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REPORT

The Development of Airfares and Airport Charges at Perth Airport

PREPARED FOR
Perth Airport Pty Ltd

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Executive Summary

Perth Airport is a major gateway for Western Australia, and the airport has made major investments in recent years in the infrastructure at the airport, including new terminal buildings to allow airlines to handle their growing traffic volumes and to upgrade the customer service experienced by passengers. Accordingly, a portion of this capital expenditure cost has been passed onto the users of the airports through increases in airport charges.

The analysis in this report examines the issue of the relationship between airport charges and airfares (measured by the base fare paid to airlines plus taxes and airport and other aviation charges) at Perth. While conventional wisdom might be that an increase in airport charges will result in higher combined airfares (base fare plus taxes and airport/aviation fees), economic theory suggests this is not necessarily the case. Theory suggests that typically only a portion of higher costs are passed through in any economic sector, and when there is price discrimination (airlines do not have uniform fares – they extensively use differential pricing for seats on the same flight and for the same seat on different flights/days/seasons) the linkage between an increased cost and the price paid by passengers weakens.

The key results are:

- Economic theory suggests that there is not a direct linkage between airport fees paid by passengers and airlines and the combined fare.
    - In normal markets, except in the case perfectly inelastic demand or perfectly elastic supply, theory suggests that a cost increase is only partially passed through. We should not automatically expect 100% pass through – it is an empirical issue.
    - In markets with a high degree of price discrimination, pass through becomes complicated and there may be little or no pass through at all. The relevant fare for consumer decisions is the “combined fare” -- base fare plus taxes and various airport and aviation fees. Airlines practice extensive price discrimination with scores of fares offered on a given route, with the mix of fares varying by day, season and flight. (As a result analysis should focus on average fares paid, not any one specific fare.) Economic theory suggests that to the extent an airline seeks to pass through higher fees to customers at all, it is more *economically efficient* to pass through any portion of the higher cost to less price sensitive passengers and little to price sensitive passengers.
    - An increase in the passenger charges are more likely to be passed through to combined fares than increases in airport rents. At Perth, the airport does not levy a passenger terminal charge on Qantas, only a monthly rent, for traffic handled in the Qantas terminal. Qantas does however pay a passenger based airfield charge.
    - Where airline markets are competitive, a change in cost at one carrier is less likely to manifest in higher fares.
- A visual inspection of monthly average “combined fare” data for origin destination (OD) pairs by carrier does not show a response (higher combined fare) to changes in airport charges. This is true for roughly 16 events where airport charges changed. Because Perth Airport negotiates

airport charges separately with each air carrier, we conducted the analysis by carrier, and separately for interstate, regional and international fares.

- In fact, airfares at Perth showed a declining trend over the majority of the years and months under analysis -- January 2012 to December 2017. (Because of the large number of OD pairs and the large variation in average fares across the hundreds of origin-destination pairs, we confined the analysis to the top ten OD pairs, accounting for over 90% of O/D traffic.)
    - For each of interstate, regional and international, there is no visual indication of an increase in average combined fare in the month of any change in airport charges, or the immediate months thereafter.
    - We note that the regular monthly and annual variation in average airfares are typically multiples much larger than the change in average airport charges, which are typically very small, less than 1% of the average combined fare. In a number of cases, average fares were decreasing when changes to airport charges took place.
- Because the change in airport charges are small relative to the month by month variation in average combined fares we undertook econometric analysis of the effect of changes in airport charges on average combined airfares. This is more likely to reveal effects than visual inspection of the data.
    - For inter-state routes, the findings are that changes in airport charges are associated with a very small partial pass-through of these charges to the average combined airfare.
        - For *interstate services*, Qantas, Virgin and Jetstar show pass-throughs of only between 5 and 16% of the increase in airport terminal charges per passenger. These results are statistically significant. The exception was Tiger (which has a small share of Perth traffic), with an 80% pass through, also statistically significant. For total airport charges (including airfield and security), the pass-through rate was between 8% and 11%, for Qantas, Virgin, and Jetstar. The result for Tiger for total charges was the wrong sign.
            - We note that the Jetstar average fare data *from Perth* has the most month by month variation of the four major domestic carriers, and from 2014 to 2016, Jetstar average combined fares were higher in almost every month than the other three carriers.
        - For the *regional services*, Qantas has an average terminal charge pass through of 6% (identical to its effect for interstate traffic) and is statistically significant. For only Virgin the pass through is 10%, compared with its 16% for interstate, again statistically significant. Neither Tiger nor Jetstar provide services on the top 10 origin-destination routes from Perth. The regional carriers we analysed had results that were statistically insignificant and often of the wrong sign. Alliance show a 14% pass-through (insignificant), while Rex and Qantaslink results show higher airport terminal charges lower average combined fares, although these results are not significant.

- For total airport charges, Qantas has a pass-through of 10% while the results for Virgin are negative and not significant. Rex shows an 11% pass-through (insignificant), while Alliance and Qantaslink results show higher airport charges lower average combined fares (the results for Alliance are not significant).

- For the international sector, there is no consistent finding. For the case of Virgin Australia, the average pass through was not statistically different than zero (for both terminal and total airport charges). For Qantas, the pass-through rate of 204% indicates that the carrier more than recovered the increase airport terminal charges. Total airport charges for Qantas had a pass-through rate of 17%, but this result is not statistically significant. Looking at a pooled model including multiple carriers, the results indicate a unit pass-through of an increase in airport terminal charges. For total airport charges, the results are less than a unit pass-through and not statistically significant.

    - Due to the inconsistency between carriers and the lack of robustness in the few findings with a large or overlarge pass-through of the airport charge, we are sceptical of any inference that is either a full pass-through or more than full pass-through of airport charges into average combined fares. For the international sector from Perth, there are few routes and carriers, which may explain the lack of robustness in the findings.

This analysis does not support a view that increases in airport charges result in proportionately higher fares. Consistent with economic theory, we instead find evidence of a very small pass-through of airport charges, generally in a range of 5-16%.

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1 Introduction

1.1 Purpose of this Study

This report was commissioned by Perth Airport Pty Ltd to understand the development of airfares at the airport and the impact of changes to airport charges on airfares at the airport. There have been major capital investments at the airport, including new terminal buildings. This has led to an increase in airport charges, above normal inflationary increases. The following analysis aims to provide an understanding of impacts (if any) to airfares from the increases in airport charges. The analysis will focus on the two largest carriers at the airport (Qantas and Virgin), although other carriers will be included. The main sectors analysed are domestic inter-state (i.e., Perth to outside Western Australia) and domestic intra-state (i.e., Perth to Western Australia).[1]

In line with the theme of this report, the Australian Airports Association commissioned Inter*VISTAS* to complete a study on the impact of airport charges on airfares in Australia.[2] The analysis in the report looked at the different components of an "all-in" airfare, which included ancillary fees commonly charged by airlines (e.g., baggage, etc.). For Perth International Airport, airport charges accounted for approximately 6% of the average domestic "all-in" airfare, and 4% of the international fare.[3] Given the small percentage that airport charges account for, this analysis focuses on measuring the airfare response by airlines to changes in airport charges.

1.2 Outline

The report is structured as follows:

- Section 2 provides a general discussion on the economic theory of pass throughs.
- Section 3 provides an overview of the methodology, including a short technical description of regression analysis, and the data used.
- Section 4 summarizes the findings from graphical data analysis looking at the relationship between airfares and airport charges at Perth.
- Section 5 provides the results of the econometric analysis undertaken, aimed at measuring the impact of changes to airport charges on airfares at the airport.
- The executive summary provides the conclusions of the research.

Additional information on the study methodology and study findings is provided in the appendices.

[1] International airfares will also be analysed, but in brief.
[2] InterVISTAS (2018), "The Impact of Airport Charges on Airfares"
[3] The percent of airport charges in the all-in airfare at Perth was below the Australian average.

2 Economic Theory and Pass-Through of Cost Increases

Analysis of the impact of an increase in a charge paid directly by a passenger should be simple; however, the underlying economic theory suggests that there is not always a direct link between the airport fees paid by passengers and airlines and the combined airfare (an airline may not pass all of a charge (or change in a charge) to a passenger.

In a normal market, economic theory suggests that an increase in costs is only partially passed through to the consumer. The increase in costs affects both the price that consumer pays and the price that supplier receives. If the increase comes from the supplier, the portion of the increase borne by the consumer is referred to as the pass-through rate. The key determinants of the pass-through rate in a market are the price elasticity of demand and the price elasticity of supply. If it is assumed that the elasticity of demand is not influenced by the supplier, then the factor that influences the pass-through rate is the price elasticity of supply. Additional discussion of the underlying economic theory and mathematical derivation of this is available in Appendix C.

From the supply side, for markets that have price discrimination as a common practice, the pass-through of costs becomes complicated. In fact, there may be little or no pass-through. Price discrimination is used extensively by airlines with multiple fares offered on a given route, with the mix varying by day, season, and flight.[4] When faced with a cost increase, an airline will be able to raise the fare more on the least price elastic customers and thus lose little of the traffic of these customers. This mitigates price increases on the more fare elastic customers. This is an economically efficient practice. Where the airport charge is a fixed amount per passenger, airlines are able to price discriminate the pass-through to passengers, merely by slightly reducing the base fare on price insensitive passengers and disproportionately increasing the base charge on price sensitive passengers.

In addition, in the face of competition, an airline is less likely to provide a full pass-through of increased costs to passengers (i.e., increase fares). In a competitive market, the supply elasticity will be lower, implying a lower pass-through rate (given the supplier cannot influence demand).

Thus, due to the market structure and pricing practices common to the airlines, an increase in a cost (such as airport charges) is likely to not be fully passed-through to the passengers.

[4] The result of this is that analysis should be done using average fares paid, not a sample fare.

3 Econometric Analysis of Airport Charges Pass-through: Data and Methodology

The following section outlines the data used in this analysis as well as the different methodological approaches used.

3.1 Average Fare Data

3.1.1 Sabre Airline Solutions Origin-Destination Air Passenger Estimates

Average fare data for this analysis is sourced from Sabre Airline Solutions[5]. Sabre collects Global Distribution Systems (GDS) booking data. Most tickets booked through travel agents, whether online or through bricks and mortar outlets, are sold through GDS channels, as are some direct airline ticket sales. To account for tickets sold via other distribution channels, Sabre uses other information on total passengers flown, total airline revenues and a number of other sources to estimate the average fare paid in a market. Sabre provides origin-destination (O/D) air passenger average fare estimates with detail specific to the route and airline, including travel class. Estimates are available for each month. Sabre provides data on both the number of passengers and on total ticket revenue, allowing for the calculation of average fares at several levels of detail and for any sector of travel.[6]

O/D traffic captures the final origin and destination of the passenger, regardless of routing. For example, O/D traffic between Perth and the Gold Coast would count all the passenger traffic between Perth and Gold Coast regardless of whether passengers travel on a direct service or via a connecting airport (e.g., Perth-Adelaide-Gold Coast). Average O/D fares are used as airlines price on an O/D basis, not by route segment.[7]

Passenger and base revenue data is available back to 2010, and the most recent full year is 2017. Sabre updates its passenger & revenue estimates every month.

In 2012, Sabre added a dimension showing both the total ticket price, which includes federal/state taxes and airport fees,[8] and the base airfare price which removes the taxes and fees from the ticket price.[9,10] In this analysis, we use the total ticket price data available for the years 2012-2017.

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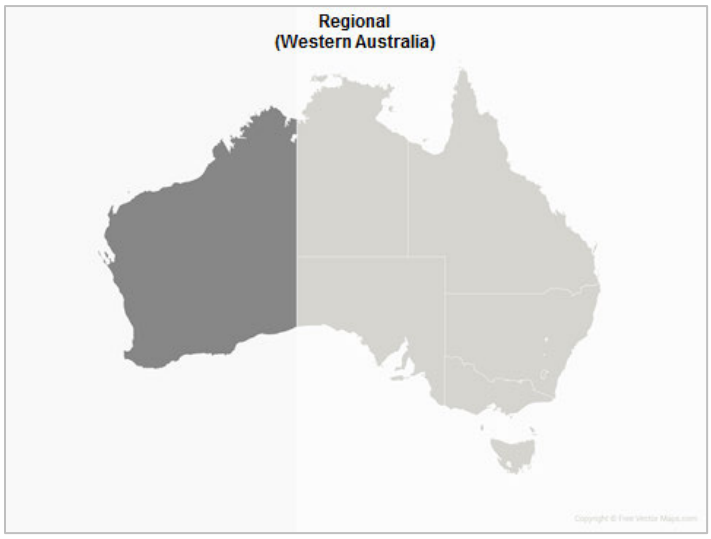
[5] There are some limitations to airfare data from Sabre and other vendors of airline origin-destination traffic and fare data. Nevertheless it has been a reasonably reflective data source and is widely used not only by researchers but by the airlines themselves.
[6] InterVISTAS believes Sabre provides an accurate reflection of tickets sold through the GDS, and that it uses a reasonable approach to estimate those tickets outside the GDS. If Sabre's estimate for non-GDS traffic is out by 5%, this will provide only a 2% error in the total market estimate. We have used sources other than Sabre in the past, but generally prefer Sabre for assessing average airfares.
[7] For example, the PER-ADL-OOL ticket would not have a fare reported for the PER-ADL segment separately from the ADL-OOL segment. The airline would simply have the PER-OOL fare.
[8] As reported by each airline. Airlines choose whether or not to report taxes and fees separately from their base airfare, and Sabre provides both the base fare and total fare information. Ancillary revenue is not currently reported by Sabre in the total fare.
[9] It does not provide data on ancillary charges.

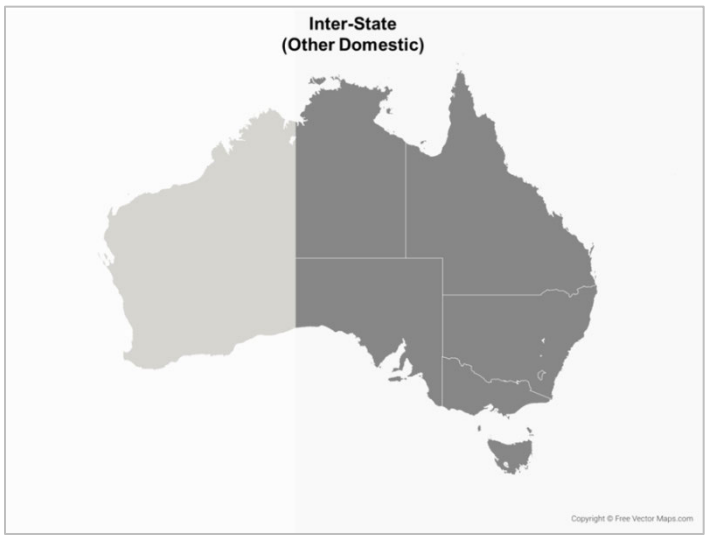
Ancillary purchases, even those made at the time of booking, are not included in either the total or base price, as currently GDSs are not reporting ancillary purchases. InterVISTAS has not supplemented the fare data with ancillary purchase estimates.

3.1.2 Sector Split

The Perth average airfare data is split into three sectors:

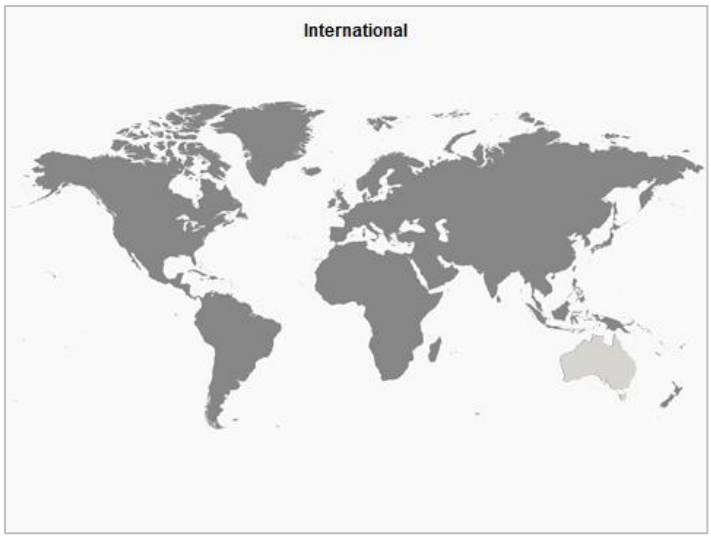


The **Regional Sector** includes airports within Western Australia.



The **Inter-State Sector** includes other Australian airports outside of Western Australia

[10] The revenue data used by Sabre is carrier-reported revenue. If a carrier separates airport charges along with the government taxes and fees, then airport charges revenue will be removed from the "Total Revenue" by Sabre when creating the "Base Revenue" data. In Australia, many carriers are reporting the airport charges (also known as "aeronautical charges") separately. Hence, the difference between Sabre's Total Revenue and Base Revenue includes both government tax and airport charges.



The **International Sector** includes the areas outside of Australia.

3.1.3 Data Description

The fare data is based on the top 10 routes for each sector, and limited to the main operating carriers. For the inter-state sector, the carriers included are Qantas, Virgin, Tiger, and Jetstar. For the regional sector, the carriers included are Qantas, Virgin, Qantaslink, Alliance, and Regional Express (Rex). For the international sector the carriers are Qantas, Virgin, Jetstar, Emirates, Singapore Airlines, Air Asia X, Air Asia Indonesia, and Qantaslink. Table 3-1 shows the top ten destination airports included, by sector.[11] For the inter-state routes, the top 10 O/D routes account for 96% of the traffic, for regional routes, 94% and for international 60%.[12]

Table 3-1
Top 10 Routes by Sector

Top 10 Inter-State Routes	Top 10 Regional Routes	Top 10 International Routes
Melbourne (MEL)	Broome (BME)	Kuala Lumpur (KUL)
Sydney (SYD)	Dampier (KTA)	Auckland (AKL)
Brisbane (BNE)	Port Hedland (PHE)	Bangkok (BKK)
Adelaide (ADL)	Newman (ZNE)	Denpasar (Bali) (DPS)
Darwin (DRW)	Kalgoorlie (KGI)	Dubai (DXB)
Canberra (CBR)	Paraburdoo (PBO)	London (Heathrow) (LHR)
Gold Coast (OOL)	Albany (ALH)	Manchester (MAN)

[11] Top ten routes were based on the top routes for 2017.
[12] Based on 2017 traffic levels.

Top 10 Inter-State Routes	Top 10 Regional Routes	Top 10 International Routes
Cairns (CNS)	Onslow (ONS)	Singapore (SIN)
Hobart (HBA)	Geraldton (GET)	Jakarta (CGK)
Alice Springs (ASP)	Learmonth (Exmouth) (LEA)	Hong Kong (HKG)

3.1.4 Airport Charges

Table 3-2 shows the changes in airport charges in each year, for each of the terminals at the airport as well as the airfield and security charges. Also shown is any major capital improvements made at the airport (leading to price changes).

Table 3-2
Airport Charges Pricing Events

FY ending June 30th	Pricing Event	Year-over-year change (+ or -) in Per-Passenger Charges						
		T1 International	T1 Domestic	T2	T3	T4 (rent-based)	Airfield Charges	Security
2012	**All:** New PSA pricing 2012-2018	+		+	+	-		
2013	**T2:** T2 Opening	+		+	+	+	+	+
2014	**Airfield:** Stand off, taxiway works complete **T1 Intl:** International Arrivals Complete	+	+	+	+	+	-	-
2015		+	-	+	+	+	+	+
2016	**T3:** Phase 2 Completed **Airfield:** Airport Drive / Gateway WA	+	+	+	+	+	+	-
2017	**T1 Intl:** IDUP + T1 Dep Lounge Expansion Complete	+	+	+	+	+	+	+
2018	**All:** End of PSA - FY18 **Airfield:** CAT III, other projects complete **T1 Intl:** Western End, Large Format Screens, T1 Airlock, Complete	+	+	+	+	+	+	-

In addition to the terminal charges, analysis was also done using total airport charges, which included the airfield charge (which is a per passenger charge) and the security charges (also per passenger, varying between domestic and international passengers).

3.2 Econometric Methodology

To determine the relationship between airfares and airport charges, two methods were used. The first is a visual review of the time series data, graphing different transformations to see if there is an apparent response to the changes in airport charges at the airport. The second method is statistical analysis to measure the relationship between airfares and airport charges.

3.2.1 Trend Analysis

The initial analysis will be to graphically analyse a time series of fare data for carriers at the airport. Plotting data allows for visual inspection to see if there are any anomalies or key trends in the data. Plots of the time series fare data will be overlayed with indicators showing changes in airport charges. The visual inspection will show any major impacts to airfares, and this will be further analysed using statistical methods.

3.2.2 Regression Analysis

Ordinary Least Squares (OLS) regression analysis is a method relating total airfares to airport charges, seasonal indicators, and other variables that have an impact on airfares, while minimizing the variance (randomness) of the estimates. The regression analysis allows the relationship between airfares and airport charges to be isolated and quantified while controlling for other factors that may impact airfares, such as route distance, seasonality, etc.

The OLS models used a log formulation, as follows:[13]

$$Ln(Average\ Combined\ Fare) = Constant + \beta_1 Ln(Airport\ Charge) + \beta_2 \ln(Var_2) + \cdots + \beta_k \ln(Var_K) + \beta_{K+1} \cdot Dummies$$

Where:

- *Average Combined Fare* is the dependent variable,
- *Airport Charge* is the average airport terminal charge per passenger (or total airport charge including security and airfield charges).
- Var_2 to Var_K are other quantifiable explanatory variables that may affect airfares (including distance and CPI).
- The dummies are variables that take the form of 1 or 0 in any observation and capture any remaining structural reasons for fare differences between routes. For example, a dummy for the month of July would take the value of 1 for any observations from July and 0 during all other months' observations.

[13] Log model formulations refer to a model specification where both the dependent (left hand side) and independent (right hand side) variables are logged, but indicator variables are not.

The regression analysis estimates the value of the parameters (constant, β_1, β_2, β_3, β_4, β_5, etc.) on each of the variables, which reflect the relative impact of each of the variables on average total fares.

In estimating the model of average fares, we recognize that fares differ by route for a variety of reasons, such as distance, differences between the portion of business or other time sensitive traffic versus fare sensitive traffic, various unique reasons why traffic might be high on a specific route such as demographic or cultural reasons (e.g., different portions of travellers by age group, historical migration data that links families or businesses at one airport to another airport, etc.). To control for this and prevent bias in our regression coefficient estimates, we estimated the model with "fixed route effects".[14] This is an appropriate and common econometric technique and it means that the estimates of the coefficients will be based on variation within routes; i.e., the effect of airport charges on average combined fare is determined by changes over time within routes. It prevents bias from things such as shifts of traffic proportions between routes. Using fixed route effects increased the portion of fare variances in the data (both variance over time and between routes) that is explained by the regression dramatically.

[14] We note that when route effects are included, it captures the effect of route distance and thus it is not possible to estimate a model with both route distance and route effects. This does not bias the coefficient on the airport charges variable.

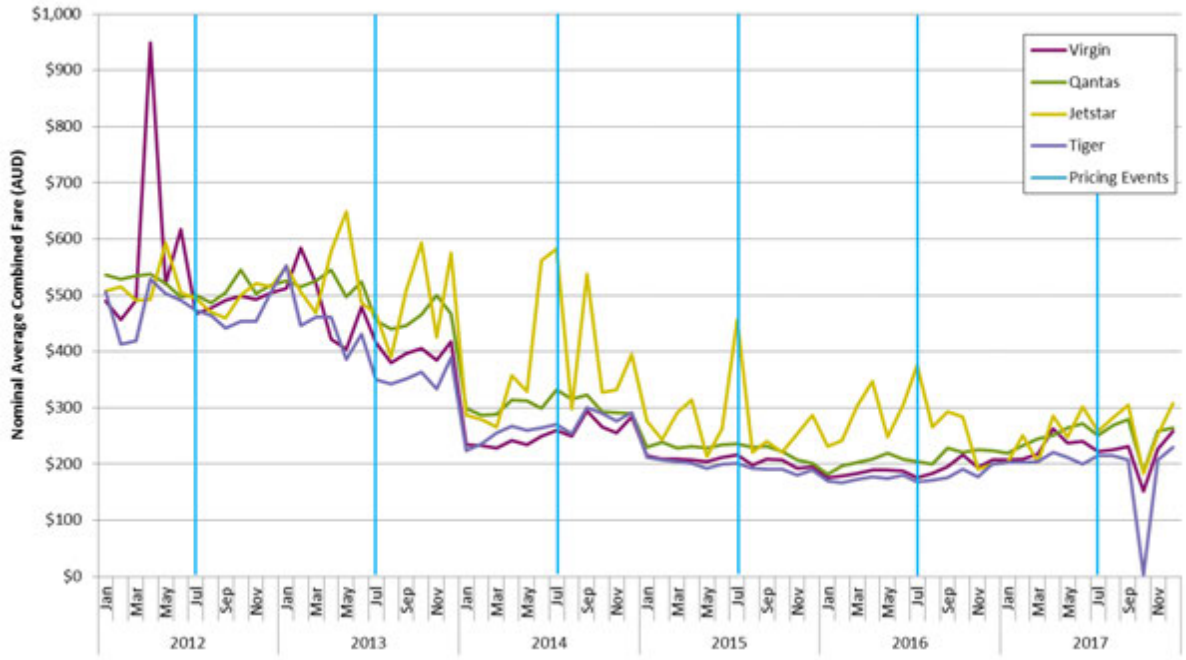
4 Trend Analysis Results

The following section summarises the key results from the visual inspection of the time series data. Average fares here are the total monthly average fare for a given carrier on a given route. The routes are the top 10 routes in each sector based on passenger traffic in 2017.[15]

4.1 Inter-State Fares

The first step in the analysis is to graph the time series airfare data. Figure 4-1 shows the average total monthly fare for each of the four main inter-state carriers.[16] It shows that there is a fundamental change in the data after December 2013. Given this change, the remaining analysis will be confined to the years 2014-2017.

Figure 4-1
Monthly Average Total Fare
Top 10 Inter-State Routes
2012-2017



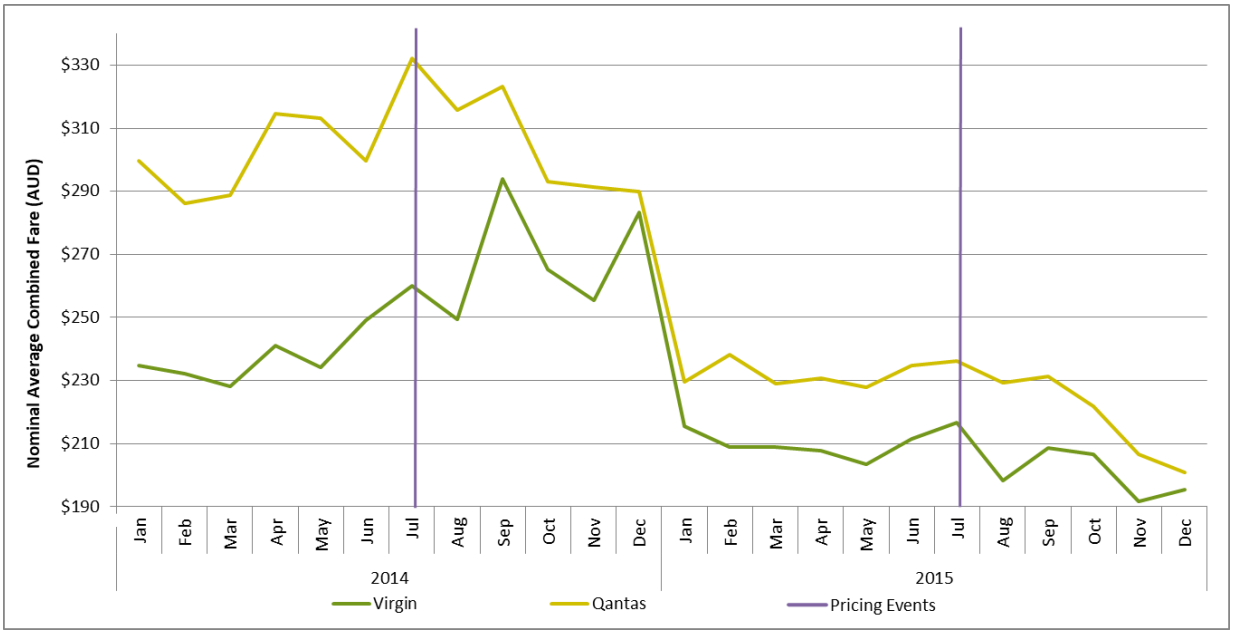
Source: InterVISTAS Analysis of Sabre Data
Note: The vertical lines indicate annual change in airport charges

[15] The top 10 routes were chosen as it limits the dataset to a reasonably manageable size for analysis.
[16] Charts have vertical lines to denote the beginning of each fiscal year (July), and a change in airport charges.

The charts below present Virgin and Qantas average airfares for Perth Airport to the top 10 inter-state routes between 2014 and 2017. Imposed on the charts are lines indicating changes in total airport charges (terminal, airfield and security). The axes on the charts change between periods to better show the change in airfares in each time period. As such, the charts should not be directly compared with each other.

As shown in Figure 4-2, airfares for both carriers had been increasing in the months prior to the change in airport charge. Following the change in airport charges, fares for Qantas fell, and although there was an increase in 3 and 5 months following for Virgin, by 6 months fares were back on a declining trend. Virgin's average fare fell from $260 to $215 in the 12 months following the change in airport charges (rather than increasing as the airport charges did). In only 3 of the 12 months following the increase in charges were fares higher for Virgin, and none for Qantas. It should also be noted that the magnitude of change in airport charges for these years is less than 1% of the total average fare. The changes in average fare for both Virgin and Qantas appear to follow overall similar patterns for these years, however Qantas does consistently have a premium on their fares above Virgin.

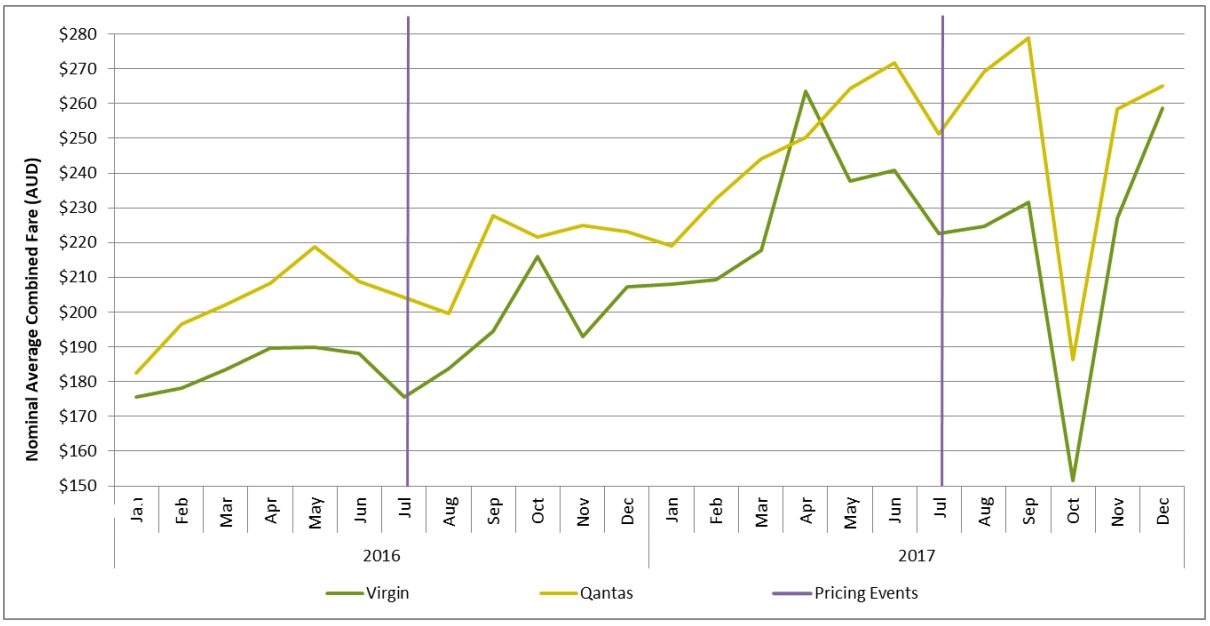
Figure 4-2
Monthly Average Total Fare
Top 10 Inter-State Routes
Qantas and Virgin
2014-2015



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

Figure 4-3 shows the average monthly total fares for 2016 and 2017. In the 6 months prior to airport charges changing, both Qantas and Virgin had an upward trend in their average fares, although in the month prior, Virgin's fares had fallen. In the 12 months post change in charges, airfares for both carriers increased, but well above the magnitude of the change in airport charges. Qantas' average fare went from $205 to $250, a $45 increase. Virgin's charges rose from $175 to $220, also a $45 increase. Again, the magnitude of the change in airport charges is less than 1% of the change in airfares. The upward trend in airfares for both carriers continued in the remained of 2017, with a sharp fall in October of 2017 (followed by an immediate increase in fares).[17]

Figure 4-3
Monthly Average Total Fare
Top 10 Inter-State Routes
Qantas and Virgin
2016-2017

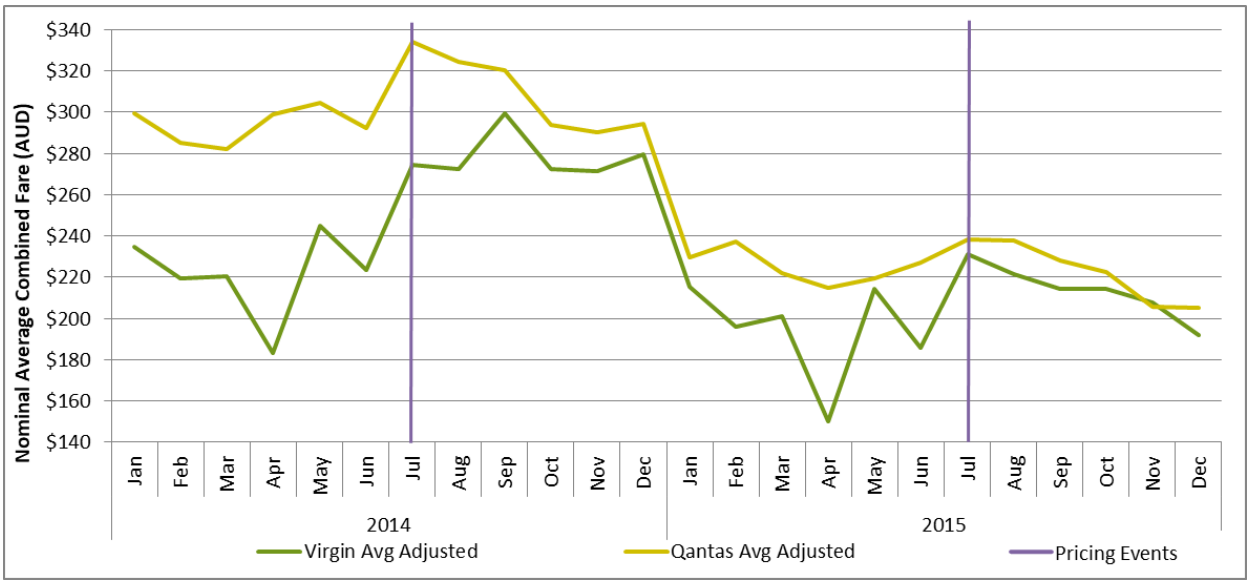


Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

In addition, the time series data was seasonally adjusted, but the results are similar to the previous charts: there is a lack of visual change in airfares due to the changes in airport charges at Perth. Downward trends in fares are present regardless of increases in airport charges, and when fares do trend upwards, the change is much larger than the magnitude of the change in airport charges.

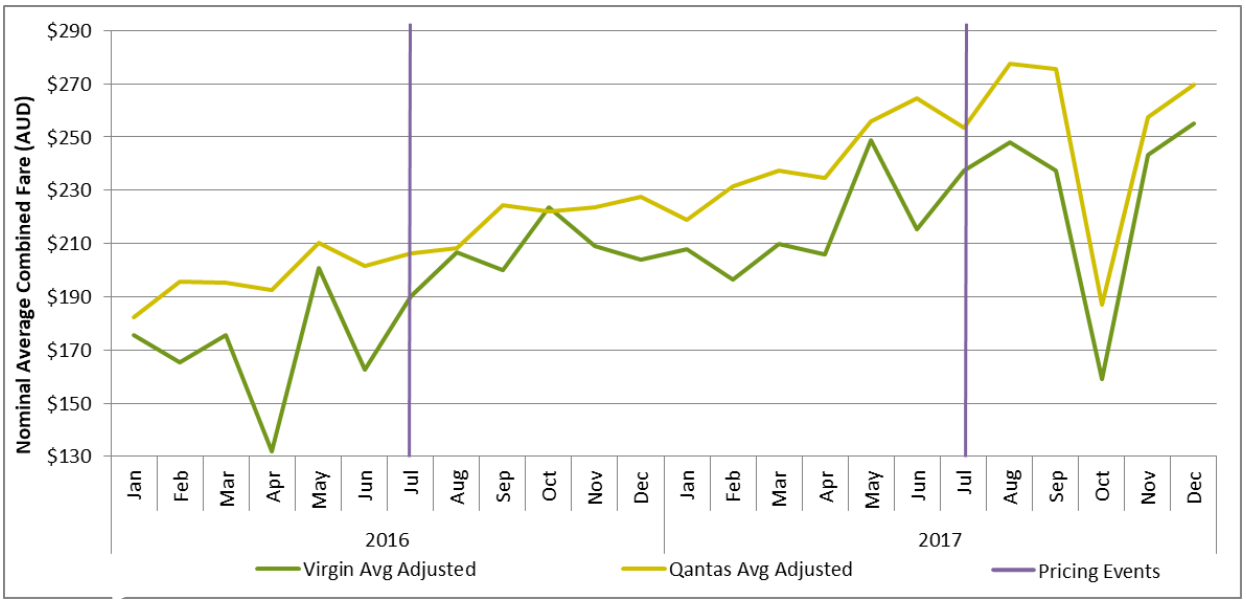
[17] The sharp decline in charges in October 2017 is due to a data error. It is dealt with further in the regression analysis.

Figure 4-4
Monthly Average Total Fare – Seasonally Adjusted
Top 10 Inter-State Routes
Qantas and Virgin
2014-2015



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

Figure 4-5
Monthly Average Total Fare – Seasonally Adjusted
Top 10 Inter-State Routes
Qantas and Virgin
2016-2017

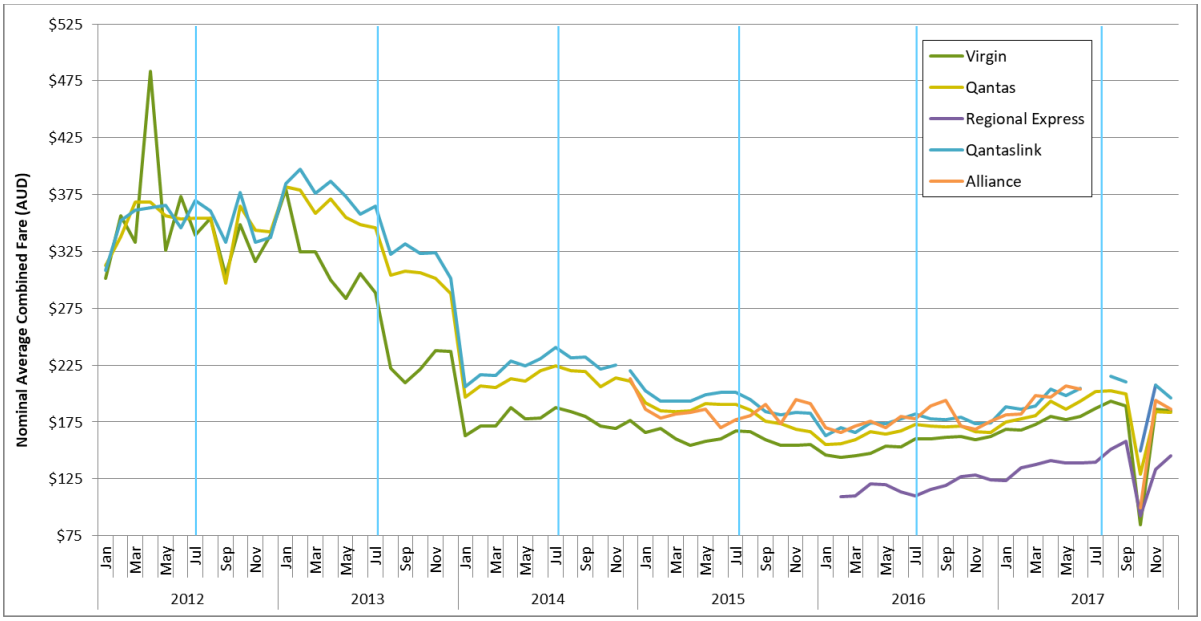


Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

4.2 Regional Fares (Intra-State)

The time series graph below (Figure 4-6) shows a similar change in the average level of total fares to the one we observed for the inter-state routes. The transition from 2013 to 2014 is marked by a fall in average combined fares. As such, the analysis for the regional fares will remain confined to the years 2014-2017.

Figure 4-6
Monthly Average Combined Fare
Top 10 Intra-State Routes
2012-2017

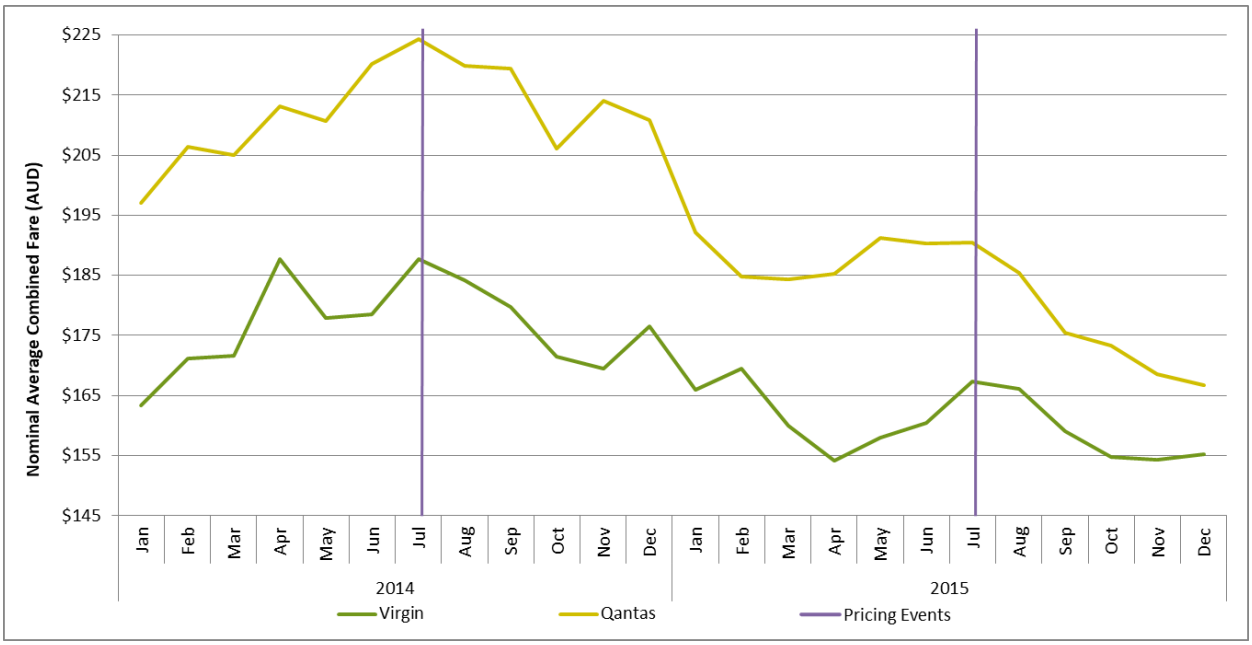


Source: InterVISTAS Analysis of Sabre Data
Note: The vertical lines indicate annual change in airport charges

The charts below present Virgin and Qantas average combined airfares for Perth Airport to the top 10 intra-state routes between 2014 and 2017. Imposed on the charts are lines indicating changes in airport charges. The axes on the charts change between periods to better show the change in airfares in each time period. As such, the charts should not be directly compared with each other.

As shown in figure 4-7, airfares for both carriers have seen a downward sloping trend for most of 2014 and 2015. Although fares rose in the first half of 2014, reaching peak average levels in July, both airlines started reducing airfares soon after. Qantas's average combined fares fell from $224 to $190 in the 12 months following the first change in airport charges. Similarly, Virgin's average combined fares dropped from $188 to $167, and kept decreasing until the last quarter of 2015. Throughout this period, Qantas maintains a premium over the fares charged by Virgin, but this difference decreases towards by end of 2015.

Figure 4-7
Monthly Average Combined Fare
Top 10 Intra-State Routes
Qantas and Virgin
2014-2015

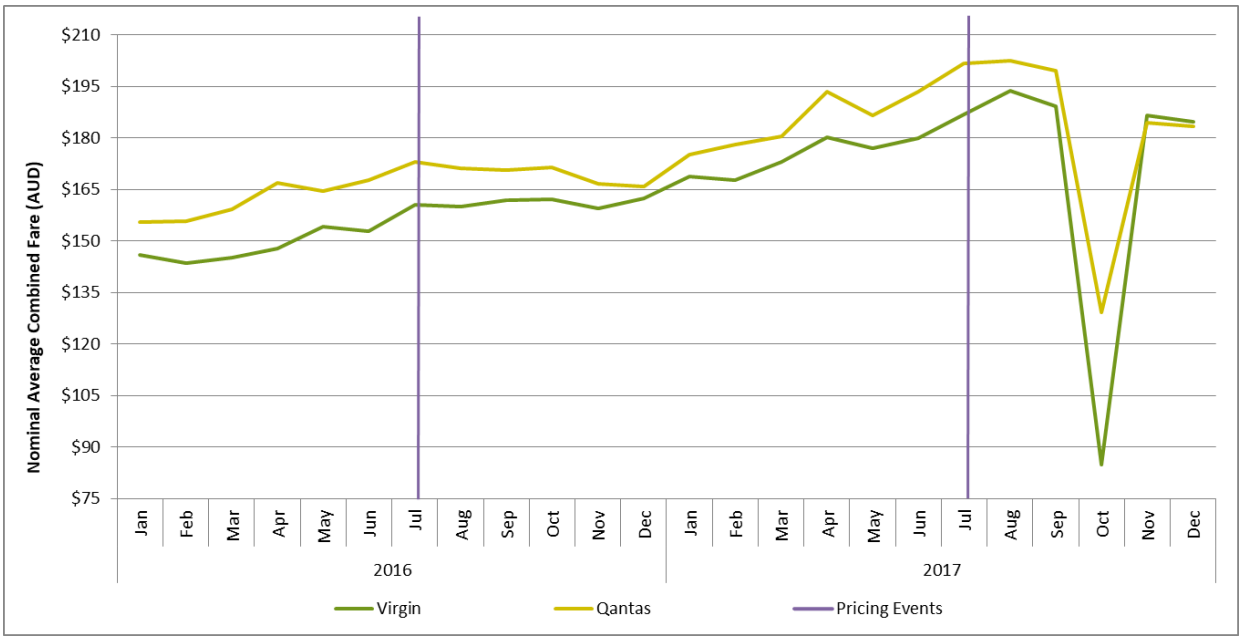


Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

Figure 4-8 shows the average monthly combined fares for 2016 and 2017. In the 6 months prior to airport charges changing, both Qantas and Virgin had an upward trend in their average fares. In the 12 months post change in charges, airfares for both carriers increased, but well above the magnitude of the change in airport charges. Qantas' average fare went from $173 to $202, a $29 increase. Virgin's charges rose from $160 to $187, a $27 increase. Again, the magnitude of the change in airport charges is less than 1% of the change in airfares. The upward trend in airfares for both carriers continued into 2017, with a sharp fall in October of 2017.[18]

[18] The sharp decline in charges in October 2017 is due to a data error. It is dealt with further in the regression analysis.

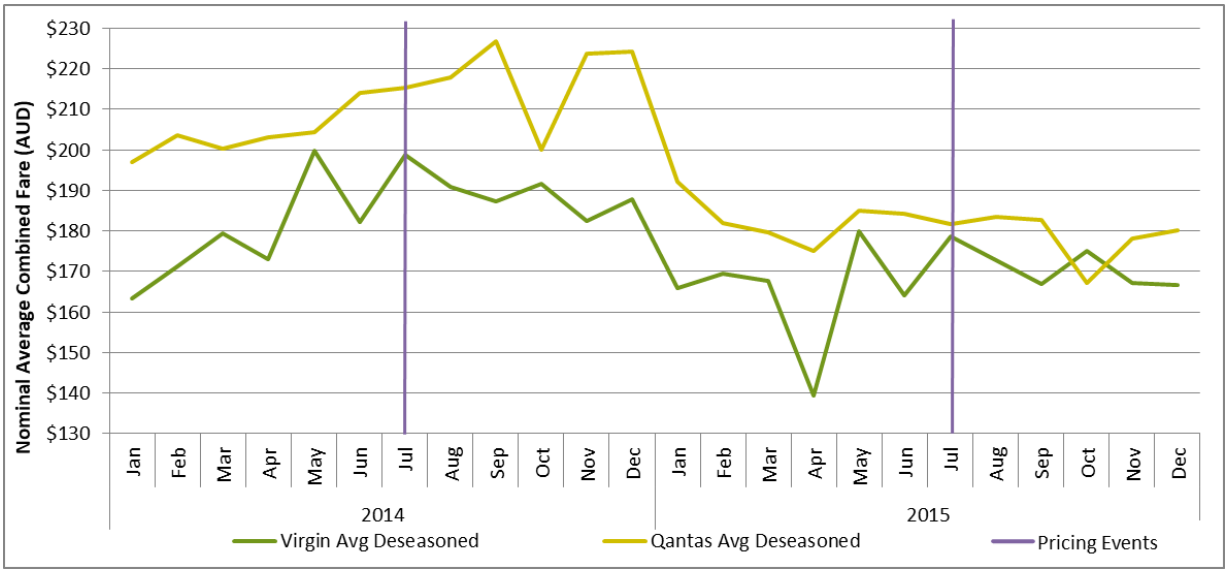
Figure 4-8
Monthly Average Combined Fare
Top 10 Intra-State Routes
Qantas and Virgin
2016-2017



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

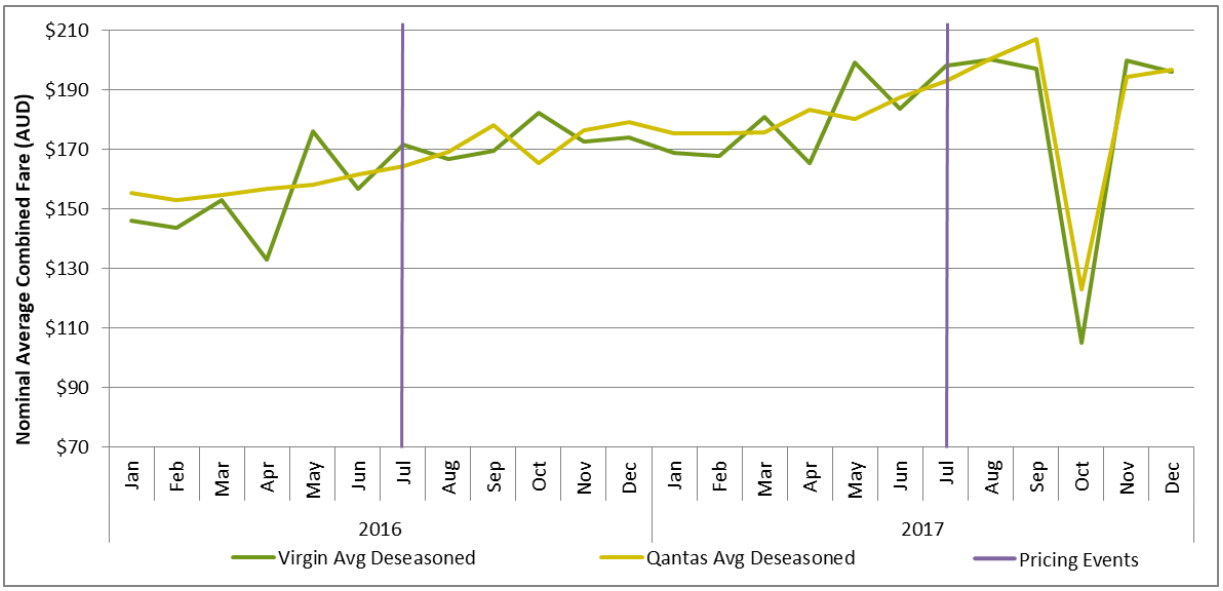
The seasonally adjusted data shows a similar trend, with no sharp increases following a change in charges, and increasing trends in fares at a larger level than the change in airport charges.

Figure 4-9
Monthly Average Combined Fare – Seasonally Adjusted
Top 10 Intra-State Routes
Qantas and Virgin
2014-2015



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

Figure 4-10
Monthly Average Combined Fare – Seasonally Adjusted
Top 10 Intra-State Routes
Qantas and Virgin
2016-2017

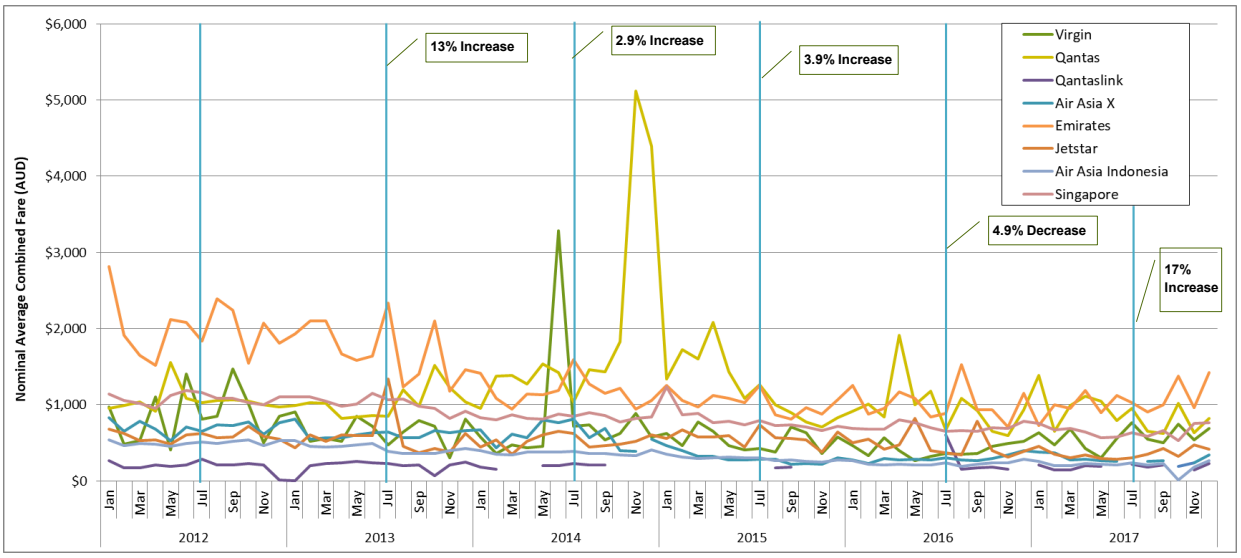


Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport

4.3 International Fares

The time series graph below (Figure 4-11) shows a drop in fares for some carriers between 2013 and 2014, though not at the same level as for the domestic fares. Qantas and Emirates have the highest combined fares for the group, while the Air Asia carriers are among the lower combined fares. For consistency with the other analysis, the analysis for the international fares will remain confined to the years 2014-2017.

Figure 4-11
Monthly Average Combined Fare
Top 10 International Routes
2012-2017

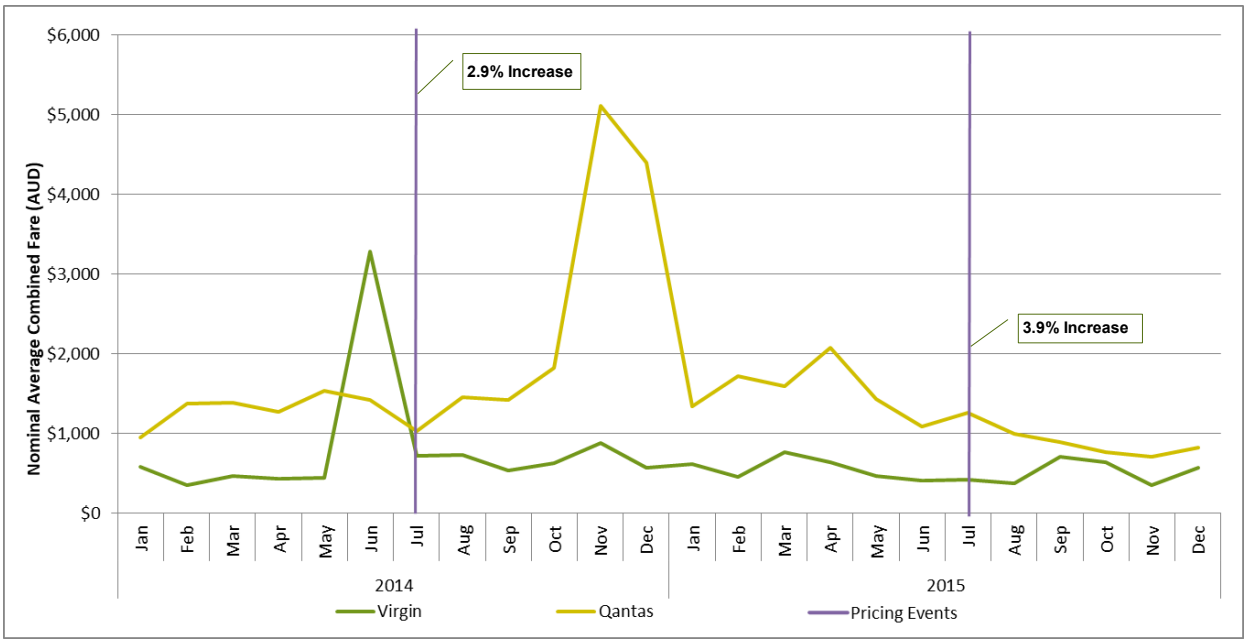


Source: InterVISTAS Analysis of Sabre Data
Note: The vertical lines indicate a change in total airport charges;
callout boxes indicate the percentage increase in total charges, year-over-year

The charts below present Virgin and Qantas average combined airfares for Perth Airport to the top 10 international routes between 2014 and 2017. Imposed on the charts are lines indicating changes in airport charges. The axes on the charts change between periods to better show the change in airfares in each time period. As such, the charts should not be directly compared with each other.

As shown in figure 4-12, airfares for both carriers fluctuated throughout 2014. There were also two months with sharp increases, which are data outliers. Qantas's average combined fares increased from $1,035 to $1,265 in the 12 months following the change in airport charges (an increase of 22%, which is much larger than the increase in airport charges). Qantas' fares however began to fall in the last 5 months of 2015, all less than that of 2014. Virgin's average combined fares dropped from $720 to $420, despite the increase in airport charges. Average combined fares were only higher in 3 of the 12 months following the increase in airport charges. Throughout this period, Qantas maintains a premium over the fares charged by Virgin, but this difference decreases towards by end of 2015.

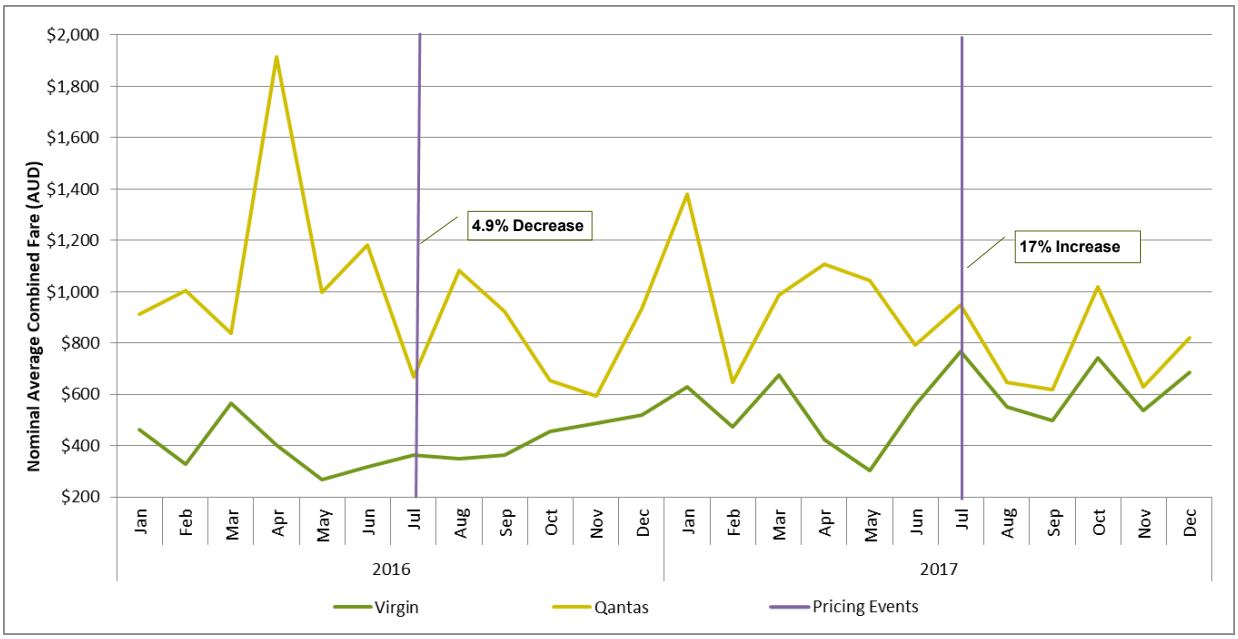
Figure 4-12
Monthly Average Combined Fare
Top 10 International Routes
Qantas and Virgin
2014-2015



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport
Note: The callout boxes indicate the percentage increase in total airport charges, year-over-year

Figure 4-13 shows the average monthly combined fares for 2016 and 2017. In the 6 months prior to airport charges changing, both Qantas and Virgin had a downward trend in their average fares. In the 12 months post change in charges, airfares for both carriers increased, but well above the magnitude of the change in airport charges. Qantas' average fare went from $670 to $950, a $280 increase. Virgin's charges rose from $360 to $765, a $405 increase. The magnitude of the change in airport charges is less than 0.1% of the change in airfares. For Virgin, 2 of the 12 months following the change in airport charges had average combined fares less than the July 2016 level, and for Qantas it was 3 of the 12 months. Average combined fares fell for both of Virgin and Qantas in the 5 months following the July 2017 increase in airport charges.

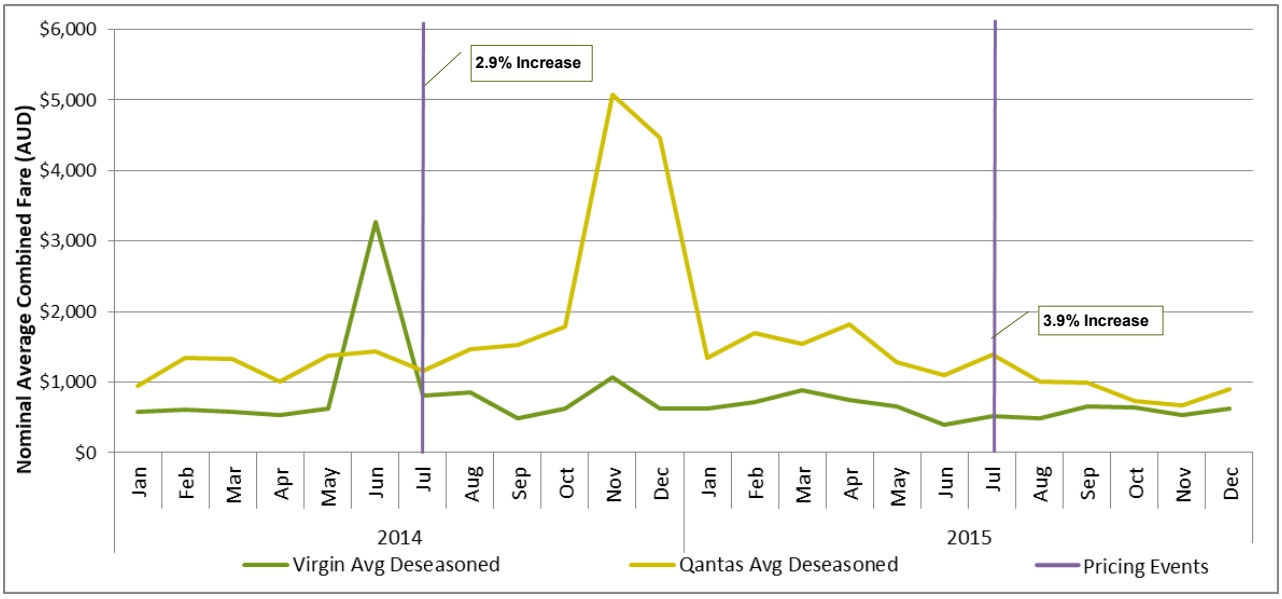
Figure 4-13
Monthly Average Combined Fare
Top 10 International Routes
Qantas and Virgin
2016-2017



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport
Note: The callout boxes indicate the percentage increase in total airport charges, year-over-year

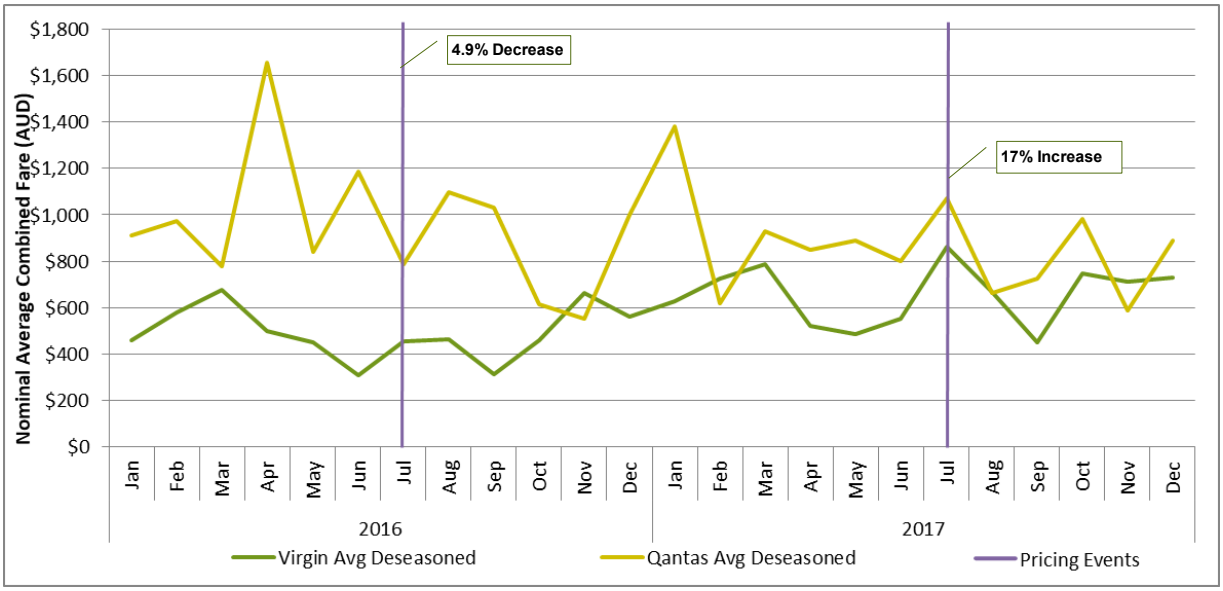
The seasonally adjusted data shows a similar trend, with no sustained sharp increases following a change in charges, and an increase in fares in 2017. Average combined fares for the two carriers begin to converge in 2015, and again in 2017.

Figure 4-14
Monthly Average Combined Fare – Seasonally Adjusted
Top 10 International Routes
Qantas and Virgin
2014-2015



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport
Note: The callout boxes indicate the percentage increase in total airport charges, year-over-year

Figure 4-15
Monthly Average Combined Fare – Seasonally Adjusted
Top 10 International Routes
Qantas and Virgin
2016-2017



Source: InterVISTAS Analysis of Sabre Data and information from Perth Airport
Note: The callout boxes indicate the percentage increase in total airport charges, year-over-year

5 Econometric Analysis

Given the lack of consistent findings from the visual inspection, the next step was to try to measure the impact of changes airport charges on average fares using econometric analysis. Various models were run to test for an impact, including various indicators used to explain other variations within the data. From the graphical analysis in section 4, there is a fundamental shift in the data, and as such, the analysis included here is confined to 2014-2017. As well, there are data errors present (specifically the large drop in fares in October 2017). To deal with this, the econometric analysis included an indicator variable for the observations with errors, so that they do not impact the key regression results.

5.1 Inter-State Fares

Although the original set of data was pooled (i.e., included all carriers by sector), given the complexity of the modelling required, each carrier was modelled separately. The following sections outline the key results of the regression analysis for each of the 4 inter-state carriers.

For each carrier, the regression analysis began by using basic models, looking for seasonality in the data. To do this, the regression model included indicator variables for the months and years. The results of the regressions were that there is no statistically significant seasonality in the airfare data. Another factor included for all carrier regressions was the effect of the different routes in the data. This was modelled in two different ways. The first method was to include a variable which measured the distance of the destination airport from Perth; this gave sensible results, the coefficient was of reasonable magnitude and statistically significant. The second method was a fixed effects model, which uses indicators for each of the different routes. This allows for analysis of the impacts while accounting for the variation caused by the different markets. When using a fixed effects model, route distance is removed from the regression analysis, as the variation from distance is already captured in the route effects.

5.1.1 Virgin Australia

The key regression result for Virgin looked at modelling the actual changes to airport charges, rather than using indicator variables to try to understand the variation in airfares (Table 5-1). The preferred regression model for Virgin Australia included a constant, month indicator variables, year indicator variables, route fixed effects, a data error indicator, and an average airport charges variable (terminal charges and then total charges). The coefficient of interest is that of the average airport terminal charges variable; the coefficient is 0.16, indicating that a 100% increase in airport charges leads to a 16% increase in combined average fares. This suggests that there is not a full pass through of an increase in airport terminal charges. The results are statistically significant. When looking at total airport charges (i.e., including airfield and security charges), the coefficient is lower (0.08), however the results are not statistically significant.

Table 5-1
Key Regression Results
Virgin
Top 10 Inter-State Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Average Total Airport Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Inter-State Model 1.VA	**Coefficient**	**4.95**	**-0.21**	**-0.28**	**-0.11**		**0.16**	**-0.48**		
	Standard Error	0.11	0.01	0.02	0.01		0.04	0.03	Yes	0.78
	T-Statistic	44.30	-14.45	-16.06	-7.40		3.62	-14.52		
LN Inter-State Model 2.VA	**Coefficient**	**5.09**	**-0.22**	**-0.31**	**-0.13**	**0.08**		**-0.47**		
	Standard Error	0.27	0.01	0.01	0.01	0.09		0.03	Yes	0.78
	T-Statistic	18.87	-16.16	-22.23	-8.60	0.94		-13.83		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity.

5.1.2 Qantas

The key regression result for Qantas, similar to Virgin, looked at modelling the actual changes to airport charges, rather than using indicator variables. As Qantas operates from two terminals, there are two potential airport charges variables of interest (one for Terminal 4 and one for Terminal 3). Table 5-2 below only shows the model with T3 Terminal Charges.[19]

Table 5-2
Key Regression Results
Qantas
Top 10 Inter-State Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Total Airport Charge per Passenger	LN T3 Terminal Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Inter-State Model 1.QF	**Coefficient**	**5.28**	**-0.30**	**-0.35**	**-0.17**		**0.06**	**-0.29**		
	Standard Error	0.05	0.02	0.02	0.02		0.02	0.03	Yes	0.78
	T-Statistic	96.62	-18.65	-18.21	-9.75		4.04	-8.36		
LN Inter-State Model 2.QF	**Coefficient**	**5.13**	**-0.31**	**-0.36**	**-0.18**	**0.10**		**-0.29**		
	Standard Error	0.10	0.02	0.02	0.02	0.03		0.03	Yes	0.78
	T-Statistic	53.87	-19.53	-19.67	-10.58	3.69		-8.36		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity.

The preferred regression model for Qantas included a constant, month indicator variables, year indicator variables, route fixed effects, data error indicator, and an average airport charges for terminal T3. The coefficients of interest is that of the T3 terminal charges variable; this coefficient is 0.06, indicating that a 100% increase in airport charges leads to a 6% increase in combined airfares. This suggests that there is not a full pass through of an increase in airport charges. This result is also statistically significant. Similar

[19] Previous models included the T4 Terminal average charges. However, those models were dropped since the results were not statistically significant and did not have the correct sign.

results were found for total airport charges, with the coefficient of interest being 0.10 (statistically significant), still indicating that there is not a full pass-through of an increase in airport charges.

5.1.3 Jetstar

Looking at other carriers at the airport, analysis was also done for Jetstar. As Jetstar operates mainly from Terminal 3, the variable of interest for this analysis is the average terminal charge per passenger variable.

Table 5-3
Key Regression Results
Jetstar
Top 10 Inter-State Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Total Airport Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Inter-State Model 1.JQ	**Coefficient**	**5.43**	**-0.33**	**-0.35**	**-0.33**		**0.05**	**-0.93**		
	Standard Error	0.15	0.05	0.05	0.05		0.04	0.10	Yes	0.59
	T-Statistic	36.22	-7.25	-6.50	-6.61		1.24	-9.68		
LN Inter-State Model 2.JQ	**Coefficient**	**5.22**	**-0.33**	**-0.35**	**-0.33**	**0.11**		**-0.93**		
	Standard Error	0.26	0.04	0.05	0.05	0.08		0.10	Yes	0.59
	T-Statistic	19.96	-7.54	-6.84	-6.88	1.47		-9.72		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity.

Table 5-3 shows the result of the key regression for Jetstar. The coefficient for the average terminal charge is 0.05, approximately the same as for Qantas, which is interpreted as a 5% increase in average combined fares induced by a 100% increase in average terminal charges. This result is not statistically significant. The results for total airport charge per passenger is also similar to that of Qantas (interpreted as an 11% increase in average combined fares for a 100% increase in total airport charges), however they are not statistically significant.

5.1.4 Tiger

The results for Tiger are of a different magnitude than the previous ones. The coefficient on Average Airport Charges is 0.79, which is equivalent to a 79% (roughly 80%) pass-through rate. The result is also statistically significant. The result for total airport charges is of the wrong sign, as it indicates that an increase in airport charges leads to a decrease in airfares.

Table 5-4
Key Regression Results
Tiger
Top 10 Inter-State Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Total Airport Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Inter-State Model 1.TT	**Coefficient**	**3.31**	**-0.33**	**-0.47**	**-0.36**		**0.79**	**-4.40**		
	Standard Error	0.95	0.01	0.03	0.05		0.35	0.04	Yes	0.98
	T-Statistic	3.48	-23.55	-16.25	-7.44		2.26	-104.30		
LN Inter-State Model 2.TT	**Coefficient**	**8.93**	**-0.23**	**-0.24**	**-0.06**	**-1.10**		**-4.39**		
	Standard Error	0.40	0.01	0.02	0.02	0.13		0.04	Yes	0.99
	T-Statistic	22.29	-17.32	-11.20	-2.52	-8.66		-116.87		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity.

5.2 Regional Fares (Intra-State)

As was the case with the inter-state regressions, each carrier was modelled separately. The following sections outline the key results of the regression analysis for each of the 5 intra-state carriers.

5.2.1 Virgin Australia

The preferred regression model for Virgin Australia included a constant, month indicator variables, year indicator variables, route fixed effects, a data error indicator, and an average airport charges variable. As in the inter-state models, the coefficient of interest is that of the average airport charges variable. In Table 5-5, the coefficient is 0.10, indicating that a 100% increase in airport charges leads to a 10% increase in average combined fares. This suggests that there is not a full pass through of an increase in airport charges. The results are statistically significant. For total airport charges, the regression results indicate that there is a small negative impact on airfares (the wrong sign); however, the results are not statistically different than zero.

Table 5-5
Key Regression Results
Virgin
Top 10 Regional Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Total Airport Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Intra-State Model 1.VA	**Coefficient**	**4.65**	**-0.12**	**-0.16**	**-0.06**		**0.10**	**-0.55**		
	Standard Error	0.17	0.02	0.02	0.02		0.06	0.04	Yes	0.76
	T-Statistic	27.84	-5.80	-6.45	-2.87		1.56	-13.68		
LN Intra-State Model 2.VA	**Coefficient**	**4.94**	**-0.13**	**-0.18**	**-0.07**	**-0.01**		**-0.54**		
	Standard Error	0.40	0.02	0.02	0.02	0.13		0.04	Yes	0.76
	T-Statistic	12.31	-6.42	-9.13	-3.16	-0.10		-13.31		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity

5.2.2 Qantas

The preferred regression model for Qantas included a constant, month indicator variables, year indicator variables, route fixed effects, data error dummy, rent charges and an average airport charges for both terminals T3 and T4. The coefficient on the T4 terminal charges variable is negative and does not have a sensible interpretation.

Table 5-6
Key Regression Results
Qantas
Top 10 Regional Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN T4 Rent Charge per Passenger	LN T3 Terminal Charge per Passenger	LN Total Airport Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Intra-State Model 1.QF	**Coefficient**	**5.52**	**-0.10**	**-0.13**	**0.03**	**-0.32**	**0.06**		**-0.39**		
	Standard Error	0.19	0.04	0.07	0.09	0.25	0.01		0.03	Yes	0.88
	T-Statistic	29.06	-2.56	-1.97	0.28	-1.30	4.28		-12.59		
LN Intra-State Model 2.QF	**Coefficient**	**5.13**	**-0.16**	**-0.23**	**-0.10**			**0.10**	**-0.39**		
	Standard Error	0.08	0.01	0.02	0.01			0.02	0.03	Yes	0.88
	T-Statistic	63.72	-12.04	-14.46	-6.95			4.38	-12.74		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity

Hence, the coefficient of interest is that of the T3 terminal charges variable; the coefficient for Terminal 3 is 0.06, indicating that a 100% increase in airport charges leads to a 6% increase in average combined fares (this is a statistically significant). This suggests that there is not a full pass through of an increase in airport charges. This result is also similar to the inter-state results for Qantas. For total airport charges, the results are similar to that of the inter-state regressions, indicating that a 100% increase in total airport charges would lead to a 10% increase in average combined fares (the results are also statistically significant).

5.2.3 Qantaslink

The model for Qantaslink reflects the structure of previous models. However, the variable of interest, average terminal charges, has the wrong sign, no statistical significance, and thus, it does not have a sensible interpretation. Similar results were found for total airport charges variable, which also does not have a sensible interpretation. Table 5-7 below illustrates this situation.

Table 5-7
Key Regression Results
Qantaslink
Top 10 Regional Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Total Airport Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Intra-State Model 1.NC	**Coefficient**	**5.69**	**-0.10**	**-0.16**	**0.03**		**-0.36**	**-0.34**		
	Standard Error	0.18	0.04	0.07	0.10		0.26	0.03	Yes	0.75
	T-Statistic	31.20	-2.46	-2.30	0.33		-1.41	-10.54		
LN Intra-State Model 2.NC	**Coefficient**	**5.94**	**-0.13**	**-0.20**	**-0.04**	**-0.22**		**-0.34**		
	Standard Error	0.16	0.02	0.02	0.02	0.07		0.03	Yes	0.75
	T-Statistic	36.70	-7.23	-9.14	-1.78	-3.18		-10.63		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity

5.2.4 Alliance

Alliance is a smaller regional carrier which was included because they provide services on some of the top 10 routes. The table below (Table 5-8) indicates that there is a 14% pass-through of increases in average airport charges on the average combined fares. However, this result is not statistically significant. For total airport charges, the results do not have a sensible interpretation (wrong sign) and are not statistically significant.

Table 5-8
Key Regression Results
Alliance
Top 10 Regional Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Total Airport Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Intra-State Model 1.QQ	**Coefficient**	**4.68**	**-0.14**	**-0.19**	**-0.06**		**0.14**	**-0.62**		
	Standard Error	2.69	0.11	0.14	0.19		0.99	0.10	Yes	0.78
	T-Statistic	1.74	-1.25	-1.39	-0.32		0.14	-6.06		
LN Intra-State Model 2.QQ	**Coefficient**	**5.36**	**-0.13**	**-0.17**	**-0.02**	**-0.09**		**-0.62**		
	Standard Error	1.43	0.12	0.13	0.14	0.45		0.10	Yes	0.78
	T-Statistic	3.75	-1.08	-1.26	-0.15	-0.21		-6.23		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity

5.2.5 Rex

As was the case with Qantaslink, the analysis for this regional carrier does not yield any insight into pass-through rates on average combined airfares. The coefficient of interest is negative (i.e. -0.15) and not statistically significant. For total airport charges, the coefficient of interest is positive (0.11), however the results are not statistically significant.

Table 5-9
Key Regression Results
Rex
Top 10 Regional Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2017	LN Total Airport Charge per Passenger	LN Rex Average Airport Charge	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN Intra-State Model 1.ZL	**Coefficient**	**5.24**	**0.20**		**-0.15**	**-0.51**		
	Standard Error	2.43	0.05		0.87	0.08	No	0.93
	T-Statistic	2.16	3.89		-0.18	-6.14		
LN Intra-State Model 2.ZL	**Coefficient**	**4.44**	**0.19**	**0.11**		**-0.51**		
	Standard Error	2.04	0.03	0.62		0.08	No	0.93
	T-Statistic	2.18	5.64	0.18		-6.14		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity
The preferred model does not include route fixed effects as Rex only operates one route of the top 10.

5.3 International Fares

As the airport terminal charge for the international terminal is the same for all carriers, the international fare regressions can be modelled for a group of carriers at the airport. The following sections outline the key results of the regression analysis for each of Virgin Australia, Qantas, and the pooled regressions including the 8 carriers.

5.3.1 Virgin Australia

The preferred regression model for Virgin Australia included a constant, month indicator variables, year indicator variables, route fixed effects, a data error indicator, an indicator for outliers, and an average airport charges variable. As in the other models, the coefficient of interest is that of the average airport charges variable. In Table 5-10, the coefficient is 0.14, indicating that a 100% increase in airport charges leads to a 14% increase in average combined fares (i.e., there is not a full pass-through of charges). These results, however, are not statistically significant. The results looking at total airport charges are not significant as well, and do not have a sensible interpretation (i.e., the coefficient of interest is negative).

Table 5-10
Key Regression Results
Virgin
Top 10 International Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Average Total Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Virgin Outliers Indicator	Fixed Route Effects	Multiple R-Square
LN International Model VA 1	**Coefficient**	**5.89**	**-0.13**	**-0.17**	**-0.01**		**0.14**	**-0.15**	**2.94**		
	Standard Error	3.33	0.09	0.12	0.20		1.40	0.13	0.41	Yes	0.67
	T-Statistic	1.77	-1.43	-1.43	-0.05		0.10	-1.20	7.11		
LN International Model VA 2	**Coefficient**	**9.46**	**-0.08**	**-0.12**	**0.10**	**-1.06**		**-0.15**	**2.94**		
	Standard Error	2.62	0.08	0.09	0.11	0.86		0.13	0.41	Yes	0.68
	T-Statistic	3.61	-1.13	-1.32	0.89	-1.23		-1.20	7.14		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity

5.3.2 Qantas

The preferred regression model for Qantas included a constant, month indicator variables, year indicator variables, route fixed effects, a data error indicator, indicators for outliers, and an average airport charges variable.

Table 5-11
Key Regression Results
Qantas
Top 10 International Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	LN Average Total Charge per Passenger	LN Average Terminal Charge per Passenger	Data Error Dummy Variable	Qantas Outliers Indicator	Over $4000 Outliers Indicator	Fixed Route Effects	Multiple R-Square
LN International Model QF 1	**Coefficient**	**1.43**	**-0.16**	**-0.46**	**-0.53**		**2.04**	**1.02**	**1.99**	**1.01**		
	Standard Error	2.08	0.06	0.07	0.12		0.87	0.40	0.31	0.10	Yes	0.79
	T-Statistic	0.69	-2.55	-6.33	-4.38		2.36	2.56	6.41	10.14		
LN International Model QF 2	**Coefficient**	**5.79**	**-0.09**	**-0.35**	**-0.29**	**0.17**		**1.03**	**1.99**	**1.01**		
	Standard Error	1.56	0.06	0.06	0.07	0.51		0.40	0.31	0.10	Yes	0.79
	T-Statistic	3.70	-1.56	-6.25	-4.24	0.34		2.56	6.40	10.12		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity

The coefficient of interest is that of the terminal charges variable; the coefficient for is 2.04, indicating that a 100% increase in airport charges leads to a 204% increase in average combined fares (this is a statistically significant). This suggests that there is a more than doubling pass-through of an increase in airport charges. For total airport charges (including airfield and security charges), the coefficient of interest is 0.17, indicating a less than full pass-through of an increase in airport charges, however the results are not statistically significant.

5.3.3 Pooled Carriers

As the terminal, security and airfield charges are consistent across the carriers, a pooled model was tested. There were two main specifications used. One specification included a constant, month indicator variables, year indicator variables, route fixed effects, a data error indicator, indicators for outliers,

indicators for carriers, and an average airport charges variable. The other specification does not include the carrier indicator variables. Table 5-12 below illustrates this situation.

Table 5-12
Key Regression Results
Pooled Carriers
Top 10 International Routes
Dates: Jan 2014-Dec 2017

	Model	Constant	yr2015	yr2016	yr2017	Virgin	Jetstar	Singapore	Emirates	Air Asia X	Air Asia Indonesia	Qantaslink	LN Average Total Charge per Passenger	LN Average Terminal Charge per Passenger	Qantas Outlier	Virgin Outlier	Over $4000 Outliers	Data Error Dummy Variable	Fixed Route Effects	Multiple R-Square
LN International Model All -1	**Coefficient**	**4.47**	**-0.16**	**-0.33**	**-0.42**	**-0.25**	**-0.38**	**-0.08**	**0.16**	**-0.78**	**-0.84**	**-0.65**		**0.95**	**1.77**	**1.76**	**1.43**	**-0.91**		
	Standard Error	1.04	0.03	0.04	0.06	0.04	0.03	0.03	0.03	0.04	0.04	0.09		0.43	0.31	0.43	0.09	0.10	Yes	0.70
	T-Statistic	4.31	-5.10	-9.15	-6.99	-6.88	-10.76	-2.67	4.74	-20.12	-21.80	-7.41		2.20	5.71	4.09	15.51	-9.48		
LN International Model All -2	**Coefficient**	**3.97**	**-0.18**	**-0.37**	**-0.47**									**1.07**	**1.70**	**1.44**	**1.46**	**-0.98**		
	Standard Error	1.26	0.04	0.04	0.07									0.53	0.38	0.52	0.11	0.12	Yes	0.55
	T-Statistic	3.15	-4.66	-8.49	-6.45									2.02	4.50	2.77	13.24	-8.48		
LN International Model All -3	**Coefficient**	**6.62**	**-0.12**	**-0.28**	**-0.31**	**-0.25**	**-0.38**	**-0.08**	**0.16**	**-0.78**	**-0.84**	**-0.66**	**0.04**		**1.77**	**1.75**	**1.43**	**-0.91**		
	Standard Error	0.78	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.04	0.04	0.09	0.25		0.31	0.43	0.09	0.10	Yes	0.69
	T-Statistic	8.51	-4.47	-10.03	-9.04	-6.81	-10.74	-2.66	4.75	-20.08	-21.79	-7.44	0.16		5.71	4.07	15.52	-9.45		
LN International Model All -4	**Coefficient**	**6.13**	**-0.14**	**-0.31**	**-0.35**								**0.13**		**1.70**	**1.43**	**1.46**	**-0.97**		
	Standard Error	0.95	0.03	0.03	0.04								0.31		0.38	0.52	0.11	0.12	Yes	0.54
	T-Statistic	6.47	-4.16	-9.40	-8.52								0.42		4.51	2.75	13.24	-8.45		

Note: Monthly indicator variables are included in the regressions, but have been excluded from the table for brevity

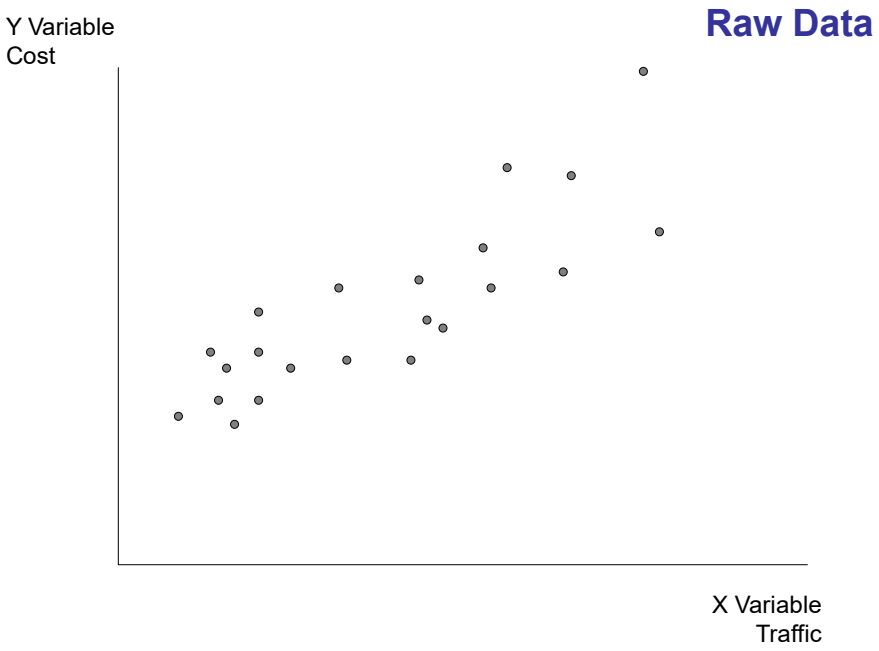
The results for the pooled models are an approximately unit pass-through effect for terminal charges. The coefficient of interest in the regression including the carrier indicators is 0.95, and the coefficient excluding the carrier indicators is 1.07 (both coefficient estimates are statistically significant). For total airport charges, the results are for a less than unit pass-through effect; however, the results are not statically significant.

Appendix A – Regression Analysis Explained

Regression Analysis

Statistical regression analysis seeks to 'fit' a line to data points. Consider **Figure A-1**. It shows a scatter of points. Each point has a value for two variables. In this hypothetical case (the data is made up for this example) the Y data element might be something such as cost, while the X variable might be a variable such as the level of traffic. The data in the figure suggest that cost is higher when traffic is higher.

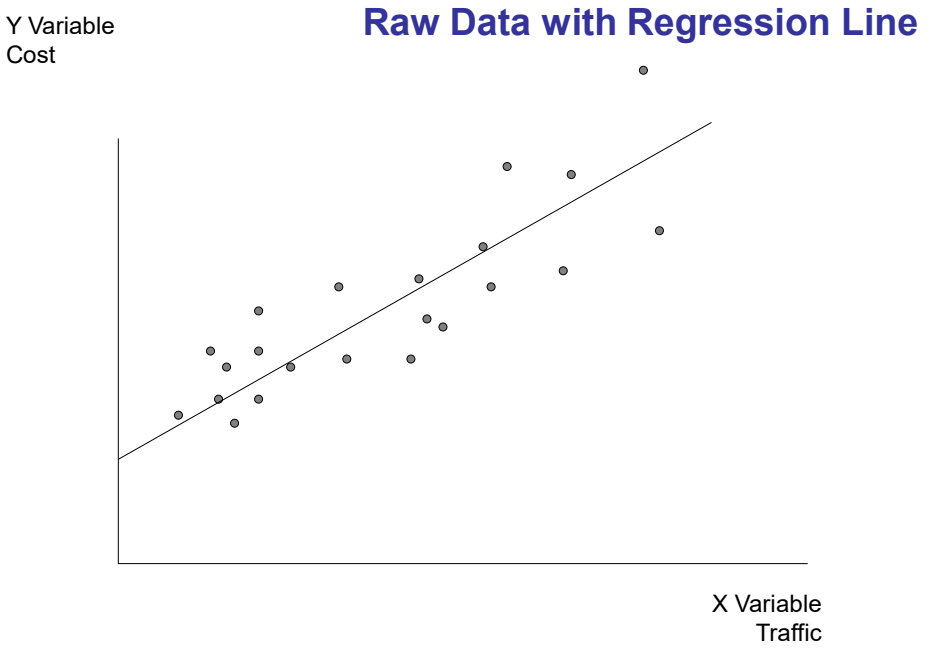
Figure A-1:
Data on Cost and Traffic



Regression analysis involves seeking a line which best 'fits' the data.[20] **Figure A-2** shows a regression line fitted to this hypothetical data. The line is displayed graphically.

[20] There are many different lines that could be fit to the data. *Least Squares* regression analysis is one such method to fit a line. It is the method which has many desirable properties and is widely accepted in the field of economics (and many other disciplines). Least squares chooses the line that minimizes the sum of the squared distances between each point and 'fitted' line. It turns out that fitting a line to minimize the sum of (un-squared) distances has some very undesirable properties. For example, the method of least absolute deviations may have multiple solutions, with no basis for choosing one versus another.

Figure A-2:
Data on cost and traffic
With Regression Line
Hypothetical Data



The above description of regression analysis is for a pair of variables: the dependent variable (the Y-axis variable, cost) and a single independent variable (the X axis variable, passenger traffic in this case). Regression analysis can also be constructed when there are multiple independent variables. This is not easy to show diagrammatically, but the concepts are the same. Regressions are typically shown via the resulting regression equation. The regression coefficients for a given X variable show the effect on the Y variable of different values of that X variable.

Regression analysis can be conducted for any set of data. It is a mathematical exercise. Econometricians perform a reality check on the results by asking whether the resulting regression actually explains much of the differences between data points on cost (also known at the variance between cost data points) in terms of traffic level. This is referred to as checking the goodness of fit of a regression. The measure for this is referred as an R-squared value. An R^2 which is unity indicates the case where the regression explains all of the variation between airports. High R^2 values are desired, of course. Models using macroeconomic time series data typically achieve high R^2 values. As a general rule, models using cross section data on consumers or firms, achieve somewhat lower R^2 values. This is because there are many unique drivers of consumer and firm decisions, and models cannot include all possible influences.

Appendix B – Descriptive Statistics

Figure B-1:
Inter-state Average Combined Fares
Descriptive Statistics

Note: The following analysis excludes the data with known errors.

Virgin Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	219
Standard Deviation	46
Minimum	124
Maximum	406
Count	462

Qantas Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	248
Standard Deviation	61
Minimum	90
Maximum	482
Count	462

Jetstar Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	302
Standard Deviation	235
Minimum	153
Maximum	2501
Count	410

Tiger Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	214
Standard Deviation	46
Minimum	130
Maximum	415
Count	298

Figure B-2:
Intra-state Average Combined Fares
Descriptive Statistics
Note: The following analysis excludes the data with known errors

Virgin Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	168
Standard Error	37
Minimum	61
Maximum	280
Count	403

Qantas Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	188
Standard Error	43
Minimum	96
Maximum	330
Count	370

Qantaslink Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	199
Standard Error	33
Minimum	120
Maximum	325
Count	321

Alliance Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	181
Standard Error	18
Minimum	146
Maximum	223
Count	66

Rex Average Combined Fare (Taxes and Fees inc.) (2014-2017)	
Mean	129
Standard Error	14
Minimum	109
Maximum	158
Count	22

Figure B-3:
Intranational Average Combined Fares
Descriptive Statistics
Note: The following analysis excludes the data with known errors

Virgin Average Combined Fare (2014-2017)	
Mean	565
Standard Deviation	377
Minimum	134
Maximum	2202
Count	188

Qantas Average Combined Fare (2014-2017)	
Mean	1129
Standard Deviation	1251
Minimum	139
Maximum	9652
Count	432

Singapore Average Combined Fare (2014-2017)	
Mean	749
Standard Deviation	324
Minimum	318
Maximum	4583
Count	436

Emirates Average Combined Fare (2014-2017)	
Mean	1070
Standard Deviation	485
Minimum	206
Maximum	3757
Count	291

Jetstar Average Combined Fare (2014-2017)	
Mean	491
Standard Deviation	338
Minimum	153
Maximum	2677
Count	233

Air Asia X Average Combined Fare (2014-2017)	
Mean	325
Standard Deviation	142
Minimum	132
Maximum	890
Count	172

Air Asia (Indonesia) Average Combined Fare (2014-2017)	
Mean	278
Standard Deviation	100
Minimum	60
Maximum	544
Count	187

Qantaslink Average Combined Fare (2014-2017)	
Mean	209
Standard Deviation	97
Minimum	139
Maximum	602
Count	26

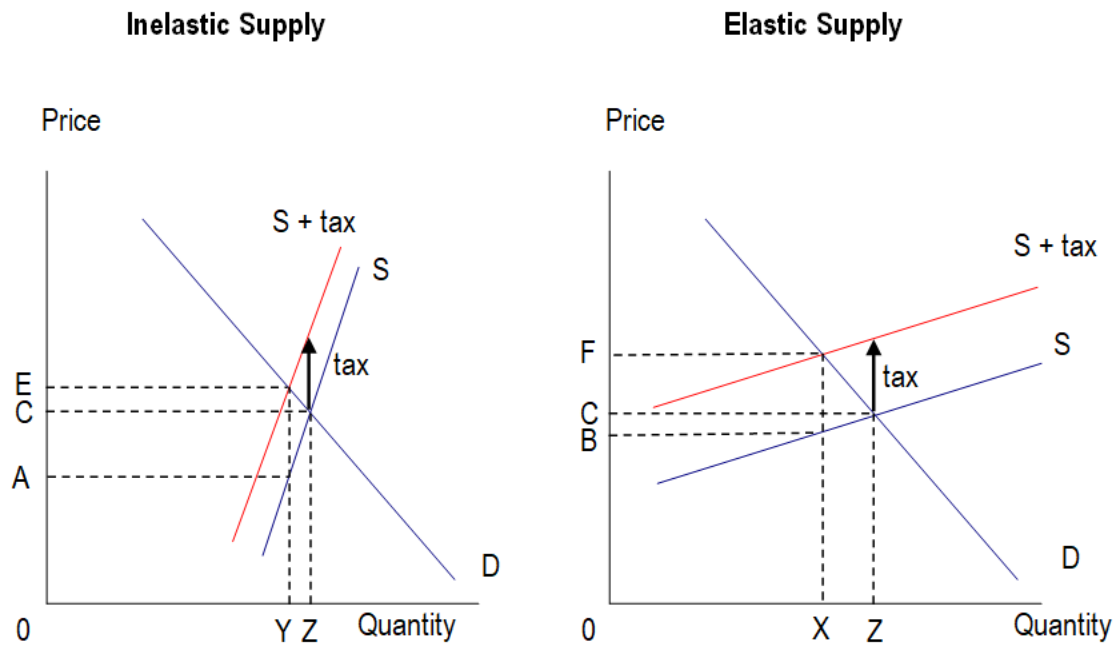
Appendix C – Economic Analysis of the Pass-Through of a Charge

Short Term Pass Through of a Tax or Other Charge – Normal Supply

When a tax is imposed on a market, or if costs increases, it affects both the price that consumer pays and the price that supplier receives. If the tax is added by the supplier, as is the case with a surcharge, the portion of the tax borne by the consumer is referred to as the pass-through rate. The key determinants of the pass-through rate in a market are the price elasticity of demand and the price elasticity of supply. If we assume that the price elasticity of demand is exogenous (i.e., the supplier has no influence over the demand curve) then the only factor that influences the pass-through rate is the price elasticity of supply. Specifically, as the price elasticity of supply increases the pass-through rate increases.

To illustrate this concept we will use the following two examples: 1) a market with relatively inelastic supply, and 2) a market with relatively elastic supply. In both diagrams the slope of the demand curve is the same and the magnitude of the tax is the same.

Figure C-1
Diagrammatic Explanation of a Tax Pass-Through



In both the cases, when there is no tax present in the market the equilibrium quantity is 0Z and the equilibrium price is 0C for the consumer and 0C for the supplier. The introduction of a tax shifts the supply curve up exactly by the amount of the tax. In the case with inelastic supply, the tax results in a new equilibrium quantity, 0Y, and the equilibrium price is 0E for the consumer and 0A for the supplier. The amount of the tax is AE. The amount borne by the consumer is CE and the amount borne by the supplier is AC. Since AC is greater than CE, the supplier pays the majority of the tax in this case, and hence the pass-through rate is low. In the case with elastic supply, the tax results in the new equilibrium quantity, 0X, and the equilibrium price is 0F for the consumer and 0B for the supplier. The amount of the tax is BF (which is the exact same as AE), the amount borne by the consumer is CF, and the amount borne by the supplier is BC. Since BC is smaller than CF, the consumer pays the majority of the tax and hence the pass-through rate is high.

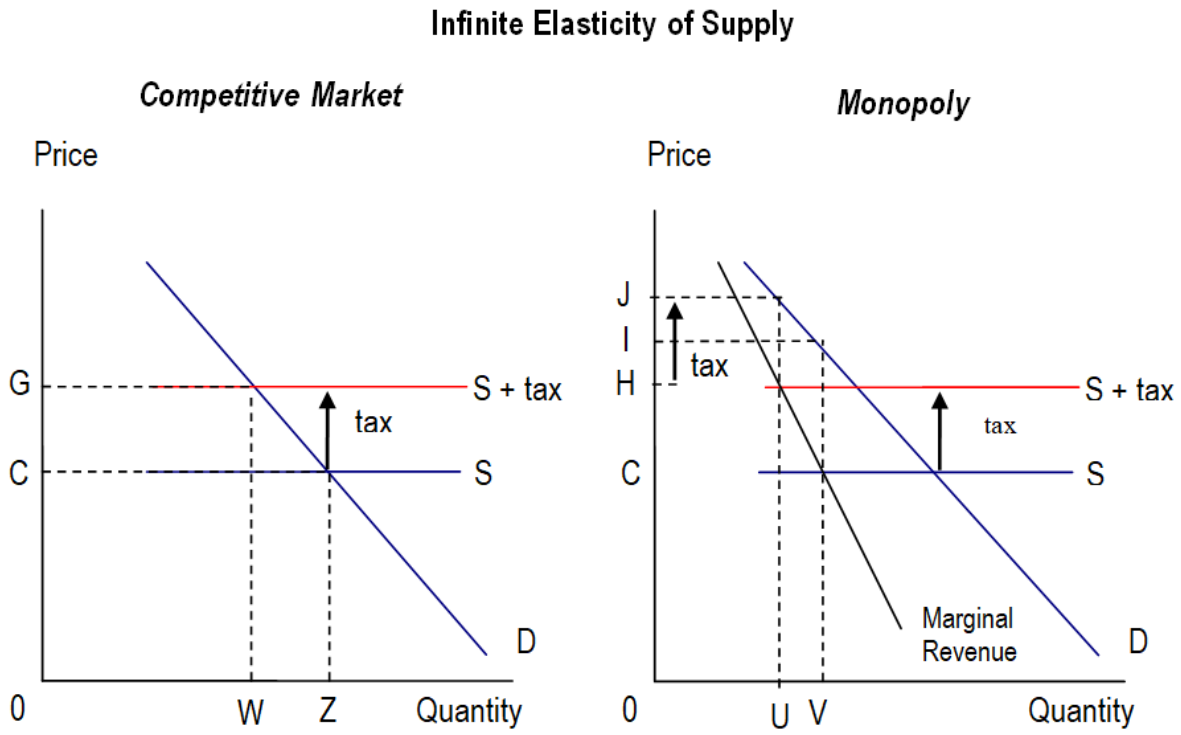
In the short-run industry supply curves are relatively inelastic because firms are committed to certain costs and constrained by existing inputs (labour, capital and land). However, in the long-run all input factors are variable and the price elasticity of supply is typically more elastic. Therefore, when a tax is added by the supplier it is probable that pass-through rate observed in short-run will be less than the pass-through rate that will be present in the long-run. If long run industry cost is constant, then the long run industry supply curve is horizontal (infinite price elasticity of supply).

Short Term Pass-Through of a Tax or Other Charge – Infinite Supply (Constant Returns to Scale)

In the case of infinite price elasticity of supply (as shown in the diagram below), there are two cases that need to be considered; 1) a market with many competing suppliers (competitive market), and 2) a market with one supplier (monopoly).[21]

[21] Infinitely elastic supply can correspond to a case of constant returns to scale in a competitive market.

Figure C-2
Diagrammatic Explanation of a Tax Pass-Through - Infinite Supply



With infinite price elasticity of a supply and a competitive market the equilibrium quantity before the tax is 0Z and the equilibrium price is 0C for the consumer and 0C for the supplier. The tax results in the new equilibrium quantity, 0W, and the equilibrium price is 0G for the consumer and 0C for the supplier. The amount of the tax is CG (which is the exact same as AE and BF) and the amount borne by the consumer is CG and the amount borne by the supplier is CC (which is zero). Therefore, with infinite price elasticity of supply and a competitive market the entire tax is passed through to the consumer (i.e. the pass-through rate is 100%).

With infinite price elasticity of a supply and a monopoly the equilibrium quantity before the tax is 0V and the equilibrium price is 0I for the consumer and 0I for the supplier. In this case, the equilibrium quantity without the tax is different than that in the other cases because a monopolist has influence over market price and as a result has a downward sloping marginal revenue curve that falls below the demand curve. The equilibrium quantity with a monopoly is less than the equilibrium quantity in a competitive market. In this case, the tax results in a new equilibrium quantity, 0U, and the equilibrium price is 0J for the consumer and 0H for the supplier. The amount of the tax is HJ (which is the exact same as AE, BF and CG) and the amount borne by the consumer is IJ and the amount borne by the supplier is HI. Therefore, even with infinitely elastic supply, we do not observe full pass-through of the tax when there is only one supplier in the market.

A horizontal supply curve is consistent with an industry with constant long-run marginal cost. In a competitive industry (i.e. many suppliers) it is possible for the suppliers to function in a manner similar to a

monopolist, through collusion, and thus move away from an equilibrium point where there are zero economic profits to a profitable point. This new equilibrium point will collectively increase supplier profits and the price the consumer pays and result in full pass-through of the tax.

Mathematical Derivation of the Pass-Through Rate of Tax

This section derives the amount of pass-through as a function of demand and supply price elasticities. Supply price elasticities depend upon the nature of marginal cost.

When a market is in equilibrium we have the condition;

$$p_D = p_S \qquad (1)$$

If a tax is added the tax adds a wedge between the price the consumer pays (p_D) and the price the supplier pays (p_S) and we have the new equilibrium conditions;

$$p_D = p_S + t \qquad (2)$$

Equation (2) can be written as;

$$\Delta p_D = \Delta p_S + \Delta t \qquad (3)$$

In equilibrium, even in a market with a tax, the quantity demanded must equal the quantity supplied.

$$Q_D = Q_S \qquad (4)$$

Given equation (3) the following equation must also hold;

$$\frac{\Delta Q_D}{Q_D} = \frac{\Delta Q_S}{Q_S} \qquad (5)$$

The definition of price elasticity of demand is given by;

$$\eta_D = \frac{dQ_D}{dP_D} \times \frac{P_D}{Q_D} \qquad (6)$$

Similarly, the definition of price elasticity of supply is given by;

$$\eta_S = \frac{dQ_S}{dP_S} \times \frac{P_S}{Q_S} \qquad (7)$$

If we multiply the price elasticities given in (6) and (7) by the percentage change in price they will yield the percentage change in quantity. Based on this we can rewrite (5) as;

$$\eta_D \times \frac{\Delta P_D}{P_D} = \eta_S \times \frac{\Delta P_S}{P_S} \quad (8)$$

Substitute (3) into (8) to get;

$$\eta_D \times \frac{\Delta P_D}{P_D} = \eta_S \times \frac{\Delta P_D - t}{P_S} \quad (9)$$

Substitute (6) and (7) into (9);

$$\frac{dQ_D}{dP_D} \times \frac{P_D}{Q_D} \times \frac{\Delta P_D}{P_D} = \frac{dQ_S}{dP_S} \times \frac{P_S}{Q_S} \times \frac{\Delta P_D - t}{P_S} \quad (10)$$

Multiply both sides of (9) by Q_S (which equals Q_D) and simplify to get;

$$\frac{dQ_D}{dP_D} \times \Delta P_D = \frac{dQ_S}{dP_S} \times (\Delta P_S - \Delta t) \quad (11)$$

Solve for $\Delta P_D / \Delta t$ to get;

$$\frac{\Delta P_D}{\Delta t} = \frac{\frac{dQ_S}{dP_S}}{\frac{dQ_S}{dP_S} - \frac{dQ_D}{dP_D}} \quad (12)$$

Now multiply both the numerator and denominator in (12) by P_S / Q_S (or the equivalent $P_D - t / Q_D$) and simplify to get;

$$\frac{\Delta P_D}{\Delta t} = \frac{\eta_S}{\eta_S - \eta_D} \quad (13)$$

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