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博士論文

The Effects of Hedging on Firm Value and Analyst Forecast Accuracy: Evidence from the Global Airline Industry

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Preface

This dissertation encompasses two essays to examine the effects of hedging activities on firm value and analyst forecast accuracy. These essays have been transformed into working papers. The first working paper, based on Chapter II is entitled " Does hedging add value? Evidence from the global airline industry". It has been presented in the 16th conference on the Theories and Practices of Securities Financial Markets on Dec. 5, 2008 at the National Sun Yat-sen University in Kaohsiung. The second working paper, entitled "Corporate hedging activities and analyst forecast accuracy: Evidence from global airline industry ", is currently under revision and will be sent to conferences in the near future.

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Rueyjiau Lin
January 20, 2009

Abstract

Two essays are comprised in this dussertation to examine whether jet fuel hedging has effects on firm value and analysts' forecast accuracy in the global airline industry. Using global data allows us to cmpare the differences of jet fuel hedging behavior and incentives for hedging across different sub-samples. Furthermore, we also examine how jet fuel hedging affects analysts' forecast erros across different sub-samples and its implications for firm disclosures about their risk exposures in the financial reports.

In the first essay, we examine whether jet fuel hedging increases the market value of airline companies around the world. Using a sample of 70 airline companies from 32 countries over the period 1995 to 2005, we find that jet fuel hedging is not significantly positively related to their firm value in the global airlines, but this positive relationship holds in the various sub-samples and is significant for US and non-alliance firms. Moreover, our results show that the risk-taking behavior of executives and the tendency to avoid financial distress are important determinants for the jet fuel hedging activities of non-US airline companies. Alleviating the problem of underinvestment is also an important factor to explain the jet fuel hedging activities of US and non-alliance firms. Our results add support to the growing body of literature which finds that hedging increases firm value for global airline companies.

In the second essay, we examine the extent analysts revise their earnings forecasts in response to oil price, interest rate and foreign exchange rate shocks they have observed during the year, and whether these revisions contain additional information about how current and past price shocks affect reported earnings, using

the sample of the global airline industry. Empirical results indicate that jet fuel hedging can increase analysts' forecast revisions in the total sample, and in the sub-sample of the volatile fuel price period. These results can also be seen in US and non-US airlines, and airlines with both strong and weak governance. Overall, our results show that oil price shocks play an important role in investor and analyst information uncertainty with regard to the global airline industry. Consequently, corporate risk disclosures only provide limited information about firms' financial risk exposures.

Chapter I

Introduction

Since the September 11 terrorist attacks, many airline companies are eager to improve their cost structure by saving operation expenses due to higher fuel prices. The extreme volatility in fuel prices is a huge burden for the global airline industry. According to IATA's (International Air Transport Association) estimation, $425 million extra operating expenses were incurred from every additional dollar increased in the price per barrel for the U.S. airline industry in 2005. If an airline company is able to control its fuel costs, it can operate more competitively in the market. For example, Southwest Airlines, the largest U.S. aircraft by market value, and the global role model for low-cost airlines, is known to undertake hedging activities against higher fuel prices. It hedged about 85% and 70% of its requirements for the years 2004 and 2005, respectively, cutting fuel and oil costs by $196 million in the second quarter of 2005. We collect hedging data for 70 airline companies across 32 countries, and it allows us to test the relationship between hedging activities and firm value in a more global content. Furthermore, we examine whether jet fuel hedging can affect analysts' forecast errors through its effect on firm value. We expect that jet fuel hedging can increase firm value and affect its earnings per share. In the second essay, we will examine if analysts can realize this effect and take it into account when making their forecasts. Investigating whether current year and one-year lagged fuel price shocks have impact on the formation of analysts' forecast is one of our objects in the second essay. In addition, we also inspect whether airline companies' fuel hedging activities have any influence on analysts' earnings forecasts. We expect that airlines with jet fuel hedging would decrease analysts' forecast errors, because hedging activities can reduce the earnings' volatility and it makes analysts' forecasts more accurate.

The first essay of this dissertation examines the relationship of jet fuel hedging activities and firm value, and explores the determinants of jet fuel hedging for airline companies around the world. Using a sample of 70 airline companies from 32 countries over the period 1995 to 2005, we find that jet fuel hedging is not significantly positive related to their firm value in the world's airline companies, but this positive relationship holds in the various sub-samples and is significant for US and non-alliance firms. Moreover, we find that economies of scale and the use of currency derivatives are important determinants for total sample. Our results also show that the risk-taking behavior of executives and the tendency for them to avoid financial distress are important determinants for the jet fuel hedging activities of non-US airline companies. Alleviating the problem of underinvestment is also an important factor to explain the jet fuel hedging activities of US and non-alliance firms. Our results add support to the growing body of literature which finds that hedging increases firm value for global airline companies.

The second essay of this dissertation examines the association between the shocks to financial markets and investors' uncertainty about firm's financial risk exposures. We use a sample of 71 airline companies in 32 countries from 1995 to 2007 to test the abnormal returns of airline companies around earnings announcements and its association of earnings forecasts. Our results show that recent oil price surge plays an important role on analyst forecast errors in the global airline industry. We compare the effects of oil, interest rate and currency hedging activities on airline companies and find that oil hedging increases the analysts forecast errors, while interest rate and foreign exchange hedging reduce the analysts forecast errors. It suggests that analysts concern more about firms engaged in oil prices hedging due to the volatile nature of oil prices.

The remainder of this dissertation is structured as follows. Chapter II explores the effects of jet fuel hedging on firm value, and the incentives of fuel hedging. Chapter III examines the association between risk exposures and investors' information uncertainty. Chapter IV provides the conclusions and future research of this dissertation.

Chapter II

Does Hedging Add Value?

Evidence from the Global Airline Industry

1. Introduction

In response to the recent leap in oil prices, more and more airline companies are engaged in hedging activities. According to the Modigliani-Miller theorem, in a perfect market hedging should add no value to the firm. However, the assumption of perfect market does not hold in the real world, and whether hedging can increase firm value is mixed in the literature. Allayannis and Weston (2001) examine the relationship between currency hedging activities and firm value in the U.S. market and conclude that hedging can increase firm value for a large sample of U.S. non-financial firms. Carter, Rogers and Simkins (2006a, b) find that jet fuel hedging is positively related to the market value of airline companies. Conversely, Jin and Jorion (2006) find that there is no relationship between hedging activities and firm value for U.S. oil and gas producers from 1998 to 2001. However, these studies focus mainly on the relationship between currency hedging activities and firm value in the U.S. market and the aim of this study is to examine whether jet fuel hedging can increase firm value in the global airline industry.

The academic literature has also focused on exploring which factors contribute to the hedging activities and risk management theory provides several reasons to explain why firms may hedge. Smith and Stulz (1985) and Leland (1998) propose that tax issues are related to such activities, while Smith and Stulz (1985), Bessembinder (1991), and Froot et al. (1993) argue that reduction of underinvestment or financial distress costs contribute to hedging. Furthermore, the risk-taking incentives of managers are also related to hedging behavior (Stulz, 1984; Smith and Stulz, 1985; Tufano, 1996; Rogers, 2002). Because the airline industry is an internationally competitive industry, variable fuel prices increase earnings volatility, a problem that hedging may be able to alleviate. Furthermore, it is hard to transfer surging oil price to customers through rising of fuel surcharge on tickets for airline companies due to their competitive operating environment. Therefore, using 70 airline companies from 32 countries during the period 1995 to 2005, we examine the sources of jet fuel hedging premium. Because such companies are subject to significant price risk due to volatile jet fuel price, this allows us to investigate the sources of added value from jet fuel hedging activities using data from global airline companies.[1]

Since September 11, 2001 terrorist attacks, many airline companies are eager to improve their cost structure to save operating expenses due to higher fuel prices. Figure 2-1 depicts the average monthly spot jet fuel prices at three locations during our sample period. It is seen that the Gulf Coast fuel price reached $2.4 per gallon in October, 2005, while the average fuel price was $0.51 per gallon at the end of 2001. Thus, from 2001 to 2005, the average fuel prices had risen 37 percent. The extreme volatility in fuel prices during this period was a huge burden for airline industry, because fuel costs are the second largest category of operating expenses.[2] According to IATA's (International Air Transport Association) estimation, $425 million extra operating expenses were incurred from every additional dollar increased in the price per barrel for the U.S. airline industry in 2005. If an airline company is able to control fuel costs, it can operate more competitively in the market. For example,

[1] I use kerosene-type jet fuel at three major US trading locations (New York Harbor, U.S. Gulf Coast, and Los Angeles) following Carter et al. to describe the trend of fuel prices. The sample period is from 1995 to 2005, the average monthly jet fuel price is 80.61 cents per gallon, and its standard deviation is 37.8 cents per gallon.

[2] For example, jet fuel costs were an average of 14.29% of total operating expenses in the U.S. airline industry from 1995 to 2005.

Southwest Airlines, the largest U.S. aircraft by market value, and the global role model for low-cost airlines, is known to undertake hedging activities against higher fuel prices. It hedged about 85% and 70% of its fuel requirements for the years 2004 and 2005, respectively,[3] cutting fuel and oil costs by $196 million in the second quarter of 2005.[4] However, as our data contains 70 airline companies across 32 countries, it allows us to test the relationship between hedging and firm value in a more global content.

This research contributes to the current literature in the following ways. Firstly, the volatility of jet fuel prices in the sample period for this study is much larger than those in the previous studies (Carter et al., 2006a, b).[5] It is thus expected that jet fuel hedging would increase firm value more significantly during our sample period. Secondly, compare to Carter et al. (2006a, b), we use data from 32 countries to examine the relationship between jet fuel hedging and firm value, and this study is the first to examine the hedging behaviors of jet fuel prices from a global perspective. Thirdly, we partition the entire sample into different sub-samples to better explore the determinants of jet fuel hedging premium.

Our regression analysis show that, on average, jet fuel hedging is not valuable for airline companies. This finding is contrary to the results of Allayannis and Weston (2001) and Carter et al. (2006a), who find that the usage of hedging derivatives can add value to the firm. Moreover, US airlines those engage in fuel hedging activities increase their firm value by approximately 7.87%. We also show that non-US

[3] The hedge ratio of fuel requirements are collected from 10-K filings in the U.S. Securities and Exchange Commission (EDGAR).

[4] Done, K., July 15, 2005, "Southwest sees profits up 41%," *Financial Times London*, p. 32.

[5] In our sample period, the annualized standard deviation of jet fuel prices is 30.35% compared to Carter et al.'s (2006a, b) report of 27%, measured from 1992 to 2003. The standard deviation of average monthly fuel prices is 37.8 cents per gallon in our sample period, as compared with their report of 15.7 cents per gallon.

airlines and airlines with an alliance[6] that hedge for fuel price risks add nothing to their firm value. We also show that fuel hedging is more valuable in the volatile period than in the stable period. This result provides evidence that airline companies can avoid declines in their value due to soaring oil prices by undertaking hedging activities. Compare to Carter et al. (2006a, b), we find that jet fuel hedging can not add value to firms for non-US airlines. They may use other substitutes to transfer the fuel price risk. For non-US airlines, they engage in fuel hedging activities to reduce financial distress costs and comply with managers' risk-aversion hedging incentives. On the other hand, alleviating underinvestment problems plays an important role on the determinants of jet fuel hedging for US airlines, but it is not significant for non-US airlines.

We also investigate the determinants of jet fuel hedging for airline companies around the world. The evidence shows that hedging to reduce the probability of incurring financial distress plays an important role for non-US airlines and in the period of stable fuel prices, and that alliance airlines and airlines in the volatile period hedge fuel price risk exposures to preserve their higher profitability. Moreover, it is seen that jet fuel hedging is motivated by managerial risk aversion for non-US airline companies, but we also find that jet fuel hedging is motivated by managerial risk-taking behavior for airlines in the stable period, which is suggested by Galai and Masulis (1976) and Saunders et al. (1990). Conversely, airlines in the stable period engage in fuel hedging activities are motivated by managerial risk-taking behavior. In addition, a fuel pass-through mechanism can substitute for fuel hedging using

[6] An airline alliance is an agreement between two or more airlines to cooperate for the foreseeable future on a substantial level. The degree of cooperation is different between alliances. Star Alliance, SkyTeam and Oneworld are the three largest alliances in the world so far. In addition, a number of alliances between cargo airlines have formed recently, such as the WOW Alliance between Lufthansa Cargo, Singapore Airlines Cargo, SAS Cargo Group and Japan Airlines Cargo.

derivatives for the global airline companies, US and non-US airlines, non-alliance airlines and airlines in the volatile period. Consistent with Froot et al. (1993) and Carter et al.'s (2006a) findings, our results show that mitigating underinvestment problems is an important reason to hedge for US airlines, non-alliance airlines and airlines in the stable period. Finally, we also document that economies of scale and the use of currency derivatives are also important in explaining all airlines' fuel hedging behavior.

The rest of this essay is organized in the following way. Section 2 gives a brief overview of hedging theories. Section 3 describes the sample and specifies the measures of hedging activities, firm value and other explanatory variables. Section 4 presents the estimated results for the impact of jet fuel hedging on airline firm value. Section 5 explores the determinants of why airline companies use derivatives to hedge jet fuel risk exposures, and Section 6 concludes this paper.

2. Literature Review

In the Modigliani-Millers's world, hedging would not add value to a firm if the financial market is perfect. However, in the real world, the financial market is not frictionless and hedging may influence the cash flow of the company. A number of academic researches have studied the relation between hedging activities and firm value. In addition, a considerable amount of literature has been focused on exploring what factors influence firms' hedging activities.

2.1 Hedging and Firm Value

Allayannis and Weston (2001) find that there is a positive relation between the usage of foreign exchange derivatives and firm value, using a sample of 720 large non-financial firms with foreign sales from 1990 to 1995. They find that the hedging premium is significant at about 4.87% of firm value, and it is larger in the period of dollar appreciation. Nain (2004) divides his sample into 548 derivatives users and 2,711 non-derivative users of U.S. firms with ex-ante foreign exchange exposure from 1997 to 1999. He shows that that foreign exchange risk management can increase firm value (proxied by Tobin's Q) if many of their competitors hedge. Conversely, Guay and Kothari (2003) argue that based on the magnitudes of the notional amount of the derivatives used by U.S. firms, the value premium is insignificantly related to a firm's hedging position.

Bartram, Brown and Fehle (2004) use a large sample of 7,319 non-financial companies in 50 countries from 2000 to 2001 to examine the impact of interest rate and foreign exchange derivatives usage on firm value. They document that the usage of derivatives is a value-adding activity, and the result is more significant for interest rate than foreign exchange hedging. Previous research also examines whether hedging of commodity risk exposures is related to firm value in the U.S. market. Lookman (2004) investigates exploration and production companies that hedge commodity price risk and the impact on firm value. He classifies oil price into primary and secondary risk to show that undiversified exploration and production companies that hedge primary risk are associated with lower value. On the other hand, he shows that for diversified companies, which have both exploration and production segments, hedging is associated with higher value. Callahan (2002) finds that the extent of gold hedging is negatively related to a firm's stock price using a sample of 20 North American gold mining firms over the period 1996 to 2000.

Carter et al. (2006a, b) study the fuel hedging of 28 companies in the U.S. airline industry during the period of 1992 to 2003. Their results show that jet fuel hedging can increase firm value, and the hedging premium is economically significant. Jin and Jorion (2006) argue that risk management has no effect on 119 U.S. oil and gas producers in the period of 1998 to 2001. In contrast, Chang, Gu and Xu (2005) examine the relationship between oil and gas hedging and firm value in Canada, and find that gas production hedging has a negative effect on firm value, while gas reserve hedging has a positive impact. This result indicates that Canadian oil and gas producers can increase their firm value by hedging gas production and reserves.

2.2 Incentives for Hedging Activities

Following Smith and Stulz's (1985) discussion of the motivations for hedging behaviors, a growing number of researchers have examined the issue. This line of empirical evidence suggests the following reasons why firms may hedge.

2.2.1 Tax Incentives

If hedging benefit can offset hedging cost, a firm may be willing to use hedging instruments to lessen its expected tax liability and reduce the variability of its pre-tax firm value. Such hedging activity associated with tax incentives can increase the firm's expected post-tax value. Smith and Stulz (1985) indicate that the convexity of the tax function makes firms hedge more, which in turn increases their value. Leland (1998) also shows that hedging can increase the debt capacity of a firm, and thus reduce their expected tax payments.

Graham and Smith (1999) use a simulation method to analyze more than 80,000 firms in the U.S. They find that 50% of their sample face convex effective tax functions and 25% face linear tax functions. They show that approximately one-quarter of the companies with convex tax functions can obtain substantial tax savings from hedging, a result that is consistent with Smith and Stulz (1985). Graham and Rogers (2002) conclude that hedging exposures of foreign exchange and interest rates enhance firm value as a result of increased debt capacity, but they find no evidence that a firm's hedging behavior responds to tax convexity.[7]

2.2.2 Managerial Incentives

Because information is asymmetric between insiders (managers) and outsiders (shareholders), it gives managers an opportunity to serve on their own interests and expropriate shareholders' benefits. Smith and Stulz (1985) indicate that the compensation function is linear and convex to firm value, which may influence managers' hedging decisions. When managers hold a substantial fraction of a firm's stock, they hedge more. DeMarzo and Duffie (1995) argue that the optimal hedging policy adopted by managers depends on the type of accounting information made available to outside shareholders. Following this argument, managers' skills and abilities are monitored more closely by outside investors. In addition, Tufano (1996) takes manager-shareholder agency problems into account and shows that managers may damage firm value by hedging. The results of his study reveal that tying managers' wealth to firm value affects hedging policies. Meanwhile, Breeden and Viswanathan (1998) show that managers with poor skills may not hedge and manage

[7] We do not discuss this issue in the following analysis, because the explanatory variable (tax loss carryforwards) is only available for airlines listed in US. Considering it would reduce our sample substantially and make our results meaningless.

risk exposures adequately without monitoring by outsiders. Finally, Rogers (2002) uses a simultaneous equation method to show that CEOs' risk-taking incentives have negative influences on firms' currency and interest rate hedging activities.

An alternative view is to regard the common stock of a firm as a call option. Thus, the market value of a firm rises as its risk increases (Galai and Masulis, 1976). In addition, Saunders et al. (1990) find that managers with more equity in their firm tend to increase risk in the banking industry, although. There are also several empirical studies that find insignificant evidence to support managerial incentives as determinants of firms' risk management behaviors (Géczy, Minton and Schrand, 1997, Gay and Nam, 1998, Allayannis and Ofek, 2001, and Haushalter, 2000).

2.2.3 Financial Distress and Underinvestment Costs

Financial distress usually occurs when a firm's revenue fails to meet its expenditures. Hedging can reduce the probability of incurring financial distress costs, and creates profitable investment opportunities through minimizing the volatility of a firm's cash flow in the foreseeable future. Mayers and Smith (1982) show that a firm's insurance contracts can reduce the expected transactions costs of bankruptcy, while Smith and Stulz (1985) also show that hedging can lower the expected costs of financial distress. Lel (2006) uses a sample of ADRs cross-listed in the U.S. and concludes that financial distress costs are related to a firm's hedging activity, although. Evidence from Mian (1996) and Tufano (1996) does not support this conclusion.

According to the pecking order theory, the external cost of capital is more expensive than the internal cost of capital for firms facing valuable investment projects, so there may be an incentive to hedge risk to assure they have enough funds to alleviate underinvestment. Froot et al. (1993) show that hedging can ensure that companies have sufficient internal funds to complete profitable investment opportunities by lowering the variability of internal funds. Gay and Nam (1998) analyze the relation between a firm's derivatives use and underinvestment problems, examining the interacting influences among firms' investment opportunities, cash stocks, and internal cash flows to identify the position of underinvestment. They argue that firms with good investment opportunities tend to use derivatives to hedge their risks.

Haushalter (2000) examines the risk management activities of 100 oil and gas producers from 1992 to 1994. He finds that the correlation between the extent of hedging and financial leverage is positive, which supports the argument that a company can reduce financial contracting costs through hedging activity. Finally, Carter et al. (2006a, b) indicate that hedging fuel costs can help airline companies to manage their potential underinvestment problem, as well as reduce the costs of financial distress.

3. Sample Description

This paper analyzes the relationship between jet fuel hedging, firm value and hedging incentives for a sample of global airline companies. We gather the financial data for these firms from the COMPUSTAT database. The information regarding whether these companies use jet fuel derivatives, interest rate and foreign exchange derivative holdings is collected from the footnotes in their annual reports, 10-K filings or 20-F forms provided by Mergent Online database (SIC codes 4512 or 4513) and airline companies' websites. All the companies in our sample indicate that they purchase or hold financial derivative instruments for hedging rather than speculating purposes. Examples of airline companies disclose about their managing of fuel price risk are presented in the Appendix.

The criteria of our sample screening are as follows. First, a total of 131 companies from 41 countries are retrieved from Mergent Online database. Second, companies with less than three annual reports during the sample period or with incomplete information on fuel costs and expenses in their reports[8] are excluded from our sample. This restriction reduces the sample size to 74 airline companies from 33 countries. Finally, we further remove 4 airlines companies with missing data for common stock price and required accounting data over our sample period. Our final sample contains 70 airline companies in 32 countries from 1995 to 2005. Table 2-1 shows the sample of global airline companies used in this study. It is seen that 31 airline companies in our sample are from the US, while the rest of the sample countries have one to three airline companies each. The sample period for each of the airline company varies due to the availability of annual reports.

3.1 Hedging Variables

Firms listed on the US markets are required to disclose derivatives usage in their financial reports, which they must file periodically with the SEC, following the US GAAP and the Financial Accounting Standards Board (FASB) rules. However, many firms outside the US to disclose their hedging activities on a voluntary basis,

[8] We use the keywords "fuel" and "oil" to search, but couldn't find any corresponding information. For example, Aircruising Australia Ltd. which engages in the operations of special interest tour programs and air cruises within and from Australia, but there is no information about fuel expenses and hedging activity in its annual report.

and thus we gather jet fuel hedging information from the footnotes and management discussions in their financial statements. In estimating the hedge ratio for jet fuel, we use the percentage rate of next year requirements hedged which is disclosed in the annual reports. Following Carter et al. (2006a),[9] we estimate the hedge ratio for fuel requirements using the notional value (amount) disclosure or gallons of fuel hedged. In this study, we use both hedge ratio and dummy variable methods (equal to one if firms have positive fuel hedged, zero otherwise) to examine our empirical results.

It is seen in our sample that the more airline companies hedge for jet fuel prices, the less the fuel costs account for their total operating expenses.[10] For example, Transmile Group BHD did not hedge for the risk exposure of jet fuel price in the sample period, and its average jet fuel costs as a percentage of total operating expenses is 36.70%, more than double the average of our total sample firms. In contrast, Iberia, Lineas Aereas de Espana, S.A. and Deutsche Lufthansa AG are all aggressive in hedging activities against higher fuel prices. Their average hedge ratios are 83.19% and 73.14%, respectively and their average percentage of jet fuel costs to total operating expenses are only 12.59% and 9.65%.[11]

3.2 <u>Proxy for Firm Value</u>

[9] Airline companies listed in the US usually disclose the percentage rate of next year requirements hedged directly, but others outside the US almost disclose the notional value (amount) of derivatives or gallons of fuel hedged. In addition, some airline companies only disclose if they have used financially derivatives to hedge the risk exposure of jet fuel price. Therefore, we also use a dummy variable in empirical tests.

[10] We don't report the results due to space limitations, but they are available upon request.

[11] I have divided total sample into two sub-groups according to variable HRD, which indicates whether airline companies engage in fuel hedging activities or not. Furthermore, I examine if there is significant difference of percentage of jet fuel costs to the total operating expenses for these two sub-samples. The result seems to show that fuel hedging activities of airline companies can reduce their fuel costs at some level.

We measure firm value using Tobin's Q, which is defined as the ratio of the market value of financial claims on the firm to the replacement cost of firm's assets. The calculation of Tobin's Q requires the market value of long-term debt and the replacement cost of fixed assets, but these data are usually not easy to obtain. For this reason, we use the simple approximation of Tobin's Q, which is developed by Chung and Pruitt (1994),[12] their method offers the advantages of computational efficiency and data availability. We construct Tobin's Q for each airline company using data from COMPUSTAT and the airline companies' annual reports. It is measured as follows:

Tobin's Q = [market value of common stock + liquidating value of preferred stock + (short-term liabilities) – (short-term assets) + book value of long-term debt]/(book value of total assets) (2-1)

all of these accounting data of equation (2-1) are retrieved from COMPUSTAT and measured at the end of year *t*.

3.3 <u>Other Variables</u>

To examine whether jet fuel hedging can add value to airline companies and the incentives for such activities, we include the following explanatory variables used by

[12] Before Chung and Pruitt (1994), the more exact calculations of Tobin's Q that were typically employed were developed by Lindenberg and Ross (1981) and Lang and Litzenberger (1989). But their calculation procedures are very complex and cumbersome, for example, L-R's procedure involves calculating the value of the firm's long-term debt adjusted for its age structure and the firm's inflation-adjusted net capital stock. Chung and Pruitt (1994) report that the R^2 values of their regressions never fall below 0.966, which means their approximate Tobin's Q can explain at least 96.6% of the total variability in L-R's Q.

Allayannis and Weston (2001) and Carter et al. (2006a) in our empirical models.

(a) *Firm size:* The log of total assets is used to control for the size effect. Most previous studies document that hedging is positively related to firm size (e.g. Nance et al., 1993). This is due to the fact that large firms are more likely to use derivatives than small firms because of the large start-up costs and economies of scale of hedging.

(b) *Cash holdings and dividend indicator:* If firms fail to obtain sufficient funds when they have good investment opportunities, they may be forced to give up these projects. Consequently, when firms face external financial constraints, their cash holdings become more important. We use a dividend dummy to proxy the ability to access funding from the financial market, since if a firm pays a dividend, it is less likely that they are subject to capital constraints. We expect cash holdings and dividend-paid out ratios to have a negative relationship with hedging activities.

(c) *Long-term debt divided by total assets:* We use long-term debt divided by total assets to proxy for financial constraints, and we expect firms with a higher debt ratio to hedge jet fuel costs more.

(d) *Cash flow to total sales ratio, cash to total sales ratio, Altman's Z-score and S&P credit rating score:* These four variables are also used to proxy for financial constraints. If airline companies can generate sufficient cash flow, they are less likely to be affected by financial constraints, and thus may have fewer incentives to hedge.[13]

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[13] In the subsequent empirical tests, we drop Altman's Z-score and S&P credit rating score because

(e) *Capital expenditures to total sales ratio:* Following Allayannis and Weston (2001), we use capital expenditure to total sales ratio as a proxy for the amount of investment opportunities. Froot et al. (1993) and Géczy et al. (1997) show that firms engage in hedging activities are more likely to have greater investment opportunities, so we expect this variable to be positively related to hedging.

(f) *Fuel pass-through agreements:* If firms have pass-through agreements to facilitate them passing the risk of volatile fuel prices to their partner airlines, they may be less inclined to hedge. We measure this variable by assigning a value of one when firms disclose their fuel pass-through agreements, and zero otherwise.

(g) *Charter operation indicator:* Charter agreements, like fuel pass-through agreements, allow airline companies to share the risk of volatile fuel prices with a particular customer. When a company discloses that it operates charter flights in its annual report, we set this variable as equal to one, and zero otherwise.

(h) *IR derivatives use:* If an airline holds interest rate derivatives, this variable is equal to one, and zero otherwise.

(i) *Foreign exchange derivatives use:* If an airline holds foreign exchange derivatives, this variable is equal to one, and zero otherwise.

(j) *Executive options-to-shares outstanding, executive shares-to-shares outstanding, CEO options-to-shares outstanding and executive shares-to-shares outstanding:* These four variables are used to proxy for managerial incentives to hedge. If managers' wealth is closely tied to firm's value, they may engage in hedging activities for their own interests at the expense of other shareholders.

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including them reduces our sample size substantially. Although credit rating score is a good explanatory factor, the results do not change when it is excluded

Variables of (a)-(e) are retrieved from COMPUSTAT, and measured at the end of year *t*. In addition, we collect data of (f)-(j) from the footnote of firms' annual reports at the end of year *t*.

Table 2-2 presents the summary statistics for the entire sample as well as for the other sub-samples. Panel A of Table 2-2 shows summary statistics for the full sample. The mean value of hedge ratio for next year's fuel requirements is 23.9%.[14] It is seen that 65.1% of our sample hedge against the risk exposure of fuel price and about 55% of airline companies use derivatives to hedge the risks of variations in interest rate and foreign currency. The percentage of firms using charter agreements is higher than the percentage using fuel pass-through. Panel B of Table 2-2 shows the summary statistics for US and non-US airline companies. The average hedge ratio for jet fuel of US airlines is 12.3%, which is higher than the 10.9% documented in Carter et al. (2006a). It appears that the hedge ratio of non-US airlines is higher than US airlines, at 25.4%. The percentage of fuel pass-through and charter agreements for non-US airlines is also higher than US airlines, at 5.2% and 34.7%, respectively.

Panel C of Table 2-2 presents the summary statistics for airlines with and without alliances. We can see that airlines with alliances have greater jet fuel hedging than these without, and the former also use more interest rate and foreign currency derivatives than non-alliance airlines. The summary statistics for sub-samples based on the periods of stable fuel price and volatile fuel price are presented in panel D of Table 2-2. The average annual jet fuel prices in our sample are 54.50 and 102.50 cents per gallon in the stable and volatile periods, respectively. The fuel price almost

[14] This average ratio is estimated across all non-missing firm-year observations. Other averages are as follows: 34.8% across all firms with an equally-weighted basis and 39.6% across firm-year observations with a positive hedge ratio.

doubled from the stable to volatile period, while the standard deviations of fuel prices were 8.18 and 38.67 cents per gallon, respectively.[15] The price of jet fuel was not only soaring rapidly, but also was volatile during our sample period. We can see that the mean value of hedge ratio in the volatile period for our sample firms is greater than that in the stable period. It could be that airline companies in the volatile period hedge more to protect their profits from the rising oil price, and also that they use more fuel pass-through and charter agreements to mitigate the oil price risk.

4. Does Jet Fuel Hedging Increase Airlines' Value?

We use the following model to examine the relationship between airlines' fuel derivatives usage and its impact on firm value.

$$\log(TobQ)_{it} = \alpha + \beta_1 CapExp_{it} + \beta_2 LTDA_{it} + \beta_3 \log(Assets)_{it} + \beta_4 CFS_{it} + \beta_5 Cash_{it} + \beta_6 Dividend_{it} + \beta_7 HRD_{it} + \beta_8 PassThu_{it} + \beta_9 Fxhedge_{it} + \varepsilon_{it} \quad (2\text{-}2)$$

where $\log(TobQ)_{it}$ is the natural logarithm of Tobin's Q for firm i in year t. $CapExp_{it}$ is the capital expenditures to total sales ratio for firm i in year t, and $LTDA_{it}$ is the ratio of long-term debt divided by total assets for firm i in year t. $\log(Assets)_{it}$ is the natural logarithm of firm's total assets for firm i in year t. CFS_{it}, $Cash_{it}$ and $Dividend_{it}$ are the cash flow to total sales ratio, cash to total sales ration and dummy

[15] The data used to estimate the average annual jet fuel price and standard deviation for these two periods are the same as in footnote 1.

variable of firm's cash dividend paid for firm i in year t, respectively. HRD_{it} is the indicator for jet fuel hedged for firm i in year t. $PassThu_{it}$ and $Fxhedge_{it}$ are dummy variables of fuel pass-through agreements and foreign exchange derivatives use for firm i in year t, respectively. And ε_{it} is the error term.

We use two models to run the regressions.[16] In Model 1, we use a dummy variable for fuel-hedging (HRD) in pooled OLS regressions which account for correlation of the observations across time for a given firm (firm effect) and correlation across firms for a given year (time effect), and report p-values using standard errors corrected for both clustering by firm and clustering by year suggested by Petersen (2009). The difference between Models 1 and 2 is that the fuel-hedging dummy variable used in Model 1 is replaced by the percentage of next year's fuel hedging requirements (HR) in Model 2. The dependent variable is the natural logarithm of firm value, which is proxied by Tobin's Q.

Table 2-3 reports the results regarding the relationship between jet fuel hedging and airline value. Contrary to Allayannis and Weston (2001) and Carter et al. (2006a), our empirical results show that there is not a significantly positive relation between hedging activities and firm value. In panel A of Table 2-3, we can see that jet fuel hedging does not add value to airline companies significantly, and this result is robust to different measures of jet fuel hedging proxies. In Model 1, although the coefficient for fuel hedging is positive (6.2%), it is not statistically significant. This illustrates that an airline which uses derivatives to hedge fuel price risk has no effect on its firm value. In Model 2, the percentage of next year's fuel requirement hedged was used as an indicator for jet fuel hedging. Our results indicate the coefficient is

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[16] The correlation coefficient matrix shows that there is only one coefficient great than 0.5 among variables. We also use the VIF (Variance Inflation Factor) to examine the concern of multicollinearity. The results show that all of these variables used in empirical tests have low VIF values, which indicate that the problem of multicollinearity is not serious.

positive but not statistically significant. This results is consistent with Jin and Jorion's (2006) findings, they find that hedging does not seem to affect firms' market value for U.S. oil and gas producers. Overall, our results show that investors seem not to value airlines' jet fuel hedging activities, and do not reward hedging firms with a higher valuation.

In Panel B of Table 2-3, we focus on the sub-groups of US and non-US airlines, with 31 firms in the former group and 39 in the latter. Our results for the US sample are similar to those reported in Carter et al. (2006a), in that airlines which engage in fuel hedging activities can increase firm value. The coefficient for fuel hedging in Model 2 is statistically significant at the 10% level when a continuous hedging measure is used and the average hedging premium is 7.87%.[17] In contrast to the US airline companies, there is no significantly positive relationship between fuel hedging and firm value for non-US airlines. However, the summary statistics in Panel B of Table 2-2 show that the average percentage of fuel hedged for next year's fuel requirements of non-US airlines is higher than that for the US airlines. It seems that the higher level of jet fuel hedging has lower effectiveness for the non-US airlines.

We also explore whether it is possible for non-US airlines to shift fuel price risk with alternatives such as fuel pass-through or charter agreements for jet fuel hedging. The results from Models 1 and 2 for the non-US sample show that fuel pass-through is an important mechanism to offset the risk of rising fuel-prices,[18] and the coefficients of fuel pass-through are statistically significant in the two models of non-US airlines.

[17] The average hedge ratio is 27.14% across firm-year observations, with positive hedging in US airlines.

[18] Another mechanism of transferring fuel price, the risk-charter agreement, also plays an important role to reduce risks for non-US airlines. We do not include it in the regressions because it will reduce our sample size in the following analysis. The function of charter agreements is similar to fuel pass-through for airline industry, so we drop it in the tests. Our results are robust to this variable. The same reason is also applied for indicator of interest rate.

The average percentages of using fuel pass-through and charter agreements with positive fuel hedging are 4.55% and 28.83% for US airlines, and the figures are much higher (29.31% and 80.93%) for non-US airlines. Comparing the summary statistics presented in Panel B of Table 2-2, it sees that US airlines with positive fuel hedging employ less fuel pass-through and charter agreements, while non-US airlines with positive fuel hedging have more fuel pass-through and charter agreements. Notably, this shows that US airlines are more efficient at hedging with jet fuel derivatives than non-US airlines are. Thus, non-US airlines need to use additional mechanisms to transfer their jet fuel risk exposures, if they are to receive the same benefits as US firms.

In Panel C of Table 2-3, we focus on sub-samples based on airlines with and without alliances. There are 31 airline companies that are part of alliances in our sample, and 39 firms that are not. It is found that jet fuel hedging adds no value to alliance airlines, but can increase firm value for non-alliance airlines. The coefficient is statistically significant at the 1% level, and the average hedging premium is 19.48%.[19] This indicates that non-alliance airlines with positive hedging for jet fuel can add 19.48% hedging premium to their firm value compared to firms without hedging.

It is an interesting question as to why fuel hedging has a positive impact on the firm value of non-alliance airlines, while only an insignificant effect on that of alliance airlines. One possible explanation is that the operational efficiencies of airlines with alliances is already high, so their firm values are affected less by oil price changes (Kleymann and Hannu, 2001). Kleymann and Hannu (2001) show that alliance airlines have benefits of resource utilization to increase labor and aircraft

[19] The average hedge ratio is 38.13% across firm-year observations, with positive hedging in non-alliance airlines.

productivity, and also that their costs for procured goods and services are lower. As such, their cash flows and ultimately firm value are less vulnerable to variations in fuel price. In contrast, non-alliance airlines are more vulnerable to variations in fuel price, and so hedging can increase their competitiveness and has a positive influence on firm value.

Panel D of Table 2-3 reports the regression results for the sub-samples of stable and volatile fuel price periods. The evidence shows that fuel hedging can increase firm value, but the coefficient is not statistically significant for both periods. In the preceding section, we found that the averages and standard deviations of jet fuel prices are different in these two periods. In the stable period, airlines' operating cash flows and profit are less threatened by rising fuel price, and hence hedging has a smaller impact on firm value. We can see that the mean value of the hedge ratio is smaller in the stable period than in the volatile period, and fuel pass-through and charter agreements are also used less often to reduce the fuel price risk in the stable period. On the other hand, we expect that airlines' operating cash flows and profit are affected more by the soaring fuel price, and in order to keep their earnings and capital expenditures stable, firms need to hedge fuel price risk more in the volatile period. However, we do not observe this significantly positive relation in our empirical results. Maybe we should extend our studying period to reflect the influence of the changes of fuel price on firm value.

Table 2-3 provides important evidence that jet fuel hedging has no significant effect on firm value for the global airline companies, although the results vary for different geographic regions, whether joining alliances or not, and for times of stability and volatility. The empirical results demonstrate that this positive and significant relationship can be observed in the sub-samples of US airlines, non-alliance airlines.

5. The Determinants of Jet Fuel Hedging of Global Airlines

5.1 What Factors Explain Airlines' Hedging Behavior?

Previous researchers have found several reasons for firms' hedging activities, and these can be classified into three categories, namely tax incentives, managerial incentives, and financial distress and underinvestment costs. In this section, we examine whether these factors provide explanations for the hedging premium in the global airline industry. The model is specified as follows.

$$
\begin{aligned}
HR_{it} = \alpha &+ \beta_1 \, CapExp_{it} + \beta_2 \, LTDA_{it} + \beta_3 \, \log(Assets)_{it} + \beta_4 \, CFS_{it} \\
&+ \beta_5 \, Cash_{it} + \beta_6 \, Dividend_{it} + \beta_7 \, ExeShares_{it} + \beta_8 \, PassThu_{it} \\
&+ \beta_9 \, Fxhedge_{it} + \varepsilon_{it} \qquad (2\text{-}3)
\end{aligned}
$$

where HR_{it} is the % of next year's fuel hedging requirements at the end of the fiscal year, and $ExeShares_{it}$ is the % of shareholdings executive management held to the total shares outstanding at the end of the fiscal year. The rest of variables are the same as in Equation (2-2). We use two models to examine this relationship. In Model 1, we apply the Tobit model using the percentage rate of next year's fuel hedging requirements at the end of the fiscal year as the dependent variables. We take account of fixed effects in each regression. In Model 2, we apply the Logit model using a dummy variable equaling one if a firm's hedge ratio is greater than zero, and zero otherwise as the dependent variable. We also use standard errors corrected for both clustering by firm and clustering by year suggested by Petersen (2009) to report p-values.

In Panel A of Table 2-4, the results show that firm size, fuel pass-through and whether the firm engaged in currency hedging or not all have a significant impact on airlines' hedging behavior. The positive coefficient on firm size suggests that economies of scale also play an important role for such companies. This result is consistent with that in Nance et al. (1993), and implies that economies of scale in risk management may apply to the operational and transaction costs of hedging, and the high start-up costs of risk management may only be affordable by large companies. It is seen that fuel pass-through agreements also have explanatory power in the regression models. The coefficients in both models are negatively significant, which indicates that fuel pass-through is an method of transferring jet fuel price risk. In addition, airlines engaged in foreign currency hedging activities also have more jet fuel hedging. In Model 1, we find that dividend paid can affect fuel hedging decision for the global airlines. The coefficient is positive at the 1% significant level, which is consistent with Breeden and Viswanathan (1999). They document that better-performing firms may have incentives to hedge to preserve their higher profitability.

In Panel B of Table 2-4, we examine the hedging incentives between US and non-US airlines. We find that the coefficients of firm size and the usage of currency hedging are significant to explain airlines' hedging activities. Consistent with Carter et al. (2006a), we find that fuel pass-through has a negative impact on US and non-US airlines' hedging behavior, due to the fact that fuel pass-through is an important alternative in mitigating the risk exposure of jet fuel price, and it can reduce the use of fuel hedging derivatives. For non-US airlines, the coefficients of cash flow-to-sales and executives' shareholdings are statistically significant at the 5% and 1% level respectively. The negative coefficient of cash flow-to-sales is consistent with a financial constraints argument, which implies that airlines that generate sufficient cash flows tend to have lower incentives to hedge. The positive coefficient of executives' shareholdings demonstrates that the higher the executives' shareholdings, the more the firms tend to hedge. This result is consistent with prior studies (Smith and Stulz, 1985; Tufano, 1996), and suggests that the more the executives' wealth is tied to firms, the more likely they are to hedge for fuel price risk.

In Panel C of Table 2-4, we examine the hedging incentives for airlines with and without alliances. The results show that the coefficient for dividend payout has a positive impact on alliance firm's hedging decision, which is against our earlier expectations. However, Breeden and Viswanathan (1999) suggest that better-performing firms may have incentives to hedge in order to maintain higher profitability, and results that are not reported indicate that the average ROE and ROA for alliance airlines are better than non-alliance airlines in the sample period.[20] Thus, alliance airlines may want to hedge more so that they are less affected by fuel price changes. For non-alliance airlines, fuel pass-through is significantly related to hedging activities. Compared to alliance airlines, they do not enjoy the benefits of operational efficiencies from alliances, so their cash flows are more vulnerable to fuel price changes. They use more other substitute mechanisms to transfer the risk of fuel price.

Panel D of Table 2-4 reports the results of hedging determinants for stable and volatile fuel price periods. The coefficients for firm size and foreign currency usage

[20] Average ROE and ROA are -4.23% and 0.60% for alliance airlines, and are much higher (-14.31% and -0.05%) for non-alliance airlines.

are also statistically significant in both periods. In the stable fuel price period, airlines tend to hedge to reduce the financial distress costs, because the coefficient of debt ratio are positively and significantly related to hedging activities, and the coefficient of cash-to-sales are negatively related to fuel hedging activities. These results comply with traditional theories that hedging provides incentives to reducing the probability of financial distress. On the other hand, the coefficients of cash-to-sales and dividend payout are positively and significantly related to hedging, which indicates that better-performing airlines want to protect their profit levels during times with volatile fuel prices period. We show that executives' shareholdings are negatively related to hedging activities, and this is consistent with the findings in Galai and Masulis (1976) and Saunders et al. (1990). They find that managers with higher equity ownership tend to take more risk. Our results also show that fuel pass-through is a good substitute for fuel hedging in volatile periods, and the greater the use of the pass-through mechanism, the less hedging that airlines need to engage in.

5.2 Does Underinvestment Problem Play An Important Role in Explaining Airlines' Hedging Behavior?

Airline companies tend to undertake hedging activities in order to make sure that future capital expenditures are less affected by high jet fuel prices. Jet fuel hedging can allow them to obtain sufficient funds to undertake valuable investments in the future, and thus, current capital expenditures might be the result of earlier hedging. Consequently, investors would value capital expenditures made by hedgers more highly, because they send a signal that good investment opportunities are expected in the near future. To examine this issue, we use a two-stage regression model, as follows:

$$CapExp_{it} = \gamma + \delta_1\ CFS_{it} + \delta_2\ lag(TobQ)_{it} + \delta_3\ lag(HR)_{it} + \upsilon_{it} \quad (2\text{-}4)$$

$$\begin{aligned} log(TobQ)_{it} = \alpha &+ \beta_1\ Pred(CapExp)_{it} + \beta_2\ LTDA_{it} + \beta_3\ log(Assets)_{it} \\ &+ \beta_4\ CFS_{it} + \beta_5\ Cash_{it} + \beta_6\ Dividend_{it} + \beta_7\ HRD_{it} \\ &+ \beta_8\ PassThu_{it} + \beta_9\ Fxhedge_{it} + \varepsilon_{it} \quad (2\text{-}5) \end{aligned}$$

where $lag(TobQ)_{it}$ and $lag(HR)_{it}$ are lagged Tobin's Q and lagged percent hedging variables respectively. $Pred(CapExp)_{it}$ is the predicted value of capital expenditures from Equation (2-4). υ_{it} is the error term of Equation (2-4). The rest of variables are the same as in Equation (2-2). We use 2SLS (tow-stage lease square) estimate controlling for fixed effects in the empirical regressions, which is suggested by Pagan (1984). In the first-stage regression, we use capital expenditures-to-sales ratio as the dependent variable, and cash flow-to-sales, lagged Tobin's Q, and lagged percentage rate of jet fuel hedging as the independent variables, as shown in Equation (2-4). The estimated values of capital expenditures-to-sales ratio obtained from Equation (2-4) are then used in the second-stage regression to estimate the link between firm value and the independent variables in Equation (2-5).

Table 2-5 reports these results, and from Panel A, we can see that the coefficient of lagged Tobin's Q to capital expenditures is positively significant at the 1% level, and the effect of lagged hedging ratio on capital expenditures is also significantly positive. This results show that alleviating the problem of underinvestment is an important factor leading firms to engage in jet fuel hedging activities in the global airlines. Panel B of Table 2-5 shows that US airlines hedge to mitigate underinvestment problem because the coefficient of lagged hedge ratio on capital expenditures is 11.9%, which is positive and statistically significant at the 1% level. It is thus seen that fuel hedging in the last period can increase firm value by ensuring and enhancing current capital expenditures, and the implied hedging premium from the models is 19.7% [e.g., (0.2714×0.119×8.823) + (-0.325×0.271)]. The first term in the parentheses is the percentage of the hedging premium attributable to the effect of hedging on capital expenditures. This term is more than 100%, which provides evidence in support of Carter et al.'s (2006a) findings that the determinants of jet fuel hedging by airlines are largely consistent with an underinvestment theory. However, the results also show that current capital expenditures are not positively related to fuel hedging undertaken in the last period for the non-US airlines. Thus, hedging to ensure future profitable investment opportunities is not an important concern for non-US airlines.

In Panel C of Table 2-5, the evidence shows that reducing the problem of underinvestment is not an important factor in alliance airlines' hedging activities, because the coefficient of lagged hedging ratio is not positively related to current capital expenditures. We find that lagged Tobin's Q also has an insignificant effect on current capital expenditures, and thus, alleviating the underinvestment problem does not play an important role in determining fuel hedging for alliance airlines. In the previous section, we saw that the most important factor in fuel hedging for alliance airlines is to stabilize their profitability. When airline companies expect to have good investment opportunities in the near future, they can finance the project with internally generated funds, which can reduce the effect of fuel hedging on capital expenditures. In contrast, non-alliance airlines hedge to alleviate underinvestment problems, which is consistent with findings of Froot et al. (1993) that hedging can reduce cash flow volatility to ensure sufficient internally generated funds to complete profitable projects in bad times. The implied hedging premium from the models is 15.35% [e.g., (0.381×0.142×6.999) + (-0.591×0.381)], and the percentage of the hedging premium attributable to the effect of hedging on capital expenditures is more than 200%.

Panel D of Table 2-5 reports the results as to whether reducing underinvestment problems is related to hedging activities in the stable and volatile fuel price periods. In the period of 1995 to 1999, when the fuel price is relatively stable, the airlines tend to hedge to ensure that future capital spending is less affected by fuel prices. The hedging premium is 6.36%, and the effect of hedging on capital spending is also more than 200%. On the other hand, the effect of hedging on capital expenditures is insignificant during the volatile period. Investors place more value on capital expenditures made by hedgers in the stable rather than volatile period, possibly due to the fact that airline companies have better investment opportunities in the stable period, and they tend to use derivatives to hedge fuel price risk to ensure that they can take advantage of them.

6. Sensitivity Checks[21]

6.1 Using Different Proxy to Measure Firm Value

We use accounting performance measures of ROA and ROE to replace natural logarithm of Tobin's Q in Equation (2-2). The results show that there is insignificantly positive relationship between jet fuel hedging and firm value in Model

[21] All of results about sensitivity checks are available upon request.

1 and Model 2 when using ROE to proxy firm value, while this positive relationship is significant in Model 1 when using ROA to proxy firm value. Moreover, we also use Tobin's Q that does not take natural logarithm to run the regression of Equation (2-2), the result shows that jet fuel hedging has significantly positive impact on firm value in Model 2.

6.2 Does "Trend" or "Volatility" of Jet Fuel Price Affect Firms' Hedging Behavior?

According to the rise or fall of jet fuel price comparing with previous year, we divide our sample into two sub-groups. The results show that the higher percentage airline companies hedge, the more their firm value increase in the rising-period. The coefficient is statistically significant at 10% level. On the contrary, the evidence shows that this positive relation is not significant in the falling-period and the coefficients are smaller than those in the rising-period.

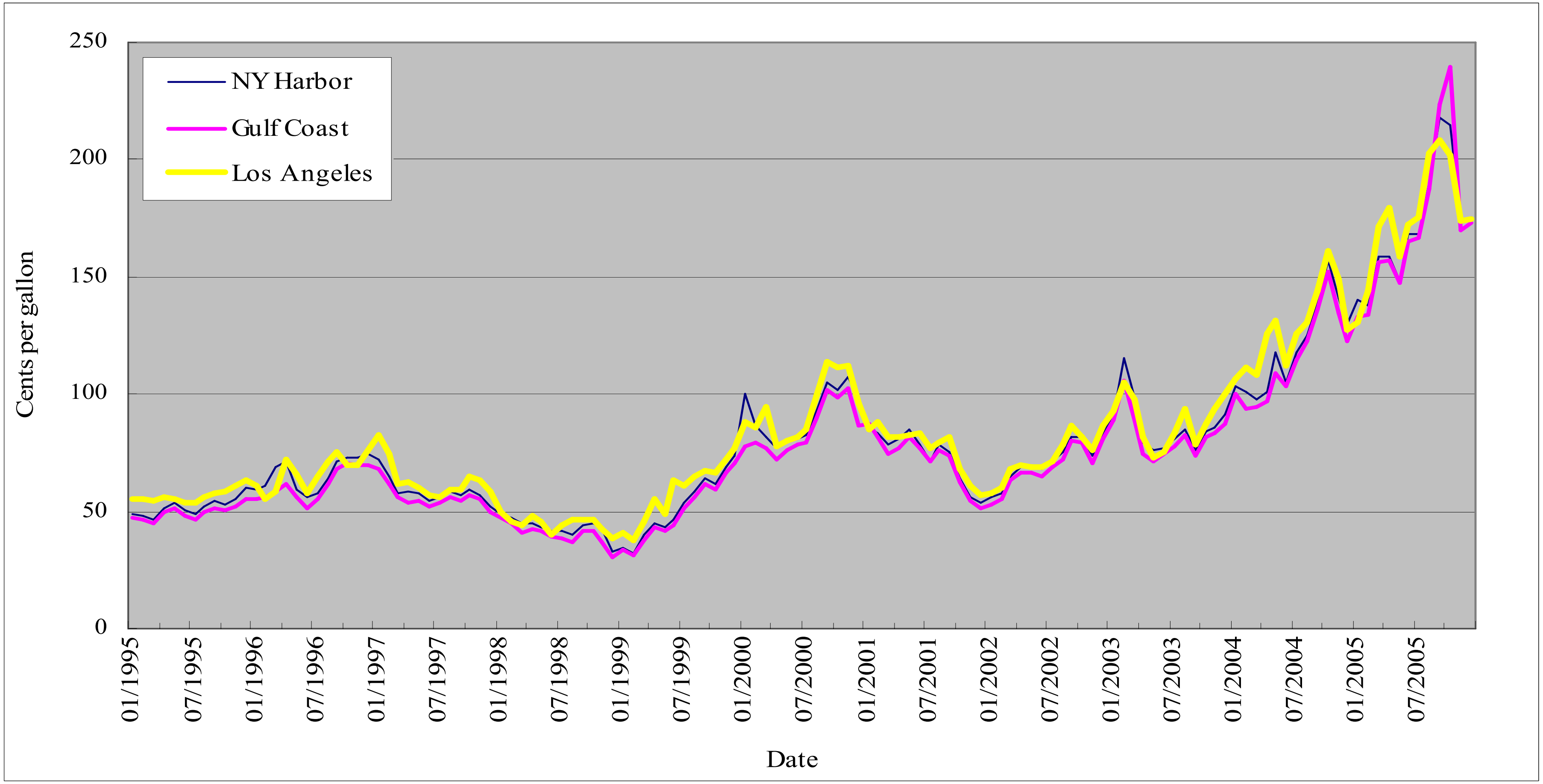
7. Conclusions

This paper provides the first in-depth analysis of the impact of jet fuel hedging on the market values of global airlines and the determinants for their hedging behavior. Using a unique data set of 70 airline companies in 32 countries from 1995 to 2005, we find that jet fuel hedging enhances the value of airline companies around the world. Moreover, we show that airlines residing in the US that engage in fuel hedging increase their firm value, while airlines not residing in the US add no extra value to their firms. In addition, we fail to find a significant relationship between fuel hedging and firm value for airlines with alliances, although this relationship is significant for airlines without them. Finally, there is no evidence revealing that fuel hedging is more valuable in the volatile fuel price period than in the stable fuel price period. This result indicates that airline companies can not protect their firm value from being hurt by surging oil prices by undertaking adequate hedging activities.

Furthermore, we explore the determinants for the jet fuel hedging of global airline companies. The evidence shows that hedging reduces financial distress costs for non-US airlines, and in the period of stable fuel prices. In contrast, alliance airlines and airlines in the volatile period hedge fuel price risk exposures to protect their profitability. Moreover, jet fuel hedging is motivated by managerial risk aversion for non-US airlines, which is consistent with traditional theory, as suggested by Smith and Stulz (1985) and Tufano (1996). On the other hand, our regression analysis also suggests that managerial risk-taking incentives are supported by airlines in the stable period. In addition, we find that the fuel pass-through mechanism can substitute for fuel hedging by derivatives. Consistent with Froot et al. (1993) and Carter et al.'s (2006a) findings, our results show that alleviating underinvestment problems to protect future positive NPV projects is an important consideration for the global airline companies and in the sub-samples of US airlines, non-alliance airlines and airlines in the stable period. Finally, we illustrate that economies of scale and the use of currency derivatives are important factors to explain the fuel hedging behavior of airline companies.

Further research can investigate the impact of corporate governance on risk management in the global airline industry. The differences in corporate governance (including internal and external factors) across countries and their effects on hedging behavior can be examined using internal airline data. Both firm-level governance mechanisms (e.g., ownership and board structures) and country-level governance mechanisms (e.g., investor protection rights) will enable us to investigate the different effects of jet fuel hedging on firm value.

Figure 2-1. Average Monthly Jet Fuel Prices (Cents per Gallon)



Source: Energy Information Administration (EIA), http://www.eia.doe.gov/.

Table 2-1. Global Airline Companies in the Sample

Company Name	Sample Period	Company Name	Sample Period
Australia		**Singapore**	
Qantas Airways Ltd.	1995~2005	Singapore Airlines Ltd.	1997~2005
Virgin Blue Holdings Ltd.	2003~2005	**South Africa**	
Austria		Comair Ltd.	1999~2005
Austrian Airlines	1997~2005	**Spain**	
Belgium		Iberia, Lineas Aereas de Espana, S.A.	1996~2005
Virgin Express Holdings PLC	1998~2004	**Sweden**	
Canada		SAS AB	1997~2000, 2002~2005
Ace Aviation Holdings Inc.	1996~2005	**Switzerland**	
Canadian Airlines Corp.	1996~1999	Swiss International Air Lines Ltd.	1997~2004
WestJet Airlines Ltd.	1999~2005	**Taiwan**	
Chile		China Airlines, Ltd.	1997~2005
Lan Airlines SA	1996~2005	EVA Airways Corp.	2000~2005
China		**Thailand**	
China Eastern Airlines Corp., Ltd.	1996~2005	Thai Airways International Public Co., Ltd.	1998~2005
China Southern Airlines Co Ltd.	1997~2005	**Turkey**	
Cyprus		Turk Hava Yollari A.O.	1997~2005
Cyprus Airways Public Ltd.	1999~2005	**United Kingdom**	
Finland		British Airways Plc	1996~2005
Finnair OY	1996~2005	Easyjet Plc	2000~2005
France		**United States**	
Air France-KLM	1997~2005	ABX Air Inc.	2003~2005
Germany		Airborne, Inc.	1995~2003
Deutsche Lufthansa AG	1997~2005	AirNet Systems, Inc.	1996~2005
Hong Kong		Airtran Holdings, Inc.	1996~2005
Cathay Pacific Airways Ltd.	1998~2005	Alaska Air Group, Inc.	1995~2005
Ireland		America West Holdings Corp.	1996~2002
Aer Lingus PLC	1997~2005	AMR Corp.	1995~2005
Ryanair Holdings PLC	1997~2005	CCAIR, Inc.	1995~1998
Italy		Comair Holdings, Inc.	1995~1998
Alitalia-Linee Aeree Italiane Roma	1997~2005	Continental Airlines Inc.	1995~2005
Japan		Delta Air Lines, Inc.	1995~2005
All Nippon Airways Co., Ltd.	1996~2005	Expressjet Holdings Inc.	2001~2005
Japan Airlines Corp	1997~2005	FedEx Corp.	1997~2005
Korea (South)		FLYi Inc.	1997~2005
Korean Air Lines Co., Ltd.	1997~2005	Frontier Airlines Holdings Inc.	1997~2005
Malaysia		Great Lakes Aviation Ltd.	1996~2005
Malaysian Airline System	1997~2005	Hawaiian Holdings Inc.	1996~2005
Transmile Group BHD	1999~2005	JetBlue Airways Corp.	2001~2005
Mexico		MAIR Holdings Inc.	1996~2005
CINTRA, S.A. de C.V.	1996~2005	Mesa Air Group Inc.	1995~2005
Netherlands		Midway Airlines Corp.	1997~2001
KLM Royal Dutch Airlines	1996~2003	Midwest Air Group Inc.	1996~2005
Martinair Holland N.V.	1997~2005	Northwest Airlines Corp.	1996~2005
New Zealand		SkyWest Inc.	1995~2005
Air New Zealand Ltd.	1996~2005	Southwest Airlines Co.	1995~2005
Norway		Tower Air, Inc.	1996~1999
Braathens ASA	1996~2000	Trans World Airlines, Inc.	1996~2000
Pakistan		UAL Corp.	1995~2005
Pakistan International Airlines Corp.	1997~2005	US Airways Group Inc.	1995~2005
Russia		Vanguard Airlines, Inc.	1997~2002
Aeroflot-Russian Airlines	2000~2005	World Air Holdings Inc.	1996~2005

Table 2-2. Summary Statistics of Variables Used in Regression Models

This table describes the summary statistics for the variables used in the regression models. Panel A presents the total sample of 70 airlines in 32 countries from 1995 to 2005. Panel B describes the summary statistics of US and Non-US airlines. There are 31 airline companies belonging to US group, while 39 airlines belonging to non-US group. Sub-groups of airlines with joining an alliance or not are reported in Panel C. There are 31 airline companies in our sample joining the airlines alliances, while the rest of airlines are not. According to the variation of jet fuel price, we partition the total sample into two sub-periods. Period of 1995 to 1999 is when the fuel price is relatively stable, and of 2000 to 2005 is when the fuel price is more volatile. Summary statistics of these two sub-periods are reported in Panel D.

Panel A: Total Sample

Variables	Mean	Median	Max.	Min.	Std. Dev.
Hedge ratio for next year's fuel requirements	0.239	0.130	1.577	0.000	0.291
Indicator for positive % fuel hedged	0.651	1.000	1.000	0.000	0.477
Capital expenditures-to-sales	0.141	0.092	2.233	-0.084	0.178
Tobin's Q	0.936	0.761	8.788	-0.048	0.690
Long-term debt-to-assets	0.278	0.274	1.300	0.000	0.176
ln(Assets)	7.427	7.646	10.399	-0.149	1.815
Cash flow-to-sales	0.075	0.089	0.395	-1.169	0.108
Cash-to-sales	0.160	0.121	1.451	0.000	0.170
Credit rating	14.699	14.000	27.000	8.000	4.209
Z-score	1.588	1.584	13.352	-80.584	6.031
Tax loss carryforwards-to-assets	0.147	0.000	3.635	0.000	0.433
Dividend indicator	0.399	0.000	1.000	0.000	0.490
Executive options-to-shares outstanding	0.009	0.002	0.289	0.000	0.023
Executive shares-to-shares outstanding	0.065	0.014	0.806	0.000	0.134
CEO shares-to-shares outstanding	0.044	0.008	0.772	0.000	0.112
Fuel pass-through indicator	0.246	0.000	1.000	0.000	0.431
Charter indicator	0.664	1.000	1.000	0.000	0.473
Indicator for foreign currency hedged	0.557	1.000	1.000	0.000	0.497
Indicator for interest rate hedged	0.544	1.000	1.000	0.000	0.499

Panel B: US vs. Non-US Sample

	U.S. Sample (n=31)					Non-U.S. Sample (n=39)				
Variables	**Mean**	**Median**	**Max.**	**Min.**	**Std. Dev.**	**Mean**	**Median**	**Max.**	**Min.**	**Std. Dev.**
Hedge ratio for next year's fuel requirements	0.123	0.000	0.850	0.000	0.193	0.377	0.320	1.577	0.000	0.326
Indicator for positive % fuel hedged	0.463	0.000	1.000	0.000	0.500	0.801	1.000	1.000	0.000	0.400
Capital expenditures-to-sales	0.125	0.083	2.233	-0.010	0.185	0.154	0.106	1.810	-0.084	0.171
Tobin's Q	1.017	0.801	3.975	-0.048	0.642	0.875	0.737	8.788	0.090	0.719
Long-term debt-to-assets	0.254	0.230	1.300	0.000	0.185	0.296	0.297	0.914	0.000	0.167
ln(Assets)	6.831	6.598	10.399	-0.149	2.031	7.875	8.236	10.375	3.188	1.485
Cash flow-to-sales	0.047	0.076	0.359	-1.169	0.125	0.097	0.100	0.395	-0.215	0.087
Cash-to-sales	0.147	0.120	0.683	0.000	0.123	0.169	0.122	1.451	0.000	0.198
Credit rating	15.438	15.000	27.000	8.000	4.379	12.887	13.000	27.000	9.000	3.117
Z-score	1.616	1.817	13.352	-80.584	7.010	1.513	1.197	9.118	-0.797	1.387
Tax loss carryforwards-to-assets	0.189	0.000	3.635	0.000	0.489	0.014	0.000	0.200	0.000	0.037
Dividend indicator	0.187	0.000	1.000	0.000	0.391	0.578	1.000	1.000	0.000	0.495
Executive options-to-shares outstanding	0.012	0.005	0.289	0.000	0.028	0.004	0.000	0.051	0.000	0.009
Executive shares-to-shares outstanding	0.091	0.035	0.806	0.000	0.156	0.028	0.000	0.389	0.000	0.082
CEO shares-to-shares outstanding	0.054	0.015	0.772	0.000	0.133	0.030	0.000	0.323	0.000	0.072
Fuel pass-through indicator	0.218	0.000	1.000	0.000	0.413	0.270	0.000	1.000	0.000	0.445
Charter indicator	0.470	0.000	1.000	0.000	0.500	0.817	1.000	1.000	0.000	0.388
Indicator for foreign currency hedged	0.239	0.000	1.000	0.000	0.427	0.829	1.000	1.000	0.000	0.377
Indicator for interest rate hedged	0.341	0.000	1.000	0.000	0.475	0.715	1.000	1.000	0.000	0.452

Panel C: Alliance vs. Non-Alliance Sample

	Alliance Sample (n=31)					Non-Alliance Sample (n=39)				
Variables	**Mean**	**Median**	**Max.**	**Min.**	**Std. Dev.**	**Mean**	**Median**	**Max.**	**Min.**	**Std. Dev.**
Hedge ratio for next year's fuel requirements	0.334	0.290	1.577	0.000	0.294	0.155	0.000	1.215	0.000	0.260
Indicator for positive % fuel hedged	0.854	1.000	1.000	0.000	0.354	0.444	0.000	1.000	0.000	0.498
Capital expenditures-to-sales	0.035	0.000	0.436	0.000	0.084	0.164	0.090	2.233	-0.084	0.230
Tobin's Q	0.116	0.094	0.542	0.000	0.086	1.105	0.863	4.748	-0.048	0.738
Long-term debt-to-assets	0.773	0.697	8.788	0.081	0.598	0.250	0.226	1.300	0.000	0.185
ln(Assets)	8.643	8.830	10.399	5.655	1.034	6.236	6.088	9.923	-0.149	1.614
Cash flow-to-sales	0.306	0.309	0.748	0.000	0.161	0.072	0.089	0.395	-0.353	0.108
Cash-to-sales	0.078	0.089	0.323	-1.169	0.108	0.182	0.118	1.451	0.000	0.215
Credit rating	0.137	0.122	0.627	0.004	0.101	14.703	15.000	27.000	8.000	4.580
Z-score	14.697	14.000	27.000	9.000	4.016	1.837	2.421	13.352	-80.584	7.571
Tax loss carryforwards-to-assets	1.163	1.219	3.765	-1.306	0.676	0.199	0.000	3.635	0.000	0.512
Dividend indicator	0.036	0.000	0.424	0.000	0.087	0.206	0.000	1.000	0.000	0.405
Executive options-to-shares outstanding	0.606	1.000	1.000	0.000	0.489	0.010	0.004	0.289	0.000	0.026
Executive shares-to-shares outstanding	0.007	0.000	0.129	0.000	0.017	0.086	0.029	0.806	0.000	0.157
CEO shares-to-shares outstanding	0.019	0.000	0.323	0.000	0.059	0.061	0.017	0.772	0.000	0.134
Fuel pass-through indicator	0.236	0.000	1.000	0.000	0.425	0.256	0.000	1.000	0.000	0.437
Charter indicator	0.669	1.000	1.000	0.000	0.471	0.660	1.000	1.000	0.000	0.474
Indicator for foreign currency hedged	0.857	1.000	1.000	0.000	0.351	0.267	0.000	1.000	0.000	0.443
Indicator for interest rate hedged	0.764	1.000	1.000	0.000	0.426	0.333	0.000	1.000	0.000	0.472

Panel D: 1995-1999 vs. 2000-2005 Sample

	1995-1999 (n=70)					2000-2005 (n=70)				
Variables	**Mean**	**Median**	**Max.**	**Min.**	**Std. Dev.**	**Mean**	**Median**	**Max.**	**Min.**	**Std. Dev.**
Hedge ratio for next year's fuel requirements	0.182	0.013	1.577	0.000	0.291	0.271	0.214	1.309	0.000	0.286
Indicator for positive % fuel hedged	0.577	1.000	1.000	0.000	0.495	0.694	1.000	1.000	0.000	0.462
Capital expenditures-to-sales	0.128	0.095	0.975	-0.084	0.120	0.151	0.091	2.233	-0.010	0.211
Tobin's Q	1.064	0.809	8.788	0.090	0.838	0.839	0.709	4.578	-0.048	0.533
Long-term debt-to-assets	0.280	0.262	0.914	0.000	0.180	0.276	0.278	1.300	0.000	0.173
ln(Assets)	7.158	7.389	10.101	2.621	1.882	7.644	7.875	10.399	-0.149	1.731
Cash flow-to-sales	0.088	0.097	0.359	-0.353	0.094	0.065	0.078	0.395	-1.169	0.117
Cash-to-sales	0.128	0.095	0.960	0.001	0.122	0.184	0.143	1.451	0.000	0.196
Credit rating	13.338	13.000	19.000	9.000	2.720	15.563	15.000	27.000	8.000	4.738
Z-score	2.429	1.826	13.352	-4.718	2.081	0.877	1.336	6.096	-80.584	7.907
Tax loss carryforwards-to-assets	0.169	0.000	2.512	0.000	0.421	0.127	0.001	3.635	0.000	0.445
Dividend indicator	0.412	0.000	1.000	0.000	0.493	0.389	0.000	1.000	0.000	0.488
Executive options-to-shares outstanding	0.011	0.002	0.289	0.000	0.031	0.007	0.002	0.144	0.000	0.015
Executive shares-to-shares outstanding	0.079	0.022	0.806	0.000	0.158	0.056	0.013	0.651	0.000	0.116
CEO shares-to-shares outstanding	0.057	0.011	0.772	0.000	0.146	0.036	0.007	0.647	0.000	0.084
Fuel pass-through indicator	0.110	0.000	1.000	0.000	0.313	0.331	0.000	1.000	0.000	0.471
Charter indicator	0.635	1.000	1.000	0.000	0.482	0.684	1.000	1.000	0.000	0.465
Indicator for foreign currency hedged	0.505	1.000	1.000	0.000	0.501	0.587	1.000	1.000	0.000	0.493
Indicator for interest rate hedged	0.442	0.000	1.000	0.000	0.498	0.602	1.000	1.000	0.000	0.490

Table 2-3. The Impact of Hedging Behavior on Firm Value

This table reports the impact of jet fuel hedging behavior on firm value, which is measured by the natural logarithm of Tobin's Q. Other firm characteristics are included as explanatory variables. The regression model is as follows:

$$\log(TobQ)_{it} = \alpha + \beta_1 \, CapExp_{it} + \beta_2 \, LTDA_{it} + \beta_3 \log(Assets)_{it} + \beta_4 \, CFS_{it} + \beta_5 \, Cash_{it} + \beta_6 \, Dividend_{it}$$
$$+ \beta_7 \, HRD_{it} + \beta_8 \, PassThu_{it} + \beta_9 \, Fxhedge_{it} + \varepsilon_{it}$$

In Model 1, we use a dummy variable for fuel-hedging (HRD) in pooled OLS regressions which account for standard errors corrected for both clustering by firm and clustering by year suggested by Petersen (2009). The difference between Models 1 and 2 is that the fuel-hedging dummy variable used in Model 1 is replaced by the percentage of next year's fuel hedging requirements (HR) in Model 2. P-values are presented in parentheses below the coefficients. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Total Sample

Variables	Model 1 Pooled OLS	Model 2 Pooled OLS
Constant	0.063 (0.651)	0.183 (0.241)
Capital expenditures-to-sales	0.297* (0.087)	0.744*** (0.000)
Long-term debt-to-assets	0.611*** (0.000)	0.485*** (0.004)
ln(Assets)	-0.084*** (0.000)	-0.097*** (0.000)
Cash flow-to-sales	1.388*** (0.000)	1.441*** (0.000)
Cash-to-sales	-0.200 (0.159)	-0.004 (0.978)
Dividend indicator	0.169*** (0.001)	0.148** (0.011)
Indicator for fuel hedged	0.062 (0.330)	
% of next year's fuel requirements hedged		0.158 (0.115)
Fuel pass-through indicator	-0.023 (0.667)	-0.022 (0.704)
Indicator for foreign currency hedged	-0.226*** (0.000)	-0.236*** (0.000)
No. of obs. / Total obs.	464 / 770	390 / 770
R^2	0.264	0.300

Panel B: US vs. Non-US Sample

	U.S. Sample		Non_U.S. Sample	
Variables	Model 1 Pooled OLS	Model 2 Pooled OLS	Model 1 Pooled OLS	Model 2 Pooled OLS
Constant	0.267 (0.172)	0.302 (0.127)	-0.088 (0.659)	0.420 (0.138)
Capital expenditures-to-sales	0.397 (0.126)	0.377 (0.131)	0.257 (0.190)	0.945*** (0.000)
Long-term debt-to-assets	0.393* (0.070)	0.384* (0.076)	1.166*** (0.000)	1.013*** (0.000)
ln(Assets)	-0.089*** (0.003)	-0.096*** (0.002)	-0.119*** (0.000)	-0.191*** (0.000)
Cash flow-to-sales	1.229*** (0.000)	1.210*** (0.000)	1.822*** (0.000)	2.498*** (0.000)
Cash-to-sales	-0.306 (0.309)	-0.363 (0.238)	0.333** (0.030)	-0.055 (0.718)
Dividend indicator	0.360*** (0.000)	0.345*** (0.001)	0.136** (0.044)	0.102 (0.199)
Indicator for fuel hedged	0.032 (0.693)		0.138 (0.126)	
% of next year's fuel requirements hedged		0.290* (0.073)		0.189 (0.113)
Fuel pass-through indicator	-0.182* (0.088)	-0.161 (0.132)	0.133** (0.022)	0.205*** (0.001)
Indicator for foreign currency hedged	-0.221** (0.019)	-0.211** (0.023)	-0.111 (0.263)	-0.052 (0.657)
No. of obs. / Total obs..	227 / 341	227 / 341	237 / 429	163 / 429
R^2	0.273	0.279	0.367	0.511

Panel C: Alliance vs. Non-Alliance Sample

Variables	Alliance Sample Model 1 Pooled OLS	Alliance Sample Model 2 Pooled OLS	Non_Alliance Sample Model 1 Pooled OLS	Non_Alliance Sample Model 2 Pooled OLS
Constant	-0.064	0.011	-0.020	0.247
	(0.734)	(0.959)	(0.919)	(0.255)
Capital expenditures-to-sales	0.523*	0.625*	0.220	0.721***
	(0.087)	(0.080)	(0.276)	(0.006)
Long-term debt-to-assets	1.019***	0.982***	0.330	0.159
	(0.000)	(0.000)	(0.175)	(0.509)
ln(Assets)	-0.085***	-0.094***	-0.060*	-0.099***
	(0.002)	(0.001)	(0.056)	(0.005)
Cash flow-to-sales	1.337***	1.335***	1.017*	1.021*
	(0.000)	(0.000)	(0.071)	(0.070)
Cash-to-sales	-0.702***	-0.695***	0.365**	0.030
	(0.001)	(0.005)	(0.037)	(0.878)
Dividend indicator	0.141***	0.132**	0.286***	0.334***
	(0.001)	(0.012)	(0.004)	(0.004)
Indicator for fuel hedged	0.003		0.095	
	(0.976)		(0.242)	
% of next year's fuel requirements hedged		-0.104		0.511***
		(0.297)		(0.006)
Fuel pass-through indicator	0.003	0.035	-0.023	-0.029
	(0.945)	(0.518)	(0.816)	(0.768)
Indicator for foreign currency hedged	-0.057	-0.028	-0.244***	-0.290***
	(0.515)	(0.715)	(0.002)	(0.004)
No. of obs. / Total obs.	223 / 341	176 / 341	241 / 429	214 / 429
R^2	0.452	0.467	0.154	0.216

Panel D: 1995-1999 vs. 2000-2005 Sample

	1995-1999		2000-2005	
Variables	Model 1 Pooled OLS	Model 2 Pooled OLS	Model 1 Pooled OLS	Model 2 Pooled OLS
Constant	0.195	0.325	-0.195	-0.132
	(0.402)	(0.208)	(0.295)	(0.544)
Capital expenditures-to-sales	0.047	0.753	0.350**	0.682***
	(0.920)	(0.199)	(0.047)	(0.001)
Long-term debt-to-assets	-0.030	-0.058	0.880***	0.760***
	(0.907)	(0.831)	(0.000)	(0.001)
ln(Assets)	-0.071*	-0.094**	-0.068**	-0.072**
	(0.088)	(0.035)	(0.012)	(0.019)
Cash flow-to-sales	0.417	0.495	1.431***	1.438***
	(0.401)	(0.350)	(0.000)	(0.000)
Cash-to-sales	0.973**	0.613	0.154	0.006
	(0.017)	(0.208)	(0.316)	(0.973)
Dividend indicator	0.138	0.149	0.173***	0.143**
	(0.103)	(0.175)	(0.005)	(0.048)
Indicator for fuel hedged	0.070		0.080	
	(0.447)		(0.341)	
% of next year's fuel requirements hedged		0.221		0.195
		(0.149)		(0.107)
Fuel pass-through indicator	0.209*	0.200*	-0.005	0.005
	(0.092)	(0.098)	(0.940)	(0.937)
Indicator for foreign currency hedged	-0.147	-0.121	-0.253***	-0.289***
	(0.219)	(0.394)	(0.001)	(0.000)
No. of obs. / Total obs.	157 / 350	136 / 350	307 / 420	254 / 420
R^2	0.254	0.303	0.308	0.327

Table 2-4. Determinants of Jet Fuel Hedging by Global Airlines

This table reports the determinants for jet fuel hedging behavior by global airlines from 1995 to 2005. The regression model is as follows:

$$HR_{it} = \alpha + \beta_1 \, CapExp_{it} + \beta_2 \, LTDA_{it} + \beta_3 \, \log(Assets)_{it} + \beta_4 \, CFS_{it} + \beta_5 \, Cash_{it} + \beta_6 \, Dividend_{it} + \beta_7 \, ExeShares_{it} + \beta_8 \, PassThu_{it} + \beta_9 \, Fxhedge_{it} + \varepsilon_{it}$$

In Model 1, we apply the Tobit model using the percentage rate of next year's fuel hedging requirements (HR) at the end of the fiscal year as the dependent variables, and take account of fixed effects in each regression. In Model 2, we apply the Logit model using a dummy variable equaling one if a firm's hedge ratio is greater than zero, and zero otherwise as the dependent variable (HRD). The standard errors are corrected for both clustering by firm and clustering by year, which is suggested by Petersen (2009). P-values are presented in parentheses below the coefficients. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Total Sample

Variables	Model 1 Tobit	Model 2 Logit
Constant	-0.677***	-4.221***
	(0.000)	(0.000)
Capital expenditures-to-sales	-0.030	-0.719
	(0.862)	(0.434)
Tobin's Q	0.048	-0.131
	(0.369)	(0.683)
Long-term debt-to-assets	0.242*	0.101
	(0.061)	(0.929)
ln(Assets)	0.065***	0.524***
	(0.000)	(0.000)
Cash flow-to-sales	-0.013	-2.588
	(0.948)	(0.122)
Cash-to-sales	0.165	1.771
	(0.347)	(0.112)
Dividend indicator	0.163***	0.705*
	(0.001)	(0.066)
Executive shares-to-shares outstanding	-0.078	-0.060
	(0.692)	(0.951)
Fuel pass-through indicator	-0.142***	-1.250***
	(0.010)	(0.000)
Indicator for foreign exchange hedged	0.285***	2.156***
	(0.000)	(0.000)
No. of obs. / Total obs.	305 / 770	355 / 770

Panel B: US vs. Non-US Sample

	U.S. Sample		Non_U.S. Sample	
Variables	Model 1 Tobit	Model 1 Logit	Model 1 Tobit	Model 2 Logit
Constant	-0.635*** (0.001)	-4.797*** (0.000)	-1.028*** (0.000)	-6.250*** (0.004)
Capital expenditures-to-sales	0.168 (0.331)	0.932 (0.434)	-0.556* (0.055)	-5.431* (0.083)
Tobin's Q	0.022 (0.672)	-0.009 (0.981)	-0.282** (0.029)	-1.899 (0.206)
Long-term debt-to-assets	0.096 (0.489)	0.528 (0.665)	0.172 (0.456)	-8.131*** (0.001)
ln(Assets)	0.073*** (0.000)	0.599*** (0.000)	0.123*** (0.000)	1.293*** (0.000)
Cash flow-to-sales	0.130 (0.495)	-0.340 (0.774)	-1.212** (0.017)	-19.976** (0.012)
Cash-to-sales	0.372* (0.092)	1.393 (0.391)	0.052 (0.828)	5.110 (0.448)
Dividend indicator	0.099 (0.149)	-0.213 (0.717)	0.085 (0.217)	1.788* (0.056)
Executive shares-to-shares outstanding	-0.190 (0.354)	-0.669 (0.611)	1.243*** (0.002)	15.270*** (0.000)
Fuel pass-through indicator	-0.322*** (0.000)	-1.515** (0.011)	-0.056 (0.504)	-2.099*** (0.007)
Indicator for foreign exchange hedged	0.015 (0.822)	0.922* (0.085)	0.650*** (0.000)	4.403*** (0.000)
No. of obs. / Total obs.	211 / 341	211 / 341	94 /429	144 /440

Panel C: Alliance vs. Non-Alliance Sample

	Alliance Sample		Non_Alliance Sample	
Variables	Model 1 Tobit	Model 2 Logit	Model 1 Tobit	Model 2 Logit
Constant	-0.662** (0.029)	-3.999 (0.271)	-0.758*** (0.006)	-3.992*** (0.000)
Capital expenditures-to-sales	-0.988** (0.022)	-4.984 (0.129)	-0.002 (0.992)	-0.579 (0.495)
Tobin's Q	-0.157 (0.263)	-2.060 (0.276)	0.050 (0.494)	-0.027 (0.937)
Long-term debt-to-assets	0.206 (0.277)	-1.071 (0.751)	0.383* (0.074)	0.671 (0.569)
ln(Assets)	0.062** (0.049)	0.526 (0.167)	0.100*** (0.001)	0.505*** (0.000)
Cash flow-to-sales	0.014 (0.951)	-2.569 (0.329)	-0.360 (0.436)	-2.376 (0.192)
Cash-to-sales	0.099 (0.740)	3.564 (0.412)	0.219 (0.346)	1.608 (0.172)
Dividend indicator	0.235*** (0.000)	2.615** (0.031)	0.092 (0.376)	-0.050 (0.927)
Executive shares-to-shares outstanding	0.392 (0.227)	6.492 (0.210)	-0.435 (0.164)	-1.501 (0.292)
Fuel pass-through indicator	0.093 (0.235)	-1.010 (0.135)	-0.377*** (0.000)	-1.731*** (0.002)
Indicator for foreign exchange hedged	0.361*** (0.000)	3.457*** (0.000)	-0.074 (0.430)	1.299*** (0.008)
No. of obs. / Total obs.	129 / 341	153 / 341	176 / 429	202 / 429

Panel D: 1995-1999 vs. 2000-2005 Sample

	1995~1999		2000~2005	
Variables	Model 1 Tobit	Model 2 Logit	Model 1 Tobit	Model 2 Logit
Constant	-0.614*	-7.130***	-0.700***	-4.578***
	(0.058)	(0.004)	(0.000)	(0.000)
Capital expenditures-to-sales	-0.157	2.148	-0.023	-1.019
	(0.747)	(0.434)	(0.903)	(0.347)
Tobin's Q	0.006	0.641	0.102	-0.193
	(0.949)	(0.351)	(0.147)	(0.647)
Long-term debt-to-assets	0.847***	4.556**	0.055	-1.079
	(0.001)	(0.021)	(0.738)	(0.471)
ln(Assets)	0.061*	0.675***	0.062***	0.582***
	(0.076)	(0.009)	(0.002)	(0.000)
Cash flow-to-sales	1.026	1.484	-0.017	-3.088
	(0.168)	(0.625)	(0.937)	(0.225)
Cash-to-sales	-0.915*	-7.919**	0.371*	4.602***
	(0.085)	(0.027)	(0.064)	(0.001)
Dividend indicator	0.114	0.974	0.162***	0.441
	(0.165)	(0.251)	(0.007)	(0.334)
Executive shares-to-shares outstanding	-1.432**	-7.217*	0.188	2.282*
	(0.035)	(0.072)	(0.437)	(0.063)
Fuel pass-through indicator	-0.036	0.508	-0.197***	-2.092***
	(0.761)	(0.583)	(0.002)	(0.000)
Indicator for foreign exchange hedged	0.204**	2.397***	0.348***	2.846***
	(0.044)	(0.006)	(0.000)	(0.000)
No. of obs. / Total obs.	106 / 350	120 / 350	199 / 420	235 / 420

Table 2-5. The Influence of Hedging on Firm Value via Capital Expenditures

This table shows results of regressions estimated with a 2SLS (two-stage lease square) estimate controlling for fixed effects in the empirical regressions, which is suggested by Pagan (1984). The models are as follows:

$$CapExp_{it} = \gamma + \delta_1\ CFS_{it} + \delta_2\ lag(TobQ)_{it} + \delta_3\ lag(HR)_{it} + \upsilon_{it} \quad (2\text{-}4)$$

$$\log(TobQ)_{it} = \alpha + \beta_1\ Pred(CapExp)_{it} + \beta_2\ LTDA_{it} + \beta_3\ \log(Assets)_{it} + \beta_4\ CFS_{it} + \beta_5\ Cash_{it} + \beta_6\ Dividend_{it} + \beta_7\ HRD_{it} + \beta_8\ PassThu_{it} + \beta_9\ Fxhedge_{it} + \varepsilon_{it} \quad (2\text{-}5)$$

In the first-stage regression, we use capital expenditures-to-sales ratio as the dependent variable, and cash flow-to-sales, lagged Tobin's Q, and lagged percentage rate of jet fuel hedging as the independent variables, as shown in Equation (2-4). The estimated values of capital expenditures-to-sales ratio obtained from Equation (2-4) are then used in the second-stage regression to estimate the link between firm value and the independent variables in Equation (2-5). P-values are presented in parentheses below the coefficients. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Total Sample

Variables	**ln(Q)**	**Cap Exp-to-Sales**
Constant	-0.827*	-0.012
	(0.077)	(0.779)
Predicted Cap exp-to-sales	7.513***	
	(0.000)	
Long-term debt-to-assets	0.673**	
	(0.047)	
ln(Assets)	-0.057	
	(0.194)	
Cash flow-to-sales	-0.844***	0.260***
	(0.248)	(0.00)
Cash-to-sales	-0.338	
	(0.331)	
Dividend indicator	0.169	
	(0.232)	
% of next year's fuel requirements hedged	-0.301	
	(0.242)	
Fuel pass-through indicator	-0.081	
	(0.553)	
Indicator for foreign currency hedged	-0.140	
	(0.330)	
Lagged Tobin's Q		0.075***
		(0.000)
Lagged % of next year's fuel requirements hedged		0.054**
		(0.030)
R^2	0.170	0.251

Panel B: US vs. Non-US Sample

	U.S. Sample		Non_U.S. Sample	
Variables	**ln(Q)**	**CapExp-to-Sales**	**ln(Q)**	**Cap Exp-to-Sales**
Constant	-0.669 (0.316)	0.033 (0.432)	-0.540 (0.246)	-0.007 (0.873)
Predicted Cap exp-to-sales	8.823** (0.038)		3.848*** (0.000)	
Long-term debt-to-assets	0.463 (0.338)		0.919*** (0.008)	
ln(Assets)	-0.085 (0.232)		-0.088* (0.096)	
Cash flow-to-sales	-0.6597 (0.1309)	0.195*** (0.007)	0.495 (0.594)	0.329*** (0.010)
Cash-to-sales	-0.242 (0.755)		-0.089 (0.734)	
Dividend indicator	0.291 (0.284)		0.153 (0.181)	
% of next year's fuel requirements hedged	-0.325 (0.585)		-0.027 (0.878)	
Fuel pass-through indicator	-0.170 (0.462)		0.091 (0.470)	
Indicator for foreign currency hedged	-0.215 (0.435)		-0.013 (0.936)	
Lagged Tobin's Q		0.021 (0.215)		0.120*** (0.000)
Lagged % of next year's fuel requirements hedged		0.119*** (0.007)		-0.028 (0.433)
R^2	0.118	0.131	0.445	0.461

Panel C: Alliance vs. Non-Alliance Sample

	Alliance Sample		Non_Alliance Sample	
Variables	**ln(Q)**	**Cap Exp-to-Sales**	**ln(Q)**	**Cap Exp-to-Sales**
Constant	-1.468 (0.275)	0.036 (0.440)	-0.805 (0.316)	0.023 (0.778)
Predicted Cap exp-to-sales	11.240* (0.070)		6.999*** (0.001)	
Long-term debt-to-assets	1.207** (0.025)		0.367 (0.450)	
ln(Assets)	-0.075 (0.379)		-0.042 (0.567)	
Cash flow-to-sales	-0.461 (0.681)	0.123** (0.014)	-2.265 (0.159)	0.430*** (0.000)
Cash-to-sales	-0.111 (0.905)		-0.245 (0.603)	
Dividend indicator	0.223 (0.224)		0.272 (0.293)	
% of next year's fuel requirements hedged	0.252 (0.482)		-0.591 (0.267)	
Fuel pass-through indicator	0.058 (0.800)		-0.121 (0.549)	
Indicator for foreign currency hedged	-0.002 (0.993)		-0.234 (0.314)	
Lagged Tobin's Q		0.036 (0.175)		0.053*** (0.002)
Lagged % of next year's fuel requirements hedged		-0.042* (0.082)		0.142*** (0.002)
R^2	0.137	0.245	0.143	0.384

Panel D: 1995-1999 vs. 2000-2005 Sample

	1995-1999		2000-2005	
Variables	**ln(Q)**	**Cap Exp-to-Sales**	**ln(Q)**	**Cap Exp-to-Sales**
Constant	0.000*** (0.000)	0.021 (0.454)	0.000*** (0.000)	0.018 (0.582)
Predicted Cap exp-to-sales	5.923** (0.040)		7.006*** (0.000)	
Long-term debt-to-assets	0.021 (0.956)		0.866* (0.067)	
ln(Assets)	-0.040 (0.446)		-0.067 (0.238)	
Cash flow-to-sales	-1.483 (0.259)	0.352*** (0.000)	-0.803 (0.367)	0.228*** (0.005)
Cash-to-sales	0.827 (0.159)		-0.373 (0.363)	
Dividend indicator	0.138 (0.405)		0.190 (0.296)	
% of next year's fuel requirements hedged	-0.312 (0.346)		0.002 (0.994)	
Fuel pass-through indicator	-0.043 (0.827)		-0.081 (0.620)	
Indicator for foreign currency hedged	-0.259 (0.168)		-0.124 (0.494)	
Lagged Tobin's Q		0.023* (0.058)		0.093*** (0.000)
Lagged % of next year's fuel requirements hedged		0.084** (0.012)		0.030 (0.362)
R^2	0.229	0.347	0.145	0.201

Chapter III

Corporate Hedging Activities and Analyst Forecast Accuracy: Evidence from the Global Airline Industry

1. **Introduction**

A growing body of research studies the role of imperfect and asymmetric information between insiders and outsiders with regard to a corporation's financial policies. Bhattacharya (1997) shows that imperfect information affects a company's dividend policy, while Myers and Majluf (1984) demonstrate that it influences a firm's capital structure, and Demarzo and Duffie (1995) show that it can affect a firm's choice of hedging policy. Although regulators, including the SEC and FASB, have established a number of regulations that require corporations to increase their disclosures, there still exists imperfect and asymmetric information between investors and companies. Guay et al. (2003) find that both investors and analysts encounter difficulties in estimating the earnings effects of the risk exposures that companies face, which indicates that the errors in analysts' expectations induced by financial shocks likely stem from either incomplete information about firms' risk exposures, or a failure to effectively utilize the available information.

Ramnath et al. (2008) indicate that studying the earnings forecast accuracy of analysts is important for at least two reasons. First, investors can benefit from more accurate forecasts and the consequent more profitable stock recommendations, since better input leads to better output (Loh and Mian, 2006). Second, from a researcher's point of view, it is important to identify more accurate forecasts, because in an efficient market, expectations should quickly reflect all the accurate information available to market participants. Studies that use analysts' forecasts to proxy for the market's earnings expectations should also consider investors' ability to identify, differentiate and evaluate earnings forecasts from individual analysts (Maines, 1996).

Following Guay et al. (2003), we use a sample of 71 airline companies in 32 countries from 1995 to 2007, and find that the abnormal returns around earnings announcements and analysts yearly earnings forecasts are associated with hedging for both current year and one-year lagged fuel prices and interest rates. It therefore seems that hedging can reduce investor uncertainty about the effects of these risk exposures on airlines' earnings. We also find that oil price shocks in the current year and one-year lagged period have an impact on the three-day absolute value of abnormal returns only during periods of oil price stability. Investors face more uncertainty in stable than in volatile times caused by oil price shocks. The results show that the current year oil price shock for US airlines increases investor uncertainty, while the one-year lagged oil price shock for non-US airlines increases investor uncertainty. In addition, investors face more uncertainty only for current year shocks with airlines that have strong governance, especially for oil price and interest rate shocks.

We examine the relationship between analysts' forecast errors and financial shocks to airlines, and find that hedging for financial risk exposures plays an important role in explaining analysts' forecast accuracy, and especially for jet fuel price hedging. The results show that there is a positive relationship between oil price hedging and forecasts' errors in the total sample and in the sub-samples of volatile fuel price period, non-US airlines and weak governance airlines. In contrast, interest rate shocks with interest rate hedging have a negative impact on the total sample, and on the sub-samples of non-US airlines and weak governance airlines.

Finally, we examine to what extent analysts revise their earnings forecasts in response to oil price, interest rate and foreign exchange rate shocks, and whether these revisions contain additional information about how current and past price shocks affect reported earnings. Empirical results also indicate that jet fuel hedging can increase analysts' forecast revisions in the total sample and in the sub-sample of volatile fuel price periods, US and non-US airlines, and both of strong and weak governance airlines. Overall, oil price shocks play an important role in investor and analyst information uncertainty in the airline industry, and corporate risk disclosures thus provide analysts and investors with some but not all of the information necessary to understand firms' financial risk exposures.

The rest of this essay is structured as follows. In section 2, we describe the sample selection and specify the variables used in the empirical analysis. In section 3, the results on the associations between fuel price, interest rate and foreign exchange rate shocks and earnings announcement returns, analysts' forecast errors, and analysts' forecast revisions are presented. Section 4 provides the concluding remarks.

2. Sample Selection and Variables Description

2.1 Sample Selection

We retrieve our initial sample from Mergent Online database. Our sample consists of global airline companies from 1995 to 2007, including 131 companies from 41 countries. After excluding companies with annual reports available for less than 3 years (as described later) and their SIC codes not equaling 4512 or 4513,[22] the sample size reduces to 73 airline companies from 32 countries. We also require that our final sample have to be sufficient analyst forecast data in the I/B/E/S, and this restriction makes our final sample contain 71 airline companies from 32 countries. The information regarding whether these companies use jet fuel, interest rate and foreign exchange derivatives is collected from the footnotes in their annual reports, 10-K filings or 20-F forms provided by the Mergent Online database (SIC codes 4512 or 4513) and airline companies' websites. To calculate earnings announcement returns, we also retrieve the airline companies' stock prices and their respective market indices from the Datastream database.

2.2 Variable Descriptions

We examine the associations between fuel price, interest rate and foreign exchange rate shocks and earnings announcement returns, analysts' forecast errors, and analysts' forecast revisions for global airline companies. Following Guay et al. (2003), we use absolute changes of these three macroeconomic risk exposures in this study.[23] The raw data of jet fuel prices, interest rates and foreign exchange rates are retrieved from Datastream. We measure the change in oil price as the percentage change of Crude Oil-WTI Spot Cushing, and the percentage point change in jet fuel price is applied for all samples. Changes in interest rate come from yearly observations of the inter-bank offering rates or three-month Treasury bill rates for each country in which the airlines are based, and then use this raw data to calculate the percentage changes in these rates for each country. Finally, changes in foreign

[22] Although we retrieve our initial sample size from Mergent Online database, we check their SIC codes in the COMPUSTAT again and use them as our final sample.

[23] Instead of predicting the direction of movement that shocks to oil price, interest rate and foreign exchange rate cause in investor and analysts' earnings forecasts, we are interested in exploring whether these shocks increase the informational uncertainty investors and analysts face with respect to accurately reported earnings.

exchange rate are gathered from yearly observations of exchange rates of each country's main circulated currency to US dollars,[24] except for the US, for which we use the trade-weighted value of the dollar against several major currencies. We also transfer the percentage point changes in these rates for each country.

Table 3-1 presents the summary statistics of absolute changes in oil price, interest and foreign exchange rates for the total sample. It is seen that both mean and median values of the change in oil price are greater than the interest rates and foreign exchange rates for current year and one-year lagged. The volatility of change in interest rate and the maximum interest rate shock over the sample period are both greater than those for the oil price and foreign exchange rate. However, the relative volatilities of these shocks do not indicate which price series has the greatest impact on firms' cash flows or earnings, nor do they indicate which series contain more information when investors form their expectations and analysts make their forecasts. Finally, we use the cumulative changes in oil price, interest rates and foreign exchange rates over the prior year preceding each yearly observation to examine whether these shocks have an impact on earnings for more than one year.

3. Empirical Analysis and Results

In this section, we provide empirical results on whether oil price, interest rate and foreign exchange rate shocks increase investor and analyst uncertainty about airline companies' earnings. We also examine whether airlines' hedging behaviors with regard to financial risk have an impact on their predicated earnings. Furthermore, we investigate how investors and analysts work to resolve the uncertainty inherent in such processes.

3.1 <u>The Impact of Changes in Fuel Price, Interest Rate and Foreign Exchange Rate on Earnings Announcement Returns</u>

Our study starts with an analysis of the extent to which airline companies' risk exposures have an impact on investors' ability to forecast earnings. If investors have imperfect information about firms' risk exposures, we expect that earnings

[24] Since we cannot obtain the effective trade-weighted exchange rate for every country in our sample from Datastream, we replace it with this one.

announcements contain additional information about the impact of recent oil price, interest rate and foreign exchange rate shocks on stock performance. We also expect that the magnitude of market reaction to earnings announcements is higher when there are large shocks to oil price, interest rates and foreign exchange rates, and for firms with greater exposures to these variables.

We use the three-day window (-1, 0, 1) around the yearly earnings announcement of a company to measure the market reaction to the announcement. Following the literature, we measure the value of abnormal returns using the absolute value. To estimate abnormal returns, we use a market model in which the model parameters are estimated over a 200-day window ending 50 trading days before the yearly earnings announcement date (Mikkelson and Partch, 1986). We also divide our sample into different sub-groups based on different categories, such as US and non-US firms to see if these price shocks have different effects on each groups.

Table 3-2 shows the summary statistics of three-day earnings announcement returns and the macroeconomic control variables used in our regression analysis. The mean (median) absolute value of announcement return for the total sample is 2.96% (1.77%), which is consistent with prior research. In the sub-groups based on the volatility of jet fuel price, we can see that the absolute value of announcement return for the stable period (1995 to 2000) is higher than that for the volatile period (2001 to 2007). Investors face more uncertainty in US rather than non-US airlines with regard to three-day announcement returns. This table also shows that three-day announcement returns of strong-governance airlines are larger than these of weak-governance airlines.

In addition to examining the current year and one-year lagged shocks of oil price, interest rate and foreign exchange rate to announcement returns, we are also interested in whether companies' hedging activities for these risk exposures have any effect on investors' information set. We collect hedging information about oil price, interest rate and foreign exchange rate risk exposures from the airlines' annual reports. We then construct a dummy variable for each hedging behavior and set it equal to 1 if a airline company hedges for a given risk exposure, and 0 otherwise.

We use the following regression to analyze the relationship between absolute abnormal stock returns around earnings announcements and absolute changes in oil price, interest rate and foreign exchange rate hedging activities:

$$
\begin{aligned}
\text{Abs(AR)}_t = \alpha &+ \beta_1 \text{ Abs}(\Delta\text{FUEL})_t + \beta_2 \text{ Abs}(\Delta\text{FUEL})_t \times \text{Hedged in FUEL} \\
&+ \beta_3 \text{ Abs}(\Delta\text{IR})_t + \beta_4 \text{ Abs}(\Delta\text{IR})_t \times \text{Hedged in IR} \\
&+ \beta_5 \text{ Abs}(\Delta\text{FX})_t + \beta_6 \text{ Abs}(\Delta\text{FX})_t \times \text{Hedged in FX} \\
&+ \beta_7 \text{ Abs}(\Delta\text{FUEL})_{t-1,\,t} + \beta_8 \text{ Abs}(\Delta\text{FUEL})_{t-1,\,t} \times \text{Hedged in FUEL} \\
&+ \beta_9 \text{ Abs}(\Delta\text{IR})_{t-1,\,t} + \beta_{10} \text{ Abs}(\Delta\text{IR})_{t-1,\,t} \times \text{Hedged in IR} \\
&+ \beta_{11} \text{ Abs}(\Delta\text{FX})_{t-1,\,t} + \beta_{12} \text{ Abs}(\Delta\text{FX})_{t-1,\,t} \times \text{Hedged in FX} \\
&+ \beta_{13} \text{ Abs(Deviation in GDP)}_t + \beta_{14} \text{ Market Volatility}_t + \varepsilon_t \qquad (3\text{-}1)
\end{aligned}
$$

where Abs(AR)_t is the absolute value of the abnormal returns during the three-day period around the yearly earnings announcements; $\text{Abs}(\Delta\text{OIL})_t$ is the absolute percentage change of crude oil price coming from WTI Spot Cushing for year *t*; $\text{Abs}(\Delta\text{IR})_t$ is the absolute percentage change of three-month yield on Treasury bills or inter-bank offering rate coming from Datastream for year *t*; $\text{Abs}(\Delta\text{FX})_t$ is the absolute percentage change of foreign exchange rate for each country retrieved from Datastream for year *t*; $\text{Abs}(\Delta\text{FUEL})_{t-1,\,t}$, $\text{Abs}(\Delta\text{IR})_{t-1,\,t}$ and $\text{Abs}(\Delta\text{FX})_{t-1,\,t}$ are the respective cumulative price shocks over one year prior to the earnings reported year *t*; $\text{Abs(Deviation in GDP)}_t$ is the absolute value of the difference between the change in GDP in year *t* and the average yearly change in GDP for each country over our sample period; and $\text{Market Volatility}_t$ is the standard deviation of daily returns for the Datastream market index value for each country in year *t*. We include $\text{Abs(Deviation in GDP)}_t$ and $\text{Market Volatility}_t$ to control for general macro-level uncertainty in the economy, which is likely to affect investors' uncertainty when they form their firm-specific expectations. Finally, ε_t is the error term. To alleviate potential contaminating effects of outliers on our results, we winsorize the absolute announcement return variables at the 99^{th} percentile of their distributions.

Table 3-3 shows the results of the regression estimates of Equation (3-1). We estimate the regressions using a pooled sample with robust standard errors, which account for the clustering sample effect of our study period. Because we use absolute values of three-day earnings announcements and changes in price shocks in the regression analysis, we predict a positive relation between investor uncertainty and the price shocks. Following the literature, we draw inferences about the significance levels of the regression coefficients based on one-tailed t-statistics. Furthermore, we find that there is correlation between current shocks and one-year lagged shock in the empirical tests.[25] Therefore, we first report two reduced form regressions of Equation (3-1), which are presented in Columns (1) and (2) of the tables. Column (1) shows the current shocks, while Column (2) shows only the one-year lagged shocks.

Panel A of Table 3-3 reports the results for the total sample. The evidence shows that investors do not fully anticipate the firm-specific effects of changes in oil price and interest rate for firms with risk exposures in the current year and one-year lagged. In contrast, when airlines hedge for these risk exposures, there is a negative relation between shocks and the absolute value of abnormal returns. Thus, it seems that hedging can reduce investor uncertainty about the effects of these risk exposures on airlines' earnings.

Panel B of Table 3-3 shows the results for the sub-sample based on jet fuel price volatility, with the sample period from 1995 to 2000 representing a relatively stable fuel price period, while 2001 to 2007 a relatively volatile one. We can see that oil price shocks in current year and one-year lagged have a positive impact on the three-day absolute value of abnormal returns only in the stable period. This suggests that investors face more uncertainty in the stable period than in the volatile period, and this result is not consistent with our expectation. Moreover, investors in the volatile period face more uncertainty for current year and one-year lagged interest rate shocks, and airlines that hedge for shock would reduce investor information uncertainty.

Panel C of Table 3-3 reports the results for the sub-sample of US and non-US airlines. The result shows that current year shock of oil price increases investor uncertainty for US airlines, while one-year lagged shock of oil price increases investor uncertainty for non-US firms. It may be that the US market is more efficient than the non-US market, so that information can be incorporated into investors' decisions

[25] For example, the correlation coefficient between the absolute value of current period shocks to oil price and the absolute value of one-year lagged shocks to oil price is 0.6186 in our sample.

more quickly and efficiently. The coefficients of interest rate shocks also indicate this phenomenon, since for US airlines, we find that hedging for interest rate risk exposure in current year and one-year lagged shock reduces investor uncertainty. The reason could be that information about financial disclosure of derivatives use is clear and easily observed in the US market, so that investors can gather related information on the effects of hedging on firms' earnings more efficiently.

Panel D of Table 3-3 shows the results for the sub-sample based on corporate governance mechanisms. We construct a composite index using six corporate governance indices suggested by LLSV (1998), which are shareholder protection laws, creditor protection laws, law enforcement, efficiency of judicial system, corruption and expropriation. By adding ranked deciles scores of these six indices, we take the median value to partition our sample into two sub-groups. The sub-group with the composite index higher than the median is called the "strong governance sample", while that with the composite index below the median is the "weak governance sample". Overall, investors encounter more uncertainty only for current year shocks with airlines in the strong governance sample, especially for oil price and interest rate shocks. Our results are consistent with Chung et al.'s (2004) finding that better corporate governance is related to higher-quality information. Furthermore, the results also demonstrate that airlines that hedge for oil price, interest rate and foreign exchange rate shocks reduce investor information uncertainty in current years.

3.2 The Impact of Changes in Fuel Price, Interest Rate and Foreign Exchange Rate on Analysts' Forecast Errors

The results in Table 3-3 show that investors encounter difficulties in dealing with the uncertainties caused by changes in oil price, interest rates and foreign exchange rates. In this section, we further examine the association between absolute changes in these three risk exposures and information uncertainty using analysts' forecasts errors to replace investors' earnings expectations as our dependent variables.

Baron et al. (1998) analytically prove that the mean forecast error, together with forecast dispersion and the number of forecasters, can be used to estimate analysts' total uncertainty and their degree of consensus (common uncertainty relative to total uncertainty). They show that analyst forecast errors and dispersion in analysts' forecasts increase with analyst uncertainty. We focus on the median analysts' consensus annual earnings per share forecasts,[26] as reported on I/B/E/S. I/B/E/S releases monthly analyst forecasts and our data are adjusted for stock splits and dividends. We calculate the absolute value of analysts' forecast errors as follows:

$$\text{Percentage absolute forecast error} = \left| (AF_t - EPS_t)/EPS_t \right| \qquad (3\text{-}2)$$

where AF_t is the median analysts' forecast in the year prior to the end of the year for which earnings are reported, and EPS_t is the actual reported earnings per share in year *t* (as defined by I/B/E/S). We winsorize the absolute analysts' forecast errors at the 99th percentile values to minimize the effect of extreme observations in the empirical studies.

Table 3-4 is the summary statistics of analysts' forecast errors and other control variables used in the regression analysis, and we also report the sub-sample's summary statistics. In Panel A of Table 3-4, the results show that the average absolute value of analysts' forecast errors is 0.6609, indicating that on average the median forecast errors is about 2/3 of reported earnings. The distribution of analysts' forecast error is right-skewed in our sample, and the median forecast error is about 22.5% of the reported earnings. The average number of analysts following an airline company is 15.17, and the median is 13. Panel B of Table 3-4 shows that average absolute value of analysts' forecast errors is 0.6968 in the stable period, slightly greater than that in volatile period, 0.6320, and the number of analysts following an airline company is almost the same for these sub-samples. Panel C of Table 3-4 shows that the average absolute value of analysts' forecast errors is greater for non-US than that for US airlines, and that the number of analysts who make forecasts for the former is also greater than that for the latter. Panel D of Table 3-4 depicts the descriptive statistics for strong and weak governance sub-groups. The average absolute value of analysts' forecast errors is higher for airlines from weak governance regions than that for these from strong governance ones.

[26] The empirical results of using mean values of analysts' consensus annual earnings per share forecasts are similar to those obtained using median values. The summary statistics in Table 4 show that our sample and sub-sample are right-skewed, therefore, we use the absolute error in the median analyst forecast to alleviate the influence of large errors caused by individual analysts, as documented by most previous studies.

We examine the relationships between changes in oil price, interest rate and foreign exchange rate shocks and analysts' forecast errors as follows:

$$
\begin{aligned}
Abs(AFE)_t = \alpha &+ \beta_1\, Abs(\Delta FUEL)_t + \beta_2\, Abs(\Delta FUEL)_t \times \text{Hedged in FUEL} \\
&+ \beta_3\, Abs(\Delta IR)_t + \beta_4\, Abs(\Delta IR)_t \times \text{Hedged in IR} \\
&+ \beta_5\, Abs(\Delta FX)_t + \beta_6\, Abs(\Delta FX)_t \times \text{Hedged in FX} \\
&+ \beta_7\, Abs(\Delta FUEL)_{t-1,\,t} + \beta_8\, Abs(\Delta FUEL)_{t-1,\,t} \times \text{Hedged in FUEL} \\
&+ \beta_9\, Abs(\Delta IR)_{t-1,\,t} + \beta_{10}\, Abs(\Delta IR)_{t-1,\,t} \times \text{Hedged in IR} \\
&+ \beta_{11}\, Abs(\Delta FX)_{t-1,\,t} + \beta_{12}\, Abs(\Delta FX)_{t-1,\,t} \times \text{Hedged in FX} \\
&+ \beta_{13}\, Abs(\text{Deviation in GDP})_t + \beta_{14}\, \text{Market Volatility}_t \\
&+ \beta_{15}\, Log(\text{No. of Analysts})_t + \varepsilon_t \qquad (3\text{-}3)
\end{aligned}
$$

where $Abs(AFE)_t$ is the absolute change in analysts' forecast errors described in Equation (3-2), and $Log(\text{No. of Analysts})_t$ is the logarithm of the number of analysts making forecasts in the year prior to the end of the year for which earnings are reported. The accuracy of consensus forecasts is likely to increase along with the number of analysts making forecasts, and there is a negative relationship between number of analysts making forecasts following a given company and both the noisy estimates of consensus and volatile analysts' forecast errors. The rest of variables are the same as in Equation (3-1).

Table 3-5 reports the estimate results of Equation (3-3). Column (1) gives the result of the impact of current year shocks to oil price, interest rate and foreign exchange rate on analysts' forecast errors, while Column (2) shows the influence of one-year lagged shocks to fuel, interest rate and foreign exchange rate on analysts' forecast errors. Finally, Column (3) presents the estimation for the full specification.

Consistent with previous research, we expect that the absolute changes of these shocks have a positive relation with analysts' forecast errors. From our regression estimates, we show that only interest rate shocks are consistent with this expectation for total sample, as shown in Panel A of Table 3-5. There is no positive or significant relationship in oil price and foreign exchange rate shocks. It is worth noting that for airlines with hedging for oil price, current year and one-year lagged oil price shocks with have a positive impact on forecast errors, while hedging for interest rate and foreign exchange rate shocks have a negative impact on forecast errors. We suggest several reasons to explain this phenomenon. First, airline companies are very concerned with the volatility of fuel price because such costs account for large amount of their operating expenses. Therefore, predicting fuel prices is important for airlines and analysts when making earnings forecasts. The positive relation between oil price shocks coupled with fuel-hedging and forecast errors may imply that analysts can not evaluate the influence of fuel price on fuel-hedged airlines' earnings, as the hedging may add to analysts' information uncertainty during an oil price rise, and thus increase forecast errors. Second, financial reports only disclose certain information about the results of fuel hedging, and analysts can not observe the exact processes and policies adapted. Therefore, analysts encounter difficulties when making earnings forecasts, because they lack information on how changes in hedging policy may affect reported earnings during the fiscal year. Third, the efficiency of fuel hedging may not be as great as analysts predict. Financial accountants' hedging skill, financial derivatives' accessibility and top managers' attitude to hedging are all factors that can affect airlines' hedging efficiency, and thus influence analysts' forecasting ability.

Panel B of Table 3-5 shows the regression results for the sub-sample based on volatility of fuel price. The absolute changes of these shocks have a significant influence on analysts' forecast errors in the volatile period. We can see that the regression coefficients of oil price and foreign exchange rates are significant in current year shocks, no matter whether they engage in hedging activities or not. Moreover, the influence of shocks to oil price on forecast errors is similar for the total sample in this period. The possibilities of making inefficient hedging decisions and the difficulties in predicting fuel prices reduce the precision of analysts' forecasts, and thus fuel hedging seems to lead to more inaccurate forecasts in the volatile fuel price period.

Panel C of Table 3-5 presents the results for US and non-US airlines. Compared with non-US airlines, analysts face more information uncertainty when making earnings forecasts for US airlines with current year and one-year lagged oil price shocks. Conversely, analysts' forecast errors are significantly greater for non-US airlines than for US airlines with jet fuel hedging for current year and one-year lagged shocks. The coefficients of absolute change in interest rate are all significant for non-US airlines. Contrary to oil price shocks, there is a positive relation between absolute changes in interest rate (current year and one-year lagged) and forecast errors, and a negative relation between absolute changes in interest rate with interest rate hedging (current year and one-year lagged) and forecast errors. This means that shocks to interest rates can increase analysts' forecast errors, but airlines with interest rate-hedged can reduce this uncertainty for the non-US airlines sub-sample. Furthermore, we see that the number of analysts making forecasts for a given firm has a negative effect on analysts' forecast errors for US airlines, and the coefficients are all significant in the three regression estimates. This is consistent with our expectation that more analysts can reduce the noisy estimates of consensus and volatile forecasting errors. Overall, the US market seems more efficient than non-US markets as the related analysts' forecast errors are less affected by such shocks and show a greater consensus.

Panel D of Table 3-5 provides the regression results for sub-samples based on corporate governance mechanisms. The coefficients of regressions in strong governance airlines are mostly insignificant, which implies that shocks to oil price, interest and foreign exchange rates have no impact on analysts' forecasts errors. This result is consistent with Chung et al.'s (2004) findings that better corporate governance is associated with higher-quality public information and generates greater consensus among analysts. On the other hand, we find that shocks to oil price and interest rates have significant effects on forecast errors in weak governance airlines. The current and one-year lagged oil price shocks reduce forecasting errors, while hedging for jet fuel price increases analysts' uncertainty. In addition, our results show that interest rate shocks have a positive effect on analysts' forecast errors, both in current year and one-year lagged shocks, but airlines with interest rate hedging can reduce this uncertainty. Finally, we find that there is a positive relation between the number of analysts and forecast errors in weak governance airlines. This relationship contradicts our previous findings, and our explanation is that when airlines have weak governance analysts will have more diverse opinions about earnings forecasts, because of inefficient information transmission or low-quality public information.

3.3 The Impact of Changes in Fuel Price, Interest Rate and Foreign Exchange Rate on Revisions in Analysts' Forecasts

A number of recent papers suggest that market participants are concerned with analysts' forecast accuracy. This implies that the intensity of the market's response to earnings forecast revisions should increase along with analyst forecasting ability. Using a broad sample of over 15,000 analyst-firm-year observations from I/B/E/S, Park and Stice (2000) find that there is a positive relation between past forecast usefulness and the market's response to individual analysts' forecast revisions. Francis and Soffer (1997) also find that the market responds more strongly to earnings forecast revisions accompanied by buy (versus hold or sell) recommendations, using 556 analyst research reports available in the Investext database from 1989 to 1991.

In this section, we examine whether and to what extent analysts revise their earnings forecasts in response to oil price, interest rate and foreign exchange rate shocks they have observed during the year, and whether these revisions contain additional information about how current and past price shocks affect reported earnings. We investigate this relationship between intra-year revisions in analysts' forecasts and changes in oil price, interest rate and foreign exchange rate during the year with an equation similar to Equation (3-3), except that the dependent variable is replaced by intra-year revisions. The intra-year revisions is measured as the Abs($Forecast_{Max}$ – $Forecast_{Min}$) scaled by the absolute value of actual reported earnings per share, where $Forecast_{Max}$ and $Forecast_{Min}$ are the maximum and minimum values of forecasts during the forecasting year.

Table 3-6 reports the results of intra-year revision regression analysis. In Panel A, we find that shocks to oil price have more significant effects on forecast revisions for the total sample. Airlines with hedging for jet fuel price increase analysts' forecast revisions significantly, and this is consistent with our previous findings that fuel hedging can confuse investors' forecasting decisions, and therefore, such revisions increase along with hedging activity. The number of analysts also has a positive effect on forecast revisions, which indicates that a greater number of analysts leads to more forecast revisions and generates less consensus. Panel B of Table 3-6 shows the resluts for the sub-sample based on volatility of fuel price. The results for the volatile period (2001 to 2007) are similar to those for the total sample, indicating that fuel hedging can lead to more revisions for analysts and that the number of analysts is significantly and positively related to forecast revisions. However, interest rate and foreign exchange rate shocks do not cause analysts to revise their forecasts significantly.

Panel C of Table 3-6 shows that current year oil price shock and one-year lagged shock with hedging for jet fuel price are negatively and positively related to forecast revisions for non-US airlines, respectively. In addition, the number of analysts increases the number of forecast revisions for non-US airlines, and we find there is little difference between these sub-samples on this point.

Panel D of Table 3-6 reports the results of the sub-samples based on corporate governance mechanisms, showing that fuel hedging can increase analysts' forecast revisions for both sub-samples, and the coefficients are significantly positive. In contrast, the significantly negative relation between oil price shock and forecast revisions only exists in weak governance airlines for both current year and one-year lagged. The relationship between interest rate shocks and forecast revisions is significant for weak governance airlines only. The absolute changes in interest rate have a positive impact on forecast revisions, while hedging for interest rate shock can reduce analysts' forecast revisions. We also find that the forecast revisions increase with number of analysts for weak governance airlines.

4. Conclusions

To the best of our knowledge, this paper provides the first in-depth research on the association between shocks to oil price, interest rate and foreign exchange rate and analyst forecast accuracy. Using a unique data set of 71 airline companies in 32 countries from 1995 to 2007, we find that the abnormal returns around earnings announcements and the errors in analysts' yearly earnings forecasts are associated with both current year and one-year lagged changes in fuel price and interest rates. It thus seems that hedging can reduce investor uncertainty about the effects of these risk exposures on airlines' earnings. We also find that oil price shocks in the current year and one-year lagged have an impact on the absolute value of abnormal returns only for the stable period. Specifically, investors face more uncertainty in the stable rather than in the volatile period, caused by oil price shock. The results show that current year oil price shocks to US airlines increase investors' uncertainty, while one-year lagged oil price shocks to non-US airlines increase investors' uncertainty. Finally, we find that investors encounter more uncertainty only for current year shocks with airlines in the strong governance sample, especially for oil price and interest rate shocks. We examine the relationship between analysts' forecast errors and shocks to oil price, interest rate and foreign exchange rate, and find that hedging for financial risk exposures plays an important role in explaining such forecasts, and especially fuel price hedging. The result shows that there is a positive relation between oil price hedging and forecast errors in the total sample and in the sub-samples of volatile fuel price period, non-US airlines and weak governance airlines. In contrast to oil price shocks, interest rate shocks with interest rate hedging have a negative impact on the total sample, and on the sub-samples of non-US airlines and weak governance airlines.

We also examine the extent analysts revise their earnings forecasts in response to the oil price, interest rate and foreign exchange rate shocks they have observed during the year, and whether these revisions contain additional information about how current and past price shocks affect reported earnings. Empirical results indicate that jet fuel hedging can increase analysts' forecast revisions in the total sample, and in the sub-sample of the volatile fuel price period. These results can be seen in US and non-US airlines, and airlines with both strong and weak governance. Overall, our results show that oil price shocks play an important role in investor and analyst information uncertainty with regard to the airline industry, since corporate risk disclosures only provide limited information about firms' financial risk exposures.

Most previous studies related to analysts' forecast errors use the quarterly data, but the availability of them is difficulity for our sample except for US airlines. We need specific information about a firm's hedging activities for jet fuel, interest rates and foreign exchange rates to examine the issues, but these detailed quarterly reports are unavailable for us. If we can get quarterly data about information of a firm's hedging activities, the empirical results may be more meaningful and indicative for regulators and accounting standard setters to improve a firm's disclosures about its risk exposures, and thus, reduce the information uncertainty of investors and analysts.

Table 3-1. Summary Statistics of Macroeconomic Risk Exposures

This table describes summary statistics for the absolute changes in fuel, interest and foreign exchange rates of the total sample, which includes 71 airline companies in 32 countries from 1995 to 2007. Absolute change in jet fuel price is the absolute percentage point change in the yearly price of Crude Oil-WTI Spot Cushing for the current year. The current year absolute change in interest rate is the absolute percentage point change in the yearly observations of the inter-bank rates or three-month Treasury bill rates for each respective country in which the airlines are based. The current year absolute change in foreign exchange rate is the absolute percentage point change in the yearly observations of foreign exchange rates for each respective country in which the airlines are based. The one-year lagged shocks in FUEL, IR and FX are the absolute cumulative changes over the prior year preceding each yearly observation for which earnings are reported.

	Mean	Median	Std. Dev.	Max.
Absolute value (change in Fuel Price)				
Current year	0.3140	0.2943	0.2832	1.1245
One-year lag	0.6473	0.6211	0.3269	1.4410
Absolute value (change in IR)				
Current year	0.2995	0.2070	0.5808	13.8571
One-year lag	0.6150	0.4791	0.9053	16.8571
Absolute value (change in FX)				
Current year	0.0734	0.0490	0.1502	3.0328
One-year lag	0.1506	0.1015	0.2655	3.5000

Table 3-2. Summary Statistics of Earnings Announcement Returns and Macroeconomic Control Variables Used in Regressions

The sample is unbalanced panel data, which consists of 923 firm-year observations from 1995 to 2007. Three-day earnings announcement return is the absolute value of abnormal return for the three day window around the earnings announcement using the market model. The absolute deviation in GDP is the absolute value of difference between the change in GDP in the year for earnings reported and the mean value of yearly change in GDP for each respective country over the sample period. Stock market volatility is the standard deviation of daily returns retrieved from Datastream during the year. Panel A presents the total sample of 71 airlines from 32 countries over the sample period. Panel B describes the sub-groups of two periods with stable and volatile fuel prices. 1995 to 2000 represents the relatively stable fuel price period, while 2001 to 2007 represents the relatively volatile fuel price period. Panel C describes the sub-groups of US and Non-US airlines. Summary statistics of the sub-groups based on corporate governance mechanisms are reported in Panel D.

Panel A: Full Sample

	Mean	Median	Std. Dev.	Max.
Earnings Announcement Returns				
3-day earnings announcement return	0.0296	0.0177	0.0364	0.2895
Macroeconomic Risks				
Absolute deviation in GDP	0.0145	0.0097	0.0256	0.5236
Stock market volatility	1.8697	0.7595	2.9062	22.1298

Panel B: 1995-2000 vs. 2001-2007 Sample

	1995~2000				2001~2007			
	Mean	Median	Std. Dev.	Max.	Mean	Median	Std. Dev.	Max.
Earnings Announcement Returns								
3-day earnings announcement return	0.0358	0.0253	0.0400	0.2895	0.0255	0.0147	0.0332	0.2082
Macroeconomic Risks								
Absolute deviation in GDP	0.0175	0.0109	0.0348	0.5236	0.0121	0.0079	0.0139	0.1011
Stock market volatility	1.6984	0.6815	2.7437	19.9529	2.0141	0.8440	3.0317	22.1298

Panel C: US vs. Non-US Sample

	US				Non-US			
	Mean	Median	Std. Dev.	Max.	Mean	Median	Std. Dev.	Max.
Earnings Announcement Returns								
3-day earnings announcement return	0.0374	0.0236	0.0429	0.2895	0.0240	0.0140	0.0297	0.1957
Macroeconomic Risks								
Absolute deviation in GDP	0.0093	0.0061	0.0058	0.0234	0.0188	0.0104	0.0336	0.5236
Stock market volatility	0.6002	0.5669	0.2323	1.1368	2.8971	1.4517	3.5898	22.1298

Panel D: Strong Governance vs. Weak Governance Sample

	Strong Governance				Weak Governance			
	Mean	Median	Std. Dev.	Max.	Mean	Median	Std. Dev.	Max.
Earnings Announcement Returns								
3-day earnings announcement return	0.0305	0.0190	0.0376	0.2895	0.0275	0.0154	0.0334	0.1957
Macroeconomic Risks								
Absolute deviation in GDP	0.0102	0.0080	0.0085	0.1005	0.0270	0.0131	0.0461	0.5236
Stock market volatility	1.4275	0.6815	2.4085	19.9529	3.0472	1.5607	3.6914	22.1298

Table 3-3. The Impact of Changes in Fuel, Interest Rate and Foreign Exchange Rate on Three-day Earnings Announcement Returns

The sample is unbalanced panel data, which consists of 923 firm-year observations from 1995 to 2007. The dependent variable is the absolute value of abnormal return for the three-day window around the earnings announcement, which is calculated from the market model. Absolute values of current year shocks to FUEL, IR and FX are estimated from the beginning to the end of earnings reported year *t*. Absolute values of one–year lagged changes in FUEL, IR and FX are measured over the one year prior to the earnings reported year *t*. t-statistics are presented in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Total Sample

	Dependent variable: Absolute value of 3-day earnings announcement return		
Variables	(1)	(2)	(3)
Constant	0.0302*** (11.0755)	0.0319*** (8.4398)	0.0321*** (8.3235)
Absolute value (change in Fuel Price)			
Current year	0.0189** (1.9416)		0.0105 (0.6874)
One-year lag		0.0114* (1.5796)	0.0053 (0.5070)
Current year*(Hedged in fuel price)	-0.0153* (-1.5841)		-0.0082 (-0.4850)
One-year lag*(Hedged in fuel price)		-0.0093* (-1.5755)	-0.0049 (-0.4840)
Absolute value (change in IR)			
Current year	0.0216** (1.8900)		0.0394** (1.7723)
One-year lag		0.0075* (1.3780)	-0.0121 (-1.2787)
Current year*(Hedged in IR)	-0.0235** (-2.0944)		-0.0376** (-1.6864)
One-year lag*(Hedged in IR)		-0.0099** (-1.8285)	0.0088 (0.9192)
Absolute value (change in FX)			
Current year	-0.0022 (-0.1357)		0.0116 (0.4152)
One-year lag		-0.0074 (-0.8947)	-0.0084 (-0.5793)
Current year*(Hedged in FX)	-0.0478** (-1.6631)		-0.0307 (-0.6165)
One-year lag*(Hedged in FX)		-0.0251* (-1.5881)	-0.0165 (-0.6268)
Absolute deviation in GDP	0.0093 (0.0869)	-0.0056 (-0.0524)	0.0118 (0.1002
Stock market volatility	-0.0000 (-1.1013)	-0.0000 (-0.8814)	-0.0000 (-0.7133)
No. of obs. / Total obs.	508 / 923	504 / 923	504 / 923
Centered R^2	0.0570	0.0522	0.0672

Panel B: 1995-2000 vs. 2001-2007 Sample

	Dependent variable: Absolute value of 3-day earnings announcement return					
	1995-2000			2001-007		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.0353*** (7.7515)	0.0349*** (5.4873)	0.0452*** (4.2892)	0.0307*** (9.0415)	0.0337*** (6.4027)	0.0362*** (6.6164)
Absolute value (change in Fuel Price)						
Current year	0.0312*** (2.4180)		0.1236** (2.0102)	-0.0182* (-1.4518)		-0.0232 (-1.2756)
One-year lag		0.0199** (1.8883)	-0.0739* (-1.5208)		-0.0068 (-0.6783)	-0.0015 (-0.1293)
Current year*(Hedged in fuel price)	-0.0159 (-1.2262)		-0.0546 (-0.9760)	-0.0001 (-0.0091)		0.0054 (0.2705)
One-year lag*(Hedged in fuel price)		-0.0098 (-1.0418)	0.0261 (0.6878)		-0.0025 (-0.3276)	-0.0053 (-0.4770)
Absolute value (change in IR)						
Current year	-0.0124 (-0.8805)		-0.0721** (-1.8407)	0.0342*** (2.6269)		0.0451** (1.8885)
One-year lag		0.0024 (0.2188)	0.0408* (1.4556)		0.0127** (2.0280)	-0.0077 (-0.7694)
Current year*(Hedged in IR)	-0.0236* (-1.4778)		0.0242 (0.5232)	-0.0346*** (-2.7024)		-0.0432** (-1.8049)
One-year lag*(Hedged in IR)		-0.0104 (-0.9249)	-0.0289 (-0.9486)		-0.0142** (-2.3072)	0.0054 (0.5390)
Absolute value (change in FX)						
Current year	-0.0195 (-0.8372)		-0.1931* (-1.3905)	-0.0012 (-0.0784)		0.0201 (0.9345)
One-year lag		-0.0099 (-0.9686)	0.0700 (1.0349)		-0.0094 (-0.7714)	-0.0182* (-1.3674)
Current year*(Hedged in FX)	-0.0505 (-0.9639)		0.1762 (1.1943)	0.0001 (0.0016)		0.0244 (0.4212)
One-year lag*(Hedged in FX)		-0.0622** (-1.7828)	-0.1241* (-1.5091)		-0.0035 (-0.1823)	-0.0139 (-0.4696)
Absolute deviation in GDP	-0.0552 (-0.3392)	-0.1477 (-0.8862)	-0.0201 (-0.1167)	0.0227 (0.1705)	0.1697 (1.0985)	0.0807 (0.5121)
Stock market volatility	-0.0000 (-0.3767)	0.0000 (0.0150)	-0.0000 (-0.2208)	-0.0000* (-1.4198)	-0.0000* (-1.4749)	-0.0000 (-1.0652)
No. of obs. / Total obs.	173 / 426	173 / 426	173 / 426	335 / 497	331 / 497	331 / 497
Centered R^2	0.1168	0.1011	0.1498	0.0727	0.0526	0.0871

Panel C: US vs. Non-US Sample

	Dependent variable: Absolute value of 3-day earnings announcement return					
	US			Non-US		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.0242*** (2.8421)	0.0371*** (3.1544)	0.0495*** (2.7747)	0.0279*** (7.3816)	0.0289*** (5.7207)	0.0287*** (5.5769)
Absolute value (change in Fuel Price)						
Current year	0.0294** (2.1921)		-0.0067 (-0.1888)	0.0040 (0.2117)		-0.0043 (-0.1311)
One-year lag		0.0066 (0.6853)	0.0092 (0.4382)		0.0038 (0.3131)	0.0024 (0.1359)
Current year*(Hedged in fuel price)	-0.0132 (-1.0657)		-0.0066 (-0.2883)	-0.0014 (-0.0772)		0.0040 (0.1187)
One-year lag*(Hedged in fuel price)		-0.0074 (-0.9938)	-0.0028 (-0.2064)		-0.0007 (-0.0601)	0.0009 (0.0513)
Absolute value (change in IR)						
Current year	0.0251* (1.6332)		0.0738*** (2.6202)	0.0156 (0.9862)		-0.1111*** (-2.6713)
One-year lag		-0.0025 (-0.3183)	-0.0449*** (-2.6150)		0.0242** (2.1376)	0.0823*** (2.9162)
Current year*(Hedged in IR)	-0.0296** (-2.1899)		-0.0463** (-1.6674)	-0.0167 (-1.0604)		0.1120*** (2.6956)
One-year lag*(Hedged in IR)		-0.0136** (-2.1581)	0.0089 (0.8271)		-0.0253** (-2.2355)	-0.0838*** (-2.9747)
Absolute value (change in FX)						
Current year	-0.0484 (-0.6750)		-0.0562 (-0.4274)	0.0073 (0.4380)		-0.0333 (-0.6222)
One-year lag		-0.0134 (-0.2636)	-0.0657 (-0.5417)		-0.0123* (-1.4259)	-0.0118 (-0.4424)
Current year*(Hedged in FX)	0.0362 (0.4429)		-0.1973 (-1.2013)	-0.0384 (-1.1430)		0.0599 (0.8514)
One-year lag*(Hedged in FX)		0.0379 (0.7403)	0.1398* (1.3311)		-0.0192 (-1.1073)	-0.0282 (-0.7750)
Absolute deviation in GDP	1.5584** (1.9626)	-0.1564 (-0.2283)	-1.1233 (-0.5725)	-0.0738 (-0.7536)	-0.1131 (-0.9911)	-0.0894 (-0.7950)
Stock market volatility	-0.0001 (-0.7679)	0.0001 (0.7678)	0.0003 (0.7912)	-0.0000 (-0.2103)	-0.0000 (-0.4478)	-0.0000 (-0.7700)
No. of obs. / Total obs.	228 / 403	228 / 403	228 / 403	280 / 520	276 / 520	276 / 520
Centered R^2	0.0776	0.0535	0.1291	0.0102	0.0424	0.0779

Panel D: Strong Governance vs. Weak Governance Sample

	Dependent variable: Absolute value of 3-day earnings announcement return					
	Strong Governance			Weak Governance		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.0273*** (7.9918)	0.0255*** (4.9628)	0.0245*** (4.4601)	0.0301*** (4.6624)	0.0349*** (3.7221)	0.0366*** (3.7206)
Absolute value (change in Fuel Price)						
Current year	0.0197** (1.8315)		0.0276* (1.5598)	0.0060 (0.2342)		-0.0134 (-0.3717)
One-year lag		0.0104 (1.2713)	-0.0026 (-0.2125)		0.0071 (0.4126)	0.0085 (0.4323)
Current year*(Hedged in fuel price)	-0.0170* (-1.5626)		-0.0262* (-1.3386)	0.0030 (0.1164)		0.0226 (0.5949)
One-year lag*(Hedged in fuel price)		-0.0068 (-0.9893)	0.0062 (0.5098)		-0.0022 (-0.1467)	-0.0107 (-0.5693)
Absolute value (change in IR)						
Current year	0.0206** (1.6630)		0.0374* (1.6095)	0.0248 (0.9648)		-0.0987 (-1.2040)
One-year lag		0.0047 (0.8007)	-0.0147* (-1.5735)		0.0314** (1.8888)	0.0733* (1.6239)
Current year*(Hedged in IR)	-0.0224** (-1.8275)		-0.0361* (-1.5514)	-0.0359* (-1.3030)		0.0967 (1.1671)
One-year lag*(Hedged in IR)		-0.0066 (-1.1446)	0.0119 (1.2780)		-0.0398** (-2.1434)	-0.0824** (-1.7436)
Absolute value (change in FX)						
Current year	0.0220 (0.3682)		-0.1691* (-1.5089)	-0.0011 (-0.0668)		-0.0166 (-0.3338)
One-year lag		0.0577* (1.4284)	0.1454** (1.9293)		-0.0221** (-2.1201)	-0.0232 (-1.0586)
Current year*(Hedged in FX)	-0.0808* (-1.4114)		0.1161 (0.9705)	-0.0156 (-0.2947)		0.0916 (0.8419)
One-year lag*(Hedged in FX)		-0.0810** (-2.2890)	-0.1431** (-1.9584)		-0.0156 (-0.7504)	-0.0371 (-0.7594)
Absolute deviation in GDP	0.3722** (1.7224)	0.2821* (1.3775)	0.3638* (1.6076)	-0.1409 (-1.0623)	-0.2433* (-1.4794)	-0.1967* (-1.2905)
Stock market volatility	-0.0000** (-1.7177)	-0.0000* (-1.3513)	-0.0000* (-1.3078)	-0.0000 (-0.0022)	-0.0000 (-0.3130)	-0.0000 (-0.3983)
No. of obs. / Total obs.	380 / 663	380 / 663	380 / 663	128 / 260	124 / 260	124 / 260
Centered R^2	0.0842	0.0729	0.1100	0.0230	0.0683	0.0969

Table 3-4. Summary Statistics of Analysts' Forecast Errors and Other Control Variables Used in the Regressions

The sample is unbalanced panel data, which consists of 923 firm-year observations from 1995 to 2007. Absolute value of analysts' forecast errors is the difference between the actual reported earnings per share and the median analysts' forecast in the year prior to the end of the year for which earnings are reported, scaled by the absolute value of actual reported earnings per share. The number of analysts is the number of analysts who make earnings forecasts in the year prior to the end of the year for which earnings are reported. Panel A presents the total sample of 71 airlines from 32 countries over the sample period from 1995 to 2007. Panel B describes the sub-groups of two periods with stable and volatile fuel prices. 1995 to 2000 represents the relatively stable fuel price period, while 2001 to 2007 represents the relatively volatile fuel price period. Panel C describes the sub-groups of US and non-US airlines. Summary statistics of the sub-groups based on corporate governance mechanisms are reported in Panel D.

Panel A: Total Sample

	Mean	Median	Std. Dev.	Max.
Absolute value of analysts' forecast errors	0.6609	0.2250	1.6734	21.0000
Number of analysts	15.1706	13.0000	11.5830	61.0000

Panel B: 1995-2000 vs. 2001-2007 Sample

	1995-2000				2001-2007			
	Mean	Median	Std. Dev.	Max.	Mean	Median	Std. Dev.	Max.
Absolute value of forecast errors (median)	0.6968	0.1750	1.9391	21.0000	0.6320	0.2600	1.4263	16.0500
Number of analysts	15.9544	13.0000	13.6462	61.0000	14.5395	13.0000	9.5798	49.0000

Panel C: US vs. Non-US Sample

	US				Non-US			
	Mean	Median	Std. Dev.	Max.	Mean	Median	Std. Dev.	Max.
Absolute value of forecast errors (median)	0.5792	0.1500	1.4744	18.6700	0.7228	0.2800	1.8094	21.0000
Number of analysts	10.2996	11.0000	5.9173	31.0000	18.8978	17.0000	13.3495	61.0000

Panel D: Strong Governance vs. Weak Governance Sample

	Strong Governance				Weak Governance			
	Mean	Median	Std. Dev.	Max.	Mean	Median	Std. Dev.	Max.
Absolute value of forecast errors (median)	0.6331	0.1900	1.6270	21.0000	0.7427	0.2900	1.8062	16.0500
Number of analysts	14.6534	13.0000	11.4474	61.0000	16.7188	14.0000	11.8821	50.0000

Table 3-5. The Impact of Changes in Fuel, Interest Rate and Foreign Exchange Rate on Absolute Analysts' Forecast Errors

The sample is unbalanced panel data, which consists of 923 firm-year observations from 1995 to 2007. The dependent variable is the absolute value of analysts' forecast error, which is measured as the difference between the median analyst forecast in the year prior to the earnings reported year *t* and actual reported earnings in year *t*, scaled by actual reported earnings in year *t*. Absolute values of current year shocks to fuel, interest and foreign exchange rates are estimated from the beginning to the end of earnings reported year *t*. Absolute values of one –year lagged changes in FUEL, IR and FX are measured over one year prior to the earnings reported year *t*. t-statistics are presented in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Total Sample

	Dependent variable: Absolute value of analysts' forecast error		
Variables	(1)	(2)	(3)
Constant	0.5020**	0.3414*	0.3581*
	(2.0045)	(1.4874)	(1.5799)
Absolute value (change in Fuel Price)			
Current year	-0.0384		0.2143
	(-0.0865)		(0.4733)
One-year lag		0.3133	0.1786
		(1.0588)	(0.6907)
Current year*(Hedged in fuel price)	0.7043*		0.0130
	(1.3117)		(0.0204)
One-year lag*(Hedged in fuel price)		0.4948**	0.5099**
		(1.7708)	(1.9546)
Absolute value (change in IR)			
Current year	0.4626*		-0.7224
	(1.2898)		(-0.9549)
One-year lag		0.3155*	0.6620*
		(1.4461)	(1.2900)
Current year*(Hedged in IR)	-0.5019*		0.7997
	(-1.3839)		(1.0564)
One-year lag*(Hedged in IR)		-0.3480**	-0.7340*
		(-1.6475)	(-1.4396)
Absolute value (change in FX)			
Current year	0.4787		1.1970
	(0.4893)		(0.7714)
One-year lag		0.1909	-0.4065
		(0.5293)	(-0.6874)
Current year*(Hedged in FX)	-2.0542**		-2.5535
	(-1.6982)		(-0.9098)
One-year lag*(Hedged in FX)		-0.8341	0.4804
		(-0.9632)	(0.2586)
Absolute deviation in GDP	5.8666	0.4941	0.6390
	(1.2020)	(0.1083)	(0.1497)
Stock market volatility	-0.0002	-0.0002	-0.0002
	(-1.1779)	(-1.0555)	(-1.0436)
Log (no. of analysts)	0.0056	-0.0499	-0.0528
	(0.0497)	(-0.4852)	(-0.5054)
No. of obs. / Total obs.	505 / 923	503 / 923	503 / 923
Centered R^2	0.0171	0.0320	0.0367

Panel B: 1995-2000 vs. 2001-2007 Sample

	Dependent variable: Absolute value of analysts' forecast error					
	1995-2000			2001-2007		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.4953 (1.0925)	0.2716 (0.6055)	0.2790 (0.3331)	0.6030** (2.1152)	0.3673* (1.6388)	0.4750** (2.0947)
Absolute value (change in Fuel Price)						
Current year	0.4665 (0.7028)		1.0933 (0.4034)	-1.1695*** (-2.9745)		-0.8670*** (-2.3886)
One-year lag		0.5903 (1.1164)	-0.0863 (-0.0380)		-0.0339 (-0.1764)	0.0777 (0.3796)
Current year*(Hedged in fuel price)	0.4739 (0.5768)		-3.4038 (-1.2236)	1.1062*** (2.5956)		0.7264* (1.4825)
One-year lag*(Hedged in fuel price)		0.4005 (0.6986)	2.8378* (1.6259)		0.6247*** (2.4329)	0.4266* (1.6191)
Absolute value (change in IR)						
Current year	1.5370 (0.8977)		1.2244 (0.4200)	0.4343 (1.1949)		-1.1237* (-1.3820)
One-year lag		0.5946 (0.7083)	0.0236 (0.0186)		0.2729 (1.1139)	0.8919* (1.4394)
Current year*(Hedged in IR)	-1.1594 (-0.7600)		0.3889 (0.1133)	-0.4536 (-1.1982)		1.1934* (1.4673)
One-year lag*(Hedged in IR)		-0.9413 (-1.2629)	-1.0591 (-0.6515)		-0.2867 (-1.1859)	-0.9366* (-1.5201)
Absolute value (change in FX)						
Current year	-0.7603 (-0.8680)		1.9501 (0.3279)	1.3994* (1.4599)		1.0484 (0.7788)
One-year lag		-0.3353 (-0.7814)	-0.9984 (-0.3575)		0.9332 (1.1989)	0.1440 (0.1867)
Current year*(Hedged in FX)	-1.3843 (-0.4639)		-4.0116 (-0.5259)	-2.8009*** (-2.5180)		-0.8328 (-0.4001)
One-year lag*(Hedged in FX)		0.5023 (0.2545)	1.7253 (0.3569)		-1.5046 (-1.7224)	-0.8565 (-0.6597)
Absolute deviation in GDP	-0.5380 (-0.0419)	2.3783 (0.1720)	1.3982 (0.0995)	3.8957 (0.7051)	-0.8970 (-0.2545)	-2.4228 (-0.8247)
Stock market volatility	-0.0004 (-0.8972)	-0.0005 (-1.1167)	-0.0005 (-1.1844)	-0.0001 (-0.5814)	-0.0000 (-0.2102)	-0.0000 (-0.1376)
Log (no. of analysts)	0.0059 (0.0256)	-0.0114 (-0.0460)	-0.0590 (-0.2626)	0.0115 (0.0987)	-0.0551 (-0.6373)	-0.0541 (-0.6486)
No. of obs. / Total obs.	174 / 426	174 / 426	174 / 426	331 / 497	329 / 497	329 / 497
Centered R^2	0.0280	0.0304	0.0404	0.0319	0.0704	0.1036

Panel C: US vs. Non-US Sample

	Dependent variable: Absolute value of analysts' forecast error					
	US			Non-US		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.8922*** (2.7109)	1.1561*** (2.8804)	0.7776 (1.0296)	0.7483** (2.0068)	0.6079** (2.0819)	0.6834*** (2.4435)
Absolute value (change in Fuel Price)						
Current year	1.1533* (1.6226)		0.6708 (0.5803)	-1.8752*** (-3.2396)		-1.5497** (-2.1031)
One-year lag		0.8165** (1.9667)	0.5334 (0.8051)		-0.3590 (-0.9709)	0.1759 (0.3694)
Current year*(Hedged in fuel price)	0.9029 (1.0516)		0.2813 (0.2561)	1.8890*** (3.3223)		1.3831** (1.7313)
One-year lag*(Hedged in fuel price)		0.5523* (1.3716)	0.3872* (1.3723)		0.7273** (1.7689)	0.2565 (0.4527)
Absolute value (change in IR)						
Current year	0.2351 (1.0086)		-0.8814 (-0.7639)	3.1051* (1.5523)		0.5280 (0.2023)
One-year lag		0.0213 (0.0670)	0.6354 (0.6590)		1.0827** (1.6923)	0.7638 (0.6685)
Current year*(Hedged in IR)	-0.1390 (-0.4614)		1.5499* (1.4723)	-3.1453* (-1.5765)		-0.4791 (-0.1839)
One-year lag*(Hedged in IR)		-0.2258 (-1.0196)	-1.0059* (-1.4717)		-1.1218** (-1.7733)	-0.8300 (-0.7270)
Absolute value (change in FX)						
Current year	-1.1953 (-0.6242)		-3.4456 (-0.7526)	0.5583 (0.7234)	0.1608 (0.4623)	0.8961 (0.7084)
One-year lag		-3.7031** (-1.8516)	-0.3938 (-0.0891)			-0.1429 (-0.2764)
Current year*(Hedged in FX)	2.4406 (0.8870)		7.5193 (0.9086)	-3.9596*** (-2.5755)		-2.1689 (-0.6937)
One-year lag*(Hedged in FX)		0.8523 (0.6854)	-2.9352 (-0.7664)		-1.6462 (-1.2605)	-0.8163 (-0.3442)
Absolute deviation in GDP	50.0685** (1.7376)	-27.2170 (-0.8697)	14.3832 (0.2464)	0.1121 (0.0182)	-1.0797 (-0.1905)	-1.7293 (-0.3034)
Stock market volatility	-0.0134** (-2.0929)	-0.0018 (-0.5517)	-0.0078 (-0.9001)	-0.0004* (-1.5322)	-0.0003* (-1.3678)	-0.0003* (-1.3484)
Log (no. of analysts)	-0.2295** (-2.0433)	-0.2397** (-2.1793)	-0.2107** (-1.8192)	0.0817 (0.5008)	0.0310 (0.2095)	0.0192 (0.1291)
No. of obs. / Total obs.	244 / 403	244 / 403	244 / 403	261 / 520	259 / 520	259 / 520
Centered R^2	0.0881	0.0992	0.1119	0.0641	0.0414	0.0480

Panel D: Strong Governance vs. Weak Governance Sample

	Dependent variable: Absolute value of analysts' forecast error					
	Strong Governance			Weak Governance		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.8677*** (3.1503)	0.6615*** (2.6800)	0.5038** (1.7663)	0.0018 (0.0047)	0.2696 (0.8782)	0.4167* (1.5549)
Absolute value (change in Fuel Price)						
Current year	0.2897 (0.6051)		0.4578 (0.8764)	-3.0419** (-1.8891)		-1.4989** (-2.0167)
One-year lag		0.4134 (1.2038)	0.3195 (0.9522)		-0.4700 (-1.1369)	-0.0665 (-0.1763)
Current year*(Hedged in fuel price)	0.6138 (1.0367)		-0.2174 (-0.2737)	2.7967** (1.8880)		1.4230** (1.8524)
One-year lag*(Hedged in fuel price)		0.5018* (1.6283)	0.5608** (1.7085)		0.7180* (1.3360)	0.1627 (0.3140)
Absolute value (change in IR)						
Current year	0.1268 (0.4244)		-0.8828 (-1.0321)	11.0308** (1.8228)		2.7750 (0.5319)
One-year lag		0.2302 (0.9975)	0.6442 (1.1383)		1.7051*** (2.5674)	0.3810 (0.2901)
Current year*(Hedged in IR)	-0.1948 (-0.6663)		0.9328 (1.0905)	-10.5295** (-1.7390)		-2.0968 (-0.3964)
One-year lag*(Hedged in IR)		-0.2816 (-1.2743)	-0.7218* (-1.2905)		-1.5720** (-1.9983)	-0.5773 (-0.4393)
Absolute value (change in FX)						
Current year	-4.0494** (-2.0461)		-7.7536* (-1.4718)	-1.1276 (-0.5796)		1.3629*** (2.7622)
One-year lag		-2.2365 (-1.1954)	1.9935 (0.6017)		-0.1151 (-0.4928)	-0.3982* (-1.3526)
Current year*(Hedged in FX)	1.8601* (1.2857)		5.9165 (0.9151)	-1.7988 (-0.8346)		-1.9626 (-0.9115)
One-year lag*(Hedged in FX)		0.9410 (0.7951)	-2.1369 (-0.5578)		-1.8259* (-1.4972)	-1.0788 (-0.5433)
Absolute deviation in GDP	4.8753 (0.8185)	-0.1021 (-0.0139)	0.9089 (0.1298)	-14.7367 (-1.2796)	-3.4678 (-0.6289)	-5.6028 (-0.6789)
Stock market volatility	-0.0002 (-0.6024)	-0.0002 (-0.5949)	-0.0002 (-0.6059)	-0.0004 (-1.2218)	-0.0003* (-1.4681)	-0.0002 (-1.2423)
Log (no. of analysts)	-0.1162 (-0.9388)	-0.1278 (-1.0562)	-0.1054 (-0.8588)	0.3796** (1.7036)	0.1357** (1.7395)	0.1219* (1.4164)
No. of obs. / Total obs.	402 / 663	402 / 663	402 / 663	103 / 260	101 / 260	101 / 260
Centered R^2	0.0253	0.0378	0.0445	0.3251	0.1993	0.2566

Table 3-6. The Impact of Changes in Fuel, Interest Rate and Foreign Exchange Rate on Revisions in Analysts' Forecasts

The sample is unbalanced panel data, which consists of 923 firm-year observations from 1995 to 2007. The dependent variable is the absolute value of analysts' forecast revision, which is measured as the Abs($Forecast_{Max}$ – $Forecast_{Min}$) scaled by the absolute value of actual reported earnings per share, where $Forecast_{Max}$ and $Forecast_{Min}$ are the maximum and minimum values of forecasts during the forecasting year. Absolute values of current year shocks to fuel, interest and foreign exchange rates are estimated from the beginning to the end of earnings reported year *t*. Absolute values of one–year lagged changes in fuel, interest and foreign exchange rates are measured over one year prior to the earnings reported year *t*. t-statistics are presented in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Total Sample

	Dependent variable: Absolute revision in analysts' forecasts		
Variables	(1)	(2)	(3)
Constant	0.7995*	0.3169	0.4763
	(1.5352)	(0.5284)	(0.8550)
Absolute value (change in Fuel Price)			
Current year	-1.8772**		-0.7851
	(-1.7572)		(-0.7064)
One-year lag		-0.1328	0.1494
		(-0.1817)	(0.1953)
Current year*(Hedged in fuel price)	2.3664**		0.3137
	(1.9355)		(0.1942)
One-year lag*(Hedged in fuel price)		1.5140***	1.4841**
		(2.5009)	(1.9721)
Absolute value (change in IR)			
Current year	1.4558		-0.1963
	(1.1552)		(-0.0827)
One-year lag		0.9479*	1.0002
		(1.3316)	(0.7812)
Current year*(Hedged in IR)	-1.5077		0.4341
	(-1.1713)		(0.1824)
One-year lag*(Hedged in IR)		-1.0066*	-1.1800
		(-1.4142)	(-0.9277)
Absolute value (change in FX)			
Current year	0.6176		5.8086**
	(0.2294)		(1.6709)
One-year lag		0.1666	-2.5689**
		(0.1523)	(-1.7746)
Current year*(Hedged in FX)	1.8765		-13.1989
	(0.3767)		(-1.0346)
One-year lag*(Hedged in FX)		3.5054	9.7667
		(0.9686)	(1.1589)
Absolute deviation in GDP	-11.2129	-16.8084*	-21.3747*
	(-0.8842)	(-1.3265)	(-1.5779)
Stock market volatility	0.0007	0.0007	0.0007
	(0.9170)	(0.8710)	(0.9336)
Log (no. of analysts)	0.6184***	0.4545***	0.4169***
	(3.0044)	(2.4829)	(2.3583)
No. of obs. / Total obs.	503 / 923	501 / 923	501 / 923
Centered R^2	0.0300	0.0406	0.0454

Panel B: 1995-2000 vs. 2001-2007 Sample

	Dependent variable: Absolute revision in analysts' forecasts					
	1995~2000			2001~2007		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	0.3454 (0.4574)	-0.3061 (-0.2848)	1.2563 (0.9516)	0.7394 (1.0627)	0.1077 (0.1420)	0.2469 (0.3017)
Absolute value (change in Fuel Price)						
Current year	-0.6547 (-0.3547)		5.2720 (0.9810)	-3.6791*** (-3.3668)		-2.8707*** (-2.6369)
One-year lag		0.6431 (0.5608)	-4.6942 (-1.1651)		-0.0710 (-0.0806)	0.6107 (0.6378)
Current year*(Hedged in fuel price)	1.4812 (0.8295)		-6.5640 (-1.1165)	4.5742*** (3.5027)		3.7700** (2.2365)
One-year lag*(Hedged in fuel price)		0.7730 (0.7064)	6.0707* (1.6095)		2.0011*** (3.0681)	0.9264 (1.2093)
Absolute value (change in IR)						
Current year	9.8735 (1.2130)		16.5135 (0.9820)	0.7092 (0.8865)		-2.0403 (-1.0240)
One-year lag		3.4386 (1.1835)	-4.2177 (-0.7123)		0.4278 (0.7023)	1.6498 (1.1100)
Current year*(Hedged in IR)	-4.2310 (-0.5704)		-6.5625 (-0.4059)	-0.8727 (-1.0431)		2.2611 (1.1318)
One-year lag*(Hedged in IR)		-2.9263 (-0.8289)	1.3137 (0.2092)		-0.5697 (-0.9387)	-1.9031* (-1.2878)
Absolute value (change in FX)						
Current year	-1.9505 (-0.9289)		-10.3603 (-0.9266)	3.4331* (1.4408)		4.5299* (1.4752)
One-year lag		-0.6137 (-0.7612)	5.3165 (1.0385)		1.7131 (0.6972)	-1.1522 (-0.5624)
Current year*(Hedged in FX)	-13.3284* (-1.4076)		-29.5958 (-0.9724)	1.8027 (0.2874)		-3.0181 (-0.2464)
One-year lag*(Hedged in FX)		2.3435 (0.2899)	12.4885 (0.6520)		1.7993 (0.4508)	3.7619 (0.5341)
Absolute deviation in GDP	-46.0662 (-1.1404)	-28.6602 (-0.7384)	-41.5191 (-1.0285)	-16.6659 (-1.0288)	-25.8789** (-1.8399)	-31.0779** (-2.1221)
Stock market volatility	0.0002 (0.2800)	-0.0003 (-0.3079)	-0.0003 (-0.3113)	0.0014 (1.2081)	0.0016* (1.4172)	0.0017* (1.4683)
Log (no. of analysts)	0.6122** (1.6737)	0.5020* (1.4543)	0.3238 (0.9171)	0.6849*** (2.7266)	0.5166*** (2.5291)	0.5065*** (2.5615)
No. of obs. / Total obs.	173 / 426	173 / 426	173 / 426	330 / 497	328 / 497	328 / 497
Centered R^2	0.0703	0.0436	0.1009	0.0526	0.0637	0.0771

Panel C: US vs. Non-US Sample

	Dependent variable: Absolute revision in analysts' forecasts					
	US			Non-US		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	1.1465* (1.5351)	0.8667 (1.1563)	-0.5645 (-0.4673)	1.4580* (1.4991)	0.6505 (0.6380)	1.0192 (1.0002)
Absolute value (change in Fuel Price)						
Current year	0.9201 (0.6525)		2.4465 (0.9926)	-7.3544*** (-3.8575)		-4.4859*** (-2.6025)
One-year lag		1.1776* (1.3619)	0.0844 (0.0569)		-1.7185 (-1.3341)	-0.1704 (-0.1488)
Current year*(Hedged in fuel price)	2.3292* (1.4260)		1.1100 (0.5039)	6.2949 (3.2440)		2.9407 (1.1946)
One-year lag*(Hedged in fuel price)		1.3160* (1.6394)	0.7056 (0.8291)		2.3474** (2.0385)	1.5459 (1.2210)
Absolute value (change in IR)						
Current year	1.0583* (1.6326)		-3.2975 (-1.2535)	8.5236 (1.1239)		11.1392 (0.7230)
One-year lag		0.9329* (1.4226)	3.3238* (1.5214)		2.8386 (1.0030)	-2.7319 (-0.5240)
Current year*(Hedged in IR)	1.0121 (0.6959)		4.5186 (1.1821)	-8.7068 (-1.1517)		-10.9785 (-0.7138)
One-year lag*(Hedged in IR)		0.1999 (0.2618)	-2.1098 (-1.0545)		-3.0054 (-1.0665)	2.4742 (0.4745)
Absolute value (change in FX)						
Current year	-0.6053 (-0.1106)		-8.7166 (-0.8890)	0.3397 (0.1418)		7.4293** (2.0851)
One-year lag		-3.7230 (-0.8043)	7.1845 (0.8549)		-0.3376 (-0.2617)	-2.2630* (-1.4021)
Current year*(Hedged in FX)	1.2046 (0.1635)		19.1793 (1.0620)	-1.4873 (-0.2272)		-17.3287 (-1.0759)
One-year lag*(Hedged in FX)		-0.7825 (-0.1763)	-10.3231 (-0.9527)		3.1705 (0.7046)	9.3164 (1.0101)
Absolute deviation in GDP	55.1061 (0.8720)	-20.6782 (-0.3371)	140.6476 (1.1290)	-21.1325 (-1.1085)	-16.9844 (-1.0329)	-21.4622* (-1.2906)
Stock market volatility	-0.0217* (-1.5569)	-0.0107 (-1.1671)	-0.0345** (-1.6664)	0.0003 (0.3600)	0.0004 (0.4640)	0.0005 (0.6147)
Log (no. of analysts)	0.1379 (0.6679)	0.1277 (0.6200)	0.2179 (0.9921)	0.7924*** (2.5196)	0.6508** (2.3222)	0.5673** (2.0767)
No. of obs. / Total obs.	243 / 403	243 / 403	243 / 403	260 / 520	258 / 520	258 / 520
Centered R^2	0.0782	0.0911	0.1109	0.0544	0.0340	0.0543

Panel D: Strong Governance vs. Weak Governance Sample

	Dependent variable: Absolute revision in analysts' forecasts					
	Strong Governance			Weak Governance		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Constant	1.3126** (2.2320)	0.6867 (0.8565)	0.6419 (0.8103)	1.1140 (0.6930)	1.3064 (0.9092)	1.5589 (1.2055)
Absolute value (change in Fuel Price)						
Current year	-0.8104 (-0.7538)		-0.4873 (-0.3572)	-11.4291*** (-3.2667)		-5.7088*** (-2.6626)
One-year lag		0.2351 (0.2940)	0.6625 (0.7273)		-3.4481** (-1.9588)	-1.5350 (-1.1757)
Current year*(Hedged in fuel price)	1.9955* (1.5595)		0.2056 (0.1094)	9.7077*** (2.9844)		4.2383* (1.4162)
One-year lag*(Hedged in fuel price)		1.4663** (2.2654)	1.3037* (1.5256)		3.6833** (2.1074)	2.1926 (1.2628)
Absolute value (change in IR)						
Current year	1.0366 (0.8661)		-0.4416 (-0.1632)	24.0677** (2.1619)		12.3271 (0.8217)
One-year lag		0.8661 (1.1480)	1.0704 (0.7748)		5.4034*** (2.5735)	-0.0548 (-0.0139)
Current year*(Hedged in IR)	-1.0874 (-0.8820)		0.6702 (0.2459)	-24.1296** (-2.1469)		-11.1132 (-0.7265)
One-year lag*(Hedged in IR)		-0.9300 (-1.2308)	-1.2530 (-0.9138)		-5.9488** (-2.3111)	-0.9559 (-0.2364)
Absolute value (change in FX)						
Current year	-6.9614 (-1.1192)		-7.4052 (-0.5883)	-2.1371 (-0.6110)		3.7161** (1.8623)
One-year lag		-3.0240 (-0.6579)	0.0559 (0.0065)		-0.3013 (-0.3367)	-0.6944 (-0.6121)
Current year*(Hedged in FX)	8.1789* (1.4479)		4.3037 (0.1928)	4.7419 (0.3748)		-20.9285 (-1.1136)
One-year lag*(Hedged in FX)		4.5157 (1.0732)	2.7677 (0.1995)		8.8765 (0.8186)	17.1181 (1.0381)
Absolute deviation in GDP	-16.4071 (-0.7928)	-22.7269 (-1.0131)	-25.2733 (-1.0447)	-50.8571** (-1.9120)	-18.8287 (-1.0930)	-28.3531 (-1.0949)
Stock market volatility	0.0012 (0.9656)	0.0012 (0.9814)	0.0012 (1.0132)	-0.0011 (-0.9685)	-0.0014 (-1.1793)	-0.0012 (-0.9883)
Log (no. of analysts)	0.3166* (1.5446)	0.2759 (1.3559)	0.2845 (1.4286)	1.4192*** (2.6051)	0.7871* (1.6469)	0.7737* (1.5644)
No. of obs. / Total obs.	400 / 663	400 / 663	400 / 663	103 / 260	101 / 260	101 / 260
Centered R^2	0.0299	0.0411	0.0428	0.1976	0.1072	0.1393

Chapter IV

Conclusions and Future Research

The first essay of this dissertation examines whether jet fuel hedging increases market values of airline companies around the world. Using a sample of 70 airline companies from 32 countries over the period 1995 to 2005, we find that jet fuel hedging is not positively related to their market values in the global airline companies, but this positive relationship holds in the sub-samples and is significant for US and non-alliance firms. Moreover, our results show that the risk-aversion behavior of executives and the tendency to avoid financial distress are important determinants for jet fuel hedging activities of non-US airline companies. Alleviating underinvestment problems is also an important factor to explain jet fuel hedging activities of US and non-alliance firms. Our results add support to the growing body of literature documents that hedging increases firm value for global airline companies. Further research can investigate the role of corporate governance on risk management of global airline industry. The differences of corporate governance (including internal and external factors) across countries and their effects on firm's hedging behavior is also an important issue. The interactions of firm-level governance structure (e.g., ownership and board structures) and country-level governance mechanism (e.g., investor protection rights) are also interesting factors that can have an impact on firm's hedging activities.

The second essay of this dissertation examines the association between airline company's hedging activities and analysts forecast errors. Our results show that recent oil price surge plays an important role on analyst forecast error in the airline industry. We compare the effects of oil, interest rates and currency hedging activities of airline companies and find that oil hedging increases the analysts forecast errors, while interest rates and foreign exchange rates hedging reduce them. It suggests that analysts concern more about firms engaged in oil prices hedging due to the volatile nature of oil prices.

Most research on the relationship between hedging activities and analysts earnings forecasts use quarterly data due to lack of interim reports for non-US firms. It will be interesting to collect more interim financial reports and examine the differential impact of oil price, interest rate and currency hedging of airline companies in different countries. Further, research can also investigate whether foreign and local analysts respond differently to hedging activities of the global airline companies.

In future research, I plan to extend the sample period to recent years, because from 2005 to 2008, the movement of jet fuel prices allows us to examine the structural change with different hedging strategy. Although the usage of fuel hedging derivatives may help airline companies avoid losses from surging oil prices, these hedging strategies may reduce their firm value when oil prices drop unexpectedly due to the misjudgement of trend of oil price. For example, Air Canada reported that they lost $132-million (Canadian) in the third quarter of 2008, mainly from failure to unwind fuel and currency hedging contracts signed previously when oil price was high. I have shown that jet fuel hedging can increase firm value when oil price was high, and it is an interesting to examine whether hedging strategies for these airline companies are profitable when oil prices drop unexpectedly from 2006 onwards. The issue is that whether airline companies relied on jet fuel hedging derivatives have superior forecasting ability or they just have good luck in hedging activity during recent oil price surges. By examining the recent drop of oil price, we can shed more light on the effectiveness of different hedging strategies based on sub-sample data.

Appendix: Example Dsclosures about Hedging for Jet Fuel Price Risk in the Global Airline Industry

This appendix provides examples of jet fuel hedging activities disclosures for the global airline industry. The information is collected from the 10-K filings, 20-F forms or firm's annual reports.

1. Southwest Airlines' 2004 10-K report:

Financial Derivative Instruments

The Company utilizes financial derivative instruments primarily to manage its risk associated with changing jet fuel prices, and accounts for them under Statement of Financial Accounting Standards No. 133, "Accounting for Derivative Instruments and Hedging Activities" (SFAS 133). See "Qualitative and Quantitative Disclosures about Market Risk" for more information on these risk management activities and see Note 10 to the Consolidated Financial Statements for more information on SFAS 133, the Company's fuel hedging program, and financial derivative instruments.

SFAS 133 requires that all derivatives be marked to market (fair value) and recorded on the Consolidated Balance Sheet. At December 31, 2004, the Company was a party to over 300 financial derivative instruments, related to fuel hedging, for the years 2005 through 2009. The fair value of the Company's fuel hedging financial derivative instruments recorded on the Company's Consolidated Balance Sheet as of December 31, 2004, was $796 million, compared to $251 million at December 31, 2003. The large increase in fair value primarily was due to the dramatic increase in energy prices throughout 2004, and the Company's addition of derivative instruments to increase its hedge positions in future years. Changes in the fair values of these instruments can vary dramatically, as was evident during 2004, based on changes in the underlying commodity prices. The financial derivative instruments utilized by the Company primarily are a combination of collars, purchased call options, and fixed price swap agreements. *The Company does not purchase or hold any derivative instruments for trading purposes.*

As detailed in Note 10 to the Consolidated Financial Statements, the Company has hedges in place for approximately 85 percent of its anticipated fuel consumption in 2005 with a combination of derivative instruments that effectively cap prices at a crude oil equivalent price of approximately $26 per barrel. Considering current market prices and the continued effectiveness of the Company's fuel hedges, the Company is forecasting first quarter 2005 average fuel cost per gallon, net of expected hedging gains, to exceed fourth quarter 2004's average price per gallon of 89.1 cents. The majority of the Company's near term hedge positions are in the form of option contracts, which protect the Company in the event of rising jet fuel prices and allow the Company to benefit in the event of declining prices.

2. Air France-KLM's 2005 20-F form:

Item 11: QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Market Risk

We have defined strict policies and procedures to measure, manage and monitor our market risk exposures. We have instituted management rules based on a segregation of operations, financial and administrative control and risk measurement. We have also instituted, for all operations managed at corporate level, an integrated system that permits real time monitoring of hedging strategies.

As part of our treasury and fuel risk management program, we selectively use derivative financial and commodity instruments in order to reduce our exposure to fluctuations in market rates and prices. *We use derivatives only for the purposes of hedging identified exposures and do not invest in derivatives for trading or speculative purposes.* The instruments used include swaps, forward contracts, and options in the currency, interest rate and fuel markets.

Commodity Risk – Fuel Prices

The impact of fuel price changes on us and our competitors is dependent upon various factors, including hedging strategies. We have a fuel hedging program in which we enter into jet fuel, heating oil and crude swap and option contracts to protect against increases in jet fuel prices. These instruments generally have maturity of up to 36 months. The table below provides information about Air France-KLM's swaps and options to manage commodity risks as at March 31, 2005.

At March 31, 2005

	Maturing before one year	Maturing after one year	Total	Fair Value
		(in € millions)		
Swaps	1,179	533	1,712	387
Options	916	1,658	2,574	796

3. SAS AB's 2004 annual report:

Price risk relating to jet fuel

The SAS Group is exposed to price risk regarding changes in the world market price of jet fuel. The SAS Group coordinates price hedging of jet fuel for Group airlines. Of the SAS Group's total costs including depreciation in 2004, approximately 10.6% (8.3%) was fuel costs. Jet fuel prices climbed to record highs in 2004, causing the SAS Group's fuel costs to increase by MSEK 1,509 to MSEK 6,252. The SAS Group's policy is to hedge normally 40-60% of the forecast consumption in the coming 12-month period. This practice may be departed from when extreme price hikes are estimated due to war, oil crisis, etc. In 2004 the SAS Group hedged an average of 16% of its fuel purchases. Of its anticipated consumption in 2005, the SAS Group has hedged an average of 50% with capped options, a level equivalent to approximately USD 450/MT.

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