Hedging and Firm Value in the European Airline Industry

-Does jet fuel price hedging increase firm value?

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Abstract

This thesis studies the relationship between hedging of jet fuel prices and the value of airlines operating in the European airline industry. Hedging theories implies that hedging, including hedging of commodities, should increase firm value, based on exploiting market imperfections. To test if this applies to the European airline industry I gather information regarding hedging and firm value of eight European airlines in the period 2001-2010.

Despite the fact that I find that the European airline industry are characterized by being an investment environment, I do not find evidence that hedging airlines are more valuable, than non-hedging airlines.

Even though I don't discover any direct evidence that hedging creates value, I cannot reject that hedging might create value in the European airline industry. The problem of collecting and quantifying hedging as a variable, where found to be challenging. Combined with the fact, that my sample only consists of 76 firm-year observations, makes it hard to come to steel firm conclusions.

Even though no unilateral conclusion will be presented, the thesis provides the reader with an overview of the theoretical implications for understanding, where the potential hedging premium and value arises from. Furthermore, it introduces the reader to the empirical findings on the topic, and discusses the importance of these. The conclusions made from previous empirical studies on the topic, also presents conflicting results, why further research appear to be sought. Both the theoretical and empirical overview on the topic, makes it fairly easy to imitate or extend this study, in order to make further investigations.

1 Introduction

The purpose of this thesis is to determine whether hedging creates value for airlines operating in the European Airline industry. Previous empirical studies have been inconclusive regarding this specific topic, why further investigation of the area, are apparent to illustrate the problem.
Risk Management, including derivatives hedging, are topics that have received remarkable attention in the last couple of decades. The focus in hedging literature, has shifted from investigating the determinants of hedging, to examining the value creating perspective, as for this thesis.

Following the financial crises, derivatives has received bad public attention, and have been appointed as "*financial weapons of mass destruction"* (Warren Buffett in Berkshire Hathaway annual report, 2002). For firms it is relevant and important to assure their stakeholders, that engaging in derivatives hedging is beneficial and doesn't harm the firm. The study of the relationship between firm value and hedging, are relevant not only to the firms, but also the stakeholders.
By examining the theoretical causal relationships, between hedging and imperfect markets, this thesis provides the basis for the performed quantitative studies of hedging and firm value in the European airline industry.
The quantitative study consists of several different methodologies, in order to be able to make robust conclusions. The quantitative methodologies used are; event study, univariate analysis and regressions, both estimating coefficients by ordinary least squares and feasible generalized least squares. This section is divided into two, separate sections. The first part is an event study of the firm value in the American airline industry. This study is included because the work with this thesis originated from an idea, of working with firm value and hedging using this approach. Since the study turned out to produce results, that where impossible to conduct a further investigation of, I continued working with a different approach and the European airline industry. Despite the fact that I didn't get the results that I hoped to, using the event study approach, I decided to include them in the thesis, in order to shed light on the challenges that I faced. All conclusions, are based on statistical tests, in order to be able to conclude on statistical relevant significance levels.

The thesis provides the reader with the theoretical implications for understanding, where the potential hedging premium and value arises from. Furthermore, it introduces the reader to the empirical findings on the topic, and discusses the importance of these. The quantitative findings are tabulated and manageable presented, to provide an easy overview for the reader.
By conducting this study, I hope to add knowledge, that complements the existing empirical findings of hedging and firm value.

1.1 Thesis structure

The structure of the thesis, will briefly be introduced in this section, to provide an overview of the content and make it easier for the reader to navigate between the different sections.
The motivation for investigating risk management, particularly the relationship between hedging and firm value, will be shortly presented in section 2. This section will also provide a definition of the problem area, in order to be able to formulate a relevant and interesting research question. The location of the problem area and research question, before the theory section and the section of empirical findings, are chosen in order to give the reader the right conditions to be able to know where focus are grounded in rest of the thesis.
Section 3, provides a discussion of the methodology used. The perspective in this section is to argue why and how the different methodologies are chosen, in relation both to theory, empirical findings and the quantitative analysis.
In section 4 the theoretical foundation will be presented. Both a short introduction to hedging and derivatives, followed by a deeper discussion of the theoretical background of the determinants of hedging of both the shareholders and management wealth maximization hypotheses. This section will also consist of a discussion of whether or not there exist a theoretical foundation, for hedging adding value to the firm. Section 4 is important in order to understand the hypotheses presented in section 2.
A discussion of previous empirical findings will be presented in section 5. This section is comprehensive and central, since this thesis is inspired by former findings. The founding's in prior studies are inconclusive regarding the relationship between firm value and hedging, the motivation for conducting similar studies in a thesis set-up are obvious. Both empirical findings on different

determinants of hedging and the value of a firm and hedging will be examined. The different methodologies used in previous studies will also be discussed.

In section 6 the quantitative and statistical analysis will be presented and discussed. The sample selection of both the event study and the study investigating firm value proxied by the approximate Q-value will be presented. First the initial analysis of hedging and firm value, using the event study approach will be outlined.
Subsequently the univariate and multivariate analysis of the determinants of hedging and the relationship between the proxy for firm value in the European airline industry, will be presented and the findings will be discussed. Possible discrepancies with the hypotheses and expectations will also be considered in this section as well.
The concluding remarks, on both theory, empirical findings and the quantitative analysis of the European airline industry will be summarized in section 7.

2 Motivation

The motivation for investigating the area of risk management, derives from several inspirational courses during my studies at CBS. Risk management consists of several sub areas and the topic has been widely examined and discussed throughout at least the last 40 years. The evolution of risk management is a topic in it self to investigate, the history is exiting and the source of my interest.

Risk management is not at all a new area within trading. Even in the ancient Egypt there are stories of how one pharaoh forecasted bad states of harvest, which turned out to be the first documentation of risk management, since the pharaoh bought and stocked large amounts of corn, in order to ensure sufficient crops even when the harvest would have failed. By doing this the pharaoh hedged his risk, since he shifted some stocks of crop from good to bad states of harvest, which can be compared with modern risk management (Froot, Scharfstein and Stein, 1994).
In the Middle Ages the futures market where introduced, so instead of storing crops, the consumers could agree with the farmer, on a predetermined price and delivery date. In this way the farmer would also hedge his risk of price drops, locking in his profit.

To most, it is obvious to see why the individual consumer can benefit from hedging. The benefits from corporations can be harder to interpret.

Corporations are mostly owned by many small investors. The risk is divided amongst every single investor only bearing a small part of the total risk. The investor himself can manage and diversify his own risk and doesn't need the corporation to manage the risk on behalf on him. Up until the 1970's this particular view on risk management and corporations where adapted by many financial specialist and the possible corporate benefits of hedging weren't completely exploited (Froot et al. 1994).

However, in the beginning of the 1970's the early financial risk management products appeared. One of the breakthroughs within the field, where the famous option pricing model from Black and Scholes (1973). This model fostered a lot of discussion and is one of the most important models within the financial field (Dionne, 2013). With the focus on mathematical finance, and the introduction of personal computers, the area of hedging and derivatives underwent an exiting development. Derivatives became the main risk management means for both financial and non-financial corporations.

In the 1980's the focus where primarily of the benefits of hedging due to hedging the possible cost of underinvestment. Froot et al. developed a framework, a so-called risk management paradigm, that relies on three basic premises:

- *The key to creating corporate value is making good investment.*
- *The key to making good investments is generating enough cash internally to fund those investments; (…).*
- *Cash flow (…) can often be disrupted by movements by external factors (…) potentially compromising a company's ability to invest.* (Froot et al., 1994)

The main idea behind, is to ensure stable, low volatile cash flows in order to be able to engage in all possible investment opportunities. By engaging in positive NPV projects, the company creates an environment with growth opportunities for the firm, making it possible for the company to increase both present and future value. There are several other financial frictions to hedge, and these will be discussed in a later section in this thesis.

With the increasing adoption of derivatives within corporations, the use of derivatives of speculation purposes also rose. The 1990's where characterized with numerous bankruptcy scandals due to misuse of derivatives. One of the most well-known scandals is the bankruptcy of Barings Bank in 1995. Nick Leeson, the head trader of the corporation, tried to benefit from unauthorized arbitrage on the Japanese futures market, locking in profit. He didn't succeed in doing so, because of several unfortunate events, and Barings Bank went Bankrupt and where ultimately sold for the amount of only £1 (Dionne, 2013).
Because of increasing misuse of derivatives the derivatives market has become more regulated throughout the more recent years. Especially focus on the financial sector with Basel I-III and the Sarbanes-Oxley act.

The recent financial crisis fostered further focus on the usage of derivatives. Many economist has blamed the poor regulation of credit default swaps for some part of the early financial crisis in 2007. The financial crisis started with the bursting bubble in the US and ended with a global financial crisis. One of the worlds most successful investors, Warren Buffet, has also criticized derivatives repeatedly. He is very known, for calling derivatives "financial *weapons of mass destruction"* (Berkshire Hathaway Annual Report, 2002). His reasoning behind this is that corporation's records profits and losses in their financial statements, even before the contract is settled. These amounts are often huge and rely on inaccurate estimates, that may not be exposed for many years (Berkshire Hathaway Annual Report 2002). Because of this, among other unfortunate events, derivatives have gotten a bad public reputation, particurlarly within non-specialist and common people. It is important to acknowledge that without the right risk management set up, using derivatives can be dangerous. But with the right knowledge and use, derivatives can be the right means to manage risk for most corporations.

The most recent literature within the risk management area focuses on Enterprise Risk Management. This area can briefly be explained by embracing all risk matters within the firm, in a more coordinated way and by creating a more overall strategic framework (Nocco and Stulz, 2006). The Enterprise Risk Management consists of two parts. One at a macro level, that addresses senior

management to manage the risk that affects the entire firm. And one at a micro level that manages risk at a business-unit-level. By combining these two, the management secures that all possible risks are identified and handled.

The overall idea of Enterprise Risk Management is to identify and quantify different risks and opportunities, both on a micro and macro level in order to determine a strategy in response of these events. By doing so, the Enterprise Risk Management approach creates value and protects the interest of the different stakeholders of the firm (Nocco and Stulz, 2006).

In hedging literature, the focus has also shifted in the last decade. From focusing on primarily the different determinants of hedging to instead investigating if hedging in fact creates value for the firm, and through which channels the value are created.

This shift, from viewing risk management as solely some form of insurance in order to minimize the losses in case of unwanted situations, to viewing risk as at matter for the total firm has created new opportunities of investigating the impact of risk management. Combined with the fact that derivatives have gotten a doubtful public reputation in response of the financial crisis, makes it most relevant to investigate if risk management and especially derivatives hedging creates additional value for the firm.

In the next section the specific problem area will be discussed and will lead to the formulation of the final problem statement and additional research questions.

2.1 Problem area and research question

As already mentioned in the previous section the most recent hedging literature focuses on risk management and firm value. As a definition of risk, I've chosen to follow Jorion (2007), he defines risk as:

"Risk can be defined as the volatility of unexpected outcomes, which can represent the value of assets, equity, or earnings". (Jorion, 2007)

Risk arises from many different sources, it can be a result of some human-created event, as inflation, wars, changes is policies or business-cycles. But risk can also occur as a result of natural events and different kind of weather disasters (Jorion 2007).

Since derivatives where introduced to the market in the 1970's, they have been widely used to hedge different types of risk, i.e. interest rate risks, currency risks and commodity risks. An interesting perspective on risk management and specifically focusing on derivatives hedging is whether it creates value for the firm.

I've been inspired by several articles on the latter topic. Most early articles investigating the relationship between firm value and hedging uses Tobin's Q as a proxy for firm value, and linear regression to measure the relationship with different risk proxies (e.g. Allayannis and Weston (2001), Carter, Roger and Simkins (2006) and Jin and Jorion (2006). This approach doesn't consider the challenge of causality and endogeneity. When discovering a relationship, it could be hard to interpret whether hedging firms have a large Tobin's Q, due to hedging, or if firms with large Tobin's Q, tend to hedge more. The most recent literature also investigates the relationship between hedging and firm value, but uses different methodologies, to avoid the question of causality (e.g. Pérez-González and Yun (2013), Chen, Han and Zeng (2015) and Gilje and Taillard (2015).

Inspired by these articles my initial approach was to investigate if jet fuel hedging creates value in the American airline industry, using the event study approach.

In order to investigate this relationship, I examine the cumulative abnormal returns for American airlines during sudden price changes in the jet fuel prices. To conduct this investigation, the following hypothesis has been formulated:

Hypothesis 1a: American airlines that hedges jet fuel risk, will have higher CAR's around oil price increases, but lower CAR's around oil price decreases, than non-hedging American airlines.

The results from this study proved to be statistical insignificant and therefore I chose to use a framework similar to the one used by Carter et al. (2006), when investigating the relationship between firm value and hedging. The overall research question therefor is:

"Does jet fuel hedging create value for airlines operating in the European airline industry?"

To substantiate this statement, different hypotheses regarding the determinants of hedging from theory, have been examined, this results in the following 7 hypotheses, that at last will make it possible to answer the research question and give a possible explanation of my findings. The hypotheses will be theoretical and empirical grounded in section 4 and 5.

Hypothesis 2a: Firms that hedge will have higher capital expenditures, than non-hedging firm.

Firms with higher capital expenditures, are more dependent on stable cash flows. Since hedging ensures stable cash flows, it's more likely that that firms in need of stable cash flows due to high costs of investment opportunities hedge more.

Hypothesis 2b: Firms that hedge will have low amounts of cash, compared to non-hedging firms.

Since sufficient internal funding, including cash holdings, makes it possible for firms to engage in all positive NPV projects, they don't have an incentive to hedge to ensure stable cash flows. I therefore expect that there is a negative relationship between cash holdings and hedging.

Hypothesis 2c: Smaller firms hedge more, than larger firms.

Since smaller firms, face relatively higher cost of financial distress compared to larger firms, I expect smaller firms to hedge more, in order to ensure stable cash flows. By ensuring stable cash flows, the firms have sufficient cash to meet their obligations. Furthermore, they don't need to take on additional external funding, to be able to engage in positive NPV projects.

Hypothesis 2d: Firms with high levels of debt, hedge more than firms with lower debt levels.

Firms with high levels of debt, also faces high costs of financial distress. In order to lower these cost and to minimize the likelihood of entering states of financial distress, these firms can engage in

hedging strategies to stabilize their cash flows, ensuring sufficient cash, to repay their debt obligations. Due to this fact, I expect hedgers to have higher levels of external funding, compared to non-hedgers.

Hypothesis 2e: Firms with relatively few passengers hedge more, than firms with more passengers.

Firms with more passengers have more customers, and thereby a competitive advantage. If customers are loyal, they wont substitute one firm with another due to e.g. small price increases as a result of increasing commodity prices. If larger firms have more loyal customers, the incentive to hedge is small and therefore I expect firms with fewer customers to hedge more, relatively to firms with more customers.

Hypothesis 2f: Firms with low Return on Total Assets hedge more, compared to firms with higher returns.

Since firms with lower returns on total assets, have low earnings, they need to engage in hedging activities in order to stabilize their cash flows. Hedgers are therefore predicted to have lower returns than non-hedging firms.

Hypothesis 2g: Firms that hedge have higher values of Approximate Q, than non-hedgers.

Since the Approximate Q-value (to be defined) are a proxy for the value of the firm, I expect this to be positively related to the firms hedging activities. By investigating especially this hypothesis, I can answer the overall research question of this thesis.

By outlining these hypotheses, I will use my theoretical findings and the empirical study of previous findings in the literature, to support the quantitative findings throughout my analysis of jet fuel hedging in the European airline industry.

2.2 Limitations

In this section I will shortly outline the limitations that have been done, in the preparation of this thesis.

Overall this thesis will work around eight listed European airlines. The sample size is small, but I've prioritized to have fewer airlines to investigate, but instead expand the time-period. Quite a lot European airlines operating during the period 2001-2010 have been omitted in this analysis, due to lack of information regarding hedging activities. Furthermore, the sample consists only of European airlines, so a comparison between the different firms will be easier to interpret.

I've chosen to focus only on the benefits and challenges of jet fuel hedging, that is hedging of only one commodity input. By doing so I've omitted investigating hedging of other reasons (e.g. currency hedging, interest rate hedging and others).
I don't focus on the choice of specific derivatives, used in the hedging strategy, but only the results of the choice and intensity of the hedging strategy. That is, I haven't investigated if the derivative is an option, future or forward contract. This is omitted since the scope is not to investigate the hedging strategy, but to investigate if hedging of a commodity is positively related to the firm value. Furthermore, only derivatives usage for hedging purposes are discussed. Derivatives usage of speculative or arbitrage purposes are omitted.

Since the primary analysis is highly inspired by an article of Carter, Simkins and Rogers (2006), it is important to outline, that I've omitted some part of their analysis compared to mine. Due to different tax regulations in the European countries, I've omitted the tax-incentives of hedging in the quantitative analysis. Unfortunately, it turned out to be hard, to obtain data, that where applicable to investigate the relationship between hedging and the compensation scheme of management and directors and therefore this view is also omitted.

The terms *firms* and *companies* are used in parallel with each other, as well as the terms *debt* and *leverage*. Stakeholders are used as a synonym for all possible participants, that might be interested in the state of the company's finance.

3 Methodology

In this section I will present the methodical approach used throughout the thesis. Overall this thesis in grounded in the deductive methodology. That is developing one hypothesis or more hypotheses, based in existing theory or empirical findings (Wilson, 2010). After developing relevant hypotheses, the design of an appropriate research strategy to investigate the hypotheses are performed.
The research strategy in this thesis are highly quantitative, since it is grounded around mostly regressions, but also other statistical tools are applied. The quantitative approach emphasizes the measurement and analysis of causal relationships between variables and often this approach doesn't take processes into account (Wilson, 2010).
Since the main research question is to identify a possible relationship between firm value and hedging, it is obvious to use a deductive and quantitative approach when trying to discover possible relationships in order to answer the research question.

The gathering of information regarding risk management and hedging, has been based on an initial literature review on the subject. The idea of investigating firm value and hedging arose in connection with an assignment in an elective at Copenhagen Business School. To gather knowledge on the subject, I've been inspired by bibliographies from articles read in relation to preparation of this thesis.

The theoretical discussion is based on the assumptions from the Miller and Modigliani (1958) perfect capital market set up. Since all the theoretical foundation presented, evolves around these quite unrealistic assumptions, they are supported by further theoretical views on the benefits of hedging. There is no specific framework to consider when investigating hedging, and that is why the theory section consists of several different views and explanations of why hedging might benefit or harm firms. The benefits of hedging due to the costs of underinvestment proved to be particular applicable to the airline industry, why this section account for at large proportion of both the motivation and the theory section. The theoretical framework focuses on the determinants of hedging as a means to explain the relationship between hedging and firm value, by exploiting the market imperfections that exists in a real world set up.

The theory section is supplemented by the section of a discussion of previous empirical findings. Since this thesis builds on recent empirical findings, it is important to include these in order to be able to make rational decisions, that are grounded in theory as well as empiricism. Since the empirical findings in hedging literature are inconclusive regarding firm value and hedging, including the discussion of those, seems even more relevant. The selection of the articles investigated, have been made in order to relevancy to the particular research question.

The are numerous different methods used in the quantitative analysis section. In section 6 I test the theory and the expected hypotheses, by using an event study approach, by conducting univariate analysis of differences between hedging and non-hedging European airlines and regression analysis of the impact of hedging on firm value. All of these methods supplements each other, and ensures robustness in my conclusions.

One of the main challenges when investigating firm value and hedging, are the problem of causality and endogeneity. The most widely used method historically, when investigating the relationship between hedging and firm value are regression analyses that regresses firm value on different proxies for hedging and other control variables (e.g. Carter, Rogers and Simkins 2006). By using this methodology, the researcher faces some problems with causality, because it could be difficult to interpret whether hedging affects the firm value, or firm value affects hedging. A few other methods have been introduced most recently, in order to come around this issue (e.g. Chen, Han and Zeng 2015). In this thesis the event study approach has been tested, in order to avoid the endogeneity problem. By testing the statistical significance of the the cumulative abnormal returns, when there are sudden and drastic changes in the oil price, the endogeneity problem is avoided, since the market reaction, to oil price changes is not a firm choice variable.

The data has been collected from the Compustat database, in which I have access through the CBS library. The data that proved to be impossible to extract from Compustat, primarily information regarding hedging, are hand collected from the firms' annual reports.
The different reasoning's and specific methodologies used, are found in the quantitative analysis section, and related appendices and will not be discussed in this section.

4 Financial Theory

4.1 Hedging and the derivatives market

This theory section will provide a short overview of hedging, the different types of traders and the use of derivatives for hedging purposes.
Shortly, a derivative is a security which price depends on an underlying asset. That is, the price of the derivative itself fluctuates with the price of the underlying. The underlying asset can be represented by a lot of different assets, e.g. stocks, bonds, interest rates, currencies or commodities (Hull, 2012).

Derivatives are sold on regulated exchanges, such as e.g. the Chicago Board of Trade or over-the-counter. The most common derivatives are by far forward contracts, futures contracts (linear structure) or different kind of option contracts (non-linear structure). A futures contract is an agreement between two parties for the sale of an asset at a specific price at a specific time. If I own SAS stocks and believe that the price will decrease, I can engage in a futures contract with someone who believes that the stock price is going to rise. If we agree upon a specific price, I will gain money if my predictions where right, and lose money if the other party where right is his predictions. Overall a futures contract is a zero-sum game, where the gains and losses are offset by each other (Hull, 2012).

Derivatives can be used for several different purposes. The specific purpose investigated in this thesis are hedging, which can be equated with insurance. Derivatives can also be used for speculative purposes or arbitrage, but these two purposes are not relevant for this thesis and will not be discussed further. When people or firms engage in hedging activities they reduce their exposure to some kind of identified risk. Hedging doesn't prevent the event from happening, but is reduces the negative outcome, when and if it happens. On the other hand, the opposite might happen leaving the firm worse off, that it would have been without hedging. Hedging, is in that way, a bet of future outcomes.
In commodity hedging, which is the focus in this thesis, firms hedge the market price of raw materials and goods. For airlines, jet fuel is a very volatile and important input (will be discussed

further later in the thesis). By engaging in hedging activities using futures contracts on crude oil, airlines can lock in the price, keeping their cash flows stable and known. Since the jet fuel prices are very volatile (in fact the volatility on jet fuel it self are also very volatile), some airlines might be tempted to take on a more speculative approach in their hedging programme. In order to get the full benefits of hedging, firms need to keep their hedging programme stable, by not entering into speculative contracts, trying to beat the market. The key to increasing the value of the firm is stable cash flows, lowering the probability of financial distress and ensuring sufficient internal funding to engage in all positive NPV projects, even in states where cash flow would have been low without hedging (Hull, 2012). The theories and empirical findings behind this reasoning's will be discussed in the following sections.

4.2 Introduction to hedging theories

As argued throughout at least the last 4 decades one of the the main goals, at least to the public, of corporations is to maximize their shareholders' wealth. In a very well-known New York Times article from 1970, Milton Friedman (Friedman, 1970) states that the only social responsibility a corporation has, is to engage in activities that increases its profits. It is therefore very important for managers to know, if the hedging activities they engage in, in fact does create value for the corporation. If the managements goal is to maximize shareholders' wealth and hedging doesn't create value for the shareholders, the managers may want to consider, if it is their own, or others interest to engage in derivatives hedging. As I will discuss throughout this and the latter section hedging can both be the means of maximizing shareholder wealth, but it can also be the means of maximizing managers' wealth and that these two groups might have conflicting interests in a hedging perspective.

4.3 Shareholders Wealth Maximization

In a world without any financial frictions, managers haven't got any incentives to engage in hedging activities, since it wont increase the firm value. There are simply no frictions to hedge. In such a perfect financial world, the choice of a firm's capital structure hasn't got any effect on the firm value, it will not increase the value nor decrease it. Hedging can be viewed as a part of the firm's capital structure (Berk and DeMarzo, 2014).

As Miller and Modigliani (1958) reasoned, in a perfect world there are no taxes, no transaction costs, no bankruptcy costs, there will be no asymmetric information between corporations and shareholders and the level of leverage will have no impact on the value of the firm. If perfect capital markets exist, shareholders have the information required and the tools to create their own risk profile by diversification. However, such a perfect friction free world doesn't exist and managers might find incentives to hedge frictions, as I will discuss throughout this and the latter sections (Berk and DeMarzo, 2014).

By introducing these financial frictions to Miller and Modigliani's perfect capital market, you would also introduce the potential benefits of hedging these frictions, since you can perceive hedging as one of the firms financing decision along with e.g. the choice of capital structure (Smith & Stulz 1985). I will discuss some of these capital market imperfections in relation to hedging and how to exploit these.

As argued by Smith and Stulz (1985) a company that operates by the shareholder wealth maximization hypothesis can engage in hedging for three different reasons; 1) taxes, 2) contracting costs, or 3) the hedging decisions impact on investment decisions, including agency cost of leverage and moral hazard and these hedging incentives will be investigated first.

4.3.1 Taxes

Smith and Stulz (1985) claims that if a firm has a convex effective tax function, it can reduce the volatility of the pre-tax firm value by engaging in hedging activities. By doing so, they reduce the expected corporate tax liability which ultimately will increase the after-tax value of the firm. The managers need to hedge the firm's income volatility in such a way, so the income will fall in between the desirable range. Because of the convex tax function, the company will pay a higher percentage of taxes, with increasing income. By assuring that the income volatility will decrease, the company will also pay a lower fraction of tax, in an average perspective at least. As Smith and Stulz argues, after-tax value will only increase if the hedging activities are costless, or if the costs of hedging doesn't exceed the value added. This perspective is rather important in a real world set-up.

The effect from hedging depends on the appearance of the effective tax function, that must be convex in order to exploit the benefits of hedging. The convexity occurs when the firm faces a

progressive marginal tax-rate. That is, a tax rate that increases when the taxable income increases. If this is not the case, the benefits from hedging can't be exploited (Smith and Stulz 1985).

4.3.2 Financial distress costs

Secondly when introducing taxes as an imperfection, you also introduce the managers' incentive of taking on debt, because of the tax-shield. The tax-shield represents the opportunity of deducting taxable income and thereby increasing the firm's earnings (Berk and DeMarzo, 2014).
When increasing leverage, it also results in increasing probability of financial distress and ultimately default, leading to higher financial distress costs. The financial distress costs are an example of another challenge the firm faces when introducing frictions to the perfect capital market. In fact, facing financial distress is not at all costless in a real world set-up.
There are several costs to take into account when a firm faces financial distress. These can be divided into two main parts, direct and indirect costs (Berk and DeMarzo, 2014). The direct costs are those related to the remuneration of professionals such as, lawyers, accounting experts and specialized auctioneers hired to take care of the tasks, that arise in the event of bankruptcy. The financial distress costs also consist of indirect costs, such as loss of customers, suppliers and employees, because of the uncertain situation, which in the end can be much costlier for the firm than the actual direct costs.
The indirect costs also represent the costs of underinvestment, which will be discussed later. If the future outcome of the company is very uncertain, customers, suppliers and employees will look elsewhere to get their different needs fulfilled. These indirect costs of financial distress can be very large and are extremely hard to price set (Berk and DeMarzo, 2014).

The sum of these distress costs, do in fact theoretically impact the firm value, since these costs represents the present value of bankruptcy costs and these are taken into account when securities are fairly price. Those cost are not only borne by the debt holders, but also the shareholders (Berk and DeMarzo, 2014).
In case of bankruptcy, shareholders will be left with nothing, so one might think that they don't care about the costs related to such an event. The shareholders do in fact pay the present value of these financial distress costs, because the debt holders in the end, will be willing to pay less for the debt,

when they know, that the firm faces relatively high probability of financial distress. When this is the case there will be less money left to pay dividends, share repurchases and investments and these three factors have impact on the shareholder's wealth (Berk & DeMarzo 2014). It is therefore in the interest of shareholders to minimize the cost of financial distress, in order to increase their own wealth.

The introduction of the possibility of taking on leverage, caused both a plausible increase in firm value in terms of the value added from the tax-shields, but also added some costs in terms of the costs of financial distress. The advantages from the tax shield, which leads to increasing firm value and the disadvantages from the financial distress costs, are known as the trade-off theory. The firm should increase its leverage, until the point when the value of the firm is maximized, that is the point when the gains from the tax shield are just off-set by the costs of financial distress (Berk and DeMarzo 2014).

In a hedging perspective the probability of financial distress can be reduced by decreasing the firm's volatility. When engaging in hedging, the volatility of future firm value will decrease. When the volatility decreases the probability of extreme left tail outcomes (bankruptcy) will also decrease (Stulz 1996). As Smith and Stulz argue, hedging can decrease the volatility, which offsets a lower probability of distress, which again decreases the costs of financial distress, resulting in a higher firm value according to theory.

When issuing new debt, managers must convince the new debt holders, that they will engage in these hedging activities, so that the probability of bankruptcy in fact is lower, than it would have been without hedging. Managers might realize, that the wealth of the shareholders, wont increase by engaging in hedging activities, but instead redistribute wealth from shareholders to bondholders. Despite the missing incentive to hedge after issuing the new debt, managers hopefully grasp that they will be punished by different market factors, if they don't keep their promise.

They will face a lack of reputation by debtholders, which eventually will lead to higher costs of new debt. If new debtholders know that there exists a great possibility, that the managers wont hedge, despite their promise to do so, they will charge a higher cost of new debt issued.

Second if they do hedge, it will lower their current probability of distress leading to fewer restrictions of engaging in potential new investment opportunities, from current debt holders. These restrictions are known as financial constraints, and these constraints is also affected by the lower volatility and can be handled through hedging (Smith & Stulz 1985). In addition to this Nance, Smith and Smithson (1993) mentions that smaller firms have more financial distress incentives to hedge than larger firms. The cost of financial distress is less than proportional to firm size, leading to a worse situation in the worst case scenario for small firms. Due to this fact, theory predicts that smaller firms tend to hedge, to a greater extend than larger firms.

By introducing frictions, I realized that financial distress is not costless and does reduce the value of the firm. By engaging in hedging activities it is possible to reduce the volatility of future uncertainties, including cash flows, earnings and firm value. By hedging these risk exposures, the financial distress costs will decrease, leading to higher firm value, maximizing the shareholders' wealth.

4.3.3 Underinvestment

Smith and Stulz (1985) primarily focused on the financial distress cost, arising from the probability of bankruptcy, when discussing hedging policies. Froot et al (1993) takes another perspective on the determinant of hedging policies, in particular, they mention how important stable and low volatile cash flows are for firms to be able to undertake new investment projects.

Undertaking new positive NPV investments, are important for firms to keep adding value to the firm, maximizing the shareholders' wealth.

Lewent and Kearney (1990) were some of the first to uncover the importance of using hedging strategies to utilize stable cash flows as a necessity of being able to make investments in research and development, in order to insure the future growth opportunities of the firm.

Froot et al. (1993), attempts throughout their article, to draw a direct link between firms' hedging strategies and investment behaviour. Their starting point are relatively simple. Firms that do not engage in hedging, will have more volatile cash flows generated by assets.

These more volatile cash flows will lead to one or two of the following or both, 1) variability in money generated from external funding, or 2) variability in the amount of money invested. Since

investments most frequently have concave return functions, variability in investments are seldom desirable, since more invested results in relatively higher returns, because of the increasing marginal return function (Froot et al. 1993).

As a response to this, the firm could instead choose to take on more funding from external sources, so their investment opportunities wont be affected and be kept at a stable or increasing level. This turns out not to be the answer either, as the marginal costs of external funding tend to increase with the amount of funding, as discussed in the previous section. The volatile cash flows, and in worst case severe lack of cash, results in fewer investment opportunities for the company and turns out to be costlier, because of increasing marginal costs of taking on external funding. These increasing marginal costs of debt, are represented by the deadweight costs of debt. Since the deadweight costs are derived by the external funding costs, they are also increasing when the external funding increases.

These cost doesn't reflect or creates any value for the firm and occurs when the company uses external funding instead of internal. The deadweight costs represent several different costs. The authors (Froot et a. 1993) mentions: both direct and indirect financial distress costs as discussed earlier, costs arising from asymmetric information between managers and outside investors and the signal it sends to the public, when the firm has to increase their usage of external funding. Froot et al. (1993) claim, that by reducing the volatility of cash flows by hedging, the value of the firm could be affected in a positive way. The increase in value has two sources, the greater possibility of taking on positive NPV projects because of more stable cash flows and the fact that more stable cash flows also reduce the need of using external funding.

Froot et al. (1993) argues that if the firm can construct an effective hedging, that can decrease the volatility of cash flows, then it will increase the value of the firm through the mechanisms just described. By engaging is such hedging strategies, the firm assures that they will have sufficient funds to engage in positive NPV projects even when the cash flow would have been low. They transfer cash flows, from states where they have exceeding funds, to states where they might have had a shortage. By doing so they reduce the cost of underinvestment. Figure 1, shows this relationship graphically.

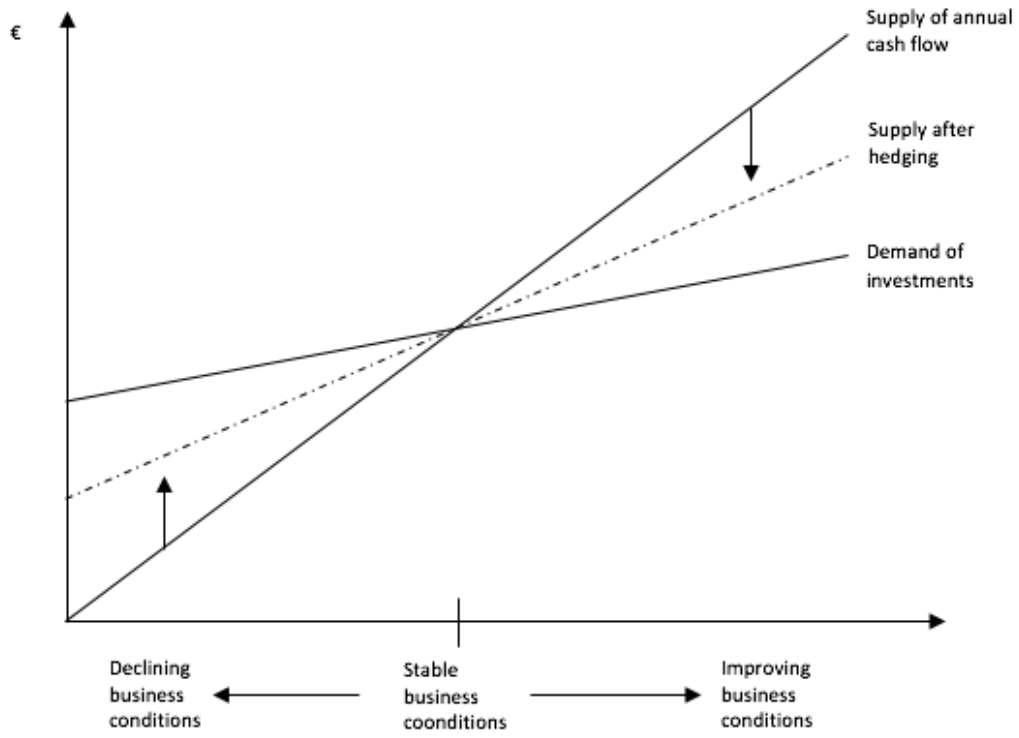

Figure 1, Anja Pagh: Shows the excess supply of cash flows, when the business conditions are improving and the short supply when business conditions are in a worse state, and how hedging shifts the supply, to better match the demand of investments in both states.

4.3.4 Agency costs of leverage

The problem of underinvestment may emerge from another source than the shortage of cash flow just described. Another well-known source is the Agency Cost of Leverage (Berk & DeMarzo 2014). These costs arise when there are conflicts of interest between a firm's different stakeholders.

When a firm has taken on leverage, to engage in potential investment projects, this increasing leverage might have different consequences for the shareholders and the holders of debt. With increasing leverage, the firm faces higher costs of financial distress. These are borne by both debt- and shareholders, but there could still be some conflicting interests between the two parties.

These conflicts between interests, often occur when the firm faces a high probability of financial distress. In such a case, the managers, who often has the same interests as the shareholders, because they are compensated in a way that depends on the value of the firm (this issue will be discussed later in the thesis), might want to engage in high risk projects, because their potential downside are limited to zero.

The shareholders and debt holders have different claims on residual cash in case of bankruptcy. Since the debt holders' claims are senior in relation to the shareholders, they will be rewarded first. In case of default, the debt holders will most likely not be repaid their full claims, because of costs related to the bankruptcy.

Debt holders aren't willing to engage in high risk projects, because they suffer the downside. The shareholders on the other hand, only has the potential upside, since they are left with nothing in case of default. Shareholders are thus willing to engage in even negative NPV projects, that might have little probability of paying a positive pay-off, in case of a high probability of financial distress. Even though the project might be very risky, it might go well, leaving the shareholders better off than they would have been, in case the firm defaults. The bottom line is that the shareholders' wealth, can be seen as a call option, with the value of the firm as the underlying.

By using the Black-Scholes model (Black and Scholes 1973) to calculate the value of such an option, one would see, that the value would increase, with increasing volatility of the underlying. The shareholders' wealth is higher (if viewed as the price of the option), when the volatility of the value of the firm increases. Since hedging decreases the volatility, it wouldn't be desirable for managers to engage in hedging if they are compensated option like.

The risk of the project is shifted from shareholders to debtholders and is known as the risk-shifting problem (Dobson & Soenen 1993). Dobson and Soenen (1993) argues that this risk-shifting problem is also hedgeable, since hedging cash flows results in lower volatility of the firm, making the states of high conflicts of interest less likely to occur.

Furthermore, when a company is highly levered, it will have more commitments to existing debt holders. A levered firm, will pay a larger fraction of the cash flows to the debt holders to meet their fixed claims, leaving only little residual cash flow the shareholders. The more levered a firm is, the more problematic, these different interests of stakeholders turn out to be, since it requires relatively high cash flows, in order to have any residual cash left for the shareholders.

Overall the conflicts between different stakeholders can lead to inefficient investment decisions, leading to a lower value of the firm (Berk & DeMarzo 2014). Hedging can decrease the agency cost of leverage, since it ensures less volatile cash flows.

4.3.5 Moral Hazard

Another Agency cost arises from the costs of moral hazard. The fact that managers may want to engage in risky projects, but wont let the potential debt holders know how risky they in fact are, since the managers possesses information, that the debt holders don't.
When managers are being dishonest to stakeholders, because of asymmetric information, it is an example of a moral hazard problem. This information asymmetry leads to debt holders, in the end, might be carrying much more risk, than they thought they would. By abusing the debt-holders trust managers might have a potential larger upside, leaving the potential downside with the debtholders. This will eventually affect the reputation of the management leading to debt holders only want to engage in short term contracts, assuming that they wont renew or extend their contracts when they discover that management are being dishonest (Dobson & Soenen 1993).

Dobson and Soenen (1993) concludes that, given rationale stakeholders, engaging in hedging, the different agency costs of debt can be reduced. First of all, by engaging in hedging the volatility of cash flow will decrease, and then follows that the cost of debt will decrease as well. With lower volatility of firm value, the interest of the different stakeholders will also be aligned, leading to a lower conflict of interests. Least of all the lower probability of distress when hedging, making the incentives for longer contacts between management and debt holders larger.

Another view on hedging and the moral hazard issue, are presented by an article by Tufano (1998). Tufano argues reversely, that by adding these agency cost, hedging might in fact destroy firm value, because hedging provides the managers with an opportunity to fund their own "pet" projects. These projects are perhaps not very beneficial for the stakeholders. Hedging gives the managers the opportunity to nourish their own projects even in states with low cash flows. The excess amount of cash in low state periods, that arises from hedging, ensures that the managers are not forced to seek external funding. External funders do realize that these personal pet-projects might not be beneficial to the stakeholders and could also be very risky only maximizing the managers own wealth. By not being obliged to use external funding, managers may abuse the internal cash flows, since there are no external control procedures assessing the pet-projects value. Although this

problem is not inconsequential, Tufano (1998) summarizes his arguments by arguing that hedging is beneficial for all stakeholders, since the bad points outweighed the good sides:

"If information asymmetries are large, tax schedules highly convex, financial distress very costly, and agency problems slight, the benefits of risk management are likely to overwhelm its costs" (Tufano, 1998).

4.4 Management Wealth Maximization

As already mentioned managers wont always act in the interest of the shareholders. Some managers seek to maximize their own wealth, before the shareholders', unless they are compensated in a way that aligns the interests of managers and shareholders. The firm's stakeholders are not always able to diversify risk in such a way, that it will fit their own risk profile (Berk and DeMarzo 2014).

Managers are hired because they have some specialized knowledge that can increase firm value. The shareholders have to allow the management, to use this knowledge with some kind of discretion, because knowledge can represent a comparative advantage to the firm. To ensure that management wont abuse this private knowledge, only in their own interest, managers are often compensated in some relation to the value of the firm. Smith and Stulz (1985) argues that if this compensation scheme is a convex function of the firm value, e.g. option like, there will be less likelihood of managers engaging in hedging, because the value of their compensation will increase with the volatility of firm value. If the management compensation scheme on the other hand is a more linear function of the value of the firm, e.g. company shares, it would increase the likelihood of management engaging in hedging, since this would decrease the volatility of value of the firm. In a hedging perspective, the manager compensation scheme would theoretically be related to the firms hedging strategy.

4.5 Concluding remarks on theory

The introduction of financial frictions from the Miller and Modigliani set-up created some incentives for managers to engage in hedging activities in order to ensure stable cash-flows, ultimately maximizing the shareholders' wealth. The benefits of hedging due to tax incentives where present when the firm faces a convex effective tax function. The stable cash flows where also found to reduce the probability of financial distress, which again theoretically led to a higher value of the firm. The lower probability of financial distress also turned out to be a means to align the interest of the different stakeholders, decreasing the agency cost of leverage. Another way to align the interest between managers and stakeholders are the way the managers are compensated. The more option like the compensation of the managers are, the less likely they are to hedge, since the value of the option (their compensation) increases with increasing volatility. By making the compensation more linear, it would align these interest increasing the likelihood of managers to hedge, and thereby increasing the value of the firm and not only maximizing the managers own wealth. The last incentive of hedging discussed where the cost of underinvestment. This cost can also be reduced by ensuring stable cash flows from hedging activities, leading to managers being able to engage in all possible positive NPV projects. By engaging in all projects, the future growth opportunities are ensured, increasing the value of the firm.

5. Empirical discussion

Regarding empirical evidence on corporative incentives of hedging and the relationship between firm value and hedging activities, there are a lot of research articles to study. I've chosen those articles most related to the scope of this thesis. I have, like in the theory section, divided the articles in two main areas of investigation. Articles that discuses the empirical findings of evidence on the hedging decision, i.e. describes which characteristics hedging firms have and how likely those are to have an impact on the firms hedging strategy. Those characteristics are closely related to the Miller and Modigliani imperfections discussed in the theory section, and how theoretical hedging strategies seek to exploit those imperfections, primarily by reducing the firm value volatility. The other main area consists of empirical evidence on how firm value are related to the choice of

hedging strategy. There are a lot relatively new inquiries on this subject, so this section will be thorough and profound, since the topic is important to the quantitative studies I have conducted in relation to this thesis. My own empirical findings will we presented in a latter section and will be held up against the empirical findings of these research articles.

5.1 Firm characteristics and determinants of hedging

5.1.1 Empirical findings on hedging and tax incentives

As discussed previous the convexity of the effective tax-function could be exploited by hedging the pre-tax cash flows. Graham and Smith (1998), shows through simulations that on average in fact a 5 percent reduction in volatility, will result in 5 percent reduction of tax base liability. In their study of 80,000 firm year observations, they furthermore find that in approximately 50 percent of the cases, firms face a convex tax function, which provides them with incentives to hedge. In the remaining 50 percent, 25 percent of the cases faces a concave tax-function providing them with a disincentive of hedging.
They also find that the distribution of the potential tax savings is quite skewed, meaning that only 25 percent of firms facing a convex effective tax function have potential tax savings that in fact appear material. Overall this leaves only 12,5% of the total firm observations, have tax savings that appear material. The remaining 75 percent of the firms with convex tax functions, have tax savings that appear impartially small. Overall they do find, that the proportion of firms facing material incentives to hedge are relatively small, representing only a fraction of approximately 10 percent of all firms.

In another article published by Graham and Rogers (2002), the authors find that firms do not hedge in response to tax convexity, even though the potential tax savings are real, at least to some firms. According to the authors, the incentive of hedging because of the tax convexity are relatively small compared to other hedging activities, making firms prioritize other hedging activities than those arising from tax savings. They do instead find evidence that firms hedge to increase their debt capacity. The possibility of having a higher capacity of debt, is another tax incentive for firms to hedge. By increasing the amount of debt, the firms also increase the amount of tax deductible

interest. In fact, they find that tax benefits resulting from hedging adds roughly 1.1 percent to firm value, which they argue are a relatively high number.

Nance, Smith and Smithson (1993), finds evidence that hedging firms face a more convex tax function, especially firms with taxable income in the more progressive area of the tax function. There results are however biased and have low power.
To measure the relationship between hedging and the tax-convexity are several proxies used, the most common are though the use of carryforwards and carrybacks since they reduce the convexity (Graham & Smith 1998 and Graham & Rogers 2002).
There are several other studies on the tax-incentive of hedging. Common to them all are that they are more or less inconclusive regarding the tax-incentive of hedging because of the convexity of the effective tax-function. The empirical findings on the incentive of hedging because of the increasing debt-capacity are more alike and this incentive will be discussed in a latter section.

5.1.2Empirical findings on hedging and financial distress costs

As discussed the most well-documented and used incentive of hedging due to tax-incentives are an increase in the debt capacity. By increasing the debt capacity, the firms can benefit from the tax-shield, since interest are tax deductible. On the other hand, more leverage increases the possibility of default, ultimately increasing the financial distress costs. This trade-off is well-known and as discussed earlier, firms must find the optimal balance between the two. In this section I will discuss the empirical findings on firms' incentives to engage in hedging in order to reduce the real financial costs of distress.

Cummins, Phillips and Smith (2001), finds evidence that insurance firms are motivated to engage in derivatives hedging in order to reduce the expected costs of financial distress. They use several measures as proxies for the probability of financial distress, including the equity capital-to-asset ratio, since firms with a larger ratio tend to have more cash on hand, to protect against adverse losses and investment shocks. The authors find an inverse relationship between the equity capital-to-asset ratio and the hedging policies, showing that firms with higher probability of financial distress tend to engage in hedging activities more often.

Amiyatosh (2008) finds strong evidence that highly levered firms hedge more. He also finds that firms with a very high probability of distress, looses the incentives of hedging. He emphasizes that firms with a high probability of distress, that also operates in a very competitive environment, have more incentives to hedge, because of their relatively large expected costs of financial distress.

Haushalter (2000) performs a study of 100 oil and gas producers' determinants of hedging in the period from 1992 trough 1994. Haushalter documents a positive relation between the extent to which a firm hedges and its level of leverage. As a proxy for leverage Haushalter uses a total debt over total assets ratio and shows that the relationship with the proportion of price risk hedged is increasing. The author also finds evidence that more financial constrained firms (high debt to asset ratio), also has a higher fraction of hedging. He furthermore mentions, the importance of acknowledging that hedging should be seen as a significant piece in the determination of the capital structure of the firm, as also discussed in the theory section.

Graham and Rogers (2002) also include the financial distress costs (proxied as the total debt over total assets) as an incentive to hedge in their analysis of especially the tax incentive to hedge. They emphasize the importance of the hedging/debt causality that can go both ways. High leverage gives firms incentives to hedge, but hedging also increases the debt capacity. When interpreting the debt coefficient, researchers should be aware of this problem. They try to avoid this dual causality by constructing a simultaneous system. They find a positive relationship between hedging as the dependent variable and debt as the explanatory variable, concluding that leverage leads to increased hedging because of higher expected costs of financial distress. In the second stage with debt as the dependent variable, they find a positive coefficient on derivatives usage, concluding that hedging increases both debt capacity and tax deductions.

Nance, Smith and Smithson (1993) examines the reduction of financial distress cost when hedging. They use proxies for both firm size and leverage. They find empirical evidence that larger firms tend to hedge more often, than smaller firms. In theory larger firms have a lower probability of financial distress than smaller firms. They explain this tendency by larger firms having a scale economy, since they more often hire risk managers with expertise in hedging strategies using derivatives.

Nance et al. don't find significant evidence that firms with a higher leverage ratio is more likely to hedge, but they do find evidence that hedgers have larger research and development (R&D) expenditures. Firms with high R&D expenditures have more incentives to hedge, because they need to stabilize their investment opportunities. Since firms with high leverage also have fewer investment opportunities, because of constraints, this could also explain why high levered firms are not hedging as much as the theory would predict, they don't have any investment opportunities to protect. The incentive of why high leverage firms should hedge is two-sided, since the higher probability of distress should encourage the firm to hedge, but they do not tend to do so, because they don't have any investment opportunities to protect (Nance et al. 1993).

All of the above studies finds evidence that there is a positive relationship between how much firms engage in hedging and the volume of leverage, financial constraints and the probability of financial distress. Tufano (1996) on the other hand, discovers no empirical support of risk management as a means to maximize shareholder wealth. He performs a single industry study, investigating the North American gold mining industry. He finds robust results, but still mentions the fact to be careful with steel firm conclusions build on the investigation of a single industry. Tufano finds no statistical significant difference in leverage means (measured as total book value of debt to total market value of financial claims) of firms with no, some or extensive risk management. Furthermore, he finds no relationship between the extent of risk management undertaken and the probability of financial distress (measured by cash costs).
Mian (1996) also finds empirical evidence inconsistent with financial distress costs models. He uses non-survey data from more than 3000 firms from 1992. His results are reported as robust.

To conclude on the empirical findings on the link between hedging and financial distress cost, the results are somewhat opposing. If financial distress isn't costless, most recent literature has discovered, some linear relationship between the level of leverage and hereby the probability of financial distress and hedging. One study found a non-linear relationship, since firms with very high probability of financial distress didn't appear to hedge, unless they operated in a very competitive environment. The reduction in financial distress costs occurs, when firms manage to hedge their

cash flows in such a way, that they get an opportunity to increase the debt capacity, followed by the possibility of exploiting the tax shield, without increasing the probability of distress.

5.1.3 Empirical findings on hedging and the cost of underinvestment

Theoretically there are several incentives for firms to engage in hedging related to the underinvestment challenge. In order for firms to be able to take on all possible positive NPV projects, they need stable and low volatile cash flows. Firms with few possibilities of internal fund generation, firms operating under significant financial constraints and firms with high future investment opportunities could exploit the benefits from hedging, in relation to the theory of underinvestment costs. The empirical findings of this issue will be discussed in this section.

Gay and Nam (1998) examine the importance of internally generated cash flow, investment opportunities and cash stock by examining 486 non-financial companies' usage of interest rate, currency and commodity derivatives. They test three hypotheses, which are a further development of the Froot et al. (1993) framework. They set up several proxies for a firm's investment opportunities and find some evidence (only two out of 5 proxies are statistically significant at the 5% level) that relates those positively to the use of derivatives. Secondly they find that firms with improved investment opportunities, tend to use derivatives more intensively when they also have low cash stocks. They also find evidence for the last of the three hypotheses, concluding that firms that have positively correlated investment expenditures and internal generated cash flows have smaller derivatives positions.

Nance, Smith and Smithson (1993) also conclude that firms with more investment opportunities do hedge more. As a proxy for growth in investment opportunities they use both the R&D expenditures and the book value of the firm's assets to the market value. They furthermore find that leverage can proxy for the firm's investment opportunities, as mentioned earlier their results have low power and should be interpreted carefully,

Géczy, Minton and Strand (1997) examine the use of currency derivatives of 372 nonfinancial firms in 1990. They find significant evidence that firms with a combination of high growth opportunities, but low access of internal and external funds are most likely to hedge. They find that their results

suggest that especially these firms use currency derivatives to reduce the variation in cash flows, to secure their opportunity of investing in valuable growth opportunities.

Graham and Rogers (2002) find somewhat unambiguous results regarding the underinvestment problem. They find a negative relationship between R&D expenditures and hedging and a positive relationship between the book-to-market ratio, which both are inconsistent with the theory. Nevertheless, they do discover the same relationship between debt multiplied with market/book ratio and hedging as Géczy et al. (1997) did, proposing that firms in fact use hedging to minimize underinvestment problems when they have large growth opportunities, that they need to ensure stable cash holdings in order to pet.

Fok, Carroll and Chiou (1997) also supports the empirical evidence on firms with a larger value derived from growth opportunities hedge more often.

On the other hand, there are also evidence conflicting with the existing theory of firms with large growth opportunities tend to hedge more.

Tufano (1996) shows in his examination of the north American gold mining industry, no evidence on risk management as a means to maximize shareholder value, including hedging as a tool for minimizing the underinvestment problem by decreasing the volatility of cash flows. As a proxy for growth he uses the firms acquisition programs.

Mian (1996) finds mixed result regarding contract costs and capital markets imperfections. The author discovers that regulated utilities are less likely to hedge, compared to firms in an unregulated environment, this is consistent with theory. On the other hand, he finds that hedgers do not have a higher market-to-book ratio.

Concluding on hedging as a means to minimize the underinvest problem, by securing less volatile cash flows the overall empirical evidence are in favour of the predictions from theory. Firms with greater investment opportunities, low possibility of generating sufficient cash from internal or external funding tend to hedge more, in order to ensure their future investment opportunities.

5.1.4 Empirical evidence on agency cost of leverage and hedging.

As mentioned previous in this thesis, the problem of underinvestment may emerge from another source than the firm being short in cash holdings, resulting in that the firm are not being able to engage in all positive NPV projects. Underinvestment might also appear when there are conflicting interests between the different stakeholders. In states when the main part of the residual cash accrues the debt holders, because of a high level of leverage, the management might tend to underinvest, since extra cash holdings will accrue the senior debt-holders. By securing stable cash flows the firms can minimize these conflicts. Since the proxies used for investment opportunities are the same as in the previous section on the underinvestment incentive to hedge, the conclusion might overlap some.

Berkmann and Bradbury (1996) find some evidence that there is a positive relationship between the use of derivatives and the firms growth opportunities. This is the case only when they apply the fair value of derivatives as a measure of hedging activity and only the long-run asset growth. As proxies for growth they use the earnings price ratio for the long run growth prospects. Froot et al. (1993) argues that it is most important to focus on the short run instead of the long run growth opportunities. The proxy for short run is current year's change in net tangible assets plus depreciation over net income plus depreciation. They do in fact discover that this measure is lower for derivatives users, which is contrary to theory.

Nance et al. (1993) argues, that the firm must restrict the states in which it would default on debt payments, minimizing the conflict between shareholders and debtholders. They could do so by hedging the cash flows. The authors find that firms with more growth investment opportunities (measured as high R&D expenditures) do hedge more. They furthermore conclude that firms with more investment opportunities have lower leverage, which could be seen as a means to minimize the agency conflicts.

Géczy et al. (1997) also finds that firms with more investment opportunities do hedge more. One of the explanations they present for hedging, according to the underinvestment problem is to minimize the agency costs of leverage.

Mian (1996) finds no evidence on hedging as a means to hedge capital market imperfections. He furthermore concludes, that he finds no evidence to use hedging in order to hedge the contacting costs of agency conflicts.

Overall it seems that there are some plausible benefits of hedging the agency cost of debt. It is hard to distinguish between the origins of the underinvestment problem. Less volatile cash flows would transfer cash from good states of economy to bad, ensuring sufficient cash to engage in possible positive NPV projects also aligning the interest of the different stakeholders, and thereby decreasing the agency cost of leverage.

5.1.5 Empirical evidence on hedging and the management wealth hypothesis

Management doesn't solely act in the the interest of shareholders. They might have personal incentives to maximize their own wealth, on the expense of the wealth of shareholders. Theoretically, managers that are compensated in a way that relies on a linear dependency on the value of the firm are more likely to hedge, because the managers expected utility of wealth is significantly affected by the variance of the firm.

Géczy et al. (1997) explains the managerial wealth dependency of compensation in two variables. One that captures the market value of common shares beneficially owned by management. And one that captures the managerial ownership of options. The theory predicts that the first would be positively related with hedging the latter negatively, since an option like compensation scheme gives the management incentives to increase the variability of the firm. Unfortunately, the results regarding these to variables are statistic insignificant, but they do find that firms that uses option like compensation schemes, also tend to hedge more, which is against the theory.

Haushalter (2000) also examines the relationship between hedging and management compensation. He finds a negative association between the fraction of production hedged and exercisable options held by officers and directors. He does though mentions, that his data has some limitations, why strong conclusions must be circumvented. Opposite to the theory predictions he finds no evidence that the extent of hedging increases with the share ownership of officers and directors.

Rogers (2002) finds no evidence that managers reduce hedging when increased firm volatility would increase their personal wealth. But they do discover a positive link between the sensitivity of the option/share holdings of management and hedging. This could be explained, as options with low convexity are more stock like, increasing the manager's incentive to hedge.

Gay and Nam (1998), also uses proxies for management risk aversion and measures the relationship to hedging. They find that the two variables measuring management holdings of stocks and options are opposite in sign that predicted, it should be mentioned though, that only the results of stockholdings are statistically significant.

Tufano (1996) also conducts studies investigating the relationship between management holdings of stocks and options. He uses, like most of the studies also mentioned, two variables to measure the relationship between hedging and managerial risk aversion. One that captures the stock holdings and one that captures the holding of options. He also includes a third variable which contains information about large holders of stocks which, is not managers or directors. This variable is included to control for purely bad managerial risk management, since holders of large proportions of stock, that are not managers should be able to diversify their own risk better than managers would. This variable is expected to be negatively related to hedging. Tufano finds, like predicted, a positive relationship between managerial options holdings and hedging and a negative relationship between managerial stock holdings and hedging.

To conclude on empirical evidence regarding managerial compensation and risk aversion, the results are quite inconclusive. Even though the empirical findings discussed in this section overall are in line with the theoretical predictions, no strict conclusion can be found.

5.2 Empirical evidence on firm value and hedging

By hedging some of the market imperfections already mentioned as a means to maximize shareholder wealth, these determinants of hedging implicitly increases firm value according to value maximizing hedging theory. In addition to the study of these determinants I want to investigate studies that directly examines the effect on hedging on firm value. Historically researchers have widely used Tobin's Q (Carter et al. (2006), Allayannis and Weston (2001) and Jin and Jorion (2006))

as a proxy for firm value, when investigating the relationship. When interpreting the results using Tobin's Q, no matter if they are in the favour of theory or not, the possibility of endogeneity should be taken into consideration, because it may de difficult to infer causal inference from the data. It could be challenging to conclude whether hedging firms have a higher Tobin's Q, or if firms with high Tobin's Q tend to hedge more.

High values of Tobin's Q, shows that the firms market value is relatively large compared to the replacement costs. If high values of Tobin's Q also can be an expression of firms having many profitable investment opportunities, then these firms might have further incentives to hedge.

In order to try to eradicate the endogeneity problem, several other approaches have been investigated in order to uncover the relationship between hedging and firm value. These approaches consist, among others, of event studies, simultaneous effect studies, natural experiments and these will be exploited throughout this section.

Allayannis and Weston (2001) where first movers in explaining a direct link between firm value and hedging. Previous studies primarily focused on the determinants of hedging. Allayannis and Weston observe the relationship between the use of foreign currency derivatives and firm value (measured as Tobin's Q) for 720 nonfinancial firms in the period 1990-1995. They find a statistically significant hedging premium of 4,87 % for firms that do have sales from foreign operations, resulting in a foreign currency exposure. They do also test the effects of reversal causality by setting up 3 hypotheses, testing whether the decision to begin or quit hedging is affected by the value of Tobin's Q. They find that both the decision to begin and quit hedging are not affected by Tobin's Q. By performing these tests, they conclude that the correlation between Tobin's Q and firm value does not stem from reversal causality. To substantiate these results, they also conduct an event study of the effect on the value of the firm of firms beginning or quitting hedging. These results support previous results as they find evidence, that hedging increase firm value. In fact, they also observe that the premium increases for firms that engages in hedging relatively to those that doesn't, and that the premium decreases form firms that cease their hedging engagements.

Carter, Rogers and Simkins (2006) investigate the fuel hedging behaviour of American airlines. Like Allayannis and Weston they find evidence, that firm value is positively related to hedging.

Additionally, they find that changes in firms hedging policies, are positively related to changes in firm value. They also identify a hedging premium which on average, are most likely to be in the range of 5-10 %. Carter et al. argues that the airline industry is particularly suited for investigating the relationship between firm value and hedging. The airlines are facing several hedgeable risk factors. One notably is the exposure of increasing jet fuel prices. Jet fuel prices serve as a very volatile production input. The risk from fuel price volatility are ubiquitous across all airlines and somewhat easy to observe and measure.

Carter et al. furthermore observes that the airline industry is characterized by the investment environment presented by Froot et al. in their 1993 paper. They investigate the correlation between the jet fuel cost and investment and the correlation between jet fuel costs and cash flows and find a strong positive correlation between the first to and a strong negative correlation between the latter two. This is consistent with the Froot et al. framework which suggest that firms with these characteristics can benefit more from hedging. The airline industry also faces substantial costs of financial distress as suggested by Pulvino (1998, 1999). The Froot et al. framework also suggest that firms facing significant financial distress costs, also tend to underinvest. Since Carter et al. finds negative correlation between jet fuel prices and cash flow, this also implies that the industry is well suited for investigating the relationship between hedging and firm value.

Carter et al. also examines the source of the value added. They conclude that large airlines can benefit the most form hedging, and that the value premium primarily stems from increasing investment opportunities. By hedging volatile cash flows, the airlines have more stable cash flows, providing the hedging firms with the opportunity to exploit the fire sales that other non-hedging firms might be forced to conduct, in order to avoid financial distress, in states with high jet fuel prices.

Jin and Jorion (2006) conducts an investigation of firm value and hedging in the U.S. oil and gas industry. Contrary to Carter et al. and Allayannis and Weston, they find no evidence that hedging increases firm value, they do however find, that hedging leads to a reduction in the firm's stock price sensitivity to oil and gas prices.

Jon and Jorion argues that the choice of a homogeneous industry, like the oil and gas industry, is preferable over a sample of U.S. multinationals as Allayannis and Weston uses in their study. The

single hedge of a commodity is easier to observe than currency hedges seem to be, they argue. Furthermore, their results might be less spurious because of the more homogenous sample. Jin and Jorion also uses Tobin's Q as a measure of firm value. They do not find significant different Tobin's Q's for hedgers and non-hedgers. They do, however discover evidence that larger firms tend to hedge more than smaller firms, which isn't in line with theory. Secondly they don't find any statistically significant evidence that hedging affects the value of the firm.

They explain the difference in their discoveries in several different ways. First of all, it seems that there is a crucial difference between the nature of the commodity risk exposure in their study, and foreign currency risk exposure in the Allayannis and Weston study. The commodity risk is much easier to identify, providing private investors the opportunity to diversify this risk themselves, as opposed to foreign currency risk, which is much more complex. Another explanation for the hedging premium found in Allayannis and Weston study, is that it stems from other sources, that are also positively correlated to Tobin's Q. Jin and Jorion mentions asymmetric information or operational hedges. Jin and Jorion finally conclude that the hedging premium as a minimum depends on the type of risk the firm is facing.

Pérez-González and Yun (2013) takes a different approach in their paper. They also study the relationship between firm value and hedging policy. Unlike prior studies, that primarily focuses on endogen variables, Pérez-González and Yun use the introduction of weather derivatives as an exogenous shock to firm's ability to hedge, and conduct a natural experiment. In that way they can avoid the causality challenge, that exists with endogen variables. Their sample consists of electric and gas utilities, since the demand of cooling and heating are offset in the current weather conditions. Before the introduction of weather derivatives, the authors find that firms with a high exposure to weather changes is less valuable and have more conservative financing policies, including less debt. When introducing the weather derivatives, the authors discover that firms with high exposure to weather volatility, are two to three times more likely to engage in weather hedges, than other utilities. The authors take this as evidence that firms do use derivatives because of hedging reasons. The also concludes that the use of derivatives does lead to an economic and statistical significant increase in the value of the firm. They use market-to-book ratios and find an increase of at least 6%. In addition to these findings they find that hedging also leads to more

aggressive financing policies and higher levels of investment's, consistent with the theory of Froot et al. (1993). Overall the conclusion is that risk management has real consequences for the outcomes of the firms, but the authors add in the end, that the further investigation of the possibility of transferring these results to hedging with financial derivatives as well.

Chen, Han and Zeng (2015) takes another approach in investigating the real consequences hedging has on firm value. In order to circumvent the endogeneity problem, the use cross-border mergers and acquisitions and perform an event study, where they use the acquiring firm's cumulative abnormal returns, CAR's as a measure of firm value. The idea of using the event study of cross-border mergers and acquisitions is that, the announcement of the acquisition is an exogenous shock, which is the same for all firms. During the pre-acquisition period and the interim periods, the acquirer are exposed to new foreign exchange risk, because the targets price will be denominated in the currency of the target. Furthermore, the acquiring firm might also face some additional interest rate risk, if they need external funding to fund the merger.

A typical acquirer faces new financial risk exposure when engaging in cross-border mergers and acquisitions. These risk exposures are not a firm choice variable, but a market reaction to the announcement. Overall the main difference between acquiring firms, are measured to which extent the firms are already engaged in risk management. Firms with existing risk management programs are better equipped and have lower costs to evaluate the financial risks associated with acquiring foreign firms. Chen et al. finds evidence that derivatives users have higher CAR's around deal announcement than non-users, they find a "hedging premium" of approximately 0,9% compared to non-derivative users. They mention several possible explanations for the difference in CAR's. First of all, hedging results in lower acquirer stock return volatility around deal announcements. This is consistent with theory from Smith and Stulz (1985), that hedging reduces future uncertainty. Chen et al. also explains the difference with lower asymmetric information for derivatives users, since engaging in risk management programs sends a signal of high ability. This also leads to lower cost of external financing. Last they find a lower cost of waiting for derivative user's acquirers than non-users. This part will not be discussed further.

Gilje and Taillard (2015) also examines if hedging has causal effect on firm value in their 2015 article. They identify two different groups, a treatment and a control group and they perform a natural experiment and uses the difference-in-differences framework, to exploit the effect when a sudden basis risk shock enters.

As treatment group they use Canadian light oil producers, since they face a plausible increase in basis risk, compared to American light oil producers. By using the basis risk shock, Gilje and Taillard avoids the endogeneity problem, since the shock is exogenous, and results in a reduction in the treatment group's ability to hedge. Following the basis risk shock the shareholder value for the treatment group decreases by 17%, compared to the control group. This is consistent with the theories linking the value of the firm with the probability of financial distress. The decrease in shareholder value primarily origins from a decrease in shareholder value of firms with high ex ante leverage compared to firms with low ex ante probability of distress. These results can be linked to the theory, since Smith and Stulz (1985) predicts that firms with high probability of distress will be less valuable.

Also consistent with hedging theory (Froot et al. 1993) the authors find that ex ante high levered firms also cut down in investment due to the shock. In terms of economic magnitude, firms with high probability of distress actually reduce their investment intensity with 53,9% compared to the control group. The authors also find evidence that treatment group firms, significantly reduce their hedging activity after the basis risk shock, compared to the control group.

Both the studies with endogen variables and those with exogenous variables find to some extent a positive relationship between hedging and firm value. The more recent approaches to the link between hedging activities and firm value, taking the problem with endogeneity into account, find very equal conclusions, that there is a causal link between hedging activities and firm value.

6 Quantitative analysis

6.1 Introduction

In this section I will present my quantitative analysis, it will be divided into four separate parts. The first section will be a short outline of accounting standards for financial derivatives, since it is a very important area to consider, when extracting information regarding derivatives and hedging form annual reports. The second section will be a discussion of the sample selection. The third section will be a presentation of my initial thoughts consisting of an event study of cumulative abnormal returns for American airlines, during both periods with large increases and decreases of oil prices. This initial analysis using the event study approach proved not to produce the results that I expected, why I've chosen to complement with another study using a methodology inspired by the one used by Carter, Rogers and Simkins (2006), therefore in the fourth part I will present both univariate, multivariate and binary analysis' of hedging in the European airline industry in the period from 2001-2010.

6.2 Accounting standards for financial derivatives

There are several challenges in extracting information regarding financial derivatives, for financial purposes, from annual reports. Information regarding the use of financial instruments, and the intensity, are not available at the Compustat database, but must be extracted manually from the annual reports.

Since all eight airlines from my sample are publicly listed, it facilitates the task a bit. Publicly listed companies are required to follow different accounting standards. All eight airlines therefore have adopted the accounting standards in accordance with the International Financial Reporting Standards (IFRS), as of Directive 2004/109/EC of the European Parliament and the Council of 15 December 2004 on the harmonisation of transparency[1]. This directive ensures that all listed European companies follows the accounting standards set by IFRS as from January 1st 2005.

[1] Information regarding accounting standards: http://ec.europa.eu/finance/company-reporting/index_en.htm . Last accessed January 22nd 2016.

The most relevant section, in the scope of this thesis, is IAS 39 – Financial Instruments: Recognition and Measurement[2]. According to IAS 39, the definition of derivative is:
A financial instrument:

- Whose value changes in response to the change in an underlying variable such as an interest rate, commodity or security price, or index;
- That requires no initial investment, or one that is smaller than would be required for a contract with similar response to changes in market factors; and
- That is settled at a future date.

All financial assets, including derivatives, should be measured at fair value. Fair value is the amount for which an asset could be exchanged, or a liability settled, between knowledgeable, willing parties in an arm's length transaction (IAS 39).
From 2005 onwards, the fair value of derivatives held for hedging purposes should therefore be listed in the annual reports. For my sample it turned out to be possible to extract both information regarding how much of next years' fuel requirements hedged (percent of ton kerosene) and also the fair value of derivatives used to hedge jet fuel price fluctuations. For those years where no information about hedging are listed in the annual reports, I've assumed that the airlines has chosen not to hedge in the current year. This assumption holds for 2005 and onwards, but is probably a little dubious for the years before 2005.

6.3 The choice of the airline industry as sample

When investigating the relationship between firm value and hedging, the most obvious choice is choosing an industry which is characterized by being exposed to one or more volatile inputs, that are possible to hedge. That could be companies that are exposed to interest rate fluctuations, exchange rates, because of operations in several countries, or firms that are using commodities as an input.

[2] http://www.iasplus.com/en/standards/ias/ias39 Last accessed January 22nd 2016.

My preliminary considerations on the choice of sample originated from the arguments which Carter, Rogers and Simkins (2006) presents in their article. They mention several arguments of choosing American airlines when investigating hedging and firm value, which can be transferred to the European airline industry as well. The airline industry is considered to be a very homogenous and competitive industry. The high degree of competitiveness forces the industry to ensure that their ticket fares are not very volatile, making it very hard to let increasing jet fuel prices pass through to passengers, by increasing the fares.

Since airlines, to a great extent, offer a very homogenous product, that is the transportation of people or goods from one place to another, it is very easy for passengers to substitute one airline with a competing one, in case of increasing ticket fares. The incentive and benefits of hedging are large for such an industry, and furthermore it makes it fairly easy to compare differences between hedging and non-hedging airlines.

By choosing airlines as my sample industry, I can focus on hedging of only one volatile input, jet fuel prices. The firms might hedge other variables as well, but I choose to focus only on fuel price hedging, to better be able to compare the results between hedged and unhedged firms, potentially avoiding spurious results. All airlines are exposed to fuel price risk, as opposed to e.g. currency risk, which perhaps only a subset airlines are exposed to and other industries might fit better to such a study.

As Carter et al. (2006) discovers, jet fuel prices are much more volatile compared to other hedgeable risk exposures, e.g. as currencies, making them well suited for this study, since more volatility leads to more volatile cash-flow and potentially more benefits from hedging. Moreover, the cost of jet fuel is increasing relatively to the total expenses according to International Air Transportation Association (IATA). In a 2010 report[3], they find that in 2001 the jet fuel costs represented 13,4% for North America and 12,2% for Europe. In 2008 the fraction has rose very sharply to 34,2% for North America and 25,3% for Europe. The jet fuel expenses represent a large part of the total expenses, and therefore also represents a significant risk exposure. As seen in figure 2, the European oil prices[4]

[3] The report is available at https://www.iata.org/whatwedo/Documents/economics/Airline_Labour_Cost_Share_Feb2010.pdf Last accessed December 5th 2015.

[4] Data collected from https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RBRTE&f=D Last accessed December 5th 2015.

has sharply increased during the beginning of this century, and furthermore the oil price are very volatile throughout the whole period.

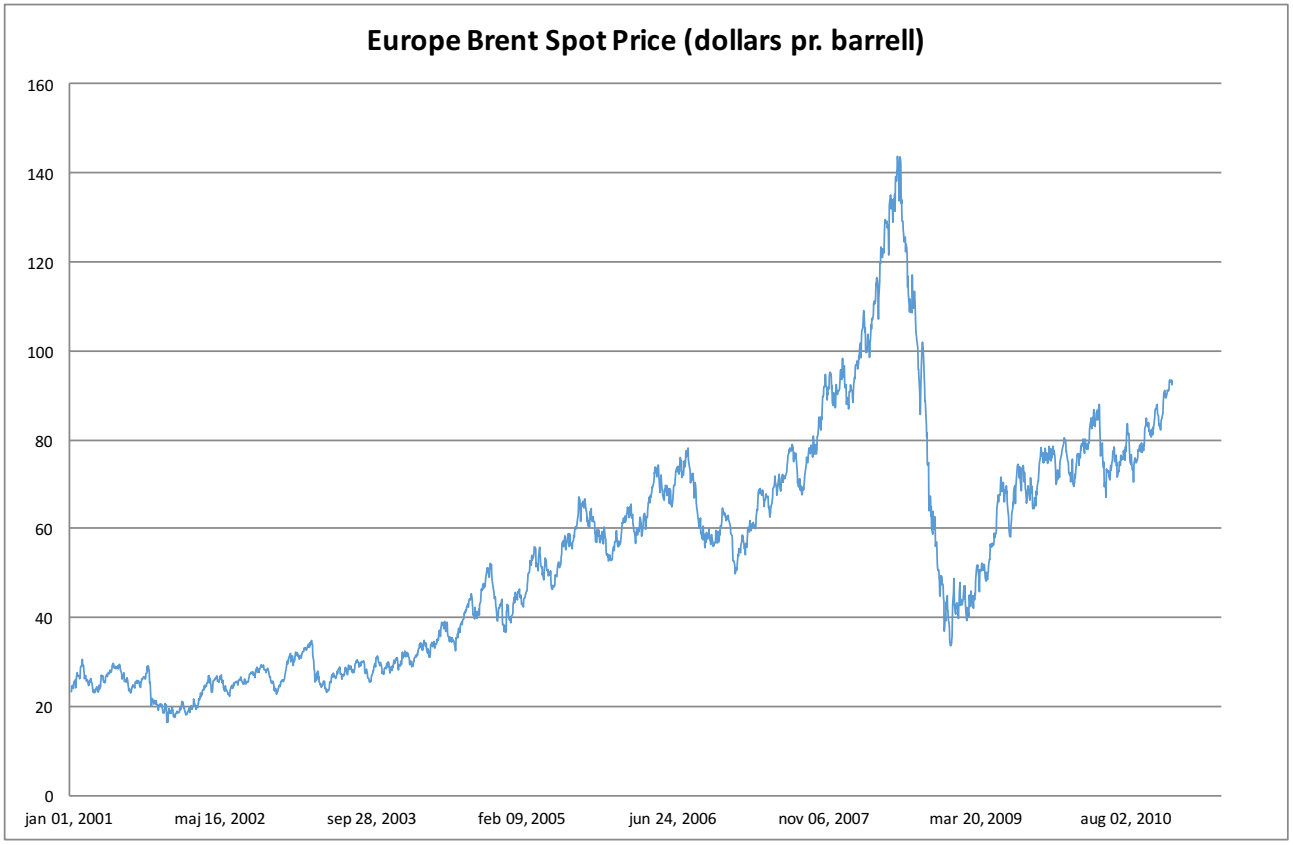

Figure 2, Anja Pagh: The Development of Brent Spot Price in dollars pr. Barrell, during the sample period.

Carter et al. (2006) also identifies two characteristics consistent with the framework of Froot et al. (1993). The airline industry is characterized as an investment environment, since the correlation between jet fuel prices and investment spending's are largely positive. The authors examine aggregate airline industry data on jet fuel costs, investment expenditures and cash flows. They find a negative correlation between cash flows and jet fuel prices. This is consistent with the findings of Froot et. al (1993) on the theory of underinvestment.

Since the fuel costs are negatively correlated with cash flows, the firms wont be able to undertake potential positive NPV projects, when jet fuel prices are high. Potential positive NPV project, could be exploiting fire sales of assets from airlines that are facing financial distress, when jet fuel prices are high (Pulvino 1998). Froot et al. (1993) also argument that the price of external funding is high when the hedgeable risk factor (here the jet fuel prices) are negatively correlated with cash flows.

This additional cost of external funding, may represent the cost of the increased likelihood of entering financial distress or other factors. Pulvino (1998) finds evidence that airlines do face significant financial distress costs, providing the airlines with even another incentive and potential benefit from hedging, in order to ensure stable cash flows. Because of the positive/negative correlation between jet fuel prices and investment spending's/cash flows the airline industry represents an obvious environment for examine hedging, since the potential benefits of hedging are large.

6.4 Event study

6.4.1 Introduction

Inspired by Chen, Han and Zeng's article "*Does Corporate Financial Risk Management Add Value? Evidence from Cross-Border Mergers and Acquisitions"* (2015) my initial idea was to conduct a similar study, using the event study approach, of the value of hedged and unhedged American airlines during sudden increases/decreases in oil prices. My preliminary thought was that a macroeconomic event, (here the sudden decrease/increase in oil prices), might affect the stock prices of airlines, since airlines have oil as a volatile input.
By using a macroeconomic factor, as the oil price change, to investigate the impact on the firm value of hedged and unhedged American airlines I avoid the endogeneity problem discussed in the preliminary methodology section.

6.4.2 Methodology

I will examine cumulative abnormal returns (CAR's) for both unhedged and hedged American airlines during two large increases and two large decreases in oil prices in the period 1998-2008. Theoretically the CAR's of the unhedged firms will be affected relatively more than the CAR's of the hedged firms in both of the cases, increasing or decreasing oil prices. As already discussed there are several theoretical explanations for this. By hedging oil prices, the hedged firms cash flows will be less volatile. Two of the main theoretical reasons why hedging might lead to higher firm value, are that stable cash flow leads to lower probability of financial distress and also higher probability of being able to engage in all positive NPV projects. Since the market reaction when oil prices changes

suddenly, is not a firm choice variable, the question is, whether the market captures the short term effect, when there is a dramatic change in the oil prices.

By using derivatives to hedge oil prices, the firms will be less affected, both when prices increases but also when prices decreases. My initial expectations are that unhedged firms will have higher CAR's around price decreases and relatively lower CAR's around oil price increases, compared to hedged firms.

If the hypothesis regarding this study (*Hypothesis 1a*) is confirmed, my interpretation is that hedged firms have higher value than unhedged firms.

Overall I use the event study approach as A. Craig MacKinlay (1997). I start by defining four events in my investigation period from 1998-2008. I use the spot price of the West Texas Intermediate (WTI) crude oil, as my benchmark for oil prices. I identify the most negative and positive percentage changes in oil prices[5] during the period. The two largest increases in oil prices are April 27th 1998 (16,62% change compared to previous trading day) and September 22nd 2008 (17,84% change compared to previous trading day). The two largest decreases in oil prices are September 24th 2001 (-15,71% change compared to previous trading day) and March 26th 2003 (-14,09% change compared to previous trading day). These four dates will represent the event dates. See figure 3, for the development of the oil prices in the period.

[5] Oil prices are collected from https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RWTC&f=D Last accessed December 5th 2015

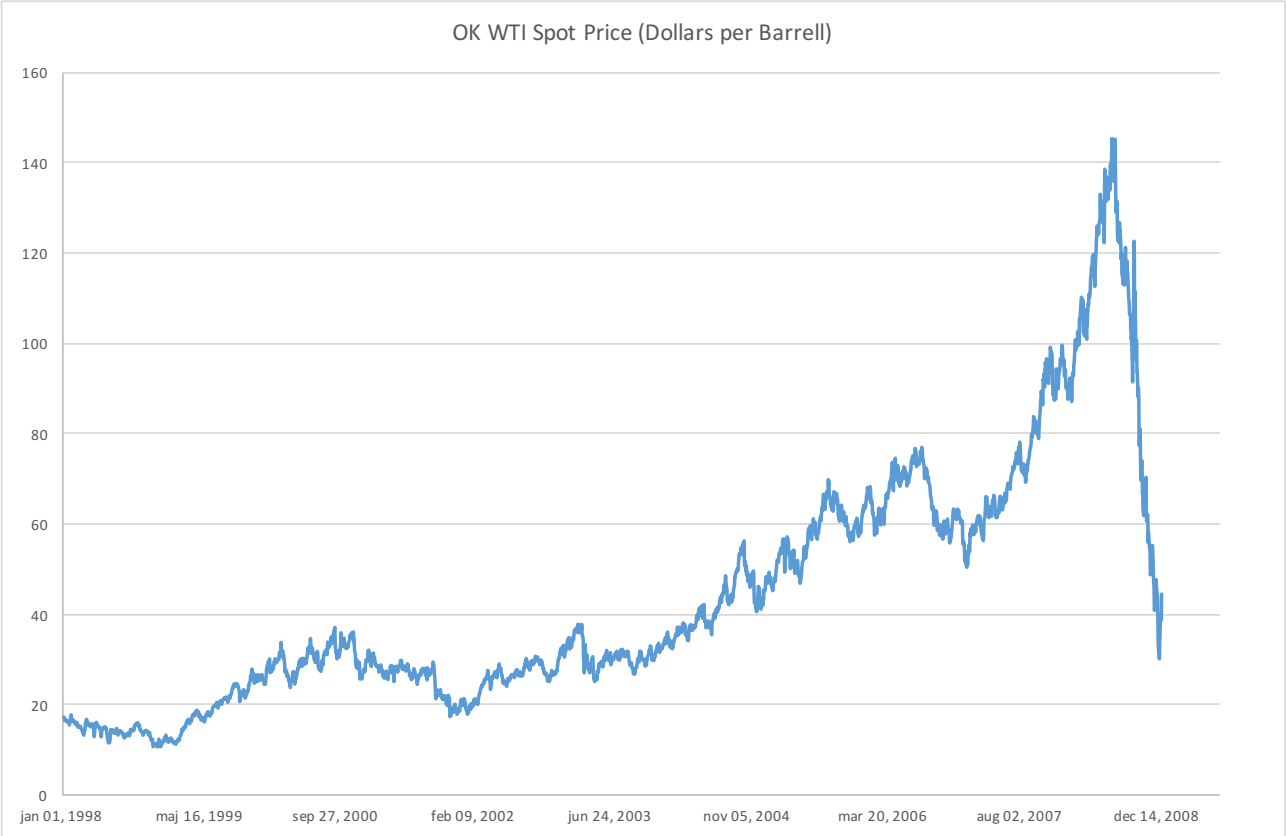

Figure 3, Anja Pagh. The WTI spot price development during 1998-2008.

I collect my sample data from Compustat and identify airlines by SIC[6] code 4512, air transportation scheduled. I collect daily stock closing prices for American airlines with SIC 4512, during January 1997 – December 2008. To test the robustness of my results, I estimate the normal returns both with a market model and constant mean return model as described by MacKinlay (1997).
As a proxy for the market, used in the market model, I use S&P 500 market weighted index, also collected from Compustat.

Since both models are only statistical and not economic, I don't expect the results to differ very much. I estimate the normal returns for both models using an estimation window of 120 non-missing daily returns, prior to the event window [-125,-5]. The choice of 120 days in the event window, is the same choice as MacKinlay (1997). The firms CAR's are measured over a window of 5 days before event date (day 0) and 5 days after event date [+5,-5]. I end up with 19-24 (depending

[6] SIC codes are *Standard Industrial Classification*, and are used to identify the primary business of the establishment. SIC 4512 represents "Air transportation scheduled".

on event) airlines for which I calculate continuous compounded returns, the chosen airlines are listed in Appendix 1. The abnormal returns are calculated as the difference between the normal return (both from market model and mean return model) and the actual returns from the event window. When these are aggregated I get the cumulative abnormal returns.

The normal returns using the market model, has been calculated as (MacKinley 1997):

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}$$

Using the estimation window, to estimate alpha and beta, R_{it} is the return for company *i* at time *t*. R_{mt} are the market return at time *t* and ϵ_{it} is the error term for company *i* at time *t*.

To calculate the abnormal return:

$$AR_{it} = R^*{}_{it} - (\alpha_i + \beta_i R_{mt})$$

Where $R^*{}_{it}$ are the actual returns from the event window.

The normal returns using the mean return model, has been calculated as (MacKinley 1997):

$$R_{it} = \mu_i + \epsilon_{it}$$

Using the estimation window to calculate μ_i, R_{it} is the return for company *i* at time *t* and ϵ_{it} is the error term for company *i* at time *t*.

To calculate the abnormal return:

$$AR_{it} = R^*{}_{it} - \mu_i$$

To get the cumulative return, for both models I get:

$$CAR_i = \sum_{t=-5}^{5} AR_{it}$$

In order to test whether the CAR's are statistically different from zero, I perform a t-test, and get corresponding p-values, from which I conclude. Results are tabulated in Appendix 2 and the most important are discussed in the following section.

6.4.3 Results

Unfortunately, only very few of my CAR's are statistically different from zero, and most of my p-values are very large and close to 1. Only after the 9/11 terror attack in 2001, I get CAR's that are different from zero at a 5% significance level, but since the market was very unstable and shocked after this event, these results are not reliable.
Because of the fact, that I only have very few, not very reliable, CAR's I must conclude that a daily oil price shock, doesn't affect the short run returns and thereby the market value of the firm, for American airlines and a further investigation of the relationship between hedging variables and CAR's are not possible based on this set of data.
In the short run, the market doesn't capture the effect of a sudden change in the oil price. The market value of the firm might be affected in the long run. An investigation of the long run effect and the choice of period to investigate, could have been another perspective on this thesis.

Since the oil prices are very volatile, even on a daily basis, a sudden price drop, can be followed by an equal price increase within the same event window. These might cancel each other out, resulting in a CAR of zero. By choosing a larger event window, capturing a period with an ongoing increase/decrease, the market might have captured the long term effect. With this type of study, it might be quite difficult to isolate the pure effect from hedging, since dramatic changes in the oil price, might effect the airline industry as a whole. I choose not to continue investigating the link between hedging and firm value using the event study approach, since I have doubts about how to create the set-up and in the end interpret the results. I've prioritized to follow a well-known approach, in order to have some results to interpret. The main quantitative analysis that follows are inspired by the one used by Carter et al. (2006).

6.5 Hedging and firm value of European airlines

Since my initial thoughts of performing an event study, to avoid the endogeneity problem, turned out to produce results that where statistically insignificant, I've decided to perform a study more or less similar to Carter, Roger and Simkins (2006). I want to test whether it is possible to transfer Carter et al.'s results to the European airline industry as well.

6.5.1 Sample description

I have gathered information about European airlines from the Compustat database. Initially I collected information on all European airlines with SIC code 4512, these have subsequently been reduced. I investigate the period from 2001 to 2010, I've chosen this period since it includes both the terrorist attack of 9/11 2001 and the financial crisis in 2008, both events had significant effect on the oil price, making the period well suited, for investigating the potential benefits from hedging jet fuel prices.

The demarcation of the period is also selected because of the scope of this thesis. Some of the hedging variables are hand collected from annual reports, making the data collection highly time consuming. The selection of the period also affects the selection of entries, since I need both financial data and annual reports for all years. I end up with eight airlines in my final sample, corresponding to 76 firm-year observations, unfortunately I lack information of 4 firm-year observations for the whole 10-year period. The final selection of airlines in the sample are presented in table 1.

Final sample of European airlines			
RYANAIR HOLDINGS PLC	*DEUTSCHE LUFTHANSA AG*	*FINNAIR OY*	*EASYJET PLC*
AEROFLOT-RUSSIAN INTL AIRL	*TURKISH AIRLINES*	*NORWEGIAN*	*SAS AB*

Table 1, Anja Pagh: Final eight airlines in sample.

Norwegian Airlines started operating in 2004, leaving out observations from 2001-2003. Despite of this lack of observations I've decided to include the airline in my study. Over the years 2004-2010 Norwegian are responsible of both unhedged and hedged firm-year observations, why I might loose important information by omitting the airline from my study. The last missing firm-year observation stems from from Turkish Airlines in 2001, since it proved impossible to retrieve data from Compustat for this particular year. I've included Turkish Airlines despite of this, since they account for many of the unhedged firm-year observations. In total I have 76 firm-year observations of which 59 firm-years are hedged, leaving 17 firm-years unhedged.

I define a firm-year as unhedged, if there are no reports of derivative usage of jet fuel hedging purposes in the annual report. As mentioned, from 2005 and onwards all 8 firms, are subject to legislation in accordance with IFRS, which means that all derivatives usage of hedging purpose must be measured at fair value and listed in the firms' respective annual reports. I don't investigate whether a firm hedges other risk exposure than jet fuel price fluctuations.

I've gathered financial data from Compustat for all eight airlines, a more detailed description of these variables follows later in this section. Since the Compustat database doesn't provide information regarding fair value of hedging instruments or how much jet fuel hedged for each firm-year, this information has been hand-picked from the annual reports for each firm. All of these annual reports are available at the respective airlines web-pages. I've gathered information regarding calendar years 2001-2010. Since the the airlines uses different accounting periods and fiscal year ends, I define annual reports disclosed in January-June as previous calendar year and annual reports disclosed July-December as current calendar year. For example, Ryan Air has fiscal year end at March 31st, resulting in the information from this report will belong to last year's calendar year.

The information about the derivatives usage has been hand collected in the annual reports. I have searched for the following keywords in order to locate the information of financial derivatives: *"derivative", "financial instrument", "forward contract", "future", "hedg", "option", "risk management", "commodity"* and *"fair value".*

Comparing the airline industry there are some regional differences between North America and Europa. The fraction of jet fuel expenses, according to the 2010 IATA report[7] to total expenses are relatively larger for North America, the difference are most significant in 2008, compared to 2001. An explanation for this, could be, that labour is relatively cheaper in North America compared to average Western European countries[8]. Even though this difference exists the fraction of jet fuel costs to total expenses are very large, also for the European airline industry. Because of this the European airline industry also faces a significant risk factor in jet fuel prices. Figure 5 shows a chart of the jet fuel prices and Brent Crude Oil. According to Investopedia Brent Crude Oil are used as a benchmark of European oil prices[9], why this and not WTI Crude Oil (which primarily serves as benchmark for the American airline industry) are chosen as benchmark in my investigation of European airlines and the benefits of hedging.

[7] The report is available at https://www.iata.org/whatwedo/Documents/economics/Airline_Labour_Cost_Share_Feb2010.pdf Last accessed December 5th 2015.

[8] Data retrieved from: http://www.theatlantic.com/business/archive/2013/09/how-americas-minimum-wage-em-really-em-stacks-up-globally/279258/ Last accessed January 22nd 2016.

[9] http://www.investopedia.com/articles/investing/102314/understanding-benchmark-oils-brent-blend-wti-and-dubai.asp?layout=orig Last accessed at January 22nd 2016.

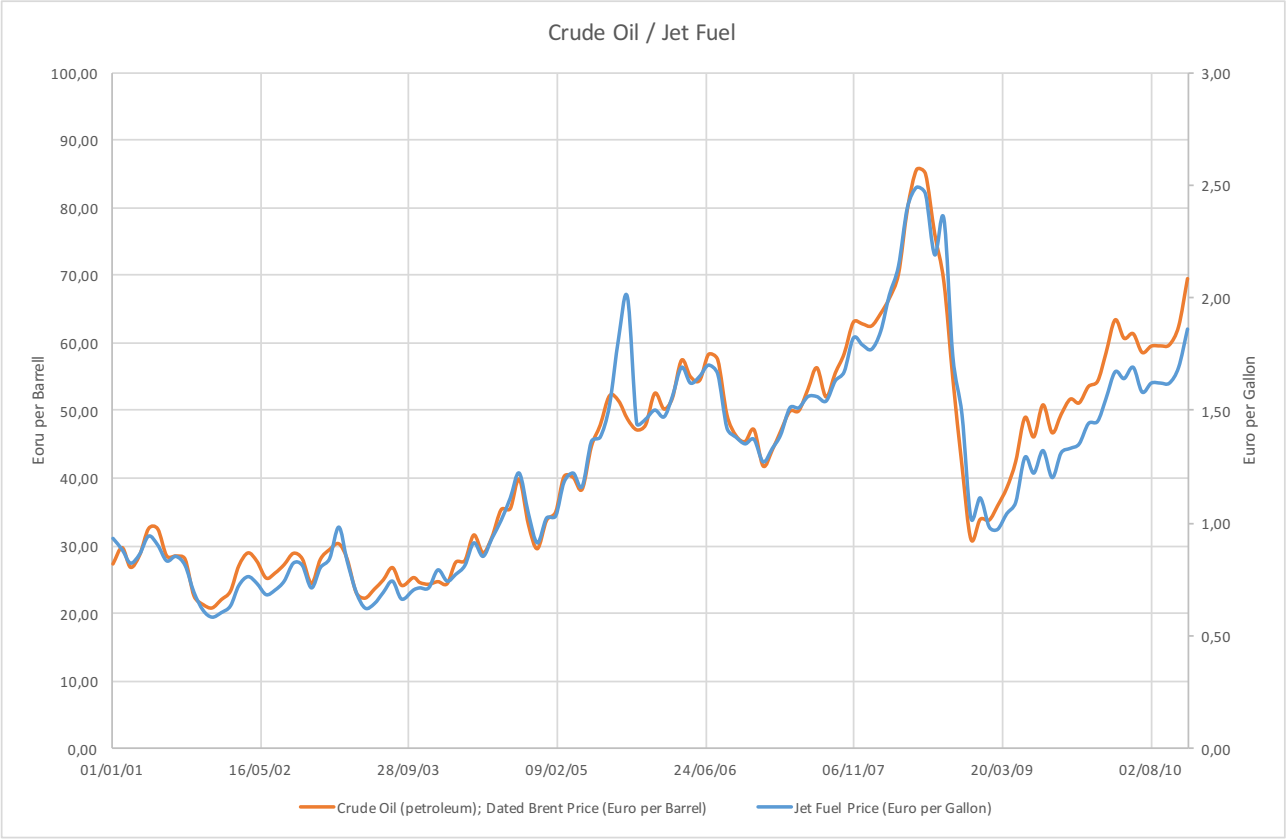

Figure 5, Anja Pagh: The development of crude oil and jet fuel prices, 2001- 2010.

From this chart, it is very clear to see that jet fuel prices are very volatile and fluctuates with the price of Brent Crude Oil. Especially from 2006 and onwards the fluctuations are very large and peaks around the financial crisis in 2008.

6.5.2 European airline as an investment environment

Carter et al. (2006) investigates whether the airline industry as a whole can be characterized as an investment environment. Since the results applies to the total industry, I can transfer these results to the European airline industry as well. Despite this, I have chosen to make a brief survey of the data I have available in order to investigate whether the chosen European airlines in the years 2001 to 2010 can be characterized as being a part of an investment environment, as Froot et al. (1993).

As a proxy for investment spending's I have used the variable for capital expenditures (CAPEX)[10] from Compustat. I have calculated a simple average of the eight airlines CAPEX as a percentage of total book value of assets, for all airlines in the years 2001-2010. I have also calculated a simple average of total long term debt[11] to total book value of assets and net cash flow from operating activities[12] to total book value of assets in a similar way, the results are reported in the table 2.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Cash flow to assets	9,3%	11,1%	9,5%	5,7%	11,4%	9,8%	11,3%	6,0%	5,9%	8,4%	8,9%
CAPEX to assets	13,2%	9,7%	7,9%	10,1%	7,4%	14,0%	9,7%	11,4%	13,9%	10,7%	10,8%
Debt to assets	22,8%	18,6%	22,7%	20,7%	18,7%	19,9%	20,1%	23,9%	26,7%	30,3%	22,5%
Jet fuel price (€/gallon)	0,81	0,73	0,73	0,92	1,38	1,53	1,55	1,99	1,18	1,62	1,24

Table 2, Anja Pagh: Investment environment.

From this small survey it is difficult to discover a clear pattern. Both cash flow and CAPEX to total book value of assets fluctuate a lot. In 2001-2003 jet fuel price declines, leading to increasing cash flow to assets. In 2004 when the jet fuel price increases the cash flow decreases sharply. In the following years there are no clear pattern, but when jet fuel prices increase rapidly in 2008 the cash flow declines. Overall the Pearson's correlation between jet fuel prices and cash flow to assets, over the whole period, are -0,1567. The correlation is negative, although it is not particularly strong. The negative correlation is consistent with the assumptions of a cash flow environment discussed by Froot et al. (1993).

In the beginning of the period CAPEX to total book value of assets fluctuates fairly well with jet fuel prices, but from 2005 and onwards the positive relationship is questionable. Overall the correlation between CAPEX to total book value of assets are 0,1691. The correlation is positive, but not very strong. The positive correlation between CAPEX to total book value of assets and jet fuel prices,

[10] The variable is described as: CAPX; This item represents the funds used for additions to property, plant, and equipment, excluding amounts arising from acquisitions (for example, fixed assets of purchased companies). This item includes property & equipment expenditures. From Compustat December 5th 2015.
[11] The variable is described as: DLTT; U.S. and Canadian GAAP Definition. The item represents debt obligations due more than one year from the company's balance sheet date. From Compustat December 5th 2015.
[12] The variable is described as: OANCF; U.S. and Canadian GAAP Definition. This item represents the net change in cash from all items classified in the Operating Activities section on a Statement of Cash Flows (Format Code = 7). From Compustat December 5th 2015.

indicates that these airlines are characterized as being a part of an investment environment, consistent with the assumptions of Froot et al. (1993). When the hedgeable variable is being expensive, i.e. the jet fuel prices are high, the airlines have high capital expenditures, meaning that the airlines could benefit from hedging the jet fuel prices, to ensure stable and less volatile cash flows. At the same time cash flows are low, making internal funding insufficient. The airlines must assure that they have enough cash on hand, to take advantage on the fire sale of assets, that the financial distressed airlines might be forced into, when jet fuel prices are high. The financial distressed airlines might also be forced to seek external funding, which increases the financial distress cost, which adds another incentive of hedging the jet fuel prices.

The total debt to assets ratio are fairly stable around 20% in the beginning of the period. It increases rapidly in the end of the period, following the very high jet fuel prices. The correlation between the two are 0,2806. When the jet fuel prices are high, cash flows are low, forcing the industry to seek expensive external funding, to be able to engage in positive NPV projects. This represents another incentive for airlines to hedge, in order to ensure stable cash flows, to avoid engaging in expensive external funding.
Overall the European airline industry is an obvious industry to investigate benefits of hedging in relation to the underinvestment and financial distress incentives to hedge, the same results that applied to the environment from the Carter et al. article.

6.5.3 Hedging in the European airline industry

Table 3 presents information regarding hedging for the sample for the years 2001-2010. Since not all annual reports are disclosed in the same currency, I have converted all currencies to Euro, using Reuters Currency converter[13], for all fiscal years.

[13] Reuters Currency Converter, can be accessed at: http://www.reuters.com/finance/currencies#umM86Yd3WeobdUcZ.97. Last accessed at December 10th 2015.

	Fiscal Year end	Calendar year observations	Currency	Jet fuel to operating expenses	Years hedged	Average per-cent of next years hedged
RYANAIR HOLDINGS PLC	March 31st	2001-2010	EUR	37,47%	2001-2010	72,35%
DEUTSCHE LUFTHANSA AG	December 31st	2001-2010	EUR	19,34%	2001-2010	74,00%
FINNAIR OY	December 31st	2001-2010	EUR	18,03%	2001-2010	51,70%
AEROFLOT-RUSSIAN INTL AIRL	December 31st	2001-2010	USD	33,19%	2005-2006; 2010	4,00%
SAS AB	December 31st	2001-2010	SEK	10,91%	2001-2010	51,20%
EASYJET PLC	September 30th	2001-2010	GBP	22,13%	2002-2010	54,10%
NORWEGIAN	December 31st	2004-2010	NOK	23,04%	2004; 2006; 2008-2010	9,43%
TURKISH AIRLINES	December 31st	2002-2010	02-03; TRL 04-10; TRY	26,90%	2009-2010	2,22%
Total				*23,88%*		*39,88%*

Table 3, Anja Pagh; Hedging for sample years 2001-2010.

Jet fuel to operating expenses are calculated as a simple average for all eight airlines. The variable varies a lot between the eight airlines. From SAS's approximate 10% to Ryanair with almost 40% on average over the 10 years of observations. Generally, the low cost airlines have higher fractions, primarily because their total operating expenses are relatively lower than for the other airlines. The fuel cost to total expenses, are fairly stable for all airlines up until 2006, where the fractions dramatically increases for most airlines. The total average over the period are almost 24 percent, which is consistent with the founding's of IATA in their 2010 report[14]. Half of the airlines are hedged against jet fuel fluctuations over the entire study period. Half of the airlines have both hedged and unhedged firm year observations. Turkish Airlines are only hedged two out of nine years, leaving them most exposed to price fluctuations, why they are kept in the analysis despite the fact that they lack one firm year observation.

The variable containing information regarding how much of next years' fuel requirements are hedged, are also very inconsistent between the airlines. Two airlines hedge on average almost ¾ of the next year's fuel requirements, 3 airlines hedge on average approximately half of next years' fuel

[14] https://www.iata.org/whatwedo/Documents/economics/Airline_Labour_Cost_Share_Feb2010.pdf Last accessed at January 22nd 2016.

requirements and the last three hedge on average less than 10 percent. Norwegian is the airlines with the most different percentages between each calendar year observation. They even shift between a hedged year followed by an unhedged year followed by a hedged year again. This may be a sign that their approach is more speculative than the remaining airlines. Despite Norwegian the other airlines, have quite stable hedging intensity and doesn't seem to speculate.

My focus in the following analysis's are primarily of the benefits of hedging from the cost of underinvestment (Froot et al. 1993) and the cost of financial distress (Smith and Stulz 1985). These variables are fairly easy to quantify and the information are available at Compustat database. The potential tax benefits are not examined primarily because of the different tax regulations for the different countries, making conclusions very time-consuming. In my initial theoretical discussion, it was also found that it was questionable whether there where any significant tax benefits from hedging, and that these benefits only where relevant for a very small proportion of firms, why omitting this part from my analysis seems judicious.
Moreover, it turned out to be more challenging than expected to gather information about the compensation scheme of managers. The way in which managers are compensated might align the interest of shareholders and management, lowering the agency cost of leverage. According to Tufano (1998) management furthermore might want to engage in hedging, in order to make sure they have sufficient cash flow holdings to feed their own "pet projects". The relationship between management compensation and hedging are therefore obvious to investigate. Some of the airlines have listed information regarding the management compensation scheme in their annual reports, but since I lacked a lot of observations and had problems with quantifying the information I've chosen to omit this part from my analysis.

6.5.4 Univariate and multivariate analysis

In this section I will conduct both univariate and multivariate analysis in order to define the determinants of hedging and investigate the value adding perspective by regression analyses. As already mentioned in the previous section, I have chosen to focus primarily of the determinants arising from financial constraints, i.e. benefits from hedging due to the costs of underinvestment and financial distress. I've omitted the tax incentives, due to two reasons. First different tax

regulations for the different countries in my sample, makes it difficult to unify the results. Second Carter et al. (2006) finds no statistical evidence that there's a relationship between hedging and carry-forwards (proxy for tax-convexity) and they omit the variable from their analysis. Due to these reasons I've chosen to omit the tax incentives of hedging.

The managerial incentives of hedging are also omitted. I didn't manage to gather information about managerial compensation for all airlines in my sample, furthermore I has difficulties in quantifying my observations. Carter et al. (2006) furthermore finds only little statistical evidence that there exists a relationship between hedging and the managerial compensation. Due to this, the managerial incentives of hedging are also omitted. The variables included in all analysis's, are control variables and hedging variables, primarily due to underinvestment and financial distress incentives.

The hedging variables are selected on the basis of the discussion in the theory section and previous empirical findings, and are chosen as proxies for different hedging determinants. Compared to the study of Carter et al. (2006) I've omitted some variables as discussed earlier and have chosen to focus primarily on the benefits of hedging from the cost of underinvestment and the cost of financial distress.

6.5.4.1 Variables description

I've selected 7 variables to compare in my univariate analysis and 7 covariates to include in my regression analysis's. A description of the variables follows in this section. The parenthesis following the name represents the shortening used in the later regression analysis.

Approximate Q (*App.Q)*: I've chosen a simplification of the original Tobin's Q as a proxy for the value of the firm. The simplified Q value (Chung and Pruitt 1994) have a very high correlation with the original Tobin's Q, but is much easier to calculate, my definition is Approximate Q:

$$App.Q = \frac{Market\ value\ of\ equity\ +\ Book\ value\ of\ liabilities}{Book\ value\ of\ total\ assets}$$

where the market value of equity is calculated as the outstanding shares multiplied with the share price. In this simplified version, it is assumed that the market value of liabilities is equal to the book value. The numerator of the fraction contains information regarding the markets perception of the value of the firm, and the denominator contains information regarding the replacement costs. An *App. Q*-value between 0 and 1, therefore corresponds to a firm, that has a market value below replacement costs, and an *App. Q*-value higher than 1, corresponds to a firm that are higher valued by the market, than the firm's replacement costs. The App. Q-value can, as a result of this, also be viewed as a proxy for the firm's growth opportunities. This means that there are several different views when interpreting this variable and that there might be some overlapping conclusions.

Company size (*Size*)**:** Is calculated as the natural logarithm of the market value of the firm. This is included since the theory of benefits of hedging due to financial distress costs, expects that small firms hedge more, since they face relatively larger costs of financial distress. Empirically the relationship has, in many studies, proved to be reverse, due to the fact that larger firms have economies of scale, when it comes to risk management programs. Theoretically I therefore expect this variable to be negatively related to hedging, and that hedgers are smaller firms compared to non-hedging firms, but the relationship will most likely be represented as positive, since the empirical findings from similar studies has proven this.

Number of passengers (*Psgn*)**:** Passengers carried in millions per year, this variable is included because airlines with more passengers, have more customers, leaving them with a competitive advantage. The initial thought is, that these firms have more loyal customers, and therefore are less likely to hedge, since the customers prefer loyalty over small price increases due to increasing jet fuel prices. I expect that hedgers have fewer yearly passengers, than non-hedgers do.

ROTA (Return on Total Assets) (*ROTA*)**:** Measures how effectively firms uses their assets. The variable are calculated as: $ROTA = \frac{EBIT}{Total\ Book\ Value\ of\ Assets}$. The larger fraction, the more profitable the firm is. I expect firms that have lower profit ratios to be hedgers, since they can benefit more from engaging in hedging activities than airlines with higher profit ratios. Low ROTA ratios corresponds to lower relative earnings; the airline would need to stabilize its cash flows in

order to ensure that they have sufficient internal funding's to engage in all positive NPV projects at all times.

Fuel costs as a percentage of total expenses (*Fuel/exp*)**:** Measures the fraction of fuel costs to total expenses. This variable is important to include for several reasons. First of all, I expect this fraction to be positively related to the likelihood of firms hedging jet fuel price risk. Secondly this variable also is important to include in the perspective of cash flows. In order to secure stable cash flows to minimize the cost of underinvestment and the cost of financial distress, I expect that hedge firms have higher ratios than unhedged firms, because they can benefit much more from hedging, since they are relatively more exposes to jet fuel risk.

CAPEX to assets (*CAPEX*)**:** Measures the growth opportunities of the firm. It is calculated as the Capital Expenditures to the Total Book Value of Assets. This variable is included because of the benefits of hedging due to the cost of underinvestment. The higher fraction, the shorter term growth opportunities the firm has. Theory expects that firms with a higher fraction would benefit more from hedging, due to the higher needs of stable cash flows, ensuring the possibility of entering all positive NPV projects. I therefore expect that hedgers have a higher ratio of CAPEX to assets and that this variable is positively related to the likelihood of hedging.

Cash to Sales (*Cash*)**:** Measures the firm's ability to generate cash. It is calculated as the Total Cash to Total Sales/turnover. The higher the ability to generate cash, the less likely it is for the firm to hedge, since they are less financial constrained. I expect hedging firms to have lower cash to sales ratio, compared to non-hedgers. The cash to sales ratio are therefore also expected to be negatively related to the likelihood of hedging, because cash provides the firms with a financial buffer, which makes it possible to avoid expensive external funding, keeping the financial distress costs low.

Debt to assets (*Debt*)**:** Measures the application of external funding. Is calculated as the Long Term Debt to the Total Book value of Assets. This is also a proxy for the cost of financial distress. According to theory, I expect firms with higher debt to assets ratio to face higher probability of financial distress, followed by higher costs of financial distress. Due to this fact, I expect hedged firms to have

a higher ratio of debt to assets than unhedged firms and that the ratio will be positively related to the likelihood of hedging.

6.5.4.2 Univariate analysis

In this section I will present my results from the univariate analysis, of different characteristic for the group of hedged and unhedged airlines and compare the results to my expectations according to theory and the hypotheses 2a-2g.

The degree of hedging is not taken into account, an airline is solely classified as a hedging airline, if they have reported some sort of jet fuel hedging in the current fiscal year. I have conducted both univariate analysis for the whole sample period but also on a yearly basis. Only results for the whole period are tabulated, but the most important findings for the different years will be discussed. I will discuss my findings and conduct an analysis of whether the mean values for the two groups are statistically different from each other, using a t-test and the corresponding p-values.
Table 3 summarizes the results, ** indicates that the mean values are statistically different form each other on a 5% level and * indicates that significance level corresponds to 10%.

	Mean		**Std dev**			
	Hedged	Unhedged	Hedged	Unhedged	t-statistic	P-value
Number of passengers (mio)	30,624	10,730	21,146	5,174	6,575	0,000**
ROTA	0,026	0,086	0,071	0,048	-4,031	0,000**
Fuel cost as a percentage of operating expenses	0,228	0,274	0,114	0,084	-1,818	0,073*
Company size	8,200	7,110	1,204	0,969	3,859	0,000**
CAPEX to assets	0,113	0,075	0,064	0,061	2,236	0,028**
Debt to assets	0,219	0,236	0,098	0,124	-0,527	0,600
Cash to sales	0,257	0,103	0,348	0,166	2,536	0,013**
App. Q	1,046	1,480	0,314	0,637	-2,713	0,000**

Table 3, Anja Pagh; characteriscts for hedged vs. Unhedged firms.

The approximate Q-value are higher for non-hedgers than for hedgers, the result is statistically significant at a 5% level. My yearly findings are consistent with this, except in 2006 where I find a reverse relationship. According to theory I would have expected to discover the opposite. My overall hypothesis is whether hedging creates value for firms. Since I use the App. Q-value as a proxy for the firm value, I would have expected that hedging firms would have had a higher value compared to unhedged firms. Interpreting the App. Q-value as growth opportunities doesn't change that my findings are contradictive to theory, since firms with more growth opportunities can exploit more benefits of hedging compared to firms with less growth opportunities.

Furthermore, I discover that hedgers have more passengers than non-hedgers, the difference are statistically significant. This is also the case for all yearly observations. This is the opposite of what I expected. I'd expected airlines with the most passengers, to have more loyal customers and therefor be less exposed to customers escape in case of ticket fare increases, due to jet fuel price increases. On the other hand, the explanation could be that in fact the airlines with the most passengers actually are more exposed to jet fuel prices due to the large customer surface, giving them an incentive to hedge

The Return on Total Assets are larger for non-hedgers than hedgers, the difference is statistically significant and applies to all yearly observations as well. Again I observe, that the relationship is opposite than what I expected. I actually observe a higher profitability for non-hedging airlines. The different are actually quite large, making unhedged firms three times as profitable than hedging firms. Non-hedgers, that are often smaller airlines, might be more focused on the core business, compared to larger firms, that also engages in risk management programs, CSR or other corporate activities. By focusing on the core business, the earnings and the profitability are important, which might explain why ROTA are larger for non-hedgers.

The fuel cost as a percentage of total expenses are larger for non-hedging airlines than hedging airlines. The difference is statistical significant at a 10% level. For most yearly observations the difference is actually significant at a 5% level. Only in 2005 and 2006 I observe no statistical significant difference. Overall airlines with a higher fraction should benefit more from hedging, since

they have a higher exposure to jet fuel price fluctuations, because of this my results are contradictive to theory. On the other hand, since my sample consists of airlines that primarily have an ongoing hedging programme, I can expect that over the whole sample period the fuel costs are lower for hedging airlines, due to benefits from hedging. This applies, because the period is characterized by a long period of increasing prices. Another possible explanation could be that larger airlines (as I will discuss later, hedging airlines are primarily large compared to unhedging airlines) have more fixed cost, which makes the denominator larger and the fraction smaller.

For my dataset, unhedged airlines are smaller than hedged airlines, the difference is statistical significant, when investigating the whole period. When looking at the yearly observations, there are several years where unhedged and hedged firms are equal of size, making it trifle difficult to interpret the results. According to theory due to the cost of financial distress, smaller firms could benefit more from hedging than larger firms. Theory expects the opposite of my findings, for the whole period, however many (Nance at al. 1993, Jin and Jorion 2006 and more) empirical studies in fact exploit that hedgers are larger than non-hedgers. Larger firms have economies of scale, making the fixed costs of having a risk management program relatively smaller. To implement a risk management program, it takes a lot of expertise in hedging and derivatives, and also involves strategic risk management programs, resources that smaller firms might lack. If large corporations already have risk management programs regarding other risk exposures than commodity prices, the costs of including hedging of jet fuel prices in the risk management program are smaller compared to small airlines that only have risk management programs in the start-up phase.

CAPEX to assets are larger for hedgers than non-hedgers, this difference is statistically significant and consistent for almost all yearly observations as well. This is consistent with theory, since firms with more short term investment opportunities, benefit more from hedging. I therefore in my sample find evidence that firms with more investment opportunities hedge to avoid the problem of underinvestment, since hedging ensures sufficient internal funding even in times where cash flows would have been low.

For the entire period I discover no statistical difference in debt to assets for hedged and unhedged airlines. When investigating yearly observations, I discover that from 2006 onwards unhedged

airlines have higher debt to assets ratios, these differences are statistically significant at a 5% level. According to theory firms with higher debt to asset ratios face a higher probability of financial distress, making it more attractive for these firms to hedge, since the benefits are large. Since my findings are opposite than what I expected, one explanation could be, that the hedging airlines don't need to take on external funding, since they have already exploited the stable cash flows that's the result of hedging, ensuring that they have sufficient interval funding.

The cash to sales ratio are higher for hedging firms than non-hedging, the difference is statistically significant. Comparing yearly observations my findings matches this, except in 2001, where there is no difference. Again this is opposite to what I's expected, since firms with a high ability to generate cash theoretically are less likely to hedge. The explanation could also be reverse. Since hedging airlines have ensured stable cash flows due to their hedging program, they have a higher cash to sales ratio.

6.5.4.1.1 Conclusion univariate analysis

In my univariate analysis most of my findings where statistical significant at a 5% level. Overall I found that hedgers are larger and have more passengers than non-hedgers. This is opposite to the theoretical expectations, but consistent with many empirical findings in prior hedging studies. Larger firms have economies of scale, making the fixed cost of risk management relatively lower than for smaller firms. When investigating different firm characteristics, I only discovered that the variable CAPEX to assets followed my prior expectations. Firms with more short term investment opportunities are hedgers, since they need to ensure stable cash flows in order to be able to engage in all positive NPV projects. For the rest of my variables I found relationships that where contradictive to theory. I found that hedgers have higher cash to sales ratio, lower debt to assets ratio and lower costs of fuel to total expenses. One explanation could be that most of my sample airlines have an ongoing hedging programme, and therefore already have exploited the benefits of hedging, that is stable cash flow, less need of external funding and lower cost of fuel, due to hedging activities. In this sample I found than non-hedging airlines are more profitable, which I explained by smaller firms (non-hedgers) having more focus on core business and thus also the earnings. Last I

found that hedgers have lower App. Q-values than non-hedgers. That is contradictive to my predictions, since hedgers theoretically should have exploited all the benefits from hedging, leading to a higher firm value.

6.5.5 Multivariate analysis

6.5.5.1 Variables

In this section of multivariate analysis, I use the variables already listed in the previous section but I also supplement with some additional variables, which are described below. The parenthesis following the name, represents the shortening used in the regression analysis:

Percent of next years' fuel hedged (*Percent hedged*): Information about how much of next years' fuel requirements are hedged at the end of current fiscal year. The information is gathered from the respective firm's annual reports.

Binary variable (*Binary hedged*): Is an indicator variable, indicating if the firm has reported any hedging activities measured as next years' fuel requirements hedged equalling one if next years' fuel hedged are larger than zero and 0 otherwise

Fair value of hedging to total assets (*Fair Value*): The fair value of derivatives regarding jet fuel hedging to total book value of assets. The information is gathered from the respective firms' annual reports.

6.5.5.2 The determinants of hedging

In the univariate analysis I examined the single variable determinants of hedging. To further investigate the determinants of hedging I've conducted two ordinary least squares regression analyses for the sample period 2001-2010, where several of the variables has been included as covariates. I have two models, one with the percentage of next years' fuel requirements hedged as dependent variable and one with the binary variable equalling one if next years' fuel hedged are larger than zero and 0 otherwise.

The results are tabulated below in table 4, ** indicates that the coefficient are significant at a 5% level * indicates the significance on a 10% level. For the first model, I started by estimating the coefficients by using ordinary least squares. I tested the assumptions (will be discussed later), and found first order autocorrelation in the remaining residuals. With autocorrelated residuals OLS are still unbiased, but not surely most efficient. Due to this I've estimated the coefficients both using OLS and Feasible Generalized Least Squares (FGLS), correcting for the autocorrelated residuals. The estimation procedure can be found in Appendix 3 (Alexander, 2008). All calculations and OLS and FGLS coefficients estimation are performed in Excel using matrix algebra, that means no data-analysis tool package functions, because of the opportunity to expand the models easily. For the binary logit model I've used SAS JMP software package to estimate the coefficients.

Model 1:

$Percent\ hedged_{it} = \beta_0 + \beta_1 App.Q_{it} + \beta_2 ROTA_{it} + \beta_3 Size_{it} + \beta_4 CAPEX_{it} + \beta_5 Debt_{it} + \beta_6 Cash_{it} + \varepsilon_{ti}$ and where $\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it} \quad \eta_t \sim i.i.d(0, \sigma_\eta^2)$

	Model 1 OLS				Model 1 FGLS			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	-103,3548	32,7576	-3,1551	0,0024**	-100,5538	33,7964	-2,9753	0,0041**
App. Q	1,8005	8,2872	0,2173	0,8287	0,4225	8,5500	0,0494	0,9607
ROTA	-158,4996	42,2089	-3,7551	0,0004**	-108,5701	43,5476	-2,4931	0,0152**
Size	18,0251	2,8459	6,3336	0,0000**	17,2883	2,9362	5,8880	0,0000**
CAPEX	48,3184	45,1390	1,0704	0,2883	37,1551	46,5706	0,7978	0,4278
Debt	-35,9035	18,5078	-1,9399	0,0567*	-16,4288	19,0948	-0,8604	0,3927
Cash	41,1224	8,9220	4,6091	0,0000**	36,4750	9,2049	3,9626	0,0002**

Table 4, Anja Pagh: Coefficients, standard errors and p-value for the constant and the covariates for model 1. Both OLS and FGLS coefficients have been reported, in order to compare the differences.

I've tested all of the assumptions of ordinary least squares regression for model 1, which are reported in Appendix 4. As already mentioned I've found some challenges with the assumptions. I've found some plausible linear relationship between the dependent variable and the covariates. I've tested whether the residuals are; $\varepsilon_{it} \sim IIDN(0; \sigma^2)$. I've found that the residuals from the model 1 are normally distributed by performing a Jarque-Bera test and furthermore that they are

homoscedastic. The assumption regarding no autocorrelation are tested using a Durbin-Watson test, I've found a positive autocorrelation for the residuals, which is a violation of the assumption. Due to this, the Gauss-Markov Theorem are invalidated, resulting in that OLS is not the best linear unbiased estimator (Andersen, 2008). The feasible generalized least squares (FGLS) are a better estimation procedure due to this lack.

When interpreting the results from the OLS and FGLS estimation procedure, there are some differences. Since the FGLS procedure is more efficient, due to the correction for the autocorrelated residuals, I choose to interpret these results. CAPEX and App. Q are statistically insignificant, because of the very high p-values, from the corresponding t-statistics. The sign of the CAPEX coefficients is positive, which are in accordance with the theory of benefits of hedging because of the costs of underinvestment. Firms having high capital expenditures and large growth opportunities should benefit more from hedging. This is consistent with theory, but unfortunately the coefficients have very large standard errors and similar p-values. The ROTA, size and cash variables all are statistically significant, but have opposite signs compared to my theoretically expectations. The model estimates that profitability are negatively related to hedging and furthermore estimates that large firms and firms with a lot of cash holdings hedge more. I'd expected profitability to be positive related to hedging, as already discussed.

The fact that size is positively related to hedging, is against theory since larger firms have lower cost of financial distress compared to smaller firms. Empirically the positive relationship has been exploited and explained before, as the result of larger firms having economies of scale. Firms with more cash holdings, should theoretically hedge less, since they themselves are able to ensure stable cash flows. Debt are negatively related to hedging, and only statistically significant at the 10% level for the OLS estimation procedure. I would have expected a positive relationship since more debt, leads to higher financial distress costs and therefore more incentives to hedge. Since most of the firms are having an ongoing risk management program, and the period I've chosen are characterized by primarily increasing jet fuel prices, the hedgers might have ensured, even greater benefits from this specific period. I have a bit of a challenge with interpreting the causality. Hedging over time, might have stabilized the firms cash flows and led them to take on less external debt.

For model 2, not all of the same assumptions need to be met, since the dependent variable is binary.

Model 2:

$$Binary\ hedged_{it} = \beta_1 App.Q_{it} + \beta_2 ROTA_{it} + \beta_3 Size_{it} + \beta_4 CAPEX_{it} + \beta_5 Debt_{it} + \beta_6 Cash_{it} + \varepsilon_{ti}$$

The most important assumption though, is again the one regarding independency for the residuals. Since binary models uses maximum likelihood estimates, it's required to have a larger sample size compared to OLS or FGLS, since the method are less powerful (Alexander, 2008). Since I only have 68 observations, I should be careful when interpreting the results. The results are tabulated below in table 5.

	Model 2 Binary Logit			
	Coefficients	*Standard Error*	*chi-square*	*P-value*
Intercept	11,7779	7,0813	2,77	0,0963*
App. Q	0,5850	1,3456	0,19	0,6637
ROTA	15,2659	6,9199	4,87	0,0274**
Size	-2,2830	0,9492	5,90	0,0152**
CAPEX	-11,3039	7,1114	2,53	0,1119
Debt	18,8349	8,2400	5,22	0,0223**
Cash	-2,7508	2,1964	1,57	0,2104

Table 5, Anja Pagh: Coefficients, standard errors and p-values for the constant and intercept for the binary logit model 2.

For model 2, when interpreting my results, some are actually consistent with the theory of benefits of hedging due to the costs of underinvestment and financial distress. When defining a binary variable, I only measure if and not how much a firm chooses to hedge next years' fuel requirements. I discover a positive relationship between the App. Q-value and hedging, unfortunately the coefficient is not statistically significant.

I find a positive relationship between the firms' profitability and hedging, which is consistent with my expectations. I furthermore discover a negative relationship between size and hedging and a positive association between debt and hedging, both of these findings are in line with the theory of financial distress costs. CAPEX and cash are statistically insignificant at standard levels, but cash presents a relationship to firm hedging, that is consistent with theory.

6.5.5.3 Conclusion multivariate determinants of hedging.

My results are quite difficult to interpret due to the very contrasting outcomes for the 2 models. For the coefficients of the variables ROTA, Size, CAPEX, Debt and Cash, the sign is opposite for the two models. Because of the challenge with the relative few observations, when using the maximum likelihood estimation procedure, I've chosen not to use the interpretation of the result of model 2, even though they fit better into the theoretical expectations. There are some challenges with this dataset, since it seems not to produce very reliable or robust results. I might have to few observations, in order to be able to interpret anything academically and statistically significant.

6.5.6 Jet fuel hedging and firm value

In the previous section, I've investigated the determinants of hedging. In this section I will examine whether airline's jet fuel hedging activities affect firm value. I've chosen the simplified App. Q value as a proxy for the value of the firms. To measure the effect of hedging, I've estimated two different models. Model 3 has next years' fuel requirements hedged as hedging variable and Model 4 has the fair value of hedging instruments in current year as hedging variable. The two variables have a correlation of 0,30, but they are not perfectly correlated, why they might explain the dependent variable, the App. Q value, differently.

Besides jet fuel hedging I've added the control variables, already examined in the previous section. The focus is primarily to control for other variables, that could affect the value of the firm. Ideally I would have liked to include other control variables, such on variables measuring the use of other risk management (currency and interest rate derivatives) or other ways of handling jet fuel price fluctuations, as Carter et al. have done in their study (2006).

The sample consists of 8 airlines over a period of 2001-2010. Given a total of 76 firm year observations. Some years are omitted, since data weren't available from the Compustat database. The omitted years a described in a previous section. All calculations are done in Excel using matrix algebra. See Appendix 3.

Model 3:

$$App.Q_{it} = \beta_0 + \beta_1 Percent\ Hedged_{it} + \beta_2 ROTA_{it} + \beta_3 Size_{it} + \beta_4 CAPEX_{it} + \beta_5 Debt_{it} + \beta_6 Cash_{it} + \varepsilon_{ti}, where\ \varepsilon_{it} \sim i.i.dN(0, \sigma^2)$$

Model 4:

$$App.Q_{it} = \beta_0 + \beta_1 Fair\ Value_{it} + \beta_2 ROTA_{it} + \beta_3 Size_{it} + \beta_4 CAPEX_{it} + \beta_5 Debt_{it} + \beta_6 Cash_{it} + \varepsilon_{ti}, where\ \varepsilon_{it} \sim i.i.dN(0, \sigma^2)$$

For both Model 3 and Model 4 it's appropriate to assume that there is a linear relationship between the dependent variable and the covariates. I've tested the independency for the residuals, using a Durbin-Watson test. Based on the test-statistic for both models, it's hard to conclude whether there are some autocorrelation in the residuals or not. Since the test-statistics, especially for Model 4, are very close to the limit value of no autocorrelation I assume that the residuals are independently distributed. None of the covariates are highly correlated for any of the two models. Only the correlation between percent of next years' fuel requirements hedged and the firm size have a correlation larger than absolute value of 0,5, but I assess that it's below the limit for multicollinearity.

I've used White's test for heteroscedasticity and conclude based on the results, that their residuals contain homoscedasticity, applying both models. Least I find that the residuals are normally distributed, testing with the Jarque-Bera test statistic. Since all of the assumptions regarding estimating the coefficients using OLS holds, I use these estimates, since they are unbiased and efficient. All calculations regarding the assumptions can be found in appendix 4.

The results for Model 3 and Model 4 are tabulated below in table 6, the matrix algebra calculations can be found in appendix 3

	Model 3 OLS				Model 4 OLS			
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Intercept	3,3010	0,3451	9,5660	0,0000**	3,2847	0,2881	11,3992	0,000**
Percent hedged	0,0004	0,0020	0,2173	0,8287				
Fair Value					1,8275	2,8404	0,6434	0,5224
ROTA	2,0869	0,6721	3,1049	0,0029**	1,9682	0,6021	3,2690	0,0018**
Size	-0,2364	0,0478	-4,9450	0,0000**	-0,2321	0,0330	-7,0219	0,0000**
CAPEX	-1,0994	0,6894	-1,5946	0,1160	-1,0406	0,6839	-1,5215	0,1333
Debt	-0,6612	0,2821	-2,3438	0,0224**	-0,6762	0,2716	-2,4901	0,0155**
Cash	-0,3418	0,1539	-2,2210	0,0301**	-0,3416	0,1337	-2,5550	0,0131**

Table 6, Anja Pagh: Coefficients, standard errors and p-values for both intercept and the covariates for model 3 and 4.

6.5.5.1 Conclusion firm value and hedging

From the results it is clear that I don't discover any hedging premium in my sample. Both hedging variables measured as percent of next fuel requirements hedged and the fair value of derivatives are statistically insignificant. Model 3 has an adjusted coefficient of determination of $\bar{R}^2 = 0{,}4757$ and model 4 has an adjusted coefficient of determination of $\bar{R}^2 = 0{,}4798$. I've explained some of the variation in the value of the firm proxied as the approximate Q-value. The relationship between the different variables and the firm value are a bit surprising. Size, CAPEX and cash are negatively related to firm value, which I'd expected to be reverse. Debt are also negatively related to firm value, which is consistent with my expectations since financial distress costs increases with debt. The profitability is positively related to firm value. This is aligned with my expectations, since firms that are better at creating profit, tend to be more valuable.

With this dataset and sample, it proved to be impossible to verify the results from the American airline industry. The overall challenge is, that this study contains relatively few firm year observations compared to the Carter et al. study. This makes it hard to produce statistically significant results. Based on these founding I can not reject that there is a hedging premium to exploit in the European airline industry. I didn't manage to discover it, based on my dataset, but

there could be several theoretical as well as practical explanations. The complicated price setting of derivatives and the vague regulations prior to 2005, regarding measurement at fair value, could explain the doubtful relationship and interpretations between my models. Quantifying the hedging variables are quite difficult, and there are several different proxies to use. All of these outcomes combined, makes the conclusions regarding the firm value and hedging in the European airline industry, based on this study, impossible.

7 Conclusion

Throughout this thesis I've investigated the relationship between firm value and hedging of jet fuel price fluctuations in the European Airline industry.

The investigation has been grounded in theoretical expectations and prior empirical findings, which made it plausible to expect, that I could exploit a hedging premium in the European airline industry. Several different methodologies have been used in order to uncover if a hedging premium exists. Prior empirical findings are inconclusive regarding firm value and hedging and the challenges with causality and endogeneity have been discussed. In order to avoid the causality problem, when interpreting whether hedging firms have higher value or if firms that have higher value hedge more, the event study approach, examining the relationship between sudden price decreases/increases in the oil prices and the CAR's of American airlines, have been tested. In the short run the CAR's weren't affected by oil price fluctuations and this methodology where dropped in favour of explaining firm value, by regressing different proxies for hedging on the App. Q. value.

I found that the European airlines industry where characterized as being an investment environment, well-suited for investigating hedging, due to underinvestment and financial distress costs. In the univariate and multivariate investigation of the determinants of hedging, the results where contrary to most theoretical expectations.

I didn't discover a hedging premium in the European airline industry, when using the App. Q-value as a proxy for firm value, but based on this dataset, I'm not either able to reject the overall research question, that hedging creates value for airlines operating in the European airline industry.

There could be several theoretical and practical explanations for this discrepancy. Whether or not hedging creates value, are dependent on the industry, in which the firms operate, the environment and different firm characteristics. Since many of these assumptions for obtaining a hedging premium in the European airline industry are present, it is more likely that the opposing results are to be explained by practicalities.

Extracting and quantifying information regarding jet fuel hedging, proved to be difficult. Measuring derivatives at fair value, have only been required since 2005 by IFRS. The price-setting of derivatives can be complicated, due to the complexity of the products, which makes the fair value a difficult measure, when interpreting the value between firms. In previous studies many different examples of hedging proxies have been used. The choice and quantification of the proxy variable obviously affects the results, as well as the choice of sample and investigation period.

The study of firm value and hedging are clearly an interesting area to keep investigating. The more recent literature are I favour of, that hedging does in fact create value to firms. To conclude, hedging can create value under the right circumstances. The root of the value added, can be hard to identify and is most likely a sum of many favourable uncertain outcomes, that can be explained by the imperfect capital markets that firms do operate in.

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https://www.iata.org/whatwedo/Documents/economics/Airline_Labour_Cost_Share_Feb2010.pdf

https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RBRTE&f=D

http://www.investopedia.com/articles/investing/102314/understanding-benchmark-oils-brent-blend-wti-and-dubai.asp?layout=orig

http://www.reuters.com/finance/currencies#umM86Yd3WeobdUcZ.97

http://www.theatlantic.com/business/archive/2013/09/how-americas-minimum-wage-em-really-em-stacks-up-globally/279258/

8.4 Annual Reports

All annual reports for the different airlines, can be downloaded on web-pages:

Aeroflot: http://www.aeroflot.ru/cms/en/reports_item/497

EasyJet: http://corporate.easyjet.com/investors/reports-and-accounts.aspx?sc_lang=en

Finnair: http://www.finnairgroup.com/group/group_12_2.html

Lufthansa: http://investor-relations.lufthansagroup.com/en/finanzberichte.html

Norwegian: https://www.norwegian.com/dk/om-os/company/investor-relations/

Ryan Air: http://investor.ryanair.com

SAS: http://www.sasgroup.net/en/category/investor-relations/financial-reports/annual-reports/

Turkish Airlines: http://investor.turkishairlines.com/en

Other:

Berkshire Hathaway Annual Report 2002: http://www.berkshirehathaway.com/2002ar/2002ar.pdf

9 Appendices

9.1 Appendix 1

List of American Airlines in the event study.

Airlines
Air T Inc
Air Transport Services Group Inc
Airnet Systems Inc.
AirTran Holdings Inc.
Alaska Air Group Inc.
Allegiant Travel Co
American Airlines Group Inc
ASA Holdings Inc
Ccair Inc
Comair Holdings Inc
Continental Airlines Inc.
Delta Air Lines Inc.
ExpressJet Holdings Inc.
FedEx Corp.
Frontier Airlines Holdings Inc
Global Aviation Holdings Inc
Hawaiian Holdings Inc.
International Consolidated Airlines Group SA
JetBlue Airways Corp
Mesa Air Group Inc
Midway Airlines Corp
Midwest Air Group Inc
Northwest Airlines Corp
Pinnacle Airlines Corp
Reno Air Inc
Republic Airways Holdings Inc
SkyWest Inc
Southwest Airlines Co.
Tower Air Inc
United Continental Holdings Inc
US Airways Group Inc

9.2 Appendix 2

The normal returns using the market model, has been calculated as (MacKinley 1997):

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it}$$

Using the estimation window, to estimate alpha and beta, R_{it} is the return for company *i* at time *t*. R_{mt} are the market return at time *t* and ϵ_{it} is the error term for company *i* at time *t*.

To calculate the abnormal return:

$$AR_{it} = R^*_{it} - (\alpha_i + \beta_i R_{mt})$$

Where R^*_{it} are the actual returns from the event window.

The normal returns using the mean return model, has been calculated as (MacKinley 1997):

$$R_{it} = \mu_i + \epsilon_{it}$$

Using the estimation window to calculate μ_i, R_{it} is the return for company *i* at time *t* and ϵ_{it} is the error term for company *i* at time *t*.

To calculate the abnormal return:

$$AR_{it} = R^*_{it} - \mu_i$$

To get the cumulative return, for both models I get:

$$CAR_i = \sum_{t=-5}^{5} AR_{it}$$

The results are reported below, **/* indicates that the CAR is significant at a 5%/10% level

	April 27th 1998 - Event 1							
	Market model				Mean return model			
	CAR	Std error	t-test	P-value	CAR	Std error	t-test	P-value
Air T Inc	-0,0944	0,9054	-0,1043	0,9180	-0,1056	0,9016	-0,1171	0,9079
Airnet Systems Inc.	-0,0943	0,2567	-0,3676	0,7171	-0,0965	0,2631	-0,3667	0,7177
AirTran Holdings Inc.	0,0631	0,5694	0,1108	0,9129	0,0563	0,5700	0,0987	0,9224
Alaska Air Group Inc.	-0,1628	0,3001	-0,5425	0,5935	-0,1772	0,3007	-0,5895	0,5621
American Airlines Group Inc	-0,0558	0,2303	-0,2421	0,8112	-0,0706	0,2297	-0,3072	0,7618
ASA Holdings Inc	-0,0402	0,2615	-0,1536	0,8795	-0,0517	0,2626	-0,1969	0,8459
Ccair Inc	0,0499	0,4732	0,1055	0,9170	0,0504	0,5039	0,1000	0,9214
Comair Holdings Inc	0,1972	0,4829	0,4084	0,6873	0,1942	0,4851	0,4002	0,6932
Continental Airlines Inc.	-0,0731	0,2478	-0,2950	0,7711	-0,0843	0,2527	-0,3337	0,7421
Delta Air Lines Inc.	-0,1013	0,2297	-0,4411	0,6639	-0,1156	0,2287	-0,5055	0,6187
FedEx Corp.	-0,0597	0,2730	-0,2186	0,8292	-0,0774	0,2718	-0,2848	0,7788
Frontier Airlines Holdings Inc	0,0020	0,6461	0,0031	0,9976	-0,0003	0,6612	-0,0005	0,9996
Global Aviation Holdings Inc	0,1819	0,4210	0,4322	0,6702	0,1796	0,4227	0,4248	0,6755
Hawaiian Holdings Inc.	-0,1551	0,3475	-0,4463	0,6602	-0,1639	0,3495	-0,4690	0,6442
International Cons. Airlines Grp.	0,0118	0,1812	0,0653	0,9485	0,0076	0,1812	0,0422	0,9668
Mesa Air Group Inc	-0,0149	0,5161	-0,0289	0,9772	-0,0242	0,5139	-0,0471	0,9629
Midwest Air Group Inc	-0,1010	0,2398	-0,4212	0,6781	-0,1135	0,2394	-0,4741	0,6406
Northwest Airlines Corp	-0,0359	0,3234	-0,1111	0,9127	-0,0568	0,3252	-0,1748	0,8630
Reno Air Inc	0,0563	0,4994	0,1127	0,9114	0,0439	0,4974	0,0883	0,9305
SkyWest Inc	-0,0661	0,3295	-0,2007	0,8430	-0,0828	0,3290	-0,2518	0,8038
Southwest Airlines Co.	-0,0913	0,5097	-0,1790	0,8597	-0,1109	0,5080	-0,2184	0,8293
Tower Air Inc	-0,0892	0,5935	-0,1504	0,8820	-0,1070	0,5911	-0,1809	0,8582
United Continental Holdings Inc	-0,0653	0,2484	-0,2631	0,7952	-0,0806	0,2496	-0,3231	0,7500
US Airways Group Inc	-0,0177	0,3154	-0,0560	0,9559	-0,0342	0,3149	-0,1085	0,9147

	September 24th 2001 - Event 2							
	Market model				Mean return model			
	CAR	Std error	t-test	P-value	CAR	Std error	t-test	P-value
Air T Inc	-0,2410	0,5655	-0,4261	0,6746	-0,2391	0,5631	-0,4246	0,6756
Airnet Systems Inc.	-0,0718	0,3279	-0,2189	0,8289	-0,0835	0,3284	-0,2541	0,8020
AirTran Holdings Inc.	-0,3666	0,4162	-0,8808	0,3889	-0,3894	0,4202	-0,9266	0,3652
Alaska Air Group Inc.	-0,4156	0,1629	-2,5516	0,0190**	-0,4414	0,1803	-2,4488	0,0236**
American Airlines Group Inc	-0,3486	0,2094	-1,6648	0,1115	-0,3877	0,2401	-1,6149	0,1220
Continental Airlines Inc.	-0,8809	0,2064	-4,2687	0,0004**	-0,9176	0,2339	-3,9228	0,0008**
Delta Air Lines Inc.	-0,3240	0,1920	-1,6880	0,1069	-0,3627	0,2244	-1,6162	0,1217
FedEx Corp.	-0,0833	0,1885	-0,4418	0,6634	-0,1143	0,2101	-0,5440	0,5925
Frontier Airlines Holdings Inc	-0,3967	0,4090	-0,9698	0,3437	-0,4343	0,4231	-1,0265	0,3169
Global Aviation Holdings Inc	-1,0300	0,5311	-1,9395	0,0667*	-1,0521	0,5331	-1,9735	0,0624**
Hawaiian Holdings Inc.	-0,2797	0,3978	-0,7031	0,4901	-0,3154	0,4107	-0,7679	0,4515
International Cons. Airlines Grp.	-0,3597	0,2333	-1,5416	0,1388	-0,4032	0,2674	-1,5077	0,1473
Mesa Air Group Inc	-1,6184	0,3291	-4,9182	0,0001**	-1,6542	0,3453	-4,7905	0,0001**
Midwest Air Group Inc	-0,4258	0,2462	-1,7297	0,0991*	-0,4449	0,2519	-1,7660	0,0926*
Northwest Airlines Corp	-0,3906	0,2478	-1,5761	0,1307	-0,4289	0,2729	-1,5715	0,1318
SkyWest Inc	-0,6053	0,3056	-1,9804	0,0616*	-0,6566	0,3420	-1,9195	0,06929*
Southwest Airlines Co.	-0,1173	0,2007	-0,5845	0,5654	-0,1569	0,2333	-0,6724	0,5090
United Continental Holdings Inc	-0,4707	0,2356	-1,9976	0,0595*	-0,5030	0,2544	-1,9771	0,0619*
US Airways Group Inc	-1,4299	0,2290	-6,2433	0,0000**	-1,4586	0,2442	-5,9721	0,0000**

	March 26th 2003 - Event 3							
	Market model				Mean return model			
	CAR	Std error	t-test	P-value	CAR	Std error	t-test	P-value
Air T Inc	0,1069	0,5378	0,1987	0,8445	0,1073	0,5408	0,1985	0,8447
Airnet Systems Inc.	0,0009	0,4744	0,0020	0,9985	0,0025	0,4737	0,0053	0,9958
AirTran Holdings Inc.	0,1005	0,4345	0,2314	0,8193	0,1176	0,4363	0,2696	0,7902
Alaska Air Group Inc.	-0,0329	0,4644	-0,0708	0,9443	-0,0138	0,4664	-0,0296	0,9767
American Airlines Group Inc	0,9421	0,9233	1,0203	0,3198	0,9787	0,9284	1,0542	0,3044
Continental Airlines Inc.	0,0880	0,7281	0,1209	0,9050	0,1192	0,7273	0,1639	0,8714
Delta Air Lines Inc.	0,0882	0,6769	0,1302	0,8977	0,1173	0,6747	0,1739	0,8637
ExpressJet Holdings Inc.	0,1779	0,5752	0,3093	0,7603	0,1886	0,5757	0,3276	0,7466
FedEx Corp.	0,0785	0,2112	0,3719	0,7139	0,0892	0,2141	0,4167	0,6814
Frontier Airlines Holdings Inc	0,1580	0,5991	0,2636	0,7948	0,1739	0,5967	0,2914	0,7738
Global Aviation Holdings Inc	-0,0437	0,6250	-0,0699	0,9450	-0,0268	0,6245	-0,0429	0,9662
International Cons. Airlines Grp.	-0,0480	0,4037	-0,1189	0,9066	-0,0305	0,4041	-0,0754	0,9407
JetBlue Airways Corp	0,0749	0,5511	0,1359	0,8932	0,0892	0,5488	0,1626	0,8725
Mesa Air Group Inc	0,3941	0,7023	0,5612	0,5809	0,4088	0,7154	0,5715	0,5740
Midwest Air Group Inc	0,1483	0,9092	0,1631	0,8721	0,1679	0,9055	0,1855	0,8547
Northwest Airlines Corp	-0,1870	0,5743	-0,3256	0,7481	-0,1626	0,5750	-0,2827	0,7803
SkyWest Inc	0,0228	0,4796	0,0476	0,9625	0,0396	0,4780	0,0829	0,9347
Southwest Airlines Co.	0,0298	0,3334	0,0893	0,9297	0,0460	0,3349	0,1373	0,8921
United Continental Holdings Inc	-0,0333	1,5929	-0,0209	0,9835	-0,0152	1,5862	-0,0096	0,9924
US Airways Group Inc	0,1407	0,5776	0,2436	0,8100	0,1495	0,5756	0,2597	0,7977

	September 22nd 2008 - Event 4							
	Market model				Mean return model			
	CAR	Std error	t-test	P-value	CAR	Std error	t-test	P-value
Air T Inc	-0,0480	0,2763	-0,1739	0,8637	-0,1081	0,2838	-0,3810	0,7072
Air Transport Services Group Inc	-0,0563	0,7413	-0,0759	0,9402	-0,1561	0,7482	-0,2086	0,8369
AirTran Holdings Inc.	0,2476	0,9021	0,2744	0,7866	-0,1016	0,9039	-0,1124	0,9116
Alaska Air Group Inc.	0,0854	0,6095	0,1401	0,8900	-0,2144	0,6089	-0,3521	0,7284
Allegiant Travel Co	0,2678	0,5975	0,4483	0,6588	0,0723	0,5954	0,1214	0,9046
American Airlines Group Inc	0,3319	0,8754	0,3792	0,7086	-0,0533	0,8717	-0,0611	0,9519
Continental Airlines Inc.	0,2632	0,9057	0,2906	0,7744	-0,1697	0,9038	-0,1878	0,8529
Delta Air Lines Inc.	0,2272	0,8200	0,2771	0,7846	-0,0849	0,8184	-0,1037	0,9184
ExpressJet Holdings Inc.	-0,0867	1,1859	-0,0731	0,9425	-0,2991	1,1864	-0,2521	0,8036
FedEx Corp.	0,0126	0,2380	0,0529	0,9583	-0,1313	0,2424	-0,5419	0,5939
Frontier Airlines Holdings Inc	0,1767	1,6648	0,1062	0,9165	0,0522	1,6729	0,0312	0,9754
Global Aviation Holdings Inc	0,3768	0,8038	0,4687	0,6443	0,3165	0,8027	0,3943	0,6975
Hawaiian Holdings Inc.	-0,1458	0,4602	-0,3169	0,7546	-0,2688	0,4585	-0,5864	0,5642
International Cons. Airlines Grp.	-0,2167	0,4299	-0,5041	0,6197	-0,4010	0,4281	-0,9369	0,3600
JetBlue Airways Corp	-0,0552	0,5082	-0,1087	0,9145	-0,2722	0,5067	-0,5373	0,5970
Mesa Air Group Inc	0,0206	1,1280	0,0183	0,9856	-0,1992	1,1268	-0,1768	0,8615
Northwest Airlines Corp	0,2380	0,9321	0,2554	0,8011	-0,1201	0,9312	-0,1290	0,8987
Pinnacle Airlines Corp	0,0144	0,5935	0,0242	0,9809	-0,0880	0,5924	-0,1485	0,8835
Reno Air Inc	0,0962	0,5464	0,1761	0,8620	-0,1029	0,5442	-0,1890	0,8520
SkyWest Inc	0,0594	0,4385	0,1356	0,8935	-0,1539	0,4399	-0,3497	0,7302
Southwest Airlines Co.	-0,0050	0,2780	-0,0179	0,9859	-0,1594	0,2895	-0,5505	0,5880
United Continental Holdings Inc	0,2394	1,2343	0,1939	0,8482	-0,2412	1,2293	-0,1962	0,8464
US Airways Group Inc	0,1112	1,0688	0,1041	0,9182	-0,3282	1,0675	-0,3074	0,7617

9.3 Appendix 3

Matrix algebra (Alexander 2008)

Y: Percent hedged

X_1: App. Q
X_2: ROTA
X_3: Size
X_4: CAPEX
X_5: Debt
X_6: Cash

$\boldsymbol{y} = \boldsymbol{X\beta} + \boldsymbol{\varepsilon}$, where $\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it} \quad \eta_t \sim i.i.d(0, \sigma_\eta^2)$

$$\boldsymbol{y} = \begin{pmatrix} Y_1 \\ \vdots \\ Y_{68} \end{pmatrix}, \boldsymbol{X} = \begin{pmatrix} 1 & X_{1,1} & \dots X_{6,1} \\ \vdots & \vdots & \ddots \ \vdots \\ 1 & X_{1,68} & \dots X_{6,68} \end{pmatrix}, \boldsymbol{\beta} = \begin{pmatrix} \beta_0 \\ \vdots \\ \beta_6 \end{pmatrix}, \boldsymbol{\varepsilon} = \begin{pmatrix} \varepsilon_1 \\ \vdots \\ \varepsilon_{68} \end{pmatrix}$$

Ordinary least squares:

The coefficients estimates:

$$\widehat{\boldsymbol{\beta}} = (\boldsymbol{X}'\boldsymbol{X})^{-1}\boldsymbol{X}'\boldsymbol{y}$$

The residuals:

$$\boldsymbol{e} = \boldsymbol{y} - \boldsymbol{X}\widehat{\boldsymbol{\beta}}$$

The residual sum of squares:

$$RSS = \boldsymbol{e}'\boldsymbol{e}$$

The estimator of the error variance:

$$s^2 = \frac{RSS}{T - K - 1}$$

where K are the explanatory variables

Estimated covariance matrix:

$$est.V\left(\widehat{\boldsymbol{\beta}}\right) = s^2(\boldsymbol{X}'\boldsymbol{X})^{-1}$$

Feasible Generalized Least Squares:

$$\widehat{\boldsymbol{\beta}}_{FGLS} = (\boldsymbol{X}'\boldsymbol{\Omega}^{-1}\boldsymbol{X})^{-1}\boldsymbol{X}'\boldsymbol{\Omega}^{-1}\boldsymbol{y}$$

Since the residuals are first order autocorrelated, $\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$ $\eta_t \sim i.i.d(0, \sigma_\eta^2)$, $\boldsymbol{\Omega}$ are a circulate matrix:

$$\boldsymbol{\Omega} = \begin{pmatrix} 1 & \rho & \rho^2 \ldots \rho^{67} \\ \rho & 1 & \rho \cdots \rho^{66} \\ \rho^2 & \rho & 1 \cdots \rho^{65} \\ \cdots & \cdots & \cdots \cdots \cdots \\ \rho^{67} & \rho^{66} \ldots \cdots & 1 \end{pmatrix}$$

For the equation I've estimated $\hat{\rho} = 0{,}3631$.

9.4 Appendix 4

Assumptions OLS determinants (Alexander 2008)

My data are time series cross sectional, so when conducting some of the test for the assumptions regarding OLS, I have to take in some considerations. I can conduct the same test as for pure time series data, since each unit (airline) represent time series data.

Linearity:

Model 1:
Regarding the assumption on linearity between the dependent variable and the covariates, the different relationships are questionable. Only one relationship can be interpreted as linear, that is the relationship between next years' fuel requirements hedged and firm size.

Model 3:
Regarding the assumption on linearity between the dependent variable and the covariates, the relationships are described as linear.

Model 4:
Regarding the assumption on linearity between the dependent variable and the covariates, the relationships are described as linear, except the relationship between the fair value of hedging instruments and the dependent variable.

Independent and identically distributed residuals (no autocorrelation):

I order my data in a chronological order for each unit, to test for autocorrelation in the residuals. I use a Durbin-Watson test statistic to test whether the residuals have some kind of autocorrelation.

$$H_0: no\ autocorrelation\ in\ the\ residuals$$
$$H_1: positive\ autocorrelation\ in\ the\ residuals$$

I will at a 5% significance level reject the null-hypothesis if I find a test statistic that is below $D_L = 1{,}44$, fail to reject the null-hypothesis if I find a test statistic that is higher than $D_U = 1{,}77$ and remain inconclusive if I find a test statisctic between the two (Newbold et al. 2013).

$$DW = \frac{\sum_{i=1}^{I}\sum_{t=2}^{T}(e_{it} - e_{it-1})^2}{\sum_{i=1}^{I}\sum_{t=2}^{T}(e_{it})^2}$$

Model 1:

I discover a test statistic of $DW = 1{,}07$ and therefor reject the null hypothesis, which equals that the residuals are positively autocorrelated.

Model 3:

I discover a test statistic of $DW = 1{,}67$ and therefore remain inconclusive regarding the correlation of the residuals. Since the test statistic are rather high, I assume that the assumption regarding autocorrelation aren't violated.

Model 4:

I discover a test statistic of $DW = 1{,}73$ and therefore remain inconclusive regarding the correlation of the residuals. Since the test statistic are rather high, I assume that the assumption regarding autocorrelation aren't violated.

Multicollinariety

Model 1:

	App. Q	*ROTA*	*Size*	*Capex*	*Debt*	*Cash*
App. Q	1					
ROTA	0,0960	1				
Size	-0,5801	0,1827	1			
Capex	-0,0872	-0,0054	-0,1803	1		
Debt	-0,2180	0,2599	0,0935	-0,0796	1	
Cash	-0,2505	0,2008	0,0195	0,2951	0,1015	1

The table above shows the correlation matrix for the covariates. None of the covariates are highly correlated. Only the correlation between App. Q and the firm size have a correlation larger than numeric 0.5, but I assume that it's below the limit for multicollinarity.

Model 3:

	Percent Hedged	*ROTA*	*Size*	*CAPEX*	*Debt*	*Cash*
Percent Hedged	1					
ROTA	-0,1751	1				
Size	0,5856	0,1827	1			
CAPEX	0,1001	-0,0054	-0,1803	1		
Debt	-0,1614	0,2599	0,0935	-0,0796	1	
Cash	0,3542	0,2008	0,0195	0,2951	0,1015	1

The table above shows the correlation matrix for the covariates. None of the covariates are highly correlated. Only the correlation between percent of next years' fuel requirements hedged and the firm size have a correlation larger than numeric 0.5, but I assume that it's below the limit for multicollinarity.

Model 4:

	Fair value	*ROTA*	*Size*	*CAPEX*	*Debt*	*Cash*
Fair value	1					
ROTA	0,2054	1				
Size	0,1943	0,1827	1			
CAPEX	-0,0559	-0,0054	-0,1803	1		
Debt	0,0729	0,2599	0,0935	-0,0796	1	
Cash	0,2107	0,2008	0,0195	0,2951	0,1015	1

The table above shows the correlation matrix for the covariates. None of the covariates are highly correlated.

Homoscedastic residuals:

I test whether the residuals have the same variance using White's heteroscedasticity test, against the alternative that the variance depend on the expected value, where $y_t = Percent\ hedged_t$:

$$e_{it} = y_{it} - \hat{y}_{it}$$

$$H_0: \varepsilon_t\ all\ have\ the\ same\ variance\ \sigma^2$$
$$H_1: \varepsilon_t have\ variances\ that\ depent\ on\ the\ expected\ values$$

I run a new regression:

$$e_{it}^2 = a_0 + a_1\hat{y}_{it} + a_2\hat{y}^2{}_{it}$$

I let R^2 be the coefficient of determination for this auxiliary regression, and I reject he null hypothesis if nR^2 is larger than $\chi^2_{2,0.05} = 5{,}991$.

Model 1:

For this regression I get a coefficient of determination of : $R^2 = 0{,}0076$, with 68 observations, I fail to reject the null hypothesis since $nR^2 = 0{,}0084 * 68 = 0{,}5168$, and therefore less extreme than the critical value. The assumption of homoscedastic residuals is therefore not violated.

Model 3:

For this regression I get a coefficient of determination of : $R^2 = 0{,}0749$, with 68 observations, I fail to reject the null hypothesis since $nR^2 = 0{,}0749 * 68 = 5{,}0932$, and therefore less extreme than the critical value. The assumption of homoscedatic residuals are therefore not violated.

Model 4:

For this regression I get a coefficient of determination of : $R^2 = 0{,}0780$, with 68 observations, I fail to reject the null hypothesis since $nR^2 = 0{,}0084 * 68 = 5{,}304$, and therefore less extreme than the critical value. The assumption of homoscedatic residuals are therefore not violated.

Normality for the residuals

To test whether the residuals are normally distributed I perform a Jarque-Bera test.

$$H_0: The\ residuals\ are\ normally\ distributed$$
$$H_1: The\ residuals\ are\ not\ normally\ distributed$$

If, the test statistic is larger than the significance points of the Jarque-Bera statistic of 4,27 (Newbold, Carlson and Thorne 2013) with approximate 68 observations, I reject the null hypothesis. $\hat{\tau}$ are the skewness and $\hat{\varkappa}$ are the excess kurtosis, are calculated as:

$$\hat{\tau} = \frac{\sum_{i=1}^{n}\sum_{t=1}^{T}(e_{it} - \bar{e})^3}{n * s^3}$$

$$\hat{\varkappa} = \frac{\sum_{i=1}^{n}\sum_{t=1}^{T}(e_{it} - \bar{e})^4}{n * s^4}$$

Model 1:

$$JB = n\left[\frac{\hat{\tau}^2}{6} + \frac{\hat{\varkappa}^2}{24}\right] = 68 * \left[\frac{-0{,}4080^2}{6} + \frac{-0{,}1160^2}{24}\right] = 1{,}8288$$

Since my test statistic are less extreme than the critical value, I fail to reject the null-hypothesis. The assumption regarding normally distributed residuals are not violated.

Model 3:

$$JB = n\left[\frac{\hat{\tau}^2}{6} + \frac{\hat{\varkappa}^2}{24}\right] = 68 * \left[\frac{0{,}3992^2}{6} + \frac{-0{,}0376^2}{24}\right] = 1{,}8101$$

Since my test statistic are less extreme than the critical value, I fail to reject the null-hypothesis. The assumption regarding normally distributed residuals are not violated.

Model 4:

$$JB = n\left[\frac{\hat{\tau}^2}{6} + \frac{\hat{\varkappa}^2}{24}\right] = 68 * \left[\frac{0{,}3954^2}{6} + \frac{-0{,}0029^2}{24}\right] = 1{,}7719$$

Since my test statistic are less extreme than the critical value, I fail to reject the null-hypothesis. The assumption regarding normally distributed residuals are not violated.