Estimated Price Elasticities for International Visitor Arrivals to New Zealand

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For the Parliamentary Commissioner for the Environment

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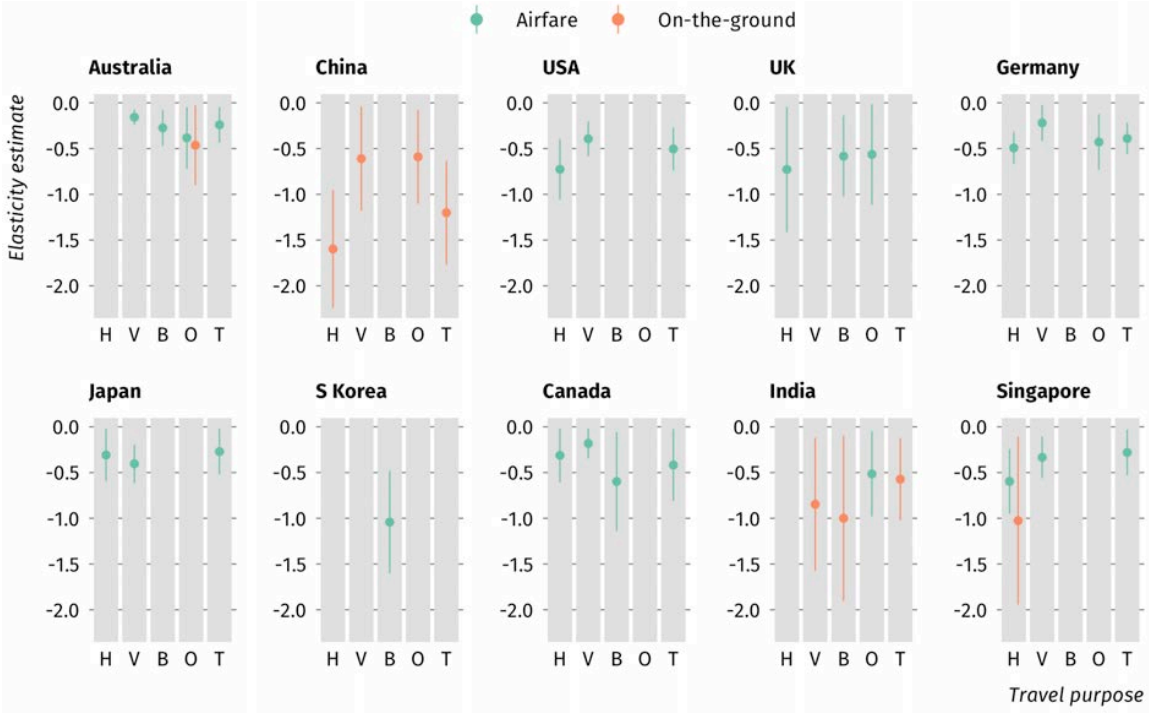
1 Summary

This report presents estimates of price elasticities for short-term international visitor arrivals to New Zealand. These elasticities measure the responsiveness of the number of quarterly visitor arrivals to changes in the price of visiting New Zealand. Elasticities were estimated using quarterly data from 2009Q1 to 2019Q4 for short-term visitor arrivals from the top 10 countries of origin in 2019: Australia, China, USA, UK, Germany, Japan, South Korea, Canada, India, and Singapore. Together, these origins accounted for 80% of visitor arrivals in 2019. For each country, elasticities were estimated for total visitor arrivals and for arrivals disaggregated by four purposes of travel: holiday, visiting friends and relatives (VFR), business, and all other purposes.

Prices faced by visitors were captured in two price indexes that reflect international airfares and 'on-the-ground' expenditure in New Zealand separately. These price indexes were expressed in foreign currency terms and were adjusted for foreign consumer price inflation to reflect the price of visiting New Zealand relative to general consumer expenditure in the foreign country.

A total of 100 elasticities were estimated, comprising all combinations of the ten origin countries, five purposes of travel, and two price indexes. Of these, 33 statistically significant elasticity estimates were obtained. These estimates and their corresponding 90% confidence intervals are shown in Figure 1. In most cases, statistically significant elasticities were found for airfares but not for on-the-ground expenditure. This may be due to the greater variation in airfares over time, and/or due to different effects of airfares and on-the-ground prices on visitor behaviour.

Figure 1 Estimated price elasticities by country of origin and purpose of travel



H = Holiday; V = Visiting Friends and Relatives; B = Business; O = Other, T = Total

The results are broadly consistent with greater price sensitivity for visitors to New Zealand from less mature origin markets such as China and India. For most of the mature markets such as

Australia, Japan, and the USA, statistically significant on-the-ground price elasticities were not found, which may indicate that for these markets, on-the-ground prices do not have a substantial effect on visitor arrivals in comparison to airfares which are often paid for up-front at the time of deciding to visit New Zealand. Distance from New Zealand may also play a role, reflected by the higher price sensitivity for visitors from the USA and the UK compared to visitors from Australia.

Overall, these results suggest:

- Visitors from Australia, Germany, and Japan are relatively insensitive to the price of visiting New Zealand, with elasticities in the range from zero to -0.5, i.e. a 10% increase in price could cause less than a 5% reduction in arrivals.
- Visitors from the USA, the UK, Canada, and Singapore are more price sensitive, but elasticities are between zero and -1.0 in most cases, i.e. a 10% increase in price could cause less than a 10% reduction in arrivals.
- Visitors from China and India appear to be more price sensitive, with some elasticities less than -1.0 and potentially less than -2.0, i.e. a 10% increase in price could cause between a 10% and 20% reduction in arrivals.

The elasticities were estimated while controlling for other factors that may affect quarterly visitor arrivals, including seasonal patterns, international migration to New Zealand, and general economic conditions in the foreign country. Appropriate econometric techniques were used to compensate for the fact that airfares and on-the-ground prices may not be independent of the number of visitor arrivals in a given quarter. While the results presented are generally robust, they should be interpreted with the following caveats in mind:

- Due to the difficulty of isolating effects of prices from other factors that affect visitor arrivals, there is relatively high uncertainty associated with the estimated elasticities for some markets, namely China, the UK, South Korea, and India. Visitors from these markets could be significantly more or less price sensitive than implied by the estimated elasticity value. In addition, finding price elasticities that are statistically insignificant from zero does not mean that prices have no effect on visitor arrivals. An insignificant elasticity means that it was not possible to isolate price effects after controlling for other variables in the model.
- The estimated elasticities may not fully reflect the responsiveness of visitor arrivals to relatively large price changes (greater than 10%). In general, demand responds more strongly to larger price changes than to smaller changes.
- The analysis undertaken in this report uses data from before the COVID-19 global pandemic and subsequent severe impacts on international travel including travel bans and quarantine requirements imposed by many countries including New Zealand. It is not yet clear if this will have permanent effects on the demand for travel to New Zealand, but it is possible that the pandemic could cause significant and long-lasting changes in the volumes, characteristics, and price sensitivity of international visitors to New Zealand.

2 Introduction and scope

This report summarises analysis undertaken for the Parliamentary Commissioner for the Environment (PCE) to better understand the price sensitivity of short-term international visitor arrivals to New Zealand. This was done by estimating price elasticities of the number of short-term international visitor arrivals to New Zealand between 2009 and 2019 from the ten countries shown in Table 1 for various purposes of travel.[1] These were the top ten countries of origin for New Zealand short-term international visitor arrivals in calendar 2019 and together represented 80% of visitor arrivals in that year.

For each country, visitor arrivals elasticities were estimated for total arrivals from that country and for arrivals disaggregated by four purposes of travel: holiday, visiting friends and relatives (VFR), business, and other.[2] In all cases, the analysis is based on arrivals of short-term visitors, defined as those who stay in New Zealand for less than 12 months.

Table 1 Short-term international visitor arrivals to New Zealand in calendar 2019

Country	**Visitor arrivals**	**Visitor arrivals (%)**
Australia	1,537,988	40.4
China*	407,141	10.7
USA	367,958	9.7
UK	231,712	6.1
Germany	98,050	2.6
Japan	97,682	2.6
South Korea	88,481	2.3
Canada	73,037	1.9
India	66,775	1.8
Singapore	64,574	1.7

Source: Statistics New Zealand

* All analysis in this report of China refers to mainland China excluding Hong Kong

[1] The price elasticity of demand is defined as the percentage change in quantity demanded in response to a given percentage change in price. In general terms, if quantity demanded as a function of price is $Q(p)$ then the price elasticity of demand at a given price is $e = Q'(p)P/Q(p)$.

[2] These four purposes were calculated by grouping the travel purposes for visitor arrivals reported by Statistics New Zealand as follows: Holiday = Holiday/Vacation; VFR = Visit Friends/Relatives; Business = Business + Conventions/Conferences, Other = Education + Other + Unspecified/Not collected.

3 Methodology

Price elasticities for each of the 50 combinations of country of origin and travel purpose described in section 2 were estimated using linear regression models fitted to quarterly data from 2009Q1 to 2019Q4 inclusive. Each model seeks to explain the quarterly number of short-term international visitor arrivals to New Zealand for a given combination of origin and travel purpose as a function of the 'price' of visiting New Zealand (defined below) and other variables that are expected to affect the number of arrivals in each quarter.

3.1 Tourism price indexes

Two price indexes were used in the models to reflect the price to visit New Zealand:

1. the international airfare from the relevant country of origin; and
2. a composite index reflecting the overall "on-the-ground" price of a typical bundle of tourism-related goods and services in New Zealand.

These two price indexes were included separately in each regression model rather than combining them into an overall composite price index. This was done due to a lack of accurate information about the appropriate weighting of international airfares relative to on-the-ground expenditure, and the fact that airfares and on-the-ground prices are experienced differently by visitors and so may have different effects on visitor behaviour. In particular, airfares are typically observed and paid for at the time of deciding to travel to New Zealand, while on-the-ground expenditure mainly occurs while the visitor is in New Zealand.

The airfare price index was based on actual airfares paid by people travelling from each origin country to New Zealand in each quarter (see section 4.2.1 below). The on-the-ground price index was constructed by weighting changes in prices for broad categories of tourism-related goods and services in New Zealand. The weights were based on the typical amounts spent on such goods and services by visitors from each origin country and these weights varied over time reflecting changes in visitor spending patterns for each origin.

Both the on-the-ground and airfare price indexes were expressed in foreign currency terms using the appropriate exchange rate for the origin country and were adjusted to real terms using the appropriate rate of consumer price inflation in the foreign country. Therefore, the price indexes can be thought of as the price of visiting New Zealand in foreign currency terms faced by visitors from each origin country *relative* to general consumer expenditure within that country.[3] The data sources and construction of these price variables are described in more detail in section 4.2 below.

3.2 Other explanatory variables

Other explanatory variables were also included in the regression models to account for factors aside from prices that may affect the quarterly number of arrivals to New Zealand. The following additional explanatory variables were included in each regression model:

[3] Due to data limitations, the price indexes were only differentiated by country of origin and not by purpose of travel.

- Real GDP per capita in the foreign country to capture general economic conditions in the origin country. This includes the effects of the 2007/08 Global Financial Crisis, which may have affected arrivals in the early part of the time period used for this analysis.
- Total net migration from the foreign country to New Zealand over the preceding five years.
- Quarterly dummy variables to capture seasonal effects.
- The number of days in a two-week window around Easter Sunday that occurred in each quarter (the timing of Easter can affect the pattern of arrivals in the first and second quarters).
- A dummy variable to capture the effects of the 2011 Rugby World Cup, which temporarily altered arrivals patterns from some markets.

3.3 Regression modelling strategy

3.3.1 Potential endogeneity of price variables

In all the regression models, the dependent variable is the number of visitor arrivals for a given combination of country of origin and purpose of travel, and the estimates of interest are the coefficients on the two price variables. This raises a question of whether the prices are independent of the number of arrivals or not. If prices and arrivals are interdependent (i.e. prices are 'endogenous') then if this is not accounted for in the analysis it may lead to bias in the estimates of the price elasticities.[4] However, the number of visitor arrivals from any given market is relatively small in comparison to the total New Zealand tourism sector, so it is not obvious whether the potential endogeneity of prices is a significant issue in practice.

A common way to accommodate potentially endogenous variables in a regression model is to use the method of 'instrumental variables' (IV). When estimating demand price elasticities, this involves replacing the price variables with suitable 'instruments' that are correlated with prices but that can be considered to be exogenously determined. In other words, the instruments should have no other effects on visitor arrivals aside from any direct effects through prices. A common approach for demand elasticity estimation is to use instruments that capture cost-related changes in prices, i.e. changes in prices that are caused by external factors on the supply-side of the market.

While the IV method can address the bias caused by endogenous variables, it generally leads to estimated regression coefficients that are less precise than ordinary least squares (OLS) regression (i.e. the estimates have wider confidence intervals). This is because it can be difficult to find suitable instruments that are highly correlated with the endogenous variable but are themselves exogenous. If the endogeneity bias is not very severe, it may be preferable to use OLS estimates that are more precise.

Given the above, the modelling strategy used in this analysis was to first estimate an IV model for each combination of origin country and purpose of travel and use the estimated price elasticities from that model if they were statistically significant at the 90% level. If not, results from an OLS

[4] In technical terms, endogeneity of prices means that random shocks that affect the number of visitor arrivals (i.e. the regression error term) could also affect prices. If so, the estimated regression coefficient on price will then pick up some of these other impacts on arrivals and attribute that to price changes, leading to a biased estimate of the price elasticity.

version of the model with the same explanatory variables were used if that produced a significant elasticity estimate. Hausman tests were performed on all models to check the extent of the potential endogeneity problems in the cases where OLS estimates were used.[5]

As described in section 4.3 below, in the IV models the instruments used were a combination of cost drivers of tourism-related goods and services in New Zealand, exchange rates, and foreign inflation rates. All of these variables can be considered to be independent of visitor arrivals for any particular combination of country of origin and travel purpose.[6] The IV models were estimated using the standard 'two-stage least-squares' procedure where the price variables are first regressed on the instruments and the predicted values from those regressions are calculated to determine the variation in prices that is independent of visitor arrivals. The predictions from the first-stage regressions were then used in place of the prices in the second-stage regression of visitor arrivals on prices and the other explanatory variables listed above.[7]

3.3.2 Estimating price elasticities from quarterly time-series data

With time-series data, it is possible to estimate price elasticities from either the levels or the differences of the variables. Using quarterly levels, the elasticities are estimated from a regression of log-levels of quarterly visitor arrivals on log-levels of prices and other variables, i.e.:

$$\ln Y_t = \beta_0 + \beta_1 \ln \hat{P}_t^{AIR} + \beta_2 \ln \hat{P}_t^{OTG} + \beta_3 X_t + e_t$$

where Y_t is the number of arrivals in quarter t, $\hat{P}_t^{AIR}$ is the international airfare price index (predicted from the first-stage regression in the case of IV models), $\hat{P}_t^{OTG}$ is the on-the-ground price index (also predicted from the first-stage regression in the IV models), and X_t is a matrix of other explanatory variables. In this model, the coefficients β_1 and β_2 are approximate estimates of the price elasticities, for relatively small changes in prices.

Alternatively, a regression that uses log-differences can be used. Given the seasonality in the visitor arrivals data, it makes sense to use year-on-year differences rather than the difference versus the previous quarter. With this approach, the elasticities are estimated from a regression of log-differences:

$$\ln Y_t - \ln Y_{t-4} = \beta_0 + \beta_1\left(\ln \hat{P}_t^{AIR} - \ln \hat{P}_{t-4}^{AIR}\right) + \beta_2\left(\ln \hat{P}_t^{OTG} - \ln \hat{P}_{t-4}^{OTG}\right) + \beta_3(X_t - X_{t-4}) + e_t$$

Since differences in logs of a variable are equivalent to percentage changes, in this model the coefficients β_1 and β_2 are direct estimates of the price elasticities.

[5] Hausman tests essentially compare the IV and OLS versions of the same model to determine whether there is evidence of endogeneity bias.

[6] In the long term, the total number of visitors to New Zealand may affect the costs of providing some tourism-related products such as accommodation services. However, each individual combination of country of origin and purpose used in this analysis is relatively small compared to the aggregated New Zealand tourism sector, thus it is reasonable to assume that cost drivers are exogenous.

[7] Two-stage least squares also involves a correction to the standard errors of estimated coefficients in the second-stage regression, to account for the fact that some of the explanatory variables are predictions from the first-stage regression.

Elasticity estimates from a log-differences model are more accurate than from a log-levels model as they directly estimate the relationship between percentage changes in prices and percentage changes in arrivals. Given the relatively small dataset available for estimating elasticities for each combination of origin and purpose, the results reported below use both the log-differences and log-levels approaches to estimate elasticities. The results from the log-differences model are used if this gives an estimated elasticity that is statistically significant at the 10% level, otherwise the results from the log-levels model are used if these are also significant at the 10% level.

3.3.3 Summary and diagnostics

The estimated price elasticities were derived from a hierarchy of models for each combination of country of origin and purpose of travel. Results were obtained from models in the following order:

1. IV, log-differences
2. IV, log-levels
3. OLS, log-differences
4. OLS, log-levels

This hierarchy reflects the trade-offs discussed above, i.e. that IV is less likely to produce biased elasticity estimates than OLS but is less precise, and that log-differences models directly estimate price elasticities while log-levels only provide an approximate estimate of the elasticity for relatively small price changes. This approach of combining results from different methods of estimating the elasticity models has the advantage of yielding more usable elasticity estimates than using a single estimation method alone. Diagnostic tests were performed on all models as described below, to ensure that the estimated elasticities are statistically reliable regardless of the method used to estimate them.

All models were estimated in R using the built-in *lm* function for the OLS models and the *ivreg* instrumental variables regression function from the *AER* package for the IV models. With time-series data, correlation over time (autocorrelation) in the regression residuals can cause standard errors of the regression coefficients to be incorrect, leading to incorrect tests of statistical significance. To mitigate this, significance tests and confidence intervals for all estimated regression coefficients in both OLS and IV models were calculated using heteroscedasticity and autocorrelation consistent (HAC) standard errors produced by the *vcovHAC* function of the *sandwich* package, via the *coeftest* and *coefci* functions of the *lmtest* package.

The following diagnostic statistics were calculated for the models to aid interpretation:

1. R-squared, i.e. the proportion of variation in the dependent variable (log arrivals or log-differenced arrivals) explained by the model.
2. The Durbin-Watson statistic and corresponding *p*-value to test for evidence of autocorrelation in the regression residuals.
3. Hausman tests of endogeneity, to test whether results from the OLS models are likely to be affected by endogeneity, where these were used.
4. For the IV models, *p*-values from weak instruments tests for the two price variables.

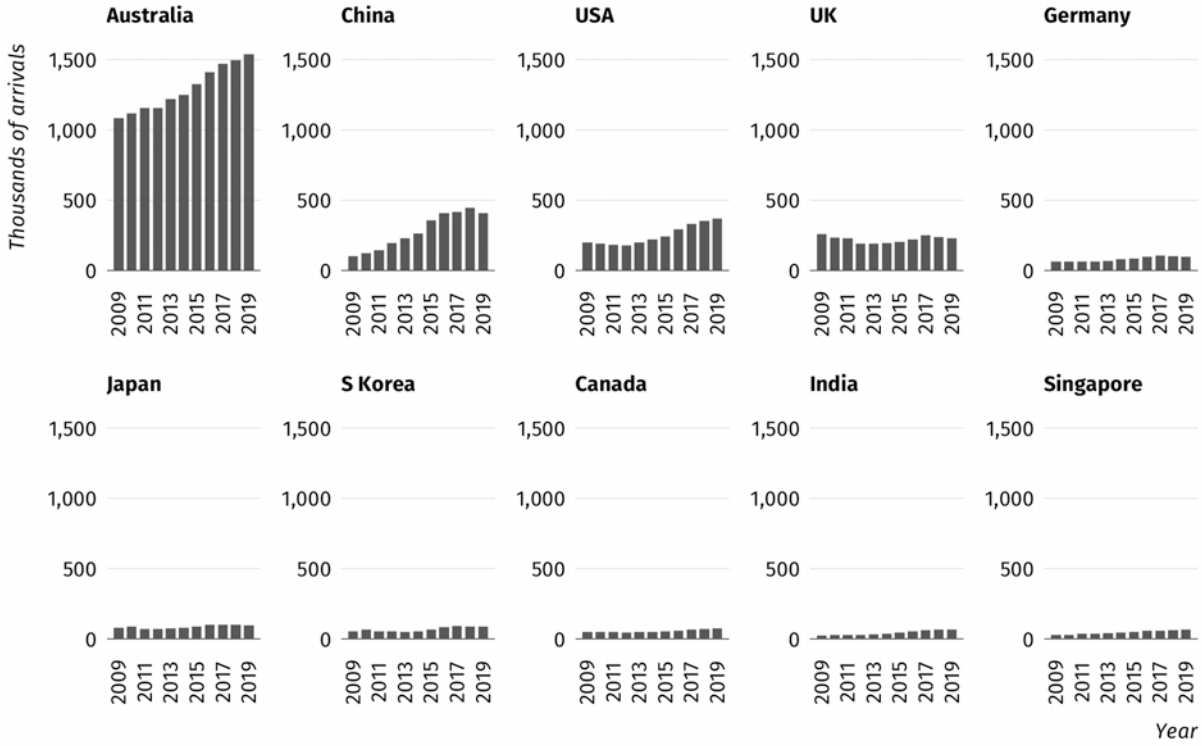
4 Data

The following briefly summarises the data used to estimate price elasticities.

4.1 International visitor arrivals to New Zealand

The dependent variable in all regression models was quarterly short-term international visitor arrivals to New Zealand, for a given country of origin and travel purpose. To illustrate the overall trends in visitor arrivals from each country, Figure 2 shows the annual number of arrivals to New Zealand from the ten countries used in this analysis, from 2009 to 2019. Over this period, arrivals from Australia, China, and the USA have increased, while arrivals from most other origins have remained roughly constant or have grown but remained relatively small origin markets for New Zealand tourism.

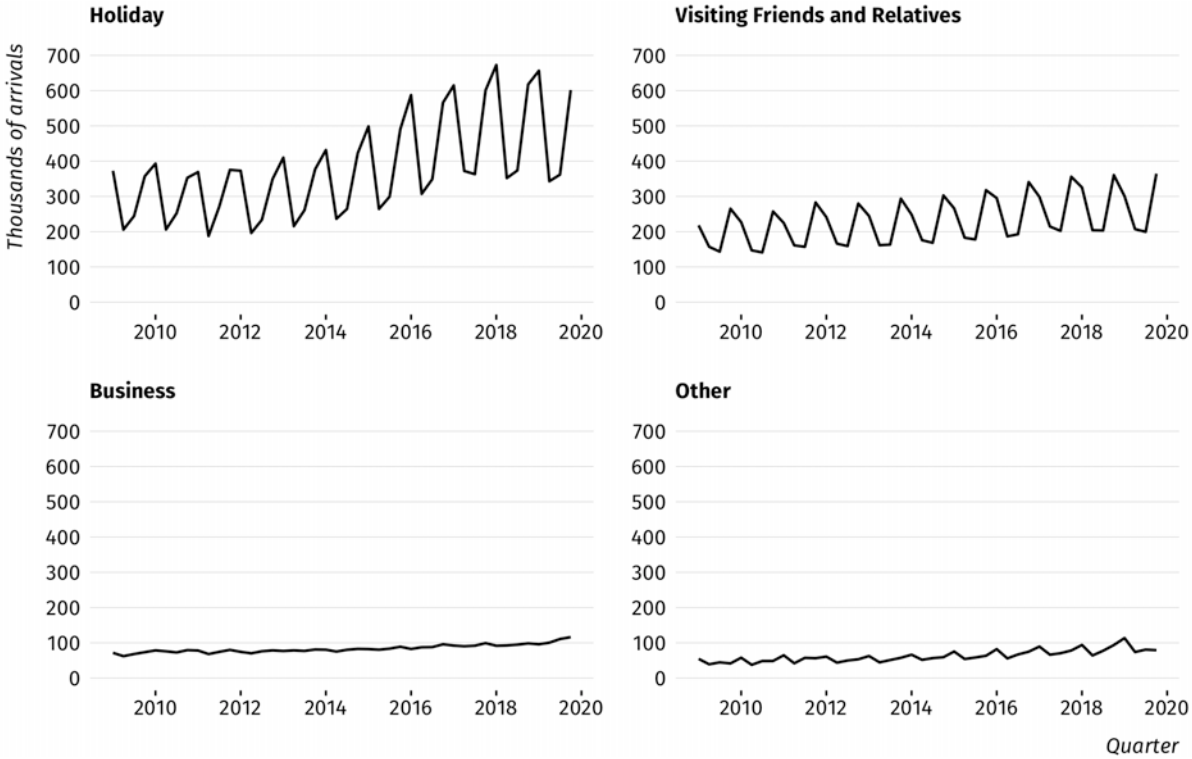
Figure 2 Annual short-term international visitor arrivals to New Zealand by country of origin



Source: Statistics New Zealand

Figure 3 shows the number of quarterly visitor arrivals to New Zealand from all countries combined (including those outside the top ten) by purpose of travel, from 2009 to 2019. This shows strong growth in holiday travel from 2013 to 2018, and the clear seasonality of arrivals for all purposes except business.

Figure 3 Total quarterly short-term international visitor arrivals to New Zealand by purpose



Source: Statistics New Zealand

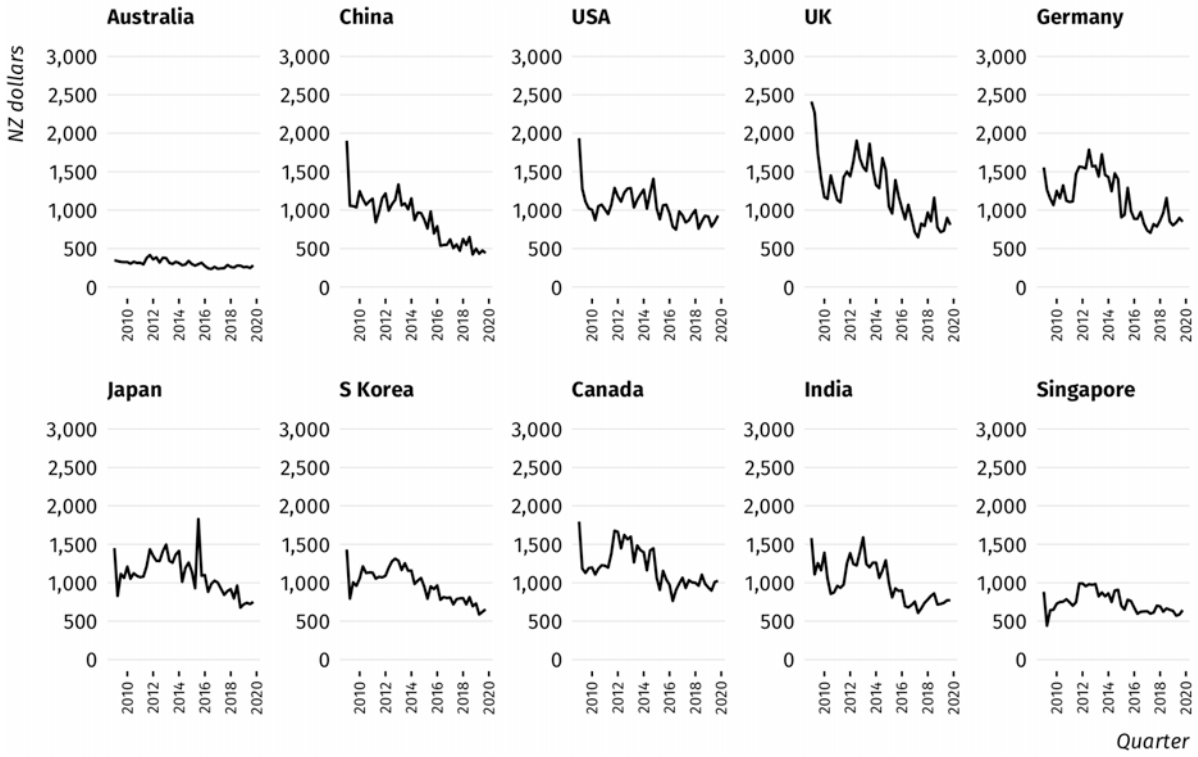
4.2 New Zealand tourism price indexes

4.2.1 International airfares

Data on quarterly average economy class base airfares paid by international travellers to New Zealand was obtained from Sabre (Figure 4).[8] These show a general downward trend over time as new international routes to New Zealand have opened and competition among airlines has intensified. Between 2009 and 2019, the average base fare from some markets such as China and the UK reduced by around 50%.

[8] Sabre is a large commercial provider of booking services to airlines. The airfare data obtained reflects average airfares actually paid by people travelling from each country of origin to New Zealand in each quarter from 2009 to 2019. The base fares reflect the revenues received by airlines and exclude government taxes and charges. As such, the total airfares paid by travelers are higher, however total airfares are expected to be highly correlated with base fares.

Figure 4 Quarterly average base economy class airfares paid for travel to New Zealand



Source: Sabre

4.2.2 New Zealand consumer price indexes

Rates of inflation from selected sub-groups of the New Zealand Consumer Price Index (CPI) were used to estimate changes in on-the-ground tourism prices in New Zealand. MBIE's Monthly Regional Tourism Estimates (MTRE) data[9] breaks down expenditure by international visitors into eight categories, which were matched to CPI categories as shown in Table 2.

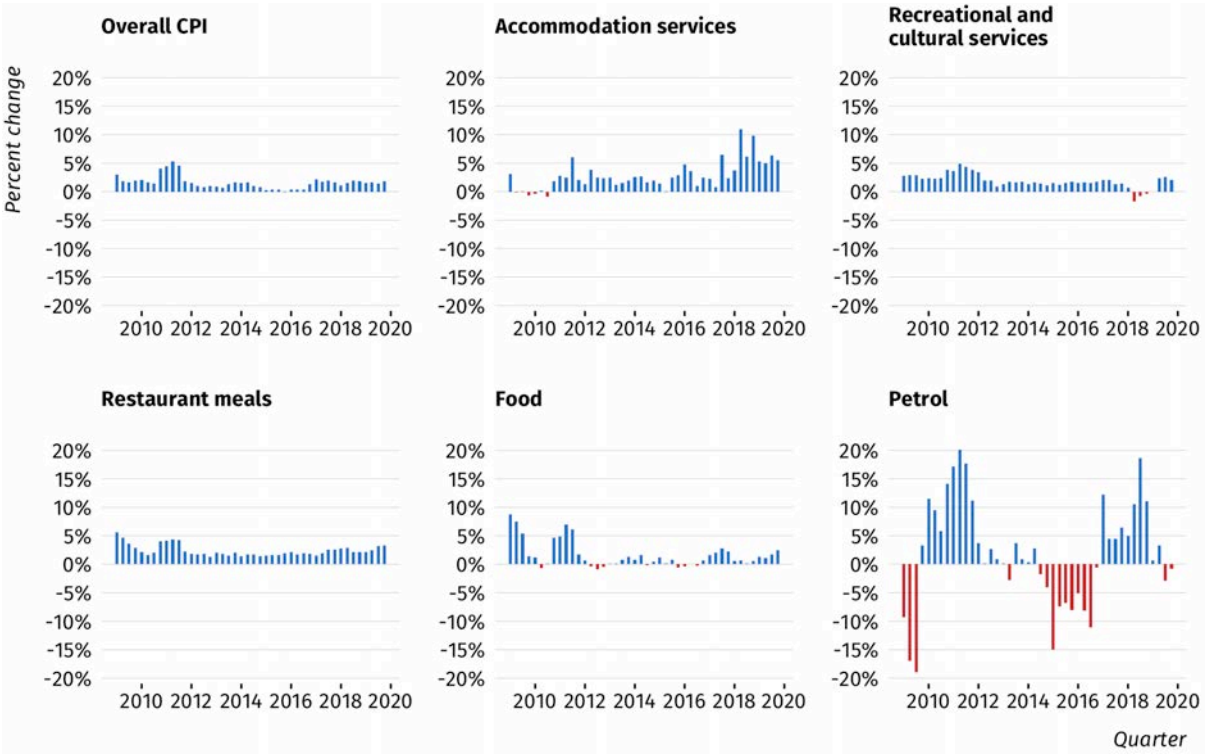
Table 2 Tourism expenditure and CPI categories used to create on-the-ground price indexes

Tourism expenditure category	CPI category
Accommodation services	Accommodation services
Cultural, recreation, and gambling services	Recreational and cultural services
Food and beverage serving services	Restaurant meals
Retail sales – alcohol, food, and beverages	Food
Retail sales – fuel and other automotive products	Petrol
Retail sales – other	Overall CPI
Other tourism products	Overall CPI

Figure 5 shows the year-on-year percentage changes in the selected New Zealand CPI categories used for this analysis. Most categories have seen prices increase almost continuously, although at varying rates. The exception is petrol, where prices have increased and decreased by relatively large percentages over time.

[9] https://www.mbie.govt.nz/immigration-and-tourism/tourism-research-and-data/tourism-data-releases/monthly-regional-tourism-estimates/

Figure 5 Year-on-year changes in selected New Zealand Consumer Price Index categories

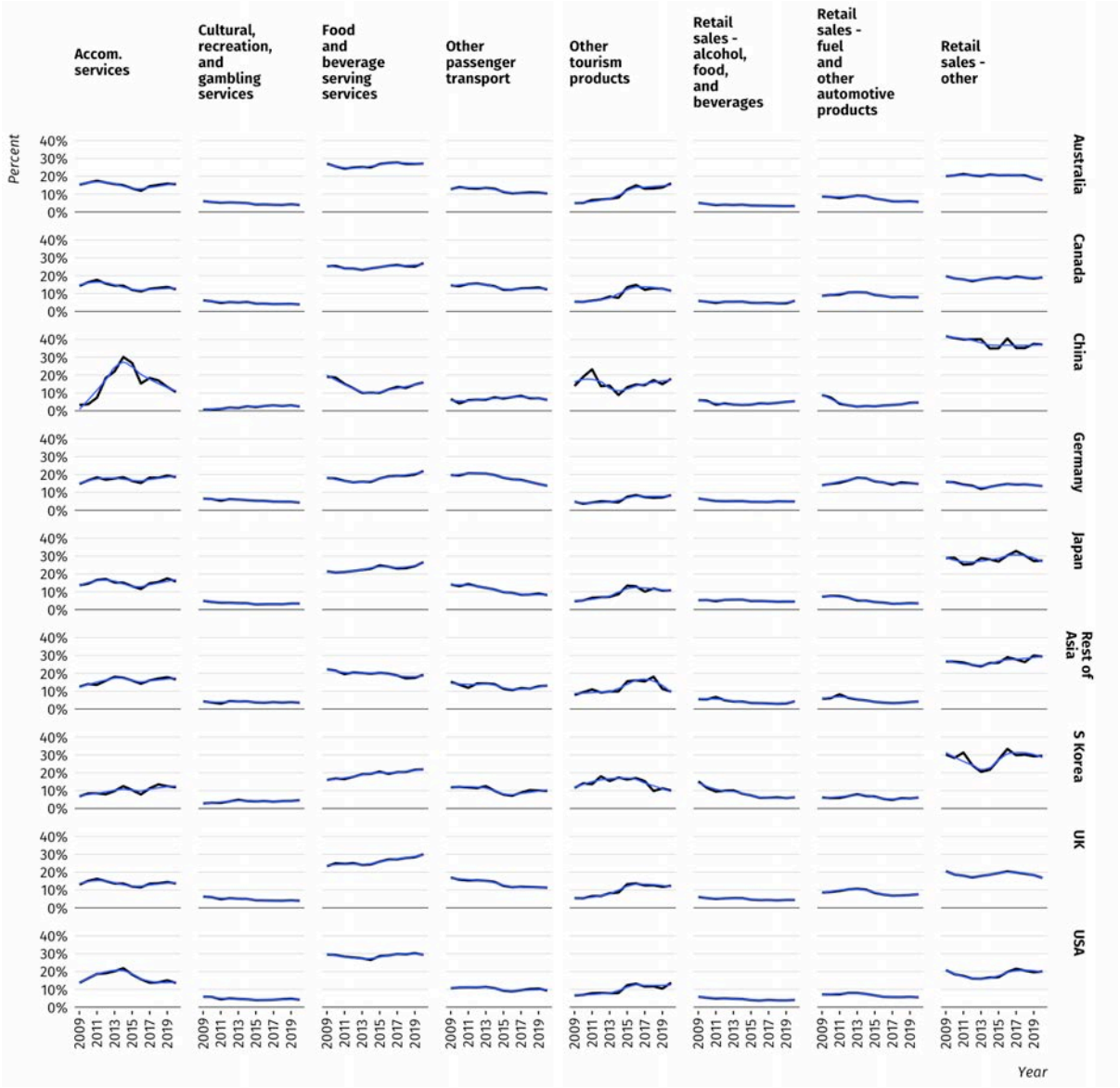


Source: Statistics New Zealand

For each origin country, a weighted average of the percentage changes in the above New Zealand CPI categories was calculated as an overall measure of changes in the on-the-ground price of visiting New Zealand, taking account of the purchasing patterns of visitors from that country. The weights were obtained from the MTRE data as shown in Figure 6 below.[10] The annual expenditure shares calculated from this data exhibit short-term fluctuations that are likely due to sampling variation rather than changes in underlying purchasing behaviour, hence the expenditure shares were smoothed before the weights were calculated. The resulting smoothed shares are shown as the blue lines in Figure 6. As the MTRE data does not provide expenditure estimates for visitors from Singapore and India, the figures for "Rest of Asia" were used instead.

[10] The MRTE expenditure data is not broken down by purpose of travel, so the on-the-ground price index is the same for all purpose for each origin country.

Figure 6 Annual expenditure shares used to calculate on-the-ground tourism price indexes



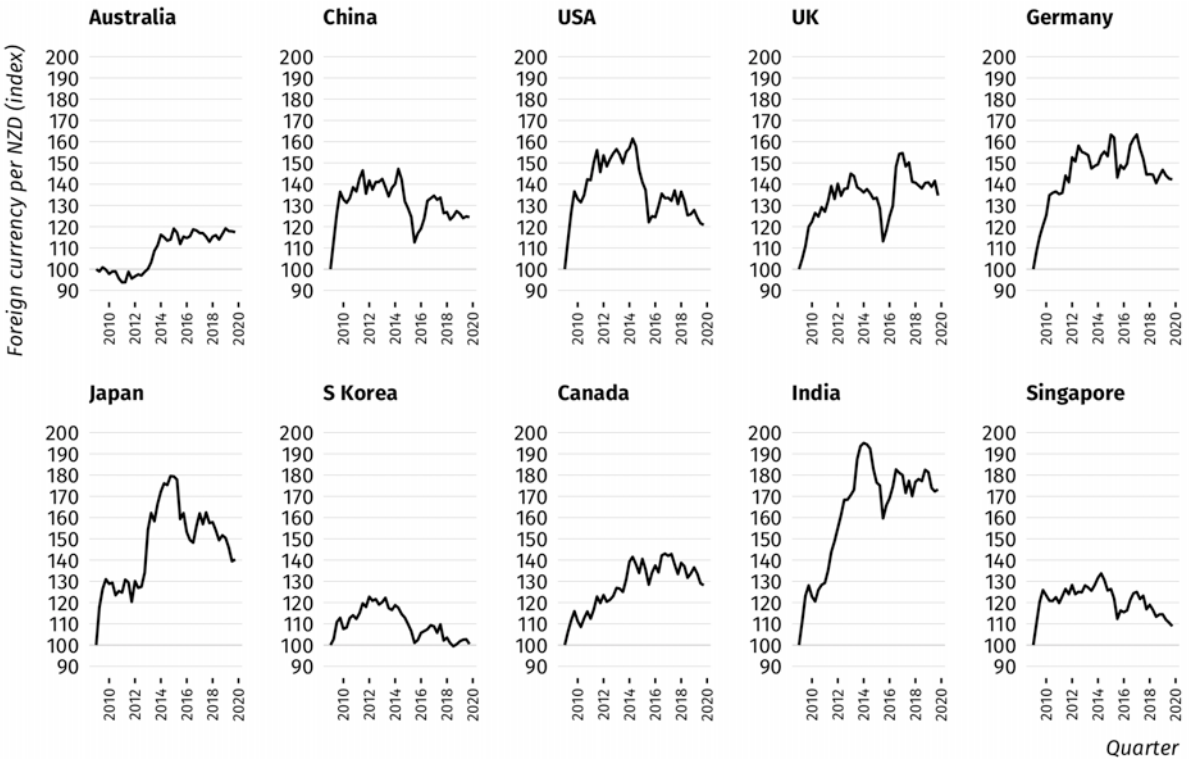
Source: MBIE Monthly Regional Tourism Estimates

4.2.3 Exchange rates and foreign inflation rates

Both the airfare and on-the-ground price indexes were converted into foreign currency terms by adjusting for relative changes in the exchange rate between the New Zealand dollar and the relevant foreign currency. Figure 7 shows the indexed values of the exchange rates used for these conversions. In general, the New Zealand dollar increased in value between 2009 and 2019, which has the effect of increasing the price of visiting New Zealand, everything else equal.

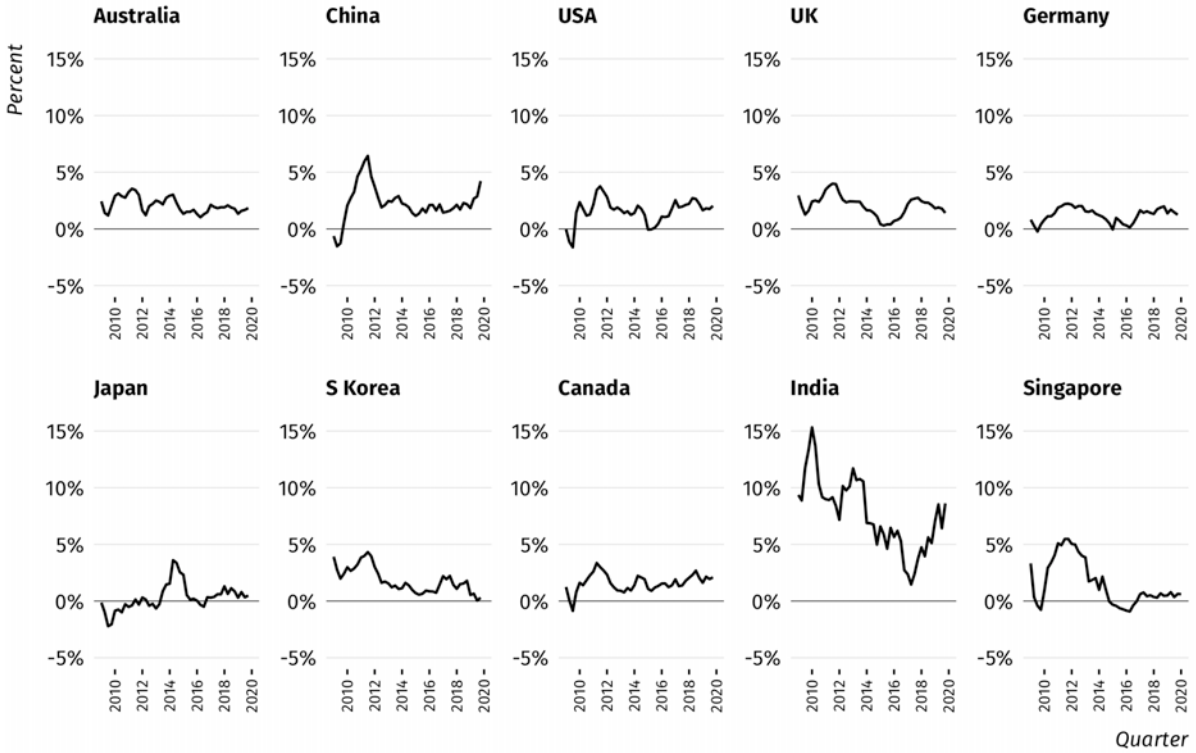
Both price indexes were also adjusted for the rate of consumer price inflation in each foreign country (Figure 8), to express the price of visiting New Zealand in relative (real) terms. Higher consumer price inflation in a foreign country has the effect of decreasing the relative price of visiting New Zealand, everything else equal.

Figure 7 Quarterly average exchange rate indexes (2009Q1 = 100)



Source: PACIFIC Exchange Rate Service

Figure 8 Quarterly year-on-year consumer price index inflation rates



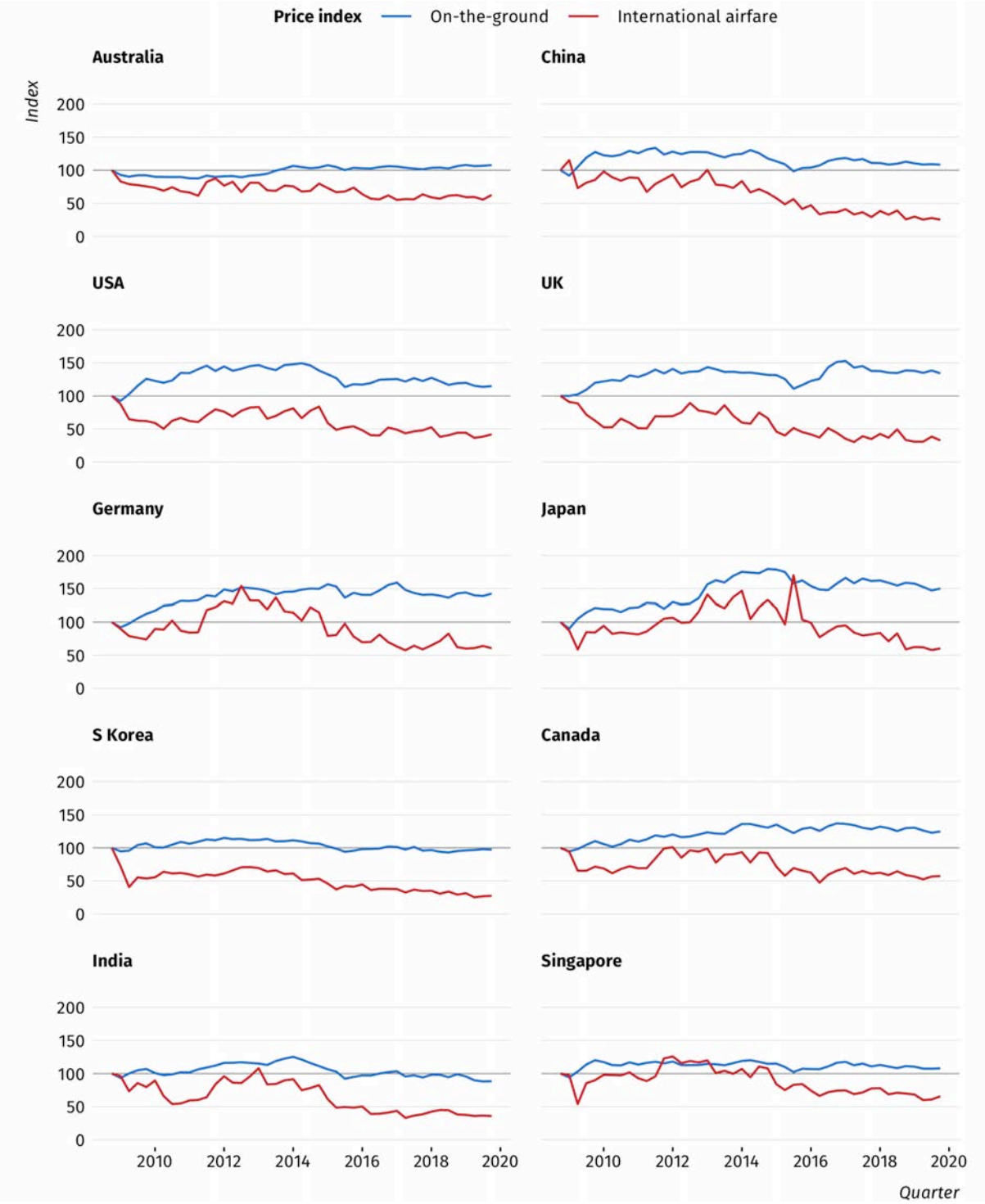
Source: OECD and Statistics Singapore

4.2.4 Calculated tourism price indexes

The combined data on airfares, on-the-ground prices in New Zealand, expenditure shares, exchange rates, and foreign inflation rates was used to calculate an on-the-ground and international airfare price index for each country of origin. The resulting on-the-ground and airfare price indexes are shown in Figure 9. This shows that between 2009 and 2019:

- For visitors from Australia, India, South Korea, and Singapore, the on-the-ground price of visiting New Zealand has remained relatively constant.
- For most other countries, the on-the-ground price has generally increased, with most of this increase occurring between 2009 and 2014. These changes were primarily driven by relatively large exchange rate changes following the Global Financial Crisis in 2008/09 (see Figure 7 above).
- In most cases the airfare price index decreased over time reflecting the strong reductions in nominal airfares shown in Figure 4 above.
- Over time, airfares show more variability that on-the-ground prices. This is due to the underlying variability in nominal airfares, compared to the relatively steady increase of prices within New Zealand.

Figure 9 Tourism price indexes for visiting New Zealand (2009Q1 = 100)



Source: Calculated

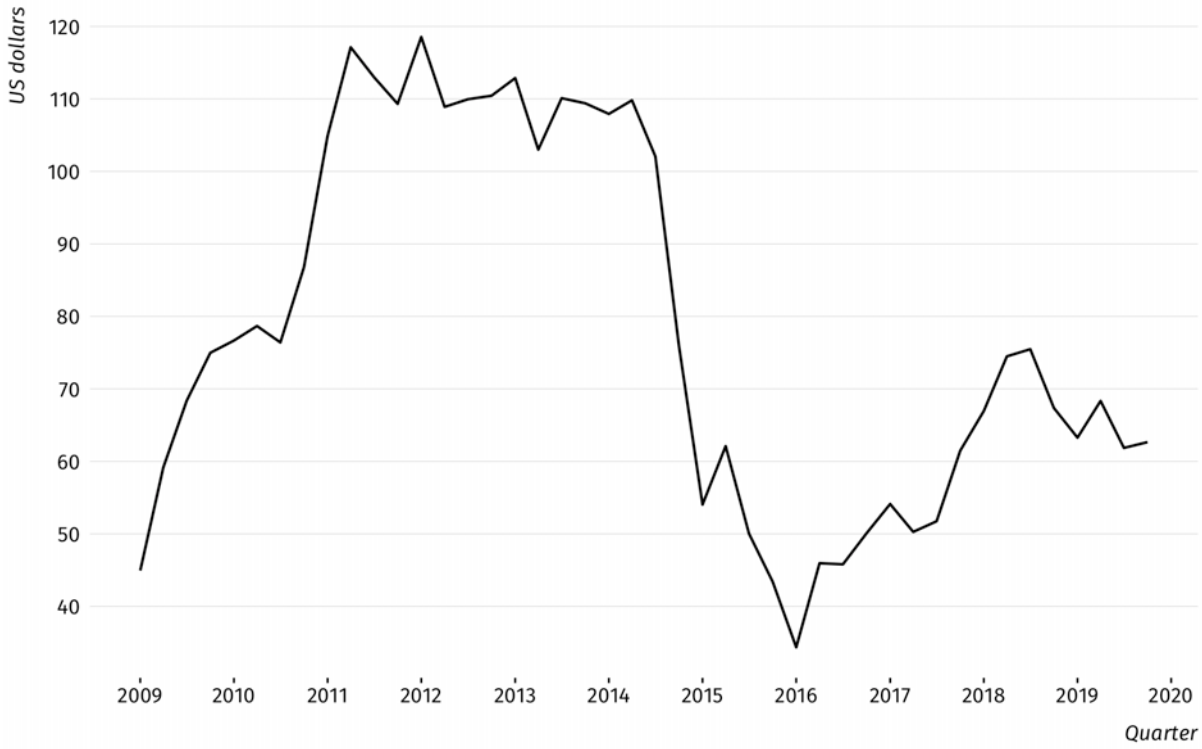
4.3 Instrumental variables for prices

As described in section 3, instrumental variables were used to correct for the endogeneity of the two price variables. The instruments described below were used in the first stage of the instrumental variables regression estimation.[11]

4.3.1 The international crude oil price

The quarterly average international oil price (Figure 10) was used as an instrument as it is expected to affect airfares and other transport-related costs and is independent of the number of visitor arrivals to New Zealand.

Figure 10 Quarterly average international crude oil price



Source: Federal Reserve Economic Data (FRED)

4.3.2 Air capacity on relevant routes

A measure of airline seat capacity was derived from Sabre data for each origin country. Air capacity is expected to affect airfares because once capacity is allocated on routes, airlines have an incentive to set airfares to maximise their revenue given the available capacity. Airlines typically allocate capacity to routes three to 12 months in advance, and thus capacity can be considered to be independent of the number of visitor arrivals. For some origin countries such as the UK and Germany, visitors to New Zealand have many alternative routes that they can use to travel to New Zealand. For such countries, available capacity was assumed to be the total capacity on all

[11] Due to software limitations, the same set of instrumental variables were used for both the airfare and on-the-ground price variables. In addition, as is standard practice in instrumental variables regressions, the other exogenous explanatory variables included in the models were also used as instruments.

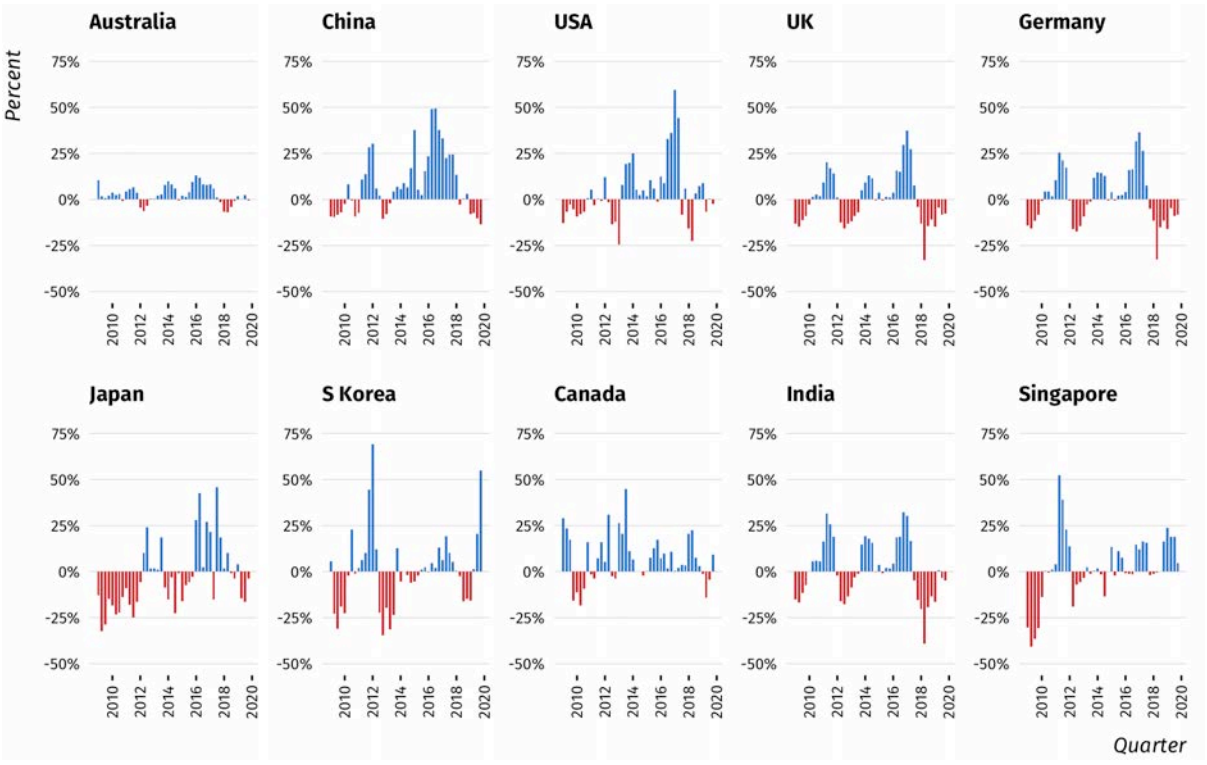
commonly used routes to New Zealand. For other countries with direct flights to New Zealand such as Australia, Japan, and Singapore, available capacity was assumed to be the capacity of the direct flights only, although in reality some travellers from these countries also arrive via indirect routes. The routes used to calculate capacity for each origin country are summarised in Table 3.

Table 3 Air routes used to calculate available air capacity

Origin country	Capacity based on routes to NZ from
Australia	Australia
China	Mainland China, Hong Kong
USA	USA
UK	UK, UAE, Qatar, Singapore, Hong Kong, Malaysia, Thailand
Germany	UAE, Qatar, Singapore, Hong Kong, Malaysia, Thailand
Japan	Japan
South Korea	South Korea
Canada	Canada
India	Singapore, Thailand, Malaysia, UAE
Singapore	Singapore

Air capacity for each origin country was measured as the total number of available seats on all relevant routes from the origin country to New Zealand in each quarter. Figure 11 shows the year-on-year percentage changes in these capacities between 2009 and 2019. Overall, capacity increased significantly on direct routes from China and the USA, and on indirect routes via the Middle East.

Figure 11 Year-on-year change in quarterly total seat capacity on relevant routes to New Zealand

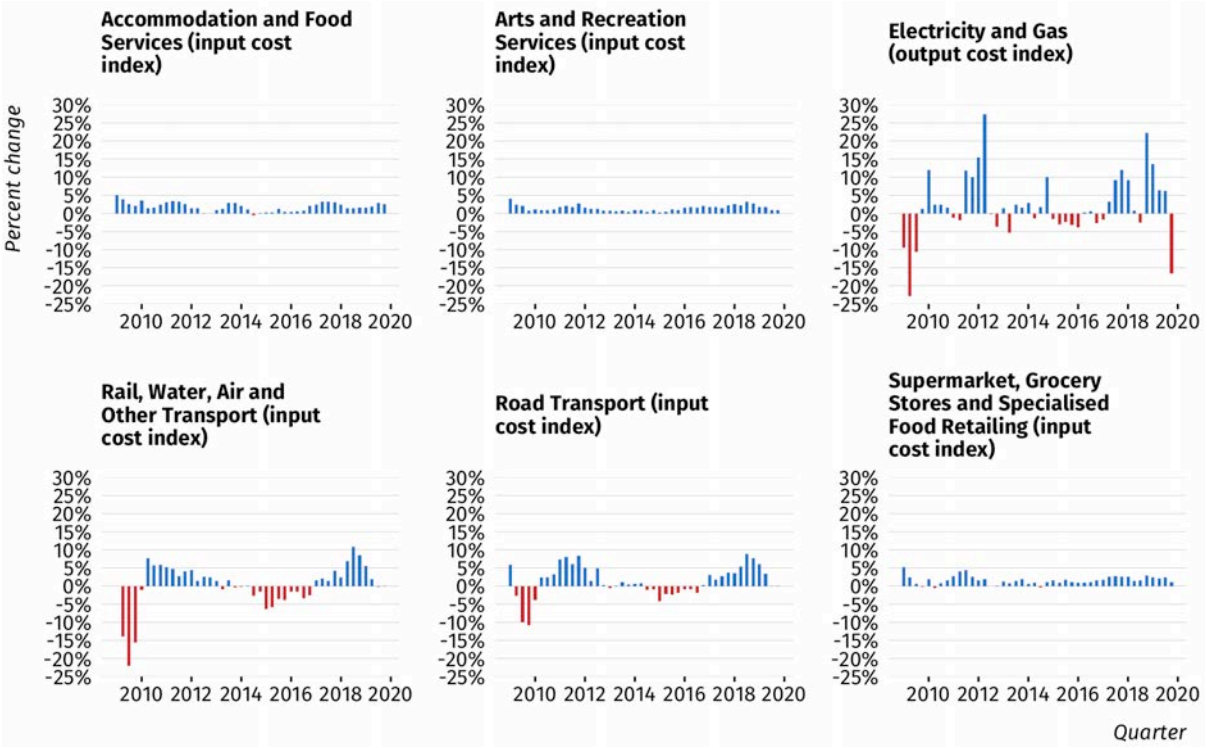


Source: Calculated from Sabre data

4.3.3 New Zealand cost indexes

Producer price input cost indexes from five selected tourism-related industries in New Zealand were used as instruments for tourism prices as these reflect changes in the costs of labour, capital, and other factors of production used by tourism businesses. In addition, the producer price output cost index for the electricity and gas industry as used as an instrument as energy costs are a general cost driver for most businesses (Figure 12).

Figure 12 Year-on-year changes in quarterly producer price cost indexes for selected industries



Source: Statistics New Zealand

4.3.4 Exchange rates and foreign inflation rates

The exchange rates and foreign inflation rates shown in Figure 7 and Figure 8 above were used as instruments for prices to capture the variation in the price indexes (expressed in relative foreign currency terms) that were driven by exchange rate changes and foreign inflation.

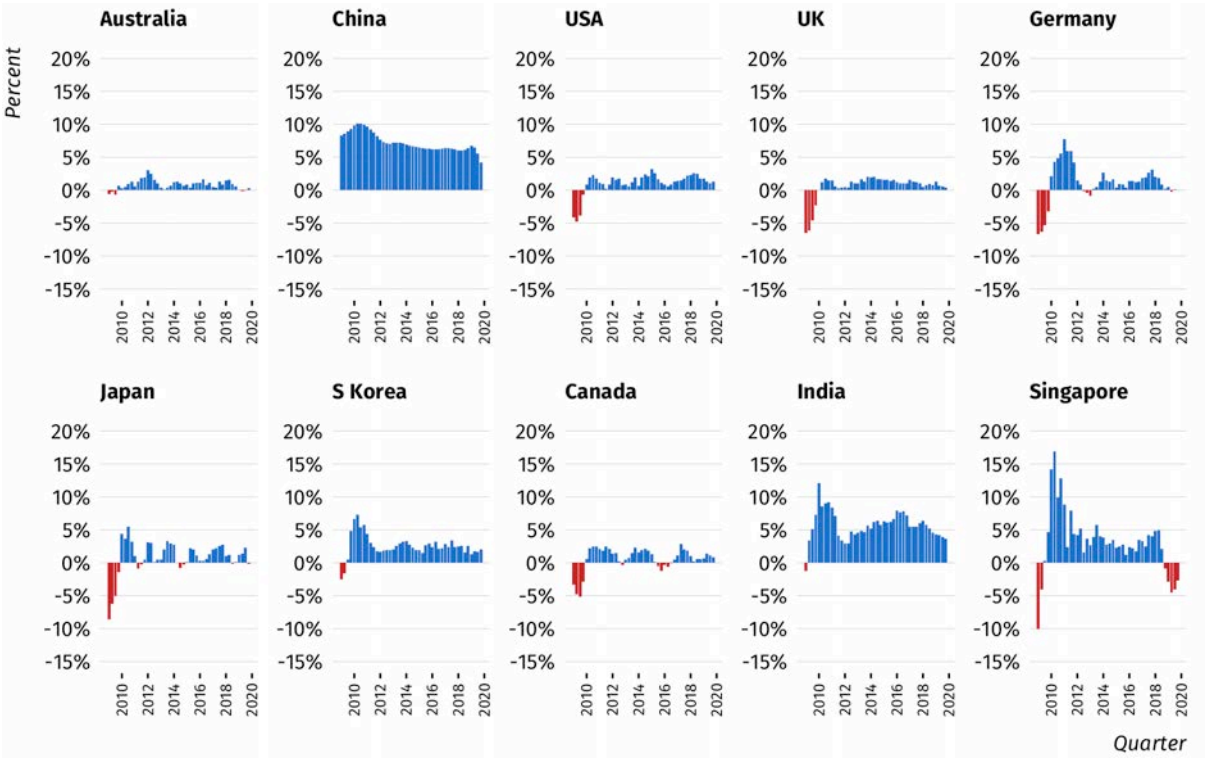
4.4 Other explanatory variables

The following variables (in addition to the instruments) were included as exogenous explanatory variables in the regression models to estimate price elasticities. These are variables that are expected to affect the number of visitor arrivals to New Zealand but that can be considered to be independent of the number of arrivals in each year.

4.4.1 Real GDP per capita in foreign countries

Real GDP per capita was included as a measure of general economic conditions in each of the origin countries (Figure 13).

Figure 13 Year-on-year change in real GDP per capita

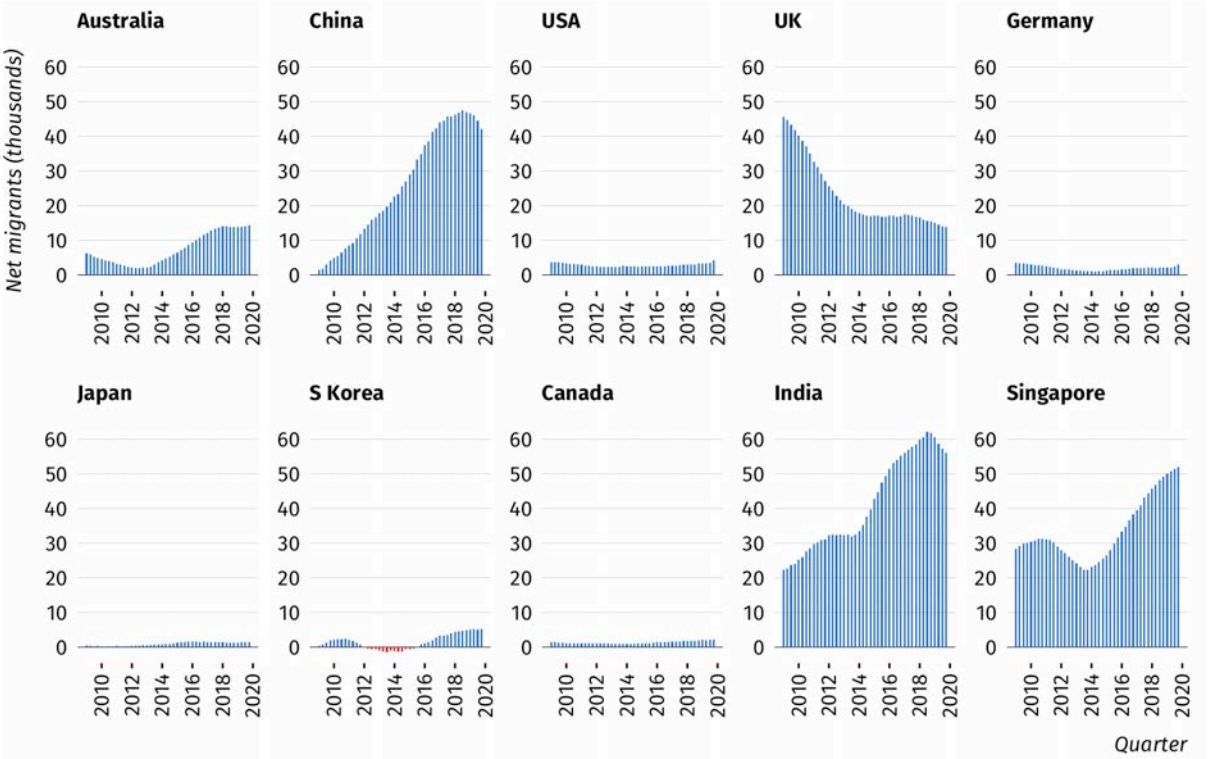


Source: OECD and Statistics Singapore

4.4.2 Net migration to New Zealand

Migration from each origin country to New Zealand is expected to have an effect on visitor arrivals, particularly for the VFR purpose. As a measure of the extent of migration and the size of the migrant population in New Zealand, the cumulative sum of net migration over the preceding five years from the relevant origin country was used as an explanatory variable (Figure 14).

Figure 14 Cumulative net migration to New Zealand over the preceding five years



Source: Calculated from Statistics New Zealand data

4.4.3 Seasonality and effects of holidays and special events

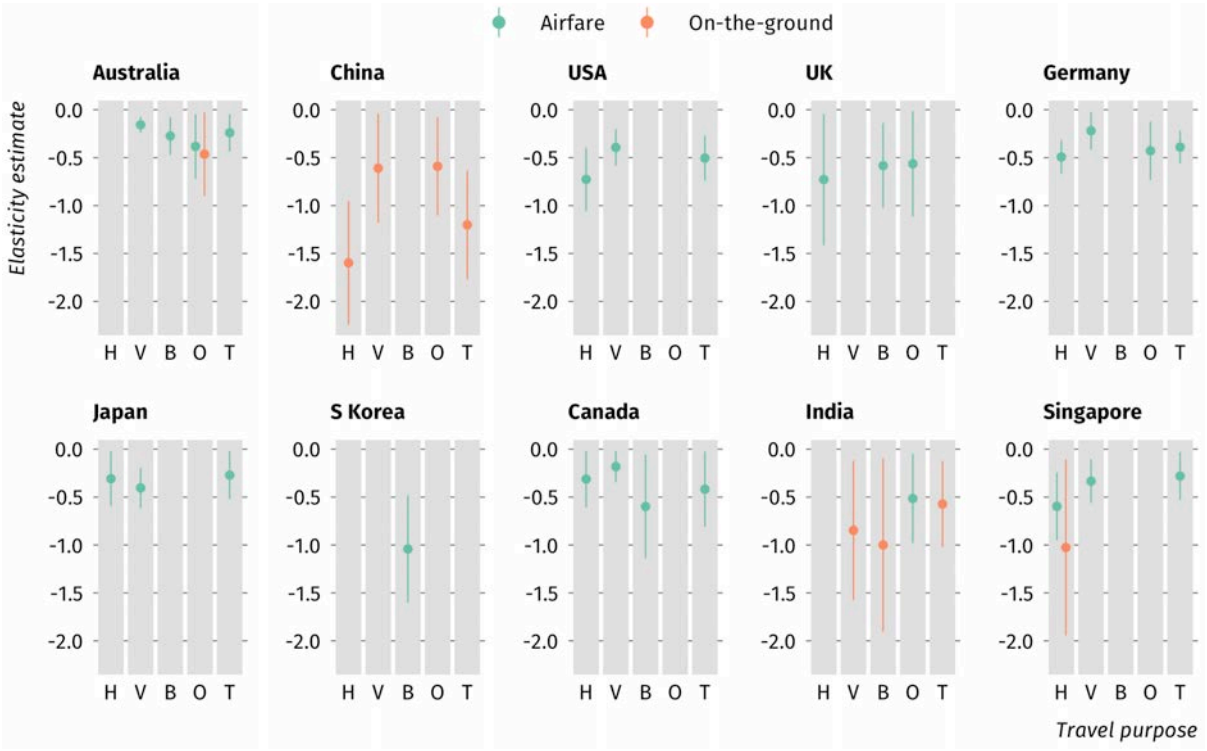
In order to capture the seasonal pattern of arrivals, quarterly dummy variables were included the regression models. A variable measuring the proportion of a two-week window around Easter Sunday was also included to capture the variation in arrivals in the first and second quarters that occurs due to the timing of Easter. Finally, a dummy variable for the third and fourth quarters of 2011 was included to capture the temporary effects of the 2011 Rugby World Cup on arrivals from certain countries such as Australia and the UK.

5 Results

5.1 Price elasticities

Figure 15 shows the estimated price elasticities that are statistically significant at the 10% level and the corresponding 90% confidence intervals. In most cases statistically significant elasticities were only found for the airfare price index and not for on-the-ground prices. This possibly reflects the greater variation in airfares compared to on-the-ground prices (see Figure 9 above), and could also reflect tourists being more sensitive to airfares than to on-the-ground prices when deciding whether to travel to New Zealand.

Figure 15 Estimated price elasticities by country of origin and purpose of travel



H = Holiday; V = VFR; B = Business; O = Other, T = Total

While the results presented are generally robust, they should be interpreted with the following caveats in mind:

- Due to the difficulty of isolating effects of prices from other factors that affect visitor arrivals, there is relatively high uncertainty associated with the estimated elasticities for some markets, namely China, the UK, South Korea, and India. Visitors from these markets could be significantly more or less price sensitive than implied by the estimated elasticity value. In addition, finding price elasticities that are statistically insignificant from zero does not mean that prices have no effect on visitor arrivals. An insignificant elasticity means that it was not possible to isolate price effects on arrivals after controlling for other variables in the model.
- The estimated elasticities may not fully reflect the responsiveness of visitor arrivals to any relatively large price changes (greater than 10%). In general, demand responds more strongly to larger price changes than smaller changes.

- The analysis undertaken in this report uses data from before the COVID-19 global pandemic and subsequent severe impacts on international travel including travel bans and quarantine requirements imposed by many countries including New Zealand. It is not yet clear if this will have permanent effects on the demand for travel to New Zealand, but it is possible that the pandemic could cause significant and long-lasting changes in the volumes, characteristics, and price sensitivity of international visitors to New Zealand.

A numerical summary of the estimated elasticities and their corresponding *p*-values and 90% confidence intervals is given in Table 4 on the next page. In all except five cases, the estimated elasticities were obtained from the IV model for the relevant combination of country and purpose. In all of those five cases where OLS results were used, the relevant Hausman tests give no significant evidence of endogeneity problems (see the diagnostic test results in section 5.2 below). As described in section 3.3 above, the results from the log-differences model are reported if possible, otherwise the log-levels model was used.

Overall, relatively few statistically significant elasticities were obtained, even when results from the alternative estimation methods were combined. This could indicate that visitors to New Zealand from some markets are relatively insensitive to prices for visiting New Zealand, particularly on-the-ground prices which are generally only experienced once the visitor has arrived in New Zealand. However, this result could also reflect the difficulty of using historic data to separate the effects of prices on visitor arrivals from the effects of other variables that have affected arrivals over time and is not conclusive evidence of the price-insensitivity of visitors.

The results are broadly consistent with earlier estimates of New Zealand visitor arrivals elasticities by Schiff and Becken (2011).[12] While that study used different definitions of visitor arrivals segments that were defined by travel style as well as travel purpose, it also found that arrivals from mature markets such as Australia, the UK, and USA were relatively insensitive to airfares or on-the-ground prices, while arrivals from South Korea and China were more price sensitive.

[12] A. Schiff & S. Becken (2011), Demand elasticity estimates for New Zealand tourism. *Tourism Management*, 32: 564-575.

Table 4 Summary of estimated elasticities that are significant at the 10% level

		On-the-ground price elasticity				Airfare price elasticity			
Country	**Purpose**	**Estimate**	**p-value**	**90% C.I.**	**Model**	**Estimate**	**p-value**	**90% C.I.**	**Model**
Australia	Holiday								
Australia	VFR					-0.16	0.00	-0.24 to -0.07	IV, log-levels
Australia	Business					-0.27	0.02	-0.47 to -0.08	IV, log-levels
Australia	Other	-0.46	0.08	-0.90 to -0.03	IV, log-levels	-0.38	0.06	-0.72 to -0.05	IV, log-levels
Australia	Total					-0.24	0.05	-0.44 to -0.05	IV, log-levels
China	Holiday	-1.60	0.00	-2.24 to -0.95	IV, log-differences				
China	VFR	-0.61	0.08	-1.18 to -0.04	IV, log-levels				
China	Business								
China	Other	-0.59	0.06	-1.10 to -0.08	IV, log-differences				
China	Total	-1.20	0.00	-1.77 to -0.63	IV, log-differences				
USA	Holiday					-0.73	0.00	-1.06 to -0.39	IV, log-levels
USA	VFR					-0.39	0.00	-0.58 to -0.20	IV, log-levels
USA	Business								
USA	Other								
USA	Total					-0.50	0.00	-0.74 to -0.27	IV, log-levels
UK	Holiday					-0.73	0.08	-1.41 to -0.04	IV, log-differences
UK	VFR								
UK	Business					-0.58	0.03	-1.03 to -0.14	IV, log-differences
UK	Other					-0.56	0.09	-1.11 to -0.01	IV, log-differences
UK	Total								
Germany	Holiday					-0.49	0.00	-0.67 to -0.31	IV, log-differences
Germany	VFR					-0.22	0.07	-0.41 to -0.02	OLS, log-levels
Germany	Business								
Germany	Other					-0.43	0.02	-0.73 to -0.12	IV, log-levels
Germany	Total					-0.39	0.00	-0.56 to -0.22	IV, log-differences
Japan	Holiday					-0.31	0.08	-0.59 to -0.02	IV, log-levels
Japan	VFR					-0.40	0.00	-0.62 to -0.19	IV, log-levels
Japan	Business								
Japan	Other								

Country	Purpose	On-the-ground price elasticity				Airfare price elasticity			
		Estimate	p-value	90% C.I.	Model	Estimate	p-value	90% C.I.	Model
Japan	Total					-0.27	0.08	-0.52 to -0.02	IV, log-levels
S Korea	Holiday								
S Korea	VFR								
S Korea	Business					-1.04	0.00	-1.60 to -0.48	IV, log-levels
S Korea	Other								
S Korea	Total								
Canada	Holiday					-0.31	0.08	-0.61 to -0.02	IV, log-levels
Canada	VFR					-0.18	0.07	-0.34 to -0.02	OLS, log-levels
Canada	Business					-0.60	0.07	-1.14 to -0.06	OLS, log-differences
Canada	Other								
Canada	Total					-0.42	0.08	-0.81 to -0.03	IV, log-differences
India	Holiday								
India	VFR	-0.85	0.06	-1.57 to -0.12	IV, log-levels				
India	Business	-1.00	0.07	-1.90 to -0.09	IV, log-differences				
India	Other					-0.52	0.07	-0.98 to -0.05	OLS, log-differences
India	Total	-0.57	0.04	-1.02 to -0.12	OLS, log-levels				
Singapore	Holiday	-1.03	0.07	-1.94 to -0.11	IV, log-levels	-0.60	0.01	-0.95 to -0.24	IV, log-differences
Singapore	VFR					-0.33	0.02	-0.56 to -0.11	IV, log-levels
Singapore	Business								
Singapore	Other								
Singapore	Total					-0.28	0.07	-0.53 to -0.03	IV, log-differences

5.2 Regression results and diagnostic tests

The tables on the following pages report estimated elasticity coefficients and diagnostic test results from the four models described in section 3.3.3.

- Elasticity *p*-values less than 0.10 are highlighted in green.
- The Durbin-Watson test results give evidence of residual autocorrelation in most models, which supports the use of HAC standard errors that correct for this.
- With a few exceptions, there is little evidence of weak instruments for either of the price variables.
- The Hausman tests for the IV models give evidence of endogeneity of prices in some models, however not in any of the five cases where the OLS models were used to obtain estimated elasticities.

Table 5 IV log-differences models: Estimated elasticities and diagnostics

		On-the-ground price index			Airfare price index			Diagnostics					
Country	Purpose	Elasticity	p-value	90% C.I.	Elasticity	p-value	90% C.I.	R-squared	D.W. stat	D.W. p-value	OTG price weak instruments p-value	Airfare price weak instruments p-value	Hausman p-value
Australia	Holiday	0.11	0.71	-0.38 to 0.60	-0.02	0.91	-0.35 to 0.31	0.35	1.63	0.07	0.00	0.00	0.22
Australia	VFR	-0.08	0.58	-0.31 to 0.16	-0.02	0.77	-0.16 to 0.11	0.60	1.95	0.31	0.00	0.00	0.60
Australia	Business	-0.15	0.35	-0.42 to 0.12	-0.02	0.89	-0.27 to 0.22	0.45	1.88	0.24	0.00	0.00	0.68
Australia	Other	-0.04	0.91	-0.69 to 0.60	0.00	0.99	-0.40 to 0.40	0.18	1.17	0.00	0.00	0.00	0.97
Australia	Total	-0.03	0.86	-0.28 to 0.23	-0.01	0.95	-0.17 to 0.16	0.37	1.72	0.12	0.00	0.00	0.40
China	Holiday	-1.60	0.00	-2.24 to -0.95	0.14	0.51	-0.21 to 0.48	0.59	1.75	0.13	0.00	0.00	0.18
China	VFR	0.05	0.86	-0.39 to 0.48	-0.06	0.69	-0.29 to 0.18	0.16	0.89	0.00	0.00	0.00	0.86
China	Business	-0.17	0.72	-0.97 to 0.63	-0.31	0.33	-0.84 to 0.22	0.07	0.69	0.00	0.00	0.00	0.03
China	Other	-0.59	0.06	-1.10 to -0.08	-0.32	0.15	-0.69 to 0.04	0.21	1.31	0.01	0.00	0.00	0.45
China	Total	-1.20	0.00	-1.77 to -0.63	0.04	0.81	-0.26 to 0.35	0.54	1.48	0.02	0.00	0.00	0.26
USA	Holiday	-0.05	0.91	-0.78 to 0.68	-0.38	0.15	-0.81 to 0.06	0.22	1.25	0.00	0.00	0.02	0.14
USA	VFR	-0.15	0.49	-0.53 to 0.22	-0.13	0.40	-0.40 to 0.14	0.22	1.65	0.07	0.00	0.02	0.73
USA	Business	0.03	0.91	-0.37 to 0.43	-0.06	0.70	-0.32 to 0.20	0.10	2.17	0.56	0.00	0.02	0.87
USA	Other	0.06	0.87	-0.52 to 0.64	-0.08	0.73	-0.48 to 0.32	0.03	1.47	0.02	0.00	0.02	0.40
USA	Total	-0.05	0.86	-0.55 to 0.44	-0.24	0.17	-0.54 to 0.05	0.21	1.20	0.00	0.00	0.02	0.25
UK	Holiday	0.42	0.35	-0.33 to 1.17	-0.73	0.08	-1.41 to -0.04	0.37	2.03	0.37	0.00	0.05	0.06
UK	VFR	0.21	0.27	-0.11 to 0.53	0.07	0.55	-0.13 to 0.28	0.27	2.12	0.47	0.00	0.05	0.14
UK	Business	-0.03	0.92	-0.49 to 0.44	-0.58	0.03	-1.03 to -0.14	0.09	1.99	0.33	0.00	0.05	0.01
UK	Other	0.04	0.91	-0.62 to 0.71	-0.56	0.09	-1.11 to -0.01	0.31	1.81	0.16	0.00	0.05	0.62
UK	Total	0.28	0.34	-0.21 to 0.76	-0.36	0.14	-0.76 to 0.04	0.38	2.00	0.34	0.00	0.05	0.10
Germany	Holiday	0.00	1.00	-0.41 to 0.42	-0.49	0.00	-0.67 to -0.31	0.28	1.68	0.08	0.00	0.00	0.15
Germany	VFR	-0.04	0.91	-0.68 to 0.59	-0.31	0.15	-0.67 to 0.05	0.07	2.31	0.69	0.00	0.00	0.34
Germany	Business	0.65	0.09	0.03 to 1.27	0.06	0.82	-0.39 to 0.52	0.14	2.04	0.38	0.00	0.00	0.61
Germany	Other	0.09	0.80	-0.51 to 0.68	-0.42	0.18	-0.93 to 0.09	0.25	1.64	0.06	0.00	0.00	0.90
Germany	Total	0.02	0.93	-0.33 to 0.37	-0.39	0.00	-0.56 to -0.22	0.28	1.29	0.00	0.00	0.00	0.17
Japan	Holiday	-0.45	0.17	-0.99 to 0.09	0.07	0.77	-0.31 to 0.45	0.33	1.39	0.02	0.00	0.08	0.83
Japan	VFR	0.20	0.48	-0.28 to 0.69	-0.20	0.38	-0.58 to 0.18	-0.03	1.47	0.04	0.00	0.08	0.23

Country	Purpose	On-the-ground price index			Airfare price index			Diagnostics					
		Elasticity	p-value	90% C.I.	Elasticity	p-value	90% C.I.	R-squared	D.W. stat	D.W. p-value	OTG price weak instruments p-value	Airfare price weak instruments p-value	Hausman p-value
Japan	Business	-0.03	0.95	-0.81 to 0.75	-0.08	0.82	-0.68 to 0.52	0.31	1.91	0.34	0.00	0.08	0.67
Japan	Other	1.21	0.00	0.64 to 1.78	-0.15	0.59	-0.63 to 0.32	0.46	2.45	0.89	0.00	0.08	0.34
Japan	Total	-0.13	0.61	-0.55 to 0.29	0.01	0.97	-0.28 to 0.30	0.34	1.33	0.01	0.00	0.08	0.72
S Korea	Holiday	-0.68	0.47	-2.28 to 0.92	0.15	0.53	-0.25 to 0.54	0.37	1.40	0.02	0.00	0.00	0.74
S Korea	VFR	-0.80	0.30	-2.08 to 0.49	-0.10	0.70	-0.52 to 0.32	0.33	1.59	0.06	0.00	0.00	0.92
S Korea	Business	0.78	0.31	-0.50 to 2.07	-0.65	0.19	-1.48 to 0.17	0.16	1.77	0.17	0.00	0.00	0.10
S Korea	Other	-0.70	0.57	-2.78 to 1.38	-0.43	0.26	-1.07 to 0.20	0.09	1.47	0.03	0.00	0.00	0.52
S Korea	Total	-0.64	0.45	-2.05 to 0.77	-0.01	0.96	-0.37 to 0.35	0.35	1.24	0.00	0.00	0.00	0.57
Canada	Holiday	0.86	0.15	-0.14 to 1.85	-0.56	0.14	-1.18 to 0.06	0.24	1.80	0.16	0.00	0.04	0.57
Canada	VFR	0.79	0.09	0.03 to 1.56	-0.29	0.13	-0.60 to 0.02	0.31	2.12	0.50	0.00	0.04	0.70
Canada	Business	0.51	0.52	-0.83 to 1.84	-0.21	0.47	-0.69 to 0.28	0.15	2.62	0.94	0.00	0.04	0.37
Canada	Other	-1.51	0.21	-3.53 to 0.50	-0.37	0.46	-1.20 to 0.46	0.13	2.41	0.81	0.00	0.04	0.03
Canada	Total	0.61	0.11	-0.02 to 1.24	-0.42	0.08	-0.81 to -0.03	0.38	2.15	0.53	0.00	0.04	0.54
India	Holiday	-0.32	0.51	-1.14 to 0.50	0.41	0.07	0.04 to 0.77	0.49	2.22	0.60	0.00	0.00	0.74
India	VFR	-0.68	0.23	-1.63 to 0.27	0.31	0.21	-0.10 to 0.72	0.23	1.16	0.00	0.00	0.00	0.64
India	Business	-1.00	0.07	-1.90 to -0.09	0.09	0.71	-0.31 to 0.48	0.38	2.30	0.69	0.00	0.00	0.20
India	Other	1.01	0.13	-0.10 to 2.12	-0.52	0.11	-1.07 to 0.02	0.23	1.79	0.16	0.00	0.00	0.94
India	Total	-0.35	0.28	-0.89 to 0.19	0.18	0.17	-0.04 to 0.39	0.49	1.47	0.02	0.00	0.00	0.76
Singapore	Holiday	-0.09	0.82	-0.76 to 0.58	-0.60	0.01	-0.95 to -0.24	0.55	1.78	0.15	0.00	0.00	0.32
Singapore	VFR	-0.09	0.81	-0.70 to 0.53	-0.33	0.16	-0.72 to 0.06	0.15	2.35	0.75	0.00	0.00	0.59
Singapore	Business	0.39	0.09	0.01 to 0.77	0.22	0.09	0.00 to 0.44	0.28	1.56	0.04	0.00	0.00	0.12
Singapore	Other	3.39	0.00	1.83 to 4.94	0.52	0.14	-0.06 to 1.10	0.37	1.62	0.06	0.00	0.00	0.27
Singapore	Total	0.29	0.26	-0.14 to 0.73	-0.28	0.07	-0.53 to -0.03	0.46	1.58	0.05	0.00	0.00	0.58

Table 6 IV log-levels models: Estimated elasticities and diagnostics

		On-the-ground price index			Airfare price index			Diagnostics					
Country	**Purpose**	**Elasticity**	**p-value**	**90% C.I.**	**Elasticity**	**p-value**	**90% C.I.**	**R-squared**	**D.W. stat**	**D.W. p-value**	**OTG price weak instruments p-value**	**Airfare price weak instruments p-value**	**Hausman p-value**
Australia	Holiday	0.37	0.12	-0.02 to 0.77	-0.31	0.23	-0.73 to 0.12	0.95	1.47	0.02	0.00	0.00	0.09
Australia	VFR	0.20	0.12	-0.01 to 0.42	-0.16	0.00	-0.24 to -0.07	0.99	1.43	0.01	0.00	0.00	0.56
Australia	Business	0.06	0.72	-0.22 to 0.33	-0.27	0.02	-0.47 to -0.08	0.91	1.38	0.01	0.00	0.00	0.88
Australia	Other	-0.46	0.08	-0.90 to -0.03	-0.38	0.06	-0.72 to -0.05	0.85	0.85	0.00	0.00	0.00	0.96
Australia	Total	0.21	0.15	-0.03 to 0.44	-0.24	0.05	-0.44 to -0.05	0.98	1.51	0.02	0.00	0.00	0.09
China	Holiday	-1.82	0.00	-2.52 to -1.13	0.15	0.48	-0.21 to 0.50	0.97	2.03	0.36	0.00	0.00	0.18
China	VFR	-0.61	0.08	-1.18 to -0.04	-0.18	0.39	-0.51 to 0.16	0.97	0.77	0.00	0.00	0.00	1.00
China	Business	-0.13	0.77	-0.90 to 0.64	-0.15	0.65	-0.73 to 0.42	0.67	0.79	0.00	0.00	0.00	0.01
China	Other	-1.28	0.00	-1.89 to -0.67	-0.01	0.93	-0.27 to 0.24	0.96	1.96	0.28	0.00	0.00	0.24
China	Total	-1.47	0.00	-2.11 to -0.82	0.02	0.89	-0.22 to 0.26	0.97	1.81	0.15	0.00	0.00	0.14
USA	Holiday	-0.08	0.84	-0.78 to 0.61	-0.73	0.00	-1.06 to -0.39	0.96	1.47	0.01	0.00	0.00	0.01
USA	VFR	-0.08	0.73	-0.44 to 0.29	-0.39	0.00	-0.58 to -0.20	0.95	1.58	0.03	0.00	0.00	0.15
USA	Business	0.13	0.35	-0.11 to 0.38	0.00	0.96	-0.16 to 0.15	0.91	2.17	0.53	0.00	0.00	0.54
USA	Other	-0.13	0.60	-0.53 to 0.27	-0.25	0.18	-0.55 to 0.06	0.89	1.88	0.19	0.00	0.00	0.16
USA	Total	-0.06	0.85	-0.54 to 0.43	-0.50	0.00	-0.74 to -0.27	0.96	1.44	0.01	0.00	0.00	0.02
UK	Holiday	-0.09	0.86	-0.93 to 0.75	-0.75	0.05	-1.37 to -0.13	0.94	1.90	0.22	0.00	0.24	0.00
UK	VFR	0.14	0.33	-0.10 to 0.38	0.00	0.97	-0.18 to 0.19	0.99	1.90	0.22	0.00	0.24	0.24
UK	Business	0.07	0.80	-0.37 to 0.50	-0.03	0.91	-0.48 to 0.42	0.78	1.76	0.11	0.00	0.24	0.78
UK	Other	-0.11	0.76	-0.70 to 0.49	-0.34	0.22	-0.80 to 0.12	0.77	1.88	0.20	0.00	0.24	0.06
UK	Total	0.02	0.93	-0.43 to 0.48	-0.32	0.14	-0.68 to 0.04	0.98	1.89	0.21	0.00	0.24	0.01
Germany	Holiday	-0.04	0.91	-0.63 to 0.55	-0.81	0.00	-1.06 to -0.57	0.99	1.73	0.09	0.00	0.00	0.00
Germany	VFR	0.11	0.73	-0.45 to 0.67	-0.22	0.14	-0.47 to 0.02	0.97	2.29	0.67	0.00	0.00	0.56
Germany	Business	0.22	0.55	-0.40 to 0.83	0.03	0.85	-0.25 to 0.32	0.69	1.90	0.21	0.00	0.00	0.62
Germany	Other	0.32	0.39	-0.30 to 0.94	-0.43	0.02	-0.73 to -0.12	0.93	1.92	0.23	0.00	0.00	0.77
Germany	Total	0.07	0.83	-0.46 to 0.59	-0.63	0.00	-0.83 to -0.42	0.99	1.74	0.10	0.00	0.00	0.03
Japan	Holiday	-0.19	0.61	-0.82 to 0.44	-0.31	0.08	-0.59 to -0.02	0.87	1.16	0.00	0.00	0.00	0.22
Japan	VFR	0.45	0.12	-0.02 to 0.93	-0.40	0.00	-0.62 to -0.19	0.89	1.86	0.21	0.00	0.00	0.00

Country	Purpose	On-the-ground price index			Airfare price index			Diagnostics					
		Elasticity	p-value	90% C.I.	Elasticity	p-value	90% C.I.	R-squared	D.W. stat	D.W. p-value	OTG price weak instruments p-value	Airfare price weak instruments p-value	Hausman p-value
Japan	Business	-0.37	0.51	-1.33 to 0.58	-0.03	0.89	-0.47 to 0.40	0.72	1.71	0.10	0.00	0.00	0.58
Japan	Other	1.02	0.03	0.26 to 1.77	-0.14	0.51	-0.48 to 0.21	0.96	2.18	0.59	0.00	0.00	0.65
Japan	Total	0.03	0.94	-0.53 to 0.58	-0.27	0.08	-0.52 to -0.02	0.91	1.18	0.00	0.00	0.00	0.12
S Korea	Holiday	-0.34	0.74	-2.05 to 1.38	-0.17	0.69	-0.90 to 0.56	0.90	1.35	0.01	0.00	0.00	0.25
S Korea	VFR	-0.72	0.49	-2.50 to 1.05	-0.29	0.50	-0.99 to 0.42	0.77	1.77	0.15	0.00	0.00	0.35
S Korea	Business	1.46	0.09	0.04 to 2.89	-1.04	0.00	-1.60 to -0.48	0.72	1.73	0.12	0.00	0.00	0.05
S Korea	Other	-0.98	0.34	-2.69 to 0.73	-0.38	0.38	-1.10 to 0.34	0.81	1.71	0.10	0.00	0.00	0.32
S Korea	Total	-0.40	0.69	-2.06 to 1.27	-0.30	0.48	-1.02 to 0.42	0.89	1.40	0.01	0.00	0.00	0.15
Canada	Holiday	0.72	0.11	-0.03 to 1.48	-0.31	0.08	-0.61 to -0.02	0.98	2.15	0.52	0.00	0.00	0.60
Canada	VFR	0.51	0.08	0.03 to 1.00	-0.19	0.15	-0.41 to 0.03	0.98	1.79	0.13	0.00	0.00	0.77
Canada	Business	0.18	0.75	-0.77 to 1.13	0.05	0.78	-0.25 to 0.35	0.73	2.53	0.89	0.00	0.00	0.26
Canada	Other	-1.04	0.12	-2.14 to 0.07	-0.36	0.16	-0.78 to 0.06	0.77	2.40	0.80	0.00	0.00	0.46
Canada	Total	0.48	0.08	0.04 to 0.93	-0.23	0.06	-0.44 to -0.03	0.99	2.42	0.82	0.00	0.00	0.79
India	Holiday	-0.10	0.84	-0.94 to 0.74	-0.13	0.57	-0.51 to 0.25	0.95	1.96	0.28	0.00	0.00	0.92
India	VFR	-0.85	0.06	-1.57 to -0.12	0.06	0.81	-0.33 to 0.44	0.95	1.27	0.00	0.00	0.00	0.31
India	Business	-1.51	0.02	-2.53 to -0.49	-0.13	0.63	-0.58 to 0.32	0.68	2.34	0.74	0.00	0.00	0.94
India	Other	-0.17	0.72	-0.98 to 0.63	-0.13	0.52	-0.46 to 0.20	0.87	1.87	0.19	0.00	0.00	0.41
India	Total	-0.50	0.12	-1.02 to 0.03	-0.09	0.62	-0.38 to 0.20	0.97	1.29	0.00	0.00	0.00	0.74
Singapore	Holiday	-1.03	0.07	-1.94 to -0.11	-0.58	0.00	-0.88 to -0.28	0.98	1.58	0.04	0.00	0.00	0.59
Singapore	VFR	0.16	0.58	-0.33 to 0.66	-0.33	0.02	-0.56 to -0.11	0.95	2.33	0.74	0.00	0.00	0.25
Singapore	Business	0.17	0.72	-0.63 to 0.97	-0.10	0.51	-0.35 to 0.15	0.77	1.19	0.00	0.00	0.00	0.00
Singapore	Other	1.86	0.14	-0.22 to 3.93	0.17	0.59	-0.35 to 0.68	0.53	1.67	0.07	0.00	0.00	0.43
Singapore	Total	-0.43	0.28	-1.09 to 0.23	-0.39	0.00	-0.58 to -0.20	0.98	1.56	0.04	0.00	0.00	0.49

Table 7 OLS log-differences models: Estimated elasticities and diagnostics

		On-the-ground price index			Airfare price index			Diagnostics		
Country	**Purpose**	**Elasticity**	**p-value**	**90% C.I.**	**Elasticity**	**p-value**	**90% C.I.**	**R-squared**	**D.W. stat**	**D.W. p-value**
Australia	Holiday	-0.01	0.98	-0.45 to 0.44	0.04	0.71	-0.16 to 0.25	0.36	1.63	0.07
Australia	VFR	-0.09	0.48	-0.30 to 0.12	-0.04	0.56	-0.14 to 0.07	0.60	1.95	0.31
Australia	Business	-0.11	0.48	-0.35 to 0.14	-0.07	0.53	-0.25 to 0.11	0.45	1.88	0.24
Australia	Other	-0.01	0.97	-0.61 to 0.58	-0.03	0.90	-0.40 to 0.35	0.18	1.17	0.00
Australia	Total	-0.06	0.64	-0.30 to 0.17	0.00	0.94	-0.09 to 0.10	0.37	1.72	0.12
China	Holiday	-1.64	0.00	-2.29 to -0.99	0.25	0.15	-0.04 to 0.54	0.59	1.75	0.13
China	VFR	0.05	0.85	-0.41 to 0.51	-0.11	0.29	-0.28 to 0.06	0.16	0.89	0.00
China	Business	-0.23	0.67	-1.15 to 0.69	0.17	0.45	-0.21 to 0.56	0.18	0.69	0.00
China	Other	-0.60	0.06	-1.11 to -0.09	-0.16	0.37	-0.45 to 0.14	0.23	1.31	0.01
China	Total	-1.23	0.00	-1.80 to -0.67	0.15	0.30	-0.09 to 0.40	0.55	1.48	0.02
USA	Holiday	-0.19	0.53	-0.71 to 0.32	-0.16	0.38	-0.46 to 0.15	0.27	1.25	0.00
USA	VFR	-0.19	0.33	-0.51 to 0.14	-0.09	0.47	-0.30 to 0.12	0.22	1.65	0.07
USA	Business	0.06	0.79	-0.29 to 0.40	-0.10	0.41	-0.30 to 0.10	0.10	2.17	0.56
USA	Other	0.00	0.99	-0.46 to 0.46	0.05	0.77	-0.25 to 0.36	0.05	1.47	0.02
USA	Total	-0.15	0.48	-0.49 to 0.20	-0.10	0.43	-0.31 to 0.11	0.26	1.20	0.00
UK	Holiday	0.48	0.25	-0.22 to 1.18	-0.30	0.24	-0.73 to 0.12	0.43	2.03	0.37
UK	VFR	0.18	0.34	-0.13 to 0.49	0.00	0.99	-0.22 to 0.23	0.28	2.12	0.47
UK	Business	0.03	0.88	-0.36 to 0.43	-0.24	0.18	-0.53 to 0.06	0.25	1.99	0.33
UK	Other	0.08	0.84	-0.55 to 0.70	-0.37	0.11	-0.76 to 0.01	0.33	1.81	0.16
UK	Total	0.30	0.28	-0.16 to 0.76	-0.17	0.33	-0.46 to 0.12	0.42	2.00	0.34
Germany	Holiday	-0.08	0.77	-0.51 to 0.35	-0.33	0.00	-0.49 to -0.17	0.33	1.68	0.08
Germany	VFR	-0.08	0.83	-0.72 to 0.56	-0.15	0.44	-0.49 to 0.18	0.08	2.31	0.69
Germany	Business	0.59	0.11	-0.01 to 1.20	0.12	0.59	-0.25 to 0.49	0.14	2.04	0.38
Germany	Other	0.07	0.82	-0.48 to 0.63	-0.41	0.06	-0.77 to -0.06	0.25	1.64	0.06
Germany	Total	-0.04	0.87	-0.41 to 0.34	-0.27	0.00	-0.40 to -0.13	0.33	1.29	0.00
Japan	Holiday	-0.45	0.18	-1.01 to 0.11	0.06	0.66	-0.17 to 0.29	0.33	1.39	0.02
Japan	VFR	-0.06	0.75	-0.38 to 0.26	0.09	0.30	-0.06 to 0.24	0.13	1.47	0.04
Japan	Business	-0.13	0.72	-0.77 to 0.50	0.02	0.89	-0.23 to 0.27	0.32	1.91	0.34
Japan	Other	1.08	0.00	0.56 to 1.59	-0.02	0.82	-0.19 to 0.14	0.47	2.45	0.89

Country	Purpose	On-the-ground price index			Airfare price index			Diagnostics		
		Elasticity	p-value	90% C.I.	Elasticity	p-value	90% C.I.	R-squared	D.W. stat	D.W. p-value
Japan	Total	-0.17	0.48	-0.58 to 0.23	0.05	0.64	-0.12 to 0.22	0.34	1.33	0.01
S Korea	Holiday	-0.82	0.37	-2.34 to 0.70	0.28	0.21	-0.09 to 0.66	0.38	1.40	0.02
S Korea	VFR	-0.85	0.21	-1.96 to 0.26	-0.03	0.89	-0.37 to 0.31	0.33	1.59	0.06
S Korea	Business	0.34	0.65	-0.92 to 1.60	-0.20	0.39	-0.59 to 0.19	0.23	1.77	0.17
S Korea	Other	-0.95	0.44	-2.99 to 1.09	-0.18	0.57	-0.71 to 0.35	0.11	1.47	0.03
S Korea	Total	-0.80	0.33	-2.15 to 0.56	0.16	0.39	-0.15 to 0.46	0.37	1.24	0.00
Canada	Holiday	0.68	0.24	-0.28 to 1.64	-0.34	0.18	-0.76 to 0.08	0.27	1.80	0.16
Canada	VFR	0.72	0.10	0.00 to 1.43	-0.18	0.12	-0.37 to 0.01	0.33	2.12	0.50
Canada	Business	0.76	0.34	-0.57 to 2.09	-0.60	0.07	-1.14 to -0.06	0.20	2.62	0.94
Canada	Other	-1.45	0.23	-3.47 to 0.57	-0.20	0.53	-0.74 to 0.34	0.14	2.41	0.81
Canada	Total	0.52	0.15	-0.07 to 1.10	-0.28	0.07	-0.54 to -0.03	0.40	2.15	0.53
India	Holiday	-0.32	0.49	-1.10 to 0.45	0.39	0.06	0.05 to 0.73	0.49	2.22	0.60
India	VFR	-0.77	0.10	-1.53 to 0.00	0.35	0.06	0.05 to 0.65	0.23	1.16	0.00
India	Business	-0.69	0.23	-1.64 to 0.26	-0.15	0.58	-0.59 to 0.30	0.39	2.30	0.69
India	Other	1.01	0.11	-0.04 to 2.06	-0.52	0.07	-0.98 to -0.05	0.23	1.79	0.16
India	Total	-0.35	0.24	-0.83 to 0.14	0.17	0.09	0.00 to 0.34	0.49	1.47	0.02
Singapore	Holiday	-0.06	0.88	-0.73 to 0.61	-0.55	0.02	-0.91 to -0.18	0.55	1.78	0.15
Singapore	VFR	-0.13	0.74	-0.77 to 0.52	-0.22	0.24	-0.52 to 0.09	0.16	2.35	0.75
Singapore	Business	0.40	0.07	0.04 to 0.77	0.32	0.03	0.08 to 0.57	0.29	1.56	0.04
Singapore	Other	3.44	0.00	1.80 to 5.08	0.19	0.52	-0.31 to 0.70	0.39	1.62	0.06
Singapore	Total	0.31	0.23	-0.12 to 0.74	-0.26	0.08	-0.51 to -0.02	0.46	1.58	0.05

Table 8 OLS log-levels models: Estimated elasticities and diagnostics

		On-the-ground price index			Airfare price index			Diagnostics		
Country	**Purpose**	**Elasticity**	**p-value**	**90% C.I.**	**Elasticity**	**p-value**	**90% C.I.**	**R-squared**	**D.W. stat**	**D.W. p-value**
Australia	Holiday	0.21	0.29	-0.12 to 0.55	-0.19	0.31	-0.49 to 0.12	0.96	1.47	0.02
Australia	VFR	0.16	0.18	-0.04 to 0.36	-0.12	0.01	-0.18 to -0.05	0.99	1.43	0.01
Australia	Business	0.02	0.89	-0.25 to 0.30	-0.23	0.01	-0.37 to -0.10	0.91	1.38	0.01
Australia	Other	-0.47	0.17	-1.03 to 0.10	-0.39	0.01	-0.64 to -0.15	0.85	0.85	0.00
Australia	Total	0.12	0.35	-0.09 to 0.32	-0.16	0.05	-0.30 to -0.03	0.98	1.51	0.02
China	Holiday	-1.88	0.00	-2.58 to -1.19	0.25	0.13	-0.02 to 0.52	0.97	2.03	0.36
China	VFR	-0.61	0.10	-1.21 to -0.01	-0.18	0.19	-0.40 to 0.04	0.97	0.77	0.00
China	Business	-0.22	0.50	-0.79 to 0.34	0.10	0.72	-0.36 to 0.55	0.69	0.79	0.00
China	Other	-1.28	0.00	-1.88 to -0.68	0.05	0.69	-0.18 to 0.29	0.96	1.96	0.28
China	Total	-1.51	0.00	-2.16 to -0.87	0.12	0.31	-0.08 to 0.33	0.98	1.81	0.15
USA	Holiday	-0.31	0.24	-0.74 to 0.13	-0.33	0.06	-0.61 to -0.04	0.96	1.47	0.01
USA	VFR	-0.18	0.33	-0.48 to 0.13	-0.21	0.11	-0.42 to 0.00	0.95	1.58	0.03
USA	Business	0.18	0.12	-0.01 to 0.37	-0.08	0.28	-0.20 to 0.04	0.91	2.17	0.53
USA	Other	-0.24	0.17	-0.54 to 0.05	-0.02	0.86	-0.22 to 0.18	0.90	1.88	0.19
USA	Total	-0.21	0.27	-0.54 to 0.11	-0.22	0.09	-0.44 to 0.00	0.97	1.44	0.01
UK	Holiday	0.06	0.82	-0.39 to 0.51	-0.15	0.32	-0.40 to 0.10	0.96	1.90	0.22
UK	VFR	0.14	0.30	-0.09 to 0.38	0.05	0.49	-0.08 to 0.19	0.99	1.90	0.22
UK	Business	0.03	0.90	-0.39 to 0.45	-0.15	0.42	-0.47 to 0.16	0.78	1.76	0.11
UK	Other	-0.07	0.79	-0.50 to 0.36	-0.09	0.59	-0.37 to 0.19	0.79	1.88	0.20
UK	Total	0.08	0.63	-0.21 to 0.38	-0.05	0.59	-0.21 to 0.11	0.98	1.89	0.21
Germany	Holiday	-0.19	0.61	-0.82 to 0.44	-0.64	0.00	-0.81 to -0.47	0.99	1.73	0.09
Germany	VFR	0.14	0.67	-0.42 to 0.70	-0.22	0.07	-0.41 to -0.02	0.97	2.29	0.67
Germany	Business	0.21	0.55	-0.38 to 0.79	0.08	0.61	-0.18 to 0.34	0.69	1.90	0.21
Germany	Other	0.27	0.41	-0.28 to 0.82	-0.40	0.01	-0.66 to -0.14	0.93	1.92	0.23
Germany	Total	-0.03	0.92	-0.57 to 0.51	-0.50	0.00	-0.65 to -0.35	0.99	1.74	0.10
Japan	Holiday	-0.39	0.24	-0.95 to 0.16	-0.20	0.21	-0.46 to 0.06	0.88	1.16	0.00
Japan	VFR	-0.06	0.83	-0.53 to 0.41	-0.14	0.20	-0.32 to 0.04	0.91	1.86	0.21
Japan	Business	-0.36	0.43	-1.12 to 0.41	-0.04	0.84	-0.34 to 0.27	0.72	1.71	0.10
Japan	Other	0.87	0.01	0.36 to 1.38	-0.06	0.60	-0.25 to 0.13	0.96	2.18	0.59

Country	Purpose	On-the-ground price index			Airfare price index			Diagnostics		
		Elasticity	p-value	90% C.I.	Elasticity	p-value	90% C.I.	R-squared	D.W. stat	D.W. p-value
Japan	Total	-0.18	0.53	-0.65 to 0.30	-0.16	0.21	-0.38 to 0.05	0.91	1.18	0.00
S Korea	Holiday	-0.90	0.33	-2.45 to 0.65	0.09	0.76	-0.40 to 0.57	0.91	1.35	0.01
S Korea	VFR	-1.31	0.14	-2.78 to 0.16	-0.01	0.98	-0.49 to 0.48	0.78	1.77	0.15
S Korea	Business	0.65	0.36	-0.54 to 1.84	-0.66	0.00	-1.01 to -0.30	0.74	1.73	0.12
S Korea	Other	-1.47	0.11	-2.99 to 0.06	-0.16	0.62	-0.68 to 0.37	0.81	1.71	0.10
S Korea	Total	-1.00	0.23	-2.40 to 0.39	-0.02	0.95	-0.46 to 0.43	0.89	1.40	0.01
Canada	Holiday	0.77	0.10	0.00 to 1.55	-0.23	0.10	-0.45 to 0.00	0.98	2.15	0.52
Canada	VFR	0.50	0.09	0.01 to 0.99	-0.18	0.07	-0.34 to -0.02	0.98	1.79	0.13
Canada	Business	0.01	0.98	-0.95 to 0.97	-0.17	0.21	-0.39 to 0.05	0.74	2.53	0.89
Canada	Other	-0.90	0.18	-2.02 to 0.22	-0.25	0.15	-0.55 to 0.04	0.77	2.40	0.80
Canada	Total	0.50	0.07	0.04 to 0.96	-0.20	0.04	-0.35 to -0.04	0.99	2.42	0.82
India	Holiday	-0.08	0.86	-0.84 to 0.68	-0.14	0.47	-0.48 to 0.19	0.95	1.96	0.28
India	VFR	-1.07	0.01	-1.70 to -0.45	0.18	0.33	-0.13 to 0.49	0.95	1.27	0.00
India	Business	-1.48	0.02	-2.48 to -0.47	-0.14	0.56	-0.56 to 0.27	0.68	2.34	0.74
India	Other	-0.02	0.97	-0.82 to 0.78	-0.21	0.21	-0.48 to 0.07	0.87	1.87	0.19
India	Total	-0.57	0.04	-1.02 to -0.12	-0.04	0.75	-0.28 to 0.19	0.97	1.29	0.00
Singapore	Holiday	-1.07	0.06	-2.00 to -0.14	-0.52	0.01	-0.82 to -0.22	0.98	1.58	0.04
Singapore	VFR	0.05	0.88	-0.49 to 0.58	-0.27	0.01	-0.42 to -0.11	0.95	2.33	0.74
Singapore	Business	0.05	0.92	-0.71 to 0.80	0.09	0.47	-0.11 to 0.28	0.79	1.19	0.00
Singapore	Other	2.00	0.10	-0.02 to 4.03	-0.03	0.89	-0.43 to 0.36	0.54	1.67	0.07
Singapore	Total	-0.49	0.23	-1.17 to 0.18	-0.32	0.01	-0.51 to -0.13	0.98	1.56	0.04