated, and the agreement promoted air travel and tourism in the two countries (see, e.g., Kissling, 1993; Hall, 1994; Pearce, 1995; ICAO, 2007). Reflecting the long-established link between these two countries, Kiwi Travel International Airlines was the first LCC to enter the trans-Tasman market in August 1995 with the introduction of its low-cost, no-frill services; thus, the duopoly of Air New Zealand and Qantas serving the short-haul trans-Tasman air travel market was disturbed (Haugh & Hazledine, 1999). With respect to the competition of low-cost services in the trans-Tasman market, a subsidiary of Air New Zealand, Mount Cook Airlines, established its own low-cost subsidiary Freedom Air in 1996 as a competitor of Kiwi Travel International Airlines, which forced the latter into liquidation in September 1996 (Francis et al., 2006; Ryan & Birks, 2006; Williams, 2007). More LCC services were later introduced into the trans-Tasman aviation market, notably Pacific Blue, a subsidiary of Virgin Blue in 2003, and Jetstar Airways in Australia (hereafter Jetstar Australia) in 2004. These actions were seen as due to the signature of the Single Aviation Market (SAM) between Australia and New Zealand, which was incorporated in the CER Agreement (Chang & Williams, 2001). The Productivity Commission (1998) noted that the SAM between Australia and New Zealand provides unrestricted capacity to, from and within each country, including cabotage. In 2000, Australia and New Zealand endorsed a historic 'open skies' agreement (ICAO, 2007). This 'open skies' agreement not only liberalized air traffic between the two countries, allowing Australia's and New Zealand's international airlines to operate across Tasman and then beyond to third countries without restriction, but also allowed Australian and New Zealand owned airlines to operate domestic services in either country (New Zealand Government, 2000). Airline competition, market growth and fare changes have been seen in this competitive aviation market since the ‘open skies’ agreement came into effect (Volwes & Tierbey, 2007). Similarly, the ‘open skies’ agreement has impacted airline competition, market growth and fare levels (consumer benefits) in the trans-Tasman market (Chang & Williams, 2001). Kong (1999) also considered the trans-Tasman market one of the most competitive aviation markets in the world.

2.2 Growth of Jetstar Group’s services across Tasman and within New Zealand

Following the liberalization of the trans-Tasman aviation market in 1996 and the signing of the ‘open skies’ agreement in 2000, the number of flights and air passenger traffic have increased considerably across the Tasman. Several carriers have entered and exited the trans-Tasman aviation market, and airfares have fallen significantly (New Zealand Government, 2019). For example, Qantas used the ‘two brands, AinA segmentation’ strategy to establish its low-cost subsidiary, the Jetstar Group (Jetstar Australia in 2004 and Jetstar NZ in 2005), in response to Virgin Blue’s aggressive growth and began operations across the Tasman in 2004, targeting price-sensitive leisure passengers in both markets (see, e.g., Graham & Vowles, 2006; Volwes & Tierbey, 2007; Gillen & Gados, 2008; Lin, 2012; Homsombat, Lei & Fu, 2014; Whyte & Lohmann, 2015b; Jetstar, 2019c; Raynes & Tsui, 2019). Virgin started as an LCC under the name of Virgin Blue and later switched to the FSA model with its name changed to Virgin Australia and acquired Tiger Airways, another LCC, as its subsidiary. Therefore, in the early days, the Qantas Group (consisting of Qantas and Jetstar) relied much on Jetstar in its expansion, including in its expansion in the trans-Tasman market. For example, Jetstar Australia first launched no-frill services between Sydney and Christchurch in December 2005 (Jetstar, 2019a). It operated a fleet of Airbus A320 and A321 on the Australian domestic market and trans-Tasman services. Later, its trans-Tasman services expanded to connect Brisbane, Coolangatta (Gold Coast), Melbourne and Sydney to Christchurch. In addition, Jetstar NZ introduced services from Melbourne and Coolangatta to Queenstown in December 2010. In November 2014, Jetstar NZ increased its weekly flight services between Sydney and Queenstown to six flights (Otago Daily Times, 2014). Jetstar NZ further expanded its trans-Tasman services in December 2015 with the launch of a flight from Coolangatta to Wellington. In February 2019, Jetstar NZ provided trans-Tasman services from Coolangatta to Auckland and Wellington, from Melbourne to Auckland, Christchurch, Queenstown and from Sydney to Auckland, Christchurch, Queenstown, and Wellington. Jetstar NZ now operates a fleet of single-aisle Airbus A320 and A321, which have 180 seats and 220 to 230 seats, respectively, with the configuration of all-economy seats in both the Australian and New Zealand markets (Jetstar, 2019b).

Kissling (1998) argued that New Zealand is at the forefront of the deregulation domestically, but the “low-cost revolution” has been slow to develop. Benefitting from the ‘open skies’ agreement between Australia and New Zealand, Jetstar NZ has extended to domestic operations in New Zealand since June 2009 (Whyte & Lohmann, 2015b). This is an important air transport development for New Zealand’s domestic LCC sector (Tsui & Henderson, 2019). Jetstar NZ started to offer budget air transport services to New Zealand’s major cities, namely, Auckland, Christchurch, Dunedin, Queenstown, and Wellington. In September 2012, Jetstar NZ grew its fleet to nine aircraft (Jetstar, 2019c). Those routes at the time were a three-way battle involving Air New Zealand and Pacific Blue (a subsidiary of Virgin) (Stuff, 2015). Jetstar NZ also adopted aggressive marketing strategies to extend its scheduled budget air travel services to four additional smaller regional cities, namely, Nelson, Napier, New Plymouth and Palmerston North, between December 2015 and February 2016 (Tsui, 2017; Tsui & Henderson, 2018). In February 2019, Jetstar NZ’s regional services in New Zealand were operated by a fleet of Bombardier Q300, which can carry 50 passengers, and a fleet of Airbus 320 for the main trunk routes, such as Auckland, Christchurch, Queenstown and Wellington (Jetstar, 2019b). Jetstar NZ has already built a strong position in New Zealand since its inception.

3 Literature Review

One of the key areas in airline business research relates to the market entry and exit of airlines (Gil-Moltó & Piga, 2008; Kawasaki & Lin, 2013; Spasojevic, Lohmann & Scott, 2018). According to Hüschelrath and Müller (2013), the existing literature with respect to market entry can broadly be subdivided into two strands: the 'determinants of entry' literature and the 'effects of entry' literature. This section focuses on studies in the former strand that investigated the key drivers of airline decisions to enter particular routes (or LCCs' route choice decisions) by estimating the likelihood of airline entry as a function of firm, route and market characteristics. Lederman and Januszewski (2003) claimed that there is heterogeneity in the entry patterns of LCCs. They suggested that LCCs can pursue two avenues while entering markets. (i) LCCs can choose to enter markets with a smaller number of existing products and offer new services on those routes. Importantly, LCCs need to differentiate their services and products to generate air travel demand. (ii) LCCs can enter markets with a large number of existing products and attempt to offer new product varieties, such as a ticket with a few restrictions for a low fare. However, prior studies aimed at explaining the entry determinants and strategies of LCCs mostly focused on the large markets in the US and Europe (see, e.g., Alderighi et al., 2012; Boguslaski, Ito & Lee, 2004; Gil-Moltó & Piga, 2008; Ito & Lee, 2003; Müller, Hüschelrath & Bilotkach, 2012; Sinclair, 1995). For example, Müller, Hüschelrath and Bilotkach (2012) used the duration analysis regression model to analyze JetBlue Airways' decisions regarding entry into the US non-stop airport-pair domestic markets, and they found that JetBlue focused on thicker routes and secondary airports. Gil-Moltó and Piga (2008) also used the conditional logit approach to investigate the entry and exit activity of three European airlines (British Airways, EasyJet and RyanAir) in the United Kingdom–Europe airline markets and concluded that airlines' entry and exit activities are more likely in large markets and in markets with a high number of incumbents, while high seasonality generally discourages airline entry. In addition, Zhang et al. (2018) suggested that competitors' presence at both endpoint airports and route concentration are two significant deterrents of entry in the EU-US market.

In the Asian market, Zhang and Lu (2013) claimed that Spring Airlines, the largest LCC in China, faced restrictions on entry into lucrative routes and in accessing ideal time slots. Importantly, their findings highlighted the tourism and economic benefits brought about by LCCs, which should be the driving forces for change in air transport policies in China. The recent study of Fu et al. (2015) on the same airlines found that Spring Airlines prefers to serve markets with high traffic volumes out of its base and, more importantly, Spring's entry decision is not significantly affected by competition, either from airlines or high-speed rail. Similarly, the LCC entry pattern in the Hong Kong aviation market has been studied by Wang et al. (2017), who suggested that LCCs in Asia have a preference for large markets with large populations, high incomes and high traffic volumes. On the other hand, the dominance of incumbent FSAs, fierce route competition and the lack of secondary airports are not critical to the growth of LCCs in Asia. Instead, government regulations and airport access are the main impediment factors. Despite the adoption of long-distance low-cost models by the airlines in Asia, geographic distance still plays an important role in LCCs' entry decisions in the region.

Few studies of LCC entry are found in South America. Notable exceptions include the study of GOL Airlines in the Brazilian domestic market by Oliveira (2004), who claimed the relevance of market size and the route presence of rivals as underlying determinants of airline profitability. The same determinants were found when Oliveira (2017) re-examined the entry of Gol Airlines into the Brazilian domestic market. It was also noted that GOL's entry pattern and route-choice behavior followed the preeminent Southwest Airlines model that focused on short-haul and high-density markets. In the Australian market, two recent empirical studies (Homsombat, Lei & Fu, 2014; Zhang, Wang & Fu, 2017) suggested that the Qantas Group uses Jetstar as a fighting brand in that Jetstar flies to a destination if and only if the regional airport is also served by rival LCCs (e.g., Virgin Australia). To the best of our knowledge, few studies have examined LCC route entry decisions in New Zealand's domestic aviation market, although this market is considered one of the most competitive aviation markets in the world (Volwes & Tierbey, 2007).

4 Methodology

To investigate the determinants of Jetstar NZ's route entry decision in New Zealand's domestic market, this study estimates a probit model with specifications similar to those validated by a number of previous studies (see, e.g., Boguslaski, Ito & Lee, 2004; Oliveira 2008; Lei & Fu, 2014; Fu et al., 2015; Homsombat, Wang et al., 2017; Wang et al., 2019). The probit model is derived from the underlying assumption that Jetstar NZ will serve a domestic route in New Zealand only if it is profitable to the Qantas Group. That is, either Jetstar NZ can make a profit, or the Qantas Group as a whole can gain at the expense of Jetstar NZ's financial loss on a specific route. The AinA strategy adopted by the Qantas Group also implies that Jetstar NZ's route entry decision may be affected by Qantas' overall network configuration and competitive pressure from other major network carriers in the trans-Tasman aviation market, which links the New Zealand domestic market to Australian destinations. With the 'open skies' agreement between the two countries, there is no need to control for any explicit or implicit restrictions imposed by bilateral ASA (Air Service Agreement) on Jetstar NZ's route entry decision in New Zealand's domestic aviation market, thus allowing this study to focus on the route-pair characteristics and market mechanism (Wang et al., 2020).[6]

Note that the Qantas Group's profitability related to Jetstar NZ's service on one route is not directly observable (latent). Let this latent profit π^* of serving a route be specified as in Equation (1):

$$\ln\pi_{it}^* = \ln\boldsymbol{x}_{it}'\boldsymbol{\varphi} + \mu_{it} \tag{1}$$

where subscript i denotes the route and subscript t denotes time. $\boldsymbol{x}_{it}$ is the vector of the observable factors affecting the Qantas Group's profitability in allowing Jetstar NZ to operate route i at time t. $\boldsymbol{x}_{it}'\boldsymbol{\varphi}$ represents the deterministic part of the profit, with the parameter vector $\boldsymbol{\varphi}$ to be estimated. μ_{it} is a random error term, which is assumed to follow the iid normal distribution (i.e., $\mu_{it} \sim iid\ N(0,1)$). Let Y denote the route entry decision of Jetstar NZ and C denote the fixed cost or a profit threshold for Jetstar NZ to operate a specific route in New Zealand's domestic market (i.e., the minimum profit acceptable by the Qantas Group for Jetstar NZ to enter a route, or the opportunity cost associated with a new market entry). Therefore, Jetstar NZ's route entry decision in New Zealand's domestic market can be specified as a function of the latent profit, such that $Y_{it} = 1$ if $\pi^* - C > 0$, and $Y_i = 0$ if $\pi^* - C \leq 0$.

[6] Since some different operational procedures are still present (e.g. customs and immigration control, baggage and passenger connection, and until recently, security control), it is still meaningful to examine domestic and international markets separately.

Our latent profit function in this study and the resultant entry decisions represent the dynamic entry and exit behaviors of Jetstar NZ in New Zealand's domestic market. It assumes that Jetstar NZ is able to adjust its route configuration at time t. That said, at the beginning of each period, Jetstar NZ can re-consider the entry or exit for each route with changing market conditions $\boldsymbol{x}_{it}^{\prime}$. As we use yearly data, it appears reasonable for us to assume that Jetstar NZ is able to adjust its network every year since airlines normally reschedule services twice per year (i.e., the spring and autumn schedules) (Wang et al., 2020).

The probability of route entry of Jetstar NZ at time t can be expressed as in Equations (2.1) and (2.2):

$$\begin{aligned}\text{Prob}(Y=1|\boldsymbol{x}) &= \text{Prob}\left(\frac{\pi^*}{C}>1\middle|\boldsymbol{x}\right)=\text{Prob}(\mathbf{ln}\boldsymbol{x}'\boldsymbol{\varphi}-\ln C+\ \ \mu>0|\boldsymbol{x}) \\ &= \text{Prob}(\ \mu>-(\mathbf{ln}\boldsymbol{x}'\boldsymbol{\varphi}-\ln C)|\boldsymbol{x})=1-\boldsymbol{\Phi}(-(\mathbf{ln}\boldsymbol{x}'\boldsymbol{\varphi}-\ln C))\end{aligned} \tag{2.1}$$

$$\begin{aligned}\text{Prob}(Y=0|\boldsymbol{x}) &= \text{Prob}\left(\frac{\pi^*}{C}<1\middle|\boldsymbol{x}\right)=\text{Prob}(\mathbf{ln}\boldsymbol{x}'\boldsymbol{\varphi}-\ln C+\ \ \mu<0|\boldsymbol{x}) \\ &= \text{Prob}(\ \mu<-(\mathbf{ln}\boldsymbol{x}'\boldsymbol{\varphi}-\ln C)|\boldsymbol{x})=\boldsymbol{\Phi}(-(\mathbf{ln}\boldsymbol{x}'\boldsymbol{\varphi}-\ln C))\end{aligned} \tag{2.2}$$

where $\boldsymbol{\Phi}$ is the cumulative probability function of the standard normal distribution. Using Equations (2.1) and (2.2), Jetstar NZ's route entry problem is transformed from the Qantas Group's profit maximization problem into a simple probit model estimation. Specifically, the maximum likelihood estimation (MLE) is adopted to estimate the following log-likelihood function in Equation (3):

$$\ln L=\sum_{t=1}^{T}\sum_{i=1}^{N}\ln\{[1-\boldsymbol{\Phi}(-(\mathbf{ln}\boldsymbol{x}_{it}'\boldsymbol{\varphi}-\ln C))]^{y_{it}}[\boldsymbol{\Phi}(-(\mathbf{ln}\boldsymbol{x}_{it}'\boldsymbol{\varphi}-\ln C))]^{1-y_{it}}\} \tag{3}$$

As Jetstar NZ is a subsidiary of the Qantas Group, serving as part of the Qantas Group's overall AinA strategy, the deterministic part of the profit depends on the factors affecting Jetstar NZ's operating profit *per se* and the factors related to the Qantas Group's network configurations and competitive conditions of the trans-Tasman market that is adjacent/connected to New Zealand's domestic market under investigation. Specifically, this study specifies the deterministic profit as shown in Equation (4). To avoid the potential endogeneity problem due to mutual causality between the route entry decision of Jetstar NZ and the route- and market-pair characteristics, the lagged values of the route- and market-pair characteristics of the explanatory variables are used for the probit model estimation in Equation (4) (Homsombat, Lei & Fu, 2014).

$$\begin{aligned}\ln x_{it}'\varphi=\alpha_0 &+\beta_1\ln(Geometric\ \ regional\ \ GDP\ \ per\ \ capita)_{it-1} \\ &+\beta_2\ln(Guest\ arrival)_{it-1}+\beta_3\ln(Orgin\ \ airport\ HHI)_{it-1} \\ &+\beta_4\ln(Destination\ \ airport\ HHI)_{it-1}+\beta_5\ln(Flying\ \ distance)_i \\ &+\beta_6 Christchurch\ \ earthquakes\ \ 2011/12 \\ &+\gamma_1\ln(JQ\ \ Freq\,from\ \ NZ\ \ to\ AUS)_{t-1} \\ &+\gamma_2\ln(QF\ \ Freq\,from\ \ NZ\ \ to\ AUS)_{t-1} \\ &+\gamma_3\ln(NZ\ \ Freq\,from\ \ NZ\ \ to\ AUS)_{t-1} \\ &+\gamma_4\ln(VA\ \ Freq\,from\ \ NZ\ \ to\ AUS)_{t-1} \\ &+\gamma_5\ln(Other\ \ Freq\ \ from\ \ NZ\ to\ AUS)_{t-1}+\tau_t\end{aligned} \tag{4}$$

The detailed definitions of the variables of interest are shown in Table 1. The following variables measure the key route-specific determinants contributing to Jetstar NZ's route entry decision (or Jetstar's operating profit): ln(*Geometric regional GDP per capita*)$_{it-1}$, ln(*Guest arrival*)$_{it-1}$, ln(*Origin airport HHI*)$_{it-1}$, ln(*Destination airport HHI*)$_{it-1}$ and ln(*Flying distance*)$_{i}$. In addition, *Christchurch earthquakes 2011/12* is a dummy variable to capture the effect of the Christchurch earthquakes on air travel demand and the resulting airline route entry profitability.

It could be more profitable for Jetstar NZ to launch its services and operations for New Zealand's domestic markets with large potential air travel demand and tourism demand. Thus, it is expected that higher regional gross domestic product (GDP) per capita and more regional tourist arrivals increase Jetstar NZ's latent profit and its route entry probability for a market or region. However, airline competition or concentration at airports (measured as the endpoint airports' Herfindahl-Hirschman indexes (HHI)) is perceived to affect airline operating costs and demand due to airline economies of scope and airline competition. Prior literature (Bresnahan, 1991; Oliveria, 2008; Wang et al., 2017) suggested that airlines intend to launch new routes from airports already served because they have already established significant operations and facilities, which allows them to save fixed costs and enhance their competitiveness. As Jetstar NZ could take up heterogeneous market shares at two endpoint airports (origin and destination) after its entry into a route, this study uses the HHI index to control the effect of airline competition or concentration (Air New Zealand *vs*. Jetstar NZ) at both the origin and the destination airports of an airport pair (route). This also captures the change in the competitive landscape on the route. It should be noted that New Zealand's domestic aviation market was monopolized by Air New Zealand and its subsidiaries (e.g., Air Nelson and Mount Cook Airlines) prior to Jetstar NZ's entry, so there was not much competition at the route level. Thus, using the HHI indices of both endpoint airports to control the competition effect is appropriate. Not including route-level competition variables also significantly reduces the possible endogeneity issue in estimation. Furthermore, the flying distance between two destinations is an essential determinant affecting both air travel demand and airline operating costs, thus impacting airline profit.

In addition to the above route-specific and market-pair-specific determinants, this study incorporates, in the existing probit model, the following spatial network factors of Qantas's flight services and the airline competition conditions on the trans-Tasman routes. This simple extension adds new insights into the AinA strategy, allowing us to empirically examine how the parent airline (Qantas) uses its subsidiary (Jetstar NZ) to explore certain markets while leveraging the whole group's spatial network. This empirical estimation controls the flight capacities of Jetstar NZ and its major rival airlines (i.e., Air New Zealand, Virgin Australia and other fifth freedom airlines) in the Tasman market. The variables used for Jetstar NZ and the Qantas Group include ln(*JQ Freq from NZ to AUS*)$_{t-1}$ and ln(*QF Freq from NZ to AUS*)$_{t-1}$, respectively. The variables for measuring the impact of major rival network carriers include ln(*NZ Freq from NZ to AUS*), ln(*VA Freq from NZ to AUS*)$_{t-1}$ and ln(*Other Freq from NZ to AUS*)$_{t-1}$.

It is expected that Jetstar NZ is more likely to launch and operate domestic routes in the New Zealand market if the LCC has more flight capacity across the Tasman because this would allow New Zealand's passenger traffic to be better linked with Jetstar Australia's domestic and international long-haul networks. It should be beneficial for the Qantas Group to secure an enlarged origin–destination (O–D) passenger traffic base. On the other hand, the strong competitors (e.g., Air New Zealand, Virgin Australia and other fifth freedom carriers) operating in the short-haul trans-Tasman air travel market could either encourage or discourage Jetstar NZ's entry into New Zealand's domestic routes. This depends on whether Jetstar NZ and its parent airline (Qantas) are willing to compete head-to-head to serve the highly competitive trans-Tasman aviation market. Jetstar NZ has replaced Qantas on a number of loss-making trans-Tasman routes (Stuff, 2015), which probably suggests that the Qantas Group does not want to engage a full price war with excessive capacity and frequency.

<Table 1 about here>

5 Data Sources and Descriptive Statistics

Table 1 summarizes the definitions and sources of the variables of interest used. The data cover annual data for seven years from 2010 to 2016 for New Zealand's 56 domestic routes, resulting in a balanced panel dataset consisting of 392 route-specific observations. In addition to explanatory variables pertaining to the route and market characteristics that are commonly used in previous studies, variables representing the airline spatial network are included.

To identify the key determinants of Jetstar NZ's route entry decision in New Zealand's domestic market, route-specific socio-economic variables controlled in the empirical estimation include regional domestic GDP per capita obtained from Statistics New Zealand, which is used to compute the geometric mean of the GDP per capita for each route using the values of the regions where the origin and destination airports are located.[7] This variable captures the level of income and is a good indicator for domestic holidays and travel propensity (Tsui, 2017). Data on total guest arrivals for each route (origin-destination pair) were also collected from Statistics New Zealand, with the aim to represent the regional tourism demand for air transport. For airline competition-related indicators, the HHI index is computed for O-D airports using airlines' scheduled available seat kilometer (ASK) data obtained from the Official Airline Guide (OAG) database, commonly used by the aviation industry (Fageda, Jiménez & Perdiguero, 2011; Wang, Bonilla & Banister, 2015; Tsui, Tan & Shi, 2017). The flying distance of each O-D airport pair was obtained from the Great Circle Mapper,[8] which measures the impact of travel distance on air travel demand or airline operating costs (Daraban & Fournier 2008, Morley, Rosselló & Santana-Gallego, 2014; Tsui, 2017) and is commonly used as a cost proxy in airline pricing studies (Hazledine, 2010). For the exogenous shock variable, the dummy variable of *Christchurch earthquakes 2011/12* was established to capture the expected negative effects on New Zealand's tourism demand (Tsui, 2017; Yeoman et al., 2012).

In addition to the abovementioned variables, we obtained the OAG data of the total direct flight frequency offered by all the key carriers operating across the Tasman, namely, Jetstar NZ, Qantas, Air New Zealand, Virgin Australia and the other fifth freedom carriers (e.g., Emirates). Airlines' flight frequency variables aim to measure the potential and actual airline competition along the highly competitive trans-Tasman routes (Hazledine, 2008; 2010) and serve as a quality indicator of airlines. In addition, these established variables assist in pinpointing the synergy and benefits of the AinA strategy of the Qantas Group (in affecting Jetstar NZ's route entry decisions in New Zealand's domestic aviation market (Homsombat, Lei & Fu, 2014; Whyte & Lohmann, 2015b).

The descriptive statistics for all variables of interest (in logarithmic form) are shown in Table 2, with the exception of the exogenous shock dummy variable (*Christchurch earthquakes 2011/12*). All domestic routes served by Air New Zealand and Jetstar NZ during the study period were included. There is not much variation in geometric regional GDP per capita, suggesting that the regional income

[7] A unique characteristic of New Zealand's airport system is the presence of only one commercial airport per region across the country (Tsui, 2017).

[8] The web link of Great Circle Mapper: http://www.gcmap.com

disparity in New Zealand is moderate. In comparison, the variation in visitor arrivals is noticeable, as the main cities (e.g., Auckland, Christchurch, Queenstown and Wellington) cater to the majority of domestic and international visitors and holidaymakers. In terms of the airline concentration and competition variables, the average values of ln(*Origin airport HHI*)$_{it}$ and ln(*Destination airport HHI*)$_{it}$ are 8.81 and 5.80, respectively, suggesting that New Zealand's domestic market has effectively transformed from a monopoly to duopolistic competition. In addition, the flight frequencies of the main competing airlines are fairly large, confirming the presence of effective competition.

<Table 2 about here>

6 Empirical Results and Discussion

6.1 Panel unit root (stationarity) tests

To ensure that the variables used in our panel data are stationary and thus that our estimation is free from spurious correlation (e.g., Baker, Merkert & Kamruzzaman, 2015; Balli, Balli & Louis, 2016; Hakim & Merkert, 2016; Tsui, Tan & Shi, 2017), panel unit root tests (Levin, Lin & Chu, Im, Pesaran & Shin, augmented Dicky–Fuller (ADF) and the Phillips–Perron (PP) test are carried out. Table 3 presents the results of the panel unit root tests and confirms that all the panel data variables are stationary, except for ln(*Origin airport HHI*)$_{it-1}$, ln(*JQ Freq from NZ to AUS*)$_{t-1}$, ln(*QF Freq from NZ to AUS*)$_{t-1}$, ln(NZ *Freq from NZ to AUS*)$_{t-1}$, ln(*VA Freq from NZ to AUS*)$_{t-1}$ and ln(*Other Freq from NZ to AUS*)$_{t-1}$. First-differencing is applied to ln(*Origin airport HHI*)$_{it-1}$, ln(*JQ Freq from NZ to AUS*)$_{t-1}$, ln(NZ *Freq from NZ to AUS*)$_{t-1}$ and ln(*Other Freq from NZ to AUS*)$_{t-1}$, and second-order differencing is applied to the variables ln(*QF Freq from NZ to AUS*)$_{t-1}$ and ln(*VA Freq from NZ to AUS*)$_{t-1}$ to obtain stationarity.

<Table 3 about here>

6.2 Estimation results

Table 4 presents the estimation results of the probit model: Model (1) examines the key determinants of Jetstar's route entry decision, and Model (2) further investigates the impact of the Qantas Group's AinA strategy and the spatial effects of Tasman competition on Jetstar NZ's entry into New Zealand's domestic market.

<Table 4 about here>

Overall, Models 1 and 2 produce consistent results. First, two statistically significant and positive socio-economic variables, ln(*Geometric regional GDP per capita*)$_{it-1}$ and ln(*Guest arrival*)$_{it-1}$, are reported in both models. Jetstar NZ's decision to enter a route pair has a positive nexus with the previous year's regional income levels, supporting previous studies' finding that LCC entry is affected by the regional economic situation, income level and market size (Oliveira, 2017; Wang et al., 2017). In addition, the statistically significant and positive coefficient estimate of ln(*Guest arrival*)$_{it-1}$ suggests that the previous year's guest arrivals of a region positively stimulated or attracted Jetstar NZ to offer its no-frill services to the region. Spasojevic, Lohmann and Scott (2018) and Chung and Whang (2011) demonstrated the close relationship between LCC entry and tourism development. In other words, the empirical findings of this study imply that Jetstar NZ is more likely to serve New Zealand's domestic routes with favorable socio-economic factors.

Second, a significant and positive coefficient estimate of ln(*Flying distance*)$_i$ is reported in Models 1 and 2. One can interpret that a longer route was more likely to be served by Jetstar NZ. This is slightly surprising because geographic distance (or flying distance) is often regarded as an impediment to aviation and air travel demand (Morley, Rosselló & Santana-Gallego, 2014; Tsui, 2017). This is likely because unlike most LCCs that use a standardized fleet, Jetstar NZ employs Airbus A320 for five main trunk routes and Bombardier Q300 for four smaller regional routes in New Zealand's domestic market. It is also notable that the longest flying distance among the sampled routes is only 1,072 kilometers. Clearly, because there are significant differences in market sizes but not flight distances, Jetstar NZ's route entry decision is mainly influenced by market demand instead of flying distance.

Last, it is surprising to find that the empirical results of ln(*Origin airport HHI*)$_{it-1}$ and ln(*Destination airport HHI*)$_{it-1}$ have no significant effects in our estimation. Similar patterns have been observed in other markets. For example, Fu et al. (2015) concluded that LCC entry decisions are not significantly affected by market competition in the Chinese domestic market. This may be ascribed to the product differentiation (full *vs*. no-frill services) and different business models (FSC *vs.* LCC) pursued by the main competing airlines in New Zealand, Jetstar NZ *vs*. Air New Zealand (Henderson et al., 2019). It may also be said that airline competition did not generally discourage Jetstar NZ from entering New Zealand's domestic aviation market, or Jetstar NZ's route entry decision was not very sensitive to domestic market competition. In addition, a nonsignificant and positive coefficient estimate of *Christchurch earthquakes 2011/12* is only reported in Model 1. This empirical finding suggests that this exogenous shock did not affect Jetstar NZ's route entry decision in New Zealand's domestic aviation market or that the Christchurch earthquakes only had a significant adverse effect on the passenger demand directly linked to Christchurch International Airport (Tsui et al., 2014; Tsui et al., 2017) but not all regions in New Zealand (Wood, Noy & Parker, 2016).

Model 2 offers some additional insights. The significant and positive coefficient estimate of ln(*JQ Freq from NZ to AUS*)$_{t-1}$ suggests that Jetstar NZ is more likely to serve a domestic route if it transports more passenger traffic in the trans-Tasman markets possibly because it can thus better feed and connect air passengers to its affiliate's network – Jetstar Australia's short-haul Australian domestic destinations and/or international long-haul destinations. Importantly, this empirical finding is in line with our expectation regarding the synergy and close collaboration between Jetstar NZ and Jetstar Australia, as the two LCCs operate in the same group (i.e., the Jetstar Group).[9] Such collaboration has a significant impact on Jetstar NZ's route entry decision in New Zealand's domestic aviation market and Jetstar NZ's passenger volumes across the Tasman. As mentioned above, Jetstar NZ is a whole subsidiary of the Qantas Group, and inevitably, it forms an integral part of the Qantas Group's two brand strategy, targeting the leisure and value-based markets (Jetstar, 2019c). In addition, the nonsignificant and negative coefficient estimate of ln(*QF Freq from NZ to AUS*)$_{t-1}$ is somehow consistent with Gillen and Gados (2008) and Rayne and Tsui (2019), who claimed that two key principals of the Qantas Group's AinA strategy are the high levels of independence and autonomy (i.e., independent management) of the Jetstar Group that allow the two distinct business models to grow. With the group's successful AinA strategy, the Jetstar Group's airlines (in both Australia and NZ) can operate with much autonomy and flexibility (Rayne & Tsui, 2019); thus, the LCC can exercise independent flight and network planning. Charitou and Markides (2003) and Graf (2005) also pointed out that a low-cost unit will be more

[9] Jetstar Group consists of Jetstar Airways (Australia and New Zealand), Jet Asia Airways based in Singapore, Jetstar Pacific Airlines based in Vietnam and Jetstar Japan based in Japan (source: https://www.jetstar.com/au/en/about-us/jetstar-group).

successful with higher autonomy to act in the market. Our empirical results also suggest that it is probably challenging or impractical to reconcile Qantas' and Jetstar NZ's flight networks and services to provide a bundled package combining FSC and LCC services for passengers travelling across the Tasman, although they are within the same group.

The trans-Tasman services of two major competitors (Air New Zealand and Virgin Australia) are seen to exert negative impacts on Jetstar NZ's route entry decision in New Zealand's domestic market, as supported by the significant and negative coefficient estimate of ln(NZ *Freq from NZ to AUS*)$_{t-1}$ and ln(*VA Freq from NZ to AUS*)$_{t-1}$ in Model 2. Note that Air New Zealand and Virgin Australia formed a strategic alliance in serving the trans-Tasman market during the study period (Air New Zealand, 2018). Furthermore, the Australian Competition and Consumer Commission (ACCC) stipulated that the Air New Zealand−Virgin Australia alliance maintain at least minimum capacity in the trans-Tasman market where the alliance is approved (ACCC, 2013; Douglas & Tan, 2017). Whyte and Lohmann (2015b) mentioned that Jetstar Australia and Jetstar NZ have demonstrated their flexibility and agility in exploring new opportunities. Jetstar NZ tried to avoid head-to-head competition with Air New Zealand on trans-Tasman routes, while it competed with an LCC (Virgin Australia) by better feeding its budget travelers across the Tasman to Jetstar Australia's domestic and international flight networks. The nonsignificant coefficient estimate of ln(*Other Freq from NZ to AUS*)$_{t-1}$ in Model 2 may suggest that other large international fifth-freedom carriers serving in the Tasman market, which prioritize long-haul international routes, have no significant impact on Jetstar NZ's route entry decision in New Zealand's domestic market. This interesting finding is reasonable, as Hazeline (2010) mentioned that six fifth freedom carriers in total operated in the trans-Tasman market and carried only 3.7% of passengers travelling on trans-Tasman itineraries during the period of 2004–2005. In 2016, approximately 10% of total flights were offered by fifth freedom carriers in the trans-Tasman air travel market (OAG data, 2016).

7 Conclusion and Future Research

This study examines LCC entry decisions in New Zealand's domestic aviation market during the period of 2010–2016 using the probit model. The empirical results suggest that Jetstar NZ's route entry decisions were significantly affected by regional GDP per capita and regional guest arrivals, but airline competition at both endpoint airports in New Zealand had no significant effects on Jetstar NZ's route entry decision.

In comparison, Jetstar NZ's flight capacity across the Tasman is a significant factor affecting its route entry decision in New Zealand's domestic aviation market. Such a network effect is likely due to the close collaboration across the Tasman between Jetstar NZ and its affiliate, Jetstar Australia. This allows Jetstar NZ to feed and/or connect its passengers across the Tasman Sea to Jetstar Australia's Australian domestic destinations and/or international long-haul destinations. Such an effect was not identified for its parent airline, Qantas, which is also within the same group. Furthermore, airline competition in the trans-Tasman market has significant impacts on Jetstar NZ's route entry decision in New Zealand's domestic aviation market.

These empirical results offer some fresh insights into the aviation literature. First, our study reveals that although LCCs do not provide connection services with typical hub-and-spoke networks, they can still leverage network effects. Although Fu et al. (2019) also found network effects for Southwest in the US domestic market, such an effect was mainly associated with the LCC's 'focus airport' operations. This is not the case for Jetstar NZ, which instead derived such benefits through adjacent (trans-Tasman) networks. Therefore, there may be alternative sources of network effects for LCCs. Second, our study identifies the spatial effects of airline competition, in that the competition in the trans-Tasman market influenced Jetstar's entry decision in New Zealand's domestic market. This suggests that the benefits of increased airline competition are probably larger than previously estimated, thanks to such 'spill-over' effects. This is a complementary finding to 'hub effects' in the literature, which studies routes linked to the same hub airport. Finally, our study also provides valuable insights related to the AinA strategy. On the one hand, our study confirms that it is important for LCC subsidiaries to maintain a high level of autonomy within an airline group. On the other hand, our new empirical finding suggests that network synergy is more easily achieved between the same type of airlines (i.e., Jetstar NZ and Jetstar Australia) but not across different types of carriers with different business models even if they are within the same group (i.e., Jetstar NZ *vs*. Qantas).

Finally, our study finds that in the context of increased competition in the international market, an airline may reduce its domestic route entry (i.e., competition in the trans-Tasman routes discourages Jetstar NZ's domestic route entry in New Zealand). This observation could have significant implications for the air transport liberalization policy in the New Zealand−Australia market. That is, increased competition in international markets may discourage a home carrier's domestic network development due to the network effect. Since our findings are obtained for one specific market with distinctive features, more advanced studies are needed to carefully examine this issue. It should be clarified that even if this result holds in general, it should not be interpreted against international liberalization. The main benefits of international liberalization are increased competition that benefits travelers and tourists and associated industries, such as tourism and logistics. A government should not stop implementing an air transport liberalization policy simply because it is not beneficial to its home carrier or because the government wants to protect the home carrier's interest. In our case, Jetstar NZ is not a home or a New Zealand carrier. There is certainly no justifiable ground for the New Zealand government to worry about its international air transport liberalization policies and schemes. More advanced studies on different aviation markets are needed to obtain more definite conclusions on this important issue.

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Table 1. Variable definition and sources

Time series and variables	Definition	Source
ln(*Geometric regional GDP per capita*)$_{it-1}$	The logarithm of the previous period's geometric regional GDP capita for origin and destination cities of route *i* at time *t*. This variable is created by taking one-period lag of ln(*Geometric regional GDP per capita*)$_{it}$	Statistics New Zealand, author's own calculation
ln(*Guest arrival*)$_{it-1}$	The logarithm of the previous period's number of guest arrivals for origin and destination cities of the route *i* at time *t*. This variable is created by taking one-period lag of ln(*Guest arrivals*)$_{it}$	Statistics New Zealand
ln(*Origin airport HHI*)$_{it-1}$	The logarithm of the previous period's airline concentration for origin airport of route *i* at time *t*. This variable is created by taking one-period lag of ln(*Origin airport HHI*)$_{it}$	Official Airline Guide, author's own calculation
ln(*Destination airport HHI*)$_{it-1}$	The logarithm of the previous period's airline concentration for destination airport of route *i* at time *t*. This variable is created by taking one-period lag of ln(*Destination airport HHI*)$_{it}$	Official Airline Guide; Author's own calculation
ln(*Flying distance*)$_{i}$	The logarithm of flying distance of the route *i;* measure in total great circle distance in kilometre.	Great Circle Mapper
Christchurch earthquakes 2011/12	A binary variable that takes 1 for the period of the Christchurch earthquakes between from February 2011 to January 2012, and 0 otherwise	Official Airline Guide, author's own calculation
ln(*JQ Freq from NZ to AUS*)$_{t-1}$	The logarithm of the total direct flight frequency offered by Jetstar NZ from New Zealand to Australia at time *t*. This variable is created by taking one-period lag of ln(*JQ Freq to AUS*)$_{t}$	Official Airline Guide; Author's own calculation
ln(*QF Freq from NZ to AUS*)$_{t-1}$	The logarithm of the total direct flight frequency offered by Qantas from New Zealand to Australia at time *t*. This variable is created by taking one-period lag of ln(*QF Freq to AUS*)$_{t}$	Official Airline Guide, author's own calculation
ln(*NZ Freq from NZ to AUS*)$_{t-1}$	The logarithm of the total direct flight frequency offered by Air New Zealand from New Zealand to Australia at time *t*. This variable is created by taking one-period lag of ln(*NZ Freq to AUS*)$_{t}$	Official Airline Guide; Author's own calculation

ln(*VA Freq from NZ to AUS*)$_{t-1}$	The logarithm of the total direct flight frequency offered by Virgin Australia from New Zealand to Australia at time *t*. This variable is created by taking one-period lag of ln(*VA Freq to AUS*)$_t$	Official Airline Guide, author's own calculation
ln(*Other Freq from NZ to AUS*)$_{t-1}$	The logarithm of the total direct flight frequency offered by other airlines from New Zealand to Australia at time *t*. This variable is created by taking one-period lag of ln(*Other Freq to AUS*)$_t$	Official Airline Guide; Author's own calculation

Table 2. Descriptive statistics for variables of interest (2010–2016)

Time series and variables	Observations	Mean	Standard deviation	Maximum	Minimum	Skewness	Kurtosis
ln(*Geometric regional GDP per capita*)$_{it}$	392	10.80	0.13	11.19	10.51	0.02	0.33
ln(*Guest arrival*)$_{it}$	392	14.78	0.47	15.72	13.36	-0.71	2.66
ln(*Origin airport HHI*)$_{it}$	392	8.62	0.41	9.21	8.16	0.44	1.61
ln(*Destination airport HHI*)$_{it}$	392	8.81	1.13	9.21	0	-7.17	55.92
ln(*Flying distance*)$_{i}$	392	5.80	0.57	6.97	4.39	-0.21	2.60
Christchurch earthquakes 2011/12	392	0.29	0.45	1	0	0.95	1.90
ln(*JQ Freq from NZ to AUS*)$_{t}$ [a]	392	5.05	2.93	7.74	0	-1.03	2.19
ln(*QF Freq from NZ to AUS*)$_{t}$ [b]	392	6.85	1.83	8.45	0	-2.68	10.57
ln(*NZ Freq from NZ to AUS*)$_{t}$ [c]	392	7.22	1.84	8.72	0	-3.13	12.78
ln(*VA Freq from NZ to AUS*)$_{t}$ [d]	392	6.65	1.53	7.97	0	-3.73	16.55
ln(*Other Freq from NZ to AUS*)$_{t}$ [e]	392	4.41	3.28	7.94	0	-0.49	1.43

Remarks: [a] denotes Jetstar's flight frequency across Tasman; [b] denotes Qantas' flight frequency across Tasman; [c] denotes Air New Zealand's flight frequency across Tasman; [d] denotes Virgin Australia's flight frequency across Tasman; [e] denotes other airlines' flight frequency across Tasman.

Table 3. Panel unit root tests (2010–2016)

Time series / Variables		Level				First-order differencing			
		Levin, Lin & Chu	Im, Pesaran & Shin	Augmented Dicky–Fuller	Phillips–Perron	Levin, Lin & Chu	Im, Pesaran & Shin	Augmented Dicky–Fuller	Phillips–Perron
ln(*Geometric regional GDP per capita*)$_{it-1}$	AIC	0.000**	0.005**	0.000**	0.000**	0.000**	0.005**	0.000**	0.000**
	SIC	0.000**	0.005**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
ln(*Guest arrival*)$_{it-1}$	AIC	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
	SIC	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
ln(*Origin airport HHI*)$_{it-1}$	AIC	0.000**	0.000**	0.883	0.720	0.000**	0.000**	0.491	0.018**
	SIC	0.000**	0.000**	0.883	0.720	0.000**	0.000**	0.491	0.018**
ln(*Destination airport HHI*)$_{it-1}$	AIC	0.000**	0.000**	0.001**	0.007**	0.000**	0.000**	0.000**	0.000**
	SIC	0.000**	0.000**	0.001**	0.007**	0.000**	0.000**	0.000**	0.000**
ln(*Flying distance*)$_i$	AIC	-	-	-	-	-	-	-	-
	SIC	-	-	-	-	-	-	-	-
Christchurch earthquakes 2011/12	AIC	0.000**	0.042**	0.000**	0.000**	0.000**	0.869	0.998	0.000**
	SIC	0.000**	0.000**	0.000**	0.000**	0.000**	0.869	0.998	0.000**
ln(*JQ Freq from NZ to AUS*)$_{t-1}$	AIC	0.000**	0.943	0.662	0.000**	0.000**	0.005**	0.005**	0.000**
	SIC	0.000**	0.943	0.662	0.000**	0.000**	0.005**	0.005**	0.000**
ln(*QF Freq from NZ to AUS*)$_{t-1}$ [a]	AIC	1.000	1.000	1.000	1.000	0.000**	0.000**	0.000**	0.000**
	SIC	1.000	1.0000	1.000	1.000	0.000**	0.000**	0.000**	0.000**
ln(*NZ Freq from NZ to AUS*)$_{t-1}$	AIC	0.000**	0.008**	0.090	0.000**	0.000**	0.000**	0.000**	0.000**
	SIC	0.000**	0.008**	0.090	0.000**	0.000**	0.000**	0.000**	0.000**
ln(*VA Freq from NZ to AUS*)$_{t-1}$ [a]	AIC	0.000**	0.992	1.000	0.994	0.000**	0.000**	0.000**	0.000**
	SIC	0.000**	0.992	1.000	0.994	0.000**	0.000**	0.000**	0.000**
ln(*Other Freq from NZ to AUS*)$_{t-1}$	AIC	1.000	1.000	1.000	0.990	0.000**	0.000**	0.000**	0.000**
	SIC	1.000	1.000	1.000	0.990	0.000**	0.000**	0.000**	0.000**

Remarks: All the panel time series variables above are stated in natural logarithms, except for Christchurch earthquakes 2011/12. The values indicate the *p*-values. The test is only shown for the constant and trend. ** indicates that rejection of the null hypothesis (H_0) that the time series has a panel unit root with constant and time trend. [a] Second-order differencing was applied to make the variable stationary. AIC denotes Akaike Information Criterion; SIC denotes Schwarz Information Criterion. The unit root test for ln(*Flying distance*)$_i$ cannot be tested due to the unchanged values over the years for each of the route-pairs.

Table 4. Estimation results for Jetstar NZ's route-choice decision in New Zealand's domestic aviation market (2010–2016)

Dependent variable	**Model (1)** *Jetstar NZ's route-choice decision*		**Model (2)** *Jetstar NZ's route-choice decision*	
Explanatory variables	**Coefficients**	**Robust standard errors**	**Coefficients**	**Robust standard errors**
Constant	-86.130***	16.934	-181.258***	-32.018
ln(*Geometric regional GDP per capita*)$_{it-1}$	3.799***	0.977	5.279***	1.500
ln(*Guest arrival*)$_{it-1}$	2.451***	0.634	7.502***	1.403
Δln(*Origin airport HHI*)$_{it-1}$	-1.340	3.781	-2.590	2.978
ln(*Destination airport HHI*)$_{it-1}$	0.018	0.094	1.435	0.086
ln(*Flying distance*)$_{i}$	1.192***	0.307	1.781***	0.377
Christchurch earthquakes 2011/12	0.219	0.403	-	-
ln(*JQ Freq from NZ to AUS*)$_{t-1}$	-	-	0.778**	0.407
ln(*QF Freq from NZ to AUS*)$_{t-1}$	-	-	-3.420	5.042
ln(*NZ Freq from NZ to AUS*)$_{t-1}$	-	-	-25.753***	7.580
ln(*VA Freq from NZ to AUS*)$_{t-1}$	-	-	-2.053***	0.421
ln(*Other Freq from NZ to AUS*)$_{t-1}$	-	-	-5.860	4.615
Pseudo R^2	0.410		0.606	
Observations	280		224	

Remarks: ** and *** indicate that the explanatory variable is significant at the p-values < 0.05 and 0.01 significance level, respectively. Yearly dummies estimations are not shown to save space. Δ denotes first-differencing applied to the non-stationary variable to make it stationary. The variable of *Christchurch earthquakes 2011/12* omitted in Model 2 because of collinearity.