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Financial Risk Exposures in the Airline Industry: Evidence from Australia and New Zealand

by
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Abstract:

Important financial risks facing the airline industry include interest-rate, currency and fuel-price risk. This paper estimates the exposure to these risks within the airline industry of Australia and New Zealand, using both linear and non-linear specifications, for a variety of horizon lengths. Evidence for exposure, both symmetric and asymmetric, tends to strengthen as the return horizon is lengthened. Exposure to these financial risks is largely unchanged by the terrorist attacks and the collapse of a major competitor in September 2001.

Keywords:

FINANCIAL RISK EXPOSURE; RISK MANAGEMENT; AIRLINE INDUSTRY.

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1. Introduction

Airlines face substantial strategic, financial, operational and hazard risks. Financial risks create uncertainty about future cash flows due to changes in general economic conditions and specific changes in revenues, operating expenditure and financing costs. Managing exposure to key financial risks is an integral part of the corporate finance function. This paper studies exposure to three major financial risks confronting the airline industry in Australia and New Zealand. It analyses the interest-rate, currency and fuel-price risk exposures for Qantas and Air New Zealand, which are the dominant airlines in Australia and New Zealand, respectively. Considerable volatility and a variety of trends occurred in interest rates, currency values and the fuel price throughout the period studied. This suggests that there were potentially large gains to be derived from managing these risks effectively.

In addition to volatility in key market variables, these airlines also confronted severe turbulence in their operating environment during the sample period. The global airline industry faced intense external pressure as a result of the terrorist attacks on September 11, 2001. Furthermore, the airline industry in both Australia and New Zealand underwent a major shakeout with the demise of Ansett and the related financial difficulties of its parent company, Air New Zealand. Ansett was the principal domestic competitor of Qantas until it was placed into voluntary administration on September 12, 2001. In the latter part of the period of this study, the airline industry also faced declining demand due to the Bali bombings, the war in Iraq and the outbreak of the SARS virus. Throughout the time frame of this study, airlines also faced actual and potential competition from new entrants to the industry.

Interest-rate, currency and fuel-price exposure are acknowledged to be important risks affecting the airline industry and are commonly hedged. For example, in its 2003 annual report to shareholders, Qantas states in note 32 that it 'is subject to interest rate, foreign currency, fuel price and credit risks'.[1] This same note indicates that Qantas 'manages these risk exposures using various financial instruments' and provides examples of hedging instruments which they employ.[2] These include interest-rate swaps, forward rate agreements and options to manage interest rate risk; cross-currency swaps, forward foreign exchange contracts and currency options to manage currency risk; options and swaps on aviation fuel and crude oil to manage fuel price risk. As this set of risk management tools provides both linear and non-linear payoffs, it is apparent that management can identify important symmetric and asymmetric components of exposure.

Three related literatures are relevant for our paper. Several papers develop theoretical models that examine the determinants of currency exposure, including Shapiro (1975), Marston (2001), Allayannis and Ihrig (2001), Bodnar, Dumas and Marston (2002). This literature establishes the prime importance of the competitive structure within the industry. Another stream of literature analyses stock returns to provide empirical measures of corporate exposure to risks such as exchange rates, interest rates and commodity prices. Risks analysed in this manner include foreign exchange (Jorion 1990), interest rate (Sweeney & Warga 1986), gold price (Tufano

1. Credit risk exposure is not analysed in this paper, as it is considered to be the least important of the four.
2. Similar evidence is contained in the annual report for Air New Zealand.

1998) etc. Finally, an extensive literature canvasses theoretical arguments for and against hedging of financial risks by non-financial corporations. For example, Stulz (1984), Smith and Stulz (1985), Froot, Scharfstein and Stein (1993) and Nance, Smith and Smithson (1993) identify tax minimisation, managerial risk aversion, financial distress, resolution of the underinvestment problem as motives for corporate hedging. Carter, Rogers and Simkins (2002) make the case that the airline industry is one in which corporate hedging is likely to add value by minimising the underinvestment problem.

Our study seeks to contribute in the following ways. Many previous studies have tested for the existence of a single extra-market risk. Most of these have been for exchange-rate exposure and while some have tested for interest-rate exposure, this has been largely for financial corporations. In contrast, we simultaneously examine interest-rate, currency and fuel-price exposures.[3] Most previous papers have examined either broadly aggregated industries or a wide spectrum of individual companies, without controlling for industry effects.[4] We argue that the analysis of companies within a single industry in a specific context provides useful incremental knowledge. Ongoing external threats to the global airline industry and public debate about competition in the Australian-New Zealand region makes these two airlines an interesting place to analyse the existence and relevance of financial risk exposures.[5]

Our main findings are as follows. Short-term returns for Qantas and Air New Zealand are negatively exposed to fuel-price risk, but not significantly exposed to interest-rate or currency risk. Using multi-week returns, the incidence of significant linear and non-linear exposures to these three risks tends to increase with the horizon length. A possible explanation for this evidence is that airlines are better able to manage their short-term exposures. Although the extraordinary events of September 2001 had a substantial impact upon airline returns, they had virtually no influence on the degree of exposure exhibited by our sample airlines to either interest-rate or currency risk. In contrast, fuel-price exposure measures show some sensitivity to these events.

The rest of our paper proceeds as follows. Section 2 provides a theoretical analysis of financial risk exposures in the airline industry. Section 3 describes the data and methods employed. Results are reported and analysed in section 4. Finally, Section 5 concludes the study.

2. Financial Risk Exposures in the Airline Industry

This section analyses the potential consequences of interest rate, currency and fuel price risk on airline stock returns. Exposure to these key financial risks is expected to impact heavily on the returns of airlines due to several distinctive features of the airline industry. This industry is characterised by: (i) cyclical demand; (ii) strong

3. For example, Carter, Rogers and Simkins (2002) provide a detailed examination of fuel hedging in the U.S. airline industry, but ignore currency and interest-rate risk.
4. An exception is Williamson (2001) who examines a sample of automotive firms.
5. On September 9, 2003, the Australian Competition and Consumer Commission rejected a proposed Strategic Alliance Agreement between Qantas and Air New Zealand, on the grounds that it was anti-competitive and not in the public interest. Since exposure and competition are related, exposure provides further, indirect evidence of the effectiveness of competition.

price competition, both domestic and international; (iii) high capital investment; (iv) high gearing levels; (v) high fixed costs of labor and equipment; and (vi) regulatory impediments such as ownership restrictions and control of landing rights. Such factors limit the ability of airlines to effectively reduce the impact of these exposures by restructuring their operations to internally hedge or to initiate other offsetting action.

As well as being in direct competition with each other on some routes, both sample airlines are in competition with other international operators. Qantas and Air New Zealand are Full Service Airlines or Network Carriers. As such, they are also subject to competition from low cost, restricted service airlines, known as Value Based Airlines. These represent a relatively recent, yet credible competitive threat. The demise of Ansett illustrates that established Full Service Airlines are susceptible to the entry of Value Based Airlines, such as Virgin Blue.

2.1 *Interest Rate Exposure*

Interest rate risk is especially important to airlines given their substantial use of debt finance. High leverage ratios are prevalent in the airline industry due to its capital intensive nature and the relatively high cost of equity. Equity can be more difficult to attract because of high earnings volatility, as reflected in the lower than average price-earnings ratios typically found in the airline sector.

Borrowing costs are directly related to interest rate changes. Moreover there are significant indirect costs associated with higher yields. Bartram (2002) emphasises the impact of interest rates on general economic conditions and the progression of the business cycle, with its consequential effect on consumer demand. This is especially pertinent for industries such as airlines, where demand is cyclical and contains a large discretionary component. Carter, Rogers and Simkins (2002) consider the underinvestment problem due to expected distress costs. Higher interest rates increase expected costs of distress and this is particularly so for the airline industry where leverage is high and distress costs are substantial.[6]

Since both direct and indirect costs of borrowing move in the same direction as interest rates, returns should be negatively related to interest rates. It is therefore expected that interest rate exposure coefficients will be negative.

2.2 *Currency Exposure*

Management of exchange rate risk is important since airline profitability is related to currency values for a number of reasons. First, revenues and expenses are denominated in several currencies. Second, borrowings often are denominated in several different currencies. Third, tourism demand, both inbound and outbound, is influenced by exchange rate levels.

Shapiro (1975), Marston (2001), Williamson (2001), Allayannis and Ihrig (2001), Bodnar, Dumas and Marston (2002), inter alios, contribute to a large literature that analyses the theoretical determinants of exchange rate exposure, under a variety of industry structures. These papers show that exposure is related

6. Forced sales of aircraft fleet represent an important source of financial distress in the airline industry. Pulvino (1998) shows that distressed airlines sell aircraft at heavily discounted prices, with the discount being larger during recessions and for airlines with above industry average debt levels.

to: (i) the mix between domestic and foreign sales revenue; (ii) the intensity of domestic and international competition; and (iii) the extent to which domestic and foreign inputs to production are substitutable.

The exposure determinant literature emphasises that the nature of the competitive structure of the firm's industry plays a crucial role. Industry related factors such as markup and pass-through strongly influence exposure levels. Markup is the price over cost margin, while pass-through refers to a firm adjusting its foreign currency price levels to offset the impact of exchange rates changes. Exposure is lower for more highly concentrated industries, since markups are higher.[7] Exposure and pass-through are related to product substitutability and market share.[8]

Appreciation [depreciation] of the domestic currency reduces [increases] the borrowing cost of foreign-denominated debt and other foreign sourced costs. This suggests a positive relation. However, the effect of currency movements on revenue is ambiguous. Foreign demand for international and domestic flights moves inversely with the value of the home currency. For example, if the $A depreciates, demand for flights to and within Australia from non-residents will rise. While domestic travel demand from residents also moves inversely with home currency, demand for international travel changes directly. For example, if the $NZ depreciates, New Zealand residents are likely to substitute domestic travel for international destinations. Competition in the airline industry is expected to prevent airlines from fully protecting their revenue from the impact of these currency movements. Given these counteracting effects, it is not possible to predict the sign of the currency exposure.

2.3 *Fuel Price Exposure*

Fuel price risk management matters since jet fuel costs comprise a significant component of airline operating costs. Carter, Rogers and Simkins (2002) argue that airlines also face an underinvestment problem whenever profitable investment opportunities arise during times of high jet fuel costs.

Short term cash flows are likely to be directly related to changes in the fuel price due to price change inertia. Revenue responsiveness may initially be slow due to advance sales, pre-committed advertised package fares, etc. In the longer term, much of the price effects are likely to be passed on as all airlines face similar fuel costs. The adjustment will not be complete, however, to the extent that total industry demand is affected. In the medium term, the impact of fuel price exposure is likely to be more firm specific and reflect varying degrees of competitive power and/or fuel efficiency across different airlines. Carter, Rogers and Simkins (2002) provide evidence that airline cash flows and stock returns are negatively correlated with fuel price changes.

7. Allayannis and Ihrig (2001) provide some empirical support for the prediction of their model that exchange rate changes have larger valuation effects during periods of higher competition and lower markups.
8. In the analysis by Bodnar, Dumas and Marston (2002), for any given market share, higher substitutability decreases pass-through and increases exposure. Empirical support for the predictions of their model is limited, although this may partly reflect the difficulty of operationalising the theoretical variables.

Airline profitability is reduced by the direct and indirect costs associated with the fuel price. Since competition prevents an airline from perfectly undoing the impact of changes in fuel prices by adjusting its fare schedule or seat capacity, the fuel price exposure coefficient is predicted to be negative.

3. Data and Method

3.1 Data

Weekly data is collected for the period August 1995 to June 2003.[9] All equity price, interest rate, currency and fuel price data is sourced from Datastream [DS]. Individual stock returns are obtained for Qantas and Air New Zealand, and the returns on the relevant DS Market Index are used to proxy for the national markets of these airlines. Returns are computed in the relevant domestic currency. Short-term interest rates are used as proxies for the risk free rate to compute excess returns—Australian 90–day Bank Accepted Bills are used for Qantas; the New Zealand 3–month Treasury Bill rate is used for Air New Zealand.

Interest rate risk is proxied by changes in the long-term interest rate. Domestic 10–year Treasury bond rates are used for Qantas and Air New Zealand. Measures of long-term interest rate exposure are preferred to their short-term counterparts, as the major proportion of airline debt financing is long-term. Changes in the trade-weighted index of the relevant domestic currency are used for assessing foreign exchange risk. As these airlines derive their revenues in many different currencies and use multi-currency debt structures, it is inappropriate to use a single exchange-rate and infeasible to estimate exposures to all relevant currencies.[10] Hence trade-weighted indexes appear the most useful, though imperfect, proxies available. Variation in fuel prices is measured from changes in the $U.S. price per barrel of jet kerosene, FoB, Singapore. This price is converted to a local equivalent by using the relevant exchange rate to isolate currency effects from fuel price effects.

Figures 1 and 2 plot the key variables throughout the study period to assist our readers visualise the potential impact on airline returns of the risks we analyse, and hence the likely gains from managing these risks effectively. Figure 1, panels (a)–(c) show the U.S. dollar return on $US1 invested in Qantas, Air New Zealand and the global airline industry, respectively.[11] In a period where the market value of the global industry declined, the results for the two airlines are very different. Although Qantas doubled in value, substantially outperforming the global market, Air New Zealand performed well below the industry average. Part of this differential performance can be attributed to the demise of Ansett. Each plot shows the large and negative initial impact of September 11, 2001. While the effect was reversed in the short term for Qantas and the global industry, the negative impact lasted longer for Air New Zealand. This reflects the divergent nature of the ongoing impacts of the closure of Ansett upon Qantas and Air New Zealand.

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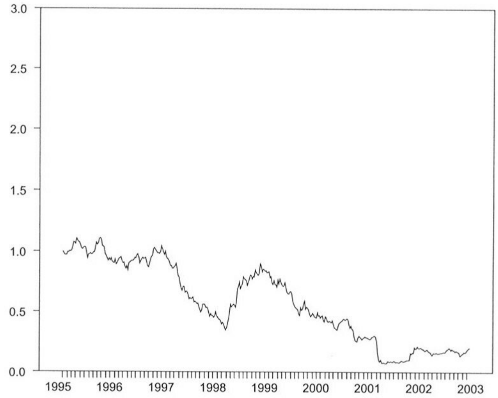
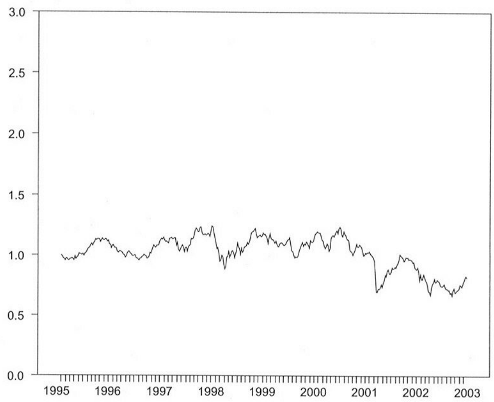
9. The start of the sample period coincides with the public listing of Qantas.
10. For example, Qantas states in its 2003 annual report that it derives revenue in approximately eighty countries.
11. Datastream's World Airlines and Airports Index is used to proxy global industry returns.

Figure 1
Airline Returns

(a) U.S. dollar return on $US1 invested in Qantas



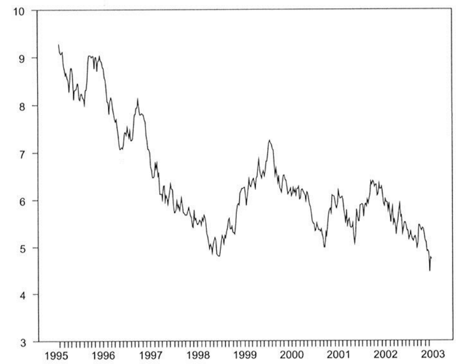
(b) U.S. dollar return on $US1 invested in Air New Zealand



(c) U.S. dollar return on $US1 invested in global airline industry

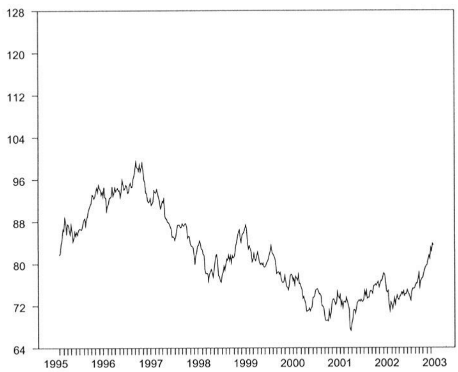
Figure 2 presents sample paths for the raw variables used to capture interest rate, currency and fuel price risk. Panels (a) and (b) graph long term interest rates in Australia and New Zealand, revealing three basic regimes that largely coincide across both countries. Falling interest rates characterise the first and last parts of the study period, with a period of rising rates occurring in the middle. Panels (c) and (d) graph the trade-weighted index value for the $A and $NZ, respectively. Plots of the Australian and New Zealand currencies display similar secular trends. After an initial period of appreciation, they tend to depreciate for much of the sample period, until they recover much of the lost ground in the final couple of years of the study. Panel (e) plots the fuel oil price which exhibits relatively high volatility. In particular, there is a substantial upward trend in the price from levels below $US15 in late 1998 to levels above $US45 in October 2000. Another temporary spike occurred during February-March 2003 with the price levels briefly breaking through the $US40 level.

Figure 2
Risk Variables



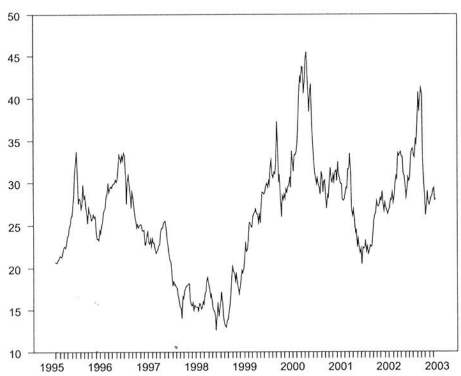
(a) Australian long-term interest rate, % per annum

(b) New Zealand long-term interest rate, % per annum



(c) $A trade-weighted index

(d) $NZ trade-weighted index



(e) Jet kerosene in $US/BBL

Selected characteristics of the airlines, collected from their annual reports, are listed in table 1, together with a description of how these characteristics are measured. These measures are relevant for assessing the potential importance of exposure to interest rate, currency and fuel price risk. They also are suggestive as to the relative ability of the airlines to respond to large and unexpected changes in these market rates.

Table 1

Selected Airline Characteristics

This table reports statistical data sourced from the airline annual reports. Both airlines end their fiscal year on June 30. Foreign Sales is percentage of total revenue derived from geographic regions outside the domestic country. Fuel Cost is cost as a percentage of total operating expenditure, excluding depreciation, amortisation and interest. Gearing is percentage of net debt to net debt plus equity. Gearing incl. Off is same as Gearing, except that it also includes off balance sheet debt. Interest Cover is earnings before interest and taxes divided by net interest expense. Long Term Debt is percentage of non-current debt to total debt, as recorded in the balance sheet. Revenue Seat Factor is percentage of revenue passenger kilometres to available seat kilometres. n.a. denotes data not available.

Fiscal Year	2003	2002	2001	2000	1999	1998	1997	1996
Panel A: Qantas								
Foreign Sales	34.5	37.7	45.4	41.1	42.1	41.7	41.7	44.3
Fuel Cost	15.5	15.8	15.1	11.4	10.7	12.7	13.0	11.8
Gearing	37	31	28	24	20	20	28	40
Gearing Incl. Off	50	50	55	48	42	44	51	62
Interest Cover	8.8	14.1	7.0	7.9	7.6	5.6	5.2	4.9
Long Term Debt	84.7	81.0	70.7	81.3	83.8	93.0	82.7	95.3
Revenue Seat Factor	78.3	78.6	76.1	75.6	73.4	72.1	78.0	78.8
Panel B: Air New Zealand								
Foreign Sales	76.8	77.7	88.8	80.5	79.1	78.0	78.6	78.8
Fuel Cost	17.9	18.0	17.4	15.7	11.8	13.6	n.a.	n.a.
Gearing	23	47	87	66	35	36	29	16
Gearing Incl. Off	65	74	93	76	56	53	52	n.a.
Interest Cover	17.8	–0.4	–0.2	3.0	3.5	4.2	11.1	69.2
Long Term Debt	89.3	91.0	76.0	68.5	87.7	86.1	82.9	72.8
Revenue Seat Factor	74.4	72.3	71.6	69.7	67.9	67.6	68.5	67.7

In reference to interest rate exposure, both airlines have high gearing ratios, with debt being predominantly of a long-term nature. Gearing ratios, including off balance sheet debt, range from 42% to 62% for Qantas and between 52% and 93% for Air New Zealand. Average end of year ratios of long-term debt to total debt, as recorded in the balance sheet over the sample was 84% for Qantas and 82% for Air New Zealand. Given their higher gearing levels, coupled with a much lower interest cover in 1999–2002, Air New Zealand appeared to have a higher exposure to interest rate risk than Qantas for much of the period studied.

Having regard to currency exposure, on the revenue side, both airlines have substantial foreign exchange earnings.[12] The lowest proportion of foreign to domestic revenue is 34.5% [Qantas, 2003] while the highest is 88.8% [Air New Zealand, 2001]. For Air New Zealand, the average annual foreign sales revenue proportion over the entire sample is approximately 80% compared to around 40% for Qantas. This imbalance suggests that the impact of currency exposure may be quite different for the two airlines.

With respect to fuel exposure, costs are a major component of airline operating costs, representing between 11–18% of total operating expenditure, across both companies. The relative importance of these costs has increased in the latter part of the sample for both airlines. In all years for which this information is available for both companies, the proportionate cost of fuel is slightly higher for Air New Zealand.

To help evaluate the comparative ability of these airlines to manage these risks from changing pricing and capacity decisions, the revenue seat factor is also provided in table 1. The revenue seat factor is the percentage of revenue passenger kilometres to available seat kilometres and provides a measure of capacity utilisation. Average annual revenue seat factor is 76.4 [Qantas] and 70 [Air New Zealand], with Qantas having the higher rate in every year of the sample. The higher revenue seat factor attained by Qantas may suggest a competitive advantage, but the difference is relatively small.

3.2 Method

3.2.1 Linear Risk Exposures While corporate managers have access to internal data for evaluating the sensitivity of their firm's cash flows to key business risks, external analysts are often restricted to share price and macroeconomic data. Operational measures of exposure to financial risks can be developed by extending the analysis of foreign exchange risk in Adler and Dumas (1984). They define exposure as the change in the market value of the firm in response to the change in the value of each currency to which the firm is exposed. They also propose that the partial regression coefficients from a multiple linear regression of firm value on the vector of exchange rates provide operational measures of exposure to the individual currencies. In the same manner, exposure to K business risks can be estimated by regressing stock returns on the returns associated with the underlying risks, that is

$$R_{jt} = \alpha_j + \sum_{k=1}^{K} \beta_{jk} R_{kt} + \varepsilon_{jt}$$

where R_{jt} is the return on the j^{th} stock and R_{kt} is the innovation in the k^{th} risk factor.

To attenuate omitted variable bias, it is usual practice to include the market return when estimating exposure coefficients. This takes into account the impact of

12. No specific information is available to analyse expenditure by currency. While segmental information provided in the financial statements of both airlines allocates revenue to different geographic areas, it apportions earnings before interest and taxes among business functional units, rather than across currencies.

market wide influences, such as macroeconomic factors, on individual asset returns. Although this procedure substantially improves the fit of the model and reduces the standard errors of the exposure coefficients, Bodnar and Wong (2001) emphasise that it changes the interpretation of the coefficient estimates. Importantly, if the market itself has non-zero exposure to the risk factors, then a zero exposure coefficient implies that the firm's exposure is not different from that for the market. It does not imply that the firm has no exposure.

To recover the usual interpretation, yet obtain the benefits of including the market return, we only include that part of the market return which is orthogonal to the risks included in the analysis. In other words, the residuals from regressing the market return on the risk factors, are used in place of the actual market returns.

In this paper, exposures to interest rate, currency and fuel price risk are estimated from the following regression

$$R_{jt,t+T} = \alpha_j + \beta_{jI} R_{It,t+T} + \beta_{jX} R_{Xt,t+T} + \beta_{jF} R_{Ft,t+T} + \beta_{jm} R_{mt,t+T} + \varepsilon_{jt,t+T} \qquad (1)$$

where $R_{jt,t+T}$ is the excess return on the individual airline; $R_{It,t+T}$ is the innovation in the long term interest rate; $R_{Xt,t+T}$ is the innovation in the exchange rate; $R_{Ft,t+T}$ is the innovation in the fuel price factor; $R_{mt,t+T}$ is that part of the excess national market return which is orthogonal to the other risk factors. Returns are computed as the log of the price/rate relative over the interval from t to T, where T equals either 1, 2, 4, 13, 52 or 156 weeks. To assess whether the exposures are jointly significant, robust Wald χ^2 test statistics are computed. These test the null hypothesis that $\beta_{jI} = \beta_{jX} = \beta_{jF} = 0$.

Evidence on foreign exchange exposure using monthly return intervals reveals a lower than expected incidence of statistically significant exposure, for example, Jorion (1990) [U.S. companies]; Loudon (1993) [Australian companies]. This unexpected result has been coined 'the exposure puzzle' in the literature. Chow, Lee and Solt (1997) argue that since the long-term effects of current exchange rate changes are difficult to evaluate and are progressively revealed through time, long horizon returns may be more informative about the true degree of exposure. Indeed they find that the incidence of exposure at the industry level increases with the return horizon. Confirming evidence is provided by Di Iorio and Faff (2001) who find similar results for the exchange-rate exposure of Australian industries. Since it is plausible that forecasting the long-term effects of interest rate and fuel price changes will present similar difficulties as exchange rate changes, we expect that a similar effect will apply for these risks. In this paper, we use several multi-week horizons stretching out to three years to examine the horizon issue.

To implement multi-week horizon analysis, we measure the multi-week return at the end of each week, using all available past weekly returns up to the horizon length. While this maximises the use of sample information, it creates the problem of serial correlation, since the returns are overlapping. To address this problem, we use the methods of Newey and West (1987) to correct the standard errors for serial correlation. These standard errors are also robust to heteroscedasticity.

3.2.2 Non-linear Risk Exposures Risk exposures may be non-linear, either because the underlying exposure itself is non-linear, or the hedging activities of the firm induce non-linearity. Selective hedging or the use of asymmetric hedging instruments by firms, may create asymmetries in exposures. Brown, Crabb and Haushalter (2001) provide evidence that firms selectively hedge, that is, their hedging strategy varies though time in response to changing market conditions. Airline management policy usually states that derivatives are not used for speculative trading purposes. However, whenever hedging is not complete but contains discretionary elements, the distinction between hedging and speculating becomes blurred. For example, the stated fuel hedging policy of Qantas is a typical example of a partial and discretionary hedging policy. Note 32(c) in its 2003 annual report states, 'Up to 100 per cent of estimated fuel costs out to 12 months may be hedged and up to 50 per cent in the subsequent 12 months, with any hedging outside these parameters requiring approval by the Board of Directors.'

Possible non-linear exposure induced by options hedging motivates Di Iorio and Faff (2000) to include asymmetric terms in their currency exposure regressions. While their findings are mixed across industries and data frequency, they find some evidence of non-linearity in the currency exposure of Australian industries. Bartram (2002) provides evidence of non-linear exposure to interest rates in a sample of German non–financial firms.

To investigate whether exposures have non-linear characteristics, we distinguish between exposure during times of positive, negative and neutral [i.e. small] changes in the non-market risk factors. To do this, we extend equation (1) to

$$R_T = \alpha + \sum_{q=1}^{3} \beta_{qI} D_{qIT} R_{IT} + \sum_{q=1}^{3} \beta_{qX} D_{qXT} R_{XT} + \sum_{q=1}^{3} \beta_{qF} D_{qFT} R_{FT} + \beta_m R_{mT} + \varepsilon_T \tag{2}$$

where D_{qkT} are dummy variables set equal to one when the k^{th} risk factor innovation is either neutral [q=1], positive [q=2] or negative [q=3], and zero, otherwise. Innovations are classified as neutral, if they fall within plus or minus half the standard deviation of all sample innovations, for that particular risk factor. Positive or negative innovations are those falling outside this range in the obvious direction. All other variables are the same as for equation (1). To simplify notation, we omit the firm subscript in equation (2) and use the time subscript T as shorthand for the variable length time horizon from t to T. As above when estimating linear exposure, T equals either 1, 2, 4, 13, 52 or 156 weeks. Multiple horizons are used to assess whether asymmetric exposure is horizon specific.

Newey-West, heteroscedastic-autocorrelation consistent standard errors are used to assess the significance of exposure coefficients estimated from multi-week, overlapping returns. For each risk factor, robust Wald tests are conducted to determine whether significant asymmetric exposure exists. They test the null hypothesis that for the k^{th} risk factor, $\beta_{1k} = \beta_{2k} = \beta_{3k}$.

3.2.3 Structural Change in Exposure To test for structural change in the exposure coefficients due to events surrounding September 2001, pre- and post-dummies are included in equation (1).[13] This yields

13. We thank a referee for suggesting a sub-analysis surrounding this period of turmoil.

$$R_T = \alpha + \beta_I^{pre} D_{pre} R_{IT} + \beta_I^{post} D_{post} R_{IT} + \beta_X^{pre} D_{pre} R_{XT} + \beta_X^{post} D_{post} R_{XT} + \beta_F^{pre} D_{pre} R_{FT} + \beta_F^{post} D_{post} R_{FT} + \beta_m R_{mT} + \varepsilon_T \quad (3)$$

where D_{pre} and D_{post} are dummy variables set equal to one for observations pre- and post-September 2001, respectively, and zero otherwise. All other variables are the same as for equation (1). Again to ease the notational burden, we omit the firm subscript in equation (3) and use the time subscript T as shorthand for the variable length time horizon from t to T, where T equals either 1, 2 or 4 in this case.

Newey-West, heteroscedastic-autocorrelation consistent standard errors are calculated. To assess the stability of the exposures, robust Wald tests are conducted. These test the null hypothesis that $\beta_k^{pre} = \beta_k^{post}$ for each of the k factors, respectively.

To estimate equation (3), we omit the three-week period ending September 26, 2001, as returns in this period were materially affected by the terrorist attacks and the demise of Ansett. Since excluding a fixed data period renders the multiple horizon, overlapping procedure inappropriate, equation (3) is only estimated using non-overlapping data. To examine multiple horizon effects, we use 1–, 2– and 4–week horizons. Regressions with longer horizons than these are not estimated so as to keep the number of observations sufficiently high. For the sake of parsimony and having regard to the relatively short length of the post-September 2001 sample period, the pre- and post- comparison is not done for non-linear response coefficients.

4. Results

4.1 Linear Risk Exposures

Table 2 reports linear exposure coefficients for interest rate, currency and fuel price risk for both airlines. Robust standard errors are enclosed in parentheses immediately below each coefficient. Exposures are estimated from equation (1), for selected multi-week horizons. To conserve space, intercepts and market betas are not reported. Robust Wald test statistics of whether exposure coefficients are jointly zero are also tabulated.

Results presented in the table are mixed. For Qantas, there is evidence of positive exposure to interest rate risk, which is opposite to what was predicted. Interest rate exposure coefficients are significantly positive at all horizons, except for weekly and 13–week returns. Conversely, there is virtually no evidence of currency exposure. All currency exposure coefficients are not significantly different from zero, apart from at the 52 week horizon, but this is only marginally significant at the 10% level. Evidence of exposure to fuel price risk exists. As predicted, fuel price exposure coefficients are negative at all horizons, with three being significant at 5% or better.

Table 2

Linear Risk Exposures

This table reports exposure coefficients for interest rate, currency and fuel price risk as estimated from the linear regression equation (1) for selected multi-week horizons. Numbers in parentheses are Newey-West robust standard errors. Rows labeled Wald contain robust χ^2 statistics from the Wald test of the null hypothesis that the fuel, currency and interest rate coefficients in equation (1) are jointly zero. The last row gives the number of observations.

Horizon in Weeks	1	2	4	13	52	156
			Panel A: Qantas			
Interest Rate Exposure	0.059	0.206**	0.258**	0.307	0.829***	0.488*
	(0.100)	(0.096)	(0.121)	(0.205)	(0.260)	(0.292)
Currency Exposure	0.042	–0.001	0.098	0.282	1.069*	0.428
	(0.170)	(0.181)	(0.266)	(0.419)	(0.639)	(0.284)
Fuel Price Exposure	–0.057	–0.098**	–0.069	–0.037	–0.404***	–0.333***
	(0.044)	(0.041)	(0.055)	(0.092)	(0.123)	(0.084)
Wald	2.181	12.134***	7.207*	5.385	61.245***	26.633***
Adjusted R^2	0.086	0.123	0.125	0.191	0.534	0.679
			Panel B: Air New Zealand			
Interest Rate Exposure	0.111	0.172	0.254	0.030	–2.248**	–2.951***
	(0.172)	(0.144)	(0.155)	(0.278)	(0.946)	(0.752)
Currency Exposure	0.211	0.739	1.371*	1.480**	0.997	–3.765***
	(0.360)	(0.653)	(0.803)	(0.735)	(0.890)	(0.294)
Fuel Price Exposure	–0.132**	–0.079	0.020	0.165	0.915*	–0.093
	(0.063)	(0.080)	(0.115)	(0.198)	(0.488)	(0.196)
Wald	8.404**	6.642*	6.447*	5.003	8.062**	461.78***
Adjusted R^2	0.145	0.171	0.201	0.160	0.350	0.783
Observations	412	411	409	400	361	257

Note: ***,** and * Significant at the 0.01, 0.05 and 0.10 levels, respectively.

Results for Air New Zealand are quite different. Interest rate exposure, where significant, is negative as predicted. However, interest rate exposure coefficients are not significant for horizons up to and including 13 weeks. Currency exposure exists in varying directions, being significant at three of the six horizons. Apart from the 156 week horizon for which it is strongly negative, currency exposure coefficients are positive. At the 1–week horizon, fuel exposure is significantly negative as expected, but surprisingly, it is significantly positive at 13 weeks, though marginally so.

Comparing results across horizons, significant exposure is detected more often over the long term, for example, nine of the twelve coefficients are significant for the 52 and 156 week horizons whereas only six of the 24 are significant for 1–, 2–, 4– and 13–week returns. This horizon effect may reflect greater true exposure or simply smaller measurement error due to the diversification of errors through time.

Evidence from the Wald tests of joint exposure is largely consistent with the above discussion of individual exposures. An exception is that while none of the exposure coefficients are significant for Air New Zealand using 2–week returns, the Wald test suggests joint significance, albeit at the 10% level only.

Explanatory power tends to increase with horizon length, especially for the longest horizons. Adjusted R^2 is 8.6% and 14.5% at the 1–week horizon, increasing to 67.9% and 78.3% at 156 weeks for Qantas and Air New Zealand, respectively.

4.2 Non-linear Risk Exposures

Table 3 reports exposure coefficients for interest rate, currency and fuel price risk as estimated from the non-linear regression equation (2) for selected multi-week horizons. To conserve space, we again suppress the reporting of intercepts and market betas. Numbers in parentheses are robust standard errors. The table also displays robust Wald test statistics of the null hypothesis that the exposure coefficients related to neutral, positive and negative innovations for the relevant risk factor are jointly equal.

Results from the Wald tests suggest that while non-linearities in exposure are important for long horizon returns, they rarely exist in the short term. For the 52– and 156–week horizon lengths, all Wald tests are significantly different from zero at 5% or better, excepting interest rate exposure for Qantas which is not significant at any reasonable level. In contrast, only two of the 24 Wald tests conducted for horizons up to 13–weeks are significant. Comparing the adjusted R^2 between the linear and non-linear specifications shows similar results. Adding the asymmetric terms only marginally increases explanatory power, if at all, for horizons up to 13 weeks, but produces a noticable improvement for the 52– and 156–week horizons.

Inspection of individual coefficients reported in table 3 reveals there are many more significant exposures for the longest two horizons than the others. Of the 72 exposure coefficients for horizons up to 13–weeks, only 15 are significant. Conversely, 26 of the 36 coefficients based on 52– and 156–week returns are significant. This reinforces the finding that non-linearities are more important in the longer term.

Comparing the individual coefficients reported in table 2 with those in table 3, reveals several instances where the linear exposure coefficient is indistinguishable from zero, yet significant exposure does exist for part of the range of innovations in the risk factor. Such cases of asymmetric responses are not restricted to the longer horizons. Consider, for instance, currency exposure for Qantas using two week returns. The linear exposure coefficient is –0.001 and non significant, however, the exposure is 1.734 and significantly positive when currency movements are small.

To ascertain the extent to which exposure to these three risks either enhances or lowers returns, it is informative to see how often significant exposures are in the favourable direction. Based on equation (2), returns are higher if either positive exposure to a given risk exists during positive changes in the underlying price, or negative exposure occurs when price changes are negative. This combination of exposures occurs in only one case, being currency exposure for Air New Zealand at the 52–week horizon. The opposite effect, with its negative impact on returns, occurs twice. For Qantas at the 52–week horizon, both currency and fuel price exposures are significantly negative when factor innovations are positive and vice versa.

Table 3
Non-Linear Risk Exposures

This table reports exposure coefficients for interest rate, currency and fuel price risk as estimated from the non-linear regression equation (2) for selected multi-week horizons. Numbers in parentheses are Newey-West robust standard errors. Neutral is exposure to risk factor innovations within plus or minus half the standard deviation of sample innovations. Positive/Negative refers to innovations outside this range. Rows labeled Wald contain robust χ^2 statistics from the Wald test of the null hypothesis that the exposure coefficients related to neutral, positive and negative innovations of the relevant risk factor are jointly equal. The last row gives the number of observations.

Horizon in Weeks	1	2	4	13	52	156
			Panel A: Qantas			
Interest Rate Exposure						
Neutral	–0.257	0.785*	–0.437	0.634	1.057**	0.146
	(0.512)	(0.427)	(0.533)	(0.723)	(0.423)	(0.344)
Positive	0.021	0.268*	0.588***	0.785**	0.923***	0.130
	(0.170)	(0.157)	(0.200)	(0.343)	(0.221)	(0.084)
Negative	0.078	0.060	0.018	–0.011	0.776**	0.454
	(0.168)	(0.157)	(0.173)	(0.245)	(0.309)	(0.279)
Wald	0.090	0.331	4.815**	1.073	0.000	0.344
Currency Exposure						
Neutral	–1.209	1.734**	–0.111	0.190	2.218	–1.984***
	(0.873)	(0.861)	(0.815)	(1.198)	(1.535)	(0.559)
Positive	0.260	0.440	0.649*	0.055	–2.229**	2.244***
	(0.326)	(0.364)	(0.384)	(0.770)	(0.987)	(0.485)
Negative	–0.066	–0.405	–0.421	0.289	2.245***	0.738**
	(0.290)	(0.260)	(0.436)	(0.543)	(0.375)	(0.312)
Wald	2.188	0.130	2.163	0.036	31.161***	71.904***
Fuel Price Exposure						
Neutral	–0.183	–0.330	–0.146	–0.349*	–0.220	0.536***
	(0.233)	(0.242)	(0.221)	(0.188)	(0.224)	(0.180)
Positive	0.047	–0.018	–0.077	–0.007	–0.696***	–0.410***
	(0.078)	(0.066)	(0.078)	(0.106)	(0.120)	(0.130)
Negative	–0.154**	–0.138**	–0.031	–0.047	0.159*	0.186*
	(0.070)	(0.068)	(0.093)	(0.149)	(0.083)	(0.096)
Wald	2.438	2.357	0.005	1.603	13.462***	113.52***
Adjusted R^2	0.085	0.136	0.140	0.202	0.669	0.755

Table 3 Continued

Non-Linear Risk Exposures

Horizon in Weeks	1	2	4	13	52	156
			Panel B: Air New Zealand			
Interest Rate Exposure						
Neutral	–0.370	0.498	0.557	1.011	–2.124	0.458
	(0.461)	(0.636)	(0.729)	(1.178)	(1.397)	(0.378)
Positive	0.132	0.118	0.123	0.573	–0.028	–5.095***
	(0.255)	(0.232)	(0.326)	(0.481)	(0.994)	(0.447)
Negative	0.182	0.246	0.357	–0.474	–2.472***	–1.873***
	(0.312)	(0.225)	(0.243)	(0.403)	(0.551)	(0.278)
Wald	0.325	0.316	0.403	0.129	9.903***	124.29***
Currency Exposure						
Neutral	–0.644	0.022	2.139*	5.225*	–9.494***	–3.789***
	(1.020)	(1.246)	(1.287)	(2.757)	(1.985)	(0.723)
Positive	–0.302	–0.198	0.948*	3.088**	3.239**	–1.518*
	(0.399)	(0.570)	(0.550)	(1.411)	(1.431)	(0.786)
Negative	0.660	1.402	1.706	–0.619	–1.305**	–4.199***
	(0.619)	(1.218)	(1.570)	(0.753)	(0.587)	(0.525)
Wald	0.241	0.874	0.463	0.457	35.496***	5.704**
Fuel Price Exposure						
Neutral	–0.086	–0.014	0.217	–0.895***	1.514*	0.493*
	(0.369)	(0.376)	(0.240)	(0.324)	(0.830)	(0.285)
Positive	–0.204**	–0.158	–0.121	–0.026	0.030	–0.225
	(0.091)	(0.114)	(0.138)	(0.157)	(0.268)	(0.153)
Negative	–0.077	–0.029	0.118	0.360	1.513***	–0.280***
	(0.096)	(0.103)	(0.164)	(0.306)	(0.457)	(0.074)
Wald	0.275	0.284	2.905*	0.833	10.117***	6.392**
Adjusted R^2	0.141	0.173	0.199	0.214	0.538	0.858
Observations	412	411	409	400	361	257

Note: ***,** and * Significant at the 0.01, 0.05 and 0.10 levels, respectively.

4.3 Consistency of Exposure, Pre- and Post- September 2001

Table 4 reports exposure coefficients for interest rate, currency and fuel price risk as estimated from the linear regression equations (1) and (3) for selected multi-week horizons, excluding the three week period ending September 26, 2001. Equation (3) includes pre- and post- September 2001 dummies to test for exposure consistency across this period. Intercepts and market betas are not reported. Numbers in parentheses are robust standard errors. Included in the table are robust Wald test statistics of the null hypothesis that the pre- and post-September 2001 coefficients in equation (3) for the respective risk factors are equal.

The Wald tests provide almost no evidence that the events of September 2001 changed the sensitivity of either airline to interest rate, currency or fuel price risk. Apart from currency exposure for Air New Zealand using two week returns, none of the other 17 Wald tests conducted is able to reject the hypothesis that the pre- and post-exposure coefficients are equal. Even in that case, the significance is only marginal. Looking at the individual coefficients shows that three exposure coefficients which were significant prior to the September exclusion period are no longer significant post September. All these are fuel price exposure coefficients. Conversely, currency exposure for Air New Zealand becomes significantly negative post September using two week returns. This is the only case where an exposure coefficient that was non-significant prior to September, became significant thereafter.

Coefficients reported in the first column of table 4 are directly comparable with those in column one of table 2 since both are estimated from equation (1) using non-overlapping returns. Those in table 4 exclude the September 2001 period, while those in table 2 include it. Excluding this unusual period, the fuel price exposure coefficient becomes significantly negative for Qantas. Significance of all other exposures is unaffected.

Results for equation (1) using 2– and 4–week non-overlapping returns as displayed in columns three and five of table 4 can be compared with those in table 2 for 2– and 4–week overlapping returns. This comparison shows that stronger evidence for exposure exists when overlapping returns are employed. Using all observations in the pre- and post- periods, none of the multi-week horizon exposures are significant using non-overlapping returns, whereas four of the twelve are significant using overlapping data for the full sample.

5. Conclusion

This study investigated the exposure of the two dominant airlines in Australia and New Zealand to key financial risks facing airlines. Both linear and non-linear specifications were used, for a variety of horizon lengths, to estimate exposures for interest-rate, currency and fuel-price risk. Three principal results have emerged from our analysis. They are briefly summarised as

1. Returns for Qantas and Air New Zealand are not significantly exposed to interest-rate or currency risk in the short term. However, both are negatively exposed to fuel-price risk in the short term. The incidence of significant exposures to these risks becomes more prevalent as the horizon length is extended.
2. Adding asymmetric terms does not tend to increase the incidence of significant exposure, at short horizon lengths. Conversely, evidence of non-linearity is quite strong for long horizon returns. Where non-linearities are found to be significant, it is rarely the case that the sign of the exposure points in the direction that enhances returns.
3. Although the events of September 2001 impacted returns of both airlines in different ways, these events had little discernible effect upon either airline's exposure to interest-rate and currency risk. However, evidence of exposure to fuel-price risk is sensitive to the time period examined.

Table 4
Structural Change in Exposure

This table reports exposure coefficients for interest rate, currency and fuel price risk as estimated from the linear regression equations (1) and (3) for selected multi-week horizons. Numbers in parentheses are Newey-West robust standard errors. All refers to exposure estimated using all observations, excluding the September 2001 period. Pre and Post is exposure for periods before and after this excluded period. Rows labeled Wald contain robust χ^2 statistics from the Wald test of the null hypothesis that the pre- and post-September 2001 coefficients in equation (3) for the respective fuel, currency and interest rate risks are equal. The last row gives the number of observations.

Horizon in Weeks Equation	1 (1)	1 (3)	2 (1)	2 (3)	4 (1)	4 (3)
Panel A: Qantas						
Interest Rate Exposure						
All	0.133		0.144		0.095	
	(0.087)		(0.120)		(0.155)	
Pre		0.144		0.185		0.181
		(0.107)		(0.132)		(0.183)
Post		0.145		0.010		–0.152
		(0.155)		(0.252)		(0.263)
Wald		0.000		0.376		1.054
Currency Exposure						
All	–0.032		0.102		0.190	
	(0.160)		(0.219)		(0.285)	
Pre		0.084		0.217		0.131
		(0.173)		(0.234)		(0.317)
Post		–0.458		–0.403		0.173
		(0.331)		(0.451)		(0.628)
Wald		2.192		1.518		0.004
Fuel Price Exposure						
All	–0.074**		–0.082		–0.068	
	(0.036)		(0.053)		(0.068)	
Pre		–0.078*		–0.098		–0.071
		(0.043)		(0.060)		(0.080)
Post		–0.064		–0.026		–0.063
		(0.075)		(0.108)		(0.122)
Wald		0.024		0.337		0.003
Adjusted R^2	0.109	0.106	0.089	0.084	0.048	0.024

Table 4 Continued
Structural Change in Exposure

Horizon in Weeks Equation	1 (1)	1 (3)	2 (1)	2 (3)	4 (1)	4 (3)
			Panel B: Air New Zealand			
Interest Rate Exposure						
All	0.081		−0.106		0.003	
	(0.132)		(0.159)		(0.186)	
Pre		0.032		−0.025		−0.038
		(0.098)		(0.125)		(0.159)
Post		0.289		−0.160		0.233
		(0.399)		(0.570)		(0.649)
Wald		0.384		0.054		0.167
Currency Exposure						
All	−0.206		−0.274		0.112	
	(0.176)		(0.312)		(0.416)	
Pre		−0.124		0.143		−0.218
		(0.182)		(0.281)		(0.423)
Post		−0.628		−1.407*		0.368
		(0.508)		(0.801)		(1.212)
Wald		0.867		3.497*		0.229
Fuel Price Exposure						
All	−0.148***		−0.077		−0.090	
	(0.043)		(0.066)		(0.083)	
Pre		−0.157***		−0.080		−0.193**
		(0.045)		(0.070)		(0.086)
Post		−0.083		0.017		0.171
		(0.107)		(0.169)		(0.228)
Wald		0.397		0.281		2.134
Adjusted R^2	0.124	0.122	0.099	0.110	0.035	0.036
Observations	409	409	204	204	102	102

Note: ***,** and * Significant at the 0.01, 0.05 and 0.10 levels, respectively.

One interpretation of our findings is that the airlines examined in this paper more effectively manage their exposure to financial risks in the short term than in the long term. This is consistent with the usual notion that readily available hedging instruments are of limited help in managing long-run risks. However, we qualify this conclusion by noting that short-horizon returns may contain too much noise to detect true exposure levels. Further, since our data and methods only allow us to observe exposure after hedging, it is not possible to determine the extent to which a lack of measured exposure reflects effective risk management rather than low underlying risk levels. Resolution of these important issues awaits data and analysis beyond the scope of this paper and is left to future research.

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