“Derivative Hedging and Value in the European Airline Industry”

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Resumé

The use of financial derivatives has steadily increased in the last decades, and today there are well-developed exchange trade markets for these financial instruments, as well as vast amounts being traded directly over-the-counter. Derivatives can be used for hedging purposes in risk management, or for speculative purposes. Many corporations and firms today engage in hedging activity, but it is not clear whether this has a positive effect on their market value of the firm. Both theory and evidence is inconclusive with regards to the possible impact derivative hedging has on non-financial companies' firm value, which makes the observed high hedging activity interesting to study with regards to its impact on the firm value.

The European airline industry is an interesting subject for studying the impact of derivatives hedging on firm value. This is because the industry displays relatively high levels of hedging activity, as well as many characteristics that makes it consistent with many theoretical assumptions of when derivatives hedging can be beneficial to firms' values. In short, the industry is competitive, comprise many large firms, and all the firms share a similar and substantial exposure to a highly volatile commodity price risk, namely jet fuel. Jet fuel is a highly volatile commodity, and constitutes a significant fraction of airline firms' operating expenses.

Theory predicts, that under such circumstances, firms may choose to hedge in order to increase firm value, by reducing several problems and costs associated with their risk exposures. This thesis presents this relevant theory, as well as competing theories that oppositely argue that hedging generally does not increase firm value, and occurs due to other reasons, and relate the theories to the specific European airline industry. Consistent with this theory, it seems plausible that hedging in the European airline industry occurs due to firms' attempts to increase firm value, and that hedging can in fact improve these firms' values.

To empirically examine these claims and theoretical predictions of hedging practices and impact on firm value in the airline industry, a quantitative analysis is conducted. The findings do not, however, uniformly support these expectations. Possible explanations are discussed, and overall the question of whether hedging can directly increase firm value, remains relatively open.

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1. Introduction

The research question of this thesis is:

"*Does hedging with derivatives add value to firms in the European airline industry*?"

In the following section we motivate the problem, and briefly introduce this subject area and common concepts, the academic subject fields from which we study the problem, and recent trends in the area of derivatives and hedging.

1.1 Motivation and Problem Area

Derivatives are financial instruments whose value is based on, or "derived", from another underlying security or asset. This can be a stock, a bond, or any current market price, for instance of a commodity, a foreign currency, an interest rate, an obligation, etc. This financial instrument is basically a contract between two parties, and this contract's value to the parties is based on expected movements in the underlying, and the actual future price movements.

Derivatives can be simple insurance contracts as well as highly complex instruments that are extremely difficult to valuate, and valuation of derivatives is a complex subject. Derivatives are traded both over-the-counter (OTC) and on exchanges, i.e. exchange-traded derivatives (ETD). OTC derivatives are contracts that are directly, and privately, negotiated and subsequently traded between the two involved parties. Since these contracts do not go through exchanges, and avoid market scrutiny, they are also more difficult to regulate, and this comprises the majority of the derivatives markets. OTC markets are frequently used for common derivatives such as swaps, forwards, options and spot markets. ETD contracts, on the other hand are traded on different intermediary exchanges, and there are several exchanges involved in derivatives trading. ETD are commonly futures, call options and put options.

Some basic derivatives can be relatively simple contracts that can be precisely valued. Basic and common derivatives, often termed "plain vanilla" include the following. A forward contract that is an agreement that obliges a party to buy the underlying asset for a specified price, at a specific time in the future, from the other party. Futures contracts are pretty much the same thing, except they are standardized and exchange-traded, while forwards are typically OTC traded. Options come in many variants, but the most basic, put and call options, gives the holding party the right, but not obligation (i.e. "option"), to buy or sell, respectively, the underlying at a time in the future at a specific price. Swaps are contracts that allow parties to exchange cash flows streams with each other, i.e. "swap" cash flows. These basic derivatives can be combined, or entirely different contract terms specified, to make so-called "exotic" derivatives. Exotic derivatives can be extremely complex instruments, whose payoff is a function of up to several underlying assets, making them very difficult to value precisely and calculate their payoffs.

The underlying assets are typically stocks (equity derivative), obligations/bonds (credit derivative), interest rates, foreign currency exchange rates, and commodities. The prices of these assets can be volatile, and derivatives can contracts facilitate the transfer of volatility risk between parties, and the associated benefits, as well as insurance against specific movements, and the speculation in these underlying price movements. There are few limits, except imagination, as to what underlying derivatives can be based on. Weather derivatives for instance, can allow parties to reduce risk associated with bad weather.

Derivatives are generally associated with two quite different types of activities, based on what the purpose or goal of entering the contract is. First, there is the use of derivatives for hedging. Hedging is a risk management activity that seeks to reduce the party's (organization, firm or individual) risk, and avoid excess risk it does not wish or afford to carry. Thus, risk can be transferred and be re-allocated to another party that is better capable of carrying this risk. This use of derivatives, in short, seeks to reduce unwanted risk. Another, quite opposite purpose of using derivatives is for speculation, which in effect is increase in risk though the speculator may not always feel so. Speculators may seek to benefit from possible movements in the underlying that they expect, and counterparties wish to avoid, or they may simply be better suited to carry a risk that is too large to bear for the counterparty, but also involves high potential payoffs. In addition, derivatives can be used to take highly speculative positions and, arguably, gamble in the

real world economy, with increased leverage. As examples of speculative derivative trading, we can mention the infamous Barings Bank incident of 1995 (Jorion, 2007), and more recently the American International Group (AIG), among many other financial institutions', involvement in the subprime-mortgage crisis and the speculative usage of complex derivatives, including collateralized debt obligations (CDO) and credit default swaps (CDS), that still has to wear off its effect on the economy[1].

However, as many economists argue, derivatives are not to blame for human speculation, and the efficiency of economies can be enhanced by the derivatives' facilitation of more efficient risk allocation, and transfers of risk to an equilibrium state where those best suited to bear risk can do so. This text will focus on this type of derivatives usage, i.e. for hedging and risk management purposes. We do not focus on the systemic effects on aggregate economic levels from the existence of derivatives, and the possible speculative usage. We focus on the corporate level of derivatives usage, and how corporations use derivatives, mainly for risk management purposes. Our main focus, and the objective of this text, is on the use of derivatives by European airline firms, and whether the usage of derivatives for hedging their fuel risk can actually enhance their firm value. This research objective is inspired by similar research on the possible effects of derivatives usage on corporations' firm value, and specifically a similar study of hedging and firm value effects in the US airline industry, by Carter, Rogers & Simkins (2006).

The choice of the European airline industry is founded in its high suitability to study derivatives usage for hedging purposes. It is a relatively fuel-intensive industry, with volatile jet fuel prices[2]. Thus, it intuitively seems to make sense that it is a fertile ground for hedging this risk through the use of derivatives.

Since we focus on hedging from the corporations' perspective, and firm valuation on the market, the relevant problem areas of this thesis are mainly Corporate Finance and Risk Management, respectively. These two subject areas are somewhat related, especially when it comes to our problem area. Risk Management is the study of exactly that: risk management, and includes theories on the valuation and pricing of derivatives, constructions of hedge portfolios, and general theories on how corporations can manage their risks in an efficient and strategic manner (Jorion,

[1] http://online.wsj.com/article/SB123906100164095047.html
[2] http://www.enriskpartners.com/RockProducts.pdf

2007). Our question is however on the potential effect hedging has on a firm's market value, and this question, as well as many of the mechanisms through which hedging can not merely manage risk, but also enhance real value of firms, are grounded in the Corporate Finance discourse (Brealy, Myers, Allen 2008).

In addition, as we shall see, conflicting interests, asymmetric information, and opportunistic behavior in face of incomplete contracts, as well as problems between agents and principals, and conflicts between the different claimholders and stakeholders of the firms, play a significant part in the theoretical frameworks concerned with the relationship between derivatives hedging and firm value. Interestingly enough, there is not yet a single, complete and widely accepted theoretical framework on the relationship between hedging and firm value. There are several differing theories, but these differ when it comes to the potential effect of hedging on firm value, and the reason why firms hedge at all. For this reason, it is important to present the relevant theories that have been posed proposed until now, and review the empirical support for the respective theories. Based on these theories, evidence supporting or discrediting them, and the specific traits of the subject industry, we reach a hypothesis, which is that the use of derivatives for jet fuel hedging does have a positive impact on firm value for European airline industries. To support our theoretical discussion, and try to validate our hypothesis, we utilize standard econometric regression models to establish and demonstrate a positive relationship between hedging and firm value.

1.2 Relevancy and Trends

Derivatives use and trading has exploded in the last four decades (Jorion, 2007), and is, arguably, a relatively new addition to financial instruments and markets, especially in the variant known today. Derivatives have since their birth been associated with possible hedging and the reduction of risk, and hedging of business risk in various forms has existed much longer than financial derivatives known today, for instance in ancient Egypt and in the Middle-Ages (Froot et al, 94).

Though, as already mentioned, the use of modern derivatives is not uncontroversial. In fact, it is widely discussed whether derivatives are tools for firms' risk management policies, or if they are mainly used for speculative purposes, and pose threats to both firms' value and the economy as a whole. This discussion has received a higher impetus after the recent US financial crisis, where derivatives played a role in creating bubbles that eventually burst, severely damaging the real economy as a consequence, and impacting global markets. There is an ongoing discussion, both in the US and in Europe, regarding the regulation of derivatives, and proposing widespread regulatory reforms. Warren Buffet has famously denounced derivatives as "weapons of mass destruction", and economists have discussed about the possible impact of financial development, including derivatives usage, on the economy as a whole[3]. It is also widely acknowledged that speculative uses of derivatives does occur, and there is anecdotal evidence of corporations gone bankrupt due to speculative trading of derivatives, such as Barings bank, Metallgesselschaft, Société Générale, etc (Jorion, 2007). There are also strictly theoretical works that argue that hedging does not add to corporate value, but rather can harm shareholders, and some evidence supporting this notion, as we shall see in later chapters.

Derivatives have, however, also received support, both theoretical and in the different discussions regarding reforms and regulations of derivatives usage and derivatives markets. Stulz (1996; 2004), for instance, acknowledges the potentially harmful effects of derivatives usage, while also arguing mainly in their defense. He argues that the stories of how derivatives can benefit companies are widespread and frequent, but much less publicized. He also argues that even though many firms can and do use derivatives for other purposes than value-maximization, or risk-minimization, and derivatives can play a role in negative and harmful speculation such as in AIG, the derivatives are not the culprit, but unfortunate and uninformed use of them. Further, he argues that both theories and practices of corporate derivatives usage are in need of a revision, but that the bottom line is that derivatives are important tools for corporations and financial markets, and that they, if correctly used, can add value both to firms and the economy.

The point is that derivatives are by no means uncontroversial, and are especially discussed in the aftermath of the recent financial crisis, and there are forces attempting to both regulate, as well as further de-regulate, derivatives usage and markets. It does not help that there is no unified theory

[3] http://www.kansascityfed.org/publicat/sympos/2005/pdf/rajan2005.pdf

of derivatives effect on firm value, supporting the benefits of hedging. As we mentioned, this text is not primarily concerned with these broader issues of risk increase in the economy due to derivatives, or the systemic effects of derivatives usage and speculation. We focus on the possibility of a firm to enhance their value through the use of derivatives. This may seem like a simple question to answer, but the fact is that derivatives' effect on firm value is difficult to isolate and measure, as well as the trade-offs between costs and benefits. Thus it is not surprising that evidence on derivatives effects on firm value is inconclusive.

The existing evidence on derivative hedging is also relatively recent, due to the difficulties in obtaining data and derivatives usage information caused by insufficient financial reporting requirements, and many studies include survey evidence on hedging. The more recent studies, from the latter half of the 90s and ongoing, have been able to obtain more relevant derivatives data due to new and more informative reporting standards of firms' derivatives inventory and purpose.

1.3 Research Objective, Scope and Hypothesis

This thesis attempts to study the potential effect that corporate hedging with derivatives has on a firm's market value in the European airline industry. Our specific research question is:

"*Does jet fuel hedging with derivatives add value to firms in the European airline industry*?"

An important sub-question is whether observed hedging activity is consistent with theories of value-adding hedging, since this supports our hypothesis that firms hedging policies are aimed at adding value.

As we have seen, there are several theories connecting hedging to firm value, but not all positively. Several studies and theoretical works attempt to illuminate this relationship, but with mixed results. Some theories argue, and some evidence support that hedging can add to a firm's value. Other theories and evidence, however, concludes with the opposite. This is highly

interesting, and may suggest incomplete understanding and practices of derivatives usage. It may also suggest that there may be differences in the possibility to add value through derivative hedging across nations, markets, and industries. This is also supported in the theories that argue that several assumptions must be fulfilled in order for hedging to have a potential value-adding impact on firms.

Bearing this in mind, our study is limited to derivatives hedging in the European airline industry. Thus it is our research objective to attempt to analyze if hedging of jet fuel has an effect on firm value of European airline industries. Grounded in theory, as will be discussed later, our main hypothesis is that hedging has a positive effect on firm value in this specific industry, similarly to this relationship that has been uncovered in the US airline industry, by Carter et al (2006). This hypothesis is based on our theoretical discussion, and on the consistency of some crucial industry characteristics and risk types in the industry, to the characteristics that theory argues can make hedging a value adding risk management activity. In line with this theoretical reasoning, we also expect the factors affecting the probability of a firm to hedge, and characteristics of firms that do hedge, to be consistent with the predictions made by theory. This possible consistency of actual hedging determinants and those that theory argue can make hedging valuable, is taken as support of our main hypothesis, that European airline firm hedge to add value.

Another limitation is possible erroneous conclusions resulting from our analysis structure and variables used. As it is difficult to acquire the necessary data, many of the factors studied are proxied by other variables, and there are several ways of measuring hedging, due to difficulties in obtaining complete and accurate information publicly. There are also several variables intended to proxy for the same factor, which may not always be congruent. However, the variables are grounded in theory, are well justified, and have also been used for the same purposes by prior studies investigating the relation between hedging and firm value.

This thesis uses a deductable method, and the theoretical discussion and analysis of industry characteristics are crucial for our hypothesis, for our structure of the quantitative analysis, and for our subsequent discussions and conclusions. Using the same theories on other industry could have led us to entirely different expectations and hypotheses. This relation of industry and firm characteristics to theory, and the subsequent expectations and specific hypotheses, will be more closely specified in the analysis chapter.

1.4 Thesis Structure

The rest of the thesis is structured as follows: Chapter 2 presents the methodology used, and the main reasoning of the text. Chapter 3 thoroughly presents the relevant theory used, and is an important basis for our subsequent discussion and analysis structure. Chapter 4 is a comprehensive presentation of prior empirical evidence on the subject, relating theory to reality, and is also important for our expectation formation, and analysis construction. Much of this work also inspired our thesis, since it is inconclusive, and has led us to examine the subject in an industry-specific setting. Chapter 5 is a quantitative analysis of our research subject, and attempts to support our theoretical conclusion and predictions for the European airline industry. Chapter 6 discusses the results and findings from the analysis, attempts to explain possible discrepancies, and briefly discusses the implications of the findings. Chapter 7 concludes.

2. Methodology

In this chapter, we present the methods used, and sources of knowledge about the subject at hand, and how we apply these in our study of hedging in the European airline industry. We use both theoretical frameworks and related literature and evidence, to form our expectations and basic understanding of the impact hedging may have on firm value in the European airline industry, and subsequently put these expectations on empirical trial by using quantitative analysis to see if hedging practices in the industry conform to our hypotheses, and if we can find evidence that firms can add value by hedging in accordance with sound theory.

2.1 Overall Research Strategy

This text is constructed as a deductive thesis. As we will see later, there are various theories predicting different reasons for why firms hedge, and what the effect of hedging will be. These theories rest on different assumptions, so it is important to bear in mind how these assumptions hold in specific situations and environments where the analysis takes place. There are generally many theories of how to implement hedging, or how to value certain derivatives, but there is no general, "one-size fits all" theory that relates hedging to effects on firm value (Froot et al, 1993).

Similarly, the empirical works yield inconsistent results, and some researchers have suggested that the observed heterogeneity in hedging practices as well as the inconsistent empirical evidence, are caused by industry-specific and firm-specific characteristics that influence the impact of hedging on firm value (e.g. Jin & Jorion, 2006; Adam, Dasgupta & Titman, 2007).

The point is that the existing theories of hedging and firm value are not necessarily generally applicable to all firms across industry borders, and sometimes not even for firms within an industry. Therefore we attempt to investigate the question of whether hedging can add value in the European airline industry by using the existing theories, empirical evidence, and methods,

and relating them specifically to our specific industry subject. Thus, building upon existing knowledge and literature, we attempt to discuss and arrive at specific hypotheses, or predicted consequences, of the activity of hedging in the European airline industry. Then we test these predictions empirically, to further support our hypotheses, or possibly discredit them.

In the following, we outline the different aspects of our study, and how we attempt to use them to illuminate our research question.

2.2 Theoretical Framework

In our deductive process, we start out by discussing the different theories of hedging and firm value. As already mentioned, there is interestingly enough a lack of a unified theory on the subject, and several different frameworks exist. Many of these theoretical frameworks argue that different mechanism are at work when a firm is hedging, and thus reach different conclusions and predictions as to what impact hedging with derivatives will have on a firm's value. As we investigate this relationship in a specific industry, we build our understanding on these existing theories to build up a general knowledge that we then can use to deduce predictions of consequences of hedging in the industry, and its effects. In this deduction, the assumptions about the industry are crucial, since as we have seen, many of the theories are based on different assumptions. Thus, we will thoroughly present the different assumptions that the different theories build on, as well as present and discuss the different theories in detail.

Since, as mentioned, many theories are differing, we attempt to uncover which are most applicable to our specific industry, and thus should hold most predictive power. We also consider prior research and empirical evidence in this forming of expectations as to the relation between hedging activity and firm value. The alternative theories may still play a role, however, and serve as a balancing anti-thesis to our predictions, especially if the evidence fails to conform to our expectations.

As mentioned earlier, most of the theories are based on problems well-known from the subject of Corporate Finance, but specifically related to hedging. The theories and models are based on frameworks much applied in this subject, and include agency costs and problems, conflicting interests between parties, opportunistic behavior, incentives, incomplete contracts, and more. Terminology from these frameworks is frequently applied.

Thus, arriving at a set of specific theories and assumptions, we will use these to discuss the possible effects of hedging on firm value, and whether the firms' reasons to hedge are in line with value-adding theory at all. We will also enhance this theoretical understanding by reviewing empirical evidence on the subject as well. Building on this theory and assumptions we arrive at, we develop a series of predictions, or hypotheses, which we subsequently test. This empirical test will either support our theories, or not.

2.3 Empiric Literature Review

After presenting the theoretical frameworks, we present a substantial list of prior empirical research on our topic. This is important for several purposes. First it supports and validates some of the theories, while showing mixed evidence for others. It also shows the somewhat incongruent findings, suggesting that hedging may have different effects and determinants in different industries and businesses. It also supports our development of theories and expectations of the effect of hedging in the European airline industry, by increasing our knowledge and understanding of the subject, as well as providing information about what we do and what we do not know about hedging.

We will include many of the relevant studies on the subject, and divide them into sections that correspond with the different theories they support or discredit. We will also include a section of empirical work that directly examines the research question of whether hedging adds value in specific industries.

Another important contribution of this prior research to our thesis, is the contribution of methodological models, arguments, variables, and connections with theory, to this specific study of subject. This is important, since much of the literature use similar econometric models and proxy variables that we will use. This is especially true of the more recent literature that directly examines the impact of derivative hedging on firm value.

While our literature review perhaps is not completely exhaustive, it includes a relatively vast amount of the research on the subject of hedging. There are, to our knowledge, no other academic studies directly examining the specific impact hedging has on firm value than the ones we present. The review also illustrates the ambiguity in the observed results. It could have been interesting to conduct a more systematic review of this prior research, perhaps a meta-analysis, but this not necessary to our research objective, and is out of the scope of this text.

2.4 Quantitative Statistical Analysis

To examine our research question quantitatively, we operationalize some of the concepts and relationships developed based on theory and empirical evidence, and construct a set of hypotheses that we subsequently test using quantitative statistical methods. The quantitative analysis is based on a regression analysis, and supplemented by univariate statistics and a binary regression model. We use three different tests to test the relations between the operationalized variables, or factors, and analyze if they conform to our expectations and theory: a unviariate model, a multivariate regression, and a binary regression. The hypothesized relationships, and the specific variables used will be specified in the relevant chapter.

The different operationalized measures are proxy variables for a factor in accordance with theory, and these are explained in the analysis chapter, along with the hypotheses we construct. Many of these have been used in corresponding research, included in the empiric review chapter, and we explain the use of the different variables in the chapter of analysis. Also the quantitative

methodology itself is based on similar studies in the prior research. In the following we explain the statistical methodology and models that will be applied in the quantitative analysis.

We start of by comparing a group identified as hedgers versus a group identified as non-hedgers, using a univariate analysis, or descriptive statistics. The hedgers are firms that report any derivative hedging activity, while the non-hedgers are not using derivatives for hedging purposes in the sample period. We compare characteristics of these two groups, and see if they differ significantly with respect to characteristics that we predict will influence hedging. In line with our theoretical discussion, we will expect the hedging firms to display characteristics that according to theory participate in making hedging a potentially value-adding activity. The expected relations between the variables are tested, and the results of these differences between hedgers' and non-hedgers' characteristics are presented in tables and discussed. We expect to observe statistically significant differences in these key variables between the discrete categories hedgers and non-hedgers. We test the significance levels of the hypotheses by testing their p-values and t-values.

The second analysis is a multivariate regression, and is utilized for conducting a more advanced analysis of the main research question, namely if hedging adds to firm value. Here, we also measure the levels of hedging, using two different hedging-variables. Using this model, we isolate the effect of the hedging variables on firm value, since it is affected by several factors, while including the other possible explanatory variables as well. Here, we use two different hedging variables, and include a dummy variable of hedging that has the value 1 if the firm hedges, thus estimating totally three specifications for the regression model. Since we here measure the extent of hedging as well, and isolate the effect of the hedging variables on firm value, this test ought to be relatively more informative then the univariate analysis, which tests based on the mere existence of hedging activity. In order to infer that hedging has a positive effect on firm value, we must exclude the effect other variables can have on this value in our test. Therefore we control for several other variables that can have an influence on firm value. Further, we conduct tests for multicollinearity, auto correlation, normality in residuals, and heteroscedascity.

Finally, to further support our theories and hypotheses, we use a binary regression model to analyze which of the variables, if any, affect the probability that a firm will hedge. We expect

these variables to be support our theoretical predictions, and be consistent with the other findings. If we observe that determinants of hedging are factors that our theory argues can make hedging a value-adding activity, we take this as supporting the notion that firms are hedging to increase value, consistent with this theory, and as indirect support of our hypothesis that hedging can add value in the European airline industry.

To summarize, it is not easy analyzing the impact hedging with derivatives can have on firms' values. The data are relatively difficult to obtain, and the quantitative tests use several proxy variables to study relationships. As mentioned, derivatives can be complex instruments, and it is not a simple task to directly measure their impact on firm value. Especially since this impact can differ across different industries and firms with different characteristics. So, the theoretical discussions, the information from prior evidence, and the discussion of specific characteristics of the industry are important insights that our industry-specific analysis builds on. The hypotheses we develop also to a large degree build on these insights about theory, evidence, and the subject industry.

3. Theory

In this chapter we will present the main existing theories that relate corporate hedging to firm value. These theories are differing in several important aspects: they build on different assumptions about the interests of actors, capital markets, corporate environment, and firm characteristics; they focus on different factors and mechanisms of derivatives hedging and its effect on firm value; in whose interest it is to hedge, who decides firms' hedging activities, and why. Some of the theories, as we will discuss later, can be argued to be specifically important in the airline industry, due to its characteristics, and the risk exposure type.

3.1 Introduction

What makes the analysis and discussion of whether hedging with derivatives can positively influence firm value, is that theories and evidence are inconclusive. There exist several different theoretical frameworks that discuss what rationale non-financial firms have to engage in derivatives usage, and what the effects of such usage and motivations can be. Specifically, there are two broad classes of theoretical explanations of why managers undertake risk management activities (e.g. Tufano, 1996): the shareholder value maximization hypotheses, that holds that managers act in the shareholders' interests when deciding to use derivatives in the firm's risk management , and attempt to maximize firm value, which is equivalent with maximizing shareholder wealth (Brealy, Myers, Allen, 2008); and, the managerial private utility maximization hypotheses that holds that managers utilize derivatives in risk management as means to maximize their own private utility, without regards to firm value. These two theories also have different predictions as to how derivatives hedging can affect firm value. In the following, we will present and discuss these different theories more thoroughly.

3.2 Shareholders' Wealth Maximization Hypothesis

The shareholder wealth maximization hypotheses argue that market inefficiencies can create costs to firms associated with the uncertainty of their value, and their volatile firm cash flows. Thus, hedging can, by stabilizing cash flows and the costs associated with volatility, increase firm value. This is also the rationale for why managers choose to hedge with derivatives. There are four specific mechanisms through which hedging can increase firm value, but all of these are based on some sort of market inefficiency, i.e. friction to the famous Modigliani & Miller (1958) assumptions of perfect capital markets. We start the theory discussion by looking at their argument of "irrelevancy" of financial structuring to firm value, and how the real world capital markets compare to these assumptions.

3.2.1 Modigliani & Millers' Perfect Markets & Real World Imperfections

Modigliani & Miller (MM) have in their seminal article proposed the "irrelevancy" argument that holds that in a "perfect world", under perfect assumptions, i.e. no taxes, bankruptcy costs, information asymmetries, and transaction costs, any changes to capital structure is irrelevant for a firm's value. That is, firm value cannot be increased, under these perfect assumptions, by changing the capital structure. Since derivatives usage is just a financial transaction, this reasoning applies to the use of derivatives as well (Haushalter, 2000). This means that firm value cannot be increased through the use of derivatives, under these frictionless and perfect assumptions.

The real world, however, does not always meet these perfect assumptions: corporations often face taxes, costs of bankruptcy and financial distress, costly external financing, and agency costs between the different claimholders of the firm (Brealy, Myers, Allen, 2008). These inefficiencies are somewhat interrelated, can increase each others' effects, and can create costs to firms as well as allow firms to potentially increase firm value through capital structure, risk management, and

use of derivatives. We will briefly look at some of these effects that frictions to the MM assumptions can create that allow firms to exploit inefficiencies, and add to firm value.

One of these value-adding possibilities is finding an optimal debt-ratio, or leverage. When a firm's debt ratio increases, there are, contrary to MM's perfect capital world, increased benefits as well as disadvantages, which can have an effect on firm value (Brealy, Myers, Allen, 2008). The net effect is difficult to calculate exactly, however, since there are many simultaneous mechanisms at work, and the effects may not be proportional to the increase in debt, as well as may be offsetting each other. The main effects of leverage, relevant to our discussion, are as follows: the benefit of increased tax-shield, since interest payments on debt are tax deductable expenses, reducing the firm's total tax expenses; the disadvantages caused by increased agency costs and conflicting interests between equity claimants and the debt claimants on the firm's asset, which in turn have several negative mechanisms compromising the maximization of firm value. First, leverage increases the expected costs of financial distress and bankruptcy. Second, leverage, especially in distress, may create perverse incentives for the managers and shareholders, at the expense of the firm's creditors/bondholders. Finally, the firm's managers, due to such information asymmetries and conflicting interests, and resulting measures that may be taken by potential external investors, may prefer internal funding of their projects over the, due to several possible reasons, more costly external funds obtained in the capital markets. The point is that leverage impacts the probability of bankruptcy, and hence also financial distress, agency and interest conflicts between the different claimants on the firm, and therefore also the cost and access to external capital. At the same time, the leverage has benefits, and directly affects firm value positively by providing the firm with a valuable tax-shield. This poses a trade-off, also known as the "trade-off theory" of capital structure.

Another important imperfection to MM, is the costs of bankruptcy and financial distress. Costs of bankruptcy and distress occur when firms cannot meet their obligations to creditors, or struggle to do so. This can create real costs to the firm, and thus has an impact on firm value. The expected costs of both distress and bankruptcy depend directly on the probability that situations of distress and bankruptcy occurs, as well as the size of these costs if such a situation should occur. Empirical evidence also shows that firms in reality do face significant costs associated with both distress and bankruptcy (Brealy, Myers, Allen, 2008)

All the imperfections above are related to some variant of violations of MM's perfect assumptions of no taxes, no bankruptcy costs, no information asymmetries, etc. The shareholder maximization hypotheses of risk management claim that hedging can help alleviate these problems, and their costs, thereby increasing firm value. The use of derivatives for hedging purposes can accomplish this by reducing the negative effects of the capital market imperfections, mainly by reducing the volatility and uncertainty of the firm's earnings and value, thereby improving information, and ameliorating the conflicting interests that especially arises when uncertainty and risk is high. The reduction uncertainty is the focus of the subject of risk management, and of value-adding hedging in the shareholder wealth hypotheses. Next, we will examine these hedging theories more thoroughly, to see how hedging can potentially impact firm value through several of these channels.

3.2.2 Costs of Bankruptcy and Financial Distress

As seen above, in MM's world bankruptcy is costless, and there are no costs inflicted on firms due to financial distress. In reality, this is not so: in case of default, or bankruptcy, a significant amount of money will be used for lawsuits, lawyers, proceedings, administration, and the bankruptcy processes, so-called direct costs of bankruptcy. Estimated 2% of pre-distress value can be lost in this process (Froot, Venter, Major, 1994). Even more important are the indirect costs, such as employees and managers turning focus and energy away from their jobs and creating value, and on to finding new jobs, managing the bankruptcy process, etc., as well as customers, suppliers and other stakeholders "jumping ship", and looking to new firms business. The latter are estimated to be as much as an order of magnitude larger than the former, and are difficult to monitor directly, and will be inflicted upon the mere prospect of distress and possible bankruptcy, inflicting additional costs and possibly reducing the firm's market valuation and hurting its reputation and stakeholder relationships (Froot et al., 1994). Thus, some theories argue, if this threat and cost may be reduced by hedging, then hedging could lead to an increased firm value.

Smith & Stulz (1985) develop a positive theory of hedging by value-maximizing corporations, and treat hedging as a part of a firm's overall financing decisions, and start by pointing out that *"…if the hedging policy affects the value of the firm, it must do so through (1) taxes, (2) contracting costs, or (3) the impact of hedging policy on the firm's investment decisions*", to explain the observed diversity in hedging practices in corporations. They develop a formal model of how debt and hedging policies are related, that considers how hedging may influence the transaction costs of bankruptcy and costs of financial distress.

In their model, assuming there exist incentives in the contracting process to maximize the market value of the firm, value-maximizing firms can increase firm value by hedging through several mechanisms, based in frictions to MM. One of these is by reducing the probability and expected costs of financial distress and, consequently, bankruptcy. Smith & Stulz adopt a general view on hedging, namely all contracts, financial decisions and real options that produce similar effects in terms of market value, and result in reduced dependence, or sensitivity, of firm value on changes in future states. Thus hedging leads to reduced volatility in future firm value.

If the value of the firm is below F (face value of debt at maturity) at the maturity of debt, the bondholders will receive only F minus the transaction costs of bankruptcy. But if firm value is higher than F, the shareholders receive firm value minus taxes paid and the bondholders' payment, F. From this, it is obvious that the lower expected bankruptcy costs are, the higher the expected residual to the firm's claimholders. In addition, financial distress costs can be sufficient to lead the firm to the ultimate bankruptcy, which could otherwise possibly have been avoided in the absence of these additional costs.

Reducing the variability of the future firm value, hedging thus reduces the probability of incurring the distress and bankruptcy costs, by leading to less future states where the firm value is low enough to create prospects of distress, and thus reduces the expected bankruptcy and distress costs. Or, the firm reduces bankruptcy costs by constructing a hedge portfolio that pays positive cash flows in states where the firm would otherwise be bankrupt without the hedge. Smith & Stulz further show graphically and mathematically how this reduction of expected costs benefits the shareholders, and conclude that *"…if transaction costs of bankruptcy are a decreasing function of firm value, and the tax rate is either constant or an increasing function of firm value, expected after-tax firm value net of bankruptcy costs is higher if the firm can costlessly hedge*".

Smith & Stulz extend the model to a levered firm with costly hedging, and show that also with costly hedging, it is still "…generally profitable to hedge", but shareholders, or managers, must now account for these costs of hedging when choosing risk management strategies.

So, Smith & Stulz have shown how shareholders benefit from hedging only because bankruptcy involves real costs to stockholders and bondholders – the direct bankruptcy costs and the loss of debt tax shields. But, there is still a potential obstacle for this improvement. For hedging to increase shareholder wealth, the firm must credibly convince creditors that it will actually hedge after the issuance of debt, and thus make the bankruptcy costs lower than the firm's unhedged investment policy would imply. But managers may renege on this commitment, since hedging is costly, and not in the shareholders interests ex ante, and potential bondholders recognize this fact. "Although hedging increases the value of the firm, it also redistributes wealth from shareholders to bondholders in a way that makes shareholders worse off". However, the market creates incentives for firms to actually hedge in two ways: through reputation, if the firm borrows frequently, they want to maintain a good reputation, and; by reducing costs of financial distress in addition to the actual bankruptcy costs, i.e. the threat/probability of bankruptcy, and thus the firms have fewer restrictions imposed on them by creditors and debt covenants, trying to safeguard their fixed claim, and hindering risk-taking from the firms.

We have shown how Smith & Stulz analyze the effect of hedging on firm value, through its effect on the present market value of its bankruptcy and distress costs, in a state preference model. They also imply there is a relationship between risk in terms of variance of firm value and the bankruptcy risk, but do not explicitly model this relation. Hahnenstein & Röder (2003) present a new model, also examining increased firm value by hedging, but they focus explicitly on the bankruptcy risk, and formally model how the probability of default can be influenced by hedging. They also claim that minimizing probability of default can serve as a substitute, or equivalent, of maximizing shareholder wealth, i.e. firm value.

Bessembinder (1991) also formalizes this argument in a model. Bessembinder shows that hedging can improve firm value by improving contracting terms, in any claim senior to equity, by changing the distribution of cash flows in a manner that reduces the likelihood of extremely small cash flow outcomes. Hedging thereby transfers cash flow to those states where cash flows are low, ameliorating the firm's ability to meet its obligations in additional states, where without

hedging it would have insufficient cash flows. In this manner hedging can improve contracting terms with creditors, customers, employees, suppliers, if the contracts with these parties are initially NPV-positive, and reduce expected costs of financial distress.

Tufano (1996) also mentions how reduced financial distress by hedging, also reduces the distress costs associated with the "detoriation of valuable relationships with buyers and suppliers who value long-term access to the firm".

The bottom line is, hedging can increase firm value by reducing the present value of expected costs of financial distress and bankruptcy, direct and indirect, as well as the probability of getting into such a state in the first place. This is achieved through a reduction of volatility of the firm's earnings, cash flows, accounting profits, or other factors of future firm value, but ultimately the reduction of the variance of firm value reduces the probability of distress. The benefits of hedging will increase if the firm faces higher costs of financial distress, and leverage increases the probability of getting into distress. Additionally, costs of financial distress is a link that explains how market value might be directly associated with variability. By reducing the likelihood of financial distress hedging can increase firm value, through a reduction in the deadweight costs. A consequence of this, that also may have positive effects on firm value through tax-shields and reduction of free-cash-flow agency conflicts between shareholders and managers, is increased debt capacity for the firm, arguments which we will examine directly in the following.

To summarize, under MM assumptions, bankruptcy is costless. Thus, changing the probability, and expected costs of distress does not affect firm value. If bankruptcy is costly, and therefore distress also becomes costly through agency costs, firms and shareholders have an incentive to hedge, in order to reduce the probability of such state occurring. This probability is reduced by hedging, since the earnings, cash flows, and ultimately firm value, become less volatile in correspondence with the hedged risk exposure. Thus, the fraction of future states in which the firm does not get into distress, increases, reducing both the number of states, and the costs associated with, distress and default. In addition, the underinvestment problems and inefficient investment incentives, discussed in the next theories, are more prevalent in states of financial distress, as the shareholders and managers have "less to lose" and more to gain from excessive risk-taking, or "gambling".

3.2.3 Underinvestment 1: Costly External Financing

In the financial distress theory above, we saw how important stable cash flows are for maintaining the firm's investment activities and strategic decisions aligned with the shareholders' interests, namely the maximization of firm value. If cash flows become sufficiently low to lead the firm into a distressed state, these overall goals and strategies of undertaking NPV-positive investments and pursue a value-maximizing strategy becomes compromised, and various conflicting interests and agency problems surface. Cash flow is, in several ways, paramount for the firm's decisions and investment policies, and these in turn directly impact the organization's value creation, and economic value added. The next two theories look at how investments may be compromised, and thus the firm value and shareholder wealth reduced. The first one, like Smith & Stulz' financial distress-theory, focuses on the advantages of stabilizing cash flows, and thus firm value, in order to successfully be able to pursue an value-maximizing strategy and investment policy. The firm's cash flows are, to varying degrees of course, frequently exposed to volatilities in external prices and macroeconomic factors, such as commodity prices, interest rates, foreign exchange/currency rates, etc., and these movements may be adversely decisive for the firm's costs, earnings, and net cash flows, and firms naturally are interested in alleviating such adverse risk exposures.

Froot, Scharfstein, & Stein (1993) attempt to develop a general framework for analyzing corporate risk management policies, and start by point out that if external finance sources are more costly to the firm then internally generated funds, i.e. retained earnings/cash flows, hedging will be beneficial. This model endogenizes the distress costs from Smith & Stulz' argument and treats the underinvestment problem as a result of deadweight costs of external financing, in an imperfect capital market. Hedging, in this setting, can add value to the extent it contributes to securing the firm has sufficient cash flows, i.e. internal funds, to undertake all NPV-positive projects and growth opportunities, and avoid foregoing good opportunities and projects due to having to turn to external financing markets. They continue by developing this simple observation to a general and wide-ranging framework that studies the implications for the design of the firm's risk management and hedging strategies. Also their model depends on the implications of capital market imperfections, which are assumed away in MM: "*broadly*

speaking, this work argues that if capital market imperfections make externally obtained funds more expensive than those generated internally, they can generate a rationale for risk management".

The additional deadweight costs incurred by the firm when obtaining external finance, they assume, can come from several sources: the costs of financial distress and bankruptcy, direct and indirect, since increased leverage increases the probability and costs of distress and bankruptcy, as discussed; the information asymmetry between managers and external investors, the signal effect of outside funding, and agency costs with monitoring and motivating managers resorting to some types of outside finance; and finally, the private benefits managers may obtain from limiting their dependence on external investors, such as reduced discipline, etc. So, whether or not the external capital actually gives additional costs or not, management may still behave in a way that tries to reduce dependence on external capital markets. In addition, Froot et al. argue, there is substantial empirical evidence that supports their notion that corporate investment is sensitive to levels of internal cash flows, providing additional validity to their theory of hedging, cash flows and investment.

The basic logic of the risk management model is as follows: an unhedged firm will have a certain variability in the cash flows created by the firm's assets. This variability in internal funds, by simple accounting logic, implies that this variability must lead to either a corresponding variability in the amount of externally raised funds, or corresponding variability in investments. Generally, assuming the investment projects are good and NPV-positive, it will be undesirable to reduce investments, at the same time as, assuming the marginal cost of capital increases with the amount of externally raised capital, it will be undesirable to fill the financial gap or slack by seeking funding in external capital markets. Obviously, cash flow volatility adversely affects either investment or financing, or both, in a way that is costly, or value-reducing.

Thus imperfections in the capital markets can result in underinvestment in states where internally generated funds are less than the amount of investment and growth opportunities that are NPV-positive, or profitable, value-adding. In this context, Froot et al. demonstrates a rationale for hedging that may increase firm value, and extends the model to find optimal hedging strategies for firms, depending on the nature of their investment and financing opportunities, showing how

a well-constructed hedging strategy can allow the firm to optimally coordinate its investments and financing policies.

To reduce the cost of underinvestment caused by cash flow volatility, and ameliorate the foregone investment and growth opportunities, the firm can construct such appropriate cash flow volatility-reducing strategies, reducing the variability of earnings. This in effect means that hedging redistributes cash flows from states where it exceeds profitable investment opportunities, to states where it is insufficient, thereby enabling the firm to maintain profitable investments and purse maximization of shareholder wealth, i.e. firm value.

The more difficulty or costly it is for a firm to access external financing markets, i.e. the more financially constrained it is, the more valuable the hedge securing cash flows is.

Besides, external financing such as equity issuance, may send negative signals to the investor markets, thus depreciating the firm's market valuation (Brealy, Myers, Allen, 2008).

However, even though firms can obviously benefit from cash flow hedging, through the alleviation of underinvestment caused by imperfections in the capital markets, the hedging of cash flows does not necessarily increase firm value. For instance, a hedging firm may still have no good projects or growth opportunities, or may have sufficient funds even in the absence of hedging. Tufano (1998) even argues that such cash flow hedging might lead to overinvestment, and consequent reduction in shareholder wealth. Managers that are entirely independent of external markets for financing, also have reduced discipline, since they are not constantly monitored and disciplined by external creditors, investors, safeguarding their investments.

3.2.4 Underinvestment 2: Agency Costs of Debt

As previously mentioned, there are two types of underinvestment problems that may reduce firm value. One is caused by costly external financing, and insufficient internal funds, and was discussed in the previous section. The other is caused by agency problems and conflicting

interests between a firm's debt- and equity-claimants, respectively, and the conflict of interests increases with a firm's leverage as well as with volatility in the firm value (Brealy, Myers, Allen, 2008). These two different groups of a firm's claimholders have differing claims on the firm's assets and residual cash flows, and a transfer of risk and benefits/wealth between them can be a result of differing capital structure, leverage, and investment policies. Here, the managers have the opportunity to make decision that transfer value from bondholders to shareholders (or risk the other way), assuming the managers act in the owners' interests. These conflicting interests can lead to inefficient investment and decisions, and may compromise the firm value, and are known as asset-substitution, risk-shifting, or debt-overhang problems (Jensen & Meckling, 1976; Myers 1977). Hedging can contribute to mitigating these agency costs, and in the following we will look more closely at how this might occur.

The first problem is known as the underinvestment or debt-overhang problem, and is simply caused by the fact that due to firm volatility and the threat of financial distress and bankruptcy associated with this volatility (see also the previous section on this subject), a leveraged firm may choose not to undertake value-adding, NPV-positive projects, which should otherwise be undertaken by a value-maximizing firm. Managers may do this, acting in their shareholders' interests and against the interests of bondholders, simply because the bondholders have the senior claim, and thus the benefit from accepting the valuable, but risky, project accrues to the bondholders while the equity holders' risk has increased. This is a larger problem the more volatile the firm's value is, and the more leveraged it is, implying it has a larger probability of getting into distress, which causes and increases these interest conflicts. When a firm is levered, and volatile, any increase in value must primarily be used to repay the debt-holders' fixed claim, while the project further increases the residual claimants' risk, since their expected residual payoff becomes lower. Thus the benefit of a risky, NPV-positive project goes to the creditors. This problem is also larger the more available good projects and growth options are available (Brealy, Myers, Allen, 2008).

Dobson & Soenen (1993) argue that this underinvestment caused by a conflict in interests, can be ameliorated by hedging, and the subsequent reduction of variability of firm value. Similarly to the earlier argument about the reduction of financial distress, also here the number of future states in which the firm value is low enough to create this agency problem, becomes lower, i.e. less

frequent and probable. Thus, the firm saves the deadweight agency costs caused by low firm value under leverage, and subsequently the firm value and shareholders' wealth increases. Especially highly leveraged firms, with high growth opportunities can benefit from this form of hedging.

The second agency problem associated with debt is the so-called problem of asset-substitution, or risk-shifting. This basically refers to the incentives managers, acting in shareholders' interests, have after the bond issuance, to substitute lower risk projects for higher risk projects, a decision that effectively shifts risk from shareholders to bondholders, or in other words, transfers value from the bondholders' claim to equity claims. This is due to the fact that equity claim can be viewed as a call option on the firm's assets. If firm value exceeds the value of debt at maturity, the shareholders are residual claimants after the debt, or "exercise price", has been paid. If the firm value is less then debt, however, i.e. "out-of-money", the shareholders' will forfeit on the firm's assets, or go bankrupt. And according to option pricing theory, the value of the option, i.e. the equity claim, is more valuable the higher the volatility, due to higher probability of extreme positive outcomes, and safeguard against corresponding extreme downside risk (Brealy, Myers, Allen, 2008). Thus, by shifting from relatively safe, to relatively risky projects, especially under excessive leverage, the managers can increase the value of equity substantially, while decreasing the value of debt correspondingly, in this zero-sum game of risk allocation.

The agency cost, or reduction of firm value, is caused by the fact that creditors anticipate such asset-substitution, and therefore take countervailing measures to hinder such ex post opportunism and wealth transfers. They can incorporate compensation for this behavior ex ante, thus increasing the firm's cost of debt capital, or they can create debt covenants, thereby restricting the investment policies of the firm. Both of these measures reduce the total firm value, and can hinder good, sound investments, even risky ones.

Dobson & Soenen (1993) show how hedging can ameliorate these agency costs of debt, by lowering the firm's risk, and thus lead to an alignment of interests of debt- and equity-claimants, In summary, Dobson & Soenen argue there are three agency costs of debt that can be reduced by hedging, leading to enhanced firm value. First, hedging reduces the firm's cash flow volatility, and thus lowers its cost of debt and restrictions imposed by creditors. Second, by reducing firm value volatility, hedging will reduce the conflicting incentives and risk shifting. Third, hedging

reduces the probability of financial distress, and hence make the contract relationships between shareholders longer.

Bessembinder (1991) also have made a similar argument, and develops a formal state-preference model, in which he shows how hedging can improve market value of the firm through alleviating the agency costs, inefficient investment, and inefficient contracting in face of conflicting interests between shareholders and any claimholders senior to equity. This occurs since the hedge stabilizes firm value variability, shifting the number of future states from default to non-default states. This in turn decreases the sensitivity of senior claim value to incremental investment, giving equity claimants a larger portion of the incremental value from new investments. A second value-increase effect occurs if the fulfillment of the senior claims is assumed to be value-adding in itself. Thus, hedging improves the value of the senior claim as well, thereby enhancing the market valuation of the firm. In other words, hedging transfers cash flows from states in which it exceeds obligations, to states where it less then obligations. If the fulfillment of obligations is more probable, the firm can also achieve better contracting terms with creditors, customers, suppliers, employees, and other stakeholders, due to less inherent risk and opportunism. Also, as in Froot et.al (1993), hedging is most valuable when the correlation between cash flows and the hedged market prices are substantially different from zero.

3.2.5 Taxes

Yet another positive theory of hedging from the seminal article of Smith & Stulz (1985) proposes a tax argument for hedging. The argument in short is that if the firm's income is subject to a convex tax code, than the firm's tax expenses can be reduced by reducing the volatility of pre-tax earnings through hedging. But this depends on the structure of the tax code. If the firm faces a linear tax function of pre-tax firm value, i.e. the effective marginal tax-rate is constant to firm value, then the total tax liability is not adversely affected by the volatility of pre-tax value. If, however, the tax liability is a convex function of the pre-tax firm value, i.e. the effective

marginal tax rates is an increasing function, then the after-tax value of the firm is a concave function the pre-tax-value.

The tax-scheme may be convex for several reasons. First, it becomes convex if the marginal corporate tax rate is progressive, that is it increases when the firm's taxable income increases. Second, different tax rules and regulations can lead to a convex tax-scheme. For instance, limits on ability to carry losses backward/forward, may indirectly lead to a convex tax-function, since the firm cannot exploit situations with low incomes and/or losses to shield future profits from taxation (Grahams & Rogers, 1996).

Smith & Stulz model how the variability of cash flows and pre-tax firm value is costly for firms that face effective convex tax functions, since expected tax liabilities increase with volatility. If hedging can reduce this volatility, it will also reduce the expected tax expenses, and thereby increase the firm value, and this effect is greater the more convex the tax function is, and the more volatile the firm is. They extend this model to a case where hedging is costly as well, due to transaction costs of hedging, and show that it is still value-increasing to hedge, as long as the tax-benefits outweigh the transaction costs of hedging. The point is that by reducing the variability of taxable income, the firm reduces the expected tax liability which in turn increase the market value of the firm.

A related, but different, tax-argument argues that hedging can offer additional tax benefits through another mechanism, namely by increasing the firm's debt capacity (Graham & Rogers 1996; Stulz 1996). Hedging can lead to increased debt capacity by reducing the volatility of incomes, and the probability of getting into a state of financial distress, as discussed earlier. And it is well-known from the trade-off theory of capital structure (Brealy, Myers, Allen, 2008), that the tax imperfection of MM's assumptions, results in high debt having a positive effect on firm value by providing a valuable tax-shield, which can reduce the firm's total tax expenditures since interests on tax payments are tax deductable. Hence, hedging can improve firm value by increasing the firm's debt capacity. A secondary, but related, positive effect is that hedging lowers the probability of bankruptcy and distress costs, resulting from unused debt capacity (Graham & Rogers 1996).

3.3 Managers' Private Utility Maximization Hypothesis

The other main category of theories of hedging is based on other foundations than the first one, in which managers, acting in shareholders' interests, seek to exploit frictions to the MM framework, in an attempt to maximize shareholder wealth. In this second category, the different theories have in common that managers hedge primarily to maximize their own private utility functions, i.e. we now instead focus on agency problems and conflicts of interests between the shareholders and their agents, the managers. Such problems are treated in Corporate Governance and Theory of the Firm literature, and in such environment information asymmetries, signaling and reputation building play a crucial role. This theory attempts to provide a different explanation of rationales for corporations to hedge, and to explain the observed ambiguity in empirical evidence on what impacts the decision to hedge, and if firms hedge to maximize value. Thus it serves as an important alternative to the shareholder maximization hypotheses, and formally shows the inherent complexity of hedging, and hedging policy decisions. According to many of these theories, hedging should primarily not affect firm value at all (Jin & Jorion, 2006), but some also conclude that it can decrease, or in some cases increase, firm value (Tufano 1996; 1998). In the following, we will present the main theories from this category, and show how they attempt to relate hedging to effects on firm value.

3.3.1 Managerial Risk Aversion and Compensation Contracting

Smith & Stulz (1985) made the argument that corporations may hedge because of managers' risk aversion, and that this may both improve or harm firm value. Managers, like other stakeholders, have incentives to diversify risks that are specific to their claims on the firm, and due to risk aversion these claimants require additional compensation when they are forced to bear undiversifiable risk of these claims. For instance, managers can require higher salary, or equity, when the risks of distress and bankruptcy are higher. While shareholders can diversify their firm-

specific risk through a well-diversified portfolio and have limited liability on their equity stake, managers cannot reduce their stake in the company by diversifying, and must bear the total risk, both specific and non-specific. Smith & Stulz argue that as long as hedging can reduce such additional compensation, and these benefits exceed the costs of hedging, this improvement in contracting can increase firm value. Thus hedging can be caused by management risk aversion and managers' compensation schemes can influence incentives to hedge. Depending on these incentives of managers to hedge, and the costs of hedging, hedging activity can impact firm value positively (through improved contracts and interest-aligning risk-allocation) or negatively (through excessive costly hedging, which does not improve firm value, but only managers' compensation and risk).

Managers must necessarily have discretion in their decision-making. But, the shareholders must devise appropriate compensation schemes in order to align the managers' incentives with their own, which is maximization of firm value. So the compensation contract must be designed so that managers expected payoff, or utility, increases when firm value increases, so that the mangers' compensation is an increasing function of firm value. Thus their expected payoff depends on the future outcomes of the firm value. If the managers' compensation depend primarily on accounting earnings, their expected utility depend both the firm's market value and its accounting earnings. If this is the situation, it follows that managers will hedge accounting earnings, even if this increases the firm's the volatility of the firm's economic value. If, on the other hand the compensation depends on stock options, and option-like features, so that the expected manager income is a convex function of the firm's expected profits, the manager will have incentives to increase risk and not hedge when he own unexercised options. Therefore, Smith & Stulz have concluded that the more option-like features there are in the compensation plans, the managers will hedge less. In this case managers can choose to increase risk of the firm in order to increase the value of their options. For instance bonus plans that pay bonus only if accounting earnings exceed some target number will make managers hedge less since this payment is a convex function of accounting earnings. If the manager owns equity stake, however, the mangers will have higher incentives to hedge more, as the managers expected wealth is a linear function to the value of the firm, and thereby reduce the variability of firm returns. So the effects of hedging are uncertain. Hedging can improve value by improving contracts, and aligning the interests of owners and their agents, managers. However, it can also have insignificant effect on firm value,

while improving mangers' utility, and it can have a negative impact on firm value, if it is excessive, and the costs outweigh the benfits to firm value, but improve managers' utility, at the shareholders' expense.

3.3.2 Informational Asymmetry and Signaling

Other manager utility theories focus on non-monetary components of managers' private utility, such as signaling their quality, reputation-building, and career considerations. Though these non-monetary incentives can induce hedging, the hedging can still have a real economic impact on firm value. The following theories focus on the effect hedging can have on the information to the environment of the firm. In a perfect world, with complete information, corporate hedging is irrelevant. In reality, however, investors, shareholders, analysts, etc., frequently rely on indicators and estimates of earnings, cash flows and profitability for inputs in their valuation models, in the absence of complete information and real values (Dadalt, Gay & Nam, 2002). Earnings and cash flows are much-used key financial numbers, capturing the effects of both manager decisions and their skills and abilities, as well as of exposures to macroeconomic factors of which shareholders may not have knowledge. By hedging, managers can reduce the noise in these measures, which are caused by factors outside of management control. This in turn reduces the asymmetric information in the market pertaining to the firm's real economic value, as well as the managers' quality and ability.

DeMarzo & Duffie (1995) formalize a model where managers have superior information to the shareholders and investors regarding the nature and extent of their firm's risk exposures, and show how hedging by managers can reduce the information asymmetries between the parties. This asymmetry also gives managers a comparative advantage in managing and hedging these risks. The mangers also know their own ability and quality, but these are unobservable characteristics to the shareholders. High quality managers have incentives to resolve this uncertainty in order to have an advantage in the competitive labor markets. Shareholders can learn about the quality of managers and the firm's investments and opportunities by observing the

firm's performance, measured by its earnings for instance. DeMarzo & Duffie show how through hedging, managers can reduce the amount of noise in this conveyed information, and improve the precision of the information content in the firm's profits. As a result, hedging increases the value of the shareholders' option to replace poorly performing managers, of presumably lower quality. So, financial hedging improves the informativeness of corporate earnings as a signal of manager ability and project quality, by limiting the noise in this information caused by uncontrollable external factors. Managers' and shareholders' incentives regarding information transmission may differ, however, causing conflicts regarding optimal hedging policy, depending on the accounting information available. The incentives for the managers to hedge and convey better info, are based purely on personal utility, as the information revealed by accounting profits and earnings have non-linear effects on their reputations, and quality signals, and hence on their future wages.

Breeden & Viswanathan (1998) make a similar argument in this setting, i.e. there is uncertainty about manager quality, and managers have superior information regarding their quality and the firm's exposure to various risks. Superior managers wish to signal their quality in order to increase future wages. However, the information conveyed to the market makes it difficult to determine whether the profits of the firm result from manager ability or from factors outside manager control. By hedging these risk factors, managers can reduce firm profits' exposure to uncontrollable price movements, thereby eliminating the effect on profits caused by external risks. Hence earnings carry more information about manager quality. Breeden & Viswanathan also acknowledge that hedging can be costly to shareholders, by reducing the value of their "equity call option". Since the cost of hedging is lower for high quality managers, the author conclude that costly hedging will create a separating equilibrium, in which high quality managers hedge, while low quality managers do not.

The arguments can be summarized as follows: managers of superior quality, in the face of asymmetric information, can have incentives to use hedging and financial risk management, in order to better signal their qualities and abilities to the markets, in order to improve their personal utilities, through building reputation, increasing expected wages, and generally achieving competitive advantages in their career building. This hedging, even though driven by managers'

private interests, can have real impacts, negative and positive, on the firm value and shareholder wealth

.

3.3.3 Informational Asymmetry and Selective Hedging

Another possibility that arises in situations with asymmetric information is the possibility of managers to attempt to exploit superior information as comparative advantage in risk taking or for speculative purposes.

Stulz (1996) argues that firms cannot expect to profit by taking financial positions based on publicly available information. Firms', however, may have specialized information of their specific markets, or believe they do, that is not publicly available, and thereby profit on this informational asymmetry. Stulz discusses whether such specialized information could be used by mangers as comparative advantage over their shareholders in taking, arguably speculative, financial positions in certain types of risks. Using a hypothetical example, Stulz posits that although there are obvious risks to such selective hedging, such as the fact that the firm's information may not be better or more complete than the market's, it is still plausible that companies' managers can have informational advantages that puts them in a better position to hedge selectively, and that such speculative hedging can be a reliable source of gain in risk management decisions.

Brown, Crabb & Haushalter (2006) show evidence that firms actually do attempt to time market prices, i.e. exercise selective, or speculative, hedging, and discuss whether such selective hedging and attempts to time the markets, can add economic gains, and whether shareholders benefit from this practice. They show how managers' frequently believe they have superior information, and attempt to exercise selective hedging policies and decisions, and attempt to add value that way, supporting evidence from behavioral finance that managers often may overestimate their information and ability. Contrary to this belief by managers', the authors find that few of these succeed, and that selective hedging does not benefit shareholders, nor add any gains or benefits.

However, managers' market views do influence their financial policy decisions. Besides costs of selective hedging may be hard to identify, and the practice may add new sub-optimal risk exposures, which may compromise firm value, rather than add to it.

3.4 Summary

To summarize, there are two main categories of hypothesis of hedging, that reach different conclusions regarding potential rationales of derivatives hedging, and possible relations to firm value. The shareholder value maximization theories claim that by exploiting inefficiencies in the MM assumptions, hedging can add value by reducing volatility, and alleviating problems associated with this variability. This theory thus argues in favor of value-adding rationales of hedging, but such hedging does not automatically increase firm value, and firms cannot simply hedge more and more and simply increase firm value. According to theory, some specific conditions must be fulfilled in order for hedging to be beneficial. And firms differing characteristics also impact how beneficial hedging can turn out to be. For instance, firms with relatively larger expected costs of financial distress can benefit more from firms with smaller expected costs. Also, in order for hedging to add value by reducing underinvestments, the firms must have valuable investment projects available, because if not, there are few costs to underinvestments, since no valuable opportunities are foregone.

Similarly, the managerial utility theories of hedging argue that hedging can have different effects on firm value, but primarily not a value-adding effect.

4. Review of Empirical Evidence

There is a significant amount of research on the topic of corporate risk management, and we have attempted to pick out the most relevant for our study on theories. Most of these previous empirical studies can be separated in to two categories, which both attempt to study the relation between hedging and the firm value, directly or indirectly.

First, there are studies that focus on the relation between firm characteristics and the decision to hedge, i.e. what influences the firms' decision to hedge. These works attempt to identify which theory best explains actual hedging activities, and thereby provide support for one of the theories presented in the previous chapter. Many articles take the evidence on what characteristics induces the firm to hedge as indirect evidence on the impact of hedging on firm value. Thus, if we observe that hedgers have the characteristics that the shareholder maximization, or MM imperfection, theories suggest, then this supports that firm's hedge in an attempt to exploit these capital market imperfections, and thereby increase firm value. If, on the other hand, hedgers display characteristics prescribed by manager utility theories, then it is indirect evidence that managers hedge primarily to satisfy their personal needs, even if at the expense of shareholders.

The second, and more recent, studies rather focus directly on the relationship between hedging and firm value. They examine whether firms that actually do hedge, and firms that hedge more than others, achieve higher market valuation and are rewarded by investors for their hedging activities. Many studies also undertake both of these two tests, to achieve a more complete understanding of both characteristics of firms that hedge, as well as how it influences the firm's market value.

What is interesting to observe is that the evidence is largely inconsistent and ambiguous. Many of the studies find highly differing evidence, as well as much inconclusive results.

We have divided the review of existing research into these three categories. First we look at evidence that primarily studies hedging practices and their consistency with the two theoretical rationales for hedging, and what support they find for the different sub-theories. Secondly, we look at the evidence on the direct relationship between hedging and firm value.

4.1 Evidence on the Shareholder Wealth Maximization Hypothesis

First, we start out by reviewing evidence that supports the notion that firms hedge mainly based on the grounds of value-adding, as the shareholder value maximization hypotheses claim. Many of the studies explicitly take support of this as determinants of corporate hedging, as indirect support of the claim that hedging can in fact add value. Similarly, those that do not find support for this, argue that this supports the arguments that firms' managers hedge for their own utility gain, and thus that hedging may not result in increased firm value.

4.1.1 Financial Distress and Bankruptcy Costs

There is already much evidence on the real costs of financial distress and bankruptcy associated with both formal legal proceedings as well as the resulting inefficiency of both management and employees in pursuing value creation (Brealy, Myers, Allen, 2008). As mentioned, while the reduction of financial distress costs reduces real costs associated with that situation, it also increases value even further through an improvement in the firm's debt capacity, i.e. its ability to increase leverage. This in turn can help improve value by providing the firm a valuable tax-shield since the interest payments on debt are tax deductable, as in the trade-off theory of capital structure. Leland (1998) supports the theory that the reduction of distress costs is a second effect to the primary goal of increasing the debt capacity, and thereby the tax shield. Increased leverage, however, also increases the expected financial distress costs, so there is a clear trade-off to hedging policies, and Haushalter (2000) argues that the firm makes the decision based on taking both of these effects into consideration.

Many other studies find evidence supporting this theory by finding a relationship between firms' hedging activities and the probability of bankruptcy. The probability of distress, and by the same token the expected costs of distress, are usually proxied by variables such as credit rating, the

debt-ratio, interest coverage, firm size, or other measures that can indicate distress due to problems with meeting debt obligations.

Dolde (1995) finds evidence supporting the distress theory, by showing that there is a positive relation between hedging and leverage, and that hedging helps reducing the expected distress costs.

Berkman & Bradbury (1996) finds non-survey evidence that firms with derivative hedging are larger, and have higher leverage, and lower interest coverage (the latter not significant however), than non-hedgers. They use firm size, interest coverage and leverage as proxies for expected costs of distress, and thus find support that firm's hedge to reduce expected costs of distress. In a similar study, examining Australian instead of U.S. firms, Berkman, Bradbury, Hancock & Innes (2002), find that firm size and leverage, proxies for expected costs of distress, are the main explanatory variables for hedging. The proxies also have the expected signs, i.e. lead to increased use of hedging. They find less support for the other theories. These findings are consistent with the financial distress rationale for corporate hedging.

Clark & Judge (2005), contrary to many previous U.S. studies according to themselves, find strong evidence that links the use of derivatives for hedging and the expected costs of financial distress, in a study of UK firms' motivations for hedging that combines survey data and data disclosed in annual reports. Using both univariate and multivariate tests, they find a strong link between hedging and expected distress costs, a result that is robust to the use of alternative proxy variables. They find that hedgers are significantly different from non-hedgers with respect to different variables used to proxy financial distress. All measures of leverage are found to be higher for hedgers, and interest coverage ratio is significantly lower for hedgers. In addition they find a negative relation between firms' liquidity, proxied by the ratio of cash and cash equivalents to current liabilities, supporting the notion that firms with high liquidity are less prone to get into financial distress, and consequently have less incentives to hedge. They also find that hedging firms are significantly larger than non-hedgers, and take this as support for economies of scale in hedging, and transaction costs in hedging.

Grahams & Rogers (2000) examines if hedging increases firm value, and find results supportive of the notion that firm hedge in response to expected costs of financial distress, firm size,

investment opportunities, and to increase debt capacity, in an attempt to increase firm value. They find that firms hedge in response to high costs of financial distress, and to increase firm value through an increased debt-capacity. The authors estimate the tax-gain to be between 1,7-2,8% added to firm value. They also find, as many studies, that larger firms hedge more, indicating a large fixed cost component to implementing risk management activities, and therefore that there exists economies of scale to hedging.

Haushalter (2000) studies hedging policies of oil and gas producers, and find that the extent of hedging is related to costs in financing. Firms with higher leverage manage price risks more extensively, supporting financial distress theory. The study also finds evidence supporting economies of scale in hedging, i.e. larger companies hedge more extensively. More specifically, the study finds that positive relation between hedging and financial leverage, and find that the fraction hedged increases with debt to assets ratio, and also is greater for more financially constrained firms, firms with less financial flexibility, measured by debt-to-cash holdings. Haushalter takes these findings as support of theories that firms hedge in order to reduce financing costs, and bankruptcy costs, due to lower cash flow variability. He points out, however, the importance of not automatically translating these results to improvements in shareholder wealth, as hedging can lead to overinvestment and less monitoring of managers, since they do not face the scrutiny of external markets.

Haushalter, Heron & Lie (2002) study sensitivity of equity values of oil producers to changes in uncertainty of future oil prices. The study documents that this sensitivity is negatively correlated to a firm's debt ratio and its production costs. These results indicate that companies that are more likely to experience financial distress, or underinvestment due to market imperfections, are adversely affected by increases in the uncertainty of future cash flows.

Nance, Smith & Smithson (1993) combines survey data with COMPUSTAT data of firm characteristics, in a comprehensive study examining the theories of corporate hedging, and hedging policies. Most of the variables they use have signs consistent with shareholder maximization theory, but not all are significant. The study proxies costs of distress by two measures of leverage, EBIT/Interests (interest coverage) and Debt/Value (debt-ratio), and also argues that the direct costs of bankruptcy are less than proportional to firm size (measured by Firm Value), implying small firms should hedge more. Smaller firms are also more likely to have

taxable income in the progressive marginal tax rate region, implying they have more convex tax functions and should hedge more. On the other hand hedging should have informational scale economies, and larger firms are more likely to have or acquire sufficient specialized knowledge to hedge profitably, implying larger firms should hedge more. The author finds that hedgers are larger than non-hedgers, indicating economies of scale outweighing the larger costs of distress for smaller firms. Further, the results of the two leverage proxies have the predicted sign, i.e. are positively related to derivatives use, but are not significant. Nance et. al. attributes this to possible bias from the survey part of the methodology, the firms' hedging extent is not measured, but a binary hedging dependent variable, and insufficient separation between exogenous and endogenous variables.

Geczy, Minton & Schrand (1997) point out the robustness problem of simply using the debt-ratio as proxy for financial distress, assuming that greater probability of financial distress leads to higher expected costs. That also ignores the possibility that exogenous distress costs may be an important determinant of a firm's debt ratio. They control for this by introducing several robustness checks, by using several different measures of expected distress costs, such as credit rating, and industry-adjusted debt ratios. However, their various proxies of financial distress are not significantly related to the likelihood of using derivatives, an evidence inconsistent with the distress rationale for hedging. Further, they find indications that firms use derivatives to hedge, and not to speculate, and that larger firms are more likely to hedge.

Gay & Nam (1998) primarily examine hedging in relation to the underinvestment problem, but use control variables to control for the other theories as well, including debt ratio and interest coverage ratio as proxies for financial distress. Supportive of this theory, they find that derivative users have significantly higher debt ratios. The interest coverage ratios on the other hand, do not differ in hedgers and non-hedgers, suggesting financial distress is irrelevant for hedging.

Mian (1996) studies three types of derivatives, commodity foreign currency, and interest rate, and their relation to corporate hedging decisions, using a much larger sample than prior hedging research. The study is inconsistent with financial distress models. The study also finds mixed evidence for the other theories of hedging as well, and only uniformly supports the hypothesis that hedging activities display economies of scale, suggesting that information and transaction costs influences the decision to hedge more than the imperfections theories. This evidence is

robust. The evidence on firm size is also itself inconsistent with the financial distress rationale for hedging, as firm size can be used as a proxy for distress, as it is done in some other studies. This suggests that smaller firms should have higher costs of financial distress, and therefore be more prone to hedging, in order to mitigate these costs. Instead the study finds that larger firms are more likely to hedge, supporting the hypothesis of economies of scale in hedging activity.

Tufano (1996) also find almost no evidence supporting any relationship between hedging and the firm characteristics predicted by the shareholder-value-maximizing theories. Thus, the maximization of shareholder wealth theories of risk management have relatively weak predictive power in the North American gold mining industry. There is no relationship in the study between hedging and the likelihood of financial distress, measured by cash costs. Though there is some weak evidence linking leverage, a proxy of expected financial distress costs, positively to hedging, the authors conclude that this does not overly support the shareholder maximization hypotheses.

Overall, it seems there is some, but not unambiguous, evidence of hedging to reduce the expected costs of bankruptcy and financial distress. The point is that if financial distress is in fact associated with costs, which there is strong evidence for and at the same time there are some benefits to having debt in the capital structure, such as tax shields, then hedging can be used to increase debt capacity and the benefits that comes with it, while simultaneously reducing the increased probability and costs of low enough cash flow realizations to get into distress. Especially in industries where the estimated costs of financial distress are large to firms, hedging can be beneficial. This is, as we shall see later, arguably true for the European airline industry.

4.1.2 Underinvestment and Costly External Financing

This theory predicts firms with lower internal fund generation, lower cash holdings, and more financially constraints, as well as high growth opportunities in their investment opportunity set, should benefit from hedging. This benefit is due to the avoidance using costly external financing,

as in the pecking-order theory, and from avoiding sending potentially negative signals to markets by issuing equity, for instance, and preserving the ability of the firm to undertake all NPV-positive projects. Several variables are used as proxy measures for the extent of growth options and investment opportunities, such as capital expenditures, R&D expenditures, price-earnings ratios, market-to-book ratios, and more, and several other for liquidity, such as quick ration, current ratio, dividend payouts, income-to-debt, and more.

Adam (2002) studies specifically whether firms use derivatives to reduce their dependence on external capital markets, as argued by the Froot et al. framework. The study finds evidence that is consistent with the hypothesis that firms secure their future investment expenditures by hedging. This implies that firms hedge in order to reduce their dependence on external capital markets, since investment expenditures are typically financed externally, but hedging cash flows are a form of internal financing. The study finds that hedgers finance a smaller part of their investments from external funds then non-hedgers, supporting the underinvestment framework as well as indicating that hedging in fact can alleviate problems caused by capital market imperfections, allowing firms to better coordinate their investment and financing policies.

Allayannis & Mozumdar (2004) similarly conduct a specific study relating hedging with the firm's ability to undertake investments by stabilizing internally generated funds, investment that might otherwise have been bypassed due to costly external financing. The study provides evidence supporting this theory. The empirical findings show that derivatives users reduce the volatility of their operating cash flows and net cash flows significantly more than non-users. Further, it shows that the sensitivity of investments to cash flows is significantly lower for firms that use derivatives, than for firms that do not. The result is robust to alternative measures of investments and cash flows, and the controlling of other variables. They take this as evidence that firms hedge to smooth out investments, avoiding underinvestment due to costly external capital, and that firms' use of derivatives is led by hedging, and not speculative, purposes.

Berkman & Bradbury (1996) test both of the underinvestment theories. For measuring the Froot et al. underinvestment rationale for hedging, which focuses on short-run ability to undertake all NPV-positive projects, they use not the mere existence of growth options, but the risk that the firm is unable to convert these opportunities to assets-in-place. They measure by proxy the firm's ability to generate sufficient cash to finance its current investment program, and find that their

measure, short-term asset growth, is unrelated to hedging activity. Thus, they find no support for this theory, even though their findings are generally consistent with the shareholder maximization hypothesis.

Grahams & Rogers (2000) find support for the theories that firms hedge to increase value by exploiting imperfections in the capital markets. They find that underinvestment costs lead to increased hedging.

Haushalter (2000) also find evidence that oil and gas producers display relatively heterogeneous hedging policies. Further, his study finds evidence that hedging is positively related to an attempt to reduce financing costs by a reduction in the firm value variability, and the author takes this as evidence supporting the Froot et al (1993) framework of hedging to reduce financing costs and underinvestment.

Haushalter, Heron & Lie (2002) examines the sensitivity of equity values to changes in uncertainty of future oil prices, for oil-producing firms. The authors find evidence that this sensitivity is negatively correlated to a firm's debt ratio and its productions costs. These findings indicate that companies more likely to experience distress or underinvestment due to low cash flows, are more affected by larger uncertainty of future cash flows. Thus, the authors argue, such firms can benefit, and increase value, by hedging to reduce the expected costs of distress and underinvestment. The results are robust to controls for other firm characteristics. The results also imply that since the value of less financially flexible firms, i.e. more leveraged firms with higher production costs, is more sensitive to adverse movements in future prices, it is also more beneficial to hedge for firms the more financially constrained they are. This means that not all firms benefit from hedging, but rather some firms with specific characteristics. For instance, there is little evidence that firms with little or no debt are sensitive to price changes, and such firms will benefit little from hedging to exploit market imperfections, with little or no gains to shareholders.

Geczy, Minton & Schrand (1997) find that firms with a combination of high growth opportunities and high financial constraint, i.e. low access to low access to internal and external financing, are most likely to use derivatives. This result supports the theory that firms hedge to alleviate the

underinvestment problem caused by financial constraints. It supports the notion that firms hedge to secure internal funds.

Gay & Nam (1998) specifically tests the underinvestment problem formulated by Froot et al, and the interaction between internally generated funds and cash holdings, and its investment opportunities, proxied by the firm's cumulative abnormal returns, R&D expenses, Tobin's Q, Market-to-book ratio, and the price-earnings ratio. They clearly distinguish the role of the underinvestment hypothesis in firms' hedging policies, and find several results that support this theory. First, they find consistent evidence relating the various investment opportunity set proxies to the usage of derivatives. Second, they find firms with high investment opportunities also hedge more with derivatives in periods where they have low cash levels. Third, they find that firms with highly correlated investment opportunities and internally generated cash flows hedge less, i.e. hedging is negatively related to this correlation, as Froot et al predicts. This correlation alone alleviates the underinvestment problem, as it is in effect a natural hedge. The authors conclude that firms can, and do, use derivatives as a strategy to maximize the shareholder value.

Mian (1996) finds mixed evidence on hedging related to capital market imperfections and underinvestment. In support of the model, regulated industry firms are more likely to hedge than firms in unregulated industries. On the other hand, firms with higher market-to-book ratios are not more likely to hedge, inconsistent with the theory.

As stated previously, Tufano (1996) find virtually no evidence linking shareholder maximization theories and hedging. Specifically, the study finds no relationship between hedging and investment opportunities, measured by the firm's acquisition programs. On the contrary, the study also finds a negative relationship between historical exploration activities and hedging.

Overall, it seems there is relatively much evidence in support of the theory that argues that firms hedge to reduce their dependence on costly external capital markets, and stabilize their internally generated funds. This is important for firms in industries where there exist investment valuable investment opportunities, and the opportunities are negatively correlated with the firms' cash flow generation. As we will show later, the European airline industry arguably fits these characteristics, making hedging potentially valuable.

4.1.3 Underinvestment and Agency Costs of Debt

Also this theory argues that firms hedge in order to avoid underinvestment problems, but due to other mechanisms then in the previous theory. Here the underinvestment may be a result of conflicting interests and opportunism between shareholders and debtholders. This is an even more significant problem and threat to firm value in case of financial distress (Brealy, Myers, Allen, 2008). As in the previous theory, the underinvestment problem is also costlier in cases where more valuable investment projects and growth options are available to the firm. Leverage and debt ratios impact the size of the investment problem, and the investment opportunities can be captured by R&D/Sales, Capital Expenditures/Total Assets, price-earnings ratios, book-market values, etc, since these measures reflect the available investment opportunities to firms. Since both of these theories use similar proxy ratios to empirically validate the importance of underinvestment to hedging, the results may overlap somewhat.

Berkman & Bradbury (1996) find weak evidence supporting the theory that firms hedge to reduce incentives to under-invest in the long run, by increasing the number of future states in which the equity holders are the residual claimholders. They predict higher hedging with derivatives for highly leveraged firms with valuable growth option, which increase the benefit and value-increase due to hedging, since this preserves its ability to undertake these valuable projects. They proxy the existence of growth options, or the firm's investment opportunity set, by an earnings-price ratio, which captures their long-run prospects of growth. However, only when they use fair value of derivatives as measure of hedging, do they find support for this hypothesis, i.e. that hedging is positively related to the present value of the firm's growth options, while their other evidence is insensitive to the measure of hedging activity.

Clark & Judge (2005) also find evidence supporting the avoidance of underinvestment costs theory of hedging. They use price-earnings ratios, R&D expenses, Capital Expenditures, and market-to-book-ratios to proxy for future growth and investment opportunities. In the univariate tests, the first two are significantly higher for hedgers. Hedgers also have larger capital expenditures, as predicted by theory, but this result is not significant. Market-to-book has the opposite relation to hedging, inconsistent with theory. Also the multivariate test positively relates

price-earnings ratios and capital expenditures to hedging, further supporting the underinvestment theory.

Nance, Smith & Smithson (1993) measure by proxy the growth options in the firm's investment opportunity set by two variables, R&D/Value and Book value/Market Value, and find that hedgers have higher growth options in their investment opportunity set. This is support of the Smith & Stulz underinvestment framework, where managers, acting in their shareholders' interest, underinvest due to conflicting interests with the creditors, inducing wealth transfers.

Geczy, Minton & Schrand (1997) find evidence supporting that financially constrained firms hedge to avoid underinvestment problems, and reduce the agency costs of debt.

Mian (1996) find evidence that is inconsistent with underinvestment, both due to capital market imperfections as well as due to contracting and agency costs of debt.

Tufano (1996) initially finds support for the theory of hedging in order to mitigate costly external finance, since smaller firms manage more risk with derivatives, and smaller firms have smaller cash reserves. However, this result disappeared when the study controlled for heteroscedasticity, indicating that this relation may have been spurious.

Overall, there seems to be substantial evidence supporting theories relating hedging to the avoidance of underinvestment problems. Some evidence focus specifically on one of the two underinvestment problem, while other measures underinvestment generally. It seems, however, plausible that under the right circumstances, hedging can help alleviate the underinvestment problems of firms.

4.1.4 Taxes

As discussed earlier, there are two benefits to hedging through tax mechanisms. The possible reduction of financial distress of hedging can also increase the firm's debt capacity, thus increasing their valuable tax shield, in case they can carry forward potential losses. Theories

supporting the financial distress theory may also be taken as indirect support of this theory. The other tax incentive for hedging is convexity in the firms' tax functions.

Berkman & Bradbury (1996) find significant evidence that derivatives usage is generally in line with the shareholder maximization hypothesis, including evidence that firms that hedge are more likely to have tax-losses carried forward, and that firms hedge to increase firm value by reducing the uncertainty of expected taxable income. They also find that firms only hedge next years' taxable income volatility, since hedging for subsequent years can instead increase the variability of their after-tax cash flows.

Nance, Smith & Smithson (1993) find that firms that hedge face more convex tax functions, proxied by tax loss carry-forwards, investment tax credits, and the range of the firm's pretax income in the progressive tax rate region. The results may, however, be methodologically flawed and have low power, according to the authors, especially due to potential bias in the survey responses.

Grahams & Rogers (2000) finds that firms do hedge in part to increase debt-capacity, and that this improves firm value through tax-shields with an estimated 1,7-2,8% of firm value. They do not, however, find evidence supporting that firms hedge in response to tax-function convexity. They find this result puzzling, since they have used the most precise measurement of tax convexity available. This may be due to the relatively small incentive to hedge for this purpose, than the other ones, which may have higher benefits. Another explanation is that small firms have the most convex functions, as well as low expected income. The equity's inherent option feature can reduce the incentives of such small, low-income firms, to hedge, if it more than offsets the relatively small benefit from hedging a low income in face of tax convexity.

Grahams & Rogers (2002) specifically studies if firms hedge in response to tax incentives, and test both tax incentives, i.e. interest tax deductions by a higher debt capacity, and tax convexity. This study finds evidence that firms hedge to increase debt capacity, and thereby their tax shield. This tax gain adds approximately 1,1% to the firm value. As for tax convexity, the study finds no evidence that firms hedge to reduce expected tax liabilities in face of convex tax functions.

Geczy, Minton & Schrand (1997) similarly find no evidence supporting that firms hedge in response to tax-function convexity. Hedgers and non-hedgers do not differ significantly in their tax positions.

Gay & Nam (1998) find support for the tax theory, since they find derivatives users to have significantly larger tax loss carryforwards than non-users.

Mian (1996) find mixed evidence for tax incentives of hedging. Foreign tax credit, proxy for the tax shield, is found to be related to higher likelihood of hedging. On the other hand, there is no relation between hedging and tax schedule progressivity, indicating tax function convexity, as well as no relation between hedging and tax loss carryforwards.

Tufano (1996) finds no relation between hedging and the degree of tax schedule convexity faced by the firms.

Overall, there seems to be mixed evidence for the tax incentives to hedge. The tax-argument heavily depends on the tax schedules, rules, and tax rate progressivity, as well as existence of tax loss carry-forwards, and other factors, that may differ significantly across industries, firms, and nations. Therefore, it may be specifically difficulty to study and compare this theory of corporate hedging across different industries and across borders. Besides, some studies that support this argument also show that this is a relatively small impact on firm value. For these reasons, and specifically the differing tax rules in different nations, we choose not to focus specifically on this argument in our quantitative analysis.

4.2 Evidence on the Manager Utility Maximization Hypothesis

The second main hypothesis of corporate hedging is based on the notion that hedging is at the managers' discretion, and that they may decide to undertake hedging and risk management activities to maximize their own personal utility, i.e. a possible agency conflict between managers and shareholders. Depending on the transaction costs of hedging, and the real effect hedging may

have on firm value, this maximization of private utility may reduce firm value, or leave it unaffected. It may also improve value, by improving contracting terms and align interests with managers, if the costs do not outweigh these benefits. In the following, we will look at evidence supporting this rationale of corporate risk management.

Berkman & Bradbury (1996) test Smith & Stulz' (1985) "contracting party diversification" theory of hedging, and use directors' share holdings as proxy. They expect, in line with this theory, that firms whose directors hold larger proportions of equity shares to hedge more, due to the latter's risk aversion and inability to diversify. Thus they should be more worried about the firm's value variability. They find evidence for this, since derivatives use is found to be positively related to increased management ownership, proxied by directors' share holdings.

Dadalt, Gay & Nam (2001) investigate the relation between derivatives use and the extent of informational asymmetry faced by the firm, and find support for DeMarzo & Duffies' and Breeden & Viswanathans' frameworks. They find that both the use of derivatives, and the extent of the usage is associated with lower information asymmetry. Further, they find that analysts' earnings forecasts are significantly more accurate and less dispersed for users than for non-user firms, implying hedging can successfully reduce noise in the information conveyed to the markets.

Graham & Rogers (2000) find that managerial risk aversion and informational asymmetry does not lead to increased use of derivatives for hedging.

Rogers (2002) finds that for a broad cross-section of firms, managerial risk-incentives are empirically important determinants of corporate hedging decisions, whereas prior studies had only found this association and support of managerial motives for hedging in single-industry studies. Risk-taking incentives in managers' payoff structures, are shown to reduce the level of hedging.

Geczy, Minton & Schrand (1997) find no evidence supporting Smith & Stulz' managerial contracting cost rationale for corporate hedging. This theory predicts that large managerial share ownership increases hedging, while manager option holding reduces hedging, due to managers' wealth and risk incentives. However, findings show that these do not support the theory, as they are insignificant, and even show that derivatives users have greater managerial option holdings.

Also, the study's results are not supportive of DeMarzo & Duffies' asymmetric information explanation of corporate hedging, which claims shareholders can benefit from managers' superior information about risks that affect the firm's results, but is unobservable, and by reducing noise in the information, allowing shareholders to make better-informed decisions. Two proxies are used for informational asymmetry, institutional ownership and analyst following, and according to theory, these should be negatively related to hedging. But, on the contrary, hedgers have larger analyst following and institutional owners.

Gay & Nam (1998) find that their two manager risk-aversion variables, manager stock holding and option holding, respectively, have opposite signs than theory predicts, but only the shareholdings variable is statistically significant.

Tufano (1996) finds virtually no evidence supporting the shareholder maximization hypothesis, and concludes that it has relatively weak predictive power in his study. On the contrary, the study finds strong support of the manager utility maximization hypothesis, and more specifically the managerial risk aversion theory. As predicted by Smith & Stulz' managerial risk aversion theory, equity ownership by managers is associated with the degree of risk management. The authors use three different proxy variables for manager ownership, and all are related to hedging, but in varying degrees of significance. Firms with managers who have more of their wealth invested in the firm's options, and therefore face larger convexity in their payoff function, are managing less risk. Also, managers who have larger proportion of equity ownership, manage more risk. Thus the study finds support for the managerial risk aversion theory of corporate hedging, and points out that such hedging may not add value to the firm, but only to the managers.

Tufanos' (1996) study also examines the theories of DeMarzo & Duffie (1995), and Breeden & Viswananthan (2000) that focus on managers' reputations in an asymmetric information environment. Since outsiders cannot observe manager quality, nor decide this precisely through the firm's profits since they cannot distinguish from managers' ability and external and uncontrollable factors, the managers have incentives to hedge to better communicate their quality to the market. This theory predicts that younger managers are more prone to undertake risk management activities, and similarly that managers with shorter tenure are more likely to do so, since they have less developed reputations then their older and longer-tenure colleagues. Such hedging may both increase shareholder value, and decrease it, depending on the transaction costs

of hedging. The study, however, does not uniformly support this theory of hedging. It does find that firms whose CFOs are newer in their jobs do manage more of the firm's risks, consistent with theory. But to support this theory, both CFO and CEO tenure would have to be related to hedging activity, and not only one of them. As for age, the findings do not suggest a meaningful relationship between CEO and CFOs' age and risk management activity, except a negative relation between CFO age and risk management with a heterscedastic specification. This evidence is inconsistent with reputation theory for hedging.

4.3 Evidence on the Effect of Hedging Directly on Firm Value

The research reviewed above has primarily examined the determinants of the corporate hedging decisions, and what firm characteristics are more likely to induce hedging. This has been taken as support, or lack thereof, of the different theories that provide theoretical rationales for why firms do hedge, and when and why they should hedge if they are maximizing value. In some of the cases, the studies has explicitly taken evidence supporting value-maximizing hedging, and the firm characteristics that make hedging valuable, as indirect evidence that hedging can increase firm value. Similarly, many of the studies finding empirical support of the manager utility maximization, make the argument that such kind of hedging may not increase firm value, but may even decrease it.

In the following, we will look at some empirical research that directly examines whether hedging has a positive impact on firm value.

4.3.1 Hedging with Derivatives Increases Firm Value

Carter, Rogers, & Simkins (2006) examines whether hedging adds value in the US airline industry, providing additional research in an are where there are conflicting results obtained from research. They argue that the airline industry is very well suitable for studying the impact of hedging on firm value, since the industry is largely homogenous and competitive. The study specifically studies the impact of hedging jet fuel prices using commodity derivatives, focusing on the hedging of a single, homogenous, and volatile input commodity. They argue that the airline industry have two characteristics that are specifically consistent with the assumptions in the Froot et al framework, making it suitable for examining whether hedging does add value, as the framework predicts it can, under the right conditions and characteristics. First, the airline industry's historical investment expenditures are positively correlated with jet fuel costs. Thus, there is no natural hedge in these cash flows, since higher jet fuel costs reduce the firms' earnings and internally generated cash flows. Second, there are significant costs of financial distress for the airlines, and for instance Pulvino (1998, 1999) find that airlines in distress are forced to sell their aircrafts at a discount price below market value of these assets. This are significant characteristics relating this specific industry to the theory of hedging, and specifically the theories of financial distress, and underinvestment: these frameworks predict hedging is more valuable when there are large costs of distress, and this distress also increases the underinvestment incentives and costs of underinvestment; also hedging should be more valuable, since investment opportunities have low correlation with cash flows from hedgeable risks. In addition, the airline firms face substantial price risk due to the high volatility of jet fuel prices, which is approximately 27% measured from monthly averages, in the period between 1992 and 2003. At the same time, jet fuel costs make up an average 13,6% of the sample firms' operating expenses in the relevant firm-year observations. Also, this risk exposure is omnipresent in the entire industry, across all firms, since it is a necessary commodity input. The bottom line is that jet fuel price volatility is an economically significant risk factor for all airline firms, and significant cash can be realized from hedging, in case of extreme price increases. As the authors argue, "[s]imply put, the airline industry provides an excellent sample setting because its environment conforms well to this theory of hedging"

Overall, the Carter et al study shows that firm value in the airline industry has a positive relationship with the hedging of future jet fuel requirements. Further, it is found that changes in hedging positively impacts firm value, and that the average hedging premium (increase in value attributable to hedging) is approximately 5%-10%, a relatively high increase in firm value attributable to jet fuel hedging. The study also attributes much of this hedging premium to the airlines' ability to fund investments in periods where high jet fuel prices otherwise may adversely affect the firms' internal fund generation. This is based on the industries investment patterns, and is measured by capital investments and capital expenditures, and these results suggest that investors view such hedging as value-increasing risk management. The study specifically relates the added value to the theories of distress and underinvestment, and show that they are the main mechanism whereby optimal hedging can improve firm value. Specifically capital investment provides the majority of the hedging premium. We will discuss this study more in our analysis chapters, comparing the results with our own findings.

Allayannis & Weston (2001) also examine the direct relationship between the use of derivatives (foreign currency derivatives) and a firm's market value. Using Tobin's Q as proxy for firm value, the study finds a positive relationship between firm value and hedging with derivatives. The hedging premium found is significant, statistically and economically, and averages 4,87% of firm value. The results are robust to various control variables, such as firm size, profitability, leverage, growth opportunities, access to financial markets, and to the use of alternative measures of Q or firm value, and to other specifications. Also consistent with theory, the study finds that firms without foreign currency exposure have a small and insignificant hedging premium associated with foreign currency derivatives use. In addition, the study finds that firms that begin to hedge, i.e. change their hedging policy, achieve a value increase above firms that remain unhedged. Similarly, firms that quit hedging, experience a decrease in firm value relative to the firms that remain hedged.

Graham & Rogers (2000) examines if corporate hedging increases firm value, as well as testing the different theories of corporate hedging. They find that hedging practices are consistent with optimal risk management, and more specifically find that hedging increases firm value through debt capacity and interest payment deductions, and estimate that this benefit of hedging may add 1,7%-2,8% to firm value.

Bartram, Brown & Fehle (2009), like Allayannis & Weston, use Tobin's Q as proxy of firm value, and find that derivative users have higher Tobin's Q than non-users.

Kim, Mathur & Nam (2004) find that financial risk management of foreign currency exposure is related to higher firm value.

Allayannis, Lei & Miller (2003) show that foreign currency derivatives users that have exposure to foreign exchange, achieve a significant premium compared to non-users.

4.3.2 Hedging with Derivatives has Insignificant or Negative Impact on Firm Value

Jin & Jorion (2006) examine evidence on firm value and hedging in US producers of oil and gas, in order to test the hypothesis that market imperfections makes it possible to increase firm market value by hedging. Their study verifies that hedging reduces the firm's stock price sensitivity to oil and gas prices, and that the market recognizes the impact of hedging on stock exposure to commodity price risks. However, they also find that hedging does not have an impact on a firm's market value in this specific industry. Their univariate analysis finds no significant systematic difference in Q-ratios between hedgers and non-hedgers, but finds strong results in difference in size across the two groups. Consistent with prior research, hedgers are significantly larger than non-hedgers. The multivariate analysis isolates the effect of hedging, and uses almost the same control variables as Allayannis & Weston. In this regression, only one of three Q-ratio coefficients is significant, but it has a negative sign, indicating that hedging decreases market value of the firm. Only one of the control variables has a consistent effect on the Q-ratios, investment growth, proxied by Capital Expenditures over Total Assets. This indicates that firms with higher investment opportunities are valued with higher Q-ratios, as one would expect. Overall, the study finds no support for the theory that hedgers have higher Q-ratios, i.e. firm market values, than non-hedgers in the oil and gas industry. Jin & Jorion discusses the possible motivation of the observed hedging practices in absence of higher market values. Since hedging

has no impact on firm value, they argue, the explanation is probably that managers hedge for personal utility gains, as predicted in the manager utility maximization hypothesis.

The study contrasts these findings with the mentioned study by Allayannis & Weston, and explicitly points out deficiencies in their study. It also discusses the Carter et al study, and concludes that the airline industry characteristics are such that a large hedging premium is justified, which may not be case in many other homogenous industries. Thus, they point out the importance of industry characteristics, risk types and exposures, and other factors that many studies do not capture, in determining the potential value increase achieved by hedging.

Guay & Kothari (2003) study the effects of derivative holdings in a sample of non-financial corporations, and find results that are inconsistent with value-increasing theories and research of hedging. They examine the sensitivity of firm market value to hypothetical extreme changes in the underlying asset prices, with firms holding different portfolios of derivatives positions. They find that any potential gains from derivatives hedging are relatively small and modest when compared to firm size, value, operating and investment cash flows and other benchmarks. They conclude that either the observed increase in firm value has other causes, for instance operational hedging or risk management that are positively correlated with derivatives holdings, or that it is a spurious relationship.

Bali, Hume & Martell (1995) find results that are consistent with the Guay & Kothari study, and that implies that hedging with derivatives is not important to the firm value. These results are robust to bivariate and univariate tests, and consistent over time.

Brown, Crabb & Haushalter (2006) examines if selective hedging can add value, but find no evidence that shareholders benefit substantially from this practice.

Nain (2004) find that risk management can increase firm value, proxied by Tobin's Q, if many competitors hedge, but leaves firm value unaffected if there are few, or none, competitors hedging

4.4 Summary

To summarize, there seems to be somewhat mixed evidence for most of the theories. There is substantial evidence supporting the shareholder value maximization hypothesis, but also some inconsistent findings. As discussed earlier, the different characteristics of different industries may be the cause that some studies in specific industries find stronger support than others. This can be argued for the mixed evidence on manager utility as well, since different industries and different nations can have differing cultures with regards to managerial compensation. This explanation can also be applied to the inconsistency that lies in evidence supporting both the shareholder maximization and the manager theories, since in some cases there may be better possibilities to increase value then in other, while in other cases the arguments of manager utility maximization may be more applicable.

As for the direct effect of hedging on firm value, it seems that in many cases hedging with derivatives can significantly impact firm value in a positive manner. Of specific interest to us are the strong results of value-adding hedging in the U.S. airline industry. As the authors have argued, many of the characteristics of this industry are consistent with the assumptions in the shareholder value maximizing theory, which makes it possible to add value through hedging. We build on many of these industry characteristics in our analysis as well, and so we expect to observe similar positive effects of hedging on firm value.

On the other hand, there is also evidence that hedging may not add value, and not be consistent with theory, so a positive relationship between hedging and firm value may not always be the case.

In the following chapter, we attempt to analyze the relationship between hedging and firm value, and if the characteristics determining hedging activity are consistent with value-maximizing risk management strategies.

5. Quantitative Analysis

5.1 Introduction

In this section we examine potential effects commodity hedging has on the European airline industry. We begin by examining whether there are any significant differences in various financial variables between the airlines that hedge their jet fuel commodity risk exposure, and those that do not. We also investigate if the risk management activity of hedging jet fuel commodity risk has an effect on firm value. To support our results, and examine determinants of hedging, we examine if we can find any variables that affect the probability that a European airline will hedge their commodity risk exposure. To test these different aspects of hedging, and possible effects on firm value, we collected data from the annual reports of 13 publicly traded European airlines from 2006 till 2008.

The reason for choosing this particular industry is somewhat congruent with some of the reasons given by Carter, Rogers and Simkins (2006), in their study of the American airline industry: They argue that it is a large industry that is competitive and homogenous. The large number of airlines that operate make the data collection easier. Fuel cost represents a major economic expense and the commodity behind this cost is very volatile, which makes the study of how the different airlines handle these fluctuations interesting.

To examine possible empirical relations between hedging, a firm's characteristics, and firm value and some key financial figures, in European airline industry, we use econometric models. We will conduct several tests, both on the direct relation between hedging and firm value, between the hedging activity and other key financial variables, and between different firm characteristics that may influence their likelihood of hedging, to see if the factors influencing hedging behavior are consistent with some of the presented theories which predict that hedging can increase a firm's market value. We start out by presenting the airline industry, and why it is well suited for testing empirical relationships between hedging and firm value according to the already presented theories of corporate hedging.

5.2 The European Airline Industry Characteristics and Exposure to Jet Fuel Price Risk

Carter, Rogers & Simkins (2006) study the US airline industry, and use the same theoretical frameworks discussed earlier as a basis for their study. They identify characteristics of the airline industry that makes it consistent with hedging theory and show how hedging can prove valuable and have a positive impact on the firm value. These industry characteristics are to a large degree, arguably, applying for the European airline industry as well.

As Carter et al. argue, the airline industry is remarkably homogenous and largely competitive, making it god for comparing differences between firms that hedge and do not hedge. The strong competitiveness additionally makes it difficult for the airlines to pass fuel-price increases through to customers, as some other industries might be able to. As Jin & Jorion (2006) also point out, the homogeneity of the sample in terms of type of risk exposure should also improve the study, and can reduce potential problems of endogenity and spurious correlations between hedging and other variables in the results. In the airline industry, all the firms have a relatively high exposure to single, homogenous, and volatile input commodity, namely jet fuel, a vital component of the firms operations. Jet fuel represents a major economic expense for the industry, and has even recently converged with the labor costs for airline firms (Carter et al, 2006), and coupled with its high volatility jet fuel constitutes a significant risk exposure. And not only are the jet fuel prices highly volatile at 27% annually, but the volatility levels are highly variable as well (Carter et al 2006). These high volatility and cost levels also apply to the European airline industry, since they share the same risk exposure and have similar dependence on this input commodity, as we will also see later. Furthermore, two specific characteristics of the industry make it relatively highly consistent with the assumptions in both the underinvestment and the financial distress frameworks of value-adding hedging.

First, the airline industry's investment expenditures are positively correlated with jet fuel costs, and hence implicitly negatively correlated with the firms' cash flows, since higher jet fuel cost reduces the earnings and operating cash flows of the airline firms. Thus, the firms in the industry do not have this natural hedge in their ability to undertake valuable investments and growth

opportunities. As predicted by the Froot et al underinvestment theory, this is a case that can make hedging valuable, since it preserves a hedged firm's ability to exploit its growth options and NPV-positive investments, especially in cases of distress and extreme cash flow variability. The firms can hedge this exposure, jet fuel prices, and stabilize their internal cash flow generation, since jet fuel costs comprise a significant part of airline firms' operating costs, and reduce their dependence on costly external financing.

Second, it has been shown empirically that firms in the airline industry face substantial costs of financial distress (Pulvino, 1998, 1999). As shown in the theory section, the higher the expected costs of financial distress facing the firms in an industry, the more they can benefit from hedging. Firms that experience high reductions in their operating cash flows, are very likely to make cuts and reductions in capital expenditures and other expenditures that can be regarded as "investing in the future" (Carter et al, 2006), increasing the underinvestment cost to these firms. The benefit of hedging both reduces the expected costs of financial distress, as well as helps alleviate the second underinvestment problem caused by agency costs of debt, a problem that is increasingly costly to firms in distress, and to firms that have high investment opportunities.

These are all significant characteristics relating the airline industry to the theory of hedging, and specifically the theories of financial distress, and underinvestment. These frameworks predict hedging is more valuable when there are large costs of distress, and this distress also increases the underinvestment incentives and costs of underinvestment. Additionally hedging should be more valuable, since investment opportunities have low correlation with cash flows from hedgeable risks. Also the specific risk exposure with its high and ubiquitous relevance to the entire population in the industry, its relatively important share of firms' operating costs, and its high levels of volatility and uncertainty, makes it ideal for studying and comparing the effects of hedging.

A look at airline industry reports and statistics, confirms this picture, and shows the increasing volatility of jet fuel prices, and its relative and increasing importance for the cost structure and cash flow realization in the industry. The industry has also been adversely affected by the current

financial crisis[4], which has further squeezed already relatively low profitability[5] and cash flows out of the industry, and impacted the volatility of global energy markets.

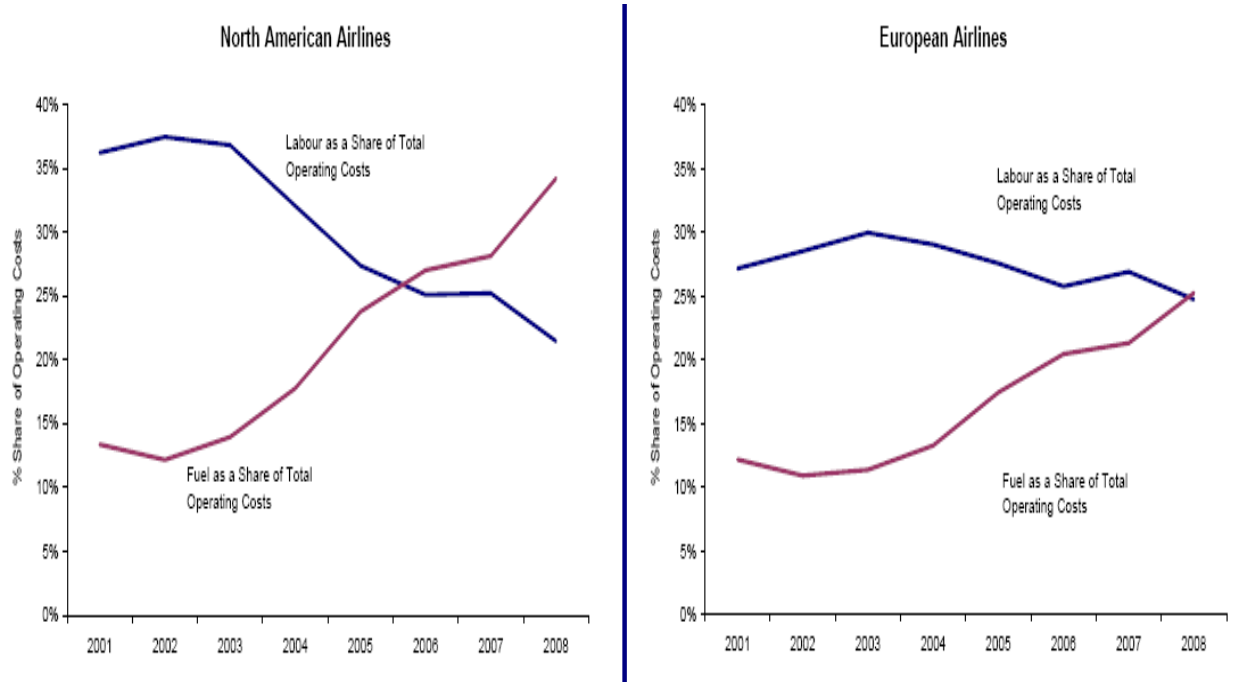

Figure 1[6]

Figure 1 supports the observation already made by Carter et al that jet fuel costs constitute a substantial part of the operating costs. The statistics for the global airline industries, including the European, shows that profitability levels are relatively low, and the impact of the global financial crisis has negatively affected the industry, partly due to reduced passenger numbers and partly through increased jet fuel prices. Figure 2 illustrates the volatility of jet fuel and crude oil prices, and this supports the argument that this constitutes a significant risk for the airline industry firms that are highly dependent on, and exposed to, this commodity. For these reasons, jet fuel hedging is a relatively common phenomenon in the airline industries. As Carter et al. argue, the relatively

4 http://www.iata.org/whatwedo/Documents/economics/IATA_Economics_Briefing_Impact_of_Recession_Dec08.pdf

5 http://www.iata.org/whatwedo/Documents/economics/Profits_and_Size_Briefing_June2006.pdf

6 http://www.iata.org/whatwedo/Documents/economics/Airline_Labour_Cost_Share_Feb2010.pdf

high competitiveness in the industry makes it difficult for the airline firms to pass through any fuel price increases to customers.

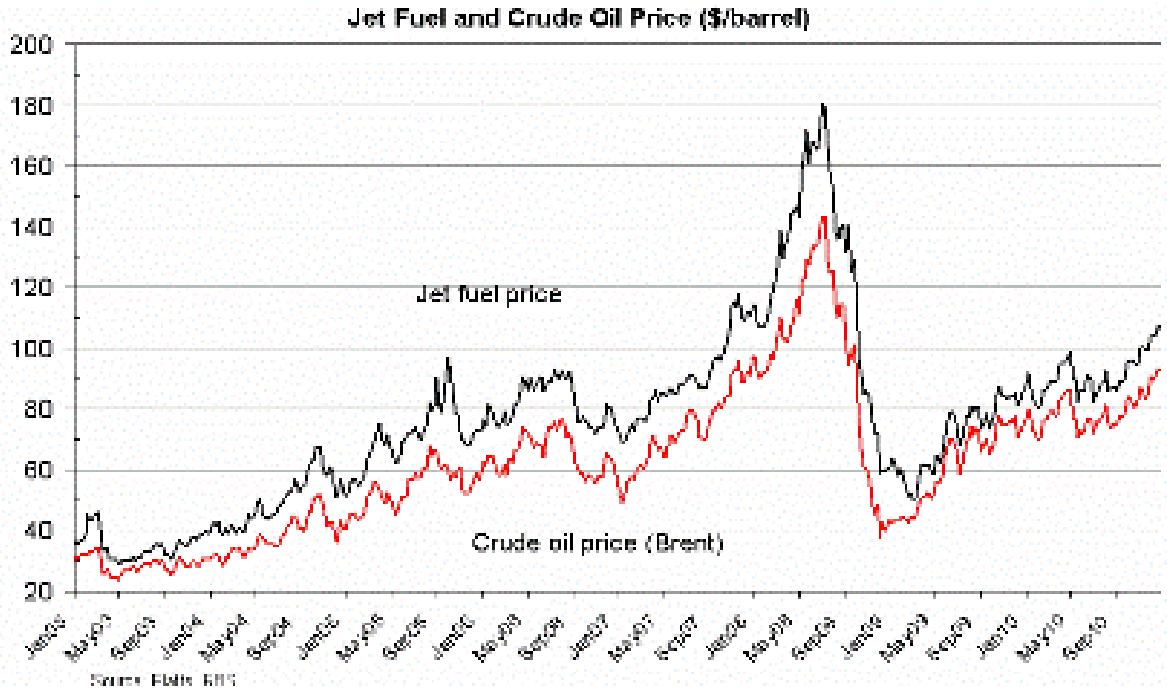

Figure 2[7]

These important characteristics are highly relevant for the theoretical discussion of hedging in the airline industry, and it seems that the same industry characteristics that made the study of the US airline industry relatively appropriate for the impact of hedging on firm value, also apply to the European industry. Even more importantly, the recent trends of jet fuel prices and airline profitability, coupled with the adverse effects of the financial crisis and recession, further augments the importance of the problems addressed by the hedging theory.

In short, jet fuel makes up a relatively large fraction of an airline's operating expenses, and this energy commodity is highly volatile and uncertain. The firms are homogenously exposed to this

[7] http://www.iata.org/whatwedo/economics/fuel_monitor/Pages/price_development.aspx

risk, and competitive pressures ensure the firms cannot pass on this risk to customers. Overall, the industry characteristics seem to fit the characteristics that the shareholder hypotheses argue can contribute in making hedging a valuable activity. We have high costs of financial distress, uncorrelated cash flows, and investment opportunities, high exposure of cash flows to a volatile commodity risk, etc. Thus, like Carter et al, we specifically focus on this category of theories. Unlike Carter et al., and due to tax differences between European nations, we have omitted closer inspection of this specific theory, so our focus is mainly on financial distress and underinvestment rationales by airline firms. These hold that airline firms can increase firm value by hedging, due to reduction of cash flow volatility, and consequent expectations of financial distress and underinvestment costs. An alternative theoretical explanation of the observed hedging activity in the industry, can be the manager utility maximization hypotheses.

In the following we will turn our attention to the central question, and impetus of this text: does hedging of commodity risk add value to European airline firms? We also attempt to illuminate this question by examining the possible determinants of hedging in the industry, and whether it is in line with value-maximizing hedging.

5.3 Sample Description

Our analyses are based on a sample of 13 publicly traded European airline companies from the years 2006-2008. The companies were chosen from Wikipedia's "List of Largest Airlines in Europe". Wikipedia's list does not say whether or not the airlines are publicly traded. To find this out we used Google Finance's database, since publicly traded corporations have more available information, due to legal requirements. The end result were the 13 publicly traded airlines found in the appendix.

All the airlines used have adopted financial statement standards in accordance with the International Financial Reporting Standards (IFRS). For our analyses the most important section

is the IAS 39: Financial Instrument: Recognition and Measurement. The IAS 39 version that includes the fair value requirement was adopted by the European Union (EU) in 2005, and was subsequently changed in 2008, due to the financial crisis. In accordance with IAS 39 as of 2005, all companies have to recognize their inventory of derivatives at fair value in their balance sheets. They are also required to disclose any Risk Management program as well as whether or not part of their derivative inventory are held for trading purposes. With very few exceptions, the airlines in our sample held derivatives solely for hedging purposes.

We were able to find 13 companies that presented the information necessary to carry out our analysis. From the sample we extracted 39 firm-years. All of these firm-years came with a reporting of some sort of hedging activity, such as exchange rate-hedging, interest rate-hedging and commodity hedging. In our analyses we have only investigated the effect of commodity hedging. We have therefore isolated this part of the derivative inventory resulting in 30 firm-years reporting commodity hedging activities in their balance sheets and 9 where no such activity was reported. To measure commodity hedging, we have extracted the fair value of their derivative inventory that concerns commodity hedging, as well as their reported hedged percentage of next year's fuel requirements.

We will utilize the collected data in the following sections, in order to perform three different econometric analyses. We wish to test if the determinants of hedging are in line with value-maximizing theories, and whether commodity hedging has an effect on European airline companies' value. First we will perform a univariate analysis, where we will compare the means of certain financial aspects and firm characteristics between the companies that hedge and the companies that do not hedge, including a firm value proxy for testing our main hypothesis, and other variables corresponding to our theories and hypotheses of hedging determinants. Second, we will perform a multivariate analysis to isolate the effect hedging has on value added, while controlling for other variables that theoretical and industry-specific considerations suggest might have an influence on this value, the Q-ratio. Finally, third, we will perform a binary analysis to see if there are any financial factors that affect the probability that a European airline will hedge, and if these are consistent with our expectations.

5.4 Description of Dependent and Independent Variables

As discussed earlier, it seems plausible that the industry characteristics and risk type of the European airline industry makes a fertile ground for value-adding hedging. Especially the theories of underinvestment and financial distress seem to be valid for this industry, so we have focused on these theories in our analysis. Thus, the different control variables and hedging determinant variables are mainly grounded in this theory, and serve as proxy measures of variables that these theories predict have explanatory power and impact on firm value through hedging. The different variables used have also been used for these purposes, and for similar proxy measures, in previous literature examining the determinants of hedging and the impact of hedging on firm value.

5.4.1The different Variables

In the univariate analysis we will calculate the means from a range of financial variables, to compare firm characteristics of hedgers and non-hedgers. Table 1 lists all the variables we have analyzed. For some of the variables we have calculated a mean for each year in the sample period as well as the whole sample period as one, while others only have one mean for the whole sample period. Where not specified, all data have been found in the companies' annual reports and financial statements.

Financial Variables Analyzed
Q-Ratio
Operating Profits
Fuel Cost Per Passenger Carried
P/E-Ratio
Company Size
Capital Expenditures
Profitability
Profit Per Passenger Carried
Fuel Cost as Percentage of Total Operating Cost
Passengers Carried

Table 1

Since the companies report in different currencies, all currencies presented have been converted into Euro, using Reuters.com's historic currency converter at the appropriate dates. The appendix shows an overview over all the exchange rates used.

Q-Ratio: The Q-ratio is our measure for firm market value, and it has been widely used as a proxy for firm value by many prior studies of hedging and its impact on firm value. Some other studies have used the original measure, Tobin's Q, which is defined as the ratio of market value of the claims on the firm to the replacement costs of these assets. The Q-ratio is, however, much more easily obtained and calculated, while it corresponds well with values of Tobin's Q (Chang & Pruitt, 1994). We have decided to define our Q-Ratio as:

> Market Value of Equity plus Book Value of Debt divided by book value of total assets. The Market Value of Equity is the company's share price multiplied with the number of common shares outstanding.

All the data used in calculating the Q-Ratios have been found using the FactSet database. The Q-Ratio will in addition to being used in the univariate analysis, also be used as a dependent

variable in the later regressions in order to determine if commodity hedging has a value adding effect.

Our main hypothesis is that hedging is positively related to firms' Q-ratios, or firm value, and that hedgers will display a larger Q-ration than non-hedgers.

Profitability: Profitability is defined as operating profit divided by total assets, and calculated using these numbers for the various firms.

Profit per Passenger Carried: This ratio is defined as operating profit divided by the number of passengers carried. Profit per passenger carried is included in all three analyses.

Operating Profits: This is defined as operating income minus the operating expenses.

The three measures above are relevant to the internal fund generation, and the cash flows created by the firm. This is important for the firms and their ability to withstand adverse movements in jet fuel prices that may substantially reduce their internal cash flow generation. This in turn can affect both the firm's ability to undertake valuable investments, including investments largely for the future, and its ability to stay out of financial distress. This is obviously related to the problems that hedging attempts to mitigate in order to enhance firm value. According to these theories, firms with lower levels of earnings and profits have more to gain from hedging, in the reduction of exposure of cash flows to commodity price movements, especially since jet fuel risk comprises a significant amount of operating expenditures. Thus, consistent with this theory, we expect to observe that firms with lower levels of these profit measures are more likely to be using derivatives, and that firms classified as hedgers display lower profit characteristics.

Fuel Cost per Passenger: This variable is measured as the total fuel cost in a given year divided by the number of passengers carried that year. A better measure would have been fuel cost per passenger per kilometer carried, but the data for this variable proved difficult to find for some companies. The measure is included in all three analyses.

Fuel Cost as Percentage of Total Operating Costs: This is another variable indicating the importance of fuel cost, and is calculated as fuel cost divided by total operating costs. This variable is included in all three analyses as well.

Similarly to the profit variables, the costs of fuel are important for the generation of cash flows and earnings. As we have argued earlier, it is exactly the airlines' relatively high dependence on, and exposure to, these fuel risks that make hedging potentially value-adding in this specific industry. And according to theory, hedging should be more potentially value-adding the higher the relative importance of jet fuel on a firm's cash flow realization. Therefore, consistent with theory, we expect that hedgers display higher relative fuel cost ratios, since these firms can gain most from hedging jet fuel risk, and that higher relative fuel cost ratios increase the likelihood that an airline firm will hedge jet fuel price.

Passengers Carried: This is the number of passengers carried by an airline during the year. The data is found using both the annual reports and the Wikipedia pages for the relevant firms.

We expect that firms with a high volume of passengers have a comparatively larger and more stable source of operating incomes, and so have cash flows less threatened by adverse fuel price movements. Therefore we expect to observe that firms with higher passenger levels are less likely to hedge.

Company Size: We measure the size of the firms as the normal logarithm of the company's total assets. This data was acquired by using the FactSet database. Company size is included in all three analyses.

Nearly all of the prior research of hedging includes the firm size as a variable, and this variable is related to the financial distress framework of hedging. According to theory, smaller firms face significantly higher costs of financial distress than larger firms do, and thus have higher benefits of hedging. It follows that we expect smaller firms to be more likely to hedge, and that company size is negatively related to hedging.

Capital Expenditures and Capital Expenditures to Total Assets: Capital expenditures are investments, or expenditures intended to create pay-offs in the future. We have used the amounts reported in the annual reports under capital expenditures. In those cases where it has not been explicitly reported we have used the cash flow to investments reported in the annual reports. Capital expenditures divided by total assets is used in the third analysis.

Price/Earnings-Ratio (P/E): P/E ratio is a well-known valuation multiple, stock price divided by firm earnings. We have used the database at BigChartes.com to find the P/E-Ratios at the dates of the annual reports.

Both of the two last variables are frequently used in hedging studies as proxies for a firm's growth prospects, or the amount of growth options in its investment opportunity set. This is an important factor of hedging in the underinvestment theory. P/E is used to proxy for the long term growth opportunities of a firm since this valuation ratio is assumed to include a market valuation of the present value of a firm's growth opportunities. As Froot et al (1993) argue, these growth opportunities are in fact intangible assets, and firms with a relatively large fraction of value based on intangibles may find it more difficult and costly to finance investments externally, since their intangible assets are not a good collateral. Capital Expenditures, and Capital Expenditures to Total Assets are another frequently used proxy for firms' investment opportunities, focusing more on short-run valuable investments available, and as Froot et al argue, hedging is important to preserve short-run ability to undertake all valuable investments. The point is that according to the underinvestment theory, hedging is valuable through its reduction of the underinvestment problem, and reduction of costs or foregone value associated with underinvestment. Hedging is more valuable the more growth options are in a financially constrained firm's investment opportunity set. Consistent with theory, we therefore expect that hedgers have higher P/E-ratios and Capital Expenditures, and that these variables increase the likelihood of hedging.

5.4.2 The Hedging Variables

The information regarding hedging and derivatives positions and inventory was acquired from the companies' annual reports. As a proxy measure of the firms' commodity hedging, we have used their holdings of jet-fuel hedge derivatives measured at fair value and the reported hedged percentage of next year's expected fuel requirements, as reported in the annual reports. In addition to the variables explained in the section above, we have constructed two hedging variables denoted D1 and D2:

- **D1**: "*Hedged Percentage of Next Year's expected Fuel Requirements*."

- **D2**: "*Fair Value of Hedging Derivatives to Total Assets-Ratio*."

D1 is the same measure that is used by Carter, Rogers and Simkins (2006). We have not been able to obtain the exact percentage for all of the hedged companies, and they have therefore been left out of that part of the analysis.

5.5 Expectations and Hypotheses Development

Our main overall hypothesis is that in the face of imperfect capital markets, a company can use financial risk management tools such as derivatives to exploit these imperfections and reduce costs associated with them, so that the company can achieve some kind of value added in terms of market value. Related to this reasoning, our hypothesis is also that determinants of hedging, and characteristics of firms that use derivatives, are consistent with theory, i.e. that the companies that have the specific characteristics that theory predict makes hedging valuable, also are the companies that are more likely to hedge in our sample.

This hypothesis is based on the shareholder wealth maximization theory of corporate hedging, that relies on the assumptions that managers act in the shareholders' interests, i.e. are maximizing firm value, and that there exist some real-world imperfections contrary to the MM perfect capital market assumptions. As we discussed in the airline industry section, the European airline industry arguably conforms to many of the assumptions of when hedging can add value. Specifically, we underlined the following relations between theories of value-adding hedging and the airline industry.

First, the relatively high importance of financial distress faced by airline firms, as also supported by empirical evidence, was mentioned. Consistent with this theory, hedging can add value to firms that can potentially get into financial distress, by reducing the volatility of their earnings, costs, and subsequent cash flows, and thereby reduce the total expected costs of financial distress. This argument is also consistent with the agency cost of debt theory, that holds that underinvestment costs caused by leverage are especially prevalent in states where a firm gets into financial distress. Thus, by reducing the probability of getting into distress, hedging can reduce the underinvestment cost associated with distress, as well as the agency costs caused by debt. A third benefit of hedging in this framework is that external parties recognize that hedging can reduce the prospect of this agency conflict with the shareholders. Thus, their required compensation need not be as high as when they expect higher conflicts of interests, and the hedging firm can lower its cost of financing and contracting with external parties.

Second, we related the airline industry specifically with the costly external financing framework of underinvestment. This theory holds that since external financing is costlier than internally generated funds, firms prefer to use their retained earnings for making investments. If internal cash flows are insufficient, firms may rather choose to avoid making these investments, even if they are valuable, do to the higher cost of raising external financing and the signals conveyed to the market by doing so. We supported this by showing that airline firms' cash flows and investment opportunities are uncorrelated, and showed the high importance of jet fuel prices to the firms' costs, and cash flows. This setting makes hedging valuable for airline firms, according to theory, by stabilizing its internal cash flow generation, and reducing its sensitivity and exposure to the high volatility in jet fuel costs.

Due to the high relevancy of the underinvestment problems and financial distress costs facing the airline firms, and the high and homogenous exposure to a commodity price, we chose to focus on these theories, and variables appropriate for testing them, to examine our hypotheses that hedging adds value and that hedgers have the characteristics that make hedging valuable in this setting. There is another mechanism through which hedging can add value to firms according to this category of hedging theories, and that is taxes. As discussed, hedging can add value to firms facing tax convexity by reducing their expected tax liabilities, and generally by increasing firms' debt capacity, which in turn increases the tax shield and reduces tax expenses. We have however

chosen not to measure this hedging incentive specifically. This is partly due to possible differences in tax convexity faced by the European firms in their respective nations and tax schedule rules, partly because prior evidence has not supported the relative importance of this incentive, and partly because as we argue, the industry specifically displays characteristics consistent with the aforementioned theories. We do bear in mind, however, that taxes may have an influence of a potential value-increase caused by hedging.

Thus, our specific hypotheses are as follows. In the first analysis, we compare hedgers and non-hedgers in terms of characteristics and financial variables. We expect hedgers to display higher Q-ratio in the this test. Further, in the univariate analysis we expect the firms classified as hedgers to display lower profit measures, i.e. lower operating profits, lower profitability, and lower profit per passenger. We also expect the hedgers to display higher fuel costs per passenger and higher fuel costs as percentage of total operating costs. We expect hedgers to be of smaller size than non-hedgers, and to have lower number of passengers. Finally, in the univariate analysis we expect the hedger category to have a higher P/E ratio, and higher capital expenditures.

In the multivariate regression, we isolate the effect of hedging on firm value, and control for other variables that may have a significant impact on the Q-ratio. This is where we test our main hypothesis, which is that hedging increases firm value, as proxied by the Q-ratio, in our sample of European airline companies. We also control for other plausible influences on firm value.

In the final analysis, the binary regression, we test which factors affect the probability that a European airline firm will hedge. Consistent with the theory, we expect firm size, jet fuel cost percentage of total operating costs, and jet fuel cost per passenger, to be positively related to the probability that a firm will hedge. We also expect capital expenditure to total assets to have a positive relationship with probability of hedging. Finally, we expect profits per passenger to be negatively related to the hedging probability.

5.6 Univariate Analysis and Results

In this section we will compare companies that hedge their commodity price exposure with those companies that do not, using a univariate analysis. The amount of hedging is not taken into account, we have only separated the companies that have reported hedging in their annual report from those who have not.

We have gathered a range of descriptive statistics, and in this section we will present the statistical tests. We have performed t-tests and calculated P-values to test whether or not the means from these data is significantly different from each other for the hedging and the non-hedging companies. We will present the tests one by one, starting with the comparisons that did not give any statistically significant results. We will comment on them shortly, but the main focus will be on the results that are statistically significant. The means are calculated for each year as well as for the whole sample period.

Q-Ratio

Table 2 shows the results from the comparison of the Q-Ratios between hedgers and non-hedgers.

Q-Ratios

	Hedgers	Non-Hedgers	t-value	P-value
Mean 2006	0,5667	0,6156	0,4748	0,6442
Mean 2007	0,5973	0,5747	0,2445	0,8114
Mean 2008	0,5723	0,7293	2,0715	0,0626
Sample Mean	0,578	0,6227	0,7579	0,4533

Table 2

We can see that non-hedgers have a higher average Q-Ratio for the years 2006, 2008 and when we handle the whole sample period as one. For 2007 the hedgers have a higher average Q-Ratio. This is inconsistent with our expectations, except for the sample year 2007. Statistically speaking, however, these differences are all insignificant.

Operating Profits

Table 3 shows the comparison of operating profits between hedgers and non-hedgers. The profits are all in million Euros.

Operating Profits

	Hedgers	Non-Hedgers	t-value	P-value
Mean 2006	235,44	316,46	0,3492	0,7335
Mean 2007	463,83	378,69	0,2885	0,7784
Mean 2008	183,92	373,52	0,5468	0,5955
Sample Mean	285,07	356,8	0,0018	0,9985

Table 3

From table 3 we can see that non-hedgers on average have a higher operating profit compared to the ones that hedge in the years 2006 and 2008. Their average operating profit is higher if we see the whole period as one as well. In 2007 the hedgers have the highest average operating profit. This result is consistent with our expectations, except for the year 2007. However, the t-values and P-values reveal that none of these differences are statistically significant.

Fuel Cost per Passenger

Table 4 sums up the comparison of fuel cost per passenger carried. All the costs are in Euros.

Fuel Cost Per Passenger Carried				
	Hedgers	Non-Hedgers	t-value	P-value
Mean 2006	34,56	63,9	1,2497	0,2399
Mean 2007	39,46	54,85	0,6783	0,5116
Mean 2008	49,29	83,69	1,0892	0,2994
Sample Mean	41,39	66,22	1,7891	0,082

Table 4

These costs do not take into account the distance over which the passengers have been carried; they only state what the fuel costs per passenger have been. As mentioned earlier, a better measure would have been the fuel cost per passenger per kilometer carried, but those numbers proved difficult to find for many of the airlines. For every period the results show that non-hedgers have a higher average fuel cost per passenger carried for all years as well as for the sample period as one. The differences are statistically insignificant at a 5% level for all periods. For the sample as a whole however, the differences in fuel cost per passenger are significant on a 10% level. This result will be confirmed in a later analysis, where we test which European airline companies are more likely to hedge. Fuel cost per passenger carried will also be included as one of the control variables in the later multivariate analysis.

P/E-Ratios

Table 5 shows the last of the comparisons that does not yield a statistically significant result.

P/E-Ratios				
	Hedgers	Non-Hedgers	t-value	P-value
Mean 2006	51,17	7,6	1,3379	0,9519
Mean 2007	14,84	16,05	0,0896	0,9301
Mean 2008	10,38	3,58	2,0507	0,0674
Sample Mean	24,92	10,82	0,06075	0,9519

Table 5

All the P/E-Ratios are measured at the dates of the annual settlements. The table shows that the hedgers on average have a considerably higher P/E-Ratio in the years 2006, 2008 and for the sample period as a whole. In 2007 the non-hedgers have a slightly higher average ratio. This is as expected, but none of the differences in P/E-Ratios are statistically significant on a 5% level.

Company Size and Capital Expenditures

The rest of the univariate analysis section will present the comparisons that returned statistically significant results. The first of these results is company size, which is presented in table 6.

Company Size				
	Hedgers	Non-Hedgers	t-value	P-value
Mean 2006	8,06	6,78	1,3316	0,2099
Mean 2007	8,52	6,8	2,99	0,0123
Mean 2008	8	7,99	0,2765	0,7873
Sample Mean	8,18	7,06	2,4535	0,019

Table 6

Table 6 shows that hedging companies on average are larger in all sample years, also when we look at the sample periods as one. The differences are statistically significant in 2007 and for the entire period. This result is inconsistent with the financial distress theory that argues that smaller firms are more prone to hedge, since they face higher costs of financial distress. The result is, however, consistent with a vast amount of the empirical research on hedging that frequently finds evidence that larger firms are more likely to hedge. Nance et al (1993) and others have argued that if there is a large fixed cost component associated with setting up a hedging program, then larger firms are more likely to hedge, due to economies of scale in hedging. Others have argued that there may be other reasons for economies of scale in hedging, such as for instance the need for a specialized and competent team of people responsible for setting up hedging policies, which larger companies are more likely to afford and attract. Carter, Rogers and Simkins (2006) also present a similar possible explanation to why large companies are more likely to hedge. They argue that smaller companies lack either sufficient resources or strategic foresight to manage a derivative hedging capability, which is highly complex. On the other hand, it can be argued, even though the non-hedgers are significantly smaller than those who hedge, they are by no means small companies, so the latter may not be a satisfactory explanation. There could also be other explanations for why large companies are more inclined to hedge compared to smaller companies. We note however, that the result is inconsistent with our theory and our expectations.

Carter, Rogers & Simkins (2006) also use the theory first presented by Smith & Stulz (1985), where the indirect cost from facing financial distress could be the explanation of why companies hedge their risks. They state that the resulting underinvestment cost could potentially be the greatest indirect cost, especially for companies with the largest growth opportunities. This theory should indicate larger capital expenditures for the hedging companies. To test this, we have compared the capital expenditures means as well as the capital expenditures divided by total assets for hedging- and non-hedging companies. Table 7 shows the results from these tests.

Capital Expenditures				
	Hedgers	Non-Hedgers	t-value	P-value
Capex Means	483,8	377,26	0,576	0,5681
Capex/Total Assets Means	0,0917	0,1848	3,0825	0,0039

Table 7

As we can see, hedging companies on average have larger capital expenditures compared to the non-hedgers, as we expected. This result though, is not statistically significant.

When we take their total assets into account, however, the hedging companies' capital expenditure ratio is lower. This difference is statistically significant on a 5% level, and is inconsistent with the financial distress theory. This is a stronger result than the above, since it is significant statistically, so overall we do not find support for our theory that firms hedge to avoid underinvestment. This inconsistent result is confirmed later when Capital Expenditures to Total Assets is included as an explanatory variable in the test of what companies are most likely to hedge.

Profitability, Profit per Passenger and Fuel Cost as Percentage of Total Operating Cost

Table 8 illustrates the comparison of Profitability and Profit per passenger, respectively, between hedgers and non-hedgers. Profitability is in the first column, and Profit per Passenger in the second.

Profitability and Profit Per Passenger

	Hedgers		Non-Hedgers		t-value		P-value	
Mean 2006	0,01816	5,59	0,1918	49,96	3,881	3,0842	0,0026	0,0131
Mean 2007	0,0561	13,86	0,1578	44,43	2,2652	1,9064	0,0447	0,0857
Mean 2008	0,01522	0,25	0,1366	47,65	2,4412	3,7241	0,0328	0,0034
Sample Mean	0,0244	6,31	0,1645	50,61	3,686	5,2928	0,0007	0,0001

Table 8

Table 8 shows that non-hedging companies on average are more profitable and have a higher profit per passenger compared to the hedgers across all periods. The differences are statistically significant on a 5% level for all periods, except for 2007 where the difference in profit per passenger only is significant on a 10% level. These results are consistent with our predictions that firms with lower profit ratios will be more able to benefit from hedging and "locking in" their cash flows, in order to avoid underinvestment and reduce probability of financial distress. More profitable companies are more likely to be able to handle potential negative effects of price movements to their cash flow generation. By the same token, firms that generate less profits have more to gain by hedging, or less to lose by not doing so, so they are more prone to undertake hedging activity.

Table 9 presents the results from comparing fuel cost as percentage of operating cost.

Fuel Cost as Percentage of Total Operating Cost				
	Hedgers	Non-Hedgers	t-value	P-value
Mean 2006	0,2275	0,296	1,59	0,1378
Mean 2007	0,2296	0,3068	1,1232	0,2876
Mean 2008	0,2453	0,4248	3,1877	0,0086
Sample Mean	0,2457	0,3294	3,3454	0,0019

Table 9

The table shows that hedging companies on average have a lower fuel cost percentage than non-hedging companies for all individual sample periods. The difference is only statistically significant on a 5% level for 2008 and for the whole period as one. This is inconsistent with our predictions, and with the finding that hedgers are less profitable than non-hedgers.

At first glance these results could be regarded as contradictive. If we also remember that the differences in fuel cost per passenger was statistically significant on a 10% level the results seem even less sensible. The explanation may be found in how the different factors are measured. Profit- and fuel cost per passenger do not take into account the distance the passengers are flown. We have already established that hedgers on average are larger airlines. It seems plausible, arguably, to assume that larger airlines typically have larger diversity of destinations and also destinations further from their home base. The higher fuel cost per passenger could very well be explained by longer flights, and thereby higher fuel costs per flight. Further it is not unlikely that it is less profitable to fly these long and fuel demanding flights compared to shorter flights. However, if we argue so, the finding that fuel cost as percentage of total operating cost is still inconsistent with our theory of firms hedging to lock in their cash flows due to the importance of jet fuel costs in the total operating costs.

The number of passengers plays a large part when profit per passenger is calculated. Table 10 shows the comparison between hedgers and non-hedgers when it comes to number of passengers carried in the sample period.

Passengers Carried				
	Hedgers	Non-Hedgers	t-value	P-value
Means	27,52	12,43	2,511	0,0168

Table 10

The table reveals an average difference which is statistically significant on a 5% level. This adds credibility to the earlier results that said that larger airlines are more likely to hedge. Given these significant differences in the number of passengers carried, combined with the insignificant difference in operating profits, the significant difference in profits per passenger is explained.

When it comes to the fuel cost as percentage of operating cost, these differences could be explained by the fact that larger companies have a larger organization, and thereby a larger share of fixed costs. If a company has offices in several countries, this will bring about larger administrative costs. Also, if an airline has more flight destinations, they will have higher airport expenses.

At last, the profitability can be explained by the combination of insignificant differences in operating profits and the significant difference in size.

Overall, the differences in characteristics between hedgers and non-hedgers did not match our expectations, and were inconsistent with our theories of hedging. As we have also discussed, these results may well be caused by other factors, and our choice of variables may be misleading, so the findings are not necessarily inconsistent with the possibility that hedging may add to firm value.

5.7 Multivariate Analysis

In the univariate analysis in the previous section we could not find any evidence that commodity hedgers display a higher firm value, as proxied by the Q-Ratio. However, since the Q-Ratio is affected by many factors, we will in this section use a multivariate regression model to isolate the effect of hedging, and then determine if commodity hedging has an effect on firms' market value. We use two different proxies for the extent of hedging activity by firms, and include a dummy variable. We also control for other variables that may impact firm value, or Q-ratio. We have estimated three specifications of a cross-sectional times series least square regression model. The three specifications are as follows:

$$Q\text{-}Ratio = \alpha + \beta \times D1(Hedged\ \%\ Of\ Next\ Year's\ Expected\ Fuel\ Requirements) + \sum \gamma_i \times Control\ Variable_i + \varepsilon_i$$

$$Q\text{-}Ratio = \alpha + \beta \times D2(Fair\ Value\ of\ Hedging\ Derivatives\ to\ Total\ Assets) + \sum \gamma_i \times Control\ Variable_i + \varepsilon_i$$

$$Q\text{-}Ratio = \alpha + \beta \times Dummy + \sum \gamma_i \times Control\ Variable_i + \varepsilon_i$$

The hedging variables D1 and D2 are defined in an earlier section. In addition to these variables we ran a regression using a dummy variable which has the value of one if the airline hedges and zero if it does not.

To control for variance and isolate the effect of commodity hedging we had to include a number of control variables in the regression. We completed a series of regressions, using different control variables, and these were the ones that proved to hold the most explanatory power:

1. Size
2. Jet Fuel Cost as Percentage of Total Operating Cost

3. Jet Fuel Cost Per Passenger
4. Profit Per Passenger

These control variables are defined the same way as in the univariate analysis. In the following we will present the results from the three regressions, which were all estimated with an intercept. Table 11 presents the results from the three regressions.

Regression 1

	Beta Coefficients	t- value	P-value
D1	-0,00049	-0,50941	0,615118
Size	0,07094	3,016978	0,00596
Jet Fuel Cost as %	0,74893	2,315117	0,029474
Jet Fuel Cost per Passenger	-0,00136	-2,37232	0,026037
Profit Per Passenger	0,00156	1,658983	0,110133

Adjusted R^2=0,3525

Regression 2

	Beta Coefficients	t- value	P-value
D2	0,02770	0,034414	0,972768
Size	0,03464	2,009458	0,053263
Jet Fuel Cost as %	1,11277	3,847511	0,000557
Jet Fuel Cost per Passenger	-0,00138	-2,3382	0,026004
Profit Per Passenger	0,00111	1,283143	0,208952

Adjusted R^2=0,2614

Regression 3

	Beta Coefficients	t- value	P-value
Dummy	-0,00664	-0,10622	0,916067
Size	0,03612	1,989743	0,055222
Jet Fuel Cost as %	1,11418	3,722905	0,000758
Jet Fuel Cost per Passenger	-0,00142	-2,48863	0,018218
Profit Per Passenger	0,00108	1,258506	0,217314

Adjusted R^2=0,3025

Table 11

For the first regression, we can see the hedging variable, D1, has a negative beta coefficient, and thereby a negative effect on firm value. This is inconsistent with our main hypothesis that hedging adds firm value. This result, however, is not statistically significant. When it comes to the control variables, size and jet fuel cost as percentage of total operating cost have statistically significant positive effects on a 5% level on firm value, while jet fuel cost per passenger has a statistically significant negative effect. Profit per passenger has a positive effect, but is statistically insignificant. The model's total explanatory power is low, at only 0,3525. The purpose of this analysis was to find whether or not commodity hedging had an effect on firm value, so the total explanatory power of the model is of less importance.

When using the hedge variable D2, the regression shows a positive effect on firm value. This is consistent with our main hypothesis, implying that hedging has a positive effect on firm value. But this result is, as in the first regression, statistically insignificant. The other variables have the same effect as in the first regression. The only difference is that size now is significant only at the 10% level. The total explanatory power of the model in regression 2 is lower than in regression 1, at only 0,2614.

As in regression 1, the dummy hedging variable has a negative effect on firm value. This result is also statistically insignificant. The effect and significance of the control variables are the same as in regression 2. Worth to notice is that the total explanatory power in this dummy regression is higher than in regression 2. The regression output for all three regressions can be found in the appendix.

5.7.1Testing the assumptions behind the least square regression model

Multicollinearity

Testing against multicollinearity was done by calculating the correlation between the control variables. The appendix presents a summary of these calculations, and they show that there are

considerable correlations between the variables. This though, does not reduce the predictive power or reliability of the regression.

Normality in residuals

Tests for whether the residuals from the regressions follow a normal distribution were performed by two different methods. First we made a formal test on each regression with the Jarque-Berra test, where all tests were made on a 95% level. The second method employed was using a histogram for a visual presentation of the distribution.

In the Jarque-Berra test the null-hypothesis is that the data is normally distributed. The null-hypothesis is accepted if the calculated JB number is smaller than the critical chi-value, which for our 95% confidence level is 5,99. The appendix shows a summary of these tests. For all regressions the null-hypothesis is rejected, indicating that our residuals are not normally distributed. This did not come as a surprise. With the relatively low sample size, and the fact that the underlying data itself is not normally distributed, passing the Jarque-Berra test is often difficult. We therefore performed another test where we plotted the residuals in histograms to check if we could recognize the characteristic bell shaped distribution related to the normal distribution.

Figures in the appendix show the histograms. For regression 2 and the Dummy regression the histograms shows a clear bell-tendency. They are however askew from the mean, which is 0 for all the regressions. For regression 1 the bell shape is less clear, but with a few adjustments to the intervals in the histogram, we are also here able to distinguish a tendency towards a bell shaped distribution. The website sportsci.org has performed tests towards how non-normal the residuals can be, as well as how small a sample size in a regression can be before the analysis falls over. According to their findings the importance of non-normality is often exaggerated, and as long as the residuals do not look really awful with respect to the bell shape, the regression analysis should be good enough. Given the fact that our histograms do have a tendency towards the desired bell shape, we conclude that the analyses are valid even though they failed the formal Jarque-Berra tests.

Hetereoscedascity:

Formal tests for heteroscedascity were performed on each of the regressions using Goldfeld-Quandt tests. In these tests the null-hypothesis, H0, is that the variance of the data is equal over the entire dataseries. The null-hypothesis is accepted if the calculated Goldfeld-Quandt ratio is lower than the critical F-Value for the given confidence level. We used a 95%-level in all our tests.

When using the chronological setup, as in the original regressions, all regressions passed the test on a 95% level. The formal test however requires the data to be organized into a high variance selection and a low variance selection. To do this we organized the data in ascending order for all variables and performed the regressions to obtain the necessary data to perform the tests. The appendix shows a summary of these tests.

Regression 1 showed no signs of heteroscedasticity. This result was consistent for all variables as well as when the data was sorted in the original chronological order. For regression 2 the results were a little less consistent. The regression failed the test when organizing the data after the hedging variable, D2. The regression did however pass the test for the rest of the variables and also when organized chronological. For the Dummy regression the results were even less consistent, failing the test when sorting after the Dummy variable as well when sorting after the jet fuel cost as percentage of total operating cost-variable. For the other variables the regression passed the test.

Overall we are satisfied with the tests for heteroscedasticity. We had some concerning signs in some of the tests, but given the somewhat limited data we believe that these discrepancies do not invalidate our model in a serious way.

Auto-Correlation

The regressions were controlled for auto correlation between the residuals when the data is organized chronological. If auto correlation is present there will be a tendency that a positive residual is succeeded by another positive residual, and vice versa for negative residuals. To control for this we sorted the data in ascending order, starting with the data for 2006 and continuing with 2007 and lastly the 2008 data.

A good formal test for auto correlation is difficult to compute and implement in the Excel spreadsheets, so we decided to control for auto correlation using a chronological plot of the residuals. Figures in the appendix show this plot for all three regressions. For regression 2 we find no problems with auto correlation, since a positive residual seems to be just as likely to be succeeded by a negative one. The same goes for the negative residuals.

For regression 1 and the dummy regression however, there seems to be a pattern where a negative residual is more likely to be followed by another negative residual. This pattern is most clear in the dummy regression, but can also be seen for regression 1. Since the regressions are based on the same data, with the only difference being the different hedge-proxies, we find this irregularity somewhat puzzling. There should be no apparent reason as to why two of the regressions are troubled with auto correlation while the third regression shows no signs of it. We believe that this can be attributed to both coincidence as well as the sample size.

5.8 Binary Analysis

In this section we will use a binary regression model where the dummy variable from regression 3 of the multivariate analysis is the dependent variable, to see which factors affect the probability of commodity hedging. We will use the same four control variables, but in addition we will add a fifth which we call Capex (capital expenditures)/Total Assets. We have added this variable to see if the result will be the same as the comparison result we got when comparing capital expenditure between hedgers and non-hedgers in the univariate analysis section.

Table 12 shows the results from the binary regression.

Binary Regression			
	Beta Coefficients	t- value	P-value
Size	0,10547	1,886215	0,06837
Jet Fuel Cost as %	-1,93881	-2,43858	0,020475
Jet Fuel Cost per Passenger	-0,00178	-0,81611	0,420468
Profit Per Passenger	-0,00483	-2,03436	0,050273
Capex/Total Assets	-0,38454	-0,40887	0,685355
Adjusted $R^2 = 0,4488$			

Table 12

We can see that there are several factors that affect the probability that a European airline will hedge their commodity risk exposure. The size variable has a positive effect on the probability, which is significant on a 10% level. This is in accordance with the results found in the univariate analysis, where the differences in the average size of the airlines were statistically significant on a 5% level. This is, however, inconsistent with our predictions and the financial distress theory of hedging, that predicts that smaller firms are more likely to hedge due to higher expected costs of financial distress.

The rest of the variables have a negative effect on the probability that an airline firm in Europe will hedge jet fuel risk. Jet fuel cost as percentage of total operating cost is negative and significant on a 5% level, which is also in accordance with the findings in the univariate analysis, but inconsistent with our expectations. Profit per passenger has a significant effect on a 10% level, whereas the difference was significant on a 5% level in the univariate analysis. In this regression jet fuel cost has an insignificant negative effect. In the univariate analysis this difference was found to be significant on a 10% level. The last variable, capex/total assets is negative and insignificant, while it was significant on a 5% level in the univariate analysis.

The results in this regression indicate the same relationships that were found in the univariate analysis. For the variables where the hedging companies had higher means, this binary regression returned a positive effect on the probability for commodity hedging, and correspondingly negative effect where the non-hedging means were higher.

5.9 Summary

This chapter investigates quantitatively the characteristics of hedging firms, what factors influence the likelihood that a firm in the airline industry in Europe will hedge, and most importantly the effect hedging against commodity price risk has on firm value. We have found our results by completing three different analyses.

The first analysis was the univariate, where the companies were divided simply by a hedging versus non-hedging criteria. From this analysis we found statistically significant results that indicate that the average hedging European airlines are larger companies that are less profitable and have less profit per passenger carried. Additionally, we found that the average hedging company has a lower fuel cost divided by total operating cost ratio than the average non-hedging company.

In the second analysis we used a multivariate regression model to determine if commodity hedging has a value adding effect. We performed two regressions using different hedging variables, and one regression using a dummy variable. The analysis gave no proof that hedging has any effect on firm value.

In the last analysis we used a binary regression model, where the same dummy variable that was used in the multivariate analysis was used as the dependent variable. The goal of this analysis was to identify which variables that affects the probability that a European airline will hedge. The analysis indicated that company size has a significant positive effect on the probability, while jet fuel cost as percentage of total operating cost and fuel cost per passenger have significant negative effects on the probability. These findings are consistent with the results from the univariate statistics.

Overall, the results do not uniformly support our hypotheses. The main hypothesis, that hedging is positively related to firm value, yielded one result with the expected sign, and one with the opposite, but both were insignificant. Consistent with our expectations, and statistically significant, were the observation that hedgers were more profitable and had higher profits per passenger. Inconsistent with our predictions, and of statistical significance, was the result that hedging is positively related to firm size. Also, contrary to our expectations, we observed that

fuel cost as percentage of operating costs and fuel cost per passenger were negatively related to hedging.

6. Discussion

Using theoretical frameworks about the relationship between hedging and firm value, we have discussed how derivatives hedging can exploit capital market inefficiencies, and through various mechanisms positively impact firm value under the right circumstances. These value-maximizing theories of value-adding hedging all build on the same mechanism, namely the reduction of firm volatility, and the stabilization of its internal cash flow generation. Empirical evidence supported these theories to a certain extent, but not unambiguously. Our main conclusion from the literature review was that the differing results could indicate the importance of industry and firm characteristics, and their rationales for hedging, in determining the effect of derivatives hedging on firm value.

Two specific relationships between hedging and firm characteristics were of high importance in our analysis of the European airline industry, namely the reduction of financial distress costs, and the reduction of underinvestment costs. By relating these specific hedging mechanisms to specific characteristics of the European airline industry, we arrived at a set of expectations regarding hedging and impact on firm value in the industry. These expectations were primarily founded on theory, and the characteristics of the airline industry. We discussed the high and increasing fraction of jet fuel in airline firms' operating costs, and argued that the high prices and volatility of this commodity could substantially impact the operating expenses of the airline firms. Coupled with the negative impact of the financial crisis on the operations of European airline firms, we argued that this risk was a relatively important one, and that it could significantly impact the internal cash flows of the firms, in turn disrupting firm value. We also argued that empirical evidence shows that airline firms face relatively high expected costs of financial distress. Similarly, evidence indicates that cash flows in the industry are negatively correlated to investment opportunities. All of these characteristics are predicted by theory to lead to a positive relationship between hedging and firm value, and augment this value-adding effect the larger they are.

Building on these theoretical relationships, we arrived at theoretically justified predictions and hypotheses regarding hedging in the industry. We primarily predicted to observe a positive effect

on firm value, robust to the use of two different hedging variables. Further, we expected the firms that hedged to display characteristics consistent with this theory, i.e. that hedging firms had higher expected costs of financial distress (proxied by size), higher levels of growth and investment opportunities (proxied by Capital Expenditures, Capital Expenditures/Total Assets, and P/E-ratios), less profits, and a higher fraction of jet fuel costs to operating costs (i.e. higher exposure of cash flows to jet fuel price), and that hedging firms displayed higher firm value (proxied by the Q-Ratio).

The results were, however, not uniformly supportive of our predictions. We found some results consistent with value-adding hedging theory, such as higher Q-ratios and P/E ratios, and lower oprating profits for hedgers, but these are statistically insignificant results. Of statistical significance, we found that hedgers are less profitable have less profits per passenger, which is consistent with theory, but also that hedgers had lower fuel cost percentage, which is inconsistent with our predictions. Also significant, and inconsistent with expectations, we found that fuel cost percentage and per passenger is negatively related to the probability of hedging. Also inconsistent with our main hypothesis we found that the isolated effect hedging had on firm value was statistically insignificant, and also had opposite sign across our two hedging variables. The finding that firm size is in a positive relationship is statistically significant, and inconsistent with our predictions that smaller firms were more likely to hedge due to higher costs of financial distress, and thus higher benefit to hedging. This result is, however, consistent with much of prior evidence that larger firms are more likely to hedge. This result supports the notion of economies of scale in hedging activity, a theory we have mentioned earlier. All in all, our results were not supportive of our hypotheses. The results are also inconsistent with evidence from the US airline industry, which we would expect to be, arguably, somewhat similar to the European with regards to the characteristics that ought to make hedging value-increasing. There may be several reasons for these results.

One possible explanation could be that even though the European and US airline industry are similar in some respects, they differ in others. For instance, our findings could be an indicator that European investors, contrary to American investors, are not willing to pay a premium on hedging airline companies, and rather want the choice to hedge their investments themselves, i.e. that hedging activity is recognized, but not valued by external investors. This explanation would

be in line with the notion that derivatives do not create value, though they may have other effects. Or that they work in the ways described, but that this does not automatically translates to increase in firm value.

Another explanation might be offered by the alternative main group of hedging theories, namely the manager utility maximization hypotheses. This theory argues that managers hedge with derivatives for their personal gain, and that the hedging activities may not have any impact on firm value, or may have a negative one, if the costs of hedging exceed any benefits. Managers might do this to diversify their own risk attached to the firm, which they cannot do by holding a diversified portfolio like the shareholders can. Or they might do this to better signal their quality to the market. Another explanation is that managers engage, unsuccessfully, in speculative use of derivatives, with resulting insignificant impact on firm value. These other rationales of why the airlines might hedge, can explain why the hedging is not significantly and positively related to firm value. This might also explain some of the observed inconsistencies of determinants of hedging, i.e. that firms do not hedge because they have low and volatile cash flow levels, or because they must preserve investing ability, but simply because the manager wants to achieve something other than increased firm value.

There may also be other reasons for the inconsistency between findings and expectations. As the relevant legislature on financial reporting that we use to obtain data about the derivatives usage is relatively new, we have not been able to obtain more and older firm-year sample in our analysis. Our study is also more recent than the US airline study, and the firm years are extracted from the years where the financial crisis had a strong impact on the world markets, which may have caused substantially deviated data and variables from their normal values. Also our sample may have been insufficient to uncover the expected relationships between the variables measured.

Another important aspect of derivatives we have mainly avoided is their inherent complexity, and the difficulties of structuring optimal hedging portfolios. Proper and objective-oriented use of derivatives is not a straight-forward task, and may be conducted with different extents of quality, precision, and strategic aim. Derivatives are also not costless, and there may be potential trade-offs between costs and transactions costs of undertaking hedging activity, and the associated benefits. Not always may the benefits be larger than the costs, and this is an important aspect to

consider when analyzing the potential value to corporations from using derivatives in their risk management policies.

7. Conclusion

This text has analyzed the activity of hedging with derivatives in the European airline industry. Consistent with sound theoretical frameworks, and some prolific traits of the industry, we argued that it seemed likely that firms could add value by hedging jet fuel risk. When we investigated the subject more thoroughly, using quantitative analysis, we did not document support for this notion. The discrepancy can have several possible explanations, both theoretical and practical, as to why we did not observe the expected results.

We would still not reject the hypothesis that hedging can possibly add value in the European airline industry, like it has been shown to do in the US airline industry. This inconsistent result is just one of many empirical investigations of the impact of derivatives hedging on firm value, and the subject is far from a closed one. As both theory and evidence largely suggests, hedging can both have a positive, negative, and insignificant impact on firm value, and depends largely on firm and industry characteristics.

Another issue, is the relative difficulty of both obtaining relevant data, and correctly measure the relations between the different factors. As discussed earlier, derivatives can be highly complex instruments, close to impossible to value precisely, and financial reporting standards have until recently not required significant disclosure of information on derivatives positions. All of this has made it difficult to directly measure the relation between hedging and firm value, and the usual methodologies include relatively widespread use of different proxy variables, that indirectly measure the intended factors.

As we discussed in the beginning, derivatives remain controversial, and the inconclusive theoretical frameworks and empirical evidence do not uniformly support the value-adding effects of hedging.

A possible general conclusion is, as already discussed, that hedging under the right circumstances can contribute to add value to firms facing costs of uncertainty and less than perfect markets, but that it is no panacea that can dramatically increase firm value automatically. The possible effects

may also not be dramatical, and can be relatively small compared to what the most enthusiastic theorists predict.

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9. Appendix

Output from statistics and regressions, Airline Sample, And exchange Rates used

	Size	Jet Fuel %	Jet Fuel Per Pass	Profit Per Pass
Size	1			
Jet Fuel %	-0,060243	1		
Jet Fuel Per Pass	0,30012135	0,29002584	1	
Profit Per Pass	-0,2307	0,18643028	0,366373991	1

Descriptive Statistics Residuals Reg 1	
Mean	7,40149E-17
Standard Error	0,018691826
Median	0,034702243
Mode	#N/A
Standard Deviation	0,102379347
Sample Variance	0,010481531
Kurtosis	0,257862689
Skewness	-0,977507225
Range	0,396517234
Minimum	-0,250567213
Maximum	0,145950021
Sum	2,22045E-15
Count	30

T/6	5
S^2	0,955520376
(K-3)^2 / 4	1,879829258

Test for Normality	
Jarque-Bera =	*14,17674817*
Chi-Value	5,99
JB > Chi -> Not Normally distributed	

Descriptive Statisticts Residuals Reg 2	
Mean	-2,91058E-16
Standard Error	0,017574515
Median	0,039030154
Mode	#N/A
Standard Deviation	0,106901602
Sample Variance	0,011427953
Kurtosis	-0,097616139
Skewness	-0,600299451
Range	0,450876892
Minimum	-0,279935551
Maximum	0,170941341
Sum	-1,07692E-14
Count	37

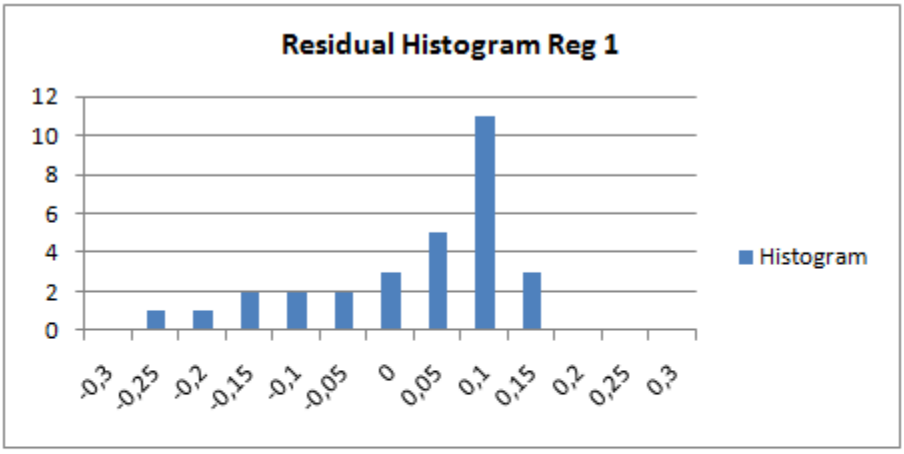
T/6	6,166666667
S^2	0,360359431
(K-3)^2 / 4	2,398806436

Test for Normality	
Jarque-Bera =	*17,01485618*
Chi-Value	5,99
JB > Chi -> Not Normally distributed	

Descriptive Statisticts Residuals Reg Dummy	
Mean	-1,40239E-16
Standard Error	0,017114518
Median	0,031263312
Mode	#N/A
Standard Deviation	0,105500976
Sample Variance	0,011130456
Kurtosis	0,047165956
Skewness	-0,630973124
Range	0,45552452
Minimum	-0,284604195
Maximum	0,170920324
Sum	-5,32907E-15
Count	38

T/6	6,333333333
S^2	0,398127083
(K-3)^2 / 4	2,179807223

Test for Normality	
Jarque-Bera =	*16,32691728*
Chi-Value	5,99
JB > Chi -> Not Normally distributed	


Residual Histogram Reg 1
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6
4
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-0,2
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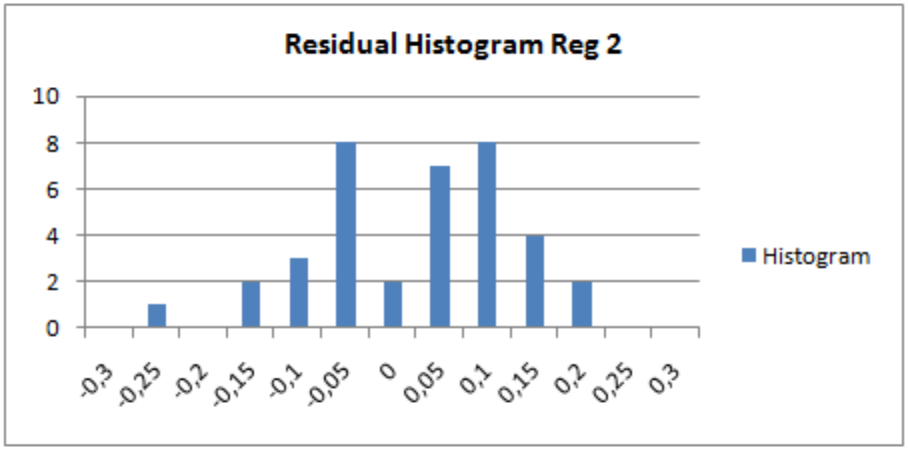
-0,05
0
0,05
0,1
0,15
0,2
0,25
0,3
Histogram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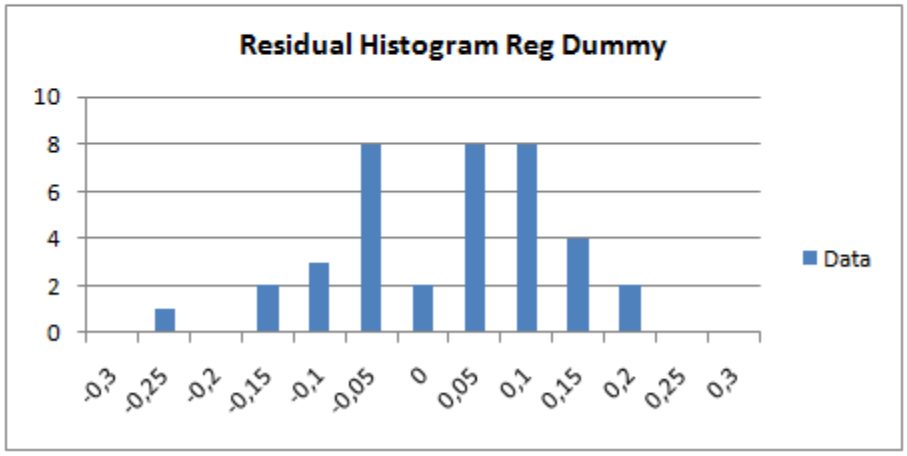
Histogram


Residual Histogram Reg Dummy
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8
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4
2
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-0,2
-0,15
-0,1
-0,05
0
0,05
0,1
0,15
0,2
0,25
0,3
Data

Regression 1:				Regression 2:			
Test for Hetereoscedasticity Organizing after Hedged Percent of Next Years Fuel Requirement				*Test for Hetereoscedasticity organizing after Fair Value Hedge/Total Assets*			
Goldfeld-Quandt =	1,503181231	Approx F-value alpha=0,05 dF1(15-K) dF2(15-K):	2,4034	Goldfeld-Quandt =	3,112853458	Approx F-value alpha=0,05 dF1(19-K) dF2(18-K):	2,1906
GQ < F-Value -> No Hetereoscedasticity				**GQ < F-Value -> Hetereoscedasticity**			
Test for Hetereoscedasticity organizing after LOG Total Assets				*Test for Hetereoscedasticity organizing after LOG Total Assets*			
Goldfeld-Quandt =	2,016709947	Approx F-value alpha=0,05 dF1(15-K) dF2(15-K):	2,4034	Goldfeld-Quandt =	1,052996738	Approx F-value alpha=0,05 dF1(19-K) dF2(18-K):	2,1906
GQ < F-Value -> No Hetereoscedasticity				**GQ < F-Value -> No Hetereoscedasticity**			
Test for Hetereoscedasticity organizing after Jet Fuel Cost Per Passenger				*Test for Hetereoscedasticity organizing after Jet Fuel Cost Per Passenger*			
Goldfeld-Quandt =		Approx F-value alpha=0,05 dF1(15-K) dF2(15-K):	2,4034	Goldfeld-Quandt =	2,133437913	Approx F-value alpha=0,05 dF1(19-K) dF2(18-K):	2,1906
GQ > F-Value -> No Hetereoscedasticity				**GQ < F-Value -> No Hetereoscedasticity**			
Test for Hetereoscedasticity organizing after Jet Fuel Cost Percent				*Test for Hetereoscedasticity organizing after Jet Fuel Cost Percent*			
Goldfeld-Quandt =	1,71147682	Approx F-value alpha=0,05 dF1(15-K) dF2(15-K):	2,4034	Goldfeld-Quandt =	2,346084898	Approx F-value alpha=0,05 dF1(19-K) dF2(18-K):	2,1906
GQ > F-Value -> No Hetereoscedasticity				**GQ < F-Value ->Hetereoscedasticity**			
Test for Hetereoscedasticity organizing after Jet Fuel Cost Percent				*Test for Hetereoscedasticity organizing after Jet Fuel Cost Percent*			
Goldfeld-Quandt =	1,310789741	Approx F-value alpha=0,05 dF1(15-K) dF2(15-K):	2,4034	Goldfeld-Quandt =	1,473865348	Approx F-value alpha=0,05 dF1(19-K) dF2(18-K):	2,1906
GQ > F-Value -> No Hetereoscedasticity				**GQ < F-Value -> No Hetereoscedasticity**			

Regression Dummy:

Test for Hetereoscedasticity organizing after Hedge

Goldfeld-Quandt =	3,503062187	Approx F-value alpha=0,05 dF1(19-K) dF2(19-K):	2,1555

GQ < F-Value -> Hetereoscedasticity

Test for Hetereoscedasticity organizing after LOG Total Assets

Goldfeld-Quandt =	1,112055891	Approx F-value alpha=0,05 dF1(19-K) dF2(19-K):	2,1555

GQ < F-Value -> No Hetereoscedasticity

Test for Hetereoscedasticity organizing after Jet Fuel Cost Per Passenger

Goldfeld-Quandt =	2,01573839	Approx F-value alpha=0,05 dF1(19-K) dF2(19-K):	2,1555

GQ < F-Value -> No Hetereoscedasticity

Test for Hetereoscedasticity organizing after Jet Fuel Cost Percent

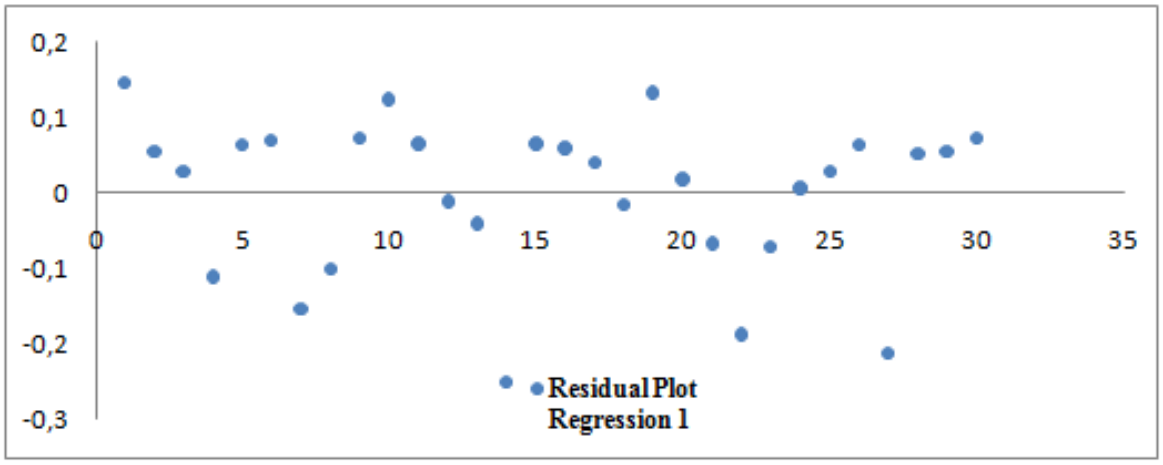
Goldfeld-Quandt =	2,218255985	Approx F-value alpha=0,05 dF1(19-K) dF2(19-K):	2,1555

GQ < F-Value ->Hetereoscedasticity

Test for Hetereoscedasticity organizing after Jet Fuel Cost Percent

Goldfeld-Quandt =	1,777498326	Approx F-value alpha=0,05 dF1(19-K) dF2(19-K):	2,1555

GQ < F-Value -> No Hetereoscedasticity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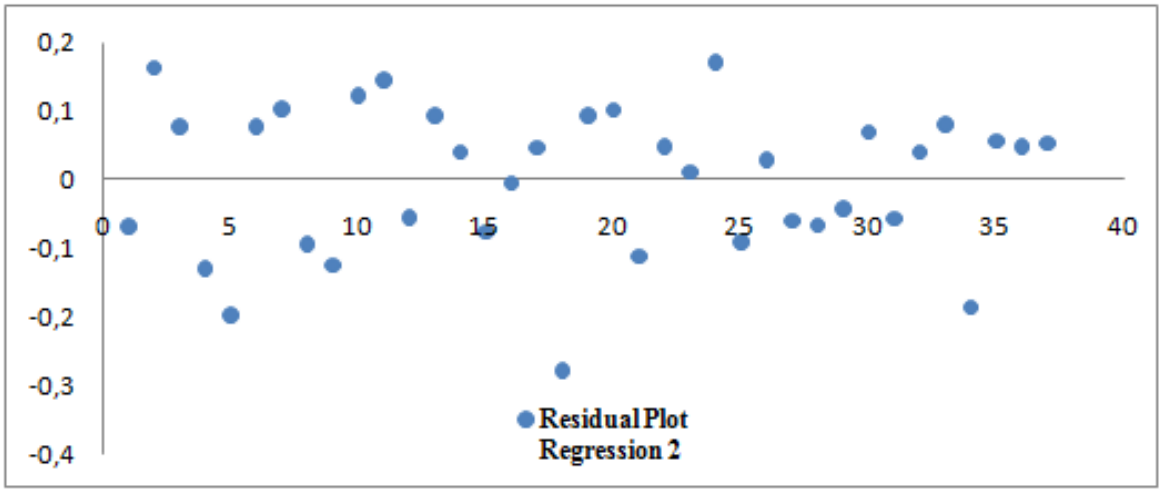
Residual Plot
Regression 1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35
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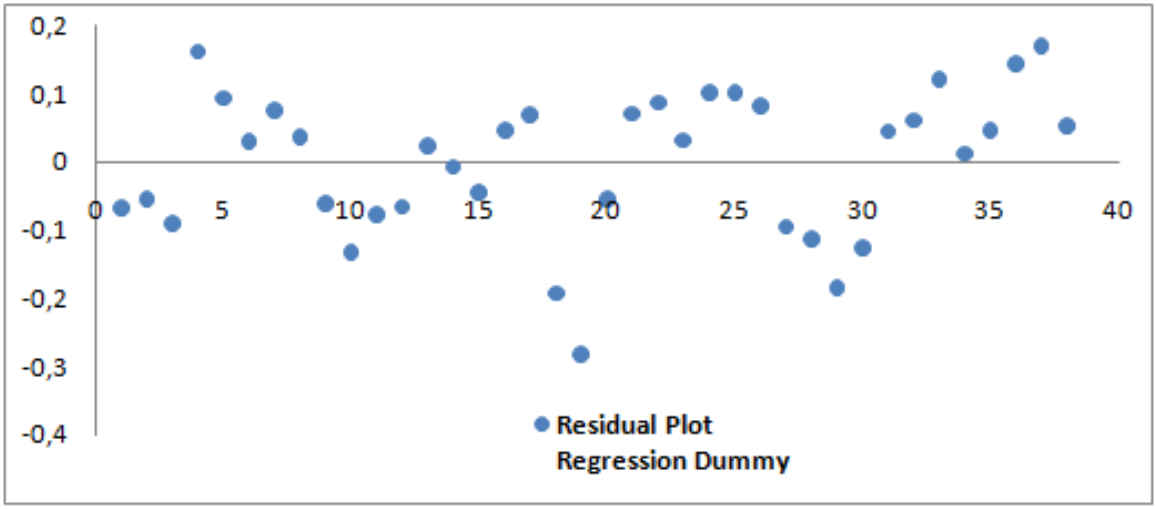
Residual Plot
Regression 2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-0,2
-0,3
-0,4
0
5
10
15
20
25
30
35
40
Residual Plot
Regression Dummy

Airlines Used in The Analyses

British Airways	Turkish Airlines
Air Berlin	Finn Air
easyJet	Iberia
Lufthansa	Aegean Airlines
Ryan Air	Aeroflot
SAS Group	Aer Lingus
Norwegian	

Exchange Rates

	EUR/GBP	EUR/NOK	EUR/SEK	EUR/USD	TRY/EUR
13.12.2006	1,49	8,24	9,04	1,31	0,54
31.03.2007	1,47				
30.09.2007	1,43				
31.12.2007	1,36	7,96	9,41	1,46	0,59
31.03.2008	1,26				
30.09.2008	1,25				
31.12.2008	1,02	9,85	10,91	1,4	0,465
31.03.2009	1,08				
30.09.2009	1,09				

	Size	Jet Fuel %	Jet Fuel Per Pass	Profit Per Pass
Size	1			
Jet Fuel %	-0,060243	1		
Jet Fuel Per Pass	0,30012135	0,29002584	1	
Profit Per Pass	-0,2307	0,18643028	0,366373991	1

SUMMARY OUTPUT D1

Regression Statistics	
Multiple R	0,68127099
R Square	**0,46413017**
Adjusted R Square	0,35249062
Standard Error	0,11253969
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	5	0,263271	0,052654	4,157399	0,00732
Residual	24	0,303964	0,012665		
Total	29	0,567235			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95,0%*	*pper 95,0%*
Intercept	-0,08578182	0,170151	-0,50415	0,618753	-0,43696	0,265394	-0,43696	0,265394
D1	**-0,00049387**	0,00097	-0,50941	0,615118	-0,00249	0,001507	-0,00249	0,001507
Size	**0,07094047**	0,023514	3,016978	0,00596	0,02241	0,11947	0,02241	0,11947
Jet Fuel Cost as %	**0,74892646**	0,323494	2,315117	0,029474	0,081268	1,416585	0,081268	1,416585
Jet Fuel Cost per Passenger	**-0,00135963**	0,000573	-2,37232	0,026037	-0,00254	-0,00018	-0,00254	-0,00018
Profit Per Passenger	**0,00156442**	0,000943	1,658983	0,110133	-0,00038	0,003511	-0,00038	0,003511

SUMMARY OUTPUT D2

Regression Statistics	
Multiple R	0,60328087
R Square	**0,3639478**
Adjusted R Square	0,26135874
Standard Error	0,11520057
Observations	37

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	5	0,235406	0,047081	3,547628	0,011881
Residual	31	0,411406	0,013271		
Total	36	0,646812			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95,0%*	*pper 95,0%*
Intercept	0,06311405	0,162287	0,388905	0,700005	-0,26787	0,3941	-0,26787	0,3941
D2	**0,02769544**	0,804784	0,034414	0,972768	-1,61367	1,669062	-1,61367	1,669062
Size	**0,03463593**	0,017236	2,009458	0,053263	-0,00052	0,06979	-0,00052	0,06979
Jet Fuel Cost as %	**1,11277198**	0,289219	3,847511	0,000557	0,522907	1,702637	0,522907	1,702637
Jet Fuel Cost per Passenger	**-0,00137668**	0,000589	-2,3382	0,026004	-0,00258	-0,00018	-0,00258	-0,00018
Profit Per Passenger	**0,00110684**	0,000863	1,283143	0,208952	-0,00065	0,002866	-0,00065	0,002866

SUMMARY OUTPUT Dummy

Regression Statistics	
Multiple R	0,62983804
R Square	**0,39669596**
Adjusted R Square	0,3024297
Standard Error	0,11344421
Observations	38

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	5	0,270792	0,054158	4,20825	0,004726
Residual	32	0,411827	0,01287		
Total	37	0,682619			

	Coefficients	*andard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95,0%*	*pper 95,0%*
Intercept	0,05992378	0,155853	0,384489	0,703159	-0,25754	0,377386	-0,25754	0,377386
Dummy	**-0,00664246**	0,062532	-0,10622	0,916067	-0,13402	0,120732	-0,13402	0,120732
Size	**0,03611941**	0,018153	1,989743	0,055222	-0,00086	0,073095	-0,00086	0,073095
Jet Fuel Cost as %	**1,1141807**	0,299277	3,722905	0,000758	0,504573	1,723788	0,504573	1,723788
Jet Fuel Cost per Passenger	**-0,00142147**	0,000571	-2,48863	0,018218	-0,00258	-0,00026	-0,00258	-0,00026
Profit Per Passenger	**0,00107857**	0,000857	1,258506	0,217314	-0,00067	0,002824	-0,00067	0,002824