International Journal of the Economics of Business

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/cijb20

Aviation Discontinuity and Regional House Prices: A Quasi-Experiment in New Zealand

Thanh Ngo

To cite this article: Thanh Ngo (11 Oct 2024): Aviation Discontinuity and Regional House Prices: A Quasi-Experiment in New Zealand, International Journal of the Economics of Business, DOI: 10.1080/13571516.2024.2412448

To link to this article: https://doi.org/10.1080/13571516.2024.2412448

Published online: 11 Oct 2024.

INTERNATIONAL JOURNAL OF THE ECONOMICS OF BUSINESS
https://doi.org/10.1080/13571516.2024.2412448

Aviation Discontinuity and Regional House Prices: A Quasi-Experiment in New Zealand

Thanh Ngo[a,b]

[a]School of Aviation, Massey University, Palmerston North, New Zealand; [b]VNU University of Economics and Business, Hanoi, Vietnam

ABSTRACT

Although there is evidence that more regional airport activities can increase regional house prices, no study has examined the relevant impacts of aviation discontinuity. My unique quasi-experiment data comes from New Zealand where Jetstar withdrew its domestic services from four airports/regions in December 2019. The synthetic control method (SCM)'s results reveal that the withdrawal created different impacts on the house prices of the regions involved, in which the overall effect was negative in the short run but the housing market in New Zealand has recovered in the long run.

ARTICLE HISTORY
Received 26 October 2023
Accepted 22 August 2024

KEYWORDS
Airline; airport; discontinuity; regional house price; Synthetic control method (SCM)

JEL CODES
C21; L93; R10; R30

1. Introduction

New situations bring new challenges. For instance, just before the COVID-19 pandemic broke out, it was forecasted that the aviation sector would reach 8.2 billion air travellers in 2037 with the expansion of 37,000 new aircraft for that period (IATA 2018; KPMG. 2019). However, the COVID-19 pandemic has affected the entire global aviation system (Air Transport Bureau 2020; Arora et al. 2021; Czerny et al. 2021), including airlines, airports, air travellers, and other third-party businesses, with a 66% decline in the revenue passenger-kilometers (RPKs), a 58% decline in the number of flights, and a 56% decline in available seat-kilometers (ASKs), compared between 2020 and 2019 (IATA 2020; Arora et al. 2021). Therefore, instead of expecting an expansion in the aviation sector (Küçükönal and Sedefoğlu 2017; Dimitriou 2018; Tsui et al. 2019), one should examine the impacts of aviation discontinuity. This article aims to look at the chances in regional housing prices relevant to their airport's activities, particularly the withdrawal of airline(s) from the airports, as what happened in New Zealand in December 2019.

Among the impacts of aviation on the other sectors, the hedonic price model (HPM) argues that house price is a function of the house's characteristics (Powe,

CONTACT Thanh Ngo t.ngo@massey.ac.nz School of Aviation, Massey University, New Zealand; VNU University of Economics and Business, Hanoi, Vietnam.

Garrod, and Willis 1995; Mulligan, Franklin, and Esparza 2002; Chau and Chin 2003), of which air quality, noise, and proximity to various types of urban infrastructure can arguably have an important influence on the price, although the direction of the impacts is inconclusive. For instance, it is commonly argued that houses located close to an airport tend to have their prices lower than their counterparts due to increased exposure to noise and air pollution (Cohen and Coughlin 2008; Dekkers and van der Straaten 2009; Zheng, Peng, and Hu 2020). Contradictory, there is also evidence that the amenity effect (regarding job opportunities and access to urban infrastructure) may outweigh the dis-amenity effect (regarding noise and pollution) and thus, houses located near an airport may have a price premium, compared to their peers (Biagi, Brandano, and Caudill 2016; Tsui, Tan, and Shi 2017; Tsui et al. 2019; Fu et al. 2021). For the latter strand, more importantly, the literature has shown that more airport activities (e.g. flight frequency, large aircraft operations, and routes) are positively associated with the amenity effect and thus, house prices (Breidenbach et al. 202021n.d.; Brueckner 2003; Tsui, Tan, and Shi 2017). However, to the best of my knowledge, there is no study on the effect of aviation discontinuity on (regional) house prices.

This paper aims to address the research question of "***How do the regional prices of houses in an airport neighbourhood change after an airline withdraws its services from that airport?***". I examine that question using a unique quasi-experiment in New Zealand for three reasons. Firstly, since December 2019, Jetstar New Zealand (hereafter referred to as Jetstar) has withdrawn its services from six domestic airports corresponding to five pairs of secondary routes of Auckland-Napier, Auckland-New Plymouth, Auckland-Nelson, Auckland-Palmerston North, and Wellington-Nelson (Jetstar 2019). As such, the four small regions of Napier, New Plymouth, Nelson, and Palmerston North were directly affected by this withdrawal in terms of air transport activities, relevant jobs and income issues, and house prices.[1] Using such quasi-experimental data, therefore, we can examine the impacts of such withdrawals on the New Zealand housing market. Secondly, the New Zealand housing market itself has experienced a boom in the last several years (Tookey 2017; Johnson, Howden-Chapman, and Eaqub 2018; Rehm and Yang 2021; St John and Baucher 2021). It is thus interesting to revisit this housing market, given changes in the discontinuity of Jetstar' services. Thirdly, despite the intensive literature on HPM and airport proximity, there remains limited evidence and empirical analyses regarding the New Zealand context. This study, therefore, will not only contribute to the HPM literature (in terms of the effects of airline discontinuity) but also provide important implications for policymakers (e.g. regarding the housing market) and aviation managers (e.g. regarding route closure and discontinuation). Although not capturing the impacts of COVID-19, as our quasi-experimental event happened before the pandemic occurred, this paper can still provide useful suggestions to future housing studies on the discontinuity effects that the pandemic brought to the aviation industry.

I construct the rest of the study as follows. Section 2 reviews the relevant HPM literature with a focus on the airport proximity setting. Section 3 introduces the empirical models and data. Section 4 reports and discusses the results, and Section 5 concludes the study.

2. Literature review

2.1. The trade-off between airport activities and house prices

There is a rich body of literature showing that, due to their negative externalities, airports can adversely contribute to the house prices in their neighbourhood (Espey and Lopez 2000; Cohen and Coughlin 2008; Salvi 2008). For instance, Rahmatian and Cockerill (2004) examined the housing market in Southern California (US) and found that the houses located within 150-300 metres and between 600-750 metres from an airport will have their prices lower than their counterparts by approximately 17,400-16,600 USD and more than 21,000 USD, respectively. For the Australian housing market, Kaur et al. (2021) also found that houses located within 400-500 meters from Essendon Airport have the lowest average price, compared to ones located further from that airport. In a similar vein, but focusing on the noise levels, Affuso et al. (2019) argued that the external cost for the housing market in Tennessee (US) can go up to 4,795 USD per decibel of noise created by the nearby Memphis International Airport. For the Taoyuan International Airport (Taiwan), airport noise can cost the neighbouring houses up to 2,356 TWD per decibel (for houses within the noise contour areas) and 3,623 TWD per decibel (outside the noise contour areas) (Tsao and Lu 2022). Regarding expansions such as building a new runway or terminal, Jud and Winkler (2006) and Mense and Kholodilin (2014) both found that housing prices react negatively to the announcement and/or implementation of such airport expansions.

A different strand of research argued that there is a trade-off between the pros and cons of the airports, which determines the neighbouring house prices. While the first strand focuses on those negative externalities (i.e. the cons), this strand focuses on the pros of an airport, including job opportunities, local economic development, and hospitality and tourism development, among others (Graham 2018; Doerr et al. 2020; Cattaneo et al. 2022). When the pros outweigh the cons, one can observe a premium in the prices of houses within the proximity of an airport, compared to their counterparts, as in the cases of Croatia (Mikulić et al. 2021), Italy (Biagi, Brandano, and Caudill 2016), the Europe (Paramati and Roca 2019), and New Zealand (Tsui et al. 2019). Consequently, one should expect that the higher traffic flows and connectivity an airport has, the higher the premium that the houses located near this airport can achieve. For instance, McMillen (2004) argued that the expansion of the Chicago O'Hare Airport (in the US) would bring more gains in both the number and values for homes with increased values, compared to the ones with decreased values. In Thailand, Limlomwongse Suksmith and Nitivattananon (2015) found that higher air traffic also helps increase the property value of the neighbourhoods of the Suvarnabhumi International Airport. For the case of New Zealand, Tsui, Tan, and Shi (2017) similarly found that a 1% increase in the airport traffic (proxied by the airport's workload units) can bring from 0.27 to 0.43% increase in the property price index of the region where that airport resides. Ngo et al. (2023) further argued that there is evidence of a U-shape relationship between airport proximity and house prices, whereas the negative externalities of airports on house prices have a diminishing effect, and that economic influences and employment may also serve as positive externality.

To sum up, the debate between the pros, the cons, and the trade-off between airport activities and neighbouring house prices is inconclusive. However, they all focus on the topic of how airport development, i.e. more airport activities, can affect house prices. Theoretically, discontinuity is the opposite of airport expansion; however, there is no empirical study on the impact of aviation discontinuity, i.e. less airport activities, on the prices of the houses located near that airport. Using quasi-experimental data from New Zealand airports/regions, where Jetstar withdrew some of its domestic services in December 2019, this study is the first to do so.

2.2. Event studies: difference-in-difference and the synthetic control method

The analysis that examines the influence of a certain policy (change) on the economy, like the case of airport expansion or discontinuity on house prices, is called an 'event study' (Armitage 1995). The purpose of an event study is to comprehend how the announcement or implementation of such policy impacts the market. It has been applied in various fields such as marketing (Sorescu, Warren, and Ertekin 2017), banking and finance (MacKinlay 1997; Campbell, Cowan, and Salotti 2010), biotechnology (Austin 1993), and building/property (Asquith, Mast, and Reed 2023).

Basically, in an event study, the researchers typically select an event window surrounding the policy announcement or implementation date and compare the performance of the market before and after the event (MacKinlay 1997). It is also important to separate the units that being impacted by the event (i.e. the treated group) and the ones that are not (i.e. the control group). A popular approach to examine this setting is the difference-in-difference (DiD) approach that can estimate the differences between the two groups (i.e. 'difference-') before and after the event (i.e. 'in-difference'). The DiD assumes that outcomes for the treated and control units follow parallel trends over time in the absence of the treatment (Abadie 2005). Another important note is that similar to other regression methods, the DiD focuses on examining an average unit (i.e. the mean) representing all the units involved (Bertrand, Duflo, and Mullainathan 2004). By examining the 'difference-''in-difference', DiD can control for unobserved heterogeneity and therefore, has been widely applied in examining changes in house prices (e.g. Zabel and Guignet 2012; Oikarinen and Engblom 2016; Bui, Wen, and Sharp 2022; Damen and Schildermans 2022). For instance, Tu (2005) examined the impact of a new FedEx stadium in Washington DC on housing values. In a wider range, Voicu and Been (2008) used DiD to analyse the effect of community gardens on neighbourhood property values in New York. For Montreal (Canada), the DiD analysis of Dubé et al. (2014) surrounds the implementation of a commuter rail transit system in the city and examines how the city's house prices changed accordingly. Recently, Zheng, Peng, and Hu (2020) used DiD to examine the impact of the relocation of Hong Kong Airport from Kai Tak to Chek Lap Kok in 1998 on the city's house prices.

Given the limitations and assumptions of the DiD, there are cases when it does not work properly. Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010) proposed the use of the synthetic control method (SCM) thanks to its advantages over the DiD (more details in the next section). These advantages give rise to

the SCM in various fields such as labour economics (Castillo et al. 2017; Peri and Yasenov 2019), transportation (Tveter, Welde, and Odeck 2017; Xin et al. 2021), taxation (Biagi, Brandano, and Pulina 2017; Ben-Michael, Feller, and Rothstein 2021), and tourism (Addessi, Biagi, and Brandano 2019; Doerr et al. 2020). However, SCM studies on house prices and the property market are scarce: a study on a property tax implemented in Shanghai and Chongqing, China (Zheng and Zhang 2013), a study on the change in the Code of Conduct for mortgage loans in The Netherlands (Rouwendal and Petrat 2022), or a study on the cancellation of house purchase restriction in Jinan, China (Zhao et al. 2024); none have examined airport discontinuity. More importantly, it helps explain the housing market in each region of New Zealand, especially the ones impacted by the discontinuity of Jetstar' services. This paper is the first to do so.

3. Methodology

3.1. The synthetic control method (SCM)

Examining the treatment effects is one challenging task for researchers because it is difficult to accurately estimate the counterfactual outcomes for the treated units in the absence of treatment, i.e. if the treatment did not happen (Li 2020). While the DiD can effectively estimate the average treatment effect for all treated units involved, one may find it difficult to examine each of those units independently. In this sense, compared to the DiD approach, the synthetic control method (SCM) has several attractive features: (i) it allows for each control unit to have their own weights in the estimation of the counterfactual outcomes of the treated units; (ii) these weights are nonnegative reassuring better extrapolation; and (iii) it can drop some (weak) control units to reduce the estimation variance. Besides, SCM also have several advantages compared to DiD (Abadie 2005; Abadie, Diamond, and Hainmueller 2010; Gilchrist et al. 2022) as follows.

- The DiD relies on the assumption of parallel trends, which assumes that the treatment and control groups would have followed a similar trend in the absence of the intervention. This assumption can be restrictive and hard to validate. In contrast, the SCM constructs a synthetic control group that is a weighted combination of control units,[2] providing a more flexible approach that doesn't require strict parallel trends assumption.[3]
- The SCM allows for more effective control of time-varying confounders that may affect the treatment and control groups differently. The constructed synthetic control unit closely matches the treated unit's pre-intervention characteristics, thereby accounting for potential time-varying factors that could bias the estimated treatment effect. DiD may struggle to adequately control for such confounders.
- The SCM can be particularly useful when dealing with small sample sizes. In situations where only a limited number of treated units are available, the SCM allows researchers to create a synthetic control group using a combination of control units, providing more robust estimates compared to DID, which may struggle to generate reliable treatment effect estimates with small sample sizes.

- The DiD estimates an average unit of the sample, while the SCM constructs the synthetic units for all treated units involved. The SCM, therefore, can provide a closer look at each of those units.

A recent study by Arkhangelsky et al. (2021) also argued that SCM is suitable for a setting with only a single, or small number, of units being treated - in this study, I have only four treated regions versus another twelve untreated ones. Particularly, this study aims to examine the impacts of Jetstar's withdrawal on several domestic routes to the local house prices of the airport/region affected. In this sense, I would like to analyse the changes in house prices of each airport/region (e.g. Palmerston North or New Plymouth) after the withdrawal (i.e. 1 December 2019) and thus, the SCM is an appropriate approach.[4] Briefly, the SCM first uses the pre-intervention data of the control units to generate a counterfactual treated unit (or "artificial unit", "synthetic unit", or "synthetic control group"). Using data from the post-intervention, one can then compare the outcome of this synthetic unit (assuming no treatment) with the actual outcome of the treated unit (with treatment) to analyse the impacts of the intervention. Note that SCM can overcome the confounding and endogeneity issues using the placebo tests (Abadie 2005; Gilchrist et al. 2022). The formulation of the SCM can be expressed as follows.

Let N be the number of regions involved in our analysis, T be the time variable, T_0 $(1 < T_0 < T)$ represents the period when the intervention happens, and N_0 $(1 \leq N_0 < N)$ be the number of regions that are affected by the intervention. Thus, Y_{it}^N is the outcome for all region i at time t in the absence of the intervention.

Let also Y_{it}^I be the outcome that would be observed for region i at time t if the regions are affected by the intervention in periods $[T_0 + 1, T]$. Consequently, we have $Y_{it} = Y_{it}^N$ $(i = 1, .., N; t = 1, .., T_0)$ for all regions before the intervention happened, and also have $Y_{it} = Y_{it}^N$ $(i = N_0 + 1, .., N; t = T_0 + 1, .., T)$ for the unaffected regions after the intervention. Generally, the observed outcome for region i at time t is

$$Y_{it} = Y_{it}^N + \alpha_{it} D_{it} \tag{1}$$

where α_{it} is the effect of the intervention on region i at time t; and D_{it} is a dummy variable that equals to one for the regions affected to the intervention at time t, and zero otherwise. Specifically,

$$D_{it} = \begin{cases} 1 \text{ if } i \leq N_0 \text{ and } t > T_0, \\ 0 \text{ otherwise.} \end{cases} \tag{2}$$

My purpose is to estimate α_{it} when $D_{it} = 1$, in which Equation (1) can be re-written as

$$\alpha_{it} = Y_{it} - Y_{it}^N = Y_{it}^I - Y_{it}^N \text{ where } i \leq N_0 \text{ and } t > T_0 \tag{3}$$

Since Y_{it}^I is observed, I need to first estimate Y_{it}^N to derive at α_{it}. Suppose that Y_{it}^N is given by a (HPM) factor model

$$Y_{it}^N = \delta_t + \theta_t X_i + \lambda_t \mu_i + \varepsilon_{it} \tag{4}$$

where δ_t is the time fixed-effect across the regions, X_i is a vector of the hedonic predictors (e.g. house size and land size contribute to house prices), θ_t is the vector of

parameters, λ_t is the vector of common factor, μ_i is the regional fixed-effect, and ε_{it} are the stochastic errors.

Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010) proved that if one can find a non-singular vector of weights $w_j^* = \left(w_{N_0+1}^*, w_{N_0+2}^*, .., w_N^*\right)$ that can satisfy the conditions in Equation (5), using data from the pre-intervention periods, then one can derive at an unbiased estimator of α_{it} as in Equation (6), using the post-intervention periods. Note that $\widehat{Y_{it}} = \sum w_j^* Y_{jt}$ in Equation (6) represents the counterfactual or synthetic treatment units (or regions).

$$\begin{aligned} &Y_{it} = \sum w_j^* Y_t \text{ and } X_i = \sum w_j^* X_j \\ &i = 1, .., N_0, \\ &j = N_0 + 1, .., N, \\ &t = 1, .., T_0. \end{aligned} \tag{5}$$

$$\begin{aligned} &\widehat{\alpha_{it}} = Y_{it}^I - \widehat{Y_{it}} = Y_{it}^I - \sum w_j^* Y_{jt} \\ &i = 1, .., N_0, \\ &j = N_0 + 1, .., N, \\ &t = T_0 + 1, .., T. \end{aligned} \tag{6}$$

3.2. The variables of interest and their data sources

The outcome variable (Y_{it}) of my SCM model is the median house prices collected from the Real Estate Institute of New Zealand (REINZ). As a membership organisation accounting for over 90% of the residential property market in New Zealand, REINZ provides data on New Zealand's housing market activities based on actual sales as they occur nationwide (REINZ 2022). Unlike previous studies which were based on the property index (Janet Ge 2009; Tsui, Tan, and Shi 2017; Squires and Webber 2019; Tsui et al. 2019), this study instead utilises the median housing price data because the median prices are more volatile to short-term shocks in the market due to changes in supply and demand, compared to other property indices (McCarthy and Peach 2004; Case and Wachter 2005; Brunauer, Feilmayr, and Wagner 2012). However, in this study, I see it as an advantage of the medium price to reflect better the volatility of the property market, especially regarding the changes in Jetstar's withdrawal. Therefore, using the medium price is another contribution of this study. In addition, there are two important notes regarding the use of this variable in my analysis. First, I have also used the property index as the outcome variable (Y_{it}) of the SCM analyses for robustness testing. Although the specific values are different, the overall effects are consistent with the results presented in Figures 2–6 and thus, are not reported here to save space. Second, I have also compared the results between using log-values and level-values of the median prices; the latter produces far better pre-treatment fitting results (R^2 ranges from 0.438 to 0.961) than the former (R^2 ranges from 0.134 to 0.784). The analyses in Section 4 below are, therefore, based on the level-value results.

Nevertheless, REINZ data covers the monthly median house prices (PRICE) for all 16 New Zealand regions from January 2017 to December 2021, yielding a total of 960 observations. Note that previous studies such as Kuethe and Pede (2011), Zhang, Hui,

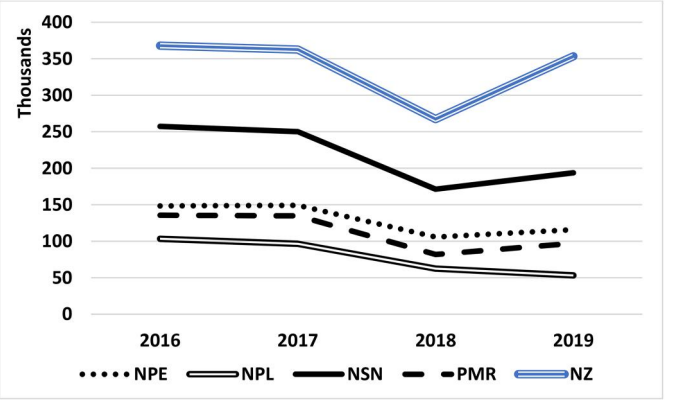

Figure 1. Total number of Jetstar' scheduled passengers in the four airports (2016-2019). Source: Official Airline Guide (2022).

and Wen (2017), Bangura and Lee (2022), and Ngo et al. (2023) also examined housing prices at the regional level with similar or fewer numbers of observations or data points.

Several factors are considered as the predictor variables (X_i) that can contribute to the changes in house prices, following a rich body of real estate literature. For instance, there is a "momentum effect" in which the house price in the current period is significantly and positively affected by the price of the last period (Head, Lloyd-Ellis, and Sun 2014; Titman, Wang, and Yang 2014; Tsui et al. 2019). Since there is a high correlation between these two prices, it is expected that the previous price can mainly explain the current price and account for other omitted factors of the SCM model. Such an approach is also popular in the generalised method of moments (GMM) econometric approach (Ullah, Akhtar, and Zaefarian 2018; Ngo et al. 2022; Yuen et al. 2022). Prices are also dependent on the supply and demand of the housing market, in which the number of approved building consent for new houses (CONSENT) can represent the supply side (Grimes et al. 2007; Masood, Lim, and González 2021), whilst the number of net migrants (MIGRANT) can proxy for the (additional) demand on the regional housing market (Janet Ge 2009; Torstensen and Roszbach 2019; Wijburg, Aalbers, and Bono 2021). I also control for the regional heterogeneity *via* its gross domestic products per capita (GDPC), as the GDPC may influence both the supply (e.g. richer regions may have more resources to build more houses) and demand (e.g. richer residents may purchase more houses) of the regional housing market. Data for those predictor variables (X_i) was collected from Statistics New Zealand (2022). Table 1 reports the descriptive statistics of the variables in this study, after matching and filtering for missing data, as follows.

It is noted that the SCM does not account for events applied to all regions such as tax policy or COVID-19, as the impact of such events will be the same across the regions and thus, there are no treated and control units for the analysis. Nevertheless, we assume that the impacts of those factors are similar across the examined regions, i.e. if COVID-19 made people lose their incomes and consequently their purchasing power, then it should happen in all regions. In this sense, our results are not strongly affected by including/excluding such (dummy) variables.

Figure 2. The 16 regions in New Zealand and the four airports involved.

4. Empirical results and Discussions

This paper aims to examine the effects of Jetstar's withdrawal of its domestic services from five pairs of secondary routes corresponding to four secondary airports in New Zealand (i.e. Napier, New Plymouth, Nelson, and Palmerston North), starting 1 December 2019. In this section, I first present some details on our case study of Jetstar New Zealand. I then show that DiD is not applicable to the current context of aviation discontinuity and the regional housing market in New Zealand. The SCM, therefore, is more appropriate.

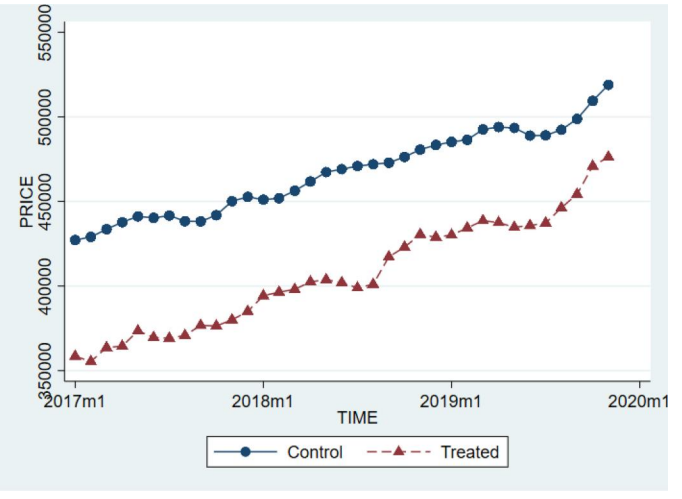

Figure 3. Average housing prices in New Zealand before Jetstar's withdrawal.

4.1. Jetstar New Zealand and its withdrawal in December 2019

Jetstar had its first commencement of operations in New Zealand on December 1st, 2015, for the Sydney – Christchurch route. In the following years, its trans-Tasman operations increased to more than 50 weekly international return flights across different Australian and New Zealand airports such as Auckland, Christchurch, Melbourne, and Sydney. It resulted in the airline's announcement in June 2009 to start its New Zealand domestic operations with over 200 weekly return flights between Auckland, Christchurch, Dunedin, Queenstown, and Wellington (Jetstar 2020). In August 2015 and then December 2015, new routes for Napier, Nelson, New Plymouth, and Palmerston North were further introduced and operated, respectively (Stuff 2019). In October 2019, however, Jetstar announced that it would withdraw from those routes in December 2019 (Jetstar 2019), putting an end to Jetstar's four years of operations (2016-2019) at those four airports. The main reasons for this decision, according to the airline, are due to loss-making, high costs, and a softening of the regional travel market (Jetstar 2019). Figure 1 shows the continuous decline in terms of passengers flying with Jetstar through those airports.

Figure 2 further illustrates the 16 regions of Auckland, Bay of Plenty, Canterbury, Gisborne, Hawke's Bay, Manawatu-Whanganui, Marlborough, Nelson, Northland, Otago, Southland, Taranaki, Tasman, Waikato, Wellington, and West Coast; of which the four airports (regions) being examined are Napier airport (Hawke's Bay region), New Plymouth airport (Taranaki region), Nelson airport (Nelson region), and Palmerston North airport (Manawatu-Whanganui region). In this SCM study, these four regions are the 'treated' units (where Jetstar's withdrawal happened), while the other twelve are the 'donor' units (i.e. not directly affected by Jetstar's withdrawal). Since Auckland and Wellington airports are the two largest airports in New Zealand, and they also accommodate international flights, we assume that Jetstar's withdrawal had fewer impacts on those two.

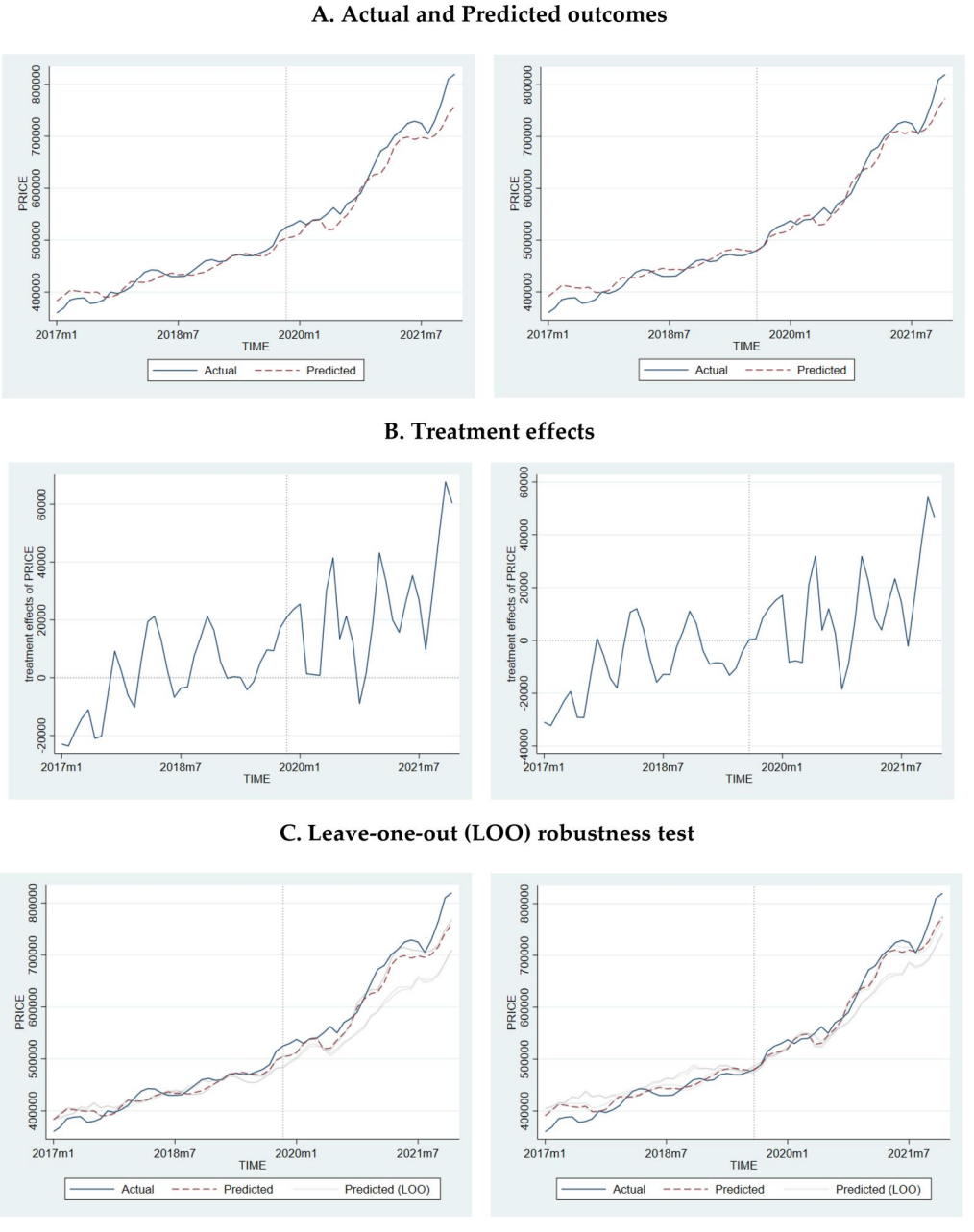

Figure 4. The results of SCM analysis for Hawke's Bay region. (A) Actual and Predicted outcomes, (B) Treatment effects, (C) Leave-one-out (LOO) robustness test

4.2. DiD analysis

We first attempt to examine the regional house prices using the conventional DiD approach. In this sense, it involves four treatment regions (i.e. Hawke's Bay, Nelson, Taranaki, and Manawatu-Wanganui) and twelve control regions (see Figure 1). The period of analysis runs from January 2017 to December 2021, with December 2019 (Jetstar's

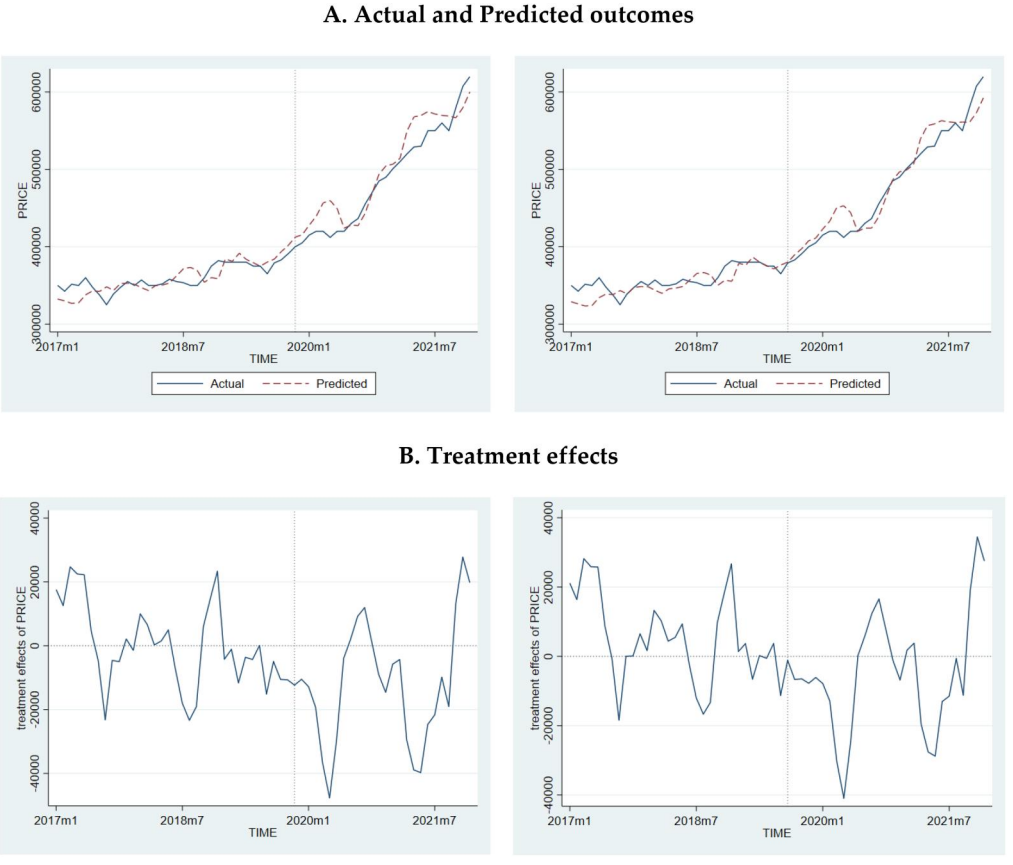

Figure 5. The results of SCM analysis for Taranaki region. (A) Actual and Predicted outcomes, (B) Treatment effects.

withdrawal) as the treatment time. A structural test following Bai and Perron (1998) and Karavias, Narayan, and Westerlund (2023) resulted in a Wald statistic of 3.21 (p-value = 0.02) confirming that December 2019 is a structural breakpoint in New Zealand house prices. The means of house prices for the two groups are plotted in Figure 3, in which one can observe that house prices in the treated regions had increased at a higher speed toward the treatment time, in comparison to those in the control regions. As such, one may expect that the trends in house prices of the two groups are not parallel.

Statistically, the pre-trends test under the null hypothesis that linear trends between the two groups are parallel before the treatment time resulted in a F-statistics of 4.12 and a p-value of 0.0605. One could, therefore, reject that null hypothesis and conclude that the parallel trends assumption does not hold; DiD is thus inappropriate. If one still insists on conducting the DiD estimation, one may find that the average treatment effect on the treated (ATET) regions is marginally small and insignificant ($coefficient = -0.0024$, $p - value = 0.807$), suggesting that there is no significant difference between the house prices across those regions after Jetstar's withdrawal. In short, DiD could not explain the impact of such aviation discontinuity on New Zealand's regional house prices. In the following subsections, we will examine this impact at each of the four treated regions and the overall impact using the SCM approach.

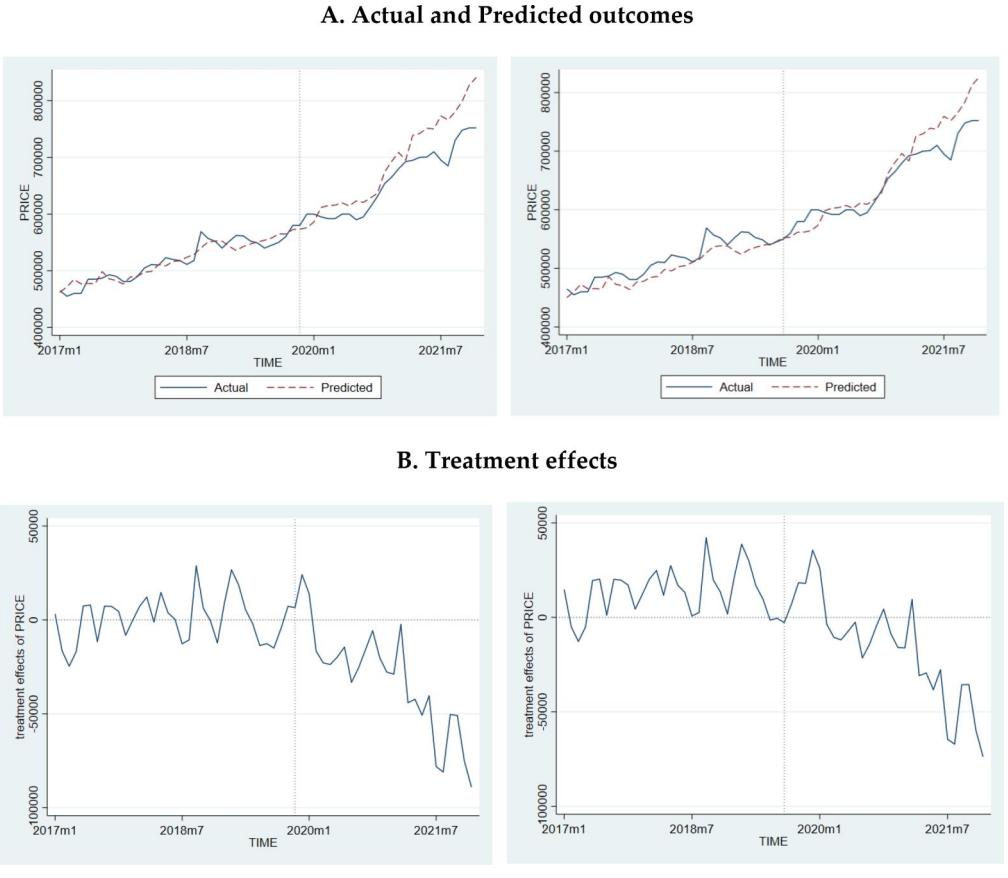

Figure 6. The results of SCM analysis for Nelson region. (A) Actual and Predicted outcomes, (B) Treatment effects.

Table 1. Descriptive statistics.

Variable	Unit	Observation	Mean	Standard deviation	Minimum	Maximum
Outcome (Y_{it})						
PRICE	NZD	960	518,449.00	186,789.20	170,000	1,280,000
Predictors (X_i)						
PRICE(-1)	NZD	944	514,454.30	183,824.20	170,000	1,250,000
MIGRANT	Person	768	60.26	421.91	−1,947	3,801
CONSENT	House	960	200.36	320.40	3	2,188
GDPC	NZD	960	4658.25	782.35	3,164.26	.25

This table provides information on the unit, mean, standard deviation, minimum and maximum values of the variables involved in our research. *PRICE* is median house price (in NZD) of region i at time t; *PRICE*(-1) is the median house price (in NZD) of region i at time $(t-1)$; *MIGRANT* represents number of net migrants (in person) into the region; *CONSENT* is the number of building consents approved in the region i at time t; and *GDPC* is the regional GDP per capita (in NZD) of region i at time t.

4.3. SCM analysis for Hawke's Bay region (Napier airport)

Recall that SCM estimates a synthetic region for Hawke's Bay, one of the four treated regions, as a weighted sum of other unaffected ones, assuming that if there is no intervention (i.e. Jetstar's withdrawal) then the house prices in Hawke's Bay should follow the synthetic outcomes, rather than the ones being observed. In this sense, I

follow Arkhangelsky et al. (2021) and exclude Auckland and Wellington from the donor pool of the SCM because they have also been affected by the withdrawal, although the magnitudes are less significant given their international and hub status.[5] As such, the donor pool of my SCM consists of ten regions (Bay of Plenty, Canterbury, Gisborne, Marlborough, Northland, Otago, Southland, Tasman, Waikato, and West Coast).

Using data before the event, i.e. monthly data from January 2017 to November 2019, the synthetic Hawke's Bay region can be seen as the weighted sum of Gisborne (the corresponding weight is 0.417), Bay of Plenty (0.376), Tasman (0.105), and Southland (0.102); the former two are in the neighbourhood of Hawke's Bay (see Figure 1). The fitting result has an R^2 of 0.840 and a Root Mean Squared Percentage Error (RMSPE) of 0.025, suggesting a good approximation of the synthetic region, compared to the actual one. For instance, the studies of Alfano, Ercolano, and Cicatiello (2021) and Xin et al. (2021) even relied on the RMSPE of as high as 2.044 and 0.18, respectively. For robustness purposes, as suggested by an anonymous reviewer, we also conducted the SCM analysis using the announcement date (i.e. October 2019) instead of the commencement one (i.e. December 2019). Accordingly, SCM results using the commencement date are reported on the left-hand side, and our discussions follow those results, while results using the announcement date are reported on the right-hand side of Figures 4–8.

Specifically, Figure 4(A) shows that the house prices of the actual and synthetic (or predicted) Napier regions closely followed each other for the pre-treatment period (visualized as a vertical dotted line at the point of December 2019); after the withdrawal, however, the actual prices were always (and slightly) higher than the synthetic ones. Therefore, one can argue that if Jetstar did not withdraw from Napier (as in the synthetic case), house prices in the region should be lower than what happened. I then argue that in Hawke's Bay, the benefits of such aviation discontinuity (e.g. fewer flights leading to less noise and pollution) may outweigh its disadvantages (e.g. less convenience for travellers), in which the demand for air travel might be smaller than the demand for houses. Consequently, the treatment effects of Jetstar's withdrawal (i.e. the differences between the actual and synthetic prices) show a positive and increasing trend as in the second quarter of Figure 4(B).

The "leave-one-out" (LOO) placebo test (Abadie, Diamond, and Hainmueller 2010) can deal with the confounding issue. Figure 4(C) shows that all other predicted movements of the synthetic Hawke's Bay regions (with different settings when one drops a random region from the donor pool represented by the grey lines) are consistently under the actual prices. It is, therefore, robust to argue that after Jetstar withdrew from Napier airport, the house prices in the Hawke's Bay region increased over time, suggesting a positive impact of the intervention on the regional house prices.

4.4. SCM analysis for Taranaki region (New Plymouth airport)

The fitting result of the synthetic Taranaki region, for the pre-intervention period, is weaker than that of the Napier region, with an R^2 of only 0.645 and RMSPE of 0.031. Consequently, one can observe a slight fluctuation between the actual and synthetic

house prices of the region for the pre-intervention period, as in Figure 5(A). The regions that are used to construct the synthetic Taranaki region are Marlborough (0.625), Southland (0.358), and Canterbury (0.017).

For the post-intervention period, one can argue that the synthetic prices were higher than the actual ones, especially right after the event and once again in mid-2021 (see Figure 5). It suggests a negative effect of the event on the regional house prices in Taranaki – note that this region is a popular tourism destination and thus, aviation discontinuity may be a counter-affect for the argument on the trade-off between the pros and cons of the airports (Biagi, Brandano, and Caudill 2016; Paramati and Roca 2019; Tsui et al. 2019; Mikulić et al. 2021). This argument is robust, according to the LOO placebo tests (similar to Figure 4(C)); although we do not report it here to save some space. More importantly, Figure 5(B) also suggests that after a sharp decrease right after Jetstar's withdrawal, the housing market in New Plymouth started to show some recovery in July-October 2020, then fell off again in the first half of 2021. The regional housing market, however, started increasing since October 2021.

4.5. SCM analysis for Nelson region (Nelson airport)

The synthetic Nelson region is heavily relied on its eighbor – Tasman region (0.773), followed by Gisborne (0.107), Southland (0.079), and lightly influenced by Bay of Plenty (0.040). The values of the R^2 and RMSPE are 0.867 and 0.021, respectively, suggesting a good fit for the synthetic region. Similar to the case of New Plymouth, Figure 6(A) shows that the actual prices of houses in the Nelson region were lower (robust to the LOO placebo test, although not reported) than what they were supposed to be (as in the case of synthetic Nelson if there was no withdrawal from Jetstar). However, unlike New Plymouth, the fourth quarter of Figure 6(B) shows that the impacts of Jetstar's withdrawal were negative for the whole period after February 2020. Although there are some signs of market recovery after September 2021 (Figure 5(a)), the decreasing trend in the treatment effects (Figure 6(B)) arguably indicates that the impacts of Jetstar's withdrawal will continue to hinder house prices in the Nelson region. I, therefore, argue that the impact of this withdrawal on the Nelson region is stronger than that of the other regions because Jetstar did not only cancel one pair of routes (e.g. for the case of Auckland-Napier) but two for Nelson (i.e. Auckland-Nelson and Wellington-Nelson).

4.6. SCM analysis for Manawatu-Wanganui region (Palmerston North airport)

Despite a moderate goodness-of-fit ($R^2 = 0.705$, $RMSPE = 0.042$), the synthetic Manawatu-Wanganui region helps identify an increasing trend in the housing prices in the regional market. As the synthetic prices were under but closely follows the actual ones (see Figure 7(A)) and because the treatment effects were mainly positive (and increasing) for the post-intervention period (see Figure 7(B)), it is reasonable to argue that the withdrawal of Jetstar from Palmerston North airport did not hinder but increased the median prices of houses in the region.

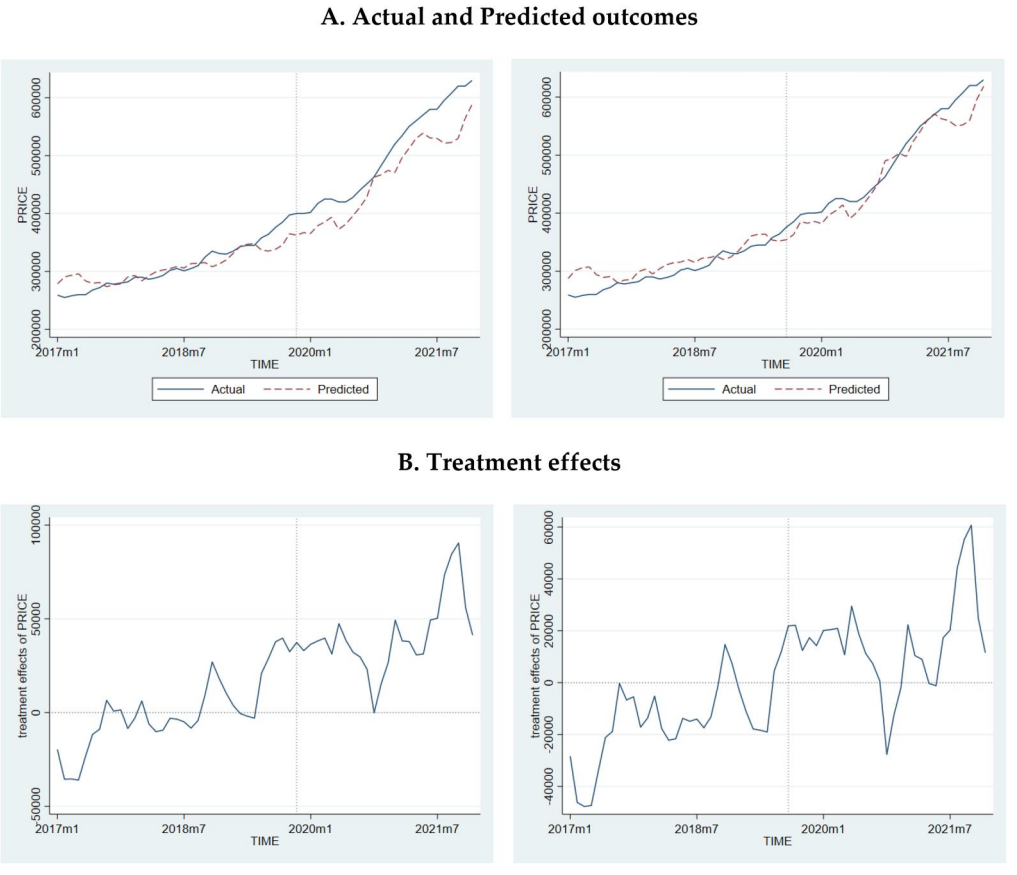

Figure 7. The results of SCM analysis for Manawatu-Wanganui region. (A) Actual and Predicted outcomes, (B) Treatment effects.

There are several plausible explanations for this situation. Firstly, the Manawatu-Wanganui region is the most populated region among the four treatment ones: in 2022, there were about 258000 persons in Manawatu-Wanganui while the same figures for Hawke's Bay, Taranaki, and Nelson were 182000, 127000, and 54000, respectively (Statistics New Zealand 2022). As such, the demand for houses contributed to the increase in house prices in this region. Secondly, the median house prices in Manawatu-Wanganui and Taranaki were both NZD$400000 in November 2019 (before the intervention); at the same time, the median prices for Hawke's Bay was NZD$525000 and the one for Nelson was NZD$580000. Obviously, the housing market in Manawatu-Wanganui will be more attractive and competitive than those of Hawke's Bay and Nelson since it is more affordable for buyers in the former region.

4.7. The overall impacts of jetstar's withdrawal on the housing market in New Zealand

Because we have multiple treated regions instead of only one, to access the overall impacts, I follow Abadie, Diamond, and Hainmueller (2010) and Kreif et al. (2016) to

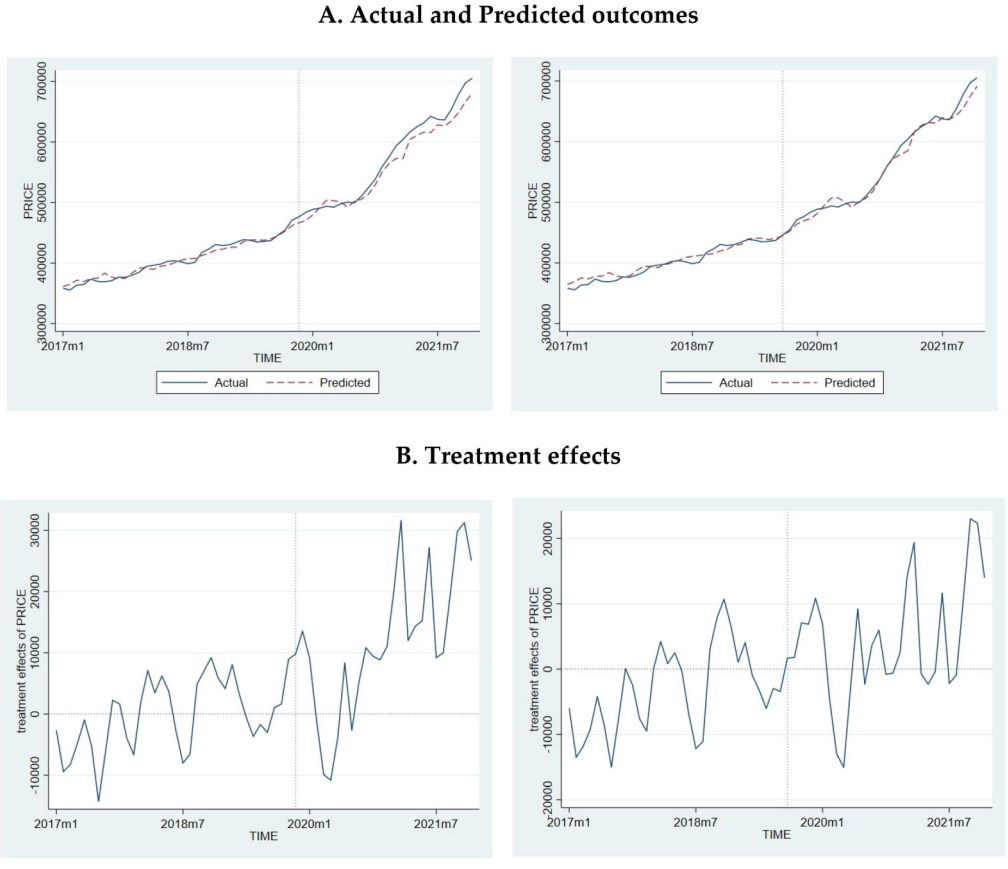

Figure 8. The results of SCM analysis for the 'artificial' ALL_FOUR region. (A) Actual and Predicted outcomes, (B) Treatment effects.

aggregate all four treated regions (Hawke's Bay, New Plymouth, Manawatu-Wanganui, and Nelson) into a single 'artificial' region named "ALL_FOUR". The SCM is then used to examine this ALL_FOUR region, similar to what has been done for each of the four regions above.

At first glance, the 'artificial' ALL_FOUR region is constructed from Marlborough (with the highest weight of 0.478), Gisborne (0.242), Northland (0.170), Canterbury (0.102), and Bay of Plenty (0.008). This combination has a goodness-of-fit R^2 of 0.731 and a RMSPE of 0.026, suggesting that the ALL_FOUR region is a good approximation to examine the overall impacts of the aviation discontinuity caused by Jetstar's withdrawal in December 2019.

Regarding the impacts of Jetstar's withdrawal on regional house prices, I have previously reported a positive impact in Hawke's Bay and Manawatu-Wanganui, and a negative impact in Taranaki and Nelson. The combination effect for all four regions, as illustrated in Figure 8(A), suggests that the positive impact generally outweighs the negative one. To be specific, one can observed that the treatment effects (i.e. the differences between the actual and synthetic prices due to the intervention) sharply dropped for four months right after the withdrawal of Jetstar but had been increased

since June 2020 (see Figure 8(B)). Consequently, my argument is that the event had a negative impact on the New Zealand housing market in short-run but a positive impact in the long-run.

5. Discussions and conclusions

This study empirically explores the effects of the withdrawal decision of Jetstar New Zealand regarding several domestic routes from 1 December 2019 on the median house prices of the airports/regions involved. Specifically, four regions of Hawke's Bay (corresponding to Napier airport), Taranaki (New Plymouth airport), Manawatu-Wanganui (Palmerston North airport), and Nelson (Nelson airport), among a total of 16 regions of the country, are examined under a quasi-experimental setting of a synthetic control method (SCM) for the period of January 2017 to December 2021. The basic idea is to estimate the synthetic prices for each region as well as for all four regions, assuming if the withdrawal did not happen, and then compare them with the actual ones. The results reveal meaningful findings and implications for the managers or policymakers of the involved airlines, airports, and regions. Future studies could extend and improve our research with larger datasets (e.g. using individual house prices or larger time frames), more modern techniques (e.g. dynamic or Bayesian synthetic controls), and different fields/topics (e.g. aviation discontinuity/disruption and regional/national socio-economic developments).

First, it is observed that Jetstar's withdrawal created some significant impacts on the house prices of the regions involved. While the previous literature has addressed the impacts of expanding airline/airport activities on the surrounding housing markets (McMillen 2004; Tsui, Tan, and Shi 2017; Affuso et al. 2019), this is the first time such discontinuity of aviation services has been examined. In this sense, it is important for regional managers and policymakers to be aware of such impacts and thus, can react accordingly. For instance, to maintain its housing market, regional councillors of Taranaki and Nelson may need to support the managers of New Plymouth and Nelson airports to keep Jetstar to stay, or to find other (low-cost) airlines to replace Jetstar as soon as possible. Indeed, Nelson has attracted Originair to provide its service on the Nelson-Wellington route from 14 February 2020 (RNZ 2020); however, the airline only provided less than a thousand scheduled seats for that route in 2020 (Official Airline Guide 2022). Consequently, with new participation from small airlines such as Originair, in comparison to Jetstar, more work is needed to get the region back to the pre-intervention period. While economic reasons are barriers for those small airlines, the spillover impacts of their operations on the regional well-being are much larger and thus, subsidies are justified (Wu et al. 2023; Wu et al. 2024).

Second, the impacts of Jetstar's withdrawal on the housing markets of each region are different. Particularly, a positive impact was found in Hawke's Bay and Manawatu-Wanganui, while Taranaki and Nelson experienced a negative impact. This is due to the characteristics of the regions and how Jetstar' services contributed to those regions before the withdrawal. For instance, Nelson was negatively affected more than the others because Jetstar pulled out two pairs of routes from this region (i.e. Auckland-Nelson and Wellington-Nelson), while it was only one pair of routes for Taranaki. Additionally, as observed in Figure 1, Nelson is more remoted in terms of

other means of transportation (e.g. land and sea), compared to the others. Therefore, reactions or solutions of each region to monitor the effects of the air service discontinuity will need to be tailored for the specific region.

Third, the overall assessment for all four impacted regions (*via* an artificial ALL_FOUR region) showed that the withdrawal had negatively affected the New Zealand housing market in the short run, but the market has recovered in long run. While there should be more to add to this story (e.g. the central government policy or other events such as the COVID-19 pandemic) that would benefit future studies, this finding suggests that the influence of Jetstar on the nation's housing market is only short-term. One main reason is that the domestic New Zealand aviation market is dominated by Jetstar's incumbent competitor, i.e. Air New Zealand (Henderson et al. 2019; Ho et al. 2021), and the increase of Air New Zealand services on these routes (Air New Zealand 2019) have helped ease out the negative impacts of Jetstar's withdrawal. Consequently, one would expect a much larger impact if the incumbent airline(s) discontinue their services from certain airports/routes. The SCM approach proposed in this study, therefore, could be extended to other countries or samples to verify this point.

Notes

1. We argue that the effect is medium- and long-term, because after Jetstar withdrew from those airports, there was little incentive for other airlines to enter such markets. For instance, Orginair operated at Nelson Airport since February 2020 but only provided less than a thousand scheduled seats for the whole year (Official Airline Guide 2022).
2. Doudchenko and Imbens (2016) further argued that DiD is a special case of SCM where all cross-sectional units' weights are equal.
3. Roth et al. (2023) pointed out that the common practice to test for the pre-treatment differences in trends ("pre-trends") often have low power, such that the absence of a significant pre-trend does not necessarily imply that parallel trends hold.
4. As noted by an anonymous referee, house prices may not react quickly upon the withdrawal. Given that the announcement was on 25th September and the commencement was 1st December (i.e., 67 days), whilst the median days for a house to sell in New Zealand continuously decreased from 41 to 31 days between May and December 2019 (REINZ 2019), we believe that the housing market had enough time to react to such withdrawals.
5. Our SCM results does not change (for the predicted prices)or changing in small magnitudes (for the treatment effects) even if we include Auckland and Wellington in the donor pool. Those results are not reported here but available upon request.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Thanh Ngo http://orcid.org/0000-0002-6090-8067

References

Abadie, A. 2005. Semiparametric Difference-in-Differences Estimators. *The Review of Economic Studies* 72 (1): 1–19. https://doi.org/10.1111/0034-6527.00321.

Abadie, A., A. Diamond, and J. Hainmueller. 2010. Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *Journal of the American Statistical Association* 105 (490): 493–505. https://doi.org/10.1198/jasa.2009.ap08746.

Abadie, A., and J. Gardeazabal. 2003. The Economic Costs of Conflict: A Case Study of the Basque Country. *American Economic Review* 93 (1): 113–132. https://doi.org/10.1257/000282803321455188.

Addessi, W., B. Biagi, and M. G. Brandano. 2019. Evaluating the Effect of the Introduction of the Euro on Tourist Flows: A Synthetic Control Approach. *The World Economy* 42 (5): 1554–1575. https://doi.org/10.1111/twec.12763.

Affuso, E., S. B. Caudill, F. G. Mixon, and K. W. Starnes. 2019. Is Airport Proximity an Amenity or Disamenity? An Empirical Investigation Based on House Prices. *Land Economics* 95 (3): 391–408. https://doi.org/10.3368/le.95.3.391.

Air New Zealand 2019. Air New Zealand Steps in to Support Affected Jetstar Customers. https://www.airnewzealand.co.nz/press-release-2019-airnz-steps-in-to-support-affected-jetstar-customers

Air Transport Bureau 2020. Effects of Novel Coronavirus (COVID-19) on Civil Aviation: Economic Impact Analysis. Paper presented at the International Civil Aviation Organization (ICAO), Montréal, Canada.

Alfano, V., S. Ercolano, and L. Cicatiello. 2021. School Openings and the COVID-19 Outbreak in Italy. A Provincial-Level Analysis Using the Synthetic Control Method. *Health Policy (Amsterdam, Netherlands)*125 (9): 1200–1207. https://doi.org/10.1016/j.healthpol.2021.06.010.

Arkhangelsky, D., S. Athey, D. A. Hirshberg, G. W. Imbens, and S. Wager. 2021. Synthetic Difference-in-Differences. *American Economic Review* 111 (12): 4088–4118. https://doi.org/10.1257/aer.20190159.

Armitage, S. 1995. Event Study Methods and Evidence on Their Performance. *Journal of Economic Surveys*9 (1): 25–52. https://doi.org/10.1111/j.1467-6419.1995.tb00109.x.

Arora, M., S. Tuchen, M. Nazemi, and L. Blessing. 2021. Airport Pandemic Response: An Assessment of Impacts and Strategies after One Year with COVID-19. *Transportation Research Interdisciplinary Perspectives* 11: 100449. https://doi.org/10.1016/j.trip.2021.100449.

Asquith, B. J., E. Mast, and D. Reed. 2023. Local Effects of Large New Apartment Buildings in Low-Income Areas. *The Review of Economics and Statistics* 105 (2): 359–375. https://doi.org/10.1162/rest_a_01055.

Austin, D. H. 1993. An Event-Study Approach to Measuring Innovative Output: The Case of Biotechnology. *The American Economic Review* 83 (2): 253–258.

Bai, J., and P. Perron. 1998. Estimating and Testing Linear Models with Multiple Structural Changes. *Econometrica* 66 (1): 47–78. https://doi.org/10.2307/2998540.

Bangura, M., and C. L. Lee. 2022. Housing Price Bubbles in Greater Sydney: Evidence from a Submarket Analysis. *Housing Studies* 37 (1): 143–178. https://doi.org/10.1080/02673037.2020.1803802.

Ben-Michael, E., A. Feller, and J. Rothstein. 2021. The Augmented Synthetic Control Method. *Journal of the American Statistical Association* 116 (536): 1789–1803. https://doi.org/10.1080/01621459.2021.1929245.

Bertrand, M., E. Duflo, and S. Mullainathan. 2004. How Much Should We Trust Differences-In-Differences Estimates?* . *The Quarterly Journal of Economics* 119 (1): 249–275. https://doi.org/10.1162/003355304772839588.

Biagi, B., M. G. Brandano, and S. B. Caudill. 2016. Tourism and House Prices in Italy: A Latent Class Approach. *Tourism Economics* 22 (5): 964–978. https://doi.org/10.5367/te.2015.0470.

Biagi, B., M. G. Brandano, and M. Pulina. 2017. Tourism Taxation: A Synthetic Control Method for Policy Evaluation. *International Journal of Tourism Research* 19 (5): 505–514. https://doi.org/10.1002/jtr.2123.

Breidenbach, P., J. Cohen, and S. Schaffner. n.d. Continuation of Air Services at Berlin-Tegel and Its Effects on Apartment Rental Prices. *Real Estate Economics*50 (6): 1548–1575. https://doi.org/10.1111/1540-6229.12385.

Brueckner, J. K. 2003. Airline Traffic and Urban Economic Development. *Urban Studies* 40 (8): 1455–1469. https://doi.org/10.1080/0042098032000094388.

Brunauer, W. A., W. Feilmayr, and K. Wagner. 2012. A New Residential Property Price Index for Austria. *Statistiken* Q3(12): 90–120.

Bui, N., L. Wen, and B. Sharp. 2022. House Prices and Flood Risk Exposure: An Integration of Hedonic Property Model and Spatial Econometric Analysis. *The Journal of Real Estate Finance and Economics* 69 (1): 100–131. https://doi.org/10.1007/s11146-022-09930-z.

Campbell, C. J., A. R. Cowan, and V. Salotti. 2010. Multi-Country Event-Study Methods. *Journal of Banking & Finance* 34 (12): 3078–3090. https://doi.org/10.1016/j.jbankfin.2010.07.016.

Case, B., and S. Wachter. 2005. Residential Real Estate Price Indices as Financial Soundness Indicators: Methodological Issues. Paper Presented at the BIS Papers No. 21 - Real Estate Indicators and Financial Stability, Basel, Switzerland.

Castillo, V., L. Figal Garone, A. Maffioli, and L. Salazar. 2017. The Causal Effects of Regional Industrial Policies on Employment: A Synthetic Control Approach. *Regional Science and Urban Economics* 67: 25–41. https://doi.org/10.1016/j.regsciurbeco.2017.08.003.

Cattaneo, M., C. Morlotti, P. Malighetti, and R. Redondi. 2022. Airports and Population Density: Where Benefits Outweigh Costs. *Regional Studies* 57 (3): 576–589. https://doi.org/10.1080/00343404.2022.2060957.

Chau, K. W., and T. Chin. 2003. A Critical Review of Literature on the Hedonic Price Model. *International Journal for Housing Science and Its Applications* 27 (2): 145–165.

Cohen, J. P., and C. C. Coughlin. 2008. Spatial Hedonic Models of Airport Noise, Proximity, and Housing Prices. *Journal of Regional Science* 48 (5): 859–878. https://doi.org/10.1111/j.1467-9787.2008.00569.x.

Czerny, A. I., X. Fu, Z. Lei, and T. H. Oum. 2021. Post Pandemic Aviation Market Recovery: Experience and Lessons from China. *Journal of Air Transport Management* 90: 101971. https://doi.org/10.1016/j.jairtraman.2020.101971.

Damen, S., and S. Schildermans. 2022. Capital Requirements, Mortgage Rates and House Prices. *Journal of Banking & Finance* 143: 106596. https://doi.org/10.1016/j.jbankfin.2022.106596.

Dekkers, J. E., and J. W. van der Straaten. 2009. Monetary Valuation of Aircraft Noise: A Hedonic Analysis around Amsterdam Airport. *Ecological Economics* 68 (11): 2850–2858. https://doi.org/10.1016/j.ecolecon.2009.06.002.

Dimitriou, D. J. 2018. Comparative Evaluation of Airports Productivity toward Tourism Development. *Cogent Business & Management* 5 (1): 1464378. https://doi.org/10.1080/23311975.2018.1464378.

Doerr, L., F. Dorn, S. Gaebler, and N. Potrafke. 2020. How New Airport Infrastructure Promotes Tourism: Evidence from a Synthetic Control Approach in German Regions. *Regional Studies* 54 (10): 1402–1412. https://doi.org/10.1080/00343404.2020.1714022.

Doudchenko, N., and G. W. Imbens. 2016. Balancing, Regression, Difference-in-Differences and Synthetic Control Methods: A Synthesis. National Bureau of Economic Research (NBER).

Dubé, J., D. Legros, M. Thériault, and F. Des Rosiers. 2014. A Spatial Difference-in-Differences Estimator to Evaluate the Effect of Change in Public Mass Transit Systems on House Prices. *Transportation Research Part B: Methodological* 64: 24–40. https://doi.org/10.1016/j.trb.2014.02.007.

Espey, M., and H. Lopez. 2000. The Impact of Airport Noise and Proximity on Residential Property Values. *Growth and Change* 31 (3): 408–419. https://doi.org/10.1111/0017-4815.00135.

Fu, X., K. W. Hong Tsui, B. Sampaio, and D. Tan. 2021. Do Airport Activities Affect Regional Economies? Regional Analysis of New Zealand's Airport System. *Regional Studies* 55 (4): 707–722. https://doi.org/10.1080/00343404.2020.1851359.

Gilchrist, D., T. Emery, N. Garoupa, and R. Spruk. 2022. Synthetic Control Method: A Tool for Comparative Case Studies in Economic History. *Journal of Economic Surveys*37*n/a*(*n/a*). (2): 409–445. https://doi.org/10.1111/joes.12493.

Graham, A. 2018. *Managing Airports: An International Perspective*. 5th ed. London: Routledge.

Grimes, A., A. Aitken, I. Mitchell, and V. Smith. 2007. Housing Supply in the Auckland Region (2000-2005) . Centre for Housing Research, Aotearoa New Zealand (CHRANZ): Wellington.

Head, A., H. Lloyd-Ellis, and H. Sun. 2014. Search, Liquidity, and the Dynamics of House Prices and Construction. *American Economic Review* 104 (4): 1172–1210. https://doi.org/10.1257/aer.104.4.1172.

Henderson, I. L., K. W. H. Tsui, T. Ngo, A. Gilbey, and M. Avis. 2019. Airline Brand Choice in a Duopolistic Market: The Case of New Zealand. *Transportation Research Part A: Policy and Practice* 121: 147–163. https://doi.org/10.1016/j.tra.2019.01.016.

Ho, T. H., D. T. Nguyen, T. Ngo, and T. D. Q. Le. 2021. Airfares Data in New Zealand Domestic Aviation Market. *Sustainability*13 (16): 8916. https://doi.org/10.3390/su13168916.

IATA 2018. IATA Forecast Predicts 8.2 billion Air Travelers in 2037 [Press release] . https://www.iata.org/en/pressroom/pr/2018-10-24-02/

IATA 2020. *Air Passenger Market Analysis – December 2020*. Geneva: International Air Transport Association (IATA).

Janet Ge, X. 2009. Determinants of House Prices in New Zealand. *Pacific Rim Property Research Journal* 15 (1): 90–121. https://doi.org/10.1080/14445921.2009.11104273.

Jetstar 2019. Jetstar confirms withdrawal from five regional domestic routes in New Zealand. Retrieved from https://newsroom.jetstar.com/jetstar-confirms-withdrawal-from-five-regional-domestic-routes-in-new-zealand/

Jetstar 2020. Jetstar Airways. https://www.jetstar.com/nz/en/about-us/jetstar-group/jetstar-airways

Johnson, A., P. Howden-Chapman, and S. Eaqub. 2018. *A Stocktake of New Zealand's Housing*. Wellington, NZ: New Zealand Government.

Jud, G. D., and D. T. Winkler. 2006. The Announcement Effect of an Airport Expansion on Housing Prices. *The Journal of Real Estate Finance and Economics* 33 (2): 91–103. https://doi.org/10.1007/s11146-006-8943-4.

Kanwal, Preet Kaur, Buly A Cardak, Richard McAllister, 2021. The Impact of Airport Noise on House Prices. *Q Open* 1 (2), qoab012. https://doi.org/10.1093/qopen/qoab012.

Karavias, Y., P. K. Narayan, and J. Westerlund. 2023. Structural Breaks in Interactive Effects Panels and the Stock Market Reaction to COVID-19. *Journal of Business & Economic Statistics* 41 (3): 653–666. https://doi.org/10.1080/07350015.2022.2053690.

KPMG. 2019. Aviation 2030: Disruption and Its Implications for the Aviation Sector. Amstelveen, Netherlands:

Kreif, Noémi, Richard Grieve, Dominik Hangartner, Alex James Turner, Silviya Nikolova, and Matt Sutton. 2016. Examination of the Synthetic Control Method for Evaluating Health Policies with Multiple Treated Units. *Health Economics* 25 (12): 1514–1528. https://doi.org/10.1002/hec.3258.

Küçükönal, H., and G. Sedefoğlu. 2017. The Causality Analysis of Air Transport and Socio-Economics Factors: The Case of OECD Countries. *Transportation Research Procedia* 28: 16–26. https://doi.org/10.1016/j.trpro.2017.12.164.

Kuethe, T. H., and V. O. Pede. 2011. Regional Housing Price Cycles: A Spatio-Temporal Analysis Using US State-Level Data. *Regional Studies* 45 (5): 563–574. https://doi.org/10.1080/00343400903497897.

Li, K. T. 2020. Statistical Inference for Average Treatment Effects Estimated by Synthetic Control Methods. *Journal of the American Statistical Association* 115 (532): 2068–2083. https://doi.org/10.1080/01621459.2019.1686986.

Limlomwongse Suksmith, P., and V. Nitivattananon. 2015. Aviation Impacts on Property Values and Management: The Case of Suvarnabhumi International Airport. *IATSS Research* 39 (1): 58–71. https://doi.org/10.1016/j.iatssr.2014.07.001.

MacKinlay, A. C. 1997. Event Studies in Economics and Finance. *Journal of Economic Literature* 35 (1): 13–39.

Masood, R., J. B. P. Lim, and V. A. González. 2021. Performance of the Supply Chains for New Zealand Prefabricated House-Building. *Sustainable Cities and Society* 64: 102537. https://doi.org/10.1016/j.scs.2020.102537.

McCarthy, J., and R. W. Peach. 2004. Are Home Prices the Next. *"Bubble"? Economic Policy Review* 10 (3): 1–17.

McMillen, D. P. 2004. Airport Expansions and Property Values: The Case of Chicago O'Hare Airport. *Journal of Urban Economics* 55 (3): 627–640. https://doi.org/10.1016/j.jue.2004.01.001.

Mense, A., and K. A. Kholodilin. 2014. Noise Expectations and House Prices: The Reaction of Property Prices to an Airport Expansion. *The Annals of Regional Science* 52 (3): 763–797. https://doi.org/10.1007/s00168-014-0609-1.

Mikulić, Josip, Maruška Vizek, Nebojša Stojčić, James E. Payne, Anita Čeh Časni, and Tajana Barbić. 2021. The Effect of Tourism Activity on Housing Affordability. *Annals of Tourism Research* 90: 103264. https://doi.org/10.1016/j.annals.2021.103264.

Mulligan, G. F., R. Franklin, and A. X. Esparza. 2002. Housing Prices in Tucson, Arizona. *Urban Geography* 23 (5): 446–470. https://doi.org/10.2747/0272-3638.23.5.446.

Ngo, T., G. Squires, M. McCord, and D. Lo. 2023. House Prices, Airport Location Proximity, Air Traffic Volume and the COVID-19 Effect. *Regional Studies, Regional Science* 10 (1): 418–438. https://doi.org/10.1080/21681376.2023.2186805.

Ngo, T., H. H. Trinh, I. Haouas, and S. Ullah. 2022. Examining the Bidirectional Nexus between Financial Development and Green Growth: International Evidence through the Roles of Human Capital and Education Expenditure. *Resources Policy* 79: 102964. https://doi.org/10.1016/j.resourpol.2022.102964.

Official Airline Guide 2022. *OAG Data Analyser*. Singapore: Official Airline Guide (OAG).

Oikarinen, E., and J. Engblom. 2016. Differences in Housing Price Dynamics across Cities A Comparison of Different Panel Model Specifications. *Urban Studies* 53 (11): 2312–2329. https://doi.org/10.1177/0042098015589883.

Paramati, S. R., and E. Roca. 2019. Does Tourism Drive House Prices in the OECD Economies? Evidence from Augmented Mean Group Estimator. *Tourism Management* 74: 392–395. https://doi.org/10.1016/j.tourman.2019.04.023.

Peri, G., and V. Yasenov. 2019. The Labor Market Effects of a Refugee Wave. *Journal of Human Resources* 54 (2): 267–309. https://doi.org/10.3368/jhr.54.2.0217.8561R1.

Powe, N. A., G. Garrod, and K. Willis. 1995. Valuation of Urban Amenities Using an Hedonic Price Model. *Journal of Property Research* 12 (2): 137–147. https://doi.org/10.1080/09599919508724137.

Rahmatian, M., and L. Cockerill. 2004. Airport Noise and Residential Housing Valuation in Southern California: A Hedonic Pricing Approach. *International Journal of Environmental Science & Technology* 1 (1): 17–25. https://doi.org/10.1007/BF03325812.

Rehm, M., and Y. Yang. 2021. Betting on Capital Gains: Housing Speculation in Auckland, New Zealand. *International Journal of Housing Markets and Analysis* 14 (1): 72–96. https://doi.org/10.1108/IJHMA-02-2020-0010.

REINZ 2019. Days to sell. https://www.interest.co.nz/charts/real-estate/days-sell

REINZ 2022. Residential property data [Online]. https://www.reinz.co.nz/residential-property-data-gallery

RNZ 2020. Originair Brings Back Nelson to Wellington Route. https://www.rnz.co.nz/news/business/407464/originair-brings-back-nelson-to-wellington-route

Roth, J., P. H. C. Sant'Anna, A. Bilinski, and J. Poe. 2023. What's Trending in Difference-in-Differences? A Synthesis of the Recent Econometrics Literature. *Journal of Econometrics* 235 (2): 2218–2244. https://doi.org/10.1016/j.jeconom.2023.03.008.

Rouwendal, J., and A. Petrat. 2022. Mortgage Underwriting and House Prices: Evidence from the 2011 Change in the Dutch Code of Conduct for Mortgage Loans. *Real Estate Economics* 50 (4): 1141–1159. https://doi.org/10.1111/1540-6229.12372.

Salvi, M. 2008. Spatial Estimation of the Impact of Airport Noise on Residential Housing Prices. *Swiss Journal of Economics and Statistics* 144 (4): 577–606. https://doi.org/10.1007/BF03399267.

Sorescu, A., N. L. Warren, and L. Ertekin. 2017. Event Study Methodology in the Marketing Literature: An Overview. *Journal of the Academy of Marketing Science* 45 (2): 186–207. https://doi.org/10.1007/s11747-017-0516-y.

Squires, G., and D. J. Webber. 2019. House Price Affordability, the Global Financial Crisis and the (ir)Relevance of Mortgage Rates. *Regional Studies, Regional Science* 6 (1): 405–420. https://doi.org/10.1080/21681376.2019.1643777.

St John, S., and T. Baucher. 2021. *The Fair Economic Return: Restoring Equity to the Social Fabric of New Zealand*. Auckland, NZ: Auckland University of Technology (AUT).

Statistics New Zealand 2022. Infoshare. Retrieved 14 October, 2022, from Statistics New Zealand (StatsNZ) https://infoshare.stats.govt.nz/

Stuff 2019. 10 Years of Jetstar: the Highs and Lows. https://www.stuff.co.nz/business/116106589/10-years-of-jetstar-the-highs-and-lows

Titman, S., K. Wang, and J. Yang. 2014. The Dynamics of Housing Prices. *Journal of Real Estate Research* 36 (3): 283–318. https://doi.org/10.1080/10835547.2014.12091394.

Tookey, J. E. 2017. *The Mess We're In: Auckland's Housing Bubble from a Construction Sector Perspective*. Auckland University of Technology (AUT): Auckland, NZ.

Torstensen, K. N., and K. Roszbach. 2019. Housing Markets in Scandinavia: Supply, Demand and Regulation. In *Hot Property: The Housing Market in Major Cities*, edited by R. Nijskens, M. Lohuis, P. Hilbers, & W. Heeringa, 129–139. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-11674-3_11.

Tsao, H.-C., and C.-J. Lu. 2022. Assessing the Impact of Aviation Noise on Housing Prices Using New Estimated Noise Value: The Case of Taiwan Taoyuan International Airport. *Sustainability*14 (3): 1713. https://doi.org/10.3390/su14031713.

Tsui, K. W. H., D. Tan, C. K. W. Chow, and S. Shi. 2019. Regional Airline Capacity, Tourism Demand and Housing Prices: A Case Study of New Zealand. *Transport Policy* 77: 8–22. https://doi.org/10.1016/j.tranpol.2019.02.007.

Tsui, W. H. K., D. T. W. Tan, and S. Shi. 2017. Impacts of Airport Traffic Volumes on House Prices of New Zealand's Major Regions: A Panel Data Approach. *Urban Studies* 54 (12): 2800–2817. https://doi.org/10.1177/0042098016660281.

Tu, C. C. 2005. How Does a New Sports Stadium Affect Housing Values? The Case of FedEx Field. *Land Economics* 81 (3): 379–395. https://doi.org/10.3368/le.81.3.379.

Tveter, E., M. Welde, and J. Odeck. 2017. Do Fixed Links Affect Settlement Patterns: A Synthetic Control Approach. *Research in Transportation Economics* 63: 59–72. https://doi.org/10.1016/j.retrec.2017.07.002.

Ullah, S., P. Akhtar, and G. Zaefarian. 2018. Dealing with Endogeneity Bias: The Generalized Method of Moments (GMM) for Panel Data. *Industrial Marketing Management* 71: 69–78. https://doi.org/10.1016/j.indmarman.2017.11.010.

Voicu, I., and V. Been. 2008. The Effect of Community Gardens on Neighboring Property Values. *Real Estate Economics* 36 (2): 241–283. https://doi.org/10.1111/j.1540-6229.2008.00213.x.

Wijburg, G., M. B. Aalbers, and F. Bono. 2021. Cuban Migrants and the Making of Havana's Property Market. *Urban Geography* 42 (9): 1362–1387. https://doi.org/10.1080/02723638.2020.1774150.

Wu, H., K. W. Hong Tsui, T. Ngo, and Y.-H. Lin. 2023. Airport Subsidies Impact on Wellbeing of Smaller Regions: A Systemic Examination in New Zealand. *Transport Policy* 130: 26–36. https://doi.org/10.1016/j.tranpol.2022.10.019.

Wu, H., Y.-H. Lin, T. Ngo, and K. W. Hong Tsui. 2024. Aviation Subsidy Policy and Regional Wellbeing: Important Indicators from Relevant Stakeholders' Perspectives. *Case Studies on Transport Policy* 16: 101181. https://doi.org/10.1016/j.cstp.2024.101181.

Xin, M., A. Shalaby, S. Feng, and H. Zhao. 2021. Impacts of COVID-19 on Urban Rail Transit Ridership Using the Synthetic Control Method. *Transport Policy* 111: 1–16. https://doi.org/10.1016/j.tranpol.2021.07.006.

Yuen, M. K., T. Ngo, T. D. Q. Le, and T. H. Ho. 2022. The Environment, Social and Governance (ESG) Activities and Profitability under COVID-19: Evidence from the Global Banking Sector. *Journal of Economics and Development* 24 (4): 345–364. https://doi.org/10.1108/JED-08-2022-0136.

Zabel, J. E., and D. Guignet. 2012. A Hedonic Analysis of the Impact of LUST Sites on House Prices. *Resource and Energy Economics* 34 (4): 549–564. https://doi.org/10.1016/j.reseneeco.2012.05.006.

Zhang, L., E. C. Hui, and H. Wen. 2017. The Regional House Prices in China: Ripple Effect or Differentiation. *Habitat International* 67: 118–128. https://doi.org/10.1016/j.habitatint.2017.07.006.

Zhao, X., B. Han, Y. Guan, Z. Cheng, and Y. Yang. 2024. Examining the Policy Outcomes of Cancelling the House Purchase Restriction: Quasi-Experimental Evidence from China. *Urban Governance*4 (2): 122–128. https://doi.org/10.1016/j.ugj.2024.04.001.

Zheng, H., and Q. Zhang. 2013. Property Tax in China: Is It Effective in Curbing Housing Price? *Economics Bulletin* 33 (4): 2465–2474.

Zheng, X., W. Peng, and M. Hu. 2020. Airport Noise and House Prices: A Quasi-Experimental Design Study. *Land Use Policy* 90: 104287. https://doi.org/10.1016/j.landusepol.2019.104287.