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Hedging, exposure and firm value: A study of European and U.S. Airlines

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Hedging, exposure and firm value: A study of European and U.S. Airlines

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by
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ABSTRACT

For several reasons, the airline industry is a reasonable industry to analyze the relation between corporate risk exposure, hedging policy, and firm value. We explore the relationship between hedging, exposure, and firm value among European and U.S. airlines. More specifically, how differences in strategy between Low-Cost Carriers and Full-Service Airlines affects this relationship, during the period Jan 1, 2010 – Dec 31, 2017. We analyze the relation between airlines fuel exposure coefficients and the percentage of next year's fuel requirement hedged. We find evidence that hedging reduces exposure to fuel prices. Further, investgating the relationship between hedging and firm value, we find that hedging is associated with higher firm value. However, we discover that differences in strategy affects the hedging premium. Our results confirms that increased hedging activity in periods of high exposure is not associated with higher firm value. Lastly, we find that alleviating the underinvestment problem appear not to be important in explaining airlines hedging behavior.

Contents

1 Introduction

The global airline industry has been exposed to remarkable changes in fuel prices over the last decade. From low fuel prices after the financial crisis, the prices raised significantly and maintained high until 2014. In 2014, an unexpected increase in oil supply, led to a significant drop in fuel prices. The plunge in the prices of oil and oil-related products saved the global airline industry for more than $70 billion in 2015 alone according to the rating agency Moody's (Flottau et al., 2015). On the other side, some airlines were left with billion-dollar losses from losing "bets" on outstanding fuel hedging contracts. When commodity prices fall faster and further than anyone expects, the benefits of low prices are reduced by hedging costs (Ngai and Dastin, 2014). In these situations, airlines without hedging contracts would be the most significant winners.

We know airlines are aware of fluctuations in fuel prices when jet fuel accounts for approximately one-third of operating expenses and up to 50% for some airlines. This means that the price of jet fuel is one of the dominant features when it comes to determine and predict business profitability. Some argue that hedging is not a part of an airlines core business, nor an area of competency and therefore should be avoided. Despite that, some airlines report that they make more revenue on their hedging programs than from their core business (P.A. Laux et al., 2014; IATA, 2014).

For that reason, we have chosen to examine how airlines use financial hedging strategies to reduce their exposure to jet fuel. Further, we investigate whether airlines can increase firm value by using derivatives to hedge fuel price risk by analyzing data in the period from 2010 - 2017. As an extended part of our analysis, we compare airlines with different strategies where Low-Cost Carriers play an important role. A Low-Cost Carrier is defined as an airline that focuses mainly on reducing its operating expenses. Hence, we investigate if there are any differences between Low-Cost Carriers and regular airlines, which we define as Full-Service airlines.

We interpret exposure as the sensitivity of a firm's stock price to changes of the underlying financial risk, i.e., the price of jet fuel (Jorion, 1990). Intuitively, the exposure to jet fuel would increase when fuel costs constitute a larger part of total operating expense, ceteris paribus. This means that exposure should vary among airlines and affect their strategies.Previous research, who have studied fuel hedging in the airline industry, focus mainly on hedging in the U.S. market in a time period where oil prices fluctuated around 100 dollars per barrel (Treanor, et al., 2014a and b; Rampini, et al., 2014; Berghofer and Lucey, 2014; Laux, et al., 2014). Besides, most of these studies focus on U.S. airlines in isolation and pay no attention to internationalization in the airline industry. The removal of geographical boundaries justifies looking at the airline industry as a global industry. Some studies investigate the difference in exposure of airlines across continents (Berghofer and Lucey, 2014), but little approved research on differences in strategies between Low-Cost Carriers and Full -Service Carriers in the European and U.S. market. For that reason, we are convinced that this study can produce useful insight to the topic of hedging in the aviation industry and examine the effect of modern financial hedging practices.

In the second part of our paper, we investigate the relationship between exposure, hedging, and firm value. In the connection between hedging and firm value, most of the prior research does not focus on differences in strategies between airlines (Carter, 2006; Lin and Chang, 2009). However, the paper by Treanor et al. (2014a), which is an expansion of Carter et al. (2006) provides more valuable insight on how hedging affects firm value and the interaction between exposure and hedging's effect on firm value. They do also compare airlines with different strategies by investigating the difference between *active* and *passive* hedgers [1]. Nevertheless, we believe that our paper can add knowledge to the relationship between exposure, hedging, and firm value by considering differences between Low-Cost- and Full-Service Airlines over continentals in a more modern timeframe.

To examine each airlines annual exposure, we regress stock price return against market return and the change in the price of jet fuel using weekly data. To

[1] Passive and selective hedgers are measured in two ways, in the first section, type of hedger is measured using the standard deviation of next year's jet fuel requirements hedged. A relatively high standard deviation is classified as a selective hedger. In the second part, hedger type is measured using the product of the variables: the change in the percent of jet fuel hedged and a dummy variable indicating the year's when industry exposure is high, otherwise zero.

estimate the effects of financial hedging in reducing exposure, we run a fixed-effects panel regression. We run multiple regressions to examine if there are any differences in geographical location or strategy. Similarlry to Bartram et al. (2011) and Treanor et al. (2014b), we find evidence that the use of derivatives reduces exposure to changes in commodity prices.

In the next section, we investigate the relationship between hedging and firm value. Using time-series feasible least squares- and fixed-effects models to measure robustness over different estimation methods, we find some evidence that hedging increase firm value. Splitting into subsamples, we find that hedging is associated with lower value for Low-Cost Carriers. Also, we discover a concave relationship between hedging and firm value, meaning that hedging increases firm value at a decreasing rate. As Treanor et al. (2014a), we find that investors do not value increased hedging in response to higher exposure. We do also investigate if an *active* hedging strategy is superior to a *passive* hedging strategy[2]. The results show a positive, but not statistically significant coefficient, signaling that an *active* hedging strategy is not superior to a *passive* hedging strategy. Lastly, we examine if the underinvestment problem is essential in explaining airlines hedging behavior. Our results cannot find any evidence that the underinvestment problem is an important factor in an airlines hedging decision.

We organize the paper as follows: In section 2, we clarify the underlying motivation for this study and provide an institutional background. In Section 3, we examine the data collection. The exposure coefficients and hedging's effect in reducing exposure is investigated in section 4. In Section 5-9, we study the relationship between hedging and firm value, if hedging is more valuable in periods of high exposure, and if investors value an active hedging strategy. Lastly, we explore if the underinvestment problem provides a rationale for airlines to hedge. Discussion of our results, conclusions, and implications for future research are provided in Section 10 and 11.

[2]In the regression we include the standard deviation of hedge ratio. An active (passive) hedger is defined as an airline that have high (low) variation in percent of fuel requirements hedged.

2 Background

2.1 The global industry, U.S. and European Airline Industry

We have chosen to concentrate our study on the European and U.S. airline market. It is favorable for many reasons. Firstly, the technological progress has decreased the physic distance between the continents. Secondly, there are similarities in culture, language, economic situation, and the legal and political system. Also, there is an international competition where the airlines compete on the same routes, making it possible to compare business practices and financial markets. They do also buy jet fuel on the same global spot market, which makes it possible to compare their exposure to jet fuel price risk. Lastly, both continents have airlines that operate with different strategies, both Low-Cost Carriers, and Full-Service Airlines. This would allow us to investigate if differences in strategies can give better or other explanations than dissimilarities in geographical locations to determine the effectiveness of hedging. Finally, data is available for both markets through annual reports and financial databases. Similarities in this data establish a basis for comparison and data analyses.

Our sample period (2010-2017) is beneficial because of the significant variation in fuel prices, which should originate changes in hedging behavior. The first part of the period is characterized as a time of low prices for oil and oil products as a result of the financial crisis. The next period from mid-2011 until June 2014, the oil price spiked, causing enormous losses for some airlines. For the aviation industry, fuel stand for up to 50 % of total operating expenses. It applies particularly to Low-Cost Carriers since they operate more cost-efficient than Full-Service airlines, meaning that fuel cost represents a larger part of operating expenses (Figure 1). Ryanair is an exceptional example of a Low-Cost Carrier. Their primary focus is to carry the passenger from A to B at a minimum cost. It is primarily done by lowering wages to a minimum and fly to secondary airports for less landing fees. Furthermore, any additional service is added directly to the ticket price.

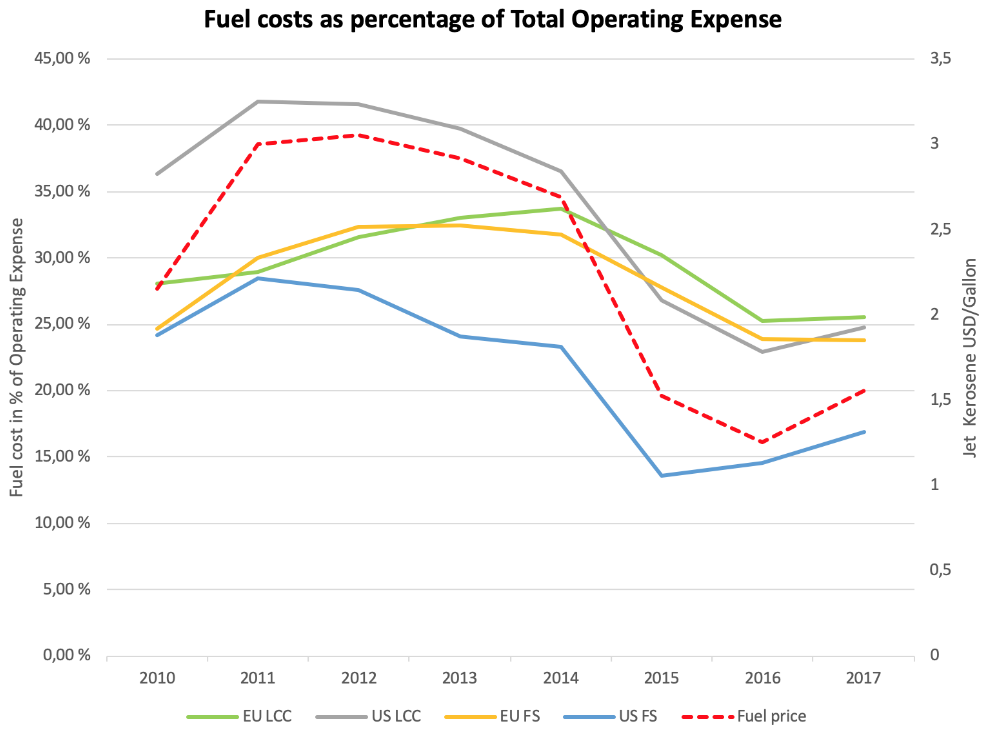

Figure 1: Airline fuel costs as a percentage of the total operating expense compared to average jet fuel prices in the sample period Jan 1. 2010- Dec 31, 2017. European and U.S. airlines organized in Low-Cost Carriers and Full-Service Carriers, respectively.

In June 2014, the oil- and jet fuel prices dropped due to an unexpected increase in oil supply (Figure 2). Overall, for the aviation industry, this drop in oil prices was beneficial, as average fuel costs dropped (Figure 2). However, for some airlines that had already hedged much of its future fuel requirements incurred massive losses. Delta Airline is one of the extreme occurrences of loss of security due to the oil crisis and reported fuel losses of $ 2.3 billion in 2015. Furthermore, CEO in Delta admits that fuel losses are up to $ 4 billion since the oil fell in June 2014 (Forbes, 2016).

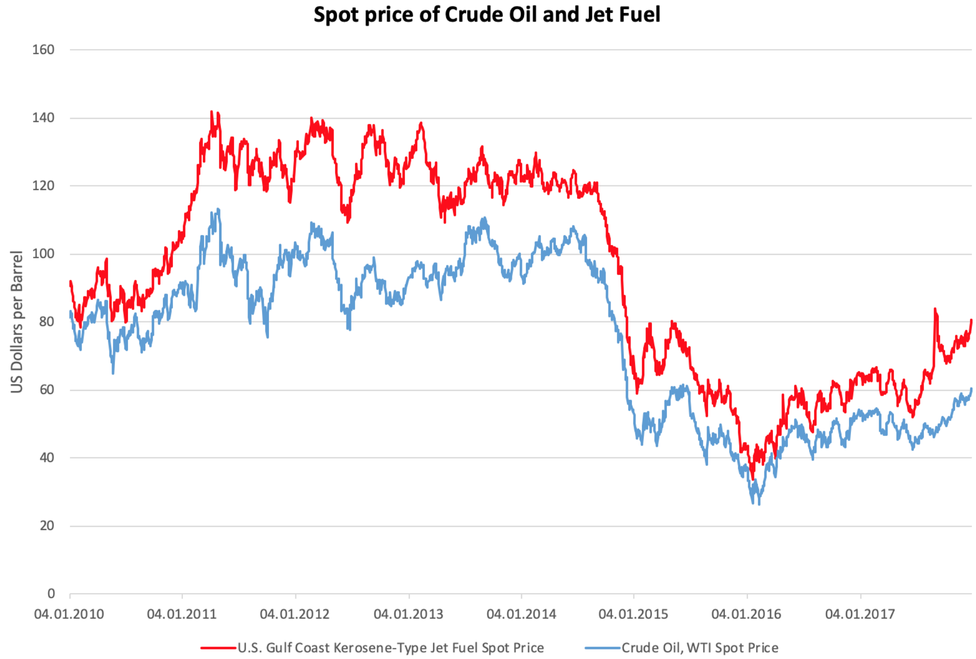

Figure 2: The graph shows the evolution of Crude Oil WTI and Jet fuel spot price in the sample period 1. Jan 2010- 31. Dec 2017.

Because of the relation between fuel costs as a percent of total operating expense and jet fuel prices, the impact of hedging is directly observable when the price of jet fuel falls. As a result, European airlines have smoother cash outflows because of higher hedging percent (Figure 1). On the other hand, U.S. airlines benefit more of falling fuel prices because of fewer outstanding hedging contracts.

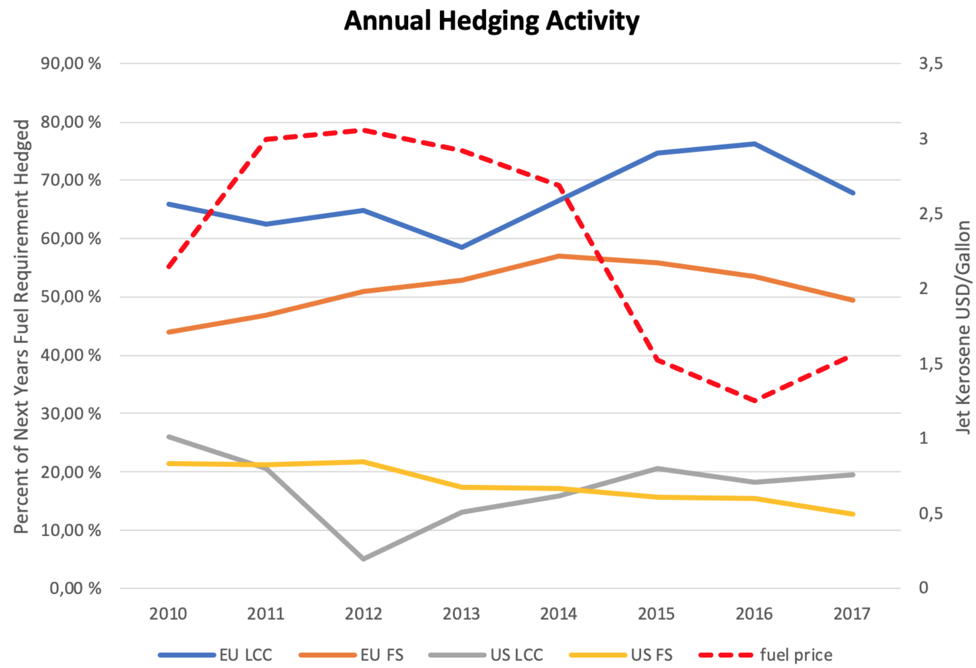

Figure 3: Airlines percent of next year fuel requirements hedged plotted alongside to the jet fuel price over the time period. The sample is grouped by respectively, geographical location and strategy.

The global aviation industry has been characterized as a struggling industry in the last decades, first by the dot.com bubble, then 9/11 and lastly, the financial crisis. Apart from that, the airline industry is a business with increased competition and regularly insolvency issues. The introduction of the internet and new digital technology, together with deregulation, have changed the airline industry creating new possibilities and further increased competition. This has given rise to new strategies and a shift in industry behavior, where Low-Cost Carriers play an essential role. In the past ten year's, business traveling has increased considerably. Due to the increased competition from Low-Cost Carriers, traveling has become cheaper, and the average seat price has dropped significantly. The competition from Low-Cost Carriers has decreased the profit margins, and increased industry consolidation. In an attempt to take on the Low-Cost Carriers and stay competitive, Full-Service airlines have engendered frequent and large mergers[3].

[3]In 2004 Air-France merged with KLM. Lufthansa have actively acquired airline companies for the past ten year's, including Austrian airlines, Germanwings, Brussels Airlines and Air Berlin. IAG was formed by the merger of British Airways and Iberia in 2011. U.S. American Airline Group was formed by the merger of American Airlines and US Airways in 2013.

Along with cost management, financial hedging is common and widely used in the aviation industry. In the period around the financial crisis, U.S. airlines attained mixed results from their hedging activities to reduce their exposure to jet fuel, and many airlines were forced to reconsider their hedging programs. As a result, hedging practices for U.S. airlines are more conservative compared to European airlines (Figure 3). European airlines hedge more of their expected fuel requirements, some up to 80-90 %. Regardless of fuel prices, this results in less volatile fuel expenses (Figure 1). The differences in hedging level are interesting because, fundamentally, a fall in fuel prices means higher profitability, but for heavily hedged airlines, a drop in prices would incur as a loss. Consequently, as the price of jet fuel changes, we should be able to detect the effects of hedging programs and decide which factors affect exposure the most. Since the commodity risk is present in the cost part of the company, we would expect to observe a negative relationship between stock price return and jet fuel price. We would also expect a higher exposure when fuel costs represent a larger piece of total operating expense. The annual exposure for each subgroup is displayed in Figure 4. We observe that the exposure for U.S. airlines is positively related with the level of prices. That is, when prices are high the exposure is higher, meaning that fluctuations in prices affect firm value more. For European airlines, the correlation between fuel prices and exposure is much weaker. This makes sense, because European airlines hedge more. It also makes sense that for an airline that does not hedge or hedges little, its exposure is positively related to prices, because when prices are high we can expect that the airlines have more difficulty cutting other costs or passing the increased fuel costs to the customers.

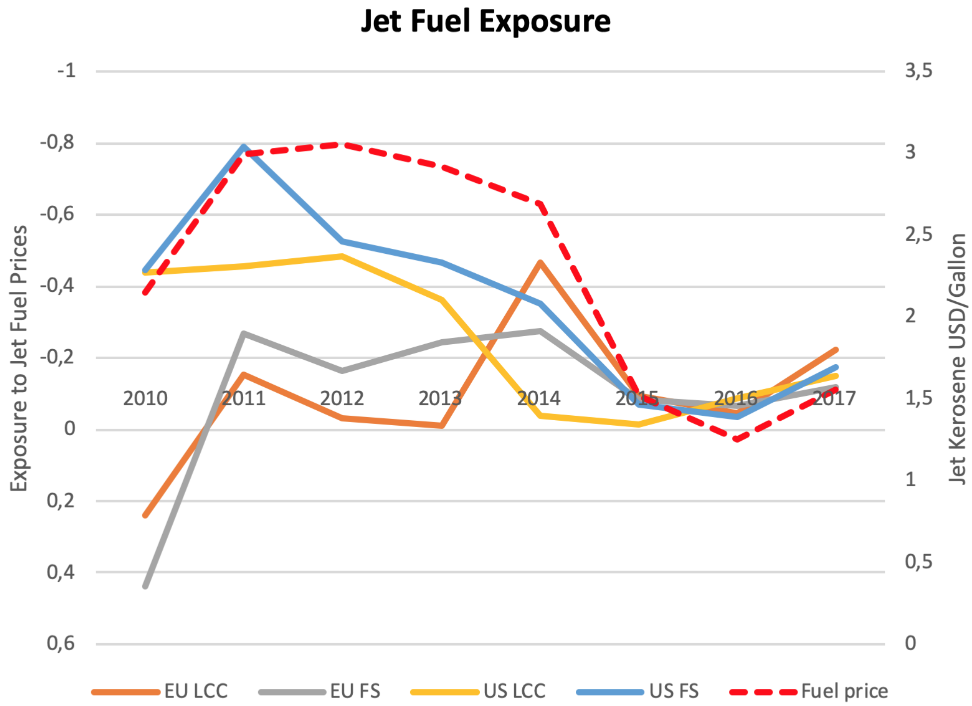

Figure 4: Airlines average annual exposure plotted alongside to fluctuations in jet fuel price. The sample is grouped by respectively, geographical location and strategy. Annual exposure to jet fuel is calculated regressing each airlines stock return on percentage change in jet fuel prices and controlling for market return, using weekly data.

2.2 Jet Fuel Hedging in the Airline Industry

We define hedging as a risk management strategy used to reduce the probability of loss from changes in the price of the underlying asset. The purpose of risk management programs is to manage such risk exposure systematically and reduce the probability for unfavorable outcomes and thereby preserve firm value. There are several ways a firm can hedge, but most common is the use of derivative contracts such as forwards, futures, options, and swaps. However, the use of derivatives can also be used for pure speculation in the underlying asset. Therefore, some people mean that hedgers are only speculative (Working, 1953; Gray, 1960). Delta Airlines 10-k filing from 2013 state that "We actively manage our fuel price risk through a hedging program intended to reduce the financial impact from changes in the price of jet fuel, and rebalance the hedge portfolio from time to time according to market conditions." hence, they are saying that the hedging program depends on their view of the market. Firms view the market differently, and some studies indicate that firms engage in speculation rather than hedging (Culp and Miller, 1995; Dolde, 1993). Several airlines have similar statements as Delta in their annual reports. Furthermore, does Ryanair specifically say that they hedge to take advantage of price movements. However, if and how derivatives are being used to either reduce risk or to speculate are challenging to prove.

Regardless of the purpose, hedging in the airline industry is not that straightforward as it seems. Apart from the Japanese market, there are no exchange-traded futures contracts available for jet fuel. Even though OTC-contracts can be arranged, such agreements involve counterparty risk, meaning that financially distressed airlines would find it either hard or expensive to find others willing to take on this risk. To get past this problem, airlines can enter into derivative contracts where the underlying asset are strongly correlated with jet fuel. This can be performed because of the high correlation between oil and oil products. The derivative market for heating- or crude oil is much more liquid, which makes it easier to hedge the right amount along with lowering the costs. Anyway, hedging using another underlying asset creates basis risk[4]. To manage the basis risk, airlines can use a differential swap which hedges the price difference between two commodities in the actual period. In that way, an airline can eliminate the risk that jet fuel prices increase more than the hedged commodity (for example Heating Oil). There are several ways an airline can use derivatives to hedge jet fuel price risk. The most used derivatives are futures, forwards and options. Appendix 1 explains the basics of these derivatives.

Hedging in the airline industry has under some circumstances provided significant savings. On the contrary, there have been some cases where airlines have suffered a substantial financial loss. In the period leading up to the financial crisis, many airlines were already fully hedged against next year's fuel price. The economic theory is quite simple; it is a winning side and a losing side in placing a bet on a future fuel price. However, the outcome was tragic for many airlines when the

[4]Basis risk is defined as the risk of offsetting investments in a hedging strategy does not experience price changes in the complete opposite direction from each other. The imperfect movement between the two assets generates the potential of excess gains or losses in a hedging strategy. They are thereby increasing the risk of the position.

financial crisis broke into a bear market. Inefficient hedges cut the airline's profits and put the industry on the brink of bankruptcy. Southwest Airlines reported a $120 million loss in the third quarter of 2008, this being the first 17-year loss. In addition, American Airlines reported a substantial loss on hedging contracts, up to $360 million over the same period (N.Y. Times, 2019). The crisis hit hard on Europe as well, and Ryanair lost €169 million in 2009 (France24, 2019). Hedging contracts declined in value due to the plunge in fuel price, made by aggressive risk management programs. The financial crisis triggered airlines to be more careful about their hedging strategy, especially in the U.S. (Rowling, 2014).

However, hedging using futures and forwards does not remove the effect of price fluctuations on the underlying asset. Futures and forwards are a function of the underlying spot price, meaning that hedging would transfer the effect forward in time. This means that derivatives can only hedge short term movements.

2.3 Why do firms hedge?

According to theory, the capital asset pricing model (CAPM) (Sharpe, 1964; Lintner, 1965; Mossin, 1966) implies that diversified investors only care about the systemic risk as a component of the total risk. If investors are well diversified (independently of CAPM), then there is no point for the firms to manage their risks. If an investor holds a portion of all companies, it does not matter which company carries which risk. The CAPM theory is substantiated by Miller and Modigliani's proposition (1958) saying that hedging activities are irrelevant because shareholders can protect themselves against such risk holding diversified portfolios. However, the Miller and Modigliani theory is based on several assumptions. These assumptions are no market frictions, neutral taxes, symmetric access to credit markets (borrowing and lending at the same interest rate), and firm financial policy reveals no information. In the real world, these assumptions do not hold. In the next section, we introduce situations where hedging can add value to a firm.

2.3.1 Financial distress- and bankruptcy costs

Financial distress costs occur when a company is close to bankruptcy, i.e. the value of the assets are close to the value of the liabilities. Besides, financial distress is related to the probability for a firm to go bankrupt. We can divide the costs of bankruptcy into two categories, direct and indirect costs. The direct costs are associated with the bankruptcy proceeding. These are legal and administrative costs and sale of assets below fair market value prices. If the assets are non-tangible or specialized, the costs can be high (Weiss 1990). The indirect costs are related to the chances of future bankruptcy and financial distress. Costs that occur is debt overhang (underinvestment), asset substitution (risk shifting), stakeholder protection costs, employee turnover and reluctance to deal with the company as customers and suppliers are not sure if unsettled obligations would be fulfilled (Andrade and Kaplan, 1998).

Leverage is related to the likelihood of incurring financial distress costs. Debt is often used to increase the value of a firm because of the tax advantages. On the other hand, payments of debt constitute obligations, which the debtholders are legally entitled. If the firm does not meet its obligations, it may lead to financial distress and in worst case bankruptcy. In perfect capital markets (Miller and Modigliani, 1958), bankruptcy is a cost-free transfer of the company's assets from shareholders to debtholders. However, in the real world, Smith and Stulz (1985) argue that bankruptcy, and the probability of future bankruptcy, creates significant costs for the company, which in turn have a negative impact on firm value. If financial distress is costly, hedging activities may reduce the bankruptcy probability. Assuming that investment policy is fixed, they argue that hedging decreases the present value of financial distress costs even if hedging is costly. They do also find that the present value of tax shield would be higher, implying that the shareholders wealth increases.

Dolde (1995) and Gould and Szimayer (2008) study the link between hedging and leverage. They find that hedging reduces the effects of leverage on financial distress costs, showing a significant positive relationship between hedging and leverage.

2.3.2 Agency costs of debt

Agency cost of debt can be defined as the bondholders' necessary compensation for managerial opportunism combined with the costs of writing and enforcing debt covenants. One agency conflict is the risk-shifting problem or asset substitution problem. Such problems can occur when the firm must choose between mutually exclusive projects. The managers, who act in the interest of the shareholders have the incentive to move towards more risky projects, especially when the firm faces high leverage and low value. Shareholders get the benefits of positive stock price movements, while the bondholders are the ones who suffer the consequences of negative price movements. This can be explained with a Call option-like claim shareholders have on the firm's assets (Merton, 1974). Shareholders would be interested in the upside and the volatility since volatility increases the value of the option. The bondholders are concerned about the downside and the probability of bankruptcy. Given the possibility to choose between projects with different riskiness, the managers have the opportunity to increase the value of equity at the expense of the value of debt. However, bondholders would protect their interests using debt covenants. Risk management can avert a firm's value to fall to a point where there are strong incentives to increase risk (Smith, 1995).

Another agency conflict is the "underinvestment problem." Opposed to Miller and Modigliani (1958), the real world has market imperfections, and the interests of the firm's stakeholders might not be congruent. These imperfections are especially relevant in cases where firms are highly leveraged, and there are information asymmetries. Firms with low value and risky bonds have a higher chance of having a suboptimal investment behavior (Myers, 1997). If the debt is high, rational management may choose not to invest in projects, even with positive net present value, as the implementation of such investments mainly benefits bondholders. In these situations, hedging can add value because the firm has enough funds accessible also in bad times to take advantage of investment opportunities. Gay and Nam (1998) study the relationship between hedging activity and growth opportunities. They argue that there is a positive relationship and that the motivation behind the use of derivatives are mainly driven by the need to avoid underinvestment problems.

2.3.3 Imperfect markets and costly external financing

Froot, Scharfstein, and Stein (1993) argue that external funds are more expensive than internally generated funds because of market imperfections. If a firm is dependent on external financing to realize investment opportunities, it will hedge their cash flows to avoid liquidity issues in bad times. Otherwise, the use of external funding can be too costly. Examples of such market imperfections, or problems with informational asymmetries, are transaction costs in obtaining external financing, lack of information regarding the riskiness of investment opportunities and the costs of potential bankruptcy. These informational asymmetries worsen during bad times for the company, which creates a situation where positive NPV projects might not be funded. Haushalter (2000) supports this in his study and shows that firms that use hedging actively are also those who are likely to face most market imperfections. Ceteris paribus, the harder it is for a firm to find external financing, the costlier would liquidity problems be. Consequently, the benefits of hedging are greater.

However, there are not necessarily only benefits from hedging activities. Tufano (1998) argues that hedging can lead to overinvestment, meaning investing in negative NPV projects, during economic or industry downturns.

2.3.4 Reduced Tax

Mayers and Smith (1982) argue that companies with more convex tax schedules (i.e., tax rate increases with income) practice hedging more actively. An investigation by Graham and Smith (1999) points out that about half of the 80 000 companies they studied had reasons to reduce their pre-tax income volatility, even for firms that were not 100 percent able to carry forward their losses. Stable cash flow over time would minimize the total taxes and hence, increase shareholder value.

Mian (1996) finds no relationship between hedging and progressive tax schedules. However, he argues that there is a relationship between the tax shield and hedging.

2.3.5 Managerial Utility and Undiversified Management

There can be more difficult for managers at the personal level to diversify away the unsystematic risk in the same way shareholders can. Managers often have a large part of their wealth, like work experience, reputation, and expertise in the company. This may cause conflicts referred to as the principal-agent relationship between managers and shareholders. Bodnar et al. (1996) argue that managers can have an incentive to take actions that benefit themselves more than the shareholders. Such events can be conglomerate mergers, sub-optimal debt-ratios, or excessive hedging that decrease the manager's risk of wealth. To reduce this non-maximizing behavior, shareholders can use monitoring, which would incur as agency costs. On the other side, there can be a dual benefit for hedging: Managers are incentivized with performance-related compensation. They are more likely to accept this if the exogenous risk factors are hedged. Further, hedging makes the firm's performance more dependent on the manager's actions, and it is easier for shareholders to assess the manager's ability.

2.4 Literature review

2.4.1 Does hedging reduce exposure?

One important aspect of hedging is to reduce the exposure of a company's cash flows to an underlying risk. Despite that, Previous research propose that hedging meet this objective is mixed. Hentschel and Kothari (2001) study both financial- and non-financial firms and discover that the increased interest rate risk related to financial firms is a result of large banks creating a market for derivatives. On the other hand, the paper shows little connection between hedging and corporate interest rate risk, currency risk, and total risk for non-financial firms. Nevertheless, they reveal that the weak interaction between hedging and risk is a consequence of derivative user decrease their risk to a level equivalent to non-derivative users.Schrand (1997) discovered that the use of interest rate derivatives does not affect their exposures to interest rates in a systematic way.

Moving over to commodity producers, Jin, and Jorion (2006) and Rajgopal (1999) concludes that oil and gas producers have significant exposure to oil and gas prices and that use of derivatives reduce their exposures. Tufano (1998) finds that exposure coefficients are a function of the gold price, gold price volatility, and corporate hedging activities in the gold mining industry. Furthermore, he explores time-varying exposure coefficients. Guay (1999) finds that a motivation to use derivatives is a decrease in exposure.

Berghofer and Lucey (2014) study financial and operational hedging impact on risk exposure for 64 global airlines in the period from 2002-2012. They find that financial hedging does not reduce exposure to fuel prices. One of the authors explanations is that the decreased volatility in jet fuel prices over the past few year's has perhaps made airlines less exposed to fuel prices and hence, financial hedging is less effective. Similarly for operational hedging, they find that fleet diversity is not related to risk exposure.

Treanor et al. (2014b), examines both financial and operational hedging in the U.S. airlines industry. They find that airlines use a combination of financial and operational hedging to reduce their exposure to jet fuel prices, but that operational hedging is more efficient, and that financial hedging is of less economic importance.

2.4.2 Does hedging affect firm value?

Chang et al. (2005) investigate the relationship between firm value, gas reserve- and oil production hedging for Canadian firms. They find that gas reserve hedging has a positive relationship with firm value. However, they discover a negative relationship between firm value and oil production hedging. Jin and Jorion (2006) study U.S. oil- and gas producers that hedge oil prices in the period from 1998-2001. They could not find any evidence that hedging increase firm value. Analyzing a large sample of U.S. non-financial firms in the period from 1990 to 1995, Allayannis and Weston (2001) determine that foreign currency hedging increase firm value with 5 %.

Adam and Fernando (2006) find that gold mining firms do not experience any increases in their cash flows from hedging activities. There is little explanation to what extent any exposure-coefficients affect firm hedging decisions, even though the changes in hedging strategies are well documented. Bartram et al. (2011) find that hedgers have positive value gains and lower levels of market risk and total risk compared to non-hedgers, investigating a large sample of domestic and international firms.

There are already some approved literature on hedging activities in the airline industry, particularly in the U.S.. Carter et al. (2006) found that jet fuel hedging is related to a premium of approximately 10 % for publicly traded U.S. airlines in the period from 1992-2003. They argue that the most likely reason to the hedging premium is the ability hedging gives to offset the underinvestment problem, caused by high fuel prices. They imply that the hedging premium can be related to the level of fuel prices, without studying this further.

Treanor et al. (2014a) study the connection between jet fuel exposures and the percentage of next year's fuel requirements hedged and how they affect the airline's firm value, investigating U.S. airlines in the period from 1994 to 2008. They find the same as Carter et al. (2006), however, with a lower hedging premium, indicating that the hedging premium has fallen in the year's from 2003 to 2008. Interestingly, they do also find that the hedging premium does not increase with the jet fuel exposure of airlines.

Lin and Chang (2009) investigate the global airline market in the period from 1995 to 2005. They find that fuel hedging is positively related to firm value. This positive relationship holds for different sub-samples and is significant for U.S. and non-alliance firms. Additionally, their results show that the behavior of executives and avoidance of financial distress are important determinants for the jet fuel hedging activities of non-U.S. and non-alliance airline companies.

3 Data

To obtain each airline's annual exposure to jet fuel prices we used weekly returns in U.S. Gulf Coast Kerosene-Type Jet Fuel and weekly stock returns for 12 U.S. and 17 European airlines in the period January 1, 2010 - December 31, 2017. Furthermore, we used two indices as proxies for the market portfolio. For the U.S. market, we applied the equally-weighted market index distributed by the CRSP[5]. For the European market, we used the MSCI Europe index, in U.S. dollars, retrieved from Thomson Reuters, Eikon. Since Jet Fuel price is denoted in dollars, we include the trade-weighted U.S. dollar index obtained from the Federal Reserve Bank of St. Louis economic research department, to control for currency exposure faced by European airlines.

To identify suitable airlines for our study, we used two different strategies for respectively U.S. and European airlines. For the U.S. sample, we used the Sector Industrial Classification (SIC) code 4512 to identify potential airlines. Further, the U.S. sample was adjusted to only identify the airlines with active operations during the period January 1, 2010, to December 31, 2017. Most of the data were extracted from the Compustat database, but some important information like the use of hedging strategies, derivatives, and fuel costs were hand-collected from each airline 10-k filings.

Identifying European airlines were not as straightforward as for the U.S. The European airline industry does not have a similar system like the U.S. to identify suitable airlines. Firstly, to find a list of airlines, we included IATA members based in Europe and achieved a list of 104 airlines sourced from the IATA database[6]. We then used this list to retrieve European airlines that were active during the period January 1, 2010, to December 31, 2017. Finally, we manually checked each airline with the European stock exchange to limit our sample only containing listed airlines. We used Thomson Reuters, Eikon and Compustat to retrieve firm-specific financial data and stock returns for the adjusted European list of 17 airlines. Like for the U.S., the remaining data we could not extract from Eikon or

[5]CRSP, The Center for Research in Security Prices, Chicago Booth
[6]IATA, The International Air Transport Association

Compustat was hand collected from each airline's annual reports. Table 1 shows an overview of the final sample of airlines used in the study.

Table 1. Overview of airline sample: European and U.S. airlines are denoted as EU and US respectively. Furthermore, we have divided the airlines into Low-Cost Carriers and Full-Service airlines. Including an overview of airlines that hedge some portion of fuel during the sample period.

Variable	**EU**	**US**	**Total**
Full-Service Carrier	9	7	16
Low-Cost Carrier	8	5	13
Total No. Of Airlines	17	12	29
Airlines that hedged fuel during the sample period	17	8	25

Table 1

4 Does hedging reduce airlines exposure to fuel prices?

As a first step to investigate the relationship between exposure, hedging, and firm value, we test the hypothesis whether hedging reduces the exposure to jet fuel prices. To do so, we run a two-stage fixed-effects regression model. In the first stage, we estimate each airline's annual exposure to jet fuel. This regression is based on Jorion (1990) risk exposure formula, with the percentage change in the stock price as the dependent variable. As independent variables, we include percentage change- in the value-weighted market index and jet fuel price. Also, we add the trade-weighted dollar index for the European airlines, as jet fuel prices are quoted in dollars. The annual exposure coefficients for each airline are estimated in Equation 1:

$$R_{i,t} = \alpha_i + \beta_{i,y} R_{m,t} + \gamma_{i,y} R_{JF,t} + \sigma_i R_{USD,t} * EU_i + \epsilon_{i,t} \quad (1)$$

Where,

$R_{i,t} =$ *weekly stock return for airline i*

$R_{m,t} =$ *return for the corresponding value weighted market index for week t*

$\beta_{i,y} =$*market risk factor airline i in year y*

$R_{JF,t} =$*weekly percentage change in jet fuel prices for week t*

$\gamma_{i,y} =$*coefficient representing exposure to jet fuel for airline i in year y*

$R_{USD,t} =$*change in trade-weighted US dollar index for week t*

$EU_i =$*dummy variable that gives value 1 if the airline is in EU and 0 if US*

In the second regression, we use the absolute value of exposure coefficients obtained from the first stage regression as the dependent variable, which is each airline's annual exposure to jet fuel prices. The independent variables used in the second stage regression are explained in the next section. These variables are PERHEDGE, which are the independent hedging variable. We also include a dummy variable FUELPASS. This variable is defined as another method of hedging. As control variables, we add LNTASS and LTDTA. Lastly, we include the variables LCC and EU for subgroup comparison. The variables are regressed for each airline for each year over the sample period using annual data[7]. Equation 2 determines how much of the variation in exposure, estimated in Equation 1, that can be explained by our chosen variables:

$$|\gamma_{i,y}| = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_{2-4}(ControlVariables)_{i,y} \tag{2}$$

Where,

$$\beta_{2-4}(ControlVariables_{i,y}) = \beta_2 FUELPASS_{i,y} + \beta_3 LTDTA_{i,y} + \beta_4 LNTASS_{i,y}$$

4.1 Variable selection

As dependent variable, we use the absolute value of each airline's annual exposure coefficient obtained from the first-stage regression ($|\gamma_{i,y}|$) where all positive exposure coefficients are set to zero. Based on prior research of jet fuel exposures (Treanor et. al 2014b; Berghofer and Lucey, 2014) and to measure exposure toward zero, we find it best to use the absolute value of exposures in the analysis.

We find the hedge ratio, PERHEDGE, in the annual report or 10-k filing as the percentage of next year's estimated fuel requirements hedged. This percentage can include all sorts of derivatives meant to hedge fuel price risk. The financial positions consist of a significant degree of swaps, forwards, futures and Call options, and the most used underlying commodities are jet fuel, crude- and heating oil. The PERHEDGE variable is used to account for variations in exposure due to differences in hedge ratios, where a ratio of 1 means that the airline is fully hedged for the next 12 months. A ratio of 0 means that the airline is fully exposed to changes in fuel prices next year. In previously studies (Carter et al. (2006) ; Treanor et al. (2014b)), they are also running a regression with hedging as a dummy variable. However, in our sample, all European and almost all U.S. airlines are hedging some parts of their jet fuel requirements. Therefore, we have chosen to

[7] Treanor et al. (2014b) and Berghofer and Lucy (2014) do a similar regression in their study, using quarterly data. However, quarterly data are not available for European airlines. For comparable reasons, we conduct annual data for both U.S. and European airlines.

not include such a variable in our study because of low explanatory power.

As an alternative hedging mechanism, we include a dummy variable if airlines have a pass-through fuel agreement (FUELPASS). Fuel pass-through agreement is defined as an agreement between the two carriers, where the regional airlines fly routes on behalf of the other carrier. The regional carrier receives fuel at a pre-specified price. This agreement serves as a substitute to hedging for the regional carrier, as any risk exposure is transferred to the mainland carrier.

We include firm size as a control variable, measured as the natural logartihm of total assets. Because of economies of scale, larger firms are more likely to have risk management programs and use financial derivatives (Haushalter, 2000). In addition, Haushalter (2000) finds that firms with high leverage and thereby more exposed to financial risk hedge more. However, Carter et al. (2006) conclude that firms facing financial distress tend to hedge less, as consistent with the debt overhang theory. Therefore, to control for the potential effect of leverage, we include the variable long term debt-to-assets (LTDTA). Lastly, for subgroup comparison, we include a dummy (EU) that takes value 1 if the airline is located in Europe otherwise 0 if located in the U.S. In the same manner, we include a dummy for strategy (LCC), taking value 1 if the airline is specified as a Low-Cost Carrier and 0 if specified as a Full-Service Airline[8]. Summary statistics of variables used in the regression are presented in section 5.2

4.2 Results

Table 2 shows the average, median and standard deviation of annual jet fuel exposure coefficients, estimated from Equation 1, compared to the average percent of next year's fuel requirements hedged for each airline in the sample period. In total, estimated from Equation 1, we have 11396 weekly observations, creating a sum of 209 annual jet fuel exposure coefficients, where 2 are removed because of insufficient data. The average exposure for the full sample of airlines is -0.16. This means that a 1 % increase in jet fuel price leads to a -0.16 % decline in

[8]Treanor et al. (2014b) do also include possible operational hedging variables in their study. However, as our paper focus on financial hedging, we do not incorporate such variables in our regressions.

average airline stock price. This is almost the same exposure as in Treanor et al. (2014) and Berghofer and Lucey (2014), which both observe an average exposure of -0.13 for U.S. airlines. Another important aspect of the exposure coefficients are the variations in exposure in the sample period, as displayed in Figure 3. We find that U.S. airlines have a higher exposure to fuel prices than European airlines on average, respectively -0.25 and -0.09. We know that European airlines hedge considerably more of their fuel requirements, meaning that this observation can indicate that hedging reduces exposure. The difference in exposure between Low-Cost Carriers and Full-Service Airlines are less remarkable. On average, Low-Cost Carriers have an exposure of - 0.10 compared to -0.19 for Full-Service airlines.

Table 2 : Estimated jet fuel exposure coefficients $\gamma_{i,y}$. We used weekly return in U.S. Gulf Coast Kerosene-Type jet and weekly stock return in order to obtain each airline's individual annual exposure to jet fuel prices. Exposure coefficient $\gamma_{i,y}$ is estimated using Equation (1): $R_{i,t} = \alpha_i + \beta_{i,y} R_{m,t} + \gamma_{i,y} R_{JF,t} + \delta_i R_{USD,t} \times EU_i + \varepsilon_{i,t}$ The table shows the airline sample with each airlines strategy, average percent of next years fuel requirements hedged and average, median and standard deviation of annual jet fuel exposure. The sample is adjusted for outliers, 3 observations were removed. Delta Airlines hedge ratio is dropped because of missing data.

				Exposure	
European Airlines	**Strategy**	**Hedge Ratio**	**Mean**	**Median**	**Std.**
Aegean Airlines	FSC	38 %	-0,13	-0,17	0,21
Aeroflot Russian Airlines	FSC	24 %	0,12	0,16	0,27
Airfrance-KLM	FSC	59 %	-0,18	-0,25	0,31
Finnair	FSC	65 %	-0,05	-0,02	0,30
IAG	FSC	53 %	-0,22	-0,25	0,27
Icelandair	FSC	53 %	-0,11	-0,03	0,09
Lufhansa Group	FSC	74 %	-0,15	-0,17	0,24
SAS	FSC	51 %	-0,09	-0,08	0,43
Turkish Airlines	FSC	46 %	-0,16	-0,24	0,28
Air Berlin	LCC	46 %	-0,13	0,13	0,56
Dart Group	LCC	98 %	-0,08	-0,07	0,28
easyJet	LCC	77 %	-0,15	-0,19	0,27
Flybe	LCC	77 %	-0,08	-0,04	0,10
Norwegian Air Shuttle	LCC	24 %	-0,10	-0,16	0,38
Pegasus Airlines	LCC	47 %	-0,02	0,01	0,30
Ryanair	LCC	91 %	-0,12	-0,13	0,21
Wizz Air	LCC	71 %	-0,09	-0,16	0,07
American Airlines	**Strategy**	**Hedge Ratio**	**Mean**	**Median**	**Std.**
Alaska Airlines	FSC	45 %	-0,21	-0,18	0,18
American Airline	FSC	11 %	-0,09	-0,02	0,11
Delta Airlines	FSC	-	-0,27	-0,35	0,26
Hawaiian Holdings	FSC	40 %	-0,27	-0,34	0,34
SkyWest	FSC	0 %	0,00	-0,10	0,45
United Continental	FSC	19 %	-0,28	-0,49	0,39
US Airways	FSC	0 %	-1,08	-0,27	0,61
Allegiant Travel	LCC	0 %	-0,23	-0,25	0,28
Jetblue Airways	LCC	13 %	-0,24	-0,35	0,39
Southwest	LCC	40 %	-0,14	-0,13	0,21
Spirit Airlines	LCC	11 %	-0,06	-0,03	0,26
Virgin America	LCC	31 %	-0,13	-0,13	0,06
Total		43 %	-0,16	-0,15	0,28

Table 2

The regression results presented in Table 3 shows the relationship between exposure to jet fuel prices and the effectiveness of hedging. The coefficients are estimated using a fixed-effects model and pooled OLS where robust standard errors are used to adjust for heteroskedasticity[9]. The absolute value of each airline's

[9]The fixed-effects model only counts for within-variation for each airline. This leads to problems for the FUELPASS variable because of no within-variation. This means that the variable is either 1 or 0 for each airline in the whole sample period, meaning there is no variation to measure. Therefore, we have included a pooled OLS regression both for estimating the FUELPASS coefficient and to check the robustness of our results over different modeling types.

jet fuel exposure coefficient is regressed against our selected variables. The results from the full model are presented in Model 1 and 2. Model 3 and 4 shows if any differences in strategy or geographical location are superior in reducing jet fuel exposure by the use of hedging.

The results in Table 3 find some statistically significant relationship between hedging and jet fuel exposure. Model 1 shows a negative coefficient on PERHEDGE which is statistically significant at the 10 %-level. Model 2 shows a negative coefficient, but this is not significant. The results from previous research are mixed. Treanor et al. (2014b) find the coefficient for the hedge ratio to be negative and statistically significant at the 1% level. However, Berghofer and Lucey (2014) find no relationship between financial hedging and exposure. Model 3 and 4, show no significantly differences between the subsamples. However, from the signs of the coefficients, the effect observed in Model 1 seems to be driven by Low-Cost Carriers and European airlines.

We find one possible explanation to why there are such mixed results in studies investigating the relationship between hedging and exposure. It can be that, even if the airlines hedge, this is only for short term cash-flows while the stock price reflects long-term cash flows. Essentially the airlines cannot escape the long-term effects of changes in fuel prices unless they hedge not only their cash-flows but also the PV of future cash flows. This means that airlines have difficulties in reduce all exposure, because hedging contracts are only short term.

Moving over to our control variables, we cannot find any explanatory power for either LNTASS or LTDTA. This is in line with the findings of Treanor et al. (2014b), who finds no relationship between firm size or leverage and exposure. Overall, our regression model shows low explanatory power, meaning that we have important omitted variables. Most previous research in this field includes operative hedging strategies as well as operative control variables. Their findings are that these hedging strategies more important than the use of financial hedging in reducing exposure (Treanor et al., 2014b; Berghofer and Lucey, 2014). Anyway, our study contributes to the field, signaling that the use of financial hedging can have an impact in reducing fuel exposure.

Table 3: The effectivness of financial heding in reducing exposure: The table presents the relationship between exposure and hedging. Coefficients are astimated using fixed effects with robust standard errors using Equation (2): $|\gamma_{i,y}| = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_{2-4}(ControlVariables)_{i,y}$ Model 3 and 4 are used to measure differences in subgroups. OLS with robust standard errors is included for comparable reasons (Model 1).

	Model 1 OLS robust	**Model 2** Fixed effect robust	**Model 3** Fixed effect robust	**Model 4** Fixed effect robust
PERHEDGE	-0.17*	-0.04	0.08	0.21
	(0.09)	(0.16)	(0.26)	(0.51)
PERHEDGE*LCC			-0.28	
			(0.28)	
PERHEDGE*EU				-0.36
				(0.49)
FUELPASS	-0.10			
	(0.07)			
LNTASS	0.03	-0.12	-0.13	-0.11
	(0.02)	(0.09)	(0.09)	(0.09)
LTDTA	0.05	-0.05	-0.04	-0.05
	(0.06)	(0.13)	(0.13)	(0.13)
Constant	0.06			
	(0.14)			
Prob>F	0.00	0.18	0.22	0.18
Observations	190	190	190	190
Number of groups	28	28	28	28
R -squared	0.08	0.03	0.04	0.04

Standard errors in parentheses
***p<0.01, **p<0-05, *p<0.10

Table 3

5 Does hedging increase firm value?

To investigate the relationship between firm value (LNQ) and jet fuel hedging (PERHEDGE), we run fixed-effects- and time-series feasible generalized least square models, both counting for heteroskedastic standard errors. The regression is motivated by the variables used in Allayannis and Weston (2001) and Carter et al. (2006). We include the explanatory variables firm size (LNTASS), dividend indicator (DIVIDEND), long term debt-to-assets (LTDTA), cash flow-to-sales (CASHFLOW), Cash and short term investments-to-sales (CASH), capital expenditures-to-sales (CAPTSAL) and Altman's Z score (ZSCORE). Also, we include dummy variables as a proxy for other risk management techniques, such as interest rate derivatives (INTERESTHEDGE), foreign currency derivatives (FXHEDGE) and pass-through agreements (FUELPASS). Lastly, we include indicator variables for geographical location (EU) and strategy (LCC). This gives us the following Equation 3:

$$ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_{2-11}(ControlVariables)_{i,y} \quad (3)$$

Where,

$$\beta_{2-11}(ControlVariables)_{i,y} = \beta_2 LNTASS_{i,y} + \beta_3 DIVIDEND_{i,y} + \beta_4 LTDTA_{i,y}$$
$$+ \beta_5 CASHFLOW_{i,y} + \beta_6 CASH_{i,y} + \beta_7 CAPTSAL_{i,y} + \beta_8 ZSCORE_{i,y}$$
$$+ \beta_9 INTERESTHEDGE_{i,y} + \beta_{10} FXHEDGE_{i,y} + \beta_{11} FUELPASS_{i,y}$$

5.1 Variable selection

As a proxy for firm value, we use the natural logarithm of a simplified version of Tobin's Q (LNQ). Tobin's Q is defined as the ratio of the market value of financial claims on the firm to the replacement cost of the firm's assets. The original Q was developed by James Tobin (Tobin J, 1969). The initial Q is hard to obtain because of data limitations and complex computations. Therefore, we use the simplified approximation, developed by Chung and Prutt (1994). Chung and Prutt's (1994) study show a high correlation between the simplified- and the original Q.

Simplified Tobin's Q:

$$Q = \frac{\begin{array}{c} Market\ Value\ of\ Equity + Liquidation\ Value\ of\ Preffered\ Stock \\ + The\ Book\ Value\ of\ Long\ Term\ Debt\ and\ Current\ Liabilities \\ - Current\ Assets + The\ Book\ Value\ of\ Inventory \end{array}}{Book\ Value\ of\ Total\ Assets}$$

The simplified Q is easy to calculate, and the data are obtainable from Compustat, 10-k filings, and annual reports. The next section of variables is control variables that may also affect the value of a firm. To control for size, we use the natural logarithm of total assets (LNTASS). Firm size is closely related to firm value, and we would expect to find a positive relationship between them. We use a dividend dummy (DIVIDEND) to proxy for the ability to access financial markets. If the firm pays a dividend, it is less likely to be capital constrained, but may also lack growth opportunities. In that case, we would expect that dividend payout is negatively related to Q. The debt ratio (LTDTA) is used as a standard measure for financial constraints. However, leverage can both have positive and negative effects on firm value. Leverage can provide a tax shield that would increase firm value. On the other hand, leverage increases the probability of bankruptcy and the costs of financial distress.

The variables CASH and CASHFLOW, standing for respectively cash- and short term investments-to-sales, and cash flow-to-sales might be proxies for financial constraints. In the case where firms view external financing more expensive than internal financing, cash holdings can work as an essential form of slack (Myers and Majluf, 1984). Cash holdings do also work as a liquidity measure. Airlines that generate a higher cash flow should have less binding financial constraints. Therefore, we expect both variables to be positively related to firm value. The probability of bankruptcy provides an essential financial constraint. As a measure for bankruptcy probability, we utilize Altman's Z score (ZSCORE), where a higher score means a lower probability for bankruptcy, indicating a positive relationship with Q:

$$Altman's\ Z\ score = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5$$

Where,

$$X_1 = \frac{Working\ Capital}{Total\ Assets}$$
$$X_2 = \frac{Retained\ Earnings}{Total\ Assets}$$
$$X_3 = \frac{Earnings\ before\ Interest\ and\ Tax}{Total\ Assets}$$
$$X_4 = \frac{Market\ Value\ of\ Equity}{Total\ Liabilities}$$
$$X_5 = \frac{Sales}{Total\ Assets}$$

The variable capital expenditures-to-sales ratio (CAPTSAL) are used to proxy the number of investment opportunities. Firms with more investment opportunities are more likely to have a higher market value.

The airline industry is exposed to other market risks than commodity price risk. The two most common financial risks besides jet fuel prices are interest rates and foreign currency. To find the potential effect of these risk management techniques, we use dummy variables, indicating if the airline uses interest- (INTERESTHEDGE) or foreign exchange (FXHEDGE) derivatives to hedge such risks. Previous research concludes that foreign currency hedging are valued by investors (Allayannis and Weston, 2001). Hence, we would expect to find a positive relationship between foreign currency hedging and firm value.

We include dummy variables for sub-sample comparisons. For geographical location (EU), we give value 1 if it is a European airline and 0 if it is a U.S. airline. Similarly, we use a dummy variable for strategy (LCC), where a value of 1 means that the airline operates as a Low-Cost Carrier, and 0 means the airline operates as a Full-Service airline.

As in Treanor et al. (2014a), we do not include managerial motive variables such as option or stock holdings into this paper. We do not view this exclusion as important to our study, given that these motives are typically not viewed as value-maximizing motives for hedging.

5.2 Descriptive Statistics

Before we move on to the results, we present the descriptive statistics for the variables used in our regression models. The results are shown in Table 4. Appendix 2 and 3 present descriptive statistics for subsamples.

On average, airlines hedge 44 % of next year's fuel requirements. This number is much higher compared to Treanor et al. (2014a), which reports an average hedging ratio of 14 %. This is mostly explained by the high level of hedging in Europe, which increase the average hedging ratio. The average long term debt-to-assets ratio for the full sample is 0.59. Interestingly, we find substantial differences between the U.S. and Europe. For the U.S., the long term debt-to-assets ratio is 1.07, compared to 0.28 for European airlines. There can be some explanations for this. Firstly, U.S. airlines tend to finance new investments, particularly by debt, while in Europe, airlines often use other types of financing. Secondly, U.S. airlines use aircraft leasing less than European airlines, meaning they do not have to finance large investments in aircrafts in the same degree as U.S. airlines (Dozic and Krnic, 2016). Another important aspect is the differences in firm size between Low-Cost Carriers and Full-service airlines. The natural logarithm of total assets is substantially lower for Low-Cost Carriers. This can be explained, as interpreted in Section 2, Full-Service airlines have been through a period of extensive and frequent mergers. Also, Low-Cost Carriers are younger firms and therefore tend to be smaller in size.

Table 4: Descriptive statistics for full sample
The table shows summary statistics for the full sample of airlines. Data are collected from the airlines' 10-k filings and annual reports, Compustat, CRSP and Thomsons Reuters, Eikon.

	Full Sample				
Variable	**Mean**	**Median**	**Min**	**Max**	***Std Dev***
LNQ	0,30	0,28	-3,47	2,45	*0,78*
PERHEDGE	0,44	0,50	0,00	1,00	0,30
LNTASS	8,62	8,57	6,22	10,90	*1,35*
DIVIDEND	0,47	0,00	0,00	1,00	*0,50*
LTDTA	0,59	0,39	0,00	2,46	*0,54*
CASHFLOW	0,08	0,08	-0,54	0,24	*0,08*
CASH	0,15	0,11	0,01	0,87	*0,13*
CAPTSAL	0,11	0,09	0,00	0,39	*0,08*
ZSCORE	1,91	1,66	-1,26	8,12	*1,15*
INTERESTHEL	0,65	1,00	0,00	1,00	*0,48*
FXHEDGE	0,68	1,00	0,00	1,00	*0,47*
FUELPASS	0,11	0,00	0,00	1,00	*0,31*

Table 4

5.3 Results

Table 5 reports the relationship between jet fuel hedging and firm value. As Carter et al. (2006), the coefficients are estimated using time-series feasible least squares model (FGLS). Fixed-effects regression is included (Model 1) to see the robustness of our results over different estimation methods. Model 3 and 4 reports differences in subsample groups for the relationship between fuel hedging and firm value.

Our regressions show evidence for a positive relationship between hedging and firm value. In the fixed-effects model, the coefficient is positive and statistically significant at the 5 %-level. In the most comparable model (Model 2) to Carter et al. (2006) and Treanor et al. (2014a), our hedging coefficient is positive, but not statistically significant. The coefficient of 0.19 can translate into a hedging premium of 8.3 % (0.19 times the average hedging percent, 44%). This is in line with Carter et al. (2006) and Treanor et al. (2014a) who reports a hedging premium of respectively 5.2 % and 10.2 %. Interestingly, in Model 3, we observe differences between Full-Service airlines and Low-Cost Carriers. The model shows a statistically significant difference between the strategies. For Full-Service airlines, the coefficient is positive and statistically significant, and translate into a hedging premium of 22 % (0.55*0.40). However, for Low-Cost Carriers, the coefficient is negative -0.19 (0.55+(-0.74)), translating into a negative hedging premium of -9.3 % (-0.19*0.49).

There can be some explanations to why hedging is associated with lower value for Low-Cost Carriers. Firstly, our sample period is characterized by the unexpected plunge in oil prices. This event alone has an impact on the hedging premium. For Low-Cost Carriers, these losses do more impact, both because fuel costs constitute a larger part of total operating expense and the fact that they hedge more. Anyway, if this theory should hold, we would expect to see greater benefits of hedging for Low-Cost Carriers in periods of high and rising fuel prices. The period prior to the plunge in fuel prices is characterized by high and rising prices. As an extra test we run a regression for the year's prior to the fall in prices (2010-2013). Our results show that hedging is not associated with higher firm value for Low-Cost Carriers. However, the coefficient for Low-Cost Carriers is still negative (-0.02) and not significant compared to Full-Service airlines, meaning that this theory does not hold.

Another theory is that hedging increases firm value, but at a decreasing rate. Comparing Europe and the U.S., we can observe the same sign on the coefficients as for the strategy subsample, even if these are not significant. We know that European airlines hedge more than U.S. so this can be another indication that hedging increases firm value at a decreasing rate. To test for this, we include next year's fuel requirements hedged squared into the Equation (3). The regression results are reported in Appendix 4. The regression shows a positive and statistically significant coefficient for PERHEDGE and a negative and statistically significant coefficient on PERHEDGE squared. This signals that hedging increases firm value, but at a decreasing rate.

In figure 5, we have plotted hedge ratio against firm value. We have included a linear and polynomial trendline. The figure sums up the results from the regression, showing a non-linear relationship between hedging and firm value. We have also included a linear trendline for comparison.

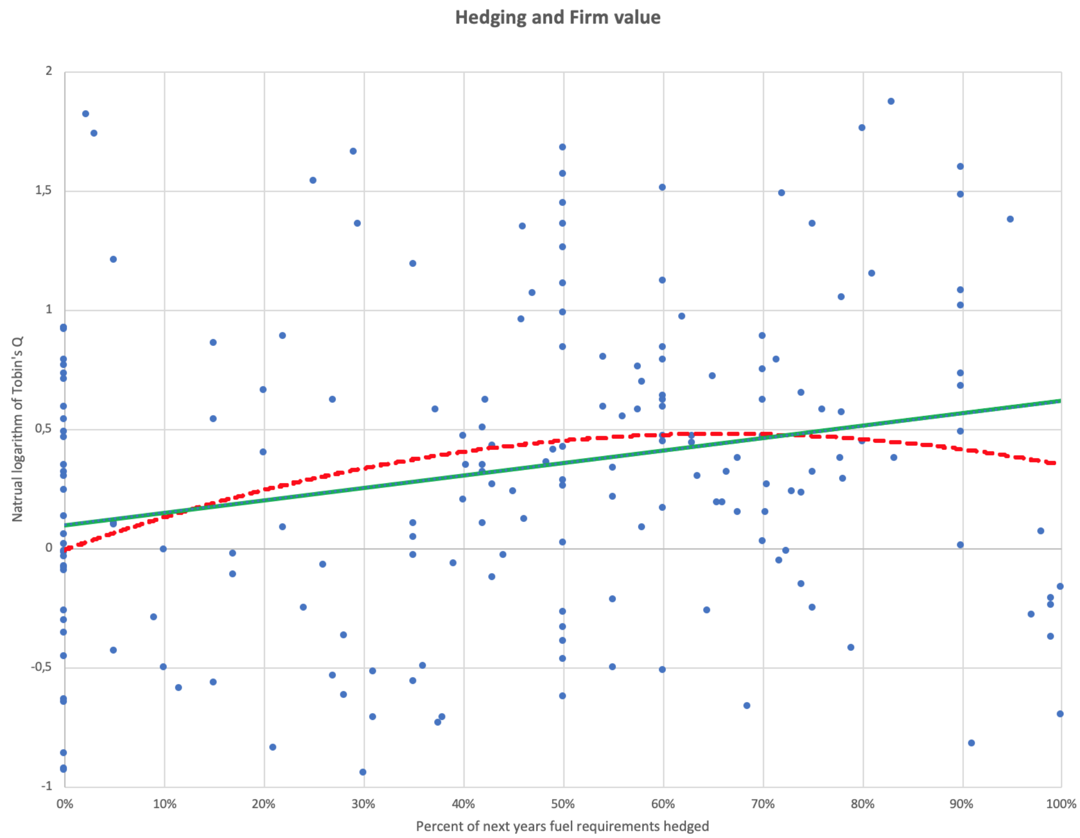

Figure 5: Scatter plot of the relationship between percent of next year's fuel requirements hedged and the natural logarithm of Tobin's Q. Including a linear and polynomial trendline.

Moving over to alternative hedging methods, we observe a positive and statistically significant coefficient for the use of foreign exchange derivatives. This is consistent with Allayannis and Weston (2001) findings, which reports that currency hedging is positively related to firm value. Further, we observe a negative relationship between the use of Pass-through agreements and firm value. This is also an indication that jet fuel hedging increase firm value at a decreasing rate. Airlines with pass-through agreements buy jet fuel at a pre-specified price, meaning that they are comparable to airlines that hedge 100 % of their fuel requirements.

Further, we can not find any statistical relationship between the use of interest rate derivatives and firm value. An explanation can be that even if airlines say they are not using derivatives to hedge interest rate risk, some airlines reports they have a combination of fixed and floating rate loans, working as a hedge for changes in interest rates. Therefore, there is little difference between those airlines that uses derivatives and those that use a "natural" hedge.

Proceeding to the next variables, we cannot find any statistically significant relationship between dividend payout and firm value. However, the coefficient is negative for all models, indicating that the lack of growth opportunities is more important than the signal of few capital constraints. We find some evidence that long term debt-to-assets ratio is positively related to firm value. The same results are found in Treanor et al. (2014a), suggesting that the benefits of tax shield are more important than the costs of financial distress in the airline industry. Surprisingly, we are observing a negative relationship between Cash-to-Sales and Cash Flow-to-Sales, and firm value. An explanation can be that airlines with lower firm value are less efficient with their excess cash. Airlines with high value either find good investment opportunities or pay out excess cash as dividends. In the same way, can the negative coefficient on cash flow-to-sales be explained by higher capital expenditures, meaning that airlines with higher firm value are investing more. This statement is supported by the observed positive and statistically significant coefficient on capital expenditures-to-sales, which also confirms the theory that airlines with more investment opportunities are valued higher.

Consistent with expectations and Carter et al. (2006) is Z score positively related to firm value, meaning that firms with lower probability of bankruptcy are valued higher. In the next two sections, we investigate the value of hedging under certain conditions.

Table 5: The relationship between jet fuel hedging and firm value.
The table presents the relationship between exposure to jet fuel and financial hedging with the difference between subsample groups. Coefficients are estimated using time-series feasible generalized least square with heteroscedastic consistent standard errors, using Equation (3): $ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_{2-11}(ControlVariables)_{i,y}$. We added Fixed effect regression with robust standard errors for comparable reasons (Model 1).

	Model 1 *Fixed effect, robust*	Model 2 *FGLS*	Model 3 *FGLS*	Model 4 *FGLS*
PERHEDGE	0.50**	0.19	0.55*	0.24
	(0.22)	(0.22)	(0.33)	(0.37)
PERHEDGE*LCC	-		-0.74**	
			(0.37)	
PERHEDGE*EU				-0.36
				(0.43)
LNTASS	0.39***	0.13*	0.14**	0.14**
	(0.10)	(0.07)	(0.07)	(0.06)
DIVIDEND	-0.04	-0.08	-0.06	-0.12
	(0.08)	(0.09)	(0.09)	(0.08)
LTDTA	0.31***	0.10	0.15	0.20
	(0.10)	(0.16)	(0.36)	(0.15)
CASHFLOW	-1.46	-1.53**	-1.34**	-1.49**
	(0.95)	(0.63)	(0.64)	(0.62)
CASH	-1.91***	-0.95**	-0.99**	-1.12***
	(0.58)	(0.41)	(0.42)	(0.39)
CAPTSAL	0.60	1.86***	1.71***	2.11***
	(0.63)	(0.59)	(0.60)	(0.58)
ZSCORE	0.43***	0.44***	0.43***	0.47***
	(0.07)	(0.06)	(0.06)	(0.06)
INTERESTHEDGE	-0.22*	-0.20	-0.23*	-0.25*
	0.13	(0.13)	(0.13)	(0.13)
FXHEDGE	0.13*	0.29*	0.41**	0.04
	(0.07)	(0.17)	(0.17)	(0.18)
FUELPASS		-0.45**	-0.49**	-0.32
		(0.22)	(0.22)	(0.20)
LCC			0.59**	
			(0.24)	
EU				1.26***
				(0.29)
Constant		-1.68***	-2.11***	-2.40***
		(0.63)	(0.64)	(0.56)
Prob>F	0.00			
Obs/firm years	199	199	199	199
Number of groups	28	28	28	28
R -squared	0.44			
Log likelihood		-123.80	-120.50	-114.58

Standard errors in parentheses
***p<0.01, **p<0-05, *p<0.10

Table 5

6 Do investors value hedging more in periods of high exposure?

In the following analysis, we investigate whether investors value hedging more in periods of high exposure. To capture the joint effect of hedging and exposure on firm value, we add the interaction term $PERHEDGE_{i,y} * EXPOSURE_{i,y}$, to the original Equation 3. Here, PERHEDGE is next year's fuel requirements hedged, and EXPOSURE is the annual jet fuel price exposure. This gives us the following Equation (4):

$$ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_2 PERHEDGE_{i,y} * EXPOSURE_{i,y} + \beta_{3-12}(ControlVariables)_{i,y} \quad (4)$$

If investors value hedging more when exposure is higher, we would expect to find a negative and statistically significant coefficient on this variable, as the average exposure is below 0. Remember that a more negative exposure coefficient signals a higher exposure. In this framework, the hedging premium is reflected by $\beta_1 + \beta_2 * EXPOSURE_{i,y}$.

6.1 Results

Table 6 represents the results of Equation 3. In Model 1, the regression is ran using fixed-effects with robust standard errors. Model 2 shows the results, estimated by FGLS. Both models show that the coefficient on the interaction between hedging and exposure is insignificant. This is a sign that investors do not value more hedging in response to higher exposure. This is consistent with Treanor et al. (2014a), who reports the same results. An explanation can be that, on average, exposure to fuel prices is highest in the year's fuel prices are high. This means that increased hedging when fuel price is high, does not add value because of the probability that fuel prices would drop. This signifies that airlines face a tradeoff between hedging their future cash flows and their market view. If their market view shows that a significant drop in fuel prices is likely, knowing their exact future cash flows would be less important.

Table 6: The table reports coefficients estimates from regressions of firm value and the product of next years fuel requirements hedged and exposure using Equation (4):

$$ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_2 PERHEDGE_{i,y} * EXPOSURE_{i,y} + \beta_{3-12}(ControlVariables)_{i,y}$$

Model 2 are estimated using FGLS. Fixed-effects with robust standard errors is included for comparable reasons.

	Model 1 Fixed effect, robust	**Model 2** FGLS
PERHEDGE	0.48**	0.25
	(0.23)	(0.16)
PERHEDGE*EXPOSURE	0.00	-0.04
	(0.24)	(0.23)
LNTASS	0.43***	0.18***
	(0.08)	(0.06)
DIVIDEND	-0.03	-0.11*
	(0.08)	(0.06)
LTDTA	0.28**	0.20*
	(0.12)	(0.12)
CASHFLOW	-1.48	-0.30
	(1.08)	(0.48)
CASH	-1.47***	-0.32
	(0.33)	(0.30)
CAPTSAL	0.22	1.41***
	(0.60)	(0.44)
ZSCORE	0.42***	0.38***
	(0.07)	(0.04)
INTERESTHEDGE	-0.24*	-0.30***
	(0.14)	(0.10)
FXHEDGE	0.12*	0.07
	(0.07)	(0.13)
FUELPASS		-0.37**
		(0.16)
Exposure	0.12	0.17
	(0.13)	(0.11)
Constant		-2.84***
		(0.65)
Prob>F	0.00	
Obs/firm years	190	190
Number of groups	28	28
R-squared	0.58	
Log likelihood		-57.66
Standard errors in parentheses		
***p<0.01, **p<0-05, *p<0.10		

Table 6

7 Does an active hedging strategy increase firm value?

Airlines use fuel hedging different. While many airlines hedge the same amount of jet fuel every year, some airlines are more active in their hedging strategy, varying their hedging level over time. To investigate this, we include the standard deviation of next year's fuel requirements hedged to Equation 3. More precise, it is the standard deviation of next year's fuel requirements hedged over the sample period for each airline. This gives us the following Equation (5):

$$\begin{aligned} ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_2 STDPERHEDGE_i \\ + \beta_{3-12}(ControlVariables)_{i,y} \end{aligned} \tag{5}$$

If an active hedging strategy is increasing firm value, we would expect to observe a positive and statistically significant coefficient on the standard deviation of next year's fuel requirements hedged. This signals that airlines with changes in hedging levels (active hedgers) are valued higher than airlines with little changes in hedging level (passive hedgers) over time.

7.1 Results

The results are presented in Table 7. For comparison pooled OLS with robust standard errors are used[10] (Model 1). Model 2 is estimated using FGLS.

The regression shows little evidence that an active hedging strategy is valued higher compared to a passive hedging strategy. The coefficient on standard deviation of next yea'rs percentage hedged is positive, but not significant. This signals that having an active hedging strategy is not beneficial compared to a passive hedging strategy. The results are consistent with Treanor et al. (2014a), who suggest that varying hedging do more harm than good.

[10] Because of no within-variation in the STDPERHEDGE variable, we could not use fixed-effect estimation as comparing model.

Table 7: The table reports coefficients estimates from regressions of firm value and the standard deviation of next years fuel requirements hedged using Equation 5:

$$ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_2 STDPERHEDGE_{i,y} + \beta_{3-12}(ControlVariables)_{i,y}$$

Model 1 is estimated using pooled OLS with robust standard errors. Model 2 is estimated using FGLS.

	Model 1 Pooled OLS, robust	**Model 2** FGLS
PERHEDGE	-0.30	0.19
	(0.38)	(0.23)
STDPERHEDGE	0.33	0.08
	(0.89)	(0.77)
LNTASS	0.14	0.13*
	(0.10)	(0.07)
DIVIDEND	-0.12	-0.08
	(0.15)	(0.09)
LTDTA	-0.19	0.10
	(0.24)	(0.16)
CASHFLOW	-2.03*	-1.52**
	(1.19)	(0.64)
CASH	-1.64**	-0.94**
	(0.69)	(0.41)
CAPTSAL	3.77***	1.87***
	(1.44)	(0.60)
ZSCORE	0.45***	0.44***
	(0.09)	(0.06)
INTERESTHEDGE	0.04	-0.20
	(0.89)	(0.13)
FXHEDGE	0.86***	0.30*
	(0.23)	(0.17)
FUELPASS	-0.42**	-0.45**
	(0.19)	(0.22)
Constant	-2.06***	-1.69***
	(0.79)	(0.64)
Prob>F	0.00	
Obs/firm years	199	199
Number of groups	28	28
R -squared	0.43	
Log likelihood		-123.80

Standard errors in parentheses
***p<0.01, **p<0-05, *p<0.10

Table 7

8 Does the underinvestment problem play an important role in explaining airlines hedging behavior?

8.1 Initial analysis

To secure that future capital expenditures are less affected by high fuel prices, airlines tend to undertake hedging activities. Fuel hedging can ensure airlines to have sufficient funds to take on investment opportunities in the future, thus can current capital expenditures be a result of earlier hedging. As a result, would investors value capital expenditures made today by hedgers higher than non-hedgers, because they are a better proxy for future capital expenditures[11]. As an initial test, we run the original Equation (3), including the interaction term between hedging and capital expenditures ($PERHEDGE_{i,y} * CAPTSAL_{i,y}$).

$$\begin{aligned} ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_2 PERHEDGE_{i,y} * CAPTSAL_{i,y} \\ + \beta_{3-12}(ControlVariables)_{i,y} \end{aligned} \tag{6}$$

The interpretation is that for airlines that hedge more of their expected fuel requirements, more significant capital expenditures are related to higher firm value. Thus, we would expect to observe a positive coefficient for the interaction term.

8.1.1 Results

Table 8 represents the results of Equation 6. In Model 1, the regression is ran using fixed-effects with robust standard errors. Model 2 shows the results, estimated by FGLS. The coefficient on the interaction between capital expenditures is negative and not statistically significant in both models. The results signal that greater capital spending for airlines that hedge, is not associated with higher firm value. However, the analysis above cannot be classified as a direct test that jet fuel

[11] Consequently, should hedgers be better able to acquire other firms. Carter et al. (2006) investigate this hypothesis and finds that airlines that hedge acquires more firms than non-hedgers.

hedging reduces the underinvestment problem. In the next section, we take this analysis a step further, using a two-stage process.

Table 8: The table reports coefficients estimates from regressions of firm value and the product of next years fuel requirements hedged and capital expenditures-to-sales using Equation (6): $ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_2 PERHEDGE_{i,y} * CAPTSAL_{i,y} + \beta_{3-12}(ControlVariables)_{i,y}$

Model 1 is estmated using fixed-effects with robust standard errors. FGLS are used to

	Model 1 Fixed effect, robust	Model 2 FGLS
PERHEDGE	0.59**	0.30
	(0.25)	(0.29)
PERHEDGE*CAPTSAL	-1.06	-0.95
	(1.35)	(1.61)
LNTASS	0.40***	0.13*
	(0.11)	(0.07)
DIVIDEND	-0.04	-0.09*
	(0.08)	(0.09)
LTDTA	0.28***	0.08*
	(0.08)	(0.16)
CASHFLOW	-1.52	1.58**
	(0.92)	(0.63)
CASH	-1.87***	-0.89
	(0.60)	(0.42)
CAPTSAL	1.06*	2.25**
	(0.57)	(0.88)
ZSCORE	0.44***	0.44***
	(0.06)	(0.06)
INTERESTHEDGE	-0.22	-0.22
	(0.14)	(0.14)
FXHEDGE	0.13*	0.30*
	(0.07)	(0.17)
FUELPASS		-0.44**
		(0.22)
Constant		-1.79***
		(0.66)
Prob>F	0.00	
Obs/firm years	199	199
Number of groups	28	28
R -squared	0.45	
Log likelihood		-123.62
Standard errors in parentheses		
***p<0.01, **p<0-05, *p<0.10		

Table 8

8.2 Analysis

As a second step to discover if the underinvestment problem plays a vital role in explaining airlines hedging behavior, we estimate a two-stage regression. The two-stage regression is motivated by the theoretical framework in the first section:

1. The hedging amount is decided at time 0.
2. The outcome of investment decisions (capital expenditures) are noticed between time 0 and 1.
3. Firm value and the firm's next hedging decision are observed at time 1.

.

This gives basis for the following empirical framework:

1. $Capital\ expenditures_t = f(hedging_{t-1}, control\ variables)$
2. $Firm\ value_t = f(predicted\ capital\ expenditures_t, hedging_t, control\ variables)$

.

To model this framework we run the following regressions, where *pred*(CAPTSAL) are predicted capital expenditures from the first regression and control variables are the same as those used in Equation 3:

$$CAPTSAL_{i,y} = \alpha_0 + \beta_1 CASHFLOW_{i,y} + \beta_2 lag(PERHEDGE)_{i,y} + \beta_3 lag(LNQ)_{i,y} \quad (7)$$

$$ln(Q)_{i,y} = \alpha_0 + \beta_1 pred(CAPTSAL_{i,y}) + \beta_2 PERHEDGE_{i,y} + \beta_{3-12}(ControlVariables)_{i,y} \quad (8)$$

If hedging is important in deciding future capital expenditures, we would expect to find a positive relationship between the lagged hedging variable and capital expenditures. Similarly, in the second stage estimation, we expect to see a positive relationship between predicted capital expenditures and firm value. Both of these are indicators that the underinvestment problem is important in airlines hedging decision.

8.2.1 Results

Table 9 reports the results from Equation 7 and 8 using a two-stage process. We cannot find any evidence that the lagged hedging variable is related to capital expenditures. Once more, we cannot find any evidence that the underinvestment problem is important in airlines hedging decision. However, in the second stage, we observe a positive and statistically significant coefficient on predicted capital expenditures-to-sales. This means that higher predicted capital expenditures increase firm value, but we cannot conclude that this effect comes from hedging. Instead, we observe a positive and statistically significant coefficient for the control variables cash flow and lagged firm value in the first stage. This shows that having a substantial cash flow and historical high firm value is more important than hedging decisions in predicting capital expenditures.

Previous literature on the field has come to mixed conclusions. Carter et al. (2006) find that the underinvestment problem is essential in describing U.S. airlines hedging decision. However, Lin and Chang (2009) find no evidence that the underinvestment problem is important for global airlines hedging decision. To sum up, we conclude that the underinvestment problem appear to not important in explaining airlines hedging behavior, however, predicted capital expenditures are valued by investors.

Table 9: The table shows results of regressions calculated with a two-stage process. In the first stage we regress capital expenditures-to-sales on cash flow-to-sales, lagged LNQ andf the lagged percentage of next years fuel requirements hedged using Equation (7):

$$CAPTSAL_{i,y} = \alpha_0 + \beta_1 CASHFLOW_{i,y} + \beta_1 lag(PERHEDGE)_{i,y} + \beta_3 lag(LNQ)_{i,y}$$

In the second stage, we regress LNQ on the predicted value capital expenditures-to-sales in the first stage using Equation (8): $ln(Q)_{i,y} = \alpha_0 + \beta_1 pred(CAPTSAL_{i,y}) + \beta_2 PERHEDGE_{i,y} + \beta_{3-12}(Controlvariables)_{i,y}$

	First Stage CAPTSAL	Second Stage LNQ
PERHEDGE		-0.12
		(0.25)
LNTASS		0.07
		(0.05)
DIVIDEND		0.06
		(0.11)
LTDTA		0.05
		(0.15)
CASHFLOW	0.27***	-2.12**
	(0.07)	(0.89)
CASH		-1.41***
		(0.45)
predicted CAPTSAL		7.20***
		(2.01)
ZSCORE		0.37***
		(0.07)
INTERESTHEDGE		0.07
		(0.12)
FXHEDGE		0.98***
		(0.17)
FUELPASS		-0.11
		(0.19)
lagged LNQ	0.01**	
	(0.01)	
lagged PERHEDGE	-0.03	
	(0.02)	
Constant	0.10***	-2.57***
	(0.01)	(0.50)
Prob>F	0.00	0.00
Obs/firm years	173	172
Number of groups	28	27
R -squared	0.13	0.43

Standard errors in parentheses
***p<0.01, **p<0-05, *p<0.10

Table 9

9 Discussion

This paper investigates the relationship between hedging, exposure, and firm value and is a complement to the findings of Berghofer and Lucey (2014), Treanor et al. (2014 a and b) and Carter et al. (2006). Our study investigates a different period and a time where fuel prices have significant variations compared to previous research. Also, we look at how differences in strategies and geographical location affect airlines when it comes to hedging, exposure, and value.

The airline industry is ideal to analyze when determining the effects of hedging as it has concentrated its risk exposure towards one commodity. Our results show that the level of exposure is correlated with fuel prices and that airlines face less exposure when prices are low. Further, our regressions find evidence that the use of hedging reduces exposure to fuel prices. We notice that Low-Cost Carriers have a higher hedge ratio than Full-Service airlines on average. Intuitively, this should make sense as jet fuel constitutes a larger part of total operating expenses, meaning Low-Cost Carriers should hedge more than Full-Service airlines to reduce the exposure to price fluctuations. However, our results cannot find any statistically significant differences between subsamples in the relationship between hedging and exposure. Nevertheless, we observe that Low-Cost Carriers have less exposure to fuel prices than Full-Service airlines. This is an indication that there can be some operative differences that are superior to hedging in reducing exposure. There are especially two operative differences we can think of where Low-Cost Carriers can be superior to Full-Service airlines. Firstly, seating density can be essential in reducing exposure. Low-Cost Carriers have higher seating density because the lack of first-class seating increases the number of seats in each plane. Secondly, Low-Cost Carriers operates a younger fleet than Full-Service airlines because of their relatively new entrant in the airline industry (Haines, 2017). A younger fleet increases fuel efficiency. Berghofer and Lucey (2014) supports this theory and suggest that operational hedging is more efficient than financial hedging.

Our study shows mixed results in exploring the relationship between hedging and firm value. In the full sample, we find evidence that hedging increase firm value. Despite that, splitting the sample into Low-Cost Carriers and Full-Service airlines, we find that hedging is associated with a lower value for Low-Cost Carriers. This is interesting because both Treanor et al. (2014a) and Carter et al. (2006) had a sample period that was less influenced by Low-Cost Carriers. We find two possible explanations for this. Firstly, this can be partially explained by the characteristics of our sample period and the plunge in oil prices, leading to significant losses for those who hedged the most. The second explanation can be that Low-Cost carriers on average hedge more than Full-Service airlines, knowing the decreasing benefits of hedging.

For future research, one would like to extend the study to find the determinants of hedging. It can be interesting to explore if differences in strategy can give different explanations in hedging decisions. To achieve this, one can use next year's fuel requirements hedged as the dependent variable and the same control variables as independent variables. Also, one could add variables to investigate managerial motives for hedging like option or stock holdings of top management.

Further, we could recommend investigating and find an optimal hedge ratio for airlines with different strategies. This can be accomplished by categorizing the hedging variable, but this would most likely demand a larger sample to get robust results. We could also recommend extending the exposure analysis also to include operational variables. This can give better explanations to what causes Low-Cost Carriers to have less exposure to fuel prices than Full-Service airlines.

10 Conclusion

Unlike many studies investigating the relationship between exposure, hedging, and firm value, our research focuses on how differences in geographical location and strategy affect this connection. This relation is investigated using a sample of 12 U.S. and 17 European airlines in the period from 2010-2017. Our results confirm that airlines stock price return are negatively correlated with fuel prices. Further, we find that fuel hedging reduces airlines exposure to fuel prices. Hedging behavior and level of exposure varies between U.S. and European airlines, but we find that the level of exposure varies more among airlines based on strategy, where exposure is lower for Low-Cost Carriers than Full-Service airlines.

Further, we find evidence that hedging is associated with higher firm value. In subsample analysis, we find that hedging increases firm value for Full-Service Airlines. However, we discover that hedging is associated with lower firm value for Low-Cost Carriers. Investigating this further, our results show that hedging increase firm value, but at a decreasing rate. Moreover, we discover that investors value hedging more in periods of high exposure. Also, we find no relationship between the standard deviation of next year's fuel requirement hedged and firm value. This indicates that investors do not value an active hedging more than a passive hedging strategy. Lastly, we investigate if the underinvestment problem can explain airlines hedging behavior. However, we find no evidence that this is the case.

Finally, we conclude that differences in strategies between Low-Cost Carriers and Full-Service airlines affect the relation between exposure, hedging and firm value. Our results signal that the average airline can have benefits of fuel hedging, both in reducing exposure and increase firm value.

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12 Appendix

Appendix 1

A futures contract is an agreement to buy or sell a specified quantity of a commodity for a predetermined price at a predetermined time in the future. The buyer has a long position, meaning an obligation to purchase the commodity in the future. The seller has a short position, meaning he has an obligation to sell the commodity in the future. Futures contracts are standardized (opposed to a forward contract) and traded on an exchange. They do also eliminate counterparty risk using a clearinghouse. The most used exchanges for oil contracts are the International Petroleum Exchange (IPE) in London and NYMEX. In oppose to futures, forward contracts are typically customized and traded over the counter. Forwards are also settled at maturity, whereas futures are marked to market daily. Lastly, forward agreements give rise to counterparty risk for both sides of the trade.

Another derivative that airlines use is Call options. A Call option gives the buyer the right, but not the obligation to buy a predetermined amount of an asset at a predetermined price in the time up to the maturity of the option. Options give airlines more flexibility, but the options can be expensive compared to other hedging strategies. The prices of commodities are often very volatile, which increases the value of the option and thereby require high premiums. An alternative to options is Collars. The point with a collar is that it gives a minimum and maximum price for the asset in a certain period. A Collar is a combination of Call and Put option. For airlines, which is a commodity buyer, the hedge is made by selling a Put option with a price below the current commodity price and buy a Call option with a strike above today's commodity price. A widely used Collar is a so-called Zero-Cost Collar. In a Zero-Cost Collar, the premium received from selling the Put options exactly offsets the premium paid for the Call option.

Appendix 2

Table 10. Descriptive statistics for Low-Cost and Full-Service Carriers.
The table shows summary statistics for Low-Cost Carriers and Full-Service Airlines. Data are collected from the airlines' 10-k filings and annual reports, Compustat, CRSP and Thomson Reuters, Eikon.

	Full-Service					Low-Cost				
Variable	**Mean**	**Median**	**Min**	**Max**	***Std Dev***	**Mean**	**Median**	**Min**	**Max**	***Std Dev***
LNQ	0,17	0,19	-1,62	2,45	*0,71*	0,48	0,47	-3,47	2,20	*0,83*
PERHEDGE	0,40	0,50	0,00	0,80	*0,25*	0,49	0,50	0,00	1,00	*0,35*
LNTASS	9,03	8,78	6,27	10,90	*1,39*	8,06	7,84	6,22	10,13	*1,08*
DIVIDEND	0,51	1,00	0,00	1,00	*0,50*	0,41	0,00	0,00	1,00	*0,49*
LTDTA	0,66	0,42	0,03	2,46	*0,55*	0,50	0,35	0,00	2,23	*0,51*
CASHFLOW	0,08	0,08	-0,04	0,23	*0,05*	0,08	0,10	-0,54	0,24	*0,11*
CASH	0,11	0,08	0,01	0,35	*0,08*	0,20	0,15	0,04	0,87	*0,17*
CAPTSAL	0,09	0,09	0,00	0,39	*0,06*	0,13	0,12	0,00	0,39	*0,09*
ZSCORE	1,62	1,46	0,19	5,37	*0,78*	2,32	2,08	-1,26	8,12	*1,44*
INTERESTHEL	0,68	1,00	0,00	1,00	*0,47*	0,61	1,00	0,00	1,00	*0,49*
FXHEDGE	0,72	1,00	0,00	1,00	*0,45*	0,61	1,00	0,00	1,00	*0,49*
FUELPASS	0,07	0,00	0,00	1,00	*0,25*	0,17	0,00	0,00	1,00	*0,38*
EXPOSURE	-0,23	-0,15	-1,46	0,80	*0,36*	-0,15	-0,13	-0,91	0,58	*0,30*

Appendix 3

Table 11: Descriptive statistics for U.S. and European airlines
The table shows summary statistics for U.S. and European airlines. Data are collected from the airlines' 10-k filings and annual reports, Compustat, CRSP and Thomson Reuters, Eikon.

	U.S.					Europe				
Variable	**Mean**	**Median**	**Min**	**Max**	***Std Dev***	**Mean**	**Median**	**Min**	**Max**	***Std Dev***
LNQ	-0,10	-0,05	-1,15	1,19	*0,51*	0,56	0,55	-3,47	2,45	*0,81*
PERHEDGE	0,20	0,13	0,00	0,78	*0,21*	0,58	0,60	0,00	1,00	*0,24*
LNTASS	8,98	8,88	6,22	10,90	*1,35*	8,38	8,23	6,27	10,67	*1,30*
DIVIDEND	0,45	0,00	0,00	1,00	*0,50*	0,48	0,00	0,00	1,00	*0,50*
LTDTA	1,07	1,02	0,00	2,46	*0,55*	0,28	0,26	0,01	0,84	*0,19*
CASHFLOW	0,10	0,10	-0,04	0,24	*0,06*	0,07	0,08	-0,54	0,21	*0,09*
CASH	0,10	0,07	0,01	0,38	*0,09*	0,18	0,14	0,02	0,87	*0,15*
CAPTSAL	0,12	0,11	0,02	0,39	*0,08*	0,10	0,09	0,00	0,32	*0,07*
ZSCORE	2,17	1,69	0,19	8,12	*1,44*	1,75	1,61	-1,26	5,37	*0,88*
INTERESTHEL	0,42	0,00	0,00	1,00	*0,50*	0,81	1,00	0,00	1,00	*0,39*
FXHEDGE	0,23	0,00	0,00	1,00	*0,42*	0,98	1,00	0,00	1,00	*0,15*
FUELPASS	0,27	0,00	0,00	1,00	*0,45*	0,00	0,00	0,00	0,00	*0,00*
EXPOSURE	-0,31	-0,23	-1,46	0,80	*0,36*	-0,13	-0,12	-0,82	0,70	*0,31*

Appendix 4

Table 12: The table reports coefficients estimated from regression of firm value and next year's fuel requirements hedged squared using the Equation: $ln(Q)_{i,y} = \alpha_0 + \beta_1 PERHEDGE_{i,y} + \beta_2 PERHEDGE_{i,y} * PERHEDGE_{i,y} + \beta_{3-12}(ControlVariables)_{i,y}$

The model is estimated using FGLS.

	FGLS
PERHEDGE	1.30**
	(0.56)
PERHEDGE *squared*	-1.27**
	(0.59)
LNTASS	0.11
	(0.07)
DIVIDEND	-0.08
	(0.09)
LTDTA	0.14
	(0.16)
CASHFLOW	-1.49**
	(0.62)
CASH	-0.90**
	(0.40)
CAPTSAL	2.04***
	(0.59)
ZSCORE	0.44***
	(0.06)
INTERESTHEDGE	-0.24*
	(0.13)
FXHEDGE	0.29*
	(0.17)
FUELPASS	-0.42**
	(0.22)
Constant	-1.72***
	(0.63)
Obs/firm years	199
Number of groups	28
Log likelihood	-121.35

Standard errors in parentheses
***p<0.01, **p<0-05, *p<0.10