FUEL PRICE EXPOSURE IN AIRLINE INDUSTRY AND RISK MANAGEMENT

BY

MR. PITCHAYAPAN SOTTHISOPA

AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE PROGRAM IN FINANCE (INTERNATIONAL PROGRAM)

FACULTY OF COMMERCE AND ACCOUNTANCY
THAMMASAT UNIVERSITY
ACADEMIC YEAR 2016
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FUEL PRICE EXPOSURE IN AIRLINE INDUSTRY
AND RISK MANAGEMENT

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ABSTRACT

The paper studies risk management of airlines toward fuel price exposure and its determinants. Furthermore, asymmetric fuel price exposure and effect toward airline's stock return is also investigated. The study find no asymmetric fuel price exposure in airline industry and fuel price has negative effect to airline stock price. Determinants of fuel price hedging are fuel price exposure, percentage change of net income and debt/equity ratio. Moreover, the study finds no relationship between firm's profitability ratio and hedging position.

Keywords: Airline, Exposure, Hedging, Determinants

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Mr. Pitchayapan Sotthisopa

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INTRODUCTION

1.1 Airline Industry

Airline Industry, despite being one of the most technologically advanced industry, perceived as one of the most risky business. In recent years, airlines struggled in operating the business as results of economic slow-down, terrorist attacks, high fuel price and competition from low cost carrier.

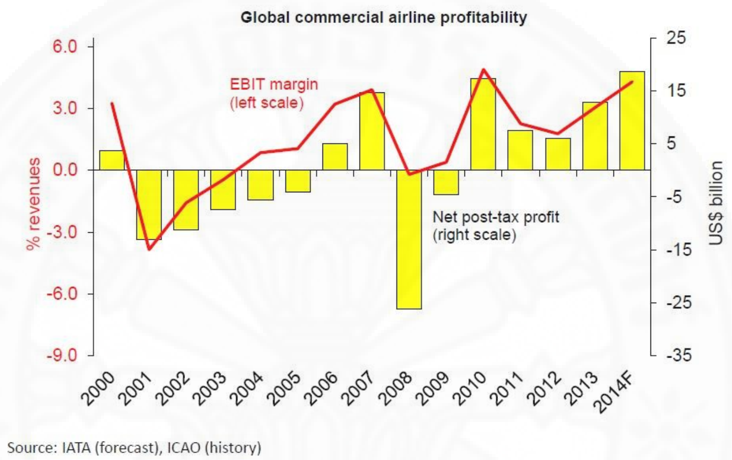

Figure 1. Global commercial airline profitability

According to Figure 1, global commercial airline's profitability range between 4.5% to -6.2%, relatively low compared to other industries. Apart from exogenous factors, airline operations face several risk exposures; strategic, operational, financial and compliance risk. Strategic risk is about positioning of the company in the industry which involves pricing. This risk is very important and normally organized by board level. Operation risk is day to day activities which comprise of the systems, processes and people such as safety, flight operation and fleet diversification. Financial risk involves uncertainty in general economic factors affecting revenues and expense of the industry. Compliance risks represent the inability of adherence with external regulations, air law and legislations. The inability to follow the rules or standards by IOSA (IATA regulation unit) will be punished as losing the reputation and huge fine to the airlines.

For airline operation, jet fuel is an essential part. It is substantial key driver in airline's operating cost since every aircraft requires fuel to operate. Jet fuel is upper fractionate from crude oil distillation (9.7% volume/volume) so the price of aviation fuel closely correlates to crude oil price. Fluctuation in crude oil price or oil crisis directly impact jet kerosene price thus cause uncertainty in airline operation cost.

Airlines need to manage the fuel risk exposure to stabilize the revenue. To mitigate the risk, airlines could either pass the increasing cost to passengers as surcharge fuel cost or they can wait until fuel price slumps back to normal level.

Table 1.1 Airlines hedging policy and fuel surcharge policy

Airlines	Hedging	Fuel Surcharge	
		International	Domestic
AIR CHINA LIMITED	✓	✓	✕
CHINA SOUTHERN AIR	✓	✓	✕
CHINA EASTERN AIRLIN	✓	✓	✕
ANA HOLDINGS INC	✓	✓	✓
KOREAN AIR LINES CO	✓	✓	✓
ASIANA AIRLINES INC	✕	✓	✓
CHINA AIRLINES LTD	✓	✓	✓
CATHAY PACIFIC	✓	✓	✓
EVA AIRWAYS CORP	✓	✓	✓
THAI AIRWAYS INT'L	✓	✓	✓
ASIA AVIATION PCL	✓	✕	✕
NOK AIRLINES PCL	✓	✕	✕
BANGKOK AIRWAYS PCL	✓	✓	✕
AIRASIA BERHAD	✓	✕	✕
AIRASIA X BHD	✓	✕	✕
PAL HOLDINGS INC	✓	✕	✕
GARUDA INDONESIA	✓	✓	✓
JET AIRWAYS	✕	✓	✓
SINGAPORE AIRLINES	✓	✓	✓
QANTAS AIRWAYS LTD	✓	✕	✕
AIR NEW ZEALAND LTD	✓	✓	✓
VIRGIN AUSTRALIA	✓	✕	✕
TRANSASIA AIRWAYS	✓	✓	✓
CEBU AIR INC	✓	✕	✕
JAPAN AIRLINES	✓	✓	-*

* there is no data in 2015

However, due to competitiveness of the industry, airlines could not always pass the unstable fuel cost to passengers. Normally, airlines could do financial hedge on the fuel price risk in several ways by such as purchasing oil option, forward, future and etc. Hedging of aviation fuel may seem straightforward, but the illiquid market and lack of derivative market may inhibit airlines from hedging aviation fuel. So, airlines tend to hedge their fuel consumption using crude oil contract or heating oil contact which closely correlate with fuel jet oil. The market is concentrated in financial hub: U.S. Gulf Coast (Houston/ New Orleans), Europe (Amsterdam, Rotterdam and Antwerp) and Singapore. On average, during 2009 – 2010, airlines do hedge their fuel consumption around 64%.

The studies in recent years focus on the European and American airline vulnerability to fluctuation in fuel oil price. However, there are very few studies that focus on Asia-Pacific market, which is another fast-growing market. So this study would emphasis on airline in Asia-Pacific region in managing fuel price risk and also be one of the guides for the firms whether they should or should not hedge fuel price risk with financial derivatives so they can develop more secure financial risk management.

1.2 Contributions

This paper will find out whether the fuel price risk exposure negatively affect airline stock price. Also, evaluate the coefficient size of hedging position in fuel price toward jet fuel exposure. Furthermore, this study will give the industry more insight in hedging activities which also could be used as preliminary guideline for hedging decision.

1.3 Research Questions

1.3.1 How does fuel price risk affect airline industry exposure?

1.3.2 What are the determinants of fuel price hedging?

1.3.3 What is the relationship between profitability of airline and hedging ratio?

CHAPTER 2
REVIEW OF LITERATURE

Financial risk exposures and risk management are vital for firms because the firms could suffer from changing underlying financial risk. There are several researches that study financial risk exposures, particularly exchange rate exposure, commodity price exposure and interest exposure.

2.1 Financial Risk Exposure

Several papers develop the model to study the effect of financial risk exposure to firms. Adler and Dumas (1984) propose that exposure of the business to risks could be measured by a simple regression of the change of firm's market value against the change of currencies value that firms that is exposed to. Because the value of firms could be measured with the stock prices, so risk exposures could be obtained by the regression of stock's price and currencies value. Market return is also regressed against the firm's value when estimating exposure coefficients by taking macroeconomic factors into account.

Bartov and Bodnar (1994) propose firms that should be included in the sample set should be heavily exposed to currency rate changes and exhibit same sign of the exposure (firms benefit or lose from depreciation and appreciation of exchange rate). Furthermore, investors might misprice the firm since exchange rate exhibits delayed effect, so they investigate this relationship and find out that one period lagged change has significant impact on the abnormal return.

Nydahl (1999) studies the changes in firm value by measure stock returns and foreign exchange rate fluctuations in Swedish firms. Using weekly data, 26% of 47 firms are significantly exposed to exchange rate fluctuation which is higher than U.S. based companies. The theory of lagged effect of foreign exchange impact is rejected. Other factors in balance sheet such as foreign direct investments and wage costs in foreign currency have no effect on firm's exposure. Moreover, the study finds that derivatives could be used to decrease exposure in firm level data.

Hentschel and Kothari (2001) investigate financial and non-financial firms, they find that corporate interest rate risk, and currency risk and total risk have response to the hedging activities. However, this weak relationship between hedging activity and the risk is a result of derivative user mitigates their risk by using financial derivatives.

Loudon (2004) investigates exposure of two dominant airlines in Australia and New Zealand to key financial risks facing airlines using both linear and non-linear specifications for several horizon lengths. He finds that exposure of interest rate, currency and fuel price risk affect the airlines in the following ways; interest rate and currency risk have no significant impact while fuel price risk affect negatively to the firms in short term period and non-linearity effect is strong in long term period.

Treanor, Rogers, Carter and Simkins (2014) examine U.S. airline industry by analyzing the relationship between corporate risk exposure, hedging policy and firm value. They find out that airline exposure rise as fuel price increases. Secondly, airlines protect themselves from fuel price fluctuation more securely when oil price is high. They also find indifference in firm’s value between the airlines that impose more hedging activities and the airline that impose stable hedging activities.

According to Jorge and Augusto (2011), financial price exposures are occurred due to firms real operations and from reduced using financial hedging instruments, they study financial risk exposure and risk management for European non-financial firms and find that there are higher percentages of exposures analyzed compared to previous studies and hedging is significantly associated with financial price exposure.

Berghofer and Lucey (2013) study the effect of financial hedging and operation hedging for global airline industry. Using fixed effect model, they reject the hypothesis that financial hedging decrease airline risk exposure. They state that the decreasing oil price volatility in recent years may be the cause that airline face lower exposure hence hedging is less effective. In the contrary, Treanor et al. (2014) compare operation hedging (Aircraft Type Diversification and Efficiency of Aircraft) to financial hedging. They find that financial hedging and operational hedging both help reduce financial exposure of airline but operation hedging has higher impact than financial hedging.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Theoretical Framework

3.1.1 Risk Exposure measurement

Risk exposure, defined as firm's elasticity to the changing of the underlying asset, could be calculated as the percentage change in the value of the particular. Treanor (1996) suggests that a firm exposed to certain risk which is systematic and orthogonal to the market risk factors could be priced according to Arbitrage Pricing Theory (APT). Since jet oil price is a significant portion of airlines operation (27% according to IATA data, 2015), so airlines are exposed to the oil price fluctuation. Two factors model is used to measure risk exposure of the firm to underlying asset by regressing the firm's return with the return of market index and the change in fuel jet oil price.

Jorion (1990) set up the analysis method of risk exposure which could be extended to investigate exposure which link key business risks to firm's cash flows. They defined that partial regression coefficients from multiple linear regression of firm value provide operational measures of exposure to the individual currencies. Analogously, exposure of the firm's to business risks could be defined as change in regressing stock returns on the returns affected by underlying risks, which is

$$R_t = \alpha_j + \sum_{i=1}^{k} \beta_k \, r_k + \varepsilon_t \qquad (1)$$

Where R_t is the return the stock and r_k is the risk factors. Moreover, the effect of macroeconomic factors such as market return should take into account in this equation. So the new equation will be as followed:

$$R_t = \alpha_0 + \beta_{Jet,t} r_{Jet,t} + \beta_{m,t} r_{m,t} + \varepsilon_t \qquad (2)$$

Where R_t is the return on the individual airline; $r_{Jet,t}$ is the return of jet kerosene price and $r_{m,t}$ is the market return. The return will be computed as natural logarithm of price. To evaluate the relationship between stock price, market returns and exchange rates, simple OLS regression will be applied.

Many literature reveal fuel price risk assumed to be symmetrically distributed. However, the effect of price fluctuation to the firm stock price might be asymmetric since firm would employ tighter risk management when oil price is high and vice versa. Therefore, asymmetric risk management will lead to asymmetric impact on cash flows which also directly affect the stock price. Koutmos and Martin (2003) study asymmetric exposure of exporters and importers of U.S., U.K., Germany and Japanese firms. They extend the model by dividing the factor into positive and negative components to test the null hypothesis that fuel price exposure is symmetric. The equation is as follows:

$$R_t = \alpha_0 + (\beta_{up,t} + \beta_{D,down,t} D_t) r_{Jet,t} + \beta_{m,t} r_{m,t} + \varepsilon_t \qquad (3)$$

Where, D_t =1 if $r_{Jet,t} < 0$ and zero otherwise. This reformulation is widely used in asymmetric risk exposure studies. The response of R_t will be equal to β_{up} when $r_{Jet,t} > 0$ and $\beta_{up} + \beta_{D,down}$ when $r_{Jet,t} < 0$. Additionally, asymmetric exposure could be measured by using the ratio of those two betas: $\frac{\beta_{up,t}+\beta_{D,down,t}}{\beta_{up,t}}$. Ratio equal to one shows symmetric risk exposure.

3.1.2 Optimal hedging ratio

Hedging could financially reduce airline's exposure to fuel price risk. By hedging, airlines lock oil price to certain level and will not affected by fluctuation of jet oil price. However, airlines do need to determine which hedging level give them minimum variance of jet fuel spot price and financial derivative price. Optimal hedging level may vary between airlines due to geographical location, financial position, In this study, optimum hedging ratio will be determined as we hypothesize that profitability of the firm will have second order relationship with hedging ratio. Optimal hedging ratio is the ratio that gives global maximum profitability ratio for airlines. So, we can set up the equation as follows:

$$ROE = \alpha_0 + \alpha_1 * hedgepos + \alpha_2 * hedgepos^2 + \varepsilon_t \qquad (4)$$

- ROE is return on equity of each airlines
- hedgepos is jet fuel hedging position as shown in firm's annual report

ROE will be used as profitability ratio of airlines will be regressed with hedging ratio to evaluate whether there is relationship between hedging ratio and profitability. After we evaluate the coefficients of second order equation, optimal hedge ratio could be obtained using analytical solution by differentiating the equation with hedging position.

3.2 Data Description

The data of the airlines use in this study must meet the following criterions; the airlines must be listed in the stock market and originate from Asia-Pacific region. The data timeframe will be 35.5 months to capture full cycle price characteristics according to MANSO (2006). The study determine oil price cycle by using Hodrick-Prescott Filter from 1972 to 2006 and finds that oil price takes take 35.5 months on average to complete the cycle. Daily data of oil price, stock price, credit rating, market data and financial ratios will be collect from Datastream program. Hedging position, fuel price passing policy of each period will be obtained directly from firm's annual report. Airline business principle dummy variable will be drawn from ICAO list. Country specific uncertainty avoidance index will be obtained directly from Hoffstede website [https://geert-hofstede.com/national-culture.html].

Table 3.1 Airline used in the study

List of Airline

Airline	Country	Ticker	Type
Qantas	Australia	QAN	Full Service
Jet Airways	India	JETIN	Full Service
Garuda Indonesia	Indonesia	GIAA	Full Service
All Nippon Airways	Japan	9202	Full Service
Japan Airlines	Japan	9201	Full Service
Asiana Airlines	Korea	20560	Full Service
Korean Air	Korea	3490	Full Service
Air New Zealand	New Zealand	AIR	Full Service
Phillipines Airlines	Phillipines	PAL	Full Service
Singapore Airline	Singapore	SIA	Full Service

List of Airline

Airline	Country	Ticker	Type
Bangkok Air	Thailand	BA	Full Service
Thai Airways International	Thailand	THAI	Full Service
Air China	China	753	Full Service
China Southern Airline	China	600029	Full Service
China Eastern Airline	China	600115	Full Service
Cathay Pacific	Hong Kong	0293	Full Service
China Airline	Taiwan	2610	Full Service
EVA Air	Taiwan	2618	Full Service
Transasia	Taiwan	6702	Full Service
Thai Air Asia	Thailand	AAV	Low Cost
Nok Air	Thailand	NOK	Low Cost
Airasia	Malaysia	AIRA	Low Cost
Airasia X	Malaysia	AAX	Low Cost
Cebu Pacifics	Philippine	CEB	Low Cost
Virgin Airlines	Australia	VAH	Low Cost

3.3 Methodology and Model Specification

To evaluate the fuel price exposure, this paper will apply two-step model following Jorge and Augusto (2011). Firstly, they apply augmented Dick-Fuller (ADF) test to verify that the data does not have unit root problem. Then they determine relationship between risk exposure and commodity price using OLS method. After that, coefficient of risk exposure will be regressed using hedging and other controlling variables.

The first equation used in the first step regression is as followed:

$$R_t = \alpha_0 + (\beta_{up,t} + \beta_{D,down,t} D_t) r_{Jet,t} + \beta_{m,t} r_{m,t} + \varepsilon_t \quad (5)$$

Where R_t is the return on the individual airline; $r_{Jet,t}$ is the return of jet kerosene price and $r_{m,t}$ is the market return. D_t =1 if $r_{Jet,t}$ < 0 and zero otherwise. This reformulation is widely used in asymmetric risk exposure studies. The response of R_t

will be equal to β_{up} when $r_{Jet,t} > 0$ and $\beta_{up} + \beta_{D,down}$ when $r_{Jet,t} < 0$. The return will be computed as natural logarithm of price. To evaluate the relationship between stock price, market returns and exchange rates, simple OLS regression will be used. The hypothesis for symmetric is: H_0: $\beta_{D,down,t} = 0$

After obtained fuel price risk exposure of each airline, the cause of hedging activities will be analyzed by examining the determinants of financial risk exposure. The regression equation is as below.

$$DHedge_j = \gamma_0 + \gamma_1\beta_{Jet,t} + \gamma_2 LTDA_j + \gamma_3 INS_j + \gamma_4 FINAC_j + \gamma_5 RTNI_j + \gamma_6 Oil_{Beta} + \gamma_7\mathrm{DAL} + \gamma_8\mathrm{ChangeinZ} + \gamma_9\mathrm{UAI} + \gamma_{10}\frac{\mathrm{D}}{\mathrm{E}} + \gamma_{11} lnINS + \mathrm{e}_t \quad (6)$$

Where **DHedge** is dummy variable assigned value = 1, if a firm uses financial hedge and 0 otherwise. Other variables are LTDA, INS, FINAC, RTNI, Coef_from_1, DAL, DOIL, ChangeinZ, UAI and D/E ratio

- **LTDA** (long term debt ratio)

For firm's debt ratio, Haushalter(2000), Graham and Rogers (2002) and Smith and Stulz (1985) find that hedging activities are linked to firm's leverage because it could help reduce the probability of company bankruptcy therefore reduce the expected cost of financial distress. As firm will face higher financial distress if it has too much debt, so firm would try to decrease this financial problem by using hedging instruments. However, Carter et al.(2006) argue that airline with low debt ratio use more derivatives than airline with high debt ratio. LTDA is expected to have positive sign to hedging.

- **INS** (percentage of ordinary shares hold by insiders)

The percentage of ordinary shares hold by insiders or management would represent the ownership of the firm. The more amount of shares hold, the more sense of belonging they will be. Hence, they tend to be more risk averse and hedge more. The expected sign is positive.

- **FINAC** (Ratio of Market Capitalization and GDP)

The ratio of market capitalization to GDP is added in the model to control the accessibility of firm for financial instruments and availability. According to CHAISRISAWATSUK (2016), the firm which registered in relatively high FINAC ratio country may have higher accessibility to financial instruments and derivatives; therefore it tends to more hedging instruments. The expected coefficient is positive.

- **RTNI** (Return of Net Income)

Fluctuation in return of N.I., computed as percentage change of the N.I.. As net income of firms fluctuates, firms would need to mitigate the uncertainty of their cost and income by hedging. The more unsecure the firms face, the more hedging activities they will do. The coefficient sign is expect to be positive.

- **Oil_Beta** (Oil Price Exposure)

Oil price exposure will be used to determine hedging decision. With increasing size of oil price exposure, managers should hedge more to compensate the size of risk. So the sign of coefficient is expected to be positive.

- **DAL** (Dummy for airline business model)

This variable measures the sensitivity between two categories of airline operating principle: full service airline and low cost airline. Low cost airline differs from full service airline in the aspect that low cost airline usually offers less comfortable seats and has lower fares. Since low cost airline already employ the minimum cost strategy in order to offer lowest air fares, therefore it could handle less risk exposure. Low cost airline would employ more fuel hedging policy comparing to full service airline. Dummy variable is used to test the effect of business strategy with 1 assigned to low cost airlines and 0 to full service airline. The coefficient sign is positive.

- **UAI** (Uncertainty Avoidance Index)

This variable reflects behavior of the firm in regard to risk aversion; managers may act differently under analogous business constraints and conditions, there are differences in culture that lead to different hedging decision. Hofstede model characterized the degree which a person in the society feels in regards to uncertainty as uncertainty avoidance index (UAI). Strong UAI index means that a people in that society would minimize the chance of unknown and unusual circumstances by planning and implementing rules and regulation. Therefore, an airline which originates in strong UAI index countries will employ hedging strategy. For example, Thailand (UAI index of 64) is less risk averse comparing to Japan (UAI index of 92) so airline from Thailand would employ less hedging strategy under same business conditions and constraints. The sign of coefficient for this variable will be positive.

- ChangeinZ (Change in Altman-Z Score)

Altman-Z score is widely use as proxy of financial health. It corporates of several factors: working capital/total assets, retained earnings/total assets, ebit/total assets, market value of equity/total liabilities and sales/total assets. Firm with high score of Altman-Z should have more stable financial health and would require less hedging. Expected sign of coefficient is negative.

- Debt/equity ratio

Debt/Equity ratio is leverage ratio that signifies level of leverage of the firm comparing to market value of shareholders. Normally, firms need to structure itself to benefit the tax shield from leverage. However, after a certain level of debt, financial distress cost overcomes tax benefit and firm will need to closely monitor its budget, so increasing D/E ratio will lead firm to control its budget more strictly. The expected sign of coefficient is positive.

3.4 Hypothesis and Expected Result

From the research questions, the null hypothesis and expected result are as follows:

1. How does fuel price risk affect airline stock performance?

Since fluctuation in fuel price deteriorates the stability of firm's income hence the relationship between fuel price return and airline stock return should be negative. $H_0 : \beta_{Jet} < 0$

2. What is the determinants of fuel price hedging?

Several hedging determinant is tested so the sign of coefficients are varied as in Table 3.2.

Table 3.2 Expected coefficient sign

Proxy Variables		Expected Sign
LTDA	Ratio of Long term debt to Total Asset	+
INS	Percentage of ordinary share held by insiders	+
FINAC	Financial Instrument Accessibility	+
RTNI	Percentage change of Net Income	-
Oil Beta	Oil Price Exposure	+
DAL	Dummy of Airline Business Principle	+
UAI	Uncertainty Avoidance Index	+
Change in Altman-Z	Dummy variable of Altman-Z Score	-
D/E	Debt/Equity Ratio	+

CHAPTER 4
RESULTS AND DISCUSSION

The study tested airline financial data altogether with its operating data over 2006 – 2015, which covers 25 listed airlines in Asia-Pacific Region. However, five airlines from China Mainland are dropped from the observation because the difficulties of annual report translation, and another one airline is dropped from the observation because it is traded over OTC.

Firstly, to evaluate the effect of fuel price movement to airline stock return, two-step regression methods will be carried. In the first step, the risk coefficient between airlines stock return and fuel price return is obtained. We also test the assumption of asymmetric exposure of oil price return to airline stock return. In the second step, hedging determinant will be evaluate with cross-sectional regression. Secondly, we investigate the relationship between firm's profitability and hedging position. We divide firm intro groups according to size and leverage level and find which level of optimal hedging ratio for airlines.

In the first step, we consider that fluctuation in oil price may affect airline stock differently between the period when oil price increases or decreases.

Table 4.1 reports result of the estimation of the regression. Doil is dummy variable added to the regression to verify if there is asymmetric oil risk exposure. According to the table 4.1, 21 from 25 airlines reports insignificant statistic test. So the test rejects the asymmetric risk exposure assumption, the variable will be dropped from the regression.

Table 4.1 Summary statistics of airline jet fuel exposure coefficients with asymmetric exposure oil price dummy.

Airline	Overall				Oil		Oil Dummy		Market		Constant	
	Obs	Prob>F	R-squared	Root MSE	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
Air China	2631	0.0000	0.4710	0.0097	-0.0322	0.0710	-0.0616	0.0290**	0.5316	0.0000	-0.0004	0.1530
China Southern Airlines	2796	0.0000	0.4318	0.0102	-0.0390	0.0330	-0.0372	0.2010	0.5187	0.0000	-0.0002	0.4450
China Eastern Airlines	2796	0.0000	0.3576	0.0246	-0.0745	0.0900	-0.0228	0.7500	1.0713	0.0000	-0.0002	0.7870
All Nippon Airways	2796	0.0000	0.2990	0.0131	-0.0455	0.0540	-0.0408	0.2770	0.5596	0.0000	-0.0005	0.1810
Korean Air	2796	0.0000	0.3234	0.0211	-0.0982	0.0100	-0.0198	0.7430	1.1673	0.0000	-0.0003	0.5610
Asiana Airlines	2796	0.0000	0.2865	0.0215	-0.1280	0.0010	-0.0094	0.8780	1.0935	0.0000	-0.0004	0.5240
China Airlines	2796	0.0000	0.2921	0.0174	-0.0813	0.0100	-0.1011	0.0430**	0.9658	0.0000	-0.0011	0.0200
Cathay Pacific	2796	0.0000	0.3724	0.0160	-0.0671	0.0210	-0.0400	0.3820	1.8640	0.0000	-0.0005	0.2710
EVA Air	2796	0.0000	0.2800	0.0194	-0.0810	0.0210	-0.1496	0.0070**	1.0435	0.0000	-0.0012	0.0150
Thai Airways	2796	0.0000	0.2433	0.0232	-0.1421	0.0010	0.0278	0.6740	1.0500	0.0000	-0.0003	0.6120
Thai Airasia	1122	0.0000	0.2296	0.0203	-0.1551	0.0080	-0.0343	0.7110	1.1969	0.0000	0.0000	0.9910
Nok Air	847	0.0000	0.1553	0.0204	-0.1034	0.0890	-0.0556	0.5700	0.9468	0.0000	-0.0020	0.0340
Bangkok Airways	490	0.0000	0.1193	0.0147	-0.1243	0.0100	0.0898	0.2670	0.6429	0.0000	0.0009	0.3320
Airasia	2796	0.0000	0.1246	0.0205	-0.0134	0.7170	-0.0185	0.7530	1.0508	0.0000	-0.0001	0.7930
Airasia X	834	0.0000	0.0341	0.0263	0.1733	0.0290	-0.2557	0.0430**	0.7379	0.0000	-0.0028	0.0200
Phillipines Airlines	2796	0.0000	0.0142	0.0410	-0.0936	0.2040	0.0616	0.6000	0.3914	0.0000	0.0009	0.3790
Garuda Indonesia	1461	0.0000	0.1000	0.0209	-0.0503	0.3650	-0.0905	0.2990	0.6645	0.0000	-0.0010	0.1650
Singapore Airlines	2796	0.0000	0.4085	0.0112	-0.0409	0.0440	-0.0457	0.1540	0.8331	0.0000	-0.0004	0.2020
Jet Airways	2796	0.0000	0.2527	0.0303	-0.1770	0.0010	-0.2453	0.7770	1.2327	0.0000	-0.0009	0.2420
Qantas	2796	0.0000	0.2342	0.0194	-0.1134	0.0010	-0.0038	0.9460	1.0033	0.0000	-0.0002	0.7610
Air New Zealand	2796	0.0000	0.1121	0.0170	-0.0335	0.2710	-0.0372	0.4440	0.9257	0.0000	-0.0002	0.6680
Virgin Airlines	2796	0.0000	0.0826	0.0306	-0.1214	0.0290	0.0879	0.3170	0.8445	0.0000	0.0000	0.9210
TransAsia Airways	1526	0.0000	0.1283	0.0152	-0.1452	0.0000	0.0765	0.2230	0.6425	0.0000	-0.0004	0.4280
Cebu Pacific	1539	0.0000	0.1567	0.0164	-0.0692	0.1010	0.0339	0.6110	0.6837	0.0000	-0.0002	0.7750
Japan Airlines	1043	0.0000	0.2114	0.0155	-0.1245	0.0070	0.0378	0.6000	0.5640	0.0000	0.0003	0.6800

* significant at 10%
** significant at 5%

Table 4.2 Summary statistics of airline jet fuel exposure coefficients without asymmetric exposure oil price dummy.

Airline	Overall				Oil		Oil Dummy		Market		Constant	
	Obs	Prob>F	R-squared	Root MSE	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|	Coeff.	P>|t|
Air China	2631	0.0000	0.4710	0.0097	-0.0322	0.0710	-0.0616	0.0290**	0.5316	0.0000	-0.0004	0.1530
China Southern Airlines	2796	0.0000	0.4318	0.0102	-0.0390	0.0330	-0.0372	0.2010	0.5187	0.0000	-0.0002	0.4450
China Eastern Airlines	2796	0.0000	0.3576	0.0246	-0.0745	0.0900	-0.0228	0.7500	1.0713	0.0000	-0.0002	0.7870
All Nippon Airways	2796	0.0000	0.2990	0.0131	-0.0455	0.0540	-0.0408	0.2770	0.5596	0.0000	-0.0005	0.1810
Korean Air	2796	0.0000	0.3234	0.0211	-0.0982	0.0100	-0.0198	0.7430	1.1673	0.0000	-0.0003	0.5610
Asiana Airlines	2796	0.0000	0.2865	0.0215	-0.1280	0.0010	-0.0094	0.8780	1.0935	0.0000	-0.0004	0.5240
China Airlines	2796	0.0000	0.2921	0.0174	-0.0813	0.0100	-0.1011	0.0430**	0.9658	0.0000	-0.0011	0.0200
Cathay Pacific	2796	0.0000	0.3724	0.0160	-0.0671	0.0210	-0.0400	0.3820	1.8640	0.0000	-0.0005	0.2710
EVA Air	2796	0.0000	0.2800	0.0194	-0.0810	0.0210	-0.1496	0.0070**	1.0435	0.0000	-0.0012	0.0150
Thai Airways	2796	0.0000	0.2433	0.0232	-0.1421	0.0010	0.0278	0.6740	1.0500	0.0000	-0.0003	0.6120
Thai Airasia	1122	0.0000	0.2296	0.0203	-0.1551	0.0080	-0.0343	0.7110	1.1969	0.0000	0.0000	0.9910
Nok Air	847	0.0000	0.1553	0.0204	-0.1034	0.0890	-0.0556	0.5700	0.9468	0.0000	-0.0020	0.0340
Bangkok Airways	490	0.0000	0.1193	0.0147	-0.1243	0.0100	0.0898	0.2670	0.6429	0.0000	0.0009	0.3320
Airasia	2796	0.0000	0.1246	0.0205	-0.0134	0.7170	-0.0185	0.7530	1.0508	0.0000	-0.0001	0.7930
Airasia X	834	0.0000	0.0341	0.0263	0.1733	0.0290	-0.2557	0.0430**	0.7379	0.0000	-0.0028	0.0200
Phillipines Airlines	2796	0.0000	0.0142	0.0410	-0.0936	0.2040	0.0616	0.6000	0.3914	0.0000	0.0009	0.3790
Garuda Indonesia	1461	0.0000	0.1000	0.0209	-0.0503	0.3650	-0.0905	0.2990	0.6645	0.0000	-0.0010	0.1650
Singapore Airlines	2796	0.0000	0.4085	0.0112	-0.0409	0.0440	-0.0457	0.1540	0.8331	0.0000	-0.0004	0.2020
Jet Airways	2796	0.0000	0.2527	0.0303	-0.1770	0.0010	-0.2453	0.7770	1.2327	0.0000	-0.0009	0.2420
Qantas	2796	0.0000	0.2342	0.0194	-0.1134	0.0010	-0.0038	0.9460	1.0033	0.0000	-0.0002	0.7610
Air New Zealand	2796	0.0000	0.1121	0.0170	-0.0335	0.2710	-0.0372	0.4440	0.9257	0.0000	-0.0002	0.6680
Virgin Airlines	2796	0.0000	0.0826	0.0306	-0.1214	0.0290	0.0879	0.3170	0.8445	0.0000	0.0000	0.9210
TransAsia Airways	1526	0.0000	0.1283	0.0152	-0.1452	0.0000	0.0765	0.2230	0.6425	0.0000	-0.0004	0.4280
Cebu Pacific	1539	0.0000	0.1567	0.0164	-0.0692	0.1010	0.0339	0.6110	0.6837	0.0000	-0.0002	0.7750
Japan Airlines	1043	0.0000	0.2114	0.0155	-0.1245	0.0070	0.0378	0.6000	0.5640	0.0000	0.0003	0.6800

* significant at 10%
** significant at 5%

Statistic figure in Table 4.2 reports the results for first step regression without asymmetric oil price variable. It shows overall coefficient, oil price exposure and market exposure. The average coefficient is = -0.0899 and 88% of those are significantly less than zero using t-test 5% significant level. The average coefficient is more than previously reported of -0.1100 in Carter et al. (2006a). The result from the regression agrees with the result from literature, oil price exposure adversely affect airline stock return with significant level of 5%.

In the second step, we evaluate the determinants of hedging by cross-sectional regressing dummy variable of hedging decision and groups of variable: long term debt, insider stock holding, financial accessibility, return of net income, change in Altman z-score, oil risk exposure, debt/equity ratio. The coefficient regressed from first-step regression is use as independent variable.

Table 4.3 Summary statistics of airline hedging decision and determinants

```
. reg  dhedge_dum ltdata ins finac rtni coef_from1 dal_n uai_n changeinz de_ratio ln_ins
```

Source	SS	df	MS		
				Number of obs =	22
				F(10, 11) =	4.32
Model	.760945446	10	.076094545	Prob > F =	0.0120
Residual	.193600008	11	.017600001	R-squared =	0.7972
				Adj R-squared =	0.6128
Total	.954545455	21	.045454545	Root MSE =	.13266

dhedge_dum	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ltdata	-.4381215	.298839	-1.47	0.171	-1.095862	.2196187
ins	-.467225	.3122351	-1.50	0.163	-1.15445	.2199997
finac	-.2358073	5.607476	-0.04	0.967	-12.57778	12.10617
rtni	-.0104144	.0040313	-2.58	0.025	-.0192872	-.0015416
coef_from1	1.158913	.4519287	2.56	0.026	.1642248	2.153602
dal_n	.080777	.0914834	0.88	0.396	-.1205766	.2821305
uai_n	.0006051	.0021664	0.28	0.785	-.0041632	.0053734
changeinz	.0618851	.040125	1.54	0.151	-.0264295	.1501996
de_ratio	.0433111	.0176687	2.45	0.032	.0044227	.0821996
ln_ins	-.00276	.014855	-0.19	0.856	-.0354556	.0299356
_cons	1.092582	.3168728	3.45	0.005	.3951497	1.790015

According to the reported result, overall coefficient is significant at 5% an R-squared value is substantially high. Return of Net Income, Oil price risk exposure and debt/equity ratio is significant at 5%. The sign of net income return is as predicted, as net return increases, firms have less cause to worry about budget constraint and will hedge less, but the size of coefficient is not very high so the effect might be minimal.

For Oil price risk exposure, sign is as predicted, as risk exposure increases, firm will hedge more with higher risk exposure and size is quite large which means that it has substantial effect to hedging decision. Lastly, debt/equity ratio is also significant, the sign of coefficient is as predicted, as size of leverage/equity increase, managers are aware that risk of financial distress rises, therefore they need to tighten budget which results in more hedging.

Finally, we explore the relationship between profitability and hedging be using ROE (return on equity) as proxy for profitability. As we hypothesize that hedging as percentage of fuel hedged affects profitability with second order relationship, the regression reports as follow:

Table 4.4 Summary statistics of ROE and hedging position of Large Airlines

```
. reg  roe  hedge_pos1 hedge_pos2

      Source |       SS       df       MS              Number of obs =      12
-------------+------------------------------           F(  2,     9) =    0.24
       Model |  .017272871     2  .008636435           Prob > F      =  0.7951
    Residual |  .330418197     9  .036713133           R-squared     =  0.0497
-------------+------------------------------           Adj R-squared = -0.1615
       Total |  .347691068    11  .031608279           Root MSE      =  .19161

------------------------------------------------------------------------------
         roe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  hedge_pos1 |  -.3421702   .5892199    -0.58   0.576    -1.675078    .9907379
  hedge_pos2 |   .3021786   .6669219     0.45   0.661    -1.206504    1.810861
       _cons |   .0611302   .0915139     0.67   0.521    -.1458887     .268149
------------------------------------------------------------------------------
```

Table 4.5 Summary statistics of ROE and hedging position of Small Airlines

```
. reg  roe  hedge_pos1  hedge_pos2

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  2,    10) =    0.76
       Model |  .037277422     2  .018638711           Prob > F      =  0.4909
    Residual |  .243772574    10  .024377257           R-squared     =  0.1326
-------------+------------------------------           Adj R-squared = -0.0408
       Total |  .281049996    12  .023420833           Root MSE      =  .15613

------------------------------------------------------------------------------
         roe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  hedge_pos1 |  -.5725614   .5215967    -1.10   0.298    -1.734751    .5896284
  hedge_pos2 |   .8346106   .6817311     1.22   0.249     -.684381    2.353602
       _cons |   .0977537   .0920703     1.06   0.313    -.1073918    .3028992
------------------------------------------------------------------------------
```

Table 4.6 Summary statistics of ROE and hedging position of High Leverage Airlines

```
. reg  roe  hedge_pos1  hedge_pos2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =    0.61
       Model |  .086031663     2  .043015832           Prob > F      =  0.5648
    Residual |  .560427177     8  .070053397           R-squared     =  0.1331
-------------+------------------------------           Adj R-squared = -0.0836
       Total |   .64645884    10  .064645884           Root MSE      =  .26468

------------------------------------------------------------------------------
         roe |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  hedge_pos1 |  -.9548531   .8686953    -1.10   0.304    -2.958068    1.048362
  hedge_pos2 |   .9838496   .9685813     1.02   0.339    -1.249703    3.217402
       _cons |   .0751778   .1435881     0.52   0.615    -.2559369    .4062926
------------------------------------------------------------------------------
```

Table 4.7 Summary statistics of ROE and hedging position of Low Leverage Airlines

```
. reg  stock_return hedge_pos1 hedge_pos2

      Source |       SS       df       MS              Number of obs =      13
-------------+------------------------------           F(  2,    10) =    1.21
       Model |  4.2733e-06     2  2.1367e-06           Prob > F      =  0.3393
    Residual |   .00001771    10  1.7710e-06           R-squared     =  0.1944
-------------+------------------------------           Adj R-squared =  0.0333
       Total |  .000021983    12  1.8319e-06           Root MSE      =  .00133

------------------------------------------------------------------------------
stock_return |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  hedge_pos1 |   -.006047   .0044458    -1.36   0.204    -.0159528    .0038588
  hedge_pos2 |   .0089006   .0058107     1.53   0.157    -.0040464    .0218476
       _cons |   .0003195   .0007848     0.41   0.692     -.001429    .0020681
------------------------------------------------------------------------------
```

All of the statistic result are insignificant at 5% level, hence there are no significant relationships between profitability and hedging position of airlines classified by either size or leverage ratio. Both of classification is divided using median of firm size natural logarithm and leverage ratio. Changing dependent variable from ROE to stock return yields same insignificant result.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

This study focuses on fuel oil price exposure on airline. We study risk management policy that airlines use to hedge oil price risk exposure. The exposure strongly affect airline business since cost of fuel accounts around thirty percent of airline cost. Firstly, to answer the research question: "How does fuel price risk affect airlines?". We evaluate the effect of oil price fluctuation to airline stock price. We test asymmetric exposure hypothesis by introducing dummy variable to the system, 84% of the airlines reports insignificant coefficient, therefore we reject the hypothesis of asymmetric oil price exposure. Next, we shows that airlines stock price are adversely affected by oil price change. To do so, we directly regress return of airlines stock price with two variables; return of jet fuel price and return of stock market. The result shows that 88% of the sample have negative effect from increasing oil price.

Secondly, after oil price risk exposure is obtained. We study further about why airlines hedge fuel price exposure, is it solely from oil price movement or firm hedge because its financial health. To answer the second research question: "Why does airline hedge fuel price exposure". The study run the cross-sectional test of hedging decision and groups of determinants. The results shows that return of net income, fuel price exposure and debt/equity ratio are the main determinants of fuel price hedging.

As we study the relationship between hedging position and firm profitability for optimum hedging ratio. Despite the assumption that there is relationship between airline's profitability ratios and hedging ratio, we do not find any relationship between them.

All in all, the study suggest that there are no asymmetric exposure of fuel price risk in Asia-Pacific airline industry an most of the airlines are negatively affected by increasing oil price. For hedging factors, determinants of hedging are risk exposure of oil price, return of net income and debt/equity ratio. Moreover, there seems to be no relationship between profitability of firm and hedging ratio. Further researches may focuses on determining optimal hedging ratio of airlines.

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