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Jet fuel hedging in the European airline industry

– Determinants and value of hedging

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ABSTRACT

This master thesis examines the jet fuel hedging behavior in the European airline industry using publicly available information. US companies are also included for comparisons between the markets. The thesis concludes that jet fuel hedging airlines have higher market-to-book ratios measured by Tobin's Q. The authors believe that putting an absolute number on the hedging premium, must be done with caution. The hypothesis that hedging adds more value in periods of greater uncertainty and higher volatility is inconclusive and rejected. Of the variables included in regressions, the papers suggest that the most important determinants of jet fuel hedging levels are company size, dividends, debt ratio and investment levels.

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PREFACE

We decided to write our master thesis about the airline industry because of several reasons. We have always been fascinated by this industry. During our bachelor's degree at NHH, we have worked with a case of Norwegian Air Shuttle and Scandinavian Airline Systems (SAS). We were particularly interested in this case because of the challenges both companies face and the nature of competition in the market. Being exposed to this case as well as extensive travel experience made this industry a natural industry to investigate.

We are both taking financial economics as a major in our master's degree and have touched upon issues such as risk management and even the famous Southwest Airlines case, where the issue is jet fuel hedging. Examining the airline jet fuel hedging in practice was therefore a natural topic for this thesis.

After choosing hedging in the airline industry as an overall topic, we started searching for existing literature on the internet, in the school library and its databases. We found that there exist extensive literature describing why non-financial firms hedge. We could not find, however, much written about whether hedging activities leads to increased value, especially not in the airline industry. We found one article written about the US airline industry, but not for the European. These markets are similar in some areas, but they are also different in a lot of others. The last couple of years, the global economy has suffered from record all-time-high commodity prices, volatility as well as a financial crisis. All these things made jet fuel hedging in the European airline industry an interesting subject.

The work has not been free from trouble. The availability of hedging data from airlines is limited. Most companies report in their annual reports the levels of hedging and instruments used, due to accounting standard requirements. However, we found it difficult to do reliable tests on the data available. Thus, the many possible subjects we wanted to explore were eliminated immediately. Another consequence of the low availability of suitable data is that the reliability of our tests and conclusions decreases.

The data collection has proved very time-consuming and frustrating. Since a lot of data is obtained from company reports, we had to find reports from all companies in all years and read through the reports searching for the relevant information. We found that many companies differ in the way they report and in the availability of reports. We have therefore contacted some of the companies ourselves to get reports from missing periods.

We have used publicly available information from company reports and websites as well as the Compustat database.

After writing this thesis, we feel that we have learned much about the airline industry in general and about jet fuel economics in particular.

We wish to thank our advisor Kyoung Sun Park for useful comments during our work.

Bergen, June 17th 2009

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Christian Kvello Henrik Nesset Stenvik

CHAPTER 1: INTRODUCTION

This thesis is aimed at examining the jet fuel behavior in the European airline industry. We are specifically interested in whether jet fuel hedging is adding value to a firm seen from an investor's perspective. If we find that hedging adds value, we try to answer two additional questions. The first is whether hedging adds more value in period when volatility and uncertainty is higher than normal. This is a very interesting question, since over the last two years, the global economy has suffered from high and volatile commodity prices followed by one of the most severe financial crisis in history. The second question is how hedging might add value. We also try to find out why airlines hedge, i.e. what are the determinants of hedging levels in the industry.

We compare our results to the American market by including American companies as well as relate our findings to existing literature in risk management in general, and in the airline industry in particular.

We investigate the industry by collecting publicly available information and perform regression analyses on these.

The thesis proceeds as follows: Chapter 2 gives an overview over the European market. Chapter 3 describes the economic effects jet fuel costs have on airlines. In chapter 4, we provide an extensive overview of existing literature with regards to why non-financial firms hedge. Chapter 5 describes the hedging behavior in the airline industry. Regression analyses and results are described in chapter 6 while chapter 7 concludes the paper. At the very end, we have put tables and graph in an appendix.

CHAPTER 2: THE EUROPEAN AIRLINE MARKET

Over the last decades, the European airline industry has gone through several changes and looks very different now than 20 years ago. Technological development and economic growth have resulted in affordable airline tickets and an increasing number of passengers transported each year.

2.1. From private to public

The typical airline was founded and owned by the government in each country. These "flag carriers" were given names such as British Airways, Air France, and Scandinavian Airlines Systems (SAS) to name a few. The companies were symbols of national pride and protectionism. As financial markets have developed and many countries have deregulated the airline market, the companies were privatized or partly privatized. Governments have given private investors the task of managing the airlines, hoping that they do it more effectively. Almost all the largest airlines are now listed on stock exchanges around Europe. The privatization has also led to mergers and acquisitions in the industry. Examples of this are the merger between Air France and KLM (2004), the acquisition of Swissair by Lufthansa (2002) and SAS' acquisition of Spanair (period up to 2007).

2.2. Open skies & deregulations

Changes in the last 25 years have been significant in airline regulation. Open Skies[1] refers to a multilateral aviation agreement which liberalizes rules for international air transportation and minimizes government intervention. After World War II, many countries invested national pride in the creation and defense of airlines. Air transportation differs from many other businesses, because airlines were wholly or partly owned by governments. Crossing boarders (with or without landing) could be seen as trespassing when special permissions were missing. Open Skies smoothened civil passenger transportation. The US began pursuing Open Skies in the late 70s and in 1982 it had signed twenty-three bilateral air service agreements worldwide, mainly with smaller nations. Several more agreements were made in the 90s between US, European and other international countries.

2.3. The rise of low cost carriers

The last decade has been characterized by the rise of low cost carriers (LCCs). LCC or "no frills" airlines offer low fares and eliminates unnecessary services, such as complementary drinks and business-class seating. These airlines often fly from more remote airports with one

[1] http://www.state.gov/e/eeb/tra/ata/index.htm

type of aircraft to cut overheads (lower access charges and maintenance costs). The aircraft cabin may be less comfortable; dispensing video screens, reclining seats and some airlines also have advertisement inside the cabin to increase revenue. Some also charge their passengers to carry luggage and reserve seats. They may also fly on odd times. LCCs have made travelling by air cheaper on many routes and forced the traditional airlines to focus on cost-cutting. The LCC is typically not member of an airline alliance, and flies point-to-point.

2.4. Terrorist threats and security issues

The terrorist attack on World Trade Center in New York, USA September 11th 2001 was a dreadful example that airlines can be subject to terrorist operations and reminded people that flying is not entirely safe. Not only did the attacks scare people from flying in the subsequent years, but airports and airlines now faced a new reality with regards to security issues. After the incident, they had to pay a lot closer attention to airport and airplane security, imposing additional costs. Passengers now have to bring identification, go through several security check points and are not allowed to bring along the items they were used to.

2.5. Alliances and codeshare agreements

Some airlines (especially the traditional and biggest carriers) cooperate in their operations via alliances and codeshare agreements. An alliance is an agreement between airlines to provide a network of connectivity and convenience for international passengers and packages. Star Alliance, SkyTeam and Oneworld are the three largest alliances worldwide. The benefits of being an alliance member include cost reductions from sales, maintenance, operational facilities and staff as well as investments and purchases. Passengers benefit through lower prices, more frequent departures, more destinations, shorter travel times and faster mileage rewards. Code sharing or codeshare is a less organized way of cooperating. The term refers to a practice where a flight operated by one airline is jointly marketed as a flight for other airlines that have a code share agreement with the operating airline. Most major airlines have such agreements with other airlines and code sharing is a key feature of alliances.

2.6. Frequent flyer programs

To maintain customer loyalty, most airlines have frequent flyer programs. As you fly, you earn “miles” or points corresponding to the distance flown and/or money spent on tickets. These miles can be redeemed for free travel or other goods such as hotel nights, rental cars or other benefits. Such programs decrease competition and allow airlines to keep prices higher than they would have been without the programs present. This is the reason why such programs are not allowed in Norway. SAS used to have one (they still have on international flights), but were forced to terminate it by the government in 2002[2].

2.7. Climate change

Airplane engines use kerosene as fuel. The jet engines emit CO_2 which is a greenhouse gas. Greenhouse gases are harmful to the environment and leads to global warming[3]. The focus on global warming has increased, especially after Al Gore won the Nobel peace price in 2007. The effect on airlines is that some are now being charged fees for polluting or the fear of soon being so.

2.8. Sample firms presentation

2.8.1. Sample firms

In this thesis we want to examine the European airline market. We have chosen 14 of the 20 largest airlines in Europe. For analyzing purposes, we need qualitative and quantitative data, and have therefore examined public firms, since they are legally committed to issuing periodically reports and figures. Below is an alphabetical list of the sample, together with main characteristics:

Sample firms characteristics (European airlines)

	Classification	Founded	Alliance	Destinations	ASK 2008 (mill.)	Sample ASK market share	Frequent flyer program	Headquarter
Aer Lingus	LCC	1936	None	69	22,400	2.2 %	Gold Circle Club	Dublin, Ireland
Air Berlin	LCC	1978	None	79	56,480	5.6 %	Topbonus	Berlin, Germany
Air-France KLM	Traditional	2004*	SkyTeam	258	256,314	25.6 %	Flying Blue	Paris, France
Austrian	Traditional	1957	Star Alliance	117	25,100	2.5 %	Miles & More	Vienna, Austria
British Airways	Traditional	1924	Oneworld	169	149,545	14.9 %	Executive Club, Premier	London, England
easyJet	LCC	1995	None	106	55,687	5.6 %	None	Luton, England
El Al Airways	Traditional	1948	None	45	20,074	2.0 %	Matmid Club	Lod, Israel
Finnair	Traditional	1923	Oneworld	126	29,101	2.9 %	Finnair Plus	Vantaa, Finland
Iberia	Traditional	1927	Oneworld	115	66,517	6.6 %	Iberia Plus	Madrid, Spain
Lufthansa	Traditional	1926	Star Alliance	209	195,431	19.5 %	Miles & More	Cologne, Germany
Norwegian Air Shuttle	LCC	1993	None	84	11,574	1.2 %	None	Oslo, Norway
Ryanair	LCC	1985	None	143	66,519	6.6 %	None	Dublin, Ireland
SAS	Traditional	1946	Atar Alliance	150	45,764	4.6 %	Eurobonus	Stockholm, Sweden
Swiss International Air Lines	Traditional	2002**	Star Alliance	76	N/A		N/A	Kloten, Switzerland

*2004 merger between Air France (founded 1933) and KLM (founded 1919)

**Founded after the bankruptcy of Swissair (founded 1931). Subsidiary of Lufthansa

Source: Company websites and annual reports

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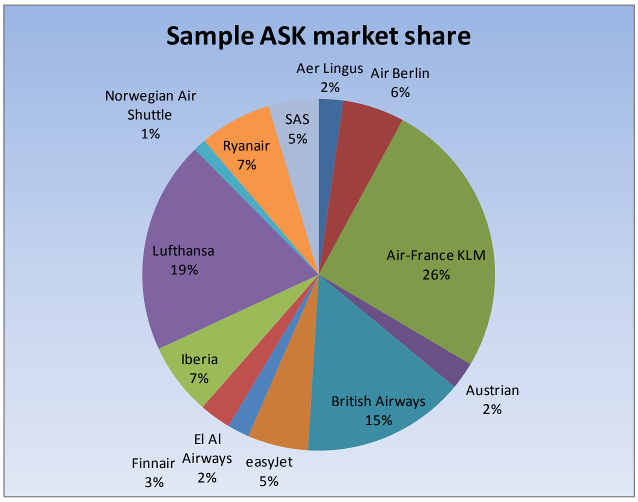
[2] http://www.konkurransetilsynet.no/no/Vedtak-og-uttalelser/Vedtak-og-avgjorelser/inngrep-mot-SAS-Wideroes-og-Braathens-bonusprogrammer/

[3] At least this is the consensus of the majority of leading researchers



ASK by airline	Total ASK 2006 - 2008 (mill.)
Air-France KLM	736,049
Lufthansa	511,259
British Airways	442,060
Iberia	198,767
Ryanair	157,106
SAS	153,752
Air Berlin	147,260
Easyjet	136,276
Austrian	83,074
Finnair	79,825
El Al Airways	59,930
Aer Lingus	59,259
Norwegian	24,505
Swiss	N/A

Among the companies are five LCCs and nine traditional airlines. Ranked by available seat kilometers [4](ASK), Air France-KLM is the biggest followed by Lufthansa and British Airways[5]. LCCs are typically not member of airline alliances, but practices codesharing to some extent.

Data collection seems a lot easier for American companies. Existing risk management literature has also only focused on the US market. We have therefore also included some American companies so that we can do a comparison between the markets[6]. These companies are among the biggest airlines in the US. We have four LCCs and eleven traditional airlines. The American market is more homogenous than the European market. The companies are more similar with regards to tax schemes, geographical diversification and other macroeconomic factors.

2.8.2. Data collection & time horizon

This thesis examines the jet fuel hedging behavior of European and US airlines. We want to investigate the relationship between firm value and hedging behavior, but also the determinants of jet fuel hedging. The data used and analyzed is publicly available information. General accounting and financial information is collected from the Compustat database[7]. All other data is collected from each company's annual reports and Investor Day

[4] One seat kilometer represent one seat flown one kilometer.
[5] See table 1 in the appendix for a full list of ASK by airline and year.
[6] See table 2 in the appendix for a list of US companies in the sample.
[7] http://wrds.wharton.upenn.edu/ds/comp/gfunda/ A subscription is necessary to access the data base. The subscription is not free.

presentations for European airlines. For US airlines, most information is found in 10-k filings or Proxy statements[8]. Such documents are found on the website of each company.

We have collected and analyzed data for the years 2001-2008.

[8] 10-k is the name of the annual financial report required by the Securities and Exchange Commission (SEC) by all publicly held corporations. A proxy statement is also required by the SEC and is sent to the shareholders of a public company. It contains proposals to be voted upon by shareholders. It also contains useful information about compensation of corporate officers and ownership of stock and stock options by company officers and directors. See reference list for website URLs.

CHAPTER 3: JET FUEL AND AIRLINE ECONOMICS

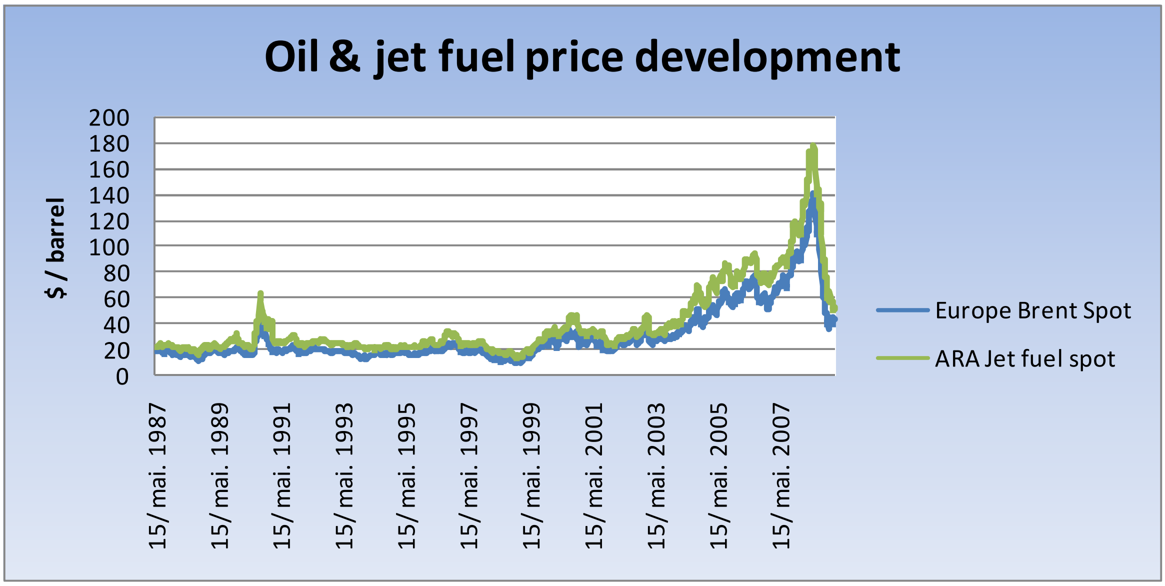
3.1. Oil and jet fuel prices

Jet fuel costs constitute a large portion of an airline's operating expenses. During the last decade, competition has become more intense; ticket fares have decreased and thus put pressure on airlines' profit margins. The years 2007, 2008 and 2009 were especially challenging, with all-time high commodity prices together with the following global financial crash.

Jet fuel is refined from crude oil; most products of oil processing are usually grouped into three categories which are light distillates (LPG and gasoline), middle distillates (heating oil, kerosene and diesel fuel), heavy distillates and residuum (fuel oil, lubricating oils, wax and tar). The products in each category share similar characteristics. Jet fuel consists of kerosene with some additives; hence it shares the same characteristics as heating oil and diesel fuel.

Jet fuel is only traded over the counter since the market for jet fuel is not liquid enough to warrant a futures contract or any other exchange traded contracts.

As seen from the graph below, oil and jet fuel prices are highly correlated:



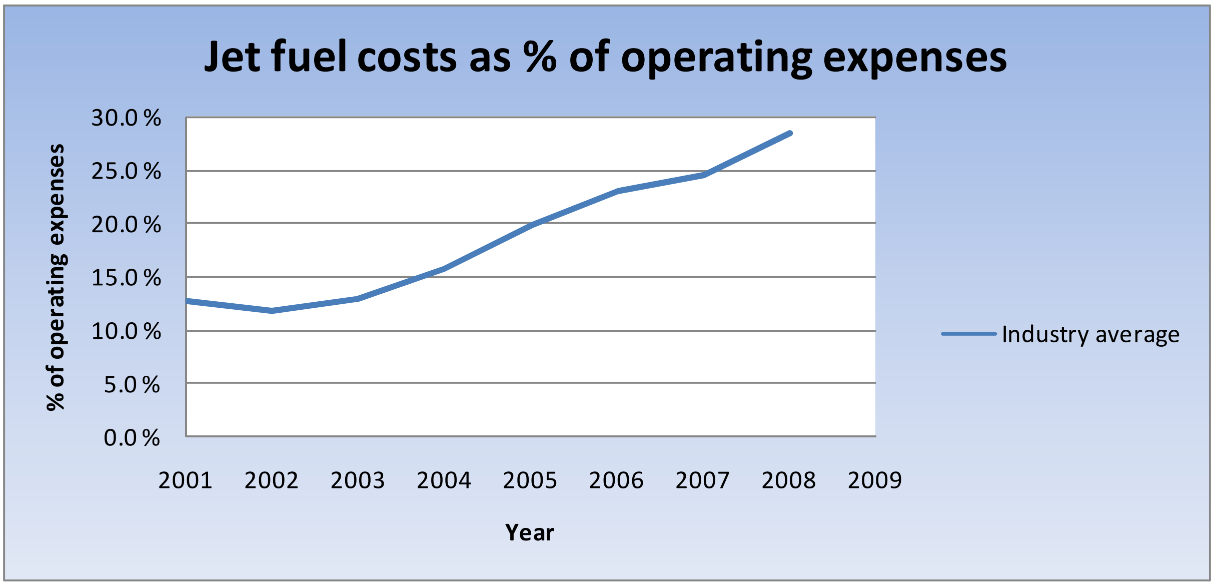
The correlations[9] between returns of Amsterdam – Rotterdam – Antwerp Jet fuel Spot and Europe Brent oil Spot is 0.74. Correlations between oil and different oil refined products are ranging from 0.6717 and 0.9285[10].

[9] Calculated using weekly data collected from EIA (1986 – 2009)

In July 2008 the oil price peaked at $ 140/barrel, and at this time many analysts predicted the oil price to rise even further[11]. Not since the 1979 energy crisis has the price of oil reached such a level adjusted for inflation. The impact of the financial crisis (late 2008) resulted in decreasing oil prices and this shows the oil price is highly unpredictable. The price of oil is very volatile since it behaves like any other commodity; the price is dependent on supply and demand. Global macroeconomic conditions controls the demand for oil, the boosting oil price in 2007 was largely created by an increasing demand from emerging economies such as India and China[12]. In recent times they have been affected by the global credit crunch, reducing their exports, resulting in a lower demand for oil.

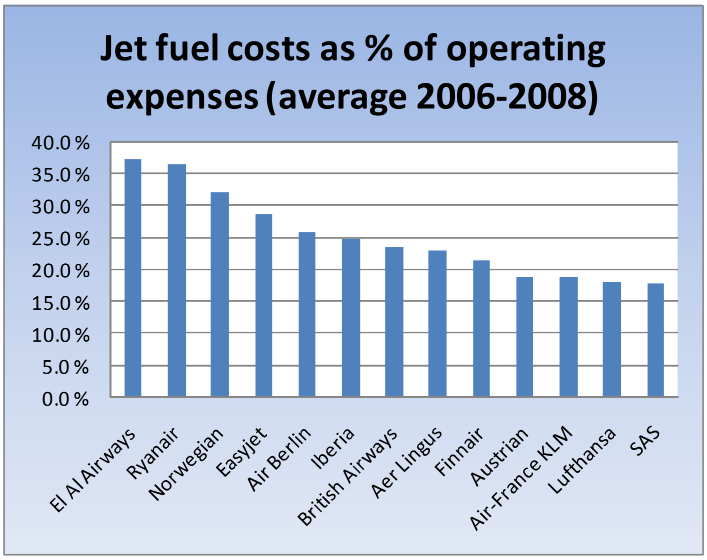
3.2. Fuel costs' portion of operating expenses

For our European sample, jet fuel costs as a percentage of operating expenses has increased from about 13% on average in 2001 to over 28% in 2008. The trend is illustrated in the figure below:



It is easy to spot differences between our sample firms. For the years 2006-2008, the percentage ranged from 17.8 (SAS) to 37.5 (El Al). Jet fuel costs constitute a larger portion of operating expenses for LCC's than traditional airlines, and this is seen from the following table (ranged from highest to lowest) for the years 2006-2008:

[10] Calculated using weekly data collected from EIA (1986 – 2009). See table 5 in the appendix for a full table of correlations.
[11] http://www.independent.co.uk/news/business/news/goldman-predicts-crude-prices-will-superspike-to-200-per-barrel-822235.html. Goldman Sachs analysts predicts oil price in May 2008.
[12] http://economictimes.indiatimes.com/articleshow/3014033.cms

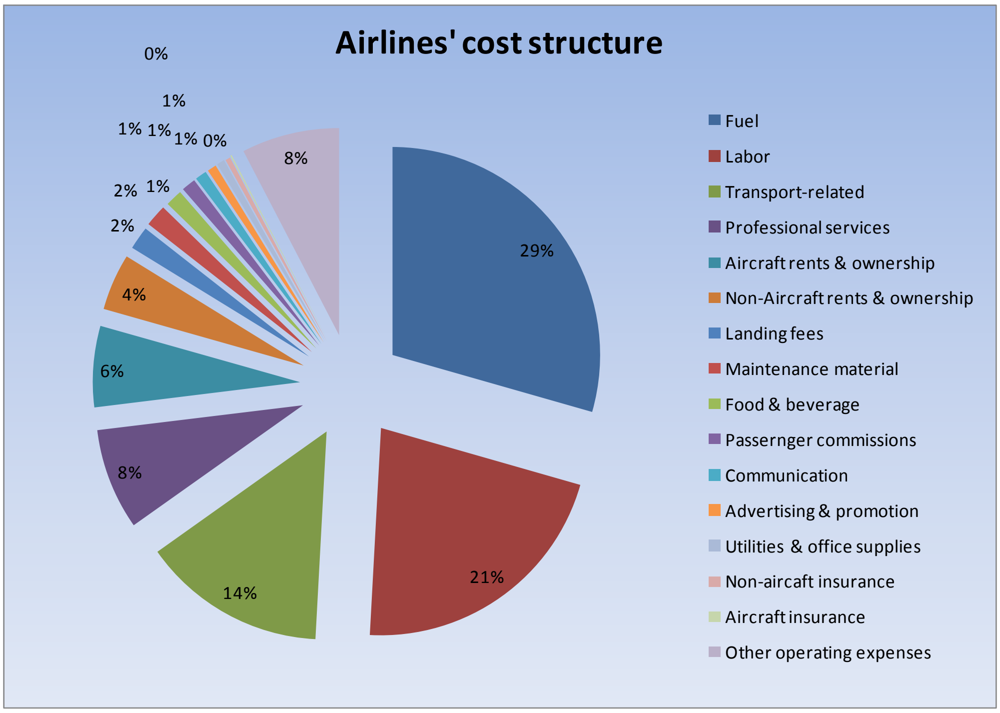


Jet fuel costs as % of operating expenses

	Classification	Average 2006-2008
El Al Airways	Trad	37.5 %
Ryanair	LCC	36.7 %
Norwegian	LCC	32.3 %
Easyjet	LCC	28.8 %
Air Berlin	LCC	25.9 %
Iberia	Trad	24.9 %
British Airways	Trad	23.8 %
Aer Lingus	LCC	23.2 %
Finnair	Trad	21.4 %
Austrian	Trad	19.1 %
Air-France KLM	Trad	19.0 %
Lufthansa	Trad	18.1 %
SAS	Trad	17.8 %
Swiss	Trad	N/A

The trend is similar for all airlines in the sample[13].

According to Air Transportation Association, fuel surpassed labor as the largest portion of operating expenses for U.S. airlines. There may be differences between the U.S. and the European market but it this chart may serve as an indicator of European airlines' cost structure:

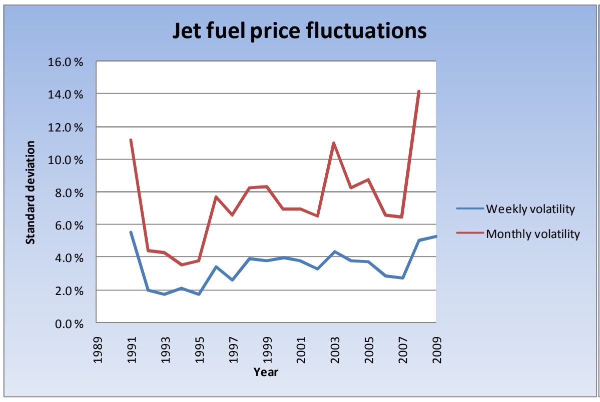


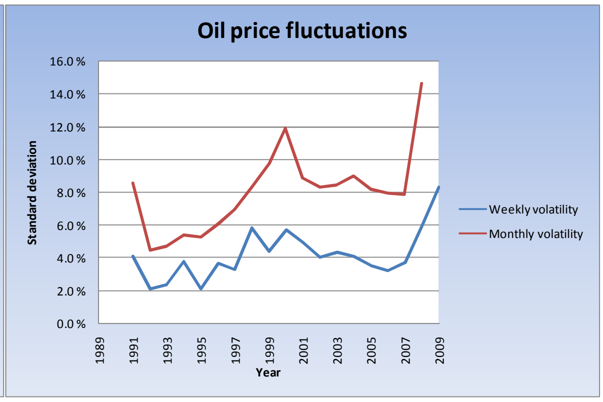
[13] See table 3 and graph 1 in the appendix for a comprehensive summary and illustration of jet fuel costs in the period 2001-2008

3.3. Jet fuel price risk exposure

3.3.1. Jet fuel price volatility

Not only did the jet fuel price reach record heights in 2008, but its volatility was also high. As seen from the graphs below, the volatility measured in standard deviation of price changes peaked at 5.1% and 14.1% for weekly and monthly changes respectively[14].





High and volatile fuel prices, together with the following global financial crisis, made 2008 a difficult year for airline companies in terms of financial management and planning.

3.3.2. Jet fuel price sensitivity and economic effects.

It is interesting to examine the economic impact on airlines from jet fuel price changes. As previously discussed, fuel prices are volatile. Since fuel costs constitute a large share of operating expenses, this volatility will in turn affect the bottom line and cash flows of an airline. According to the Air Transportation Association[15] the US airline industry will face $18.8 billion more in operating expenses if the price were a dollar higher for a gallon of fuel over the course of 2008. We have no such data for European airlines, but the US numbers indicate that the impact of rising prices is huge for the entire industry.

One approach to measure the economic impact from jet fuel price fluctuation is to regress year-over-year changes in quarterly operating income before depreciation on the changes in quarterly fuel price. We use year-over-year data because of seasonality in income. We scale operating cash flow by sales. For the years 2005 to 2008, the regressions yield the following results:

[14] Calculated using daily data collected from EIA (1986 – 2009)
[15] http://www.airlines.org/economics/energy/fuel+QA.htm

Regression summary: YOY jet fuel price effect on quarterly operating cash flow			
Year	Coefficient	P-value	#obs
2005-2008	-0.0439	0.007	159
2008	-0.0189	0.743	31
2007	0.0097	0.832	50
2006	-0.0561	0.436	45
2005	0.0059	0.932	31

For the entire period, the coefficient was -0.0439 and significant at a 95% confidence level indicating that rising jet fuel prices are negatively related to operating cash flow[16].

Another way of investigating the fuel price impact on airlines is estimating a market model that includes a weekly jet fuel return factor. Based on weekly returns from stock, market index and jet fuel price we construct the following model:

$$R_{it} = \alpha_i + B_i R_{Mt} + \gamma_i R_{Jt} + \varepsilon_{it}$$

were R_{it} is the stock return on company i in week t, R_{Mt} is the return on the index where the company is listed in week t, R_{Jt} is the percentage change in jet fuel prices in week t and ε_{it} is the idiosyncratic error. B_i and γ_i are the coefficients, representing the stock return's sensitivity to market and jet fuel price changes. For each company we use the index on the exchange were the stocks are traded, i.e. FTSE500 for companies listed on London Stock Exchange, OSEBX for Norwegian Air Shuttle etc[17]. Other things being equal, airlines (and airline stock owners) would prefer low fuel prices. We would therefore expect the coefficient to be negative.

The table below shows the regression coefficient for airlines' stock returns versus jet fuel price changes and market returns respectively. For American airlines we have used New York Harbour jet fuel prices and for European airlines we have used Amsterdam-Rotterdam-Antwerp jet fuel prices. Our sample consists of 18 airlines (6 biggest American and 12 European). The result shows a negative exposure for the median for all periods except 2001 and 2009. 2001 was a year with few company observations and 2009 is a year with few total observations at the time this thesis was written. The mean exposure differs in 2004 and 2005

[16] See graph 2 and 3 in the appendix for illustrations
[17] Data is collected from http://finance.yahoo.com/

where the coefficient is positive for European airlines. The stock returns for the whole period of 2001 – 2009 are negatively related to jet fuel price changes for all airlines.

Regression; Stock price vs Jet fuel price and market	
	2001-2009 Coefficient
Average jet fuel coef all airlines	-0.1532
Average jet fuel coef US airlines	-0.2156
Average jet fuel coef European airlines	-0.1220
Median jet fuel coef all airlines	-0.1324
Median jet fuel coef US airlines	-0.1335
Median jet fuel coef European airlines	-0.1270
Average Index coef All	1.2536
Average Index coef US	1.9208
Average Index coef EUR	0.9200
Median Index coef All	1.1197
Median Index coef US	2.1534
Median Index coef EUR	0.9843

The P-values are rarely significant within a 95% confidence level, so the results are inconclusive[18]. All companies show a negative relation between stock return and jet fuel price changes. In 2008, however, there is a big difference between the coefficient for European and American firms. American firms seems much more negatively related to jet fuel price changes in the first half of the year, while they seem much more positively related to jet fuel price changes in the second half. This is hard for us to explain without further investigation. What we do know is that oil and fuel prices were rising in the first half, and started falling significantly in the second half. At the same time, the credit crunch and financial crisis hit the market with full effect.

3.4. Hedging price risk

We have seen that jet fuel prices have been high and volatile, representing a huge portion of an airline's operating expenses. Our regressions show that rising fuel prices negatively affect financial performance and stock returns. In addition to increasing competition and profit margin pressure, this may be a reason why a financial manager wants to hedge this price risk. In the following chapter we turn to hedging theory and try to find reasons why companies hedge risk.

[18] See table 4 in the appendix for a regression summary

CHAPTER 4: RATIONALES FOR NON-FINANCIAL FIRMS TO HEDGE

4.1. Introduction and historical overview

Financial or corporate risk, the risk deriving from earnings fluctuations, influences the value of a company. Allen and Santomerano (1995)[19] argue that the importance of financial risk management has increased in the decades after 1960. This is due to a combination of deregulations, international competition, interest rates and foreign exchange rate volatility, together with commodity price discontinuities. Before derivative markets were highly developed, companies that wanted to hedge their risks had few opportunities, but operational hedging strategies e.g. establishing plants abroad to minimize exchange rate risks or trying to match the currency structure of their assets and liabilities (Santomero 1995) [20].

During the last three decades, the derivative markets have developed incredibly. The range of financial instruments available and the use thereof has skyrocketed. A great number of non-financial firms are now using these instruments, traded both on exchanges and Over-The-Counter (OTC). Together with this development, risk management has become an important objective of companies' strategies (Bartram 2000[21])

In recent decades there has been several studies trying to explain why firms manage risk, or hedge. The literature focuses on non-financial firms because financial firms are considered as users and providers of hedging instruments and could therefore have different factors affecting their hedging strategies. Several researchers have tried to explain why risk management activities create value, and the explanations rely on some frictions to the Modigliani and Miller (1958) (MM)[22] theory that say hedging does not add value to a firm. Even though the predicted power of the theories has been indicated in many papers, there is not yet a unique, well accepted framework that practitioners can rely on when setting their hedging strategies. Another problem is data collection. Empirical testing has often proved difficult, due to lack of available/quality corporate hedging data.

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[19] Allen, F and Santomero A.M (1995): What do Financial Intermediaries Do*?, Business Week*, June 12 1995, p. 70

[20] Santomero, A.M. (1995), Financial Risk Management: The Whys and Hows, *Financial Markets, Institutions and Instruments* 4 (5), pp. 1-14

[21] Bartram, S.M (2000), Corporate risk management as a lever for shareholder value creation, *Financial-markets, institutions and instruments* 9 (5), pp. 279-324

[22] Miller, M. and Modigliani, F. (1958). "The Cost of Capital, Corporation Finance and the Theory of Investment". *American Economic Review* 48 (3): 261–297

Since theory and practice obviously departs, and this is explained by market imperfections, scholars have constructed two classes of explanations for hedging of non-systematic risk. The first class focuses on hedging activities and their relation to shareholder maximization while the second class focuses on the relation to managers' private utility. We will now present motives non-financial firms may have to hedge risk.

4.2. Does hedging really matter?

It was for a long time believed that hedging activities were irrelevant for the value of the firm. The Capital Asset Pricing Model (CAPM) (Sharpe 1964[23], Lintner 1965[24], Mossin 1966[25]) implies that diversified investors should only care about the systematic component of the total risk. As a result, it appears that managers that want to maximize shareholder value should be indifferent about hedging unsystematic risk. The findings from CAPM are also supported by Miller and Modigliani's proposition. This proposition says that hedging decisions are completely irrelevant, because shareholders already can protect themselves against such risks by holding well diversified portfolios. However, the MM world is based upon several more or less unrealistic assumptions, such as (i) neutral taxes; (ii) no capital market frictions (i.e., no transaction costs, asset trade restrictions or bankruptcy costs); (iii) symmetric access to credit markets (i.e., firms and investors can borrow or lend at the same interest rates); and (iv) firm financial policy reveals no information). Under these conditions it is hard to reject the hypothesis, but in real life the conditions does not hold.

4.3. Shareholder maximization hypothesis

4.3.1. Financial distress costs

Financial distress costs are related to the probability of an actual bankruptcy or the probability thereof. Bankruptcy costs can be divided into two categories; direct and indirect costs. Direct costs are related to the costs incurred in the bankruptcy proceeding, e.g. legal and administrative costs (fees to lawyers, expert witnesses, accounting fees), and the sale of assets to below fair market value prices. These can be large if the assets are specialized or non-

[23] Sharpe, W.F (1964): Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *Journal of Finance* 19 (3), pp 425 - 265
[24] Lintner, J. (1965): Security prices, risk and maximal gains from diversification, *Journal of Finance* 20 (4), pp 587-615
[25] Mossin, J (1966): Equilibrium in a Capital Asset Market, *Econometrica* 34 (4), pp. 768-783

tangible (Weiss 1990) [26]. Indirect costs arise as soon as stakeholders perceive a realistic chance of future bankruptcy. They refer to costs such as stakeholder protection costs, debt overhang (underinvestment) and asset substitution (risk shifting), reluctance to deal with the company (as suppliers and customers cannot be ensured that unsettled credits will be honored, warranties fulfilled, spare parts available, etc.) and employee turnover. (Andrade & Kaplan 1998)[27].

Non-systematic risk affects the probability of going bankrupt and therefore imposes costs. That may be one reason why management chooses to hedge on behalf of the shareholders. These costs are one reason why performance and market value might be directly associated with volatility (Haushalter 2000) [28]. Hedging will reduce the volatility of the firm's cash flows or accounting profits and decreases the probability of bankruptcy. In turn, this will lower costs and boost value.

Leverage is one of the most popular measures for financial distress costs. The tax advantage of debt makes it possible to increase the value of the firm when increasing its debt. On the other hand, debt puts pressure on the firm, as payments of debts and interest constitute obligations which the debtholders are legally entitled. Employees are similarly legally entitled to their wages. If the company does not meet these obligations in time, it may encounter financial distress, and at the extreme, bankruptcy. If the capital markets were perfect (MM), bankruptcy would lead to a costless renegotiation of the company's assets, ending in a transfer of assets from the shareholders to the debtholders. Smith and Stulz (1985) [29] argue that bankruptcy, and also the probability of future bankruptcy, creates significant costs for the company, which in turn have a negative impact on firm value in the real world. If financial distress is costly, hedging activities may reduce the bankruptcy probability. They argue that hedging decreases the present value of financial distress costs even if hedging is costly, assuming that the investment policy is fixed. Expected loss of the debt tax shield will also be lower. In these ways, shareholders' wealth increases.

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[26] Weiss, L.A. (1990) : Bankruptcy Resolution: Direct Costs and Violation of Priority of Claims, *Journal of Financial Economics* 27, pp. 285-314

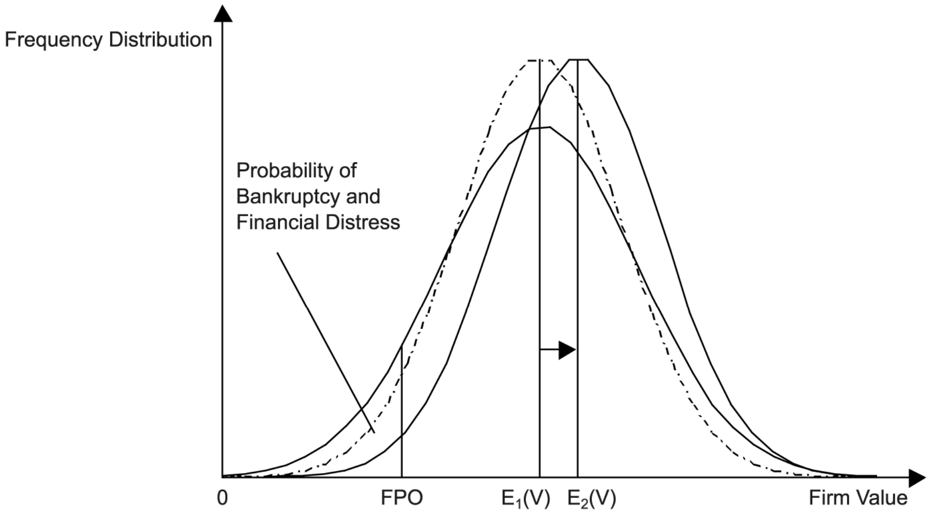
[27] Andrade, G and Kaplan (1998): How Costly is Financial (not Economic) Distress? Evidence from Highly Leveraged Transactions that Became Distressed, Journal of Finance 53 pp. 1443-1494

[28] Haushalter, G.D (2002): Fiancing Policy, Basis Risk, and Corporate Hedging: Evidence from Oil and Gas Producers, *The Journal of Finance* 55 (1), pp. 107-152

[29] Smith, C.W. Jr and Stulz, R.M. (1985), "The determinants of firms' hedging policies", *Journal of Financial and Quantitative Analysis*, Vol. 20 No. 4, pp. 391-405

Simultaneously, risk management also raises the potential to carry debt. This leads to a higher optimal debt ratio or lower financing costs, and thus a higher value of the tax shield, since interest payments are tax-deductible.

The figure illustrates how hedging lowers the costs of financial distress:



FPO: Level of fixed payment obligations.
E_1 (V): Expected firm value without corporate hedging.
E_2 (V): Expected firm value with corporate hedging.

Source: Aretz,K ., Bartram,S.M. , Dufey,G. (2007) [30]

According to Dobson and Soenen (1993)[31], hedging of foreign exchange will lower the probability of bankruptcy. Therefore, they argue that hedging tends to improve the moral-hazard-agency problem. Moral hazard derives from conflicts of interest between company stakeholders. When the bankruptcy probability decreases, the perceived duration of contractual relations between stakeholders increases. They also claim that when firms undertake international capital projects, uncertainty exists concerning the domestic currency value of the future cash flows from these projects. Foreign exchange hedging reduces this uncertainty by smoothing the future cash flow stream. This hedging can increase value, because when the cash flow is smoother, the cost of debt financing tends to be lower.

[30] Aretz,K ., Bartram,S.M. , Dufey,G. (2007): Why hedge? Rationales for corporate hedging and value implications, *The Journal of Risk Finance*

[31] Dobson, J. and L. Soenen (1993): Three Agency-Cost Reasons for Hedging Foreign Exchange Risk, *Managerial Finance* 19 (6) pp 35-44

Bessembinder (1991)[32] also show that hedging can create value by enhancing the debt contracting terms.

The linkage between hedging and leverage is explored by Dolde (1995)[33], Gould and Szimayer (2008)[34]. They unravel a previous puzzle in corporate finance, showing a significant positive relationship between hedging and leverage. They present evidence that hedging mitigates the effects of leverage on costs of financial distress.

4.3.2. Agency costs of debt

Scholars describe agency costs of debt as the bondholders' necessary compensation for managerial opportunism combined with the costs of writing and enforcing debt covenants.

One agency conflict is referred to as the underinvestment problem. As opposed to the MM world, the real world consists of imperfect contracts and the interests of a firm's stakeholders might not be congruent. This is especially the case when the firm is highly leveraged and when there are information asymmetries. Firms with risky bonds outstanding and with low value are in particular those who may not have an optimal investment behavior. This stems from the fact that, if fixed payment obligations are high, rational management may choose not to invest, even in positive NPV projects, as the realization of such investments primarily benefits bondholders (Myers, 1977) [35]. In other words, the problem results when firms find that external financing is sufficiently expensive and therefore must cut investment spending during times when internally generated cash flows are not sufficient to finance growth opportunities. Hedging risks in this situation adds value because it helps ensure that the corporation has sufficient funds available to take advantage of attractive investment opportunities. Gay and Nam (1998)[36] find evidence of a positive relation between a firm's hedging activity and its growth opportunities. They also argue that the use of derivatives is partly driven by the need to avoid potential underinvestment problems.

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[32] Bessembinder, H. (1991): Forward Contracts and Firm Value: Investment Incentive and Contracting Effects, *The Journal of Financial and Quantitative Analysis* 26 (4) pp. 519-532

[33] Dolde, W (1995): Hedging, Leverage, and Primitive Risk, Journal of Financial Engineering 4 (2) pp 187-216

[34] Gould, J. and Szimayer, A (2008): The Joint Hedging and Leverage Decision, *Working Paper Series* http://ssrn.com/abstract=1085964

[35] Myers, S.C (1977): Determinants of corporate borrowing, *Journal of Financial Economics* 5, pp. 147-75

[36] Gay, G.D and Nam, J. (1998): The Underinvestment Problem and Corporate Derivatives Use, Financial Management 27 (4), pp 53-69

Another agency conflict is referred to as the asset substitution problem or the risk shifting problem. This problem arises when the firm must select between mutually exclusive investment projects. When managers act in the interest of the shareholders, they have incentives to shift towards riskier projects, particularly when firm leverage is high and value low. This is because shareholders mainly receive the benefits of positive stock price developments while bondholders suffer the consequences of negative price developments. Shareholders have a call-option like claim on the firm's assets (Merton 1974)[37]. According to option theory, shareholders will be interested in the upside and the volatility, since volatility increases the value of the option. Bondholders, on the other hand, will be concerned about the downside and the risk of bankruptcy. When choosing among projects with different riskiness, management can therefore increase the value of equity at the expense of the value of the debt. However, bondholders can protect themselves by designing debt covenants that protect their interests. Smith (1995)[38] indicates that risk management may prevent a drop in firm value to a point where there are strong incentives to increase risk. These incentives are usually the strongest when the value is low, and where the transfer of wealth from bondholders to shareholders is largest.

Based on agency costs, Dobson & Soenen (1993) discuss three sound reasons why management should manage risk. As mentioned, hedging smoothes cash flows and thereby reduces uncertainty which in turn will lower the cost of external financing. Since management bear agency costs, assuming asymmetric information between managers and bondholders, hedging will increase the value of the company. Management will therefore rationally choose to hedge. Second, when the firm is leveraged, cash flow smoothing through exchange risk hedging will tend ameliorate the risk-shifting agency problem. The third argument states that hedging increases duration of contractual relations between stakeholders, because the probability of financial distress is lower.

4.3.3. Imperfect Markets and Costly External Financing

Hypotheses exist why corporate risk management is a result of market imperfections. If access to external debt or equity financing is costly, and the firm is dependent on external financing to realize investment opportunities, it will hedge their cash flows to avoid a shortfall in their funds. Otherwise, a visit to the capital market would be very costly. Froot,

[37] Merton, R.C (1974): On the Pricing of Corporate Debt: The Risk Structure of interest rates, Journal of Finance 29, pp 449-470
[38] Smith, C.W. (1995): Corporate Risk Management: theory and practice, Journal of Derivatives 2 (4), pp 21-30

Scharfstein and Stein (1993)[39] argue that market imperfections are the reason why external funds are more costly than internally generated funds. Transaction costs to obtain external financing, imperfect information as to the riskiness of the investment opportunities present in the firm, and the high costs of potential bankruptcy are among the imperfections. Other things equal, the harder it is for a firm to obtain external financing, the more costly a shortfall in cash flow will be. Hence, benefit from hedging is greater. Haushalter (2002) supports this theory and shows that companies that are more likely to face market imperfections, hedges risk more actively.

Even though there are benefits from hedging, and the firm is less dependent on the capital market, it does not automatically translate to value added. Tufano (1998)[40] shows that hedging in fact can result in overinvestment, i.e. investing in negative NPV projects.

4.3.4. Reducing tax burden

Companies often face convex tax-schedules, i.e. the tax rate increases with higher income. In this context, Graham and Smith (1999)[41] points out that about half of the 80,000 firms they investigated had tax-based incentives to reduce the pre-tax income volatility. This goes also for firms that are not 100 % able to carry forward their losses to future periods. A stable income will minimize the tax payments and thus increase shareholder value. Mayers and Smith (1982)[42] provides evidence that firms with more convex tax schedules engages more in hedging activities while Mian (1996)[43] argues that there is no relation between hedging and progressive tax schedules, and between hedging and the incidence of carry-forward tax losses. Instead, he found a relationship between foreign tax credit (proxy for tax shield) and hedging.

4.4. Managerial Utility Maximization Hypothesis

4.4.1. Undiversified management

Shareholders can usually diversify away the unsystematic risk of their positions, while this is more difficult for managers at the personal level. The difficulty arises because of the tied

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[39] Froot, K.A., Scharfstein, D.S. and Stein, J.C (1993): Risk Management: Coordinating Corporate Investment and Financing Policies, Journal of Finance 48 (5), pp. 1629-1658

[40] Tufano, P (1998): The Determinants of Stock Price Exposue: Financial Engineering and the Gold Mining Industry, *The Journal of Finance* 53 (3), pp. 1015-1052

[41] Graham, J.R. and Smith, C.W jr (1999): Tax incentives to hedge with derivatives, *Journal of Finance* 54 (6), pp. 2241-2263

[42] Mayers, D. and Smith, C.W jr (1982): On the Corporate Demand for Insurance, *The Journal of Business* 55 (2), pp. 281-296

[43] Mian, S. (1996): Evidence on Corporate Hedging Policy, *Journal of Financial and Quantitative Analysis* 31 (3), pp. 419-439

relationship between managers and the firm. They often have proportions of their wealth invested in the firm; they have worked there for several years, have obtained specific expertise and have a reputation to protect. Because of this, conflicts resulting from the principle-agent relationship between shareholders and managers might emerge. Managers might take actions that benefit themselves more than the shareholders. Such actions may be conglomerate mergers or sub-optimal debt-ratios, as they decrease the risk of their own wealth position (Bodnar et al., 1997)[44]. Agency costs incur in the shareholders effort to reduce this non-maximizing behavior, e.g. through monitoring.

4.4.2. Incentive structures

Managers are hired by the shareholders to act in their interest, which is usually maximizing their wealth. It is then important that management have the right incentives to ensure goal congruency. Risk management might lower the agency costs, because it lowers the risk of profitable growth opportunities. The variability of firm value will decrease and give the managers less incentive to engage in non-value maximizing activities deriving from different risk preferences. Smith and Stulz (1985) discuss how the compensation scheme influences managers hedging choices. When the scheme includes option-like provisions, the managers have more incentive to take on more risk. The authors of the article conclude that managers therefore hedge less. The same cannot be said when a substantial portion of the compensation takes form of shares itself (i.e. the compensation follows the stock price movements one to one). Bartram (2000)[45] argues that this will intensify the undiversified managers' risk aversion.

There are several factors that the management cannot control, e.g. interest rate risk and currency risk. The stock price performance may therefore not be a good indicator of the management quality in the absence of risk management. Due to this influence of risks unrelated to management performance on stock price, management compensation schemes are rendered less effective, as they sometimes reward poorly performing and reward well-performing managers. However, hedging can reduce the effects of unrelated financial risks on company value and therefore strengthen the relationship between share price and

[44] Bodnar, G.M., Tang, C. and Weintrop, J. (1997): Both Sides of Corporate Diversification: The Value Impacts of Geographic and industrial diversification, *NBER Working Paper Series*, NBER, Cambridge, MA
[45] Bartram, S.M (2000): Corporate Risk Management as a Lever for Shareholder Creation, Financial Markets, Instititions, and Instruments 9 (5), pp. 279-324

management performance. Campbell and Kracaw (1987)[46] claim that it will also be easier to distinguish efficient and inefficient managers.

4.4.3. Asymmetric information and reputation

Breeden and Viswananthan (2002)[47] put forward a different theory about hedging and this is based on asymmetric information and management reputation. They dispute that executives may hedge risks so as to better communicate their skills to the labor market. They claim that younger managers are more open to new concepts like risk management, than their not so young counterparts. This might be explained by the facts that younger managers have less developed reputations and would therefore have an incentive to signal their quality through hedging.

May(1995)[48] contradicts this relationship and argues that managers' years with the firm should be negatively related to the risk characteristics of the firm, and therefore creating more incentives to hedge. The reason is that managerial skills become more firm-specific as time goes by. If diversification reduces human capital risk, firms with "old" managers are more likely to pursue risk management. Tufano (1996)[49] tested the assumptions and found only a negative relation between CFO age and hedging activities, while no relationship with CEO and hedging activities. He also found that the number of years the CFO has been with a firm is negatively related to hedging.

4.5. Other rationales for corporate hedging

4.5.1. Ownership concentration

As previously explained, corporate hedging may be explained by agency conflicts between managers, shareholders and debtholders. Corporate governance characteristics should affect hedging policy because corporate governance is the market solution to the agency problems. Agency costs are generally lower in firms characterized by high ownership concentration and should hedge mainly in order to maximize their value. Larger shareholders have both resources and incentive to exercise strict monitoring of the managers activities, and thus

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[46] Campbell, T.S. and Kracaw, W.A. (1987): Optimal Managerial Contracts and the Value of Corporate Insurance, Journal of Quantitative Analysis 22 (3), pp. 315-28

[47] Breeden, D. and Viswananthan, S. (1996): Why do Firms Hedge? An Asymmetric Information Model, Duke University Working Paper

[48] May, O.D. (1995): Do Managerial Motives Influence Firm Risk Reduction Strategies?, *The Journal of Finance* 50(4), pp. 1291-1308

[49] Tufano, P. (1996): Who Manages Risk? An Empirical Examination of Risk Management Practices in the Gold Mining Industry, *Journal of Finance* 51(4), pp. 1097-1137

reducing their incentives to hedge in their own interests. Lel (2004)[50] examines the effect of large inside and outside shareholders and suggest that the presence of an inside blockholder decreases the likelihood of hedging while the presence of an outside blockholder or /and an institutional blockholder increases this likelihood.

4.5.2. Board characteristics

There are also theories based on the board characteristics. Whidbee and Wohar (1999)[51] were the first to explore the link between derivatives use and the board independence, measured by the proportion of outside directors in the board. It should be noted that it can be difficult to distinguish inside investors from outside investors, and therefore also difficult to measure the board independence. They suggest that hedging activities are influenced by outside directors' presence only at low levels of insiders' shareholdings. The explanation for this is that managers that own a small fraction of the company's shares are more likely to be disciplined after poor performance. In this situation, managers will usually seek more hedging. Borokhovich et. al (2004)[52] investigated whether hedging activities can be explained by board size and the presence of a bank executive on the board, but found no relationship. Evidence suggesting that the financial education of the board and the audit committee affect hedging is found by Dionne and Triki (2005)[53], but this topic is quite new in risk management theory and is expected to develop in near future.

4.5.3. Country-specific characteristics.

Risk management strategies can be affected by informational and institutional environment. Bodnar and Gebhardt (1999)[54] applied a matched-industry procedure and concluded that German firms hedge more with derivatives than US firms. Bodnar, De Jong and Macrae (2003)[55] find a similar relationship between Dutch firms and US firms. They explain this by the fact that Dutch firms may be more exposed to currency risk than the US counterparts together with differences in economy orientation and the presence of a legal structure that is

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[50] Lel, U (2004): Currency Risk Management, Corporate Governance, and Financial Market Development, *Working Paper*, University of Indiana

[51] Whidbee, D. and Wohar, M (1999): Derivatives Activities and Managerial Incentives in the Banking Industry, Journal of Corporate Finance 5 (3), pp. 251 - 276

[52] Borokhovich, K., Brunarski, K., Crutchley, C. and Simkins, B. (2004): Board Composition and Corporate Use of Interest Rate Derivatives, The Journal of Financial Research 27 (2), pp. 199-216

[53] Dionne, G. and Triki, T. (2004): On Risk Management Determinants: What Really Matters?, *Working Paper* 04-04, Canada Research Chair in Risk Management and HEC Montreal

[54] Bodnar, G. and Gebhardt, G. (1999): Derivatives usage in risk management by US and German Non-Financial Firms: A Comparative Survey, Journal of Financial Management and Accounting 10 (3), pp. 153-187

[55] Bodnar, G, De Jong, A and Macrae, V. (2003): The Impact Of Institutional Differences on Derivatices Usage: A comparative study of US and Dutch Firms, European Financial Management 9, pp. 271-297.

more protective of shareholder rights in the US. Lel (2004) takes into consideration financial market developments, legal and macroeconomic characteristics of the country as possible reasons for differences in hedging strategies. He argues that firms in emerging economies face higher macroeconomic risk and are therefore more likely to use hedging instruments.

4.5.4. Size

According to the Froot, Scharfstein and Stein (1993) model, firms that have costly external financing should be more likely to hedge. Smaller firms suffer more to informational asymmetries and more costly financing, and should therefore hedge more. On the contrary, if hedging costs are fixed, larger firms should engage more in risk management activities because they are costly activities that smaller firms cannot afford. Another rationale for large firms to hedge is because they have more geographically dispersed operations and faces risks on several levels. Several scholars have reported a relationship between size and hedging activity, such as Nance, Smith and Smithson (1993) and Haushalter (2002).

4.6. Substitutes to hedging with derivatives

Risk management does not necessarily translate to derivatives. In literature, three techniques are mentioned to serve as alternatives to derivatives hedging

4.6.1. Risk management through operation activities

It is not easy to measure hedging through operations, but Petersen and Thiagarajan (2000)[56] argues that firms with operating costs flexibility are less likely to hedge with financial instruments. Diversified firms face less non-systematic risk and will therefore not be as likely to hedge. Diversification can in other words be a substitute to the use of derivatives.

4.6.2. Risk management through financing activities

Nance, Smith and Smithson (1993)[57] introduced a theory that says the usage of preferred stocks and convertible debt as substitutes to hedging. External financing in the form of preferred stock or convertible debt reduces the probability of financial distress compared to regular debt. It follows that the need for hedging decreases.

[56] Petersen, M and Thiagarajan, R. (2000): Empirical Measurement and Hedging: With and Without Derivatives, *Financial Management* 29(4), pp. 5-30

[57] Nance, D., Smith, C. Jr and Smithson, C. (1993): On The Determinants Of Corporate Hedging, The Journal of Finance 48 (1), pp. 267-284

4.6.3. Liquidity buffers

The first two alternatives are substitutes for financial instruments, while a liquidity buffer is a substitute for hedging regardless of instruments used to manage risk. Nance, Smith and Smithson (1993) claim that a retention of earnings (instead of paying it out as dividends) will build a liquidity buffer that can be used when firms need cash or faces volatile earnings.

CHAPTER 5: HEDGING IN THE AIRLINE INDUSTRY

5.1. Introduction

Hedging using jet kerosene is preferable for an airliner because it fully reflects the commodity that the airline needs to operate its fleet. However, apart from the little-traded Japanese market, there are no exchange traded futures available for jet fuel, although OTC-trades can be arranges. This involves counterparty risk for both sides, and thus financially weak airlines would find it hard to find others willing to take this risk. We will now present available substitutes.

5.2. Hedging instruments used by airlines

5.2.1. "Plain vanilla swap"

A plain vanilla swap is an off-balance-sheet agreement where a floating price is exchanged for a fixed price over a certain period of time. The name is derived from the fact that it is simple and basic compared to more exotic swap contracts. The contract is purely a financial agreement, and does not include physical delivery of the commodity itself. The contractual obligations are settled in cash. A fuel swap specifies volume, duration and the fixed floating prices for fuel. The difference between the floating and fixed price are settled in cash for specific period. This is typically monthly, but sometimes also quarterly, semi-annually or annually. The airline is typically the fixed price payer.

5.2.2. Differential swaps and basis risk

The plain vanilla swap is based on price differences for the same commodity. A differential swap is based on the price difference between a fixed differential for two different commodities and their actual differential over a period. These swaps can be used to manage the basis risk[58] from other hedging activities. Some airlines hedge their jet fuel exposure using plain vanilla swaps on highly correlated commodities, such as heating oil. The airline can then use an additional contract, a differential swap for jet fuel versus heating oil, to hedge the basis risk from the first contract. In this way the airline can eliminate the risk that jet fuel price rise more than the price of heating oil.

[58] Basis risk is defined as the risk that offsetting investments in a hedging strategy will not experience price changes in entirely opposite directions from each other. This imperfect correlation between the two investments creates the potential for excess gains or losses in a hedging strategy, thus adding risk to the position

5.2.3 Call options

A call option gives the buyer the right, but not the obligation, to buy a particular asset at a predetermined fixed price at a time up until the maturity date. OTC options on oil are usually settled in cash while exchange-traded oil options on the New York Mercantile Exchange (NYMEX) are exercised into futures contracts. OTC option settlement is usually based on the average price for a period, normally a calendar month. Airlines like settlement against average prices because they usually refuel their aircrafts several times a day. Since they are effectively paying an average price during the month, they typically prefer to settle hedges against an average price, called average price options.

Options are often used to hedge cross-market risk in the energy industry, especially when market liquidity is an issue. An airline may buy an option on heating oil as a cross-market hedge against a rise in the jet fuel price. Such hedges should only be used if the prices are highly correlated.

Airlines value the flexibility that energy options give, but these options can be expensive compared to other available options. The prices of commodities are often very volatile, giving such options great value and therefore great premiums.

5.2.4. Collars

An alternative to buying expensive option is to use collars. A collar is a combination of a call and put option. For a commodity-buying hedger, it is created by selling a put option with a price below the current commodity price and purchasing a call option with a strike price above the current commodity price. The premium received by selling the put option is used to purchase the call option and thus offset some / all of the costs. A “zero cost collar” is established when the premium received from the put options exactly offsets the premium paid for the call options. This collar strategy ensures a minimum and maximum price for the commodity for a certain period. A “premium collar” occurs when the hedger wants more protection from upward price movements, or more benefit from declining prices. That is, having a lower call option strike price and selling a put option with a lower strike price. With this collar the premium from the put option only partly offset the cost of the call option.

Using a zero-cost collar may seem reasonable since it involves no or low upfront costs, but the company may ending up buying fuel at higher prices than their un-hedged competitors (or companies that did not employ a collar strategy) in the event of a price drop.

5.2.5. Futures and forward contracts

A futures contract is an agreement to buy or sell a specified quantity and quality of a commodity for a predetermined price at a predetermined time in the future. The buyer has a long position, meaning an obligation to purchase the commodity while the seller has a short position, meaning an obligation to sell the commodity. Futures contracts are standardized (e.g. quantity, quality, delivery, etc.) and traded on an exchange. They also eliminate counterparty risk (a clearing house guarantees the financial performance of contracts with the help of margin requirements. Only a small percentage of contracts result in physical delivery (Less than 1% according to NYMEX). Instead buyers or sellers offset their positions. The main exchanges offering oil contracts are the International Petroleum Exchange (IPE) in London and NYMEX.

A forward contract is the same as a futures contract except for two important differences. First, forwards are typically customized and not traded on organized exchanges, i.e. "OTC". Second, forwards are settled at maturity, whereas futures are marked to market daily. The purchaser has full counterparty risk.

5.3. Instrument suitability

The most liquid market available for closely related products is oil, with contracts available in Brent crudes and WTI crudes. No market exists for OPEC produced oil products, although the price for these products tracks Brent and WTI crudes closely. The higher the correlation between jet fuel and the commodity hedged the better suitability. Below it is illustrated how the related products correlate with jet fuel[59].

Correlations of return with jet fuel			
	New York Harbor Kerosene-Type Jet Fuel	U.S. Gulf Coast Kerosene-Type Jet Fuel	Amsterdam-Rotterdam-Antwerp (ARA) Kerosene-Type Jet Fuel
Cushing, OK WTI Spot	0.6717	0.7423	0.6935
Europe Brent Spot	0.6975	0.7652	0.7404
New York Harbor No. 2 Heating Oil	0.9121	0.8215	0.7408
U.S. Gulf Coast No. 2 Heating Oil	0.8808	0.9285	0.7944

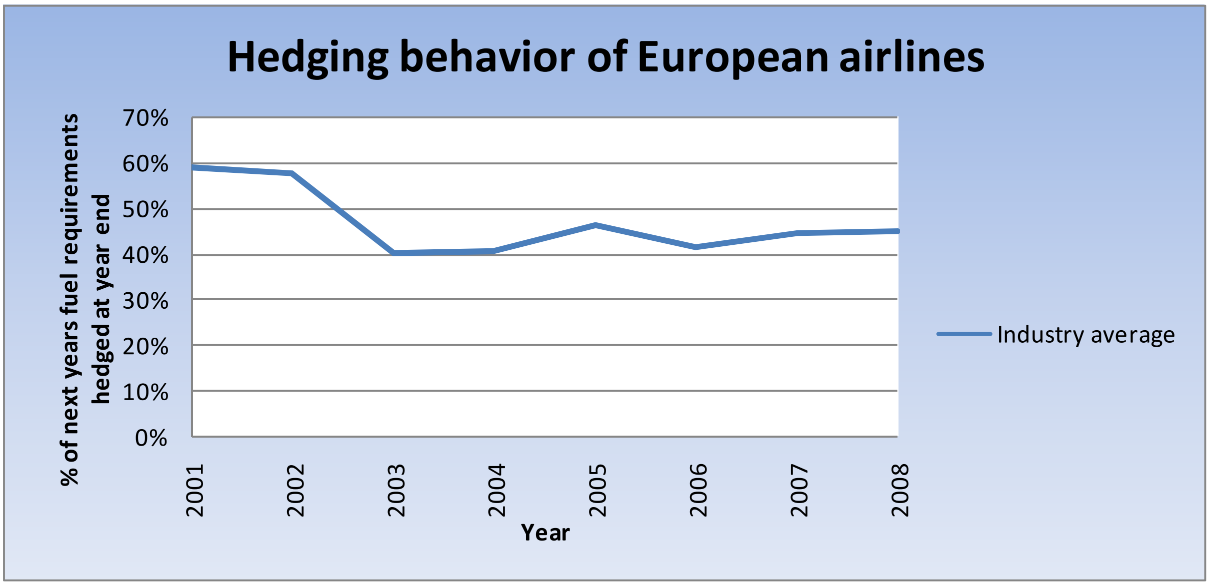
[59] Calculated using data collected from IEA (1986-2009). See table 6 in the appendix for a full matrix.

The correlations[60] between returns of jet fuel, oil and heating oil prices are ranging from 0.6717 to 0.9285. Heating oil has a higher correlation with jet fuel prices than oil which is not surprising since heating oil and jet fuel are both refined products. It is worth mentioning that the return of jet fuel prices in Amsterdam is less correlated with the return of oil and heating oil prices than jet fuel in the US. The rationale for this is there are no prices available for heating oil in Europe.

5.4. Fuel hedging behavior in the European airline industry

5.4.1. Trend in hedging levels

In the years from 2001 and 2008 almost all the sample companies hedged parts of their jet fuel consumption. The companies apply different strategies with different derivatives[61]. We have seen how oil and jet fuel prices have reach record prices together with a high volatility. It is tempting to believe that this may have caused airlines to hedge more of their fuel requirements. The first interesting thing to notice is that hedging levels have not been significantly changed during the years from 2001 to 2008. At fiscal year end the development of next year's fuel requirement hedged is illustrated below:



In fact, industry aggregate hedging levels are lower in 2008 than in 2001. It is dangerous to draw conclusions, because we have missing observations for several airlines both in the beginning and the end of the period.

[60] See table 5 in the appendix for a full table of correlations.
[61] See table 6 in the appendix for a full summary of each airline's hedging behavior at year end for the period.

5.4.2. Instruments used

Each company has different hedging strategies. Some companies use only fixed price contracts (futures or swaps) while others use options or option-structures (collars or zero-cost collars) and some a combination of fixed price. The strategy also changes over time. All the companies have used both fixed-price contracts and options to hedge their fuel costs, except Ryanair and Norwegian, that rely solely on fixed-price contracts. For all the companies together, fixed-price contracts were used in 86% of the observations while options were used in 78%. The maturities of the hedges are also variable and may change over time and from company to company. For the entire sample, the average maturity of hedges was 1,67 years, ranging from 0,5 years for Norwegian to four years for Air France-KLM.

CHAPTER 6: THE VALUE AND DETERMINANTS OF JET FUEL HEDGING

6.1. Does hedging add value?

We have seen that jet fuel costs constitute a large portion of an airline's operating expenses and witnessed how price levels and variation has caused great uncertainty. Since so many airlines are hedging this risk, it is time to turn to the important question; does hedging add value to a firm?

Allayannis and Weston (2001)[62] conclude that foreign currency hedging increases firm value with approximately 5% after examining a large sample of US non-financial firms from 1990 to 1995. Carter et al. (2006)[63] found that jet fuel hedging is associated with a premium of about 10% for US airline shares in the period 1992-2003. On the other hand, Jin and Jorion (2006) could not find any evidence of increased value for US oil- and gas producers that hedge oil price in the period 1998-2001. Chang et al (2005) actually finds that oil production hedging for Canadian firms is negatively related to firm value while gas reserve hedging is positively related.

As we know, there has not been performed a similar test for European airlines with regards to jet fuel hedging. Fuel prices have been higher and more volatile recent years, so an investigation of this market is very interesting. We will now go through the set-up of our regression analyses.

6.1.1. Regression analysis

We have chosen to perform a regression analysis to try and answer the question whether fuel hedging adds value or not. We need information about how much airlines hedge, and such information is found from annual reports, 10-k filings and other sources on each airline's website. The measure of hedging level we use is the percentage hedged of next year's expected fuel requirements at the fiscal year end. We have aborted observations where this percentage is absent in the regressions. In addition to this percentage, we include a hedging dummy if the firm hedges more than 0%. Since different companies report in different currencies we transform all numbers into euro equivalents.

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[62] Allaynnis, G. and Weston, J. (2001): The Use of Foreign Currency Derivatives and Firm Market Value, *Review of Financial Studies* 14, pp. 243-276

[63] Carter, D., Rogers, D.A. and Simkins, B.J. (2006): Does Hedging Affect Firm Value? Evidence from the US Airline Industry, *Financial Management* 35 (1)

Dependent variable

We have chosen to use Tobin's Q as a proxy for firm value. This Q is defined as a ratio of market value of financial claims on the firm to the replacement cost of the firm's assets. The ratio was originally developed by James Tobin (1969)[64] . However, the initial Q requires hard-to-obtain data and complex computations. We have therefore chosen to use a simple approximation of Q, developed by Chung and Pruitt (1994)[65]:

$$\text{Tobin's } Q = \frac{\begin{array}{c}\text{Market value common stock} + \text{liquidating value preferred stock} + \\ \text{book value of long term debt} + \text{book value of short term liabilities} \\ - \text{book value of current assets} + \text{book value of inventories}\end{array}}{\text{Book value total assets}}$$

This approximation is easier to calculate and data is available from the Compustat database as well as annual reports. The authors also found a high correlation between the simple approximation and the more complex calculations.

Other control variables

Fuel hedging could be one source of value for an airline. But there are many other variables that may also contribute to the value of a firm. We want to control for these by constructing the following control variables:

<u>Size:</u> Evidence that size attributes to firm value is ambiguous. However, since a hedging program can be costly to start and manage, large companies may be more likely to use derivatives in risk management than small firms. The *natural logarithm of total assets* is used to control for size.

<u>Financial constraints:</u> Hedgers may forgo projects because they are unable to obtain sufficient financing. Q may remain high because they only invest in positive NPV projects. We use a *dividend dummy* to proxy for the ability to access financial markets. If the firm pays a dividend, it is less likely to be capital constrained, but may also lack investment (growth) opportunities. The dividend factor is therefore expected to be negatively related to Q[66]. We also include other variables to adjust for capital constraints: *cash divided by sales, operating cash flow divided by sales and EBIT*[67]*/interest expenses (Interest coverage).*

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[64] Tobin, J (1969): A General Equilibrium Approach to Monetary Theory, *Journal of Money Credit and Banking* 1 (1) pp. 15-29
[65] Chung, K.H and Pruitt, S.W (1994): A Simple Approximation of Tobin's Q, *Financial Management* 23, pp. 70-74
[66] Brealey, R.A and Myers, S.C (2007): *Corporate Finance, 8th* edition. McGraw Hill
[67] EBIT: Earnings Before Interest and Taxes

Capital structure: Leverage can both have a positive and negative effect on firm value. Since interest expenses are tax deductible, leverage can provide a tax shield. On the other hand, as leverage increases so does the probability of bankruptcy and the costs of distress. *Book value of long-term debt divided by total assets* is used to control for differences in capital structure.

Profitability: A profitable firm is more likely to trade at higher premiums than less profitable firms. To control for this we have included *net income divided by total assets* in the previous year (*ROA*)

Investment opportunities: Firms with investment opportunities are also more likely to have a higher market value. Firms that hedge may also have more opportunities when they gain on their hedges. Investment opportunities are defined as *capital expenditures divided by sales*.

Insider ownership: Insider ownership typically has strong signaling effect. When insiders (executives / board of directors) buys and own shares, this is typically a sign that the shares are undervalued and a sign of good future profitability. A high ownership could also be seen as incentives to do a good job as a manager, since they have a lot of their own wealth invested in the company. We use the *natural logarithm of the executives' share value* and expect it to be positively related to firm value.

Use of other hedging instruments: In our sample, the companies are exposed to other market risks than jet fuel price uncertainty. The two most common risks are interest rates and foreign currency. As mentioned, Allayannis and Weston (2001)[68] found that foreign currency hedgers have a higher Q than non-hedgers. We control for this by including a *foreign currency hedging dummy*. It is more difficult to control for interest hedging since it is hard to distinguish fixed-rate loans from swaps and contracts.

Model set-up

We have done regressions for European, US and for both markets' firms together. Two models have been applied; one where we include the percentage hedged (Model 1) and another where we include a hedging dummy if a company hedge or not (Model 2). Since almost all European airlines hedge, the dummy variable is not so meaningful.

[68] Allaynnis, G. and Weston, J. (2001): The Use of Foreign Currency Derivatives and Firm Market Value, *Review of Financial Studies* 14, pp. 243-276

6.1.2. Results

The regression analyses yield several interesting results[69]. For European companies the hedging percentage variable has a positive coefficient of 0.4446 and is statistical significant[70] (p-value 0.0270). This means that for our sample, firms that hedge have a higher value measured by Tobin's Q[71]. The coefficient translates to a stock premium of 44.46 % for firms hedging 100%. An average hedging level of 47% and a coefficient of 0.4446 translate to a premium of 20.6 % (coefficient * average hedging %) for our sample firms in the whole period. However, we believe it is difficult to label the premium with a specific percentage, but the results indicate that hedging adds value, anyway.

Other variables also explain firm value. A coefficient of -0.2355 and a p-value of 0.000 show that firm size negatively affects firm value. A possible explanation may be that the biggest firms are usually the traditional carriers with a well established route network and business. These may be tied to "old cost structures" (different types of aircraft, labor unions and high salaries, etc.) and lack of growth opportunities.

Dividend payments are also negatively related to value. The dividend indicator has a coefficient of -0.2420 and a p-value of 0.016. This could be explained by a lack of investment opportunities and therefore less growth opportunities. Such firms may have a lower market to book value[72]

Variables that affect Q positively are ROA and operating cash flow to sales with coefficients of 2.2006 and 2.2777 with p-values of 0.028 and 0.000, respectively. This is not surprising, since profitable firms typically have higher values. On the other hand, a start-up firm may have low ROA and negative cash flows. The market could despite this expect that the future is bright. However, our results indicate that ROA and operating cash flow to sales explain higher firm values.

For US airlines the results are quite similar. The coefficient of percentage hedged is 0.4127 with a p-value of 0.0720 in model 1. In model 2, a dummy variable is used if a company hedges. This indicator has a coefficient of 0.2994 and a p-value of 0.004. In other word, both our models suggest that hedging adds value to a hedging firm. An average percentage hedged

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[69] See table 7 in the appendix for a full regression summary.

[70] For the results, p-values below 0.01 is statistical significant at the 99% confidence level, p-values below 0.05 is statistical significant at the 95% confidence level and p-values below 0.10 is statistical significant at the 90 % confidence level.

[71] See table 8 in the appendix for a summary of average Qs for European airlines

[72] Brealey, R.A and Myers, S.C (2007): *Corporate Finance, 8th edition*. McGraw Hill

of 19% and a coefficient of 0.4127 yields a premium of 7.9%. The hedging indicator can itself be translated to a hedging premium. Since the coefficient is 0.2994, a premium of 29.94% is present in our sample. The difference between 7.9% and 29.94% is huge; this also shows that it is dangerous for us to but an absolute value on the value of hedging. But as for the European companies, there seems to be a positive relation between hedging and value.

There are two main differences between our US and European samples. The first is that the value of executive owned shares has a positive influence on Q with coefficients of 0.0750 and 0.0584, p-values of 0.003 and 0.023 in model 1 and 2 respectively..

The other difference is that some American airlines use pass-through agreements to pass on fuel cost increases to partner airlines. Companies that have such agreements are more likely to have higher values of Q since the coefficients in model 1 and 2 are 0.4576 and 0.5070 and have p-values of 0.000 and 0.000.

6. 2 Value of hedging in different time periods

We have previously shown that the uncertainty in general and volatility in fuel prices in particular has been increasing over the last two years. It is therefore interesting to see whether hedging is more valuable in these years. If hedging adds value to a firm (as indicated in the precious regressions), we intuitively expect that hedging adds even more value in periods of high volatility.

6.2.1 Regression analysis

We have split the regression performed above into two; one for the years 2001 – 2006 and the other for the years 2007 – 2008. In this way, we can see whether there is a difference in the relation between hedging and value for different time periods.

6.2.2 Results

For the years ranging from 2001 to 2006 the % hedged-variable is statistically significant at 99% confidence level for European airlines and 95% confidence level for European and American airlines all together[73]. The hedge dummy variable is statistically significant at 99% confidence level for American airlines. These are the same results we got from the regression for the whole period of 2001 -2008.

We are particularly interested in the years 2007-2008. These were years with an increasing uncertainty; rising fuel prices, higher volatility and the global financial crisis. If hedging is

[73] See table 9 in the appendix for a regression summary

valuable because the future is uncertain, it should intuitively be even more valuable when this uncertainty increases. However, in these years only the hedging dummy variable for American airlines is statistically significant at a 90% confidence level[74]. We find this result surprising.

The oil price was increasing during the years from 2001 to 2006, which may explain why investors value hedging more. If each year, the expectations were a further increase in prices, hedging would decrease costs in the future and, hence, hedging is valued.

In the last year, declining oil prices has lead to a loss on the various hedging instruments. Being hedged for many years with a high locked-in jet fuel price will result in more costs than competitors with less or no hedge at all. If investors think the trend in the oil price is declining it is reasonable to believe they value hedging less. In 2008, the year with the beginning of the financial crisis, there were (and still is) a lot of financial challenges, uncertainty and deviation from fundamentals in valuation of companies. This would make it more difficult to extract the hedging impact from all the data we have collected. We also suffer from few observations in the years 2007-2008. Our results could implicate that the % hedging variable is not significant during 2007 – 2008. Further studies and more observations are required to conclude whether hedging adds value in this period.

6.3 Determinants of jet fuel hedging

The risk management strategies vary from firm to firm. The next question we try to answer is: What determines an airline's choice of hedging? More specific we look for variables that can explain the level of hedging. The theory chapter lists many reasons why non-financial firms hedge. We want to check whether these theories applies to the airline's hedging decisions[75].

6.3.1 Regression analysis

In this regression we use a lot of the same data and variables from the previous regressions.

Dependent variable

As a measurement of hedging behavior we use the percentage of next year's expected fuel requirements hedged at fiscal-year end.

[74] See table 10 in the appendix for a regression summary

[75] Some variables are easier to check than others, and we have only included variables that we either feel more comfortable with or that the information is easily available or testable (limited by our own skills).

Independent variables

We use the same variables as in the previous regressions. In addition, we include the fuel cost percentage of operating expenses as we intuitively suspect that this must somehow be related to the hedging decisions.

6.3.2 Results

For European companies, we found four explanatory variables[76]. First, size explains hedging behavior[77]. With a coefficient of 0.1341 and a p-value of 0.000 we conclude that bigger firms hedge more than smaller firms. The reason may be that it is costly to set up and manage a hedging program and that big firms can afford this. The absolute amount of money at risk is also higher for biggest firms. Another rationale for large firms to hedge is because they have more geographically dispersed operations and faces risks on several levels

Second, firms that pay dividends hedge more than firms that does not. This is somewhat surprising, since we may expect capital constrained firms (typically firms that does not pay dividends) to hedge their margins. The coefficient for the hedging dummy is 0.1223 and the p-value is 0.059.

Third, the debt ratio is negatively related to hedging levels[78]. This is may also be surprising, since leveraged firms may be more risky and hence be more interested in hedging this risk. The coefficient is -0.9411 and the p-value is 0.

The last statistically significant variable is CAPEX/sales[79]. With a coefficient of 0.6147 and a p-value of 0.069, we see that firms that invest much tend to hedge more. This may be because they want to hedge future investment opportunities, i.e. make sure they have sufficient cash for future investments.

What we found surprising, was that jet fuel's share of operating expenses did not show any significance at all. If jet fuel constitutes a large portion of expenses, and jet fuel prices are volatile, intuition says that the company may hedge. Size showed a positive relation to hedging levels, and big companies have typically lower jet fuel costs as percentage of operating expenses. This can explain why we did not find any significance.

[76] See table 11 in the appendix for a regression summary
[77] See graph 4 in the appendix for an illustration
[78] See graph 5 in the appendix for an illustration
[79] See graph 6 in the appendix for an illustration

Another surprising part of the regression results, was that foreign hedging activity did not seem to be adding value, as opposed to jet fuel hedging. This may be explained by the fact that information available on currency hedging is hard to interpret, and a hedging dummy variable may therefore not be the best suited variable to include. Moreover, most companies hedge currency exposure, so that we have few observations of companies that do not hedge.

For the US sample, size and dividend dummy can explain hedging behavior, just like the European ones. The coefficients were 0.0243 and 0.1593 and the p-values 0.049 and 0.005 respectively. In addition to these, foreign currency and cash/sales shows statistically significant. Firms that hedge foreign currency, tends to hedge less jet fuel. The coefficient is -0.1022 and the p-value is 0.060. The cash/sales variable has a coefficient of 0.4134 and a p-value of 0.046. Another remark worth noticing is that the value of executive shares seems positively related to hedging levels, but it is not possible to conclude since p-value is 0.118

The combined sample yields much the same results. Size and dividends are positively related to hedging levels with coefficients of 0.0424 and 0.1565 and p-values of 0.001 and 0.001. Debt ratio has a coefficient of -0.3443 and a p-value of 0.001. In addition to these variables, Tobin's Q shows a positive relation to hedging levels. The coefficient is 0.1272 and the p-value is 0.001.

6.4 How does jet fuel hedging add value?

We have found that jet fuel hedging correlates positively with firm value. This leads to the next important question: Why?

6.4.1 Reduction of the underinvestment problem?

The variables explaining why European airlines hedge are size[80] (+), dividends (-), debt ratio (-) and investment levels (+). We believe that one or more of these variables therefore can give insights about why hedging adds value.

Size and value were negatively related in our first regression (hedging vs. value) while it was positively related in the second (determinants of hedging), so we exclude this variable immediately.

Dividends, debt ratio and investment levels are interrelated in business. If you pay dividends you are not likely to be capital constrained, and there may not be a need for rapidly payment of debt. In addition, economic theory says that if the company has positive net present value

[80] (+) refers to positive significant relation and (-) refers to negative significant relation.

investment opportunities, income should be reinvested in the business instead of being paid out as dividends. Dividend payments may therefore be evidence of few investment opportunities. If you invest you can do this either by internal finances[81] or borrow money. Big established companies tend to have more (positive) stable cash flows, but also a lower market to book value because of fewer growth opportunities. Since they are bigger and more stable, this may increase their ability to carry debt and may be a reason why debt ratio is negatively related to Tobin's Q[82].

Since investment levels shows statistical significance as an explanatory variable in both the value regression and the determinants regression, we suspect that airlines hedge because they want to decrease the underinvestment problem (decrease the costs of financial distress). Another reason why we believe this is because Tobin's Q is positively related to hedging levels.

Froot et. Al (1993) developed a theoretical framework for hedging and value. Based on this framework, Carter et. al (2006) showed that for American airlines, the hedging premium was related to the underinvestment problem. We follow the footsteps of Carter et. al, we try to see whether this is the answer to the European market as well.

The framework applied in the airline industry implies that the higher the correlation between jet fuel costs and investment combined with a negative relation between jet fuel costs and cash flow, the greater the benefit of hedging.

We have already shown that there is a negative relation between jet fuel costs and cash flow in chapter 3. Unfortunately, we are not able to find a positive relation between jet fuel costs and investment levels. We can therefore not use this framework to conclude.

Our hypothesis that the value added derives from alleviation of the underinvestment problem is inconclusive, but there are several intuitive arguments that the added value from hedging is related to the underinvestment problem.

When airline purchases aircraft, this process takes several years and aircraft is typically very expensive. If the payment is settled years from now, it is important to have the cash at the settlement date. Hedging reduces this uncertainty. To illustrate this point consider the

[81] Internal finances is money retained equity from income. Income can either be distributed to shareowner as dividend or retained in the business to finance investments.
[82] Brealey, R.A and Myers, S.C (2007): *Corporate Finance, 8th* edition. McGraw Hill

following: An airline company decides to buy aircraft with delivery four years from now. If the company does not hedge fuel costs, and jet fuel prices boost, the company may not have the cash for the aircraft. If investors believe investments in new aircraft are positive net present value projects at the settlement date, the company suffers from underinvestment because they cannot afford the aircraft. If the company had hedged the price of fuel, they may have had sufficient funds. The company therefore would have been better off if they have hedged, and investors would value hedges in place at the ordering date.

When airlines face financial trouble, many companies are forced to sell assets (aircraft) below market prices. This is direct costs of financial distress. If the company had hedged, this may have been avoided. Moreover, these aircraft is being bought by other companies. If these companies have hedged, they are able to do even larger investments at below market prices. So there are two arguments for valuing hedges in light of costs of financial distress.

CHAPTER 7: CONCLUSIONS & REMARKS

In this thesis we have examined the jet fuel hedging behavior in the European airline industry as well compared this industry to the US industry. More specific, we have tried to see whether jet fuel hedging leads to a higher firm value and why airlines chooses to hedge. The period ranges from 2001 to 2008. The availability and collection of information is limited and time-consuming, resulting in few possible ways to measure impacts of hedging. The sample ended up consisting of 14 European airlines and 15 American.

Our results show that, for European airlines hedging is positively related to Tobin's Q with a coefficient of 0.4446 and a p-value of 0.027. The coefficient can be seen as a 44.46% premium of an airline hedging 100% of its fuel requirements. Since the average percentage hedged over the period is 47%, the average premium for the sample firms is 20.6%. This is higher than the premium of 10% found by Carter et. al.(2006). However, the standard error of the coefficient is large, so we believe it is difficult to put an absolute number on the premium.

For the American companies the results were similar. In addition to the hedging % as an independent variable, we included a hedging dummy variable (1 if % hedged is larger than zero, 0 if zero) in a second, separate model. The coefficient of this dummy can be considered as a hedging premium of the company stock. The coefficient of percentage hedged is 0.4127 with a p-value of 0.0720 in model 1. This leads to a hedging premium of 7.9%. In model 2, where we included the hedging dummy, the coefficient was 0.2994 with a p-value of 0.004. This translates to a premium of 29.94%. Since the difference between 7.9% and 29.94% is huge, we believe that it is also here dangerous to put an absolute number of the value of hedges.

Our best guess is that the hedging premium is related to the underinvestment problem, since the intuition behind the argument is logically sound.

If hedging adds value because of uncertainty, we expect it to be valued even more when this uncertainty increases. We therefore split the regression analysis into two, one for the period 2001-2006 and the other from 2007-2008. While the first period showed similar results as the entire period, the last period did surprisingly not show the same.

However, a criticism to these results is few observations which weaken the conclusion.

We also tried to search for the determinants of jet fuel hedging decisions, i.e. what can explain the level of hedging. For European companies, we found four explanatory variables. First, size explains hedging behavior. With a coefficient of 0.1341 and a p-value of 0.000 we conclude that bigger firms hedge more than smaller firms.

Second, firms that pay dividends hedge more than firms that does not. This is somewhat surprising, since we may expect capital constrained firms (typically firms that does not pay dividends) to hedge their margins. The coefficient for the hedging dummy is 0.1223 and the p-value is 0.059.

Third, the debt ratio is negatively related to hedging levels. This is may also be surprising, since leveraged firms may be more risky and hence be more interested in hedging this risk. The coefficient is -0.9411 and the p-value is 0.

The last statistically significant variable is CAPEX/sales. With a coefficient of 0.6147 and a p-value of 0.069, we see that firms that invest much tend to hedge more. This may be because they want to hedge future investment opportunities.

What we found surprising, were that jet fuel's share of operating expenses did not show any significance at all as an explanatory variable. If jet fuel constitutes a large portion of expenses, and jet fuel prices are volatile, intuition says that the company would hedge.

For the US sample, size and dividend dummy can explain hedging behavior, just like the European ones. The coefficients were 0.0243 and 0.1593 and the p-values 0.049 and 0.005 respectively. In additions to these foreign currency and cash/sales shows statistically significant. Firms that hedge foreign currency, tends to hedge less jet fuel. The coefficient is -0.1022 and the p-value is 0.060. The cash/sales variable has a coefficient of 0.4134 and a p-value of 0.046.

The combined sample yields much the same results. Size and dividends are positively related to hedging levels with coefficients of 0.0424 and 0.1565 and p-values of 0.001 and 0.001. Debt ratio has a coefficient of -0.3443 and a p-value of 0.001. In addition to these variables, Tobin's Q shows a positive relation to hedging levels. The coefficient is 0.1272 and the p-value is 0.001.

REFERENCES

Articles and books

Allaynnis, G. and Weston, J. (2001): The Use of Foreign Currency Derivatives and Firm Market Value, *Review of Financial Studies* 14, pp. 243-276

Allen, F and Santomero A.M (1995): What do Financial Intermediaries Do*?, Business Week*, June 12 1995, p. 70

Andrade, G and Kaplan (1998): How Costly is Financial (not Economic) Distress? Evidence from Highly Leveraged Transactions that Became Distressed, Journal of Finance 53 pp. 1443-1494

Aretz,K ., Bartram,S.M. , Dufey,G. (2007): Why hedge? Rationales for corporate hedging and value implications, *The Journal of Risk Finance*

Bartram, S.M (2000), Corporate risk management as a lever for shareholder value creation, *Financial-markets, institutions and instruments* 9 (5), pp. 279-324

Bessembinder, H. (1991): Forward Contracts and Firm Value: Investment Incentive and Contracting Effects, *The Journal of Financial and Quantitative Analysis* 26 (4) pp. 519-532

Bodnar, G.M., Tang, C. and Weintrop, J. (1997): Both Sides of Corporate Diversification: The Value Impacts of Geographic and industrial diversification, *NBER Working Paper Series*, NBER, Cambridge, MA

Bodnar, G. and Gebhardt, G. (1999): Derivatives usage in risk management by US and German Non-Financial Firms: A Comparative Survey, Journal of Financial Management and Accounting 10 (3), pp. 153-187

Bodnar, G, De Jong, A and Macrae, V. (2003): The Impact Of Institutional Differences on Derivatices Usage: A comparative study of US and Dutch Firms, European Financial Management 9, pp. 271-297

Borokhovich, K., Brunarski, K., Crutchley, C. and Simkins, B. (2004): Board Composition and Corporate Use of Interest Rate Derivatives, The Journal of Financial Research 27 (2), pp. 199-216

Brealey, R.A and Myers, S.C (2007): *Corporate Finance, 8th* edition. McGraw Hill

Breeden, D. and Viswanathan, S. (1996): Why do Firms Hedge? An Asymmetric Information Model, Duke University Working Paper

Campbell, T.S. and Kracaw, W.A. (1987): Optimal Managerial Contracts and the Value of Coporate Insurance, Journal of Quantitative Analysis 22 (3), pp. 315-28

Carter, D., Rogers, D.A. and Simkins, B.J. (2006): Does Hedging Affect Firm Value? Evidence from the US Airline Industry, *Financial Management* 35 (1)

Chung, K.H and Pruitt, S.W (1994): A Simple Approximation of Tobin's Q, *Financial Management* 23, pp. 70-74

Dionne, G. and Triki, T. (2004): On Risk Management Determinants: What Really Matters?, *Working Paper* 04-04, Canada Research Chair in Risk Management and HEC Montreal

Dobson, J. and L. Soenen (1993): Three Agency-Cost Reasons for Hedging Foreign Exchange Risk, *Managerial Finance* 19 (6) pp 35-44

Dolde, W (1995): Hedging, Leverage, and Primitive Risk, Journal of Financial Engineering 4 (2) pp 187-216

Froot, K.A., Scharfstein, D.S. and Stein, J.C (1993): Risk Management: Coordinating Corporate Investment and Financing Policies, Journal of Finance 48 (5), pp. 1629-1658

Gay, G.D and Nam, J. (1998): The Underinvestment Problem and Corporate Derivatives Use, Financial Management 27 (4), pp 53-69

Gould, J. and Szimayer, A (2008): The Joint Hedging and Leverage Decision, *Working Paper Series*

Graham, J.R. and Smith, C.W jr (1999): Tax incentives to hedge with derivatives, *Journal of Finance* 54 (6), pp. 2241-2263

Haushalter, G.D (2002): Fiancing Policy, Basis Risk, and Corporate Hedging: Evidence from Oil and Gas Producers, *The Journal of Finance* 55 (1), pp. 107-152

Lel, U (2004): Currency Risk Management, Corporate Governance, and Financial Market Development, *Working Paper*, University of Indiana

Lintner, J. (1965): Security prices, risk and maximal gains from diversification, *Journal of Finance* 20 (4), pp 587-615

May, O.D. (1995): Do Managerial Motives Influence Firm Risk Reduction Strategies?, *The Journal ofFinance* 50(4), pp. 1291-1308

Mayers, D. and Smith, C.W jr (1982): On the Corporate Demand for Insurance, *The Journal of Business* 55 (2), pp. 281-296

Merton, R.C (1974): On the Pricing of Corporate Debt: The Risk Structure of interest rates, Journal of Finance 29, pp 449-470

Mian, S. (1996): Evidence on Corporate Hedging Policy, *Journal of Financial and Quantitative Analysis* 31 (3), pp. 419-439

Miller, M. and Modigliani, F. (1958). "The Cost of Capital, Corporation Finance and the Theory of Investment". *American Economic Review* 48 (3): 261–297

Mossin, J (1966): Equilibrium in a Capital Asset Market, *Econometrica* 34 (4), pp. 768-783

Myers, S.C (1977): Determinants of corporate borrowing, *Journal of Financial Economics* 5, pp. 147-75

Nance, D., Smith, C. Jr and Smithson, C. (1993): On The Determinants Of Corporate Hedging, The Journal of Finance 48 (1), pp. 267-284

Petersen, M and Thiagarajan, R. (2000): Empirical Measurement and Hedging: With and Without Derivatives, *Financial Management* 29(4), pp. 5-30

Santomero, A.M. (1995), Financial Risk Management: The Whys and Hows, *Financial Markets, Institutions and Instruments* 4 (5), pp. 1-14

Sharpe, W.F (1964): Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *Journal of Finance* 19 (3), pp 425 – 265

Smith, C.W. Jr and Stulz, R.M. (1985), "The determinants of firms' hedging policies", *Journal of Financial and Quantitative Analysis*, Vol. 20 No. 4, pp. 391-405

Smith, C.W. (1995): Corporate Risk Management: theory and practice, Journal of Derivatives 2 (4), pp 21-30

Tobin, J (1969): A General Equilibrium Approach to Monetary Theory, *Journal of Money Credit and Banking* 1 (1) pp. 15-29

Tufano, P. (1996), Who Manages Risk? An Empirical Examination of Risk Management Practices in the Gold Mining Industry, *Journal of Finance* 51(4), pp. 1097-1137

Tufano, P (1998): The Determinants of Stock Price Exposue: Financial Engineering and the Gold Mining Industry, *The Journal of Finance* 53 (3), pp. 1015-1052

Weiss, L.A. (1990) : Bankruptcy Resolution: Direct Costs and Violation of Priority of Claims, *Journal of Financial Economics* 27, pp. 285-314

Whidbee, D. and Wohar, M (1999): Derivatives Activities and Managerial Incentives in the Banking Industry, Journal of Corporate Finance 5 (3), pp. 251 – 276

Company websites

European airlines

Aer Lingus: www.aerlingus.com

Air Berlin: www.airberlin.com

Air France-KLM: www.af-klm.com

Austrian Airlines : www.aua.com

British Airways: www.ba.com

El Al Israel Airways: www.elal.co.il

easyJet: www.easyjet.com

Finnair: www.finnair.com

Iberia: www.iberia.com

Lufthansa: www.lufthansa.com

Norwegian Air Shuttle: www.norwegian.no

Ryanair: www.ryanair.com

SAS: www.sas.no

Swiss International Air Lines: www.swiss.com

US airlines

AirTran Airways: www.airtran.com

American Airlines: www.aa.com

Continental Arlines: www.continental.com

Delta Air Lines: www.delta.com

ExpressJet Airlines: www.expressjet.com

Frontier Airlines: www.frontierairlines.com

Great Lakes Airlines: www.greatlakesav.com

Hawaiian Airlines: www.hawaiianair.com

JetBlue Airways: www.jetblue.com

Mesa Air Group: www.mesa-air.com

Midwest Airlines: www.midwestairlines.com

SkyWest Airlines: www.skywest.com

Southwest Airlines: www.southwest.com

US Airways: www.usairways.com

United Airlines: www.united.com

Other websites

Air Transportation Association: www.airlines.org

COMPUSTAT database (requires subscription):
http://wrds.wharton.upenn.edu/ds/comp/gfunda/ (Data collected during march and april 2009)

Energy Information Administration: www.eia.doe.gov (Data collected February 23rd 2009)

The Independent: http://www.independent.co.uk/news/business/news/goldman-predicts-crude-prices-will-superspike-to-200-per-barrel-822235.html (May 24th 2009)

Konkurransetilsynet: http://www.konkurransetilsynet.no/no/Vedtak-og-uttalelser/Vedtak-og-avgjorelser/inngrep-mot-SAS-Wideroes-og-Braathens-bonusprogrammer/ (June 11th 2009)

US Department of State: http://www.state.gov/e/eeb/tra/ata/index.htm (May 25th 2009)

Yahoo! Finance: www.finance.yahoo.com (Data collected during march 2009)

APPENDIX

Table 1: Available seat-kilometers for European airlines.

Data is collected from each airline's annual reports.

Available Seat Kilometres (millions)									
	Total ASK	Year by year							
	2006 - 2008	2001	2002	2003	2004	2005	2006	2007	2008
Air-France KLM	736,049					220,897	234,669	245,066	256,314
Lufthansa	511,259	126,400	119,877	124,026	140,647	144,182	146,720	169,108	195,431
British Airways	442,060	123,197	151,046	139,172	141,273	144,189	144,194	148,321	149,545
Iberia	198,767	58,467	55,405	56,145	61,058	63,628	65,796	66,454	66,517
Ryanair	157,106	7,142	9,784	14,069	22,520	28,640	39,099	51,488	66,519
SAS	153,752	38,120	54,235	54,800	60,173	62,445	63,555	44,433	45,764
Air Berlin	147,260					29,620	31,400	59,380	56,480
Easyjet	136,276	7,003	10,769	21,024	25,448	32,141	37,088	43,501	55,687
Austrian	83,074	20,518	19,561	24,800	29,218	30,887	31,374	26,600	25,100
Finnair	79,825	18,489	17,785	18,644	21,907	23,038	23,846	26,878	29,101
El Al Airways	59,930				18,665	20,325	19,752	20,104	20,074
Aer Lingus	59,259				13,786	15,440	17,226	19,633	22,400
Norwegian	24,505		248	1,149	2,301	3,464	5,371	7,560	11,574
Swiss	0	6,252	31,520	33,478	27,483				

Table 2: American sample firms.

Data is collected from each airline's annual reports and websites.

Sample firms characteristics (US airlines)								
	Classification	Founded	Alliance	Destinations	ASM 2008 (mill.)	Sample ASM market share	Frequent flyer program	Headquarter
Airtran Airways	LCC	1992	None	62	23,809	2.4 %	A+ Rewards	Orlando, Florida
American Airlines (AMR Corp)	Trad	1930	Oneworld	161	163,532	16.6 %	Aadvantage	Fort Worth, Texas
Continental Airlines	Trad	1934	SkyTeam	292	115,511	11.7 %	OnePass	Houston, Texas
Delta Air Lines	Trad	1924	SkyTeam	375	246,164	24.9 %	SkyMiles	Atlanta, Georgia
ExpressJet Airlines	Trad	1986	None	151	12,606	1.3 %	OnePass	Houston, Texas
Frontier Airlines	LCC	1994	None	59	N/A	N/A	EarlyReturns	Denver, Colorado
Great Lakes Airlines	Trad	1977	None	64	361	0.0 %	None	Cheyenne, Wyoming
Hawaiian Airlines	Trad	1929	None	19	9,479	1.0 %	HawaiianMiles	Honolulu, Hawaii
Jet Blue Airways	LCC	1999	None	58	32,442	3.3 %	TrueBlue	Forest Hills, NYC
Mesa Air Group	Trad	1980	None	165	8,028	0.8 %	None	Phoenix, Arizona
Midwest Airlines	Trad	1948	None	12	N/A	N/A	Midwest Miles	Milwaukee, Wisconsin
Skywest Airlines	Trad	1972	None	160	22,020	2.2 %	Midwest Miles	St. George, Utah
Southwest Airlines	LCC	1971	None	65	103,271	10.5 %	Rapid Rewards	Dallas, Texas
United Airlines	Trad	1927	Star Alliance	210	152025	15.4 %	Mileage Plus	Chicago, Illinois
US Airways	Trad	1939	Star Alliance	231	74,151	7.5 %	Dividend Miles	Tempe, Arizona

Source: Company websites and annual reports

Table 3: Jet fuel costs' share of operating expenses for European airlines.

Data is collected from each airline's annual reports.

Jet fuel costs as % of operating expenses									
	Average	Year by year							
	2006-2008	2001	2002	2003	2004	2005	2006	2007	2008
El Al Airways	37.5 %				26.0 %	31.0 %	33.0 %	36.0 %	43.4 %
Ryanair	36.7 %	17.0 %	22.5 %	22.3 %	20.8 %	26.3 %	34.5 %	39.3 %	36.4 %
Norwegian	32.3 %		10.3 %	16.2 %	20.8 %	25.5 %	29.7 %	31.2 %	35.9 %
Easyjet	28.8 %	17.1 %	13.2 %	16.1 %	16.3 %	23.0 %	26.0 %	26.7 %	33.7 %
Air Berlin	25.9 %					19.5 %	22.4 %	25.9 %	29.5 %
Iberia	24.9 %	13.7 %	12.4 %	12.5 %	14.0 %	18.0 %	22.5 %	22.1 %	30.1 %
British Airways	23.8 %	12.4 %	12.2 %	11.4 %	12.9 %	15.6 %	20.9 %	24.3 %	26.1 %
Aer Lingus	23.2 %					15.1 %	19.2 %	21.2 %	29.2 %
Finnair	21.4 %	11.6 %	10.1 %	9.7 %	12.0 %	16.8 %	20.1 %	20.0 %	24.2 %
Austrian	19.1 %	11.3 %	9.2 %	9.8 %	13.6 %	17.5 %	19.3 %	17.5 %	20.4 %
Air-France KLM	19.0 %						17.5 %	19.5 %	20.1 %
Lufthansa	18.1 %	8.8 %	7.7 %	7.6 %	10.2 %	14.2 %	16.2 %	17.1 %	21.0 %
SAS	17.8 %	10.0 %	8.5 %	8.3 %	11.2 %	14.0 %	18.0 %	17.0 %	18.5 %
Swiss	N/A		11.6 %	14.6 %	15.0 %				

Graph 1: Illustration of jet fuel costs' share of operating expenses for European airlines in the years 2001-2008

Illustration of the numbers in table 3

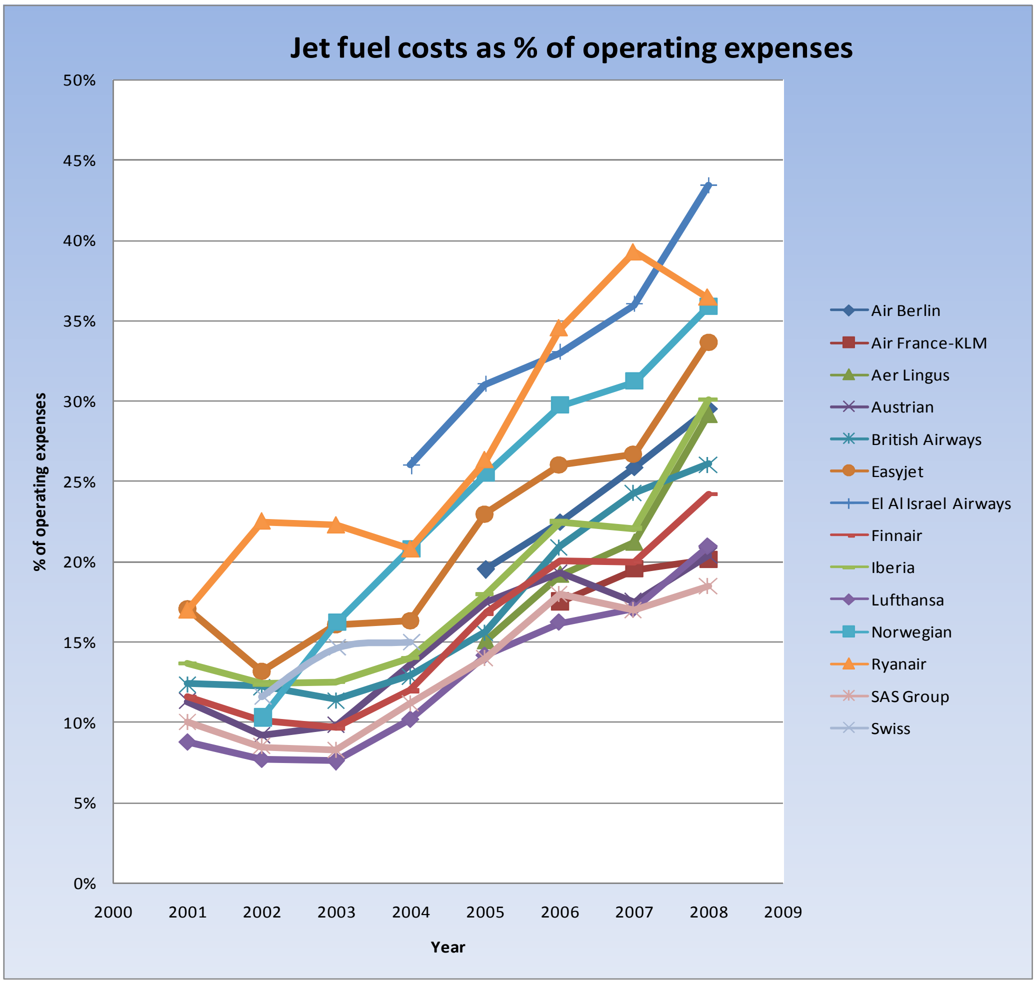
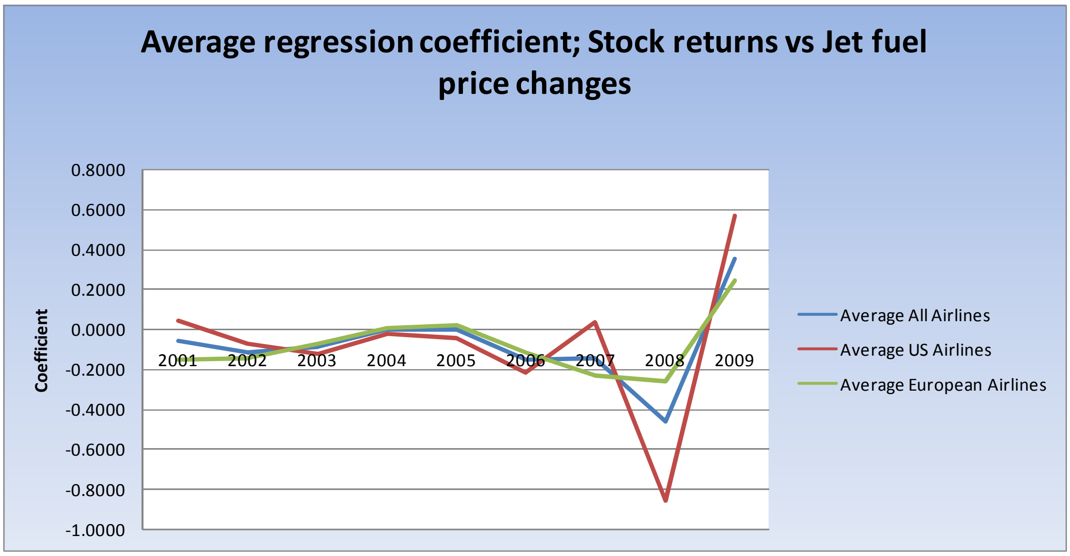


Table 4: Regression summary of European and US airlines' stock price sensitivity to fuel price changes and stock market (index) returns.

Stock and market data is collected from Yahoo! Finance while jet fuel prices are collected from Energy Information Administration.

Regression results: Stock Price vs. Jet fuel and market																				
	2001 - 2009		2001		2002		2003		2004		2005		2006		2007		2008		2009	
	Coef	P	Coef	P	Coef	P	Coef	P	Coef	P	Coef	P	Coef	P	Coef	P	Coef	P	Coef	P
Average jet fuel coef All	-0.1532	0.269	-0.0548	0.427	-0.1146	0.521	-0.0868	0.458	0.0024	0.614	0.0008	0.570	-0.1470	0.292	-0.1434	0.366	-0.4586	0.279	0.3534	0.469
Average jet fuel coef US	-0.2156	0.182	0.0421	0.494	-0.0751	0.751	-0.1255	0.519	-0.0223	0.690	-0.0478	0.632	-0.2204	0.293	0.0314	0.418	-0.8594	0.066	0.5665	0.268
Average Jet fuel coef EUR	-0.1220	0.313	-0.1517	0.360	-0.1443	0.348	-0.0697	0.431	0.0123	0.584	0.0203	0.544	-0.1164	0.292	-0.2308	0.339	-0.2581	0.385	0.2468	0.569
Median Jet fuel coef All	-0.1324	0.175	-0.0847	0.334	-0.1255	0.525	-0.0807	0.378	-0.0089	0.602	-0.0122	0.583	-0.1927	0.274	-0.1683	0.316	-0.3544	0.171	0.3284	0.417
Median Jet fuel coef US	-0.1335	0.096	0.0301	0.397	-0.0663	0.791	-0.0722	0.502	-0.0326	0.689	-0.0474	0.718	-0.2990	0.223	-0.0507	0.373	-1.0291	0.006	0.5497	0.201
Median Jet fuel coef EUR	-0.1270	0.247	-0.1219	0.270	-0.1494	0.370	-0.0866	0.378	0.0293	0.584	-0.0017	0.532	-0.1673	0.303	-0.2089	0.316	-0.2448	0.288	0.1130	0.661
Jet fuel coef Low All	-0.4686	0.001	-0.2658	0.137	-0.3323	0.128	-0.3036	0.011	-0.2435	0.178	-0.1076	0.034	-0.3678	0.011	-0.6650	0.000	-1.6416	0.001	-0.4313	0.072
Jet fuel coef Low US	-0.4686	0.034	-0.1022	0.246	-0.1255	0.662	-0.3036	0.148	-0.0621	0.570	-0.0795	0.223	-0.3678	0.156	-0.3491	0.085	-1.6416	0.001	0.0910	0.072
Jet fuel coef Low EUR	-0.4002	0.001	-0.2658	0.137	-0.3323	0.128	-0.2988	0.011	-0.2435	0.178	-0.1076	0.034	-0.3604	0.011	-0.6650	0.000	-0.6711	0.002	-0.4313	0.129
Jet fuel coef high All	-0.0052	0.899	0.1984	0.838	0.0539	0.799	0.2033	0.988	0.1191	0.962	0.1857	0.998	0.3182	0.846	0.5195	0.971	0.1826	0.959	1.3421	0.980
Jet fuel coef high US	-0.0147	0.623	0.1984	0.838	-0.0336	0.799	-0.0541	0.924	0.0380	0.812	-0.0169	0.870	0.0837	0.475	0.5195	0.971	0.1826	0.215	1.0739	0.646
Jet fuel coef high EUR	-0.0052	0.899	-0.0673	0.674	0.0539	0.525	0.2033	0.988	0.1191	0.962	0.1857	0.998	0.3182	0.846	-0.0161	0.941	0.0399	0.959	1.3421	0.980
Average Index coef All	1.2536	0.003	1.5255	0.013	1.0887	0.022	2.1526	0.001	1.6735	0.032	1.0488	0.083	1.0742	0.092	1.1655	0.019	1.2045	0.011	1.1170	0.177
Average Index coef US	1.9208	0.000	2.2256	0.000	1.4810	0.001	3.3567	0.002	2.8037	0.000	1.4940	0.014	1.7455	0.068	1.4427	0.004	1.9785	0.000	2.3086	0.018
Average Index coef EUR	0.9200	0.005	0.8254	0.026	0.7945	0.038	1.6175	0.001	1.2215	0.045	0.8707	0.111	0.7945	0.102	1.0269	0.026	0.8175	0.016	0.5212	0.256
Median Index coef All	1.1197	0.000	1.4087	0.000	0.9346	0.000	1.6545	0.000	1.4033	0.001	1.0381	0.003	0.7172	0.004	1.2047	0.001	0.9067	0.000	1.0285	0.097
Median Index coef US	2.1534	0.000	2.2473	0.000	1.4970	0.000	2.8336	0.000	2.7369	0.000	1.7120	0.014	2.0624	0.004	1.4519	0.002	2.0780	0.000	2.5368	0.014
Median Index coef EUR	0.9843	0.000	0.4938	0.027	0.7181	0.019	1.6545	0.000	1.3587	0.014	0.9334	0.002	0.6694	0.004	1.1277	0.001	0.6860	0.001	0.8282	0.194
Index coef low All	0.3257	0.000	0.3698	0.000	0.1589	0.000	0.7050	0.000	0.3788	0.000	-0.3774	0.000	-0.1280	0.000	0.2989	0.000	0.3656	0.000	-1.3617	0.001
Index coef low US	0.9275	0.000	1.2047	0.000	0.9346	0.000	1.1597	0.000	1.5316	0.000	0.5918	0.004	0.6898	0.001	0.7534	0.000	0.8515	0.000	1.0742	0.001
Index coef low EUR	0.3257	0.000	0.3698	0.000	0.1589	0.000	0.7050	0.000	0.3788	0.000	-0.3774	0.000	-0.1280	0.000	0.2989	0.000	0.3656	0.000	-1.3617	0.016
Index coef high All	2.5937	0.058	3.2247	0.052	2.0114	0.114	6.6000	0.009	4.2093	0.213	1.9601	0.619	2.4996	0.932	2.2161	0.226	2.9604	0.115	3.1050	0.806
Index coef high US	2.5937	0.000	3.2247	0.000	2.0114	0.004	6.6000	0.009	4.2093	0.000	1.9601	0.025	2.4996	0.328	2.2161	0.014	2.9604	0.000	3.1050	0.039
Index coef high EUR	1.3725	0.058	1.6127	0.052	1.5831	0.114	2.6724	0.004	1.6474	0.213	1.7682	0.619	1.9906	0.932	1.6315	0.226	1.6419	0.115	1.2861	0.806

Graph 2: Illustration of the average sensitivity of airline stock returns to jet fuel price changes.



Graph 3: Illustration of the median sensitivity of airline stock returns to jet fuel price changes.

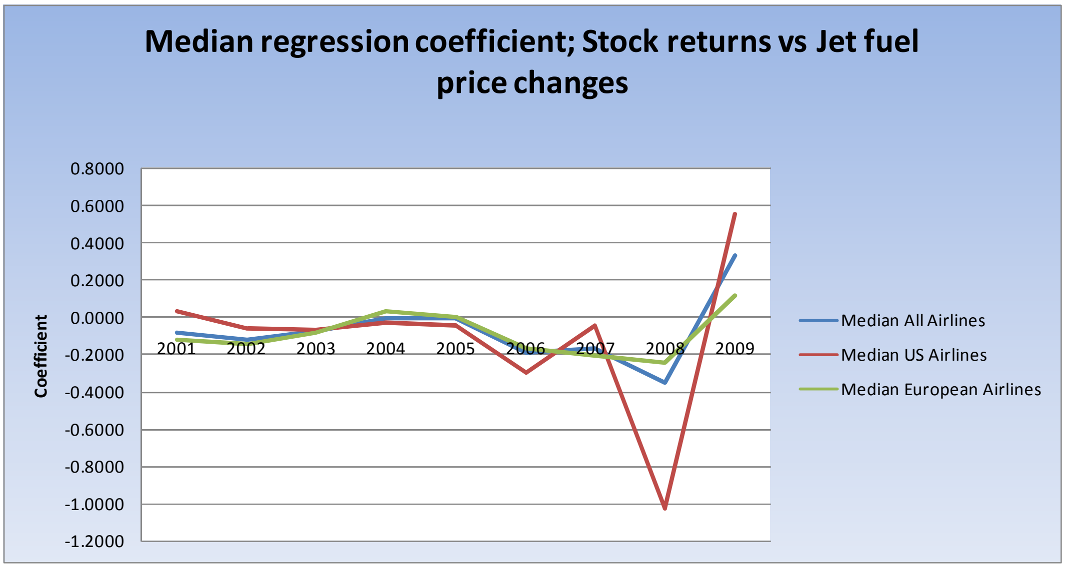


Table 5: Correlations between the changes in prices of oil and oil refined products from 1986-2009.

Data is collected from Energy Information Administration.

Correlations							
	Cushing, OK WTI Spot	Europe Brent Spot	New York Harbor No. 2 Heating Oil	U.S. Gulf Coast No. 2 Heating Oil	New York Harbor Kerosene-Type Jet Fuel	U.S. Gulf Coast Kerosene-Type Jet Fuel	Amsterdam-Rotterdam-Antwerp (ARA) Kerosene-Type Jet Fuel
Amsterdam-Rotterdam-Antwerp (ARA) Kerosene-Type Jet Fuel	0.6935	0.7404	0.7408	0.7944	0.7575	0.7566	1
U.S. Gulf Coast Kerosene-Type Jet Fuel	0.6887	0.7128	0.8215	0.9285	0.8802	1	
New York Harbor Kerosene-Type Jet Fuel	0.6717	0.6975	0.9121	0.8808	1		
U.S. Gulf Coast No. 2 Heating Oil	0.7423	0.7652	0.8965	1			
New York Harbor No. 2 Heating Oil	0.6865	0.7115	1				
Europe Brent Spot	0.8262	1					
Cushing, OK WTI Spot	1						

Table 6: Summary of hedging behavior for European airlines in the period 2001-2008 at fical year end.

A indicator is set to 1 if the companies have used certain types of instruments. The lists shows average values. The maximum maturity of any hedges is also included and the table shows each company's average.

Hedging behaviour by airline								
	Years Observed	Average % of next year's fuel hedged	Use of swaps/ forwards	Use of options/ collars	Maturity of hedge	Use of IR derivatives	Use of FX derivatives	Missing observations
Aer Lingus	2001-2008	56%	1.00	1.00	1.33	1.00	1.00	None
Air Berlin	2006-2008	55%	1.00	1.00	1.67	1.00	1.00	2001-2006
Air France-KLM	2006-2008	78%	1.00	1.00	4.00	1.00	1.00	2001-2007
Austrian	2003-2008	13%	0.50	0.33	0.67	1.00	1.00	2001-2002
British Airways	2002-2008	37%	1.00	1.00	1.50	1.00	1.00	2001
easyJet	2001-2008	45%	0.88	0.75	1.88	0.38	0.88	None
El Al	2004-2008	46%	1.00	1.00	2.00	1.00	1.00	2001-2003
Finnair	2001-2008	51%	1.00	1.00	2.13	1.00	1.00	None
Iberia	2002-2008	52%	0.71	0.86	1.00	1.00	1.00	2001.00
Lufthansa	2001-2008	70%	1.00	1.00	2.00	1.00	1.00	None
Norwegian	2003-2008	5%	0.50	0.00	0.50	0.17	1.00	2001-2002
Ryanair	2001-2008	50%	0.83	0.00	1.17	1.00	1.00	None
SAS	2001-2009	43%	0.63	1.00	1.00	1.00	1.00	None
Swiss	2002-2005	50%	1.00	1.00	2.50	0.50	1.00	2001, 2006-2008

Table 7: Regression summary: Jet fuel hedging and firm value.

Dependent variable is Tobin's Q. In model 1 the percentage of next year's fuel requirements hedged is included, while a dummy variable indicating fuel hedging is used in model 2. The dummy equals 1 if the company has hedged more than 0 %, 0 otherwise.

Regression summary: Jet fuel hedging and firm value						
	Europe		US		All	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Constant	**2.5108**	**2.3900**	**-0.0350**	**-0.0911**	**1.0251**	**0.9737**
	0.0000	0.0000	0.8760	0.6750	0.0000	0.0000
% hedged	**0.4446**		**0.4127**		**1.0251**	
	0.0270 **		0.0720		0.0500 **	
Hedging dummy		**-0.0182**		**0.2994**		**0.0783**
		0.8980		0.0040 ***		0.3320
ln (total assets)	**-0.2355**	**-0.1785**	**-0.0346**	**-0.0443**	**-0.1305**	**0.0783**
	0.0000 ***	0.0000 ***	0.1950	0.0920	0.0000 ***	0.0000 ***
Dividend dummy	**-0.2420**	**-0.1985**	**-0.0279**	**0.0865**	**0.1312**	**0.1799**
	0.0160 **	0.0500 **	0.8090	0.4350	0.1520	0.0480 **
Debt/Assets	**0.1292**	**-0.3523**	**1.1912**	**1.2187**	**1.0285**	**0.9660**
	0.7580	0.3810	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
ROA	**2.2006**	**1.9123**	**0.0809**	**0.0867**	**0.1696**	**0.1704**
	0.0280 **	0.0600 *	0.2810	0.2350	0.0580 *	0.0590 *
CAPEX/Sales	**0.1567**	**0.4739**	**0.2725**	**0.2518**	**0.1529**	**0.1592**
	0.7700	0.4080	0.2550	0.2800	0.5510	0.5420
Operating cash flow/sales	**2.2777**	**2.5305**	**-0.2526**	**-0.0806**	**1.1470**	**1.2794**
	0.0000 ***	0.0000 ***	0.6780	0.8920	0.0230 **	0.0120 **
EBIT/Interest expenses	**0.0000**	**0.0002**	**0.0344**	**0.0390**	**0.0020**	**0.0023**
	0.9980	0.9190	0.0000 ***	0.0000 ***	0.2960	0.2340
FX hedging dummy	**-0.2728**	**-0.3519**	**-0.0611**	**0.0081**	**0.1029**	**0.1266**
	0.4230	0.3190	0.5950	0.9440	0.1920	0.1010
Cash / Sales	**0.2678**	**0.2673**	**1.8064**	**1.8111**	**1.0290**	**1.0627**
	0.3650	0.3800	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
ln (value of executive shares)	**0.0171**	**0.0126**	**0.0750**	**0.0584**	**0.0380**	**0.0357**
	0.3480	0.5010	0.0030 ***	0.0230 **	0.0180 **	0.0270 **
Pass through agreement			**0.4576**	**0.5070**		
(US firms only)			0.0000 ***	0.0000 ***		

Table 8: Summary of Tobin's Q for European airlines

Average Tobin's Q for European airlines			
	Years Observed	Average Tobin's Q	Skipped observations
Aer Lingus	2001-2008	0.99	None
Air Berlin	2006-2008	0.65	2001-2006
Air France-KLM	2006-2008	0.54	2001-2007
Austrian	2003-2008	0.41	2001-2002
British Airways	2002-2008	0.62	2001
easyJet	2001-2008	1.23	None
El Al	2004-2008	0.47	2001-2003
Finnair	2001-2008	0.58	None
Iberia	2002-2008	0.73	2001.00
Lufthansa	2001-2008	0.56	None
Norwegian	2003-2008	1.37	2001-2002
Ryanair	2001-2008	2.29	None
SAS	2001-2009	0.52	None
Swiss	2002-2005	0.29	2001, 2006-2008

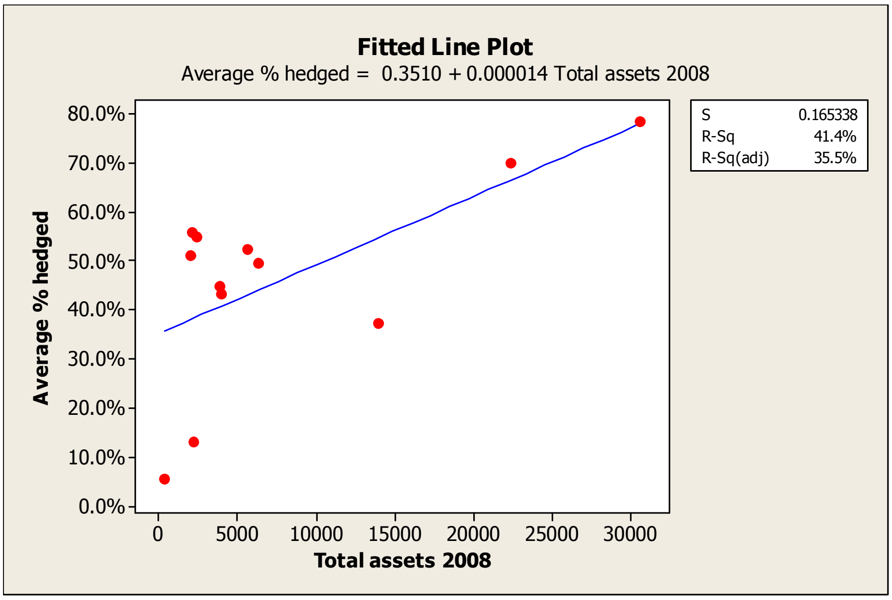
Table 9: Regression summary: Jet fuel hedging and firm value (2001-2006)

Regression summary: Jet fuel hedging and firm value (2001 - 2006)						
	Europe		US		All	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Constant	**3.3468**	**2.9031**	**-0.1547**	**-0.2134**	**1.0013**	**0.9258**
	0.0000 ***	0.0000 ***	0.5950	0.4450	0.0000 ***	0.0000 ***
% hedged of fuel requirements	**0.7801**		**0.4905**		**0.4018**	
	0.0060 ***		0.1210		0.0430 **	
Hedging dummy		**0.1920**		**0.3988**		**0.1380**
		0.2780		0.0050 ***		0.1620
ln (total assets)	**-0.3366**	**-0.2467**	**-0.0204**	**-0.0318**	**-0.1382**	**-0.1296**
	0.0000 ***	0.0000 ***	0.5560	0.3430	0.0000 ***	0.0000 ***
Dividend dummy	**-0.3120**	**-0.2679**	**-0.0713**	**0.0735**	**0.1379**	**0.1996**
	0.0110 **	0.0410 **	0.6660	0.6110	0.2520	0.0930 *
Debt/Assets	**0.9668**	**0.0382**	**1.2190**	**1.2150**	**1.2135**	**1.1512**
	0.0990 *	0.9440	0.0000 ***	0.0000 ***	0.0000 ***	0.0000 ***
ROA	**2.0470**	**1.1800**	**0.0794**	**0.0944**	**0.1621**	**0.1687**
	0.1180	0.4100	0.3620	0.2590	0.1090	0.0990 *
CAPEX/Sales	**0.2725**	**0.5717**	**0.1992**	**0.1730**	**0.0141**	**-0.0024**
	0.6650	0.4090	0.5140	0.5540	0.9640	0.9940
Operating cash flow/sales	**3.0160**	**3.5109**	**0.1015**	**0.1529**	**1.6111**	**1.7874**
	0.0010 ***	0.0010 ***	0.9180	0.8700	0.0270 **	0.0150 **
EBIT/Interest expenses	**0.0009**	**0.0016**	**0.0360**	**0.0436**	**0.0013**	**0.0017**
	0.6830	0.5160	0.0080 ***	0.0010 ***	0.5360	0.0150 **
FX hedging dummy	**-0.5483**	**-0.5724**	**-0.0516**	**0.0798**	**0.1162**	**0.1390**
	0.1250	0.1440	0.7470	0.6230	0.2640	0.1730
Cash/Sales	**-0.3851**	**-0.2931**	**1.7673**	**1.7751**	**0.9004**	**0.9471**
	0.3090	0.4710	0.0010 ***	0.0000 ***	0.0010 ***	0.0010 ***
ln (value of executive shares)	**0.0703**	**0.0525**	**0.0721**	**0.0503**	**0.0449**	**0.0431**
	0.0009 ***	0.0590 *	0.0250 **	0.1130	0.0310 **	0.0390 **
Pass through agreement			**0.4471**	**0.5098**		
(US firms only)			0.0260 **	0.0050 ***		

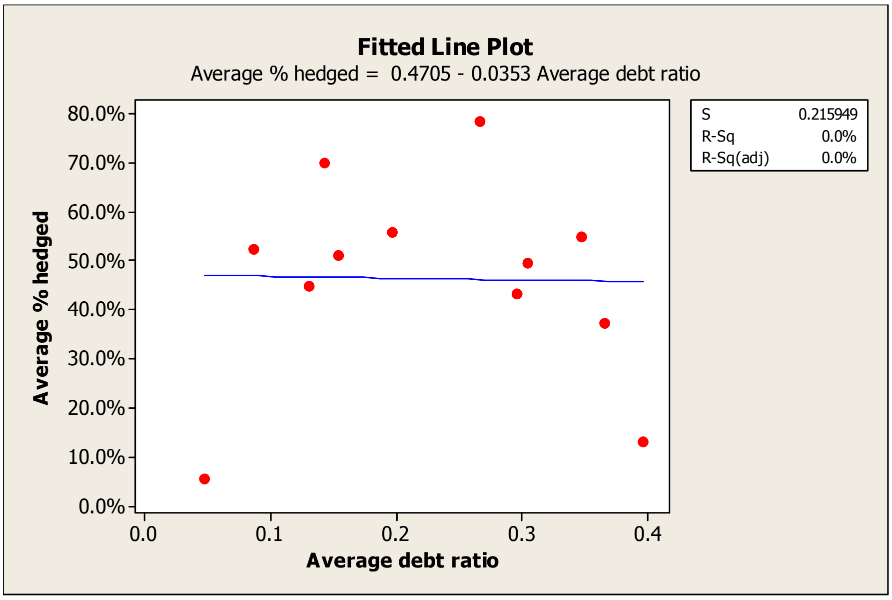
Table 10: Regression summary: Jet fuel hedging and firm value (2007-2008)

Regression summary: Jet fuel hedging and firm value (2007 - 2008)						
	Europe		US		All	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Constant	**1.8748**	**1.7857**	**0.3905**	**0.4245**	**1.2021**	**1.1276**
	0.0030 ***	0.0040 ***	0.0410 **	0.0160 **	0.0000 ***	0.0000 ***
% hedged of fuel requirements	**0.2115**		**0.0563**		**-0.0890**	
	0.4520		0.7590		0.6630	
Hedging dummy		**-0.6067**		**0.1471**		**-0.2345**
		0.2030		0.0880 *		0.0760 *
ln (total assets)	**-0.1854**	**-0.0970**	**-0.0521**	**-0.0678**	**-0.1079**	**-0.0730**
	0.0220 **	0.2790	0.0080 ***	0.0010 ***	0.0020 ***	0.0550 *
Dividend dummy	**-0.1984**	**-0.1877**	**0.2028**	**0.2037**	**0.0706**	**-0.0043**
	0.3360	0.3250	0.0310 **	0.0170 **	0.5210	0.9680
Debt/Assets	**0.5192**	**0.3562**	**1.0133**	**1.0133**	**0.2379**	**0.1125**
	0.4680	0.5960	0.0000 ***	0.0000 ***	0.4580	0.7170
ROA	**4.0430**	**3.3100**	**0.5020**	**0.4016**	**0.5250**	**0.6329**
	0.0230 **	0.0480 **	0.0960 *	0.0870 *	0.3060	0.2010
CAPEX/Sales	**-1.0760**	**-0.1720**	**-0.1702**	**0.0224**	**0.0667**	**0.2441**
	0.3070	0.8870	0.5980	0.9400	0.9080	0.6640
Operating cash flow/sales	**2.0020**	**1.8320**	**-0.4460**	**-0.4784**	**0.0793**	**-0.1003**
	0.0800 *	0.0970 *	0.2140	0.1040	0.8910	0.8560
EBIT/Interest expenses	**0.0070**	**0.0003**	**0.0077**	**0.0190**	**0.0168**	**0.0143**
	0.4380	0.9760	0.5200	0.1340	0.0280 **	0.0540 *
FX hedging dummy			**0.0189**	**0.0419**	**0.1371**	**0.1382**
			0.7310	0.4020	0.1520	0.1120
Cash/Sales	**2.0020**	**0.8745**	**0.9608**	**0.6886**	**1.0181**	**1.0519**
	0.0800 *	0.1810	0.0260 **	0.0820 *	0.0180	0.0110
ln (value of executive shares)	**-0.1480**	**-0.0346**	**0.0536**	**0.0440**	**0.0342**	**0.0362**
	0.6530	0.3280	0.0080 ***	0.0170 **	0.1130	0.0800 *
Pass through agreement			**0.2198**	**0.3029**		
(US firms only)			0.0250 **	0.0040 ***		

Graph 4: Illustration of size vs. hedging level



Graph 5: Illustration of debt ratio vs. hedging level



Graph 6: Illustration of investment level vs. hedging level

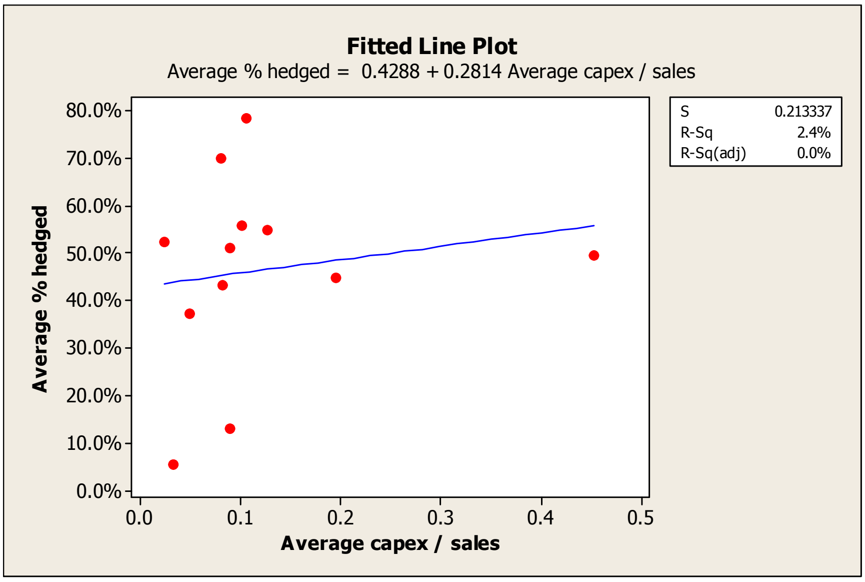


Table 11: Regression summary: Determinants of jet fuel hedging behavior.

The percentage of next year's fuel requirements is used as dependent variable.

Regression summary: Determinants of jet fuel hedging levels						
	Europe		US		All	
Constant	**-0.4658**		**-0.0458**		**-0.0164**	
	0.1850		0.6870		0.8750	
Q	**0.1666**		**0.0923**		**0.1272**	
	0.1666		0.0610		0.0010	***
ln (total assets)	**0.1341**		**0.0243**		**0.0424**	
	0.0000	***	0.0490	**	0.0010	***
Dividend dummy	**0.1223**		**0.1593**		**0.1565**	
	0.0590	*	0.0050	***	0.0010	***
Debt/Assets	**-0.9411**		**-0.1843**		**-0.3443**	
	0.0000	***	0.1410		0.0010	***
ROA	**-0.7587**		**-0.0090**		**-0.0221**	
	0.2510		0.7970		0.5940	
CAPEX/Sales	**0.6147**		**-0.0271**		**0.0907**	
	0.0690	*	0.8100		0.4440	
Operating cash flow/sales	**-0.5475**		**-0.0065**		**0.1546**	
	0.2470		0.9820		0.5130	
EBIT/Interest expenses	**0.0006**		**-0.0009**		**0.1546**	
	0.6170		0.8320		0.5130	
FX hedging dummy	**-0.2323**		**-0.1022**		**0.0242**	
	0.3240		0.0600	*	0.5460	
Cash / Sales	**-0.0619**		**0.4134**		**-0.0070**	
	0.7430		0.0460	**	0.9480	
ln (value of executive shares)	**0.0005**		**0.0189**		**-0.0110**	
	0.9700		0.1180		0.1600	
Fuel % of operating expenses	**-0.1585**		**-0.0711**		**-0.2457**	
	0.6510		0.7160		0.1940	
IR hedging dummy	**0.1209**		**-0.0488**		**0.0197**	
	0.1890		0.1950		0.6040	
Pass through agreement			**-0.2507**		**-0.3027**	
(US firms only)			0.0000		0.0000	

Graph 7: Illustration of investments and jet fuel costs