Hedging and Firm Value:
Measuring the Implications of Airline Hedging Programs*

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ABSTRACT

This paper examines the relation between hedging and firm value for global airline sample from 2000 to 2012, resulting in 411 firm-year observations. We show that hedging strategies are effective at reducing the variability of operating cash flows. We find an average value premium of 6.5% associated with hedging for low cost carriers but no value premium for major carriers. Our results empirically evidence the value maximization via hedging when firms have potential financial distress costs and significant investment opportunities (alleviating the underinvestment problem), which has been the case for low cost carriers during their high growth stage.

In a frictionless Modigliani and Miller (1958) world, corporate hedging is irrelevant and the value of the firm is independent of whether or not it hedges. Based on frictionless market assumptions (no taxes, no information asymmetry and no transactions costs), authors argue that investors can identify and hedge their own exposures and do not pay premium for firm level hedging.

Introducing capital market imperfections to the Modigliani and Miller world, prior studies rationalize hedging behavior with minimization of tax volatility, maximization of tax shields, reduction of firm level risk (through financial distress costs), managerial risk aversion and reduction in agency costs (alleviation of

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potential underinvestment problems (Smith and Stulz, 1985; Mayers and Smith 1987 Graham and Smith, 1998; Tufano, 1996; Stultz, 1996; Froot et al. 1993)).[1] Academics have long been interested in empirically testing these theoretical arguments, yet the direct empirical examination of firm value and hedging is a relatively new phenomenon. The pioneering work that examines the relation between firm value and hedging is the Allayannis and Weston (2001) study. Examining the foreign currency derivative use in a sample of nonfinancial US firms between 1990 and 1995, and using Tobin's Q as a measure of firm value, authors observe that hedging is associated with value premium of 4.87%. More recently, Carter et al. (2004, 2006) examining the US airline industry report a jet fuel hedging premium of 12% to 16% for the 1994 to 2000 period and 5% to 10% for the 1992 to 2003 period.

In this paper, we revisit the argument of the hedging and firm value using a dataset consisting of 54 global publicly traded airline companies over a 13-year period from 2000 to 2012. There lie three fundamental reasons for the motivation to examine jet fuel hedging and shareholder value maximization in the airline industry.

The first reason is the noticeable discrepancy in the empirical findings of studies focusing on shareholder value maximization via commodity price risk management for commodity producers and end-users. Empirical studies support the shareholder value maximization proposal for commodity end-users (airline industry - Carter et al., 2004, 2006), but reject it for commodity producers (oil producers - Jin and Jorion, 2006; gold miners – Tufano 1996). It can be argued that investors' different risk perception for the two sides in commodity price risk

[1] Underinvestment problem is essentially an agency problem between the management and creditors of the firm. However, the term has been used interchangeably with coordinating investment and financing hypothesis (Gay and Nam, 1998; Carter et al. 2006). The fact that both hypotheses propose that hedging significantly contributes to the efficiency in investments is most likely the reason for the joint use of the two terms. In this paper, we will follow suit the literature and refer to the underinvestment hypothesis as the one discussed in Froot et al. (1993) study.

equilibrium is the reason for the divergence in empirical findings. For example, Jin and Jorion (2006) state that investors may invest in oil-producing firms to gain exposure to oil price movements.

The second reason is that despite the recent interest in the area of commodity price risk management, there still are a number of arguments, particularly in the airline industry, that are overlooked by the literature. These arguments can potentially have economical and statistical significance for the implications of jet fuel price risk management. For example, unlike Carter et al. (2006), we split our sample into a more up-to-date business model classifications, namely; low cost carriers (abbreviated as LCCs) and major carriers (abbreviated as MCs) [2].

Low cost carriers have gained significant strength from the beginning of the early 2000s. Descriptive statistics and univariate analysis in Panels B of Tables II and III provide evidence of the investment opportunities, measured by capital expenditures as a percentage of revenues (CAPEX/Revenues) and retention ratio, calculated as $\left(1-\frac{Dividends\ per\ Share}{Earnings\ per\ Share}\right)$ for LCCs and MCs. Both measures indicate that LCCs have a greater set of investment opportunities and reinvest more of their internal cash flows for future growth opportunities. Based on these statistical observations, this period can be ascribed as a high-growth period for the low cost carriers. Thus, the partition of the sample into low cost carrier and major carrier sub-samples enables us to control and test for the association

[2] Major Carriers built hub-and-spoke networks with a dynamic revenue management system where different seats are priced differently depending on the class and the availability of the seats. These carriers are dependent on their operations within their hub-and-spoke network and continue to serve routes within these networks regardless of the route being profitable or not. The abandonment of a given route would be penalized by the network structure with a loss of potential customers on related routes. Low cost carriers, on the other hand, has much more flexibility in terms of route construction, operate under one business class and operate same type of aircraft (which are easier to maintain and cost efficient), and usually use secondary airports with lower fares and higher punctuality. These companies serve the short-haul segment of passenger travel and have more mobile network structure compared to major carriers.

between hedging and potential underinvestment problems for the two different business models; one in high growth state and the other in the mature state.

Airline companies in the Carter et al. (2006) study are classified into major carriers and small carriers based on the scale of annual revenues which is the classification of the Air Transport Association in the US. Within that sample, however, the majority of the firms regarded as small carriers are actually regional carriers. These carriers have a totally different business model in comparison to both LCCs and MCs[3], particularly in two aspects. First, these carriers mostly have fixed-fee agreements with major airline contractors which are set to cover the regional carriers' operating costs and to guarantee a pre-determined level of profit. These fixed-fee contract schemes, which are effectively used since the late 1990s, eliminate all of the risks related to passenger demand and profit margins. More precisely, unlike the high price elasticity of passenger demand statement made in Carter et al. (2006), in practice the size of revenues for regional carriers is independent of the number of passengers carried. Second, their business model allows them to transfer the majority of the jet fuel price risk to their contractor firms which provide them with the most effective risk management tool available. Appendix I provides further evidence on the fuel price risk management by some of these regional carriers.

Unsurprisingly, regional carriers hedge almost none of their jet fuel price risks and are the only airline companies that do not hedge in the sample of Carter et al. (2006). This fact is somewhat acknowledged by the authors with the use of fuel pass-through and charter dummies to control for other means of risk management practices. However, fuel pass-through schemes are not only utilized by regional carriers but also periodically utilized by major carriers.

[3] Regional carriers operate passenger services on routes that do not attract sufficient demand for mainline services of larger players. In general regional carriers function as a feeder airline (usually contract based with a larger carrier or as a subsidiary of a larger carrier) - serving the hub and spoke network structure of major carriers and have much lower scale of operations and mostly ununionized labor. (Forbes and Lederman, 2007).

Additionally, the use of fuel pass-through dummy variables doesn't adequately capture the magnitude of cash flow volatility (as a result of fuel price fluctuations) transferred from regional carriers to major carriers. We argue that an analysis examining firm value and hedging with a sample composition involving regional carriers (which can utilize close to perfect operational hedging strategy by transferring almost all the oil price risk to the parent contractor airline company) alongside with major and low cost carriers (that have to utilize financial hedging strategies) will produce potential endogeneity bias. Such analysis will effectively collapse to a comparison between financial hedging and operational hedging. As a result, we exclude regional carriers from our analysis.

The partition of the sample into low cost and major carrier sub-samples also serves this purpose of controlling for a potential bias towards a specific business model which can affect the hedging decision. We observe similar jet fuel hedging levels for the two sub-samples; 33% for the low cost carriers and 35% for the major carriers, which eliminates the risk of endogeneity. Both samples demonstrate variability in hedging levels and constitute homogeneity in our test variable which is the percentage of the next year's consumption hedged.

Finally, in this paper, we expand the analysis to the global level that enables us to control for cross regional differences among airline companies. This is important in terms of capturing differences between deregulated markets like the US and/or Europe and the rest of the world. Additionally, our dataset allows us to control for the implications of government ownership on risk management practices in the industry.

The airline industry offers an ideal environment to study hedging behavior for a number of reasons. First, the industry is significantly exposed to the availability and price of oil. Consequently, airline companies extensively use financial instruments to manage fuel prices. System-wide fuel expenses reached $140B in 2012, which is equivalent to one-third of operating expenditures and hence, have a major effect on profitability (The International Air Transport Association, 2012). Second, the likelihood of speculation through hedging is very low, since low operating margins make the industry extremely cash conscious and firms are very likely to be risk averse. Third, the industry does not benefit from natural hedging. The increased demand for air travel (and as a result expected increases in revenues) from the stimulation in the economy is shared among the entire industry, whereas increases in oil prices as a result of the same economic activity will have a direct and a proportionate impact on the fuel expenditure of each and every airline company (in the absence of hedging). Finally, the industry makes extensive use of debt financing, which accompanied with highly competitive low-margin environment, increase the probability of experiencing financial distress costs. Consequently, potential benefits from hedging are expected to be high for the industry[4].

Avoiding firm year observations for which there has been insufficient disclosure of hedging practices (avoiding dummy variables) and excluding regional carriers, we obtain 411 firm-year observations from a global sample of 54 publicly traded airline companies. To the best of our knowledge, this is the largest sample examined that uses non-binary hedging variables. Further, our study is the first to extend the coverage of the airline industry to a global scale comprising of 13 US, 14 European, and 27 international airline companies. The first major contribution of this study is that this research instrument facilitates analysis of any value premium using actual fuel hedging data for a global sample of airline companies.

This paper differentiates from the existing literature by taking a two-step approach in testing the implications of corporate hedging. The single most

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[4] The theory of corporate risk management states that there is little or no benefit from hedging for firms with little or no debt financing. Having virtually zero probability of financial distress risks, these firms can find it easier to access external funding and have more room for increasing debt capacity at lower costs absent hedging. Consequently, hedging is expected to be most beneficial for firms with high financial leverage and inadequate cash balances to service obligatory payments and utilize investment opportunities.

important underlying motivation for corporate risk management is the elimination of the undesired volatility risk inherent in future operating cash flows (Smith and Stulz, 1985; Froot et al., 1993; Nance, Smith and Smithson, 1993). Often, empirical studies that examine the value premium associated with corporate hedging disregard the core principle of cash flow volatility reduction via hedging. As an example, none of the studies analyzing corporate hedging and firm value in commodity price risk management tests whether hedging is useful in terms of reducing variability in operating cash flows.

Parallel to the corporate risk management theory, in the first stage of our analysis we examine whether hedging is useful in terms of reducing variability in operating cash flows as a percentage of revenues (CFO/Revenues) and the level of fuel costs as a percentage of operating expenses (Fuel Costs/OPEX). We separate our sample into hedging-year and non-hedging-year sub-samples and conduct a univariate test of differences in variances of operating cash flows. Additionally, in order to measure the fuel economies achieved via hedging, we test the relation between hedging and fuel costs as a percentage of operating expenses (Fuel Costs/OPEX), which, via the "effective fuel cost estimation"[5] proposed by the two main accounting systems (IFRS and US GAAP), show a direct relation.

Our results indicate that hedging enabled airline companies (both LCCs and MCs) to reduce the variability in operating cash flows, satisfying the fundamental motivation for corporate risk management. Additionally, univariate analysis of hedging and non-hedging year-observations demonstrate that fuel costs as a percentage of operating expenses (Fuel Costs/OPEX) are, on average, 6% lower for the hedging sub-sample compared to non-hedging sub-sample. Similarly, the

[5] Effective fuel cost is the effective USD price paid per barrel of jet fuel consumed. This effective fuel price paid includes the entire fuel cost savings (loss) realized from the derivatives instruments in addition to the fuel costs realized in the spot market. It is calculated as the USD spot price paid per barrel of fuel costs less (plus) USD gains (losses) from the derivative instruments.

multivariate analysis in the section III indicates that hedging is statistically negatively associated with fuel costs scaled by operating expenses (Fuel Costs/OPEX).

The second contribution of this paper is to test *why* we would expect investors to pay premium for firms that hedge at all using a larger sample than prior work? If investors are well-diversified, most of the risks related to oil prices should not materially increase the risk of their portfolio. However, when the magnitude of the financial risks becomes such that the volatility in the operating cash flows significantly increases the probability of financial distress, even well-diversified investors will be concerned (Stulz, 1996). The probability of financial distress is a direct function of a company's fixed claims relative to its total assets (Nance, Smith and Smithson, 1993), a ratio which is typically very high for the airline industry. Additionally, the industry operates on low profit margins and jet fuel expenses constitute more than one third of all cash expenses. As a result, the industry is exposed to significant risk of financial distress and investors are particularly cognizant of the importance of the oil price risk management[6].

Moreover, if investors can easily identify and hedge their own risk exposures, why would they ever need firm level hedging? Despite the rationale behind in-house risk management argument**,** quantifying the risk exposure might not be as straightforward for investors as theoretically argued when there are information asymmetries (Myers and Majluf, 1984; Miller and Rock, 1985; Noe and Rebello, 1996; Krishnaswami and Subramaniam, 1999). The ability to measure and hedge the firm-specific risks might be limited by the quantity and/or quality of

[6] Most of the airline companies have institutional shareholders with well-diversified portfolios. Around 20% of the total sample, however, involves significant government ownership (equity ownership of 20% of the total shares or above). We expect managements of these companies to be less risk averse given implicit and/or explicit potential for government endorsements at times of most need. As a result, these companies are expected to hedge lower proportion of their future jet fuel consumption compared to privately held airline companies. Both in univariate and in multivariate analysis we control for the government ownership.

financial disclosure. The information as to the level of exposure to a specific risk factor is harder to obtain for companies in emerging markets in comparison to companies in established markets. For example, in the case of a US airline company, a US investor may calculate the approximate risk exposure to oil prices. The information related to the periodical fuel consumption is readily (mandatorily) available for these companies. However, the same information is only voluntarily disclosed for non-US firms. In fact, for a US airline company an investor faces a single dimensional risk of oil prices that are traded in the same functional currency of a US airline company.

For a non-US airline company, however, the risks related to oil prices also have US dollar exchange rate dimension that makes the overall risk exposure harder to quantify. A non-US airline company that hedges a certain portion of its US dollar fuel expenditures might prefer to net-out some of the currency risks related to the hedged portion of oil price exposure using its receivables. This might function as an effective means of operational hedge but the information related to the extent of such strategy is likely to be company specific. As a result, investors with the information asymmetry might over or under hedge the actual exposure.

Given these information asymmetries and the significant probability of experiencing financial distress costs, investors might prefer airline companies that acknowledge and implement operational and/or financial hedging strategies against these risk factors. Hedging might contribute to firm value maximization if it reduces cash flow volatility and preserves internally generated cash funds which help reduce potential underinvestment problems and the probability of financial distress. Thus, the second stage of our analysis examines the value-additive proposal of corporate hedging.

Our results indicate a positive relation between hedging and firm value for the sub-sample of low cost carriers. We don’t find any evidence supporting the association between firm value and hedging for major carriers. Based on the

33% average hedging level we calculate a value premium of 6.5% for the low cost carrier sample. Provided that hedging is beneficial in terms of reducing the variability in operating cash flows for both major carriers and low cost carriers, the value maximization proposal can be explained as a function of the availability of future growth opportunities and the degree of competition. Low cost carriers have significant investment opportunities and hold a significantly greater portion of earnings within the company. This observation indicates that these firms use retained earnings to make necessary cash infusions to ongoing/future investment projects and/or help increase borrowing capacity. In either case, it is reasonable to expect that a significant portion of these airlines market value is the present value of their investment opportunities rather than assets in place, which is the case for mature companies (MCs).

Our results confirm the theoretical and empirical evidence indicating that the availability of internal cash flows when they are most needed, either to fund investments or to repay debt, might be more pronounced for high-growth firms. Given a significantly greater set of investment opportunities available, the risk of experiencing underinvestment problem is more intensified for these companies (Myers, 1977; Brennan and Schwartz, 1981; Essig, 1991; Aretz and Bartram, 2010). In line with agency theory, positive association between hedging and firm value for the low cost carriers might be the alleviation of the potential underinvestment problem.

As is the case for any empirical corporate finance research, our study might be subject to potential endogeneity related problems. Our test variable; the percentage level of next year's fuel consumption hedged, is determined by company management. In the decision making process, management might be influenced by factors which are unobservable such as the ability to transfer the portion of fuel costs on to customers (fuel surcharges), managerial expectations about future cash flows and managerial risk aversion. All these unobservable factors subject our analysis to potential omitted variable bias. We tackle this potential omitted variable bias using first differenced analysis and fixed effects models in section IV.

On the other hand, some of the firm-specific factors, such as government ownership, differences in business models and operating regions are observable variables that we control for in order to prevent potential endogeneity related bias. We conduct univariate tests in section III and use a dummy variable in an interaction regression analysis in section IV which controls for government ownership. Our results suggest a positive association between hedging and firm value for the low cost carrier subsample are strongly robust to these control variables and analyses.

The remainder of the paper is structured as follows. Section I analyzes the theoretical arguments and empirical observations for hedging. Section II describes the sample selection and methodology. Section III conducts univariate tests for control variables and cash flow volatility. Section IV tests the value-additive proposal. Section V concludes.

I. Arguments for Corporate Hedging

Drawing from the frictionless market assumptions of the Modigliani and Miller (1958, 1963) framework, corporate hedging literature theorize and empirically test *whether* and *why* firms hedge. Additionally, empirical studies question the hypothesis of shareholder value maximization via hedging. The literature proposes four rationales for corporate hedging and shareholder value maximization that are based on lowering cash flow volatility via hedging.

The tax incentives argument states that hedging reduces the variability of pretax earnings and expected taxes payable, which in turn increases firm value (Smith and Stulz, 1985; Nance et al. 1993). However, empirical evidence on the tax convexity motivation for hedging has not been strongly supported; Foo and Merlyn (2009), Mian (1996), Graham and Rogers (2002), and Gézcy et al. (1997) find no evidence of tax convexity incentives for hedging. Shanker (2000) shows that the tax incentive to hedge is conditioned on the ability to move tax loss carryforwards both forward and back.

The second argument for the tax incentives for corporate hedging is the expected benefits of tax shields obtained from debt financing (Morellec and Smith, 2007). As a result of increased debt financing, firms enjoy greater tax shield benefits (Graham and Rogers, 2002). Even though increased financial leverage might result in agency problems, such as the underinvestment and/or asset substitution problems (Mayers and Smith 1987), Leland (1998) argues that the expected tax benefits from increased leverage are much higher than the agency related costs.

Despite its tax shield benefits, increased leverage brings the risk of direct and indirect costs of financial distress (Smith and Stulz, 1985). Nance et al. (1993) argue that the probability that a company will face financial distress costs increases as the proportion of fixed claims in total assets increase. Hedging reduces the expected costs of bankruptcy by reducing the variance of firm value (Mayers and Smith, 1982; Smith and Stulz, 1985). Empirical support for the financial distress hypothesis is weak (Mian, 1996; Purnanandam, 2005).

Additionally, the misalignment of management and shareholder interests is considered to be an important determinant of corporate hedging. Management is likely to have an appetite for risk that may not necessarily conform to shareholders' best interests (Smith and Stulz, 1985). This is usually the case when a large portion of managers' personal wealth is strongly tied to the value of the business. Managers that are unable to diversify away personal wealth from company-specific risk factors become more risk-averse and might be more inclined to hedge to reduce firm level risks (Smith and Stulz, 1985).

Stock options provide greater flexibility in terms of wealth diversification and might offer management greater incentives for risk taking. Smith and Stulz (1985) argue that there are greater incentives to hedge if managers' compensation depends on stock performance and managers are unable to diversify away their wealth from firm specific factors. There is some empirical support for the managerial risk aversion hypothesis (Tufano, 1996; Bartram et al., 2007; Gay and Nam, 1998; and Haushalter, 2000).

Finally, Froot et al. (1993) investigate the role of hedging on firm-level capital investments under imperfect markets assumptions. They argue that the underinvestment problem occurs if corporations forego profitable investment opportunities when they have a cash flow shortfall and/or face costly external financing. The uncertain nature of cash flows creates a mismatch between timing of available internal cash funds and investment opportunities, leaving corporations with two options when they have insufficient amount of internal cash funds. They can either forgo profitable investment opportunities or they can resort to external financing. In reality, debt financing is constrained by direct and indirect costs such as issuance and transaction costs (Myers, 1977), asymmetric information problems (Myers and Majluf, 1984), and contracting problems (Jensen and Meckling, 1976; Myers, 1977). Hedging is beneficial to the extent that it can reduce the variability in operating cash flows and thus preserve internally generated funds that can be used in value-adding investment opportunities without the need for costly external financing.

II. Sample Selection and Research Method

We use COMPUSTAT Global database with a SIC code of 4512 resulting in 972 firm year observations. In order to achieve as much economically meaningful data as possible, we apply three selection criteria on this data sample. First, the airline must be publicly traded to calculate the Tobin's Q ratio. Second, in order to prevent endogeneity, it must operate in the passenger business (excluding cargo carriers) but not be a regional carrier. In Appendix 1 we show that regional carriers transfer the fuel cost burden (and the related volatility in their operating cash flows) to the major carriers through operational hedging. And finally, it must disclose sufficient information on its use of fuel derivatives, including the percentage of jet fuel consumption hedged[7]. Based on the above selection criteria and after the exclusion of small jets with trivial scale of business, we are left with 70 airline companies. Of these 70 airline companies, 16 disclosed no hedging data, giving us a final sample of 54 airline companies. Examining the time period from 2000 to 2012 provides us with 411 firm-year observations in total. To our knowledge this sample is the largest in the literature that uses hedging percentage data rather than the less informative dichotomous hedging dummy variables. Similarly, to our best knowledge, this is also the first global airline sample studied with actual percentage hedging information to date with 13 US, 14 European and 27 international airline companies.

The test variable, the percentage of the next year's fuel consumption hedged, is readily available for most airline companies that have an established risk management policy. The availability of this data avoids the hazard of making subjective assumptions about the size, scope, and tenure of derivative contracts.

Panels A and B of Table I present the descriptive statistics. The first 16 airline companies are low cost carriers and the rest of the sample are major carriers. The table is sorted from the highest level of fuel consumption hedged to the lowest. It demonstrates that for both low cost and major carrier subsamples, as

[7] The advantage of the airline industry is that the data related to jet fuel price hedges are easier to obtain in comparison to many other industries. Economically, there is a substantial difference between 5% hedging and 50% hedging, regardless of the scope of the risk exposure (whether it is a commodity or currency risk or a combination of both). The economical substance of the actual amount of fuel consumption hedged would be disregarded by the use of dichotomous hedging variables, which would be a non-trivial oversight for the airline industry.

the level of forecasted fuel consumption hedged increases fuel costs as a percentage of operating expenses decreases.

A limitation of our paper is that our sample is constrained by the lack of consistency in the disclosure of hedging data for non-US airline companies. European airline companies only started to disclose the necessary information on fuel risk management after the implementation of International Accounting Standard 32 (*Disclosure of Financial Instruments*, IAS32) for financial years beginning in January 2005, prior to which disclosure is voluntary. Some of the international airlines do not fall under the umbrella of the International Generally Accepted Accounting Principles (iGAAP) or US Generally Accepted Accounting Principles (US GAAP). Having controlled for the regional differences, we find no evidence that the accounting, financial, and economic fundamentals of airlines that voluntarily disclose such information are materially different from mandatory disclosers. These techniques result in an unbalanced panel, but we obtain the most diversified sample on the airline industry.

We use company annual and quarterly reports, 10-K filings, and company presentations to gather fuel hedging levels and financial data. We obtain stock price data from DataStream and Bloomberg to calculate Tobin's Q as a measure of firm value. We adjust for off-balance-sheet leases to more reliably reflect the assets, liabilities, operational leverage, asset turnover, and profitability measures. Following Damodaran (2002), we add the present value of operating leases to assets and liabilities and obtain Q values (Adjusted Q) that reflect the impact of hidden assets and liabilities that take into account the true amount of firm commitments.

<<Insert Table I about here>>

There are many different ways to estimate the Q value but there is a lack of consensus as to the best measure (Whited, 2001). We use Chung and Pruitt (1994) approximation which gives unadjusted Q measure as:

$$Unadjusted\ Q = \frac{\text{MV of Equity + BV of Preferred Stocks + BV of Debt}}{\text{Total Assets}} \qquad (1)$$

The numerator is the summation of the market value of equity, which we estimate by multiplying the number of shares outstanding with share price, the liquidation value of preferred stocks outstanding, and the book value of short and long-term debt. The denominator is total assets.

It is well known that the airline industry makes extensive use of off balance sheet leasing arrangements to facilitate its operations. Following Damodaran (2002), in the last column of Panel D in Table II we show that for our sample, the ratio of off-balance-sheet leases to total assets is 41% for low cost carriers (growth firms) and 24% for major airlines (mature firms). The adjusted measure of Tobin's Q for the robustness test performed is:

$$Adjusted\ Q = \frac{MV\ of\ Equity + BV\ of\ Preferred\ Stocks + BV\ of\ Debt + BV\ of\ operating\ leases}{Total\ Assets + BV\ of\ off\ balance\ sheet\ leases} \qquad (2)$$

As Jin and Jorion (2006) state, to prevent endogeneity in hedging and firm value variables, it is preferable to have a dataset that incorporates firms with different levels of hedge ratios. Table II Panels A, B, and C exhibit our analysis on the hedging percentages and control variables. Panel A summarizes the hedging and non-hedging firm-year data for the total sample and the low-cost and major airlines subsamples. Columns 2 to 10 show the hedging levels in percentages ranging from zero to 90%, where H stands for hedging percentage. These subsamples yield 88 non-hedging-firm year and 323 hedging-firm year observations. On the other hand, 60% of the low-cost carriers sample and 45% of the major carriers sample are hedging less than their group average hedge levels and 25% and 35% of the airlines are hedging less than 10% and 20%, respectively. Average hedging levels of each group are summarized in Table II, Panels B and C, as 34%, 33%, and 35% for the “total sample”, “low-cost carriers”, and “major carriers”, respectively. The similarity in the hedging levels reassures us that our sample does not suffer from the endogeneity problem. We also provide summary statistics for the US, European, and international airline company regional subsamples that we examine for the robustness of our analysis.

<<Insert Table II about here>>

Column 9 in Panels B and C of Table II, display the unadjusted and adjusted values for Tobin’s Q. After adjusting for off-balance-sheet leases, the largest reduction in the average value of Tobin’s Q is observed for the low cost carriers. The relatively lower asset base for these companies is the main reason for the drop in Q value but this has no impact on regression findings. Columns 2 and 3 of Panels B and C show the amount of expected fuel consumption hedged and the average percentage of fuel costs in total operating expenses.

The airline companies in our sample that do not hedge in any year of the sample period examined are Jet Airways, Kingfisher, and SpiceJet (India); Jazeera (UAE); Asiana (Korea); and Hainan and China Southern (China). However, some airlines hedge sporadically, and when they do hedge, it is usually a small percentage of their fuel consumption. Turkish Airlines (Turkey) did not hedge until 2009 and since then has only hedged between 10% and 20% of total consumption. Allegiant (US) hedged insignificant amounts (10% and 2% in 2006 and 2007, respectively) and stopped hedging in 2008. Air Arabia (Saudi Arabia) did not hedge from 2007-2010 and then only hedged 17% and 25% in 2011 and 2012, respectively. Similarly, US Airways abandoned hedging in year 2008 and has not hedged since.

III. Univariate Tests of Control Variables

The fundamental underlying of hedging, alongside theoretically documented incentives, is to facilitate the timely delivery of forecast cash flows. Although it is not possible to eliminate all the risks to future cash flows, those related to hedgeable risk factors are manageable using financial instruments. Hedging can be referred to as a “success” if it helps reduce the undesired level of volatility in cash flows. If the target level of variability in cash flows is assured, management can focus on its core operations more efficiently. Hence, this section begins by testing if hedging is useful in lowering variability in internal cash flows.

Panel A of Table III conducts univariate analysis for hedging and non-hedging firm-year observations. We report both mean and median level differences for each control variable as well as adjusted and unadjusted Q dependent variables. Neither mean nor median values for control variables are statistically different from one another except for fuel costs-to-total operating expenses and leverage (both unadjusted and adjusted for off-balance sheet leases). Our results indicate that, on average, hedging firm years coincide with 6% lower fuel costs-to-total operating expenses compared to non-hedging firm-year observations. Additionally, in line with our expectations, we observe lower variability in operating cash flows (CFO/Rev) and capital expenditures (Capex/Rev), both scaled by revenues, for hedging-year observations compared to non-hedging year observations. Non-hedging firms tend to use significantly more financial leverage compared to hedging firms. However, the sustainability of heavy reliance on external financing of investments and/or day-to-day operations in the extremely concentrated, low-margin environment of the airline industry is questionable.

In addition, multivariate analysis in Panel C test for the effect of one period lagged percentage of the next year's consumption hedged on the level of fuel costs scaled by total operating expenses. The one year lagged hedge variable is used as an independent variable in order to better reflect the timely impact of the hedging decision that is made in year $t-1$ and the results from actual hedging that materializes in year t. In the airline industry, fuel is a nonfinancial asset and is reported as the "net effective fuel cost" (i.e., the difference between actual jet fuel costs on the spot market including taxes, less (plus) any gain (loss) from the hedging transactions). As a result, any financial impact from hedging transactions at time $t-1$ will be recognized in fuel cost expenses at time t. Hence, we test the following equation:

$$Fuel\ Costs/Operating\ Costs_{(t)} = \alpha_0 + \beta_1 Hedging_{(t-1)} + \beta_2 Fuel\ Costs_{(t)} + \varepsilon \quad (3)$$

The results show that the ratio of fuel costs to operating expenses at time t is significant and negatively associated with the hedging percentage entered into at time $t-1$, and significant and positively associated with jet fuel prices at time t. Given the accounting requirements of IAS39 and the US equivalent SFAS133, we interpret these results as evidence that hedging reduces fuel costs.

The analysis in Panel B of Table III is a univariate test of control variables for low-cost and major airline subsamples. We observe statistically significant differences in firm value, measured by both unadjusted (UAQ) and adjusted Tobin's Q (Adj.Q); the level of investment opportunities, measured by Capex-to-revenues (Capex/Rev); the level of operating cash flows; measured by cash flows from operations scaled by revenues (CFO/Rev); and profitability, measured by both unadjusted (RoA) and adjusted return on assets (RoA Adj.).

The results in Panel B of Table III demonstrate the superior performance of the low cost carrier business model over the major carrier business model for the sample period. We observe significantly greater capital expenditures, cash flows from operations, and return on assets for the low-cost sub-sample, indicating higher growth expectations, compared to the major airlines sub-sample. Additionally, major carriers have utilized significantly more external financing than low-cost carriers. This suggests that compared to major carriers, low-cost carriers finance a greater proportion of their investment opportunity set by using internal funds which is also evidenced by the analysis in Figure 2. Whether this is attributable to capital budgeting policy or to limitations on the extent of the availability of external financing, or both, it might suggest that as high growth firms, low-cost carriers can be more sensitive to the level of internal cash funds (see Figure 2). Consequently, the deficiency of internally generated cash flows might expose low cost carriers to significant underinvestment problems. This argument is analyzed in greater detail using multivariate analysis in section IV.

<<Insert Table III about here>>

The deregulation of the airline industry outside of the US occurred gradually largely because governments put national interests before operational efficiency. Although aviation markets are more efficient compared to 20 years ago, there still remains some government intervention within the managements of some of the major carriers; also called "flagship carriers". About 40% of the airline companies in the major carriers sample have government ownership at or above 20% of the total shares outstanding (see Appendix II), which theoretically can exert significant influence over planning and budgeting decisions. In our opinion, these airline companies might enjoy competitive protectionism and financial support from their governments to a certain extent that might make them less risk averse compared to privately owned airline companies.

Univariate analysis in Panel A of Table IV compares airline companies with government ownership to privately owned airline companies. Privately owned airline companies include all of the low cost airlines in addition to major airlines with no government ownership. The analysis in Panel B of Table IV compares major carriers with government ownership to major carriers with no government ownership.

<<Insert Table IV about here>>

In both panels, we observe higher firm value for airline companies with no government ownership. Parallel to our expectations, in both panels, major carriers with significant government ownership hedge a significantly lower amount of their total expected fuel consumption compared to airline companies with no government ownership. We argue that the differences in hedging behavior might be a result of the comfort of having the financial support from governments (*too big to fail*) and/or lack of effective risk management policies[8]. These results should not necessarily suggest a positive association between hedging and firm value for these privately owned airline companies. Univariate tests in Panels A and B in Table IV are not a direct examination of hedging and firm value relationship. Higher firm values for privately owned airline companies might be a result of differences in operational efficiency other than hedging, which we cannot capture with univariate tests. Consequently, we control for government ownership in the multivariate regression analyses in section IV.

IV. Value-Additive Proposal

[8] Despite being privately owned, some airline companies still receive government support. This is usually the case if the airline in question is a national carrier (flag carrier) of a country. An example of such transaction has been Japanese Airlines (JAL) which received ¥350B from Japanese government during the re-structuring period in 2010. We are unable to capture majority of similar implicit government and a carrier relationships as the information with regards to government subsidies are not usually publicized. Additionally, the degree of government support for these national carriers might not necessarily be in the form of net cash infusion but rather in the form of easier access to external capital through state owned borrowing channels.

Panels A and B of Table IV present the results of regression analyses testing for the association between hedging and firm value for the low-cost carriers, and major airlines. The model that we test is:

$$Ln\ Q = \alpha_0 + \beta_1 Control\ Variables + \beta_2 Hedging + \varepsilon \quad (4)$$

The dependent variable; $Ln\ Q$, is the natural logarithm of the unadjusted and adjusted Tobin's Q. The independent control variables are as follows:

1. Log (assets): Firm size is directly and positively related to derivatives usage (Nance et al., 1993; Mian, 1996 and Gézcy et al., 1997). Prior studies test whether firm size, for which they use the natural logarithm of total assets as the proxy, is associated with firm value. Their results are mixed. Allayannis and Weston (2001) and Carter et al. (2006) find a negative relationship between the two but Jin and Jorion (2006) reports a positive relation. We find a negative value relation between firm value and firm size for low-cost carriers and a positive value relation for major carriers.

2. Leverage: To control for financial leverage we use the ratio of total debt to total equity. Consistent with Carter et al. (2006), we find no relation between firm value and leverage.

3. RoA: We use return on assets (Net Income/Total Assets) as a control variable for profitability. Carter et al. (2006) do not control for a profitability variable and Jin and Jorion (2006) find no association between return on assets (RoA) and firm value. Unlike prior studies, we find that the relation between return on assets and firm value is largely positively and significant for both unadjusted RoA and RoA adjusted for off-balance sheet leases.

4. Capex/Rev: We use the ratio of capital expenditure-to-revenues to control for the investment expenditure of airlines. Consistent with Jin and Jorion (2006), we

find that firm value is positively associated with our proxy for investment opportunities for low-cost carriers and the total samples. For major airlines the association is positive, but not significant.

5. CFO/Rev: To control for internal cash flow generation we use the ratio of cash flow from operations to sales revenue. Consistent with prior studies, we observe a significant positive association between internally generated cash flows and firm value.

6. Fuel/Opex: We add the ratio of fuel expenditures to operating expenses to examine the importance of fuel costs on firm value. We expect this variable to be negatively related to firm value, i.e., an increase in fuel costs will reduce airlines' profit margins. Our results show no direct relation between fuel costs and firm value.

7. Dividends: We add a dummy variable to indicate whether the firm paid a dividend to its ordinary shareholders. This is a test for "reaching the financial market" (Jin and Jorion, 2006). Contrary to prior studies, we observe negative relation between dividends and firm value.

8. Interest rate hedging (HIR): We use a dummy variable to indicate whether a firm has hedged its interest rate exposure or not.

9. Foreign currency risk hedging (HFXP): We control for the foreign currency risk management using a dummy variable. Some US companies (usually low cost carriers) have no foreign currency exposure. Our dummy variable takes into consideration whether an airline company is exposed to foreign currency risk or not. We use an interaction dummy variable where if the firm is exposed to currency risk and hedges we assign a dummy variable (HFXP) of 1, and 0 otherwise. Firms with no exposure to foreign currency risk are not hedging.

However, neither the interest rate nor the currency hedging dummy variable provide information as to the level of hedges in our analysis. Unfortunately, using dummy variables to control for these hedges, we assume that 5% hedging has the same economical substance as 90% hedging.

10. Time effects: We add a time dummy variable for $n-1$ year observations. Our test variable, hedging is robust to time effects.

Panels A and B of Table V present regression results using unadjusted and adjusted Tobin's Q as dependent variables and hedging as a test variable alongside with control variables. Columns 2 and 3 show the results of our estimations for the low-cost carriers sub-sample (LCC), and columns 4 and 5 show the results for major carriers sub-sample (MC). In all regressions we use ordinary least squares (OLS R.) and generalized least squares regressions (GLS. R), both with heteroskedastically adjusted standard errors. The analyses indicate a significant and positive association between hedging and firm value for the low-cost carriers. The results in Panel B are robust to firm value (adjusted Tobin's Q), firm size, firm leverage and profitability control variables, adjusted for off-balance sheet leases in all of the regressions. We do not observe, however, any statistically significant relation between firm value and the percentage of fuel consumption hedged for major airlines.

<<Insert Table V about here>>

In Panels A and B of Table VI we tackle the potential issue of omitted variable bias that may influence the hedging premium for the low cost carrier sub-sample. Following Allayannis and Weston (2001), in columns 2 and 3 in Panel A, we conduct a first-differenced regression on the hedging variable and firm value where the dependent variable in the column 3 is the adjusted Tobin's Q. Our analyses examine whether the value premium from hedging is driven by actual changes in the levels of hedging, enabling us to control for potential omitted variable bias. Results indicate that for both unadjusted and adjusted Q measures, hedging is a robust contributor to firm value for the low cost carriers sub-sample.

In the analysis reported in columns 4 and 5 in Panel A of Table VI, we use quantile regressions to control for the influence of possible outliers. For the analysis in column 4 with unadjusted Q measure as the dependent variable, we observe the association between hedging and firm value is at the p=0.11 level, which is slightly outside the usual significance levels. In column 5, our analysis using adjusted Q measure is robust at p=0.05.

<<Insert Table VI about here>>

Next, in columns 2 and 3 in Panel B of Table VI we conduct fixed effect regressions using both unadjusted and adjusted Tobin's Q as a dependent variable, respectively. Results in both columns indicate that the association between hedging and firm value is robust to potential omitted variable bias for the low cost carriers sub-sample. Additionally, in columns 4 and 5 we allow for correlation within each group of observations (airline companies) using cluster analysis. By relaxing the assumption of independent observations, in both regressions we obtain the same positive results for hedging and firm value for the low cost carriers sub-sample.

Panel A and B of Table VII test for the categorical variable bias. Columns 2 to 5 use a low cost carrier dummy variable (LCCdummy), alongside with its interaction (hedgeLCC) with our test variable; hedging for the total sample for unadjusted and adjusted firm value and control variables. In these analyses we aim to test whether the positive results for hedging and firm value for the low cost carriers are robust to hidden "low cost carrier" firm bias. More precisely, the question we ask is; whether our results are driven by unobservable characteristics of the low cost carriers (managerial abilities etc.). If the direct positive relation between hedging variable and firm value is genuine, then the coefficient between the interaction variable (hedgeLCC) and firm value should be positive regardless of the coefficient between the low cost carrier dummy variable (LCCdummy) and the firm value. We use heteroskedasticity adjusted ordinary least squares regression (OLS R.) and generalized least square regression (GLS. R.), with robust standard errors. In all of the regressions, we observe positive association between the interaction variable (HedgeLCC) and firm value, regardless of the coefficient for low cost carrier categorical variable (LCCdummy). These results indicate that the association between fuel hedging and firm value is robust to a possible low cost carrier firm bias.

The analyses in Panel B of Table VII divide the sample into US, European, and international subsamples and assign $n-1$ dummy variables (USdummy for US firms and EUdummy for EU firms and use international sample as base) to control for the potential influence of jurisdictional differences. Additionally, $n-1$ interaction variables are used to (HedgeUS and HedgeEU for US and European firms, respectively) control for the next year's fuel consumption hedged by airline companies from both regions. This is important since we have a set of global airline companies that are subject to different accounting regulations and industry specific characteristics which we could not control for. We perform heteroskedasticity adjusted ordinary least squares regression (OLS R.) and generalized least square regression (GLS. R.), with robust standard errors in all regressions for both unadjusted and adjusted firm value and control variables. Results indicate that hedging and firm value relation is robust to low cost carrier hedging interaction variable indicating that there is no significant regional level outlier that affects our results.

Finally, Table VIII examines whether there is an influence of government ownership on our results. Hedging and firm value relation for the low cost carrier sample might be driven by the relatively poor financial performance of the major carriers with government ownership. If this is the case, we would expect to see a positive firm value and hedging relation for privately owned major carriers. In this context, in all columns a dummy variable (GOVdummy) is added that takes the value of 1 if the government ownership is at or more than 20% of the total number of outstanding shares and a variable (hedgeGOV) is added to represent the interaction between government ownership and hedging. Columns 2 and 3 conduct categorical variable regression analysis on the unadjusted data for the major carriers sub-sample and columns 4 and 5 conduct categorical variable regression analysis on the adjusted data for the major carriers sub-sample. Both ordinary least squares (OLS R.) and generalized least squares (GLS R.) regressions use heteroskedasticity adjusted robust standard errors. The variable “hedging” in all columns represents the hedging coefficient for privately owned major carriers.

Results in all columns indicate significantly lower firm values for airline companies with government ownership. This is in line with our expectations stated in sections I and III. However, the interaction variable (hedgeGOV) presents no statistical relation between firm value and hedging for these airlines in any of the regressions. Hedging coefficient for major carriers is insensitive to the government ownership control variable. These findings suggest that the results for the low cost carriers might be driven by the investors’ appreciation of greater growth potential and relatively higher sensitivity for internal cash funds for low cost carriers’ business model and as a result, the need for fuel risk management to assure an orderly cash flow stream. Based on 33% average level of hedging for the low cost carrier sample, the coefficient for hedging corresponds to a value premium of 6.5% on average.

IV. Summary and Conclusion

In this paper we use a sample of 54 publicly traded airline companies yielding 411 firm year observations for the13 year period between 2000 and 2012. To the best of our knowledge, this is the largest sample that examines corporate hedging and firm value maximization using actual hedging variables.

The benefits of examining the airline industry can be outlined under four headings. First, the industry is significantly exposed to jet-fuel price risk; the proportion of jet fuel prices has exceeded one third of total operating expenses. Consequently, the industry cash flows and investments are extremely sensitive to adverse movements in oil prices. Second, the percentage levels of jet fuel hedges are readily available for the majority of the airline companies. Third, given the intense competitive environment, the industry can only transfer a limited portion of jet fuel price risks to customers, hence the availability of operational hedges are somewhat limited (excluding regional carriers). And fourth, the industry operates at low profit margins and utilizes significant financial leverage, potentially exposing companies to the risk of financial distress. Our analysis enables us to examine the implications of jet fuel hedging for an industry in which theoretically the benefits from hedging are expected to be highest.

The basic tenet of corporate risk management theory is the reduction in variability of operating cash flows. Necessarily, the first question we ask is whether hedging is useful in reducing variability in internal cash flows? The results of the univariate analysis suggest that the variability in operating cash flows and capital expenditures are significantly lower for hedgers compared to non-hedgers. Multivariate analysis in section IV also indicate that both internal cash flows and capital expenditures are important contributors to firm value.

Additionally, fuel costs as a percentage of total operating expenses are 6% lower for hedging year observations compared to non-hedging year observations. These results indicate the benefits of jet fuel hedging in terms of preserving internal cash funds and alleviating potential underinvestment problems for both low cost carriers and major carriers.

Next, we examine the value premium associated with hedging under conditions when there are information asymmetries and greater risk of financial distress that are inherent in our sample of global airline companies. We separate our sample in two sub-samples of 1) low cost carriers, 2) major carriers. This allows us to control for economically important differences between these two business models, one in its high growth state (low cost carriers) and the other in its mature state (major carriers). Using two Q measures for each regression, one of which is adjusted for off-balance sheet leases, we find that hedging has contributed to firm value for the low-cost carriers with a value premium of 6.5%, on average. We find no association between hedging and firm value for the major carrier sample examined.

At their growth stage we would expect market values of low cost carrier firms to be largely comprised of the present value of future growth opportunities. Lacking implicit/explicit financial support of governments, and significant competition for investment opportunities, we observe that low cost carriers use significantly lower debt financing relative to major carriers. This, in our opinion, makes these high-growth firms more sensitive to the level of internally generated cash flows. Accordingly, we would expect low cost carriers to be more prone to significant underinvestment problems if they are unable to take advantage of investment opportunities due to funding constraints. Our empirical observations suggest that investors acknowledge the potential benefits of hedging for these high-growth firms and reward the awareness and/or penalize the ignorance of risks related to oil prices for these companies. These findings confirm the agency theory of corporate finance.

We subject our results to a number of endogeneity tests where we take potential omitted variable bias into account and additionally control for the influence of government ownership and locational differences among sample airlines. Empirical observation of positive association between hedging and firm value for the low cost carriers sub-sample is stable and statistically robust across these different estimations.

In this paper we find evidence supporting the value maximization via hedging when firms have significant investment opportunities and potential financial distress costs which confirm the theoretical incentive for corporate risk management. Albeit contributing to the empirical evidence documenting the benefits of hedging for commodity end-user risk profile, our results, just as any prior study, may also be influenced by differences in risk management strategies and financial instruments used which could be a subject for further research.

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Table I
Statistical Properties of the Sample

This table exhibits the mean levels of the control variables used in the sample ordered by the highest level of next year's fuel consumption hedged (column 2). Panel A is unadjusted for off-balance sheet leases, and Panel B is adjusted for off-balance sheet leases. In column 1, the first 16 companies are low-cost carriers (LCCs) and the following 38 companies are major carriers (MCs). Columns 2 and 3 show the amount of next year's fuel consumption hedged and the proportion of fuel expenses in total operating costs in percentages. These two data do not change in Panel B. Column 4 exhibits the Return On Assets control variable for profitability calculated as; "Net Income/Total Assets". This ratio is adjusted for off-balance-sheet leases and is lower for each company in Panel B. Columns 5 and 6 measure the financial leverage calculated as; "Total Debt/Shareholder's Equity" and firm size as Log of Assets. Columns 7 and 8 show the levels of cash flows and capital expenditures both scaled by revenues. Column 9 shows the average level of firm value measured by Tobin's Q. Q measure is adjusted for off-balance sheet leases in Panel B.

PANEL A: Firm Level Data Unadjusted for Off-Balance Sheet Leases

	Hedging	F/O	RoA	Lvrg	Lnasset	CF/Rev	Capex/Rev	TBQ
Low Cost Carriers								
Ryanair	73%	32%	6%	1.31	8.29	35%	39%	2.11
Southwest	63%	25%	3%	1.45	9.45	15%	14%	1.54
Vueling	52%	26%	6%	1.43	6.20	10%	0%	1.14
Air Berlin	50%	23%	-2%	6.00	7.70	1%	7%	1.04
Easyjet	46%	23%	4%	1.09	7.57	14%	19%	1.22
Airtran	31%	31%	1%	4.74	7.10	5%	4%	1.47
Virgin Blue	30%	27%	6%	2.14	7.76	19%	27%	1.40
Airasia	30%	46%	6%	2.20	8.81	19%	58%	1.65
GOL	28%	37%	4%	1.77	7.76	7%	9%	1.44
Jetblue	27%	31%	1%	3.19	8.39	15%	39%	1.30
Westjet	19%	27%	5%	1.66	7.53	19%	27%	1.75
Frontier Airlines	8%	23%	0%	3.61	6.44	7%	17%	1.24
Air Arabia	8%	43%	6%	0.16	8.72	24%	13%	0.95
Allegiant	2%	45%	9%	0.86	6.13	17%	11%	2.29
Jazeera	0%	46%	0%	5.11	4.73	15%	35%	1.36
Spice Jet	0%	42%	-12%	13.41	9.28	-7%	18%	1.86
Major Carriers								
ANA	77%	18%	1%	3.36	14.35	10%	15%	1.22
Lufthansa	74%	16%	1%	3.13	9.99	10%	8%	1.02
JAL	73%	18%	-20%	7.89	14.54	4%	6%	1.18
British Airways	60%	28%	3%	3.99	9.31	9%	5%	1.05
IAG	60%	37%	-5%	2.92	9.90	2%	7%	0.95
Aer Lingus	59%	24%	0%	1.29	7.53	4%	6%	0.95
Air New Zealand	58%	33%	2%	2.08	8.51	12%	13%	0.95
Qantas	57%	23%	2%	2.36	9.91	10%	10%	0.99
Air France KLM	55%	22%	1%	2.89	10.10	7%	10%	0.90
Finnair	53%	21%	0%	1.75	7.52	6%	9%	0.95

Aeromexico	50%	35%	7%	3.10	10.12	8%	7%	1.38
SAS AB	49%	17%	-3%	2.82	10.79	0%	7%	0.92
Iberia	47%	21%	3%	2.15	8.60	4%	6%	1.10
Alaska Airlines	42%	24%	1%	3.86	8.23	12%	13%	1.12
Hawaiian	37%	29%	3%	7.77	6.93	11%	10%	1.15
El Al Israel	37%	37%	-1%	7.97	8.76	6%	8%	0.98
LAN	36%	36%	7%	4.66	14.52	18%	22%	1.94
Thai	36%	36%	1%	3.27	12.47	9%	11%	0.99
Cathay Pacific	33%	36%	4%	1.47	11.62	12%	11%	1.14
Singapore	33%	32%	5%	0.69	10.00	20%	19%	1.14
United	30%	32%	9%	13.90	10.23	6%	2%	1.07
Latam	28%	35%	2%	3.62	9.44	13%	25%	1.57
Atlantic Airways	28%	26%	3%	0.74	6.00	17%	10%	0.74
Delta	27%	29%	-10%	33.48	10.40	3%	5%	1.00
Air Canada	25%	27%	-1%	4.04	9.27	3%	7%	0.88
AMR Corp	24%	24%	-3%	69.35	10.23	4%	8%	1.01
Copa	23%	37%	10%	1.77	7.61	22%	23%	1.65
Air China	16%	36%	3%	2.53	11.57	17%	18%	1.41
Aegean	16%	26%	2%	1.14	6.02	4%	4%	1.08
China Eastern	15%	34%	-2%	12.75	11.34	8%	10%	1.62
US Airways	9%	27%	-2%	33.43	8.95	2%	2%	1.18
Turkish Airlines	5%	27%	6%	1.84	8.50	15%	8%	1.07
Jet Airways	0%	34%	-1%	25.29	11.92	5%	21%	1.33
Kingfisher	0%	37%	-18%	4.78	11.27	-13%	3%	0.89
Hainan	0%	35%	1%	5.59	11.07	24%	40%	1.11
Asiana	0%	35%	0%	4.98	8.59	6%	4%	1.06
China Southern	0%	34%	3%	3.72	11.61	16%	23%	1.03
Pakistan Air.	0%	37%	-5%	27.57	11.33	1%	10%	1.10

PANEL B: Firm Level Data Adjusted for Off-Balance Sheet Leases

	Hedging	F/O	RoA	Lvrg	Lnasset	CF/Rev	Capex/Rev	TBQ
Low Cost Carriers								
Ryanair	73%	32%	6%	1.44	8.35	35%	39%	2.02
Southwest	63%	25%	3%	1.89	9.61	15%	14%	1.44
Vueling	52%	26%	4%	2.71	6.61	10%	0%	1.10
Air Berlin	50%	23%	-1%	11.67	8.20	1%	7%	1.02
Easyjet	46%	23%	4%	1.35	7.68	14%	19%	1.17
Airtran	31%	31%	0%	15.00	8.15	5%	4%	1.14
Virgin Blue	30%	27%	5%	2.86	7.97	19%	27%	1.32
Airasia	30%	46%	6%	2.37	8.85	19%	58%	1.58
GOL	28%	37%	3%	2.56	8.02	7%	9%	1.33

Jetblue	27%	31%	1%	4.32	8.63	15%	39%	1.22
Westjet	19%	27%	4%	2.53	7.82	19%	27%	1.55
Frontier Airlines	8%	23%	-1%	4.47	7.23	7%	17%	1.09
Air Arabia	8%	43%	6%	0.25	8.79	24%	13%	0.95
Allegiant	2%	45%	9%	0.94	6.17	17%	11%	2.29
Jazeera	0%	46%	0%	5.11	4.73	15%	35%	1.25
Spice Jet	0%	42%	-5%	-0.98	10.15	-7%	18%	1.47
Major Carriers								
ANA	77%	18%	1%	3.72	14.43	10%	15%	1.18
Lufthansa	74%	16%	1%	3.34	10.04	10%	8%	1.02
JAL	73%	18%	-17%	9.24	14.68	4%	6%	1.10
British Airways	60%	28%	3%	4.76	9.45	9%	5%	1.04
IAG	60%	37%	-4%	3.70	10.08	2%	7%	0.96
Aer Lingus	59%	24%	0%	1.52	7.62	4%	6%	0.96
Air New Zealand	58%	33%	2%	2.61	8.67	12%	13%	0.95
Qantas	57%	23%	2%	2.86	10.04	10%	10%	0.98
Air France KLM	55%	22%	1%	3.28	10.23	7%	10%	0.91
Finnair	53%	21%	0%	1.68	7.52	6%	9%	0.96
Aeromexico	50%	35%	2%	5.25	10.54	8%	7%	1.25
SAS AB	49%	17%	-3%	2.82	10.79	0%	7%	0.92
Iberia	47%	21%	2%	2.97	8.83	4%	6%	1.08
Alaska Airlines	42%	24%	1%	5.02	8.43	12%	13%	1.07
Hawaiian	37%	29%	1%	15.76	7.52	11%	10%	1.09
El Al Israel	37%	37%	-1%	8.16	8.78	6%	8%	0.99
LAN	36%	36%	5%	1.81	14.83	18%	22%	1.73
Thai	36%	36%	1%	3.27	12.47	9%	11%	0.98
Cathay Pacific	33%	36%	3%	1.74	11.73	12%	11%	1.13
Singapore	33%	32%	5%	0.82	10.07	20%	19%	1.13
United	30%	32%	6%	12.10	10.54	6%	2%	1.05
Latam	28%	35%	2%	3.82	9.48	13%	25%	1.54
Atlantic Airways	28%	26%	3%	1.12	6.04	17%	10%	0.81
Delta	27%	29%	-7%	28.02	10.65	3%	5%	0.99
Air Canada	25%	27%	-1%	3.81	9.43	3%	7%	0.89
AMR Corp	24%	24%	-3%	57.64	10.50	4%	8%	1.00
Copa	23%	37%	9%	2.06	7.71	22%	23%	1.61
Air China	16%	36%	1%	2.94	11.68	17%	18%	1.38
Aegean	16%	26%	1%	2.10	6.40	4%	4%	1.08
China Eastern	15%	34%	-2%	15.20	11.51	8%	10%	1.59
US Airways	9%	27%	0%	49.90	9.73	2%	2%	1.08
Turkish Airlines	5%	27%	6%	1.98	8.54	15%	8%	1.07
Jet Airways	0%	34%	-1%	40.33	12.78	5%	21%	1.17
Kingfisher	0%	37%	-10%	-5.93	11.82	-13%	3%	0.92

Hainan	0%	35%	1%	6.33	11.17	24%	40%	1.10
Asiana	0%	35%	0%	6.51	8.82	6%	4%	1.13
China Southern	0%	34%	3%	4.85	11.81	16%	23%	1.02
Pakistan Air.	0%	37%	-5%	20.82	11.35	1%	10%	1.10

Table II
Descriptive Statistics

Panel A summarizes the total firm–year data observable for various levels of hedging percentages (abbreviated as H) for three main subsamples studied in the analysis and for additional regional samples. The table ranges from zero hedging in column 2 to 90% hedging in column 10. In columns 2 to 10 we also summarize the ratio of total number of firm-years in each hedging level. The subsamples; Total sample, Low-Cost Carriers (LCC) sample and Major Carriers (MC) sample, are the main samples we study. We also display the statistics for a regional samples examining the US, European. and international companies. The mean levels of hedging are 35% for the “total sample”, 33% for the “LCC sample”, 35% for the “major carriers sample”, 26% for the “US sample”, 49% for the “European sample”, and 26% for the “international sample”. Panels B and C tabulate the mean levels for the control variables used. Panel B uses unadjusted data. Panel C uses “off-balance-sheet leasing” adjusted data where the present values of operating leases are added back on “Total Assets” and “Total Debt”, which in turn adjust “Return on Assets”, “Financial Leverage” and “Tobin’s Q”. The first three study groups are “total sample”, “low cost carriers” and “major carriers” sample. We also present summary statistics for additional regional subsamples in both panels: US firms, European firms, and International firms. In Panel B and C, Columns 2, 3, and 4 show the mean levels of fuel cosnumption hedged, the ratio of fuel cost to operating expenses, and return on assets (Net Income/Total Assets) in percentages. Columns 5 and 6 show the amount of financial leverage used (Total Debt/Total Equity) and the natural logarithm of the assets. In columns 8, 9, and 10 we display cash flow from operations and capital expenditures both scaled by revenues (CFO/Rev and Capex/Rev) and unadjusted and adjusted values of Tobin’s Q. The only variables that are different in Panels B and C are profitability, leveage, firm size control variables, and the firm value. Panel D provides further summary statistics. Columns 1, 2, and 3 show the number of airline companies and the number of hedging and non-hedging airlines for each subsample. Columns 4 and 5 show the average and median market capitalizations in US dollars for each group. Column 6 shows the proportion of off-balance sheet leases used relative to total assets.

Panel A: Distribution of Firm Year Observations per Hedging Percentage Level

SAMPLE GROUPS	H≤0%	H≤10%	H≤20%	H≤Mean	H≤50%	H≤60%	H≤70%	H≤80%	H≤90%
Study Sample	88	101	142	201	297	333	363	392	405
Total Sample									
LCC Sample	33	42	57	82	97	106	114	127	134
MC Sample	55	59	85	124	200	227	249	265	271
Pct. of Total S.	22%	25%	35%	49%	73%	81%	89%	96%	99%
Pct. of LCCs	24%	31%	42%	60%	71%	78%	84%	93%	99%
Pct. of MCs	20%	21%	30%	44%	71%	81%	89%	94%	97%
Reg. Sample									
US Airlines	20	29	52	64	115	118	121	125	127
European Air.	9	12	18	48	51	72	96	111	120
Int. Airlines	59	59	71	84	128	140	144	153	155
Pct. of US S.	16%	23%	41%	50%	90%	92%	95%	98%	99%
Pct. of EU S.	7%	10%	15%	39%	42%	59%	79%	91%	98%
Pct. of INT S.	37%	37%	45%	53%	81%	88%	91%	96%	97%

PANEL B: Summary Statistics of Unadjusted Control Variables

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	Hedging	Fuel/Opex	ROA	Lvrg.	Log(assets)	CFO/Rev	Capex/Rev	TBQ
Study Sample								
Total Sample	34%	28%	1%	6.7	9.1	11%	14%	1.2
LCC Sample	32%	30%	3%	2	8	16%	23%	1.48
MC Sample	34%	28%	0%	8.5	9.7	8.6%	10.7%	1.13
Regional Sample								
US Airlines	27%	28%	1.0%	14.5	8.3	8.6%	11.7%	1.3
Euro. Airlines	48%	23%	2.0%	2.2	8.3	9.2%	10.0%	1.1
Int. Airlines	26%	33%	0.9%	3.6	10.0	10.7%	15.3%	1.2

Panel C: Summary Statistics of Control Variables Adjusted for Off-Balance Sheet Leases

	Hedging	Fuel/Opex	RoA	Lvrg.	Log assets	CFO/Rev	Capex/Rev	TBQ
Study Sample								
Total Sample	34%	28%	1%	9.6	9.4	11%	14%	1.18
LCC Sample	32%	30%	3%	4.3	8.1	16%	23%	1.40
MC Sample	34%	28%	1%	11.8	9.9	9%	11%	1.08
Regional Sample								
US Airlines	27%	28%	1%	8.7	21.9	9%	12%	1.22
Euro. Airlines	48%	23%	2%	3.1	8.5	9%	10%	1.10
Int. Airlines	26%	33%	1%	10.2	5.0	11%	15%	1.19

Panel D: Average Market Capitalization and Off-Balance Sheet Leasing Used

	Num. Firms	Hedging	Non-Hedging	MCAP $ (mean)	MCAP $ (median)	Off-BS Leases/T. Assets
Study Sample						
Total Sample	54	45	10	3605	1905	31%
LCC Sample	17	13	4	2842	1300	41%
MC Sample	38	32	6	3985	2432	24%
Regional Sample						
US Airlines	13	13	0	2699	1347	33%
Euro. Airlines	14	13	0	3753	1944	15%
Int. Airlines	27	19	8	3170	1933	27%

Table III
Test of Cash Flow Variability and Fuel Cost Efficiency

In Panel A, we statistically analyze the differences among hedging-firm year observations and non-hedging firm year observations. We compare the mean and median values of both unadjusted firm value (UAQ) and adjusted firm value (Adj.Q), capital expenditures (Capex/Rev), operating cash flows (CFO/Rev), return on assets (RoA), fuel costs as a percentage of operating expenses (Fuel/Opex) and leverage (Leverage) for hedging and non-hedging firm-year observations. Additionally we also estimate standard deviations of all the control variables. In Panel B we compare the same control variables as in the Panel A for low-cost carriers and major carriers. In both Panel A and B, we assume unequal variance for mean differences using Welch (1947) degress of freedom and Wilcoxon (1945) rank-sum test for the median differences. In the final columns of Panels A and C we report p values of statistical significance. Numbers in brackets are critical t-values. Star signs above the paranthesis represents significance levels; * used for 10%, ** used for 5% and *** used for 1% significance levels.

In Panel B we analyze the relation between Fuel/Opex and the percentage of the next year's fuel consumption hedged (hedging (t-1)) at time (t-1). We use the equally weighted average of spot market jet fuel prices and firm size as control variables.

$$\text{Fuel Costs/Opex (t)} = \beta 1\times \text{Hedging (t-1)}+\beta 2\times\text{Avg.(Jet Fuel Prices)} + \beta 3\times\text{Log (Assets)} + \square$$

Panel A: Univariate Test of Control Variables for the Hedging and Non-Hedging Firm-Year Observations

Variable	Hedgers Sample	Non-Hedgers Sample	Difference	*t*-statistics (mean) *z*-statistics (median)	p-Value
UAQ (mean)	1.23	1.3	-0.08	-1.3	0.2
UAQ (median)	1.09	1.13	-0.04	-1.3	0.2
UAQ Std. Dev.	49%	48%	0.01	0	1
Adj.Q. (mean)	1.18	1.23	-0.05	-1	0.3
Adj.Q. (median)	1.08	1.1	-0.02	-0.4	0.7
Adj. Q Std. Dev.	42%	36%	0.05	0	1
Capex /Rev (mean)	13.4%	17.4%	-4%	-2	0
Capex/Rev (median)	10%	10%	0%	-0.3	0.7
Capex/Rev Std. Dev.	15%	21%	-6%	0.4	0.7
CFO/Rev (mean)	10.7%	9.30%	1.4%	1.1	0.3
CFO/Rev (median)	10.4%	11%	-0.6%	0.1	0.9
CFO/Rev Std. Dev.	10%	14%	-4%	2.3	0.02
RoA (mean)	1.5%	0.00%	1.5%	1.2	0.2
RoA (median)	2.3%	3.00%	-1.3%	-0.2	0.9
RoA Std. Dev.	10%	10%	0%	0	1
RoA Adj. (mean)	1.2%	0.7%	0.5%	0.6	0.6
RoA. Adj. (median)	1.8%	1%	0.8%	0	1
RoA. Adj. Std. Dev.	8%	7%	1%	0	1
Fuel/Opex (mean)	28%	34%	-6%	-5.8	0
Fuel/Opex (median)	29%	31%	-2%	-5.7	0
Fuel/Opex Std. Dev.	9%	9%	0%	0	1

Leverage (mean)	5	11.6	-6%	-3.6	0
Leverage (median)	2.5	4.2	-1.7%	7.1	0
Leverage Std. Dev.	12%	24%	-12%	0	1
Leverage Adj. (mean)	6.8	18.2	-11%	-4.4	0
Leverage Adj. (median)	3	5.2	-2.2%	-4	0
Leverage Adj. Std. Dev.	15%	37%	-21%	0	1

Panel B: Univariate Test of Control Variables for the Low Cost and Major Carriers

Variable	LCC Sample	MC Sample	Difference	*t*-statistic (mean) *z*-statistic (median)	p-Value
UAQ (mean)	1.48	1.13	0.35	7.89	0
UAQ (median)	1.31	1.06	0.25	26	0
Adj.Q (mean)	1.38	1.1	0.28	7.37	0
Adj.Q (median)	1.2	1.04	0.16	28.4	0
Hedging (mean)	33%	35%	-2%	-0.67	0.5
Hedging (median)	30%	34%	-4%	-1.79	0.18
Capex /Rev (mean)	23%	11%	12%	6.9	0
Capex/Rev (median)	15%	8%	7%	16	0
CFO/Rev (mean)	16%	9%	7%	5.95	0
CFO/Rev (median)	14%	9%	5%	17.95	0
RoA (mean)	3%	1%	2%	2.31	0.02
RoA (median)	4%	2%	2%	14.39	0
RoA Adj. (mean)	3%	1%	2%	2.44	0.02
RoA. Adj. (median)	3%	1%	2%	9.8	0
Fuel/Opex (mean)	30%	28%	2%	2.692	0
Fuel/Opex (median)	29%	28%	1%	0.3	0.59

Panel C: Dependent Variable is Fuel Costs/Operating Expenses

	Total Sample	LCC Sample	MC Sample
Observations	334	120	235
R^2	0.39	0.51	0.24
Hedging (t-1)	-0.122*** (-8.65)	-0.08*** (-3.49)	-0.153*** (-9.48)
Jet Fuel Prices	0.0016*** (13.45)	0.0019*** (9.13)	0.0015*** (11.05)
Log (assets)	0.0003 (0.16)	0.008 (1.59)	0.006*** (2.93)

Table IV
Univariate Test of Government Ownership

Panel A conducts a univariate test on the differences between mean and median values of both unadjusted firm value (UAQ) and adjusted firm value (Adj.Q), hedging, capital expenditures (Capex/Rev), operating cash flows (CFO/Rev), return on assets (RoA), and fuel costs as a percentage of operating expenses (Fuel/Opex) for airline companies with government ownership to privately owned airline companies. The first column lists the control variables tested. The second and third columns list the parameters for privately owned and airlines with government ownership respectively. The fourth column shows the differences between control variable and column five displays statistical significance of the differences. We assume unequal variance for mean differences using Welch (1947) degress of freedom and Wilcoxon (1945) rank-sum test for the median differences. In the final column we report p values of statistical significance.

Panel A: Univariate Test for Airlines with Government Ownership vs. Private Ownership

Variables	Priv. Own	Gov. Own	Difference	*t*-statistics (mean) *z*-statistics (median)	p-Value
UAQ (mean)	1.31	1.06	0.26	7.20	0.00
UAQ (median)	1.14	0.98	0.16	6.81	0.00
Adj.Q (mean)	1.11	1.06	0.04	5.86	0.00
Adj.Q (median)	1.24	0.99	0.25	6.08	0.00
Hedging (mean)	35%	30%	5%	2.21	0.00
Hedging (median)	37%	29%	8%	2.00	0.05
Capex /Rev (mean)	16%	12%	4%	3.56	0.00
Capex/Rev (median)	10%	9%	1%	1.59	0.11
CFO/Rev (mean)	11%	10%	1%	2.70	0.00
CFO/Rev (median)	11%	8%	3%	2.52	0.01
RoA (mean)	1.4%	0.5%	1%	1.10	0.27
RoA (median)	2.7%	1.8%	1%	2.69	0.00
RoA Adj. (mean)	1.4%	0.5%	1%	1.58	0.12
RoA. Adj. (median)	2%	1.4	0.6%	2.50	0.01
Fuel/Opex (mean)	29%	30%	0%	1.06	0.29
Fuel/Opex (median)	29%	31%	0%	0.78	0.44

Panel B: Univariate Test for Major Carriers with Government Ownership vs. Private Ownership

Variable	Non-Gov.MC	Gov. MC	Difference	*t*-statistics (mean) *z*-statistics (med.)	p-Value
UAQ (mean)	1.15	1.06	0.09	3.09	0.00
UAQ (median)	1.09	0.98	0.12	4.63	0.00
Adj.Q (mean)	1.11	1.06	0.04	2.05	0.04
Adj.Q Measure (median)	1.06	0.99	0.07	3.83	0.00
Hedging (mean)	39%	26%	13%	2.88	0.00
Hedging (median)	38%	29%	9%	2.53	0.01
Capex /Rev (mean)	10%	12%	-2%	-0.28	0.78
Capex/Rev (median)	8%	9%	-1%	-0.40	0.62
CFO/Rev (mean)	9%	10%	-1%	0.32	0.74
CFO/Rev (median)	9%	8%	1%	0.69	0.49
RoA (mean)	0%	0%	0%	-0.17	0.87
RoA (median)	2%	2%	0%	0.74	0.46
RoA Adj. (mean)	0%	0%	0%	0.06	0.95
RoA. Adj. (median)	1%	1%	0%	0.70	0.49
Fuel/Opex (mean)	27%	29%	-2%	-0.82	0.41
Fuel/Opex (median)	27%	29%	-2%	-0.82	0.39

Table V
Multivariate Analysis of Firm Value and Hedging

Panel A below displays the regression analysis examining the relationship between firm value and hedging for the 2 sub-sample groups examined; low cost carriers sample and major carriers sample. In Panel A we analyse firm value and hedging relationship using the following model:

$$\text{Log of Tobins Q} = \beta_1 \times \text{Hedging} + \Sigma(\beta i \times \text{Conrol Variable i}) + \varepsilon.$$

There are a total of 411 firm-years of which 136 belong to the low cost carriers sample and 275 belong to the major carriers sample. Panel A examines the relation between unadjusted firm value and hedging. Panel B examines the relation between firm value adjusted for off-balance sheet leases and hedging. For all samples examined, we use the usual ordinary least squares model with Huber-Sandwich robust standard errors (OLS R.) and the genealize least squares regression with robust standard errors adjusted for heteroskedasticity (GLS R.). Numbers in paranthesis represent t-values for the OLS models and z-values for FGLS model. Numbers in brackets represent critical t and z values for OLS and FGLS regressions respectively. Star signs above the parantheses represents significance levels; * used for 10%, ** used for 5% and *** used for 1% significance levels.

Panel A: Dependent Variable is Unadjusted Tobin's Q				
	LCC Sample		MC Sample	
	OLS R.	GLS R.	OLS R.	GLS R.
Observations	136	136	275	275
R^2	0.4		0.28	
Wald chi^2		118.26		83.49
Log(assets)	-0.079** (-2.51)	-0.12*** (-5.15)	0.03*** (4.82)	0.02*** (4.39)
Leverage	0.005 (1.03)	0.0011 (0.39)	0.0003 (1.41)	0.0001 (0.95)
ROA	1.11 (2.3)	1.34*** (3.8)	0.39 (1.44)	0.152** (2.65)
Fuel/Opex	0.17 (0.45)	0.064 (0.24)	0.264 (1.00)	-0.05 (-0.41)
Hedge	**0.25** (2.27)**	**0.36*** (3.81)**	**-0.013 (-0.25)**	**-0.043 (-1.20)**
CFO/Rev	0.41 (1.48)	0.65** (2.69)	0.29* (1.67)	0.49** (2.66)
Capex/Rev	0.35*** (3.15)	0.29*** (2.81)	0.24 (1.42)	0.104 (0.86)
Dividends	-0.11 (-1.06)	0.00 (0.13)	0.013 (0.45)	-0.002 (1.32)
HIR	-0.017 (-0.30)	-0.01 (-0.24)	0.04* (1.86)	0.146 (0.73)
HFXP	-0.07 (-1.29)	-0.08 (-1.04)	-0.146 (-4.77)	-0.115 (-5.18)

Panel B: Dependent Variable is Adjusted Tobin's Q				
	LCC Sample		MC Sample	
	OLS R.	GLS R.	OLS R.	GLS R.
Observations	136	136	275	275
R^2	0.37		0.28	
Wald chi^2		133.68		95.74
Log(assets)	-0.060** (-2.24)	-0.083*** (-4.20)	0.025*** (4.47)	0.018*** (4.11)
Leverage	-0.0018 (-0.72)	-0.0002 (-0.24)	0.0001 (2.05)	0.0000 (1.24)
ROA	2.05*** (3.26)	1.83*** (3.92)	0.33 (1.92)	0.19 (2.43)
Fuel/Opex	0.16 (0.55)	0.17 (0.83)	0.10 (-0.33)	-0.10 (-1.17)
Hedge	**0.24** (2.10)**	**0.33*** (4.06)**	**-0.056 (-0.75)**	**-0.07 (-0.23)**
CFO/Rev	0.196 (0.73)	0.43** (2.09)	0.485** (2.22)	0.43*** (2.90)
Capex/Rev	0.284*** (3.13)	0.27*** (3.13)	0.188 (1.16)	0.078 (0.86)
Dividends	-0.107 (-1.15)	-0.019 (-0.34)	0.0045 (1.05)	0.027 (1.65)
HIR	0.018 (0.39)	-0.00 (-0.19)	0.032 (1.46)	0.012 (0.70)
HFXP	-0.062 (-1.26)	-0.04 (-1.14)	-0.114 (-4.40)	-0.097 (-5.00)

Table VI
Low Cost Carriers Robustness Analysis I

Panel A and B of Table VI conduct robustness checks on the value premia obtained for low-cost carriers hedging practices. Columns 2 and 3 present OLS regression results on the first differenced data analysis for unadjusted and adjusted firm value and control variables.

$$\Delta\text{Log of Unadjusted/Adjusted Tobin's Q} = \beta 1 + \beta 2 \times(\Delta\text{Percentage Hedged}) + \Sigma i\times(\beta i \times \Delta\text{Control Variable i}) + \varepsilon$$

Columns 4 and 5 provide a quantile regression analysis on unadjusted and adjusted firm value and control variables. Columns 2 and 3 of Panel B perform fixed effects models for both unadjusted and adjusted firm value and control variables. Columns 4 and 5 of Panels B use Quantile regressions on both unadjusted and adjusted firm value and control variables. Star signs above the paranthesis represents significance levels; * used for 10%, ** used for 5% and *** used for 1% significance levels.

Panel:A Dependent Variable Log of Tobin's Q				
	First Diff.	First Diff. Adj.	Quantile	Quantile Adj.
Observations	120	120	136	136
R^2	0.35	0.31	0.2183	0.2
Log(assets)	-0.36*** (-4.1)	-0.52*** (-3.40)	-0.064*** (-2.18)	-0.041** (-1.76)
Leverage	0.003 (1.26)	-0.0017 (-1.43)	0.013*** (3.03)	-0.0001 (-0.1)
Roa	1.083*** (5.17)	1.24*** (3.70)	1.063** (2.27)	0.91 (1.44)
Fuel/Opex	0.15 (0.39)	0.36 (0.67)	-0.418 (-1.14)	-0.12 (-0.43)
Hedge	**0.167** (2.00)**	**0.315*** (2.74)**	**0.208 (1.60)**	**0.198** (1.91)**
CFO/Rev	0.15 (0.87)	0.028 (0.13)	0.473 (1.49)	0.47** (1.78)
Capex/Rev	-0.065 (-0.62)	-0.16 (-0.96)	0.33** (2.18)	0.298** (2.40)
Dividends	-0.022 (-0.35)	-0.0035 (-0.06)	-0.002 (-0.02)	-0.0037 (-0.05)

Panel B: Dependent Variable Log of Tobin's Q				
	FE	FE Adj.	Cluster	Cluster Adj.
Observations	136	136	136	136
R^2	0.72	0.69	0.33	0.37
Log(assets)	-0.33*** (-8.96)	-0.29*** (8.96)	-0.078 (-1.27)	-0.065 (-1.11)
Leverage	0.000 (0.32)	0.000 (-1.41)	0.003 (1.30)	-0.018* (-1.79)
Roa	1.09*** (4.47)	1.02*** (4.47)	1.10*** (3.29)	2.05*** (4.50)
Fuel/Opex	0.08 (0.24)	0.08 (0.24)	0.333 (1.11)	0.16 (0.36)
Hedge	**0.29*** (3.40)**	**0.26*** (3.4)**	**0.17 (1.25)**	**0.24* (1.91)**
CFO/Rev	0.28 (1.39)	0.15 (0.82)	0.41 (1.38)	0.18 (0.65)
Capex/Rev	0.07 (0.73)	0.17 (0.2)	0.35*** (2.89)	0.30*** (2.54)
Dividends	-0.1 (-1.58)	-0.006 (-1.60)	-0.10** (-0.80)	-0.95 (-0.85)
HIR	0.019 (0.26)	0.033 (0.54)	-0.17 (-0.16)	0.018 (0.19)
HFXP	0.20 (0.22)	0.00 (0.04)	-0.07 (-0.76)	-0.06 (-0.76)

Table VII
Low Cost Carriers Robustness Analysis II

Panels A and B performs categorical variable regression. Panel A use low cost carrier dummy variable (lccdummy) and interaction variable (hedgeLCC). Columns 2 and 3 perform ordinary least squares (OLS R.) regression with heteroskedastically adjusted standard errors on both unadjusted and adjusted firm value and control variables. Columns 4 and 5 perform generalized least squares (GLS R.) regression with heteroskedastically adjusted standard errors on both unadjusted and adjusted firm value and control variables. Columns 2 and 3 in Panel B use regional dummy variables (USdummy and EUdummy to represent US firms and European firms, respectively) and to apply international carriers as base. Additionally, the analyses use interaction variables hedgeUS and hedgeEU which control for the level of fuel consumption hedged by each region. "hedging" control variable in column 4 represents the level of fuel consumption hedged for privately held major carriers only. All of the regression in both panels use heteroskedastically adjusted standard errors. Star signs above the paranthesis represents significance levels; * used for 10%, ** used for 5% and *** used for 1% significance levels. Numbers in brackets are critical t-values.

Panel A: Dependent Variable Log of Tobin's Q				
	OLS R.	OLS R. Adj.	GLS R.	GLS R. Adj.
Observations	411	411	411	411
R^2	0.32	0.33		
Wald chi^2			210.56	198.47
Log(assets)	0.014** (1.82)	0.01*** (1.53)	0.006 (1.38)	0.05 (1.39)
Leverage	0.000 (1.17)	0.0002 (1.46)	0.000 (1.21)	0.0001* (1.68)
Roa	0.46*** (3.40)	0.51* (1.84)	0.43** (4.13)	0.40*** (3.44)
Fuel/Opex	-0.006 (-0.04)	0.36 (0.67)	-0.08 (-0.95)	-0.12 (-0.43)
Hedge	-0.029 (-0.42)	-0.034 (-0.69)	-0.05 (-1.50)	0.20** (1.91)
CFO/Rev	0.48*** (3.29)	0.50*** (3.29)	0.41*** (4.05)	0.47** (1.78)
Capex/Rev	0.35*** (3.97)	0.31*** (4.01)	0.33** (4.12)	0.30*** (2.40)
Dividends	-0.03 (-0.98)	-0.008 (-0.31)	-0.01 (-0.62)	-0.003 (-0.05)
LCCdummy	0.16*** (3.47)	0.08* (1.77)	0.13*** (3.26)	0.05 (1.63)
HedgeLCC	**0.16* (1.65)**	**0.22** (1.97)**	**0.21** (2.31)**	**0.26*** (3.40)**

Panel B: Dependent Variable Log of Tobin's Q				
	OLS R.	OLS R. Adj.	GLS R.	GLS R. Adj.
Observations	411	411	411	411
R^2	0.34	0.35		
Wald chi^2			274.5	239.67
Log(assets)	0.000 (1.03)	0.003 (0.36)	-0.02 (-0.51)	-0.001 (-0.23)
Leverage	0.000 (1.07)	0.0002 (1.23)	0.000 (1.01)	0.0001 (1.49)
Roa	0.47* (1.84)	0.53** (1.97)	0.41*** (3.80)	0.38*** (3.28)
Fuel/Opex	-0.185 (-1.03)	0.06 (-0.35)	-0.22** (-2.3)	-0.13 (-1.53)
Hedge	0.06 (0.70)	0.04 (0.50)	0.03 (0.61)	0.02 (0.04)
CFO/Rev	0.46*** (2.65)	0.47*** (3.20)	0.37*** (3.64)	0.37*** (3.78)
Capex/Rev	0.32*** (3.19)	0.29*** (3.78)	0.24*** (3.40)	0.23*** (3.82)
Dividends	-0.05 (-1.34)	-0.02 (-0.81)	-0.025 (-1.29)	-0.02 (-1.09)
LCCdummy	0.13** (2.10)	0.06 (1.16)	0.12*** (2.83)	0.05 (1.28)
HedgeLCC	**0.21** **(1.56)**	**0.27**** **(2.25)**	**0.18**** **(2.03)**	**0.25***** **(3.17)**
USdummy	-0.003 (-0.05)	0.002 (0.05)	-0.064* (-1.68)	-0.06** (-1.98)
EUdummy	-0.14 (-1.80)	-0.10 (-1.42)	-0.14*** (-2.89)	-0.10** (-2.18)
hedgeUS	-0.11 (-0.67)	-0.14 (-0.90)	0.076 (0.73)	0.05 (0.64)
hedgeEU	-0.024 (-0.17)	-0.03 (-0.24)	0.0195 (0.22)	0.005 (0.06)
constant	0.065 (0.49)	0.011 (0.09)	0.14 (2.09)	0.09 (1.36)

Table VIII
Government Ownership Analysis

The table below represents the results of the analysis examining the effects of government ownership in our earlier results. Columns 2 and 3 perform ordinary least squares (OLS R.) regression with heteroskedastically adjusted standard errors on both unadjusted and adjusted firm value and control variables. Columns 4 and 5 perform generalized least squares (GLS R.) regression with heteroskedastically adjusted standard errors on both unadjusted and adjusted firm value and control variables. The dummy variable (GOVdummy) represents the government ownership in excess of 20% of the total shares outstanding. The interaction variable (HedgeGOV) represents the combined effect of hedging variable and government ownership on firm value. "hedging" test variable represents the consumption of jet fuel hedged for privately owned major carriers. Star signs above the paranthesis represents significance levels; * used for 10%, ** used for 5% and *** used for 1% significance levels. Numbers in brackets are critical t-values.

Dependent Variable Log of Tobin's Q				
	OLS R.	OLS R. Adj.	GLS R.	GLS R. Adj.
Observations	0.27	275	275	275
R^2	0.34	0.25		
Wald chi^2			101.57	92.41
Log(assets)	0.025 (3.33)	0.02 (2.97)	0.025 (4.03)	0.02 (3.69)
Leverage	0.000 (1.08)	0.0002 (1.35)	0.000 (0.67)	0.0001 (0.67)
Roa	0.28* (1.47)	0.34** (2.04)	0.28*** (2.47)	0.34 (2.77)
Fuel/Opex	0.15 (1.31)	0.15 (1.45)	0.15 (1.04)	0.15 (1.14)
Hedge	-0.04 (-0.53)	-0.015 (-0.26)	-0.04 (-0.55)	-0.015 (-0.24)
CFO/Rev	0.51 (2.86)	0.44 (3.16)	0.50 (3.12)	0.45** (3.14)
Capex/Rev	0.32 (1.85)	0.22 (1.51)	0.32*** (2.39)	0.22** (1.85)
Dividends	-0.006 (0.22)	0.014 (0.61)	0.005 (0.22)	-0.015 (0.64)
GOVdummy	-0.083 (-1.67)	-0.12 (-0.45)	-0.08 (-2.04)	-0.02 (-0.55)
HedgeGOV	-0.091 (-0.89)	-0.13 (-1.52)	-0.091 (-0.95)	-0.14 (-1.59)
Constant	-0.23 (-2.8)	-0.22 (-2.84)	-0.24 (-3.29)	-0.22 (-3.37)

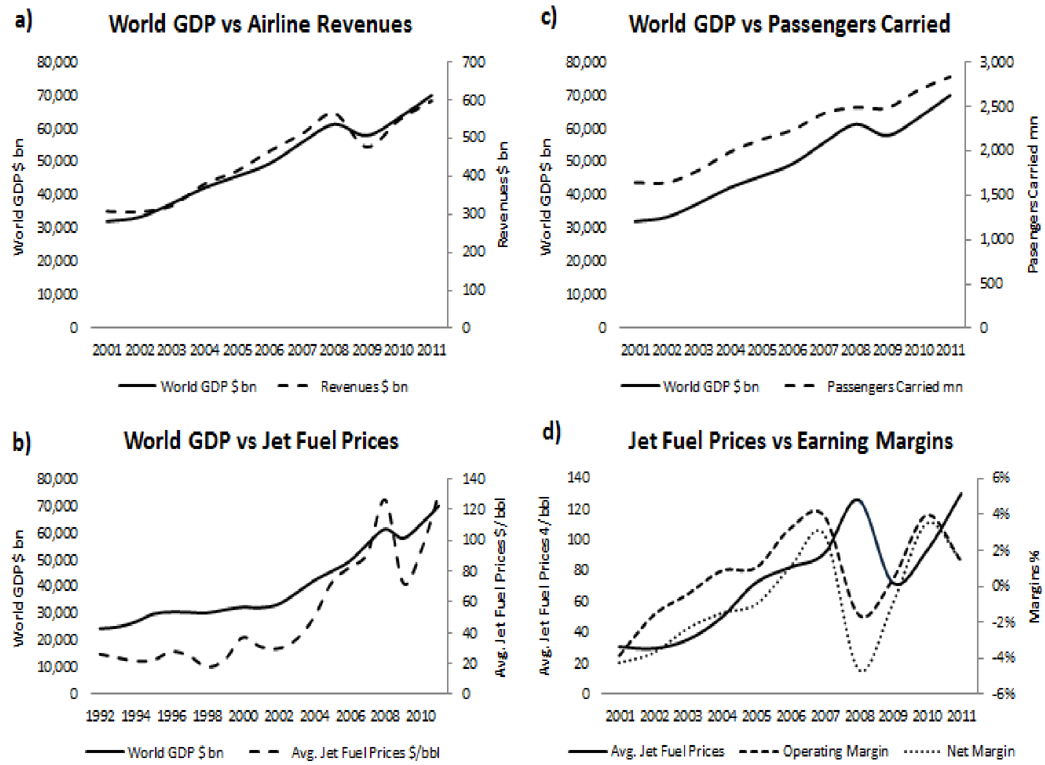

Figure 1: Implications of Global Economic Activity on Airline Industry Performance: Figure 1 demonstrates the relationships between jet fuel prices, passenger numbers, economic activity and earnings margins. Figures 1-a, 1-b and 1-c graph the association between world GDP per year and total airline revenues, jet fuel prices and passenger numbers, respectively. Figure 1-d shows the sensitivity of profit margins (including transacion costs) to jet fuel prices. The increase in jet fuel costs is fuelled through two channels: 1) increases in spot jet fuel prices and 2) increase in fuel consumption through increased operating activity and capacity (measured by available seat kilometers).

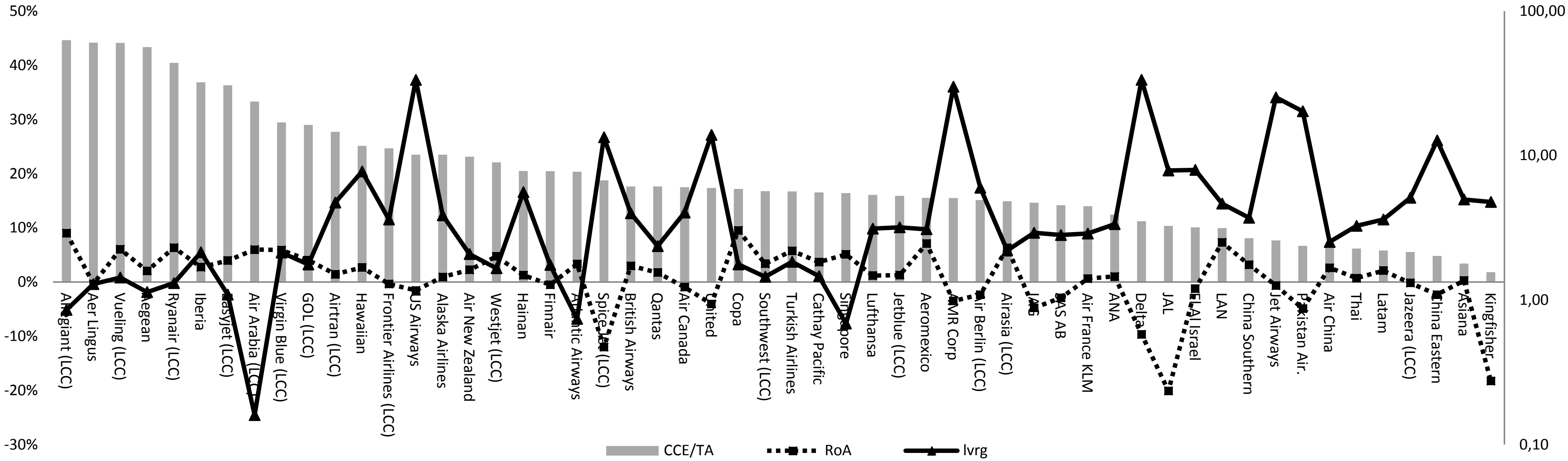

Figure 2: The Analysis of Cash Holdings, Investments and Profitability: Figure 2 demonstrate the association between the cash holdings (which include cash + cash equivalents) as a percentage of total assets and the level of financial leverage used for the sample airline companies. The grey bars which are abbreviated as CCE/TA are scaled to the left axis and represent the proportion of cash and cash equivalents held in proportion to total assets. The black straight line which is abbreviated as lvrg is the natural log of financial leverage and scaled to the left axis. The dotted black line is the mean RoA estimates as Net Income/ Total Assets and is scaled to the left axis. Low cost carriers are identified with (LCC). The figure is ordered by the highest level of CCE/TA holdings. If we call the firms with the highest CCE/TA levels as the most liquid firms, we observe 7 low cost carriers among the top 10 most liquid airline companies. Additionally, 10 out of all of 16 low cost carriers in our sample is among the most liquid 20 airline companies in our sample. Expectedly these low cost carriers also have the lowest level of financial leveage which graphically confirms our estiates in the univariate analysis in Panel B of Table III in section III that low cost carriers can be more sensitive to the level of internal cash funds relative to major carriers.

Appendix I: Excerpts from Regional Carriers' Annual Reports

Excerpt from Skywest 2010 SEC Filing:

"Our code-share agreements with Delta, United and Continental provide for fuel used in the performance of the code-share agreements to be reimbursed by our major partners, thereby reducing our exposure to fuel price fluctuations. United purchased fuel directly from fuel vendors for our United Express aircraft under contract operated out of Chicago, San Francisco, Los Angeles and Denver; Continental purchased all of the fuel for our Continental aircraft directly from Continental's fuel vendors; and as of June 1, 2009, Delta purchased the majority of the fuel for our Delta aircraft under contract directly from its fuel vendors. During the year ended December 31, 2010, approximately 76% of our fuel purchases were associated with our Delta and United code-share agreements and were reimbursed or paid directly by our major partners and approximately 24% of our fuel purchases were associated with our pro-rate operations."

Excerpt from Republic Airlines 2011 SEC Filing:

Fuel Hedging Transactions

Under our fixed-fee agreements we are not exposed to changes in fuel prices. Our fixed-fee agreements provide for our partners to purchase fuel directly or reimburse us for fuel expense as a pass through cost.

As of December 31, 2011, we did not have a hedge position. We will continue to monitor fuel prices closely and may take advantage of fuel hedging opportunities as they become available."

Appendix II: Government Ownership of Major Carriers

This table exhibits the descriptive statistics for the major airline companies with government ownership equal to or exceeding 20% of the total shares outstanding. One exception in the table is the Asiana airlines where the ownership ratio is 19% which is very close to the theoretical level at which a shareholder can exert significant influence. Additionally, the company doesn't hedge its fuel consumption. Our results in regression analyses in Table VIII are not affected by the addition and inclusion of Asiana. As a result we add Asiana Airlines in the list. The first column lists the 12 airline companies with government ownership equal to or less than 20% of the total shares outstanding. The second column demonstrates the level of government ownership for each airline company. The third and fourth columns show the level of the next year's fuel consumption hedged and furl costs as a percentage of operating expenses, respectively. The final column shows the firm value measured by the Q measure.

Airline Company	Hedge Ratio	Fuel/Opex	TBQ
Asiana	0%	35%	1.06
Aer Lingus	59%	24%	0.95
Air France	55%	22%	0.9
Thai Airways	36%	36%	0.99
Finnair	53%	21%	0.95
SAS AB	49%	17%	0.92
Turkish Airlines	5%	27%	1.07
Air New Zealand	58%	33%	0.95
Pakistan Airlines	0%	37%	1.1
Atlantic Airways	28%	36%	0.74
Air China	16%	36%	1.41
China Eastern	15%	34%	1.62
China Southern	0%	34%	1.03
Hainan	0%	35%	1.11
Aeromexico	50%	35%	1.38
min	0%	17%	0.74
mean	32%	34%	0.97
max	59%	37%	1.62
Standard Deviation	23%	7%	24%