Operational and Financial Hedging: Friend or Foe? Evidence from the U.S. Airline Industry

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This paper analyzes three operational hedges that are at the disposal of an airline to determine if operational and financial hedges are complements or substitutes. The operational hedges studied are: fleet composition, fleet fuel efficiency, and whether the fleet is leased. We find that with respect to fleet composition airlines are more likely to use financial derivatives. However, we do not find a statistically significant relation between fleet fuel efficiency or leased fleet and financial hedging. Consistent with prior research, we find the use of financial derivatives increases firm value. However, surprisingly, the use of operational hedges actually decreases the value of the firm.

INTRODUCTION

There is inconsistency in the risk management literature regarding the extent to which firms use financial derivatives. Some studies indicate that the use of financial derivatives provides little protection to a firm's cash flows (Guay and Kothari 2003). Other studies show that the use of financial derivatives is value-enhancing to the firm (Allayannis and Weston 2001; Mackay and Moeller 2007; Carter, Rogers, and Simkins 2006), although this result is not conclusive (Jin and Jorion 2006). Furthermore, most studies find that the use of financial derivatives reduces the firm's overall risk exposure to the underlying asset being hedged (Allayannis and Ofek 2001; Hentschel and Kothari 2001; Schrand 1997). This inconsistency poses the question: how can an expensive risk management program reduce the overall risk of a firm and increase its value, but yet provide little protection to the firm's cash flow. Guay and Kothari (2003) suggest that the risk management program which uses both operational and financial hedges to manage a firm's risk would be consistent with their and others' findings that financial derivatives are only used to fine tune a firm's overall risk management program. Furthermore, they conclude that the inconsistency mentioned above is driven by the exclusion of the operational hedge.

This chapter examines the following: 1) if financial and operational hedges are substitutes or complements[1] and; 2) whether the use of operational and financial hedges increases the value of the firm. This chapter contributes to the literature concerning the use of operational and financial hedges, and also examines whether hedging increases the firm's value (Allayannis, Ihrig, and Weston 2001; Kim, Mathur, and Nam 2006; Carter, Rogers, and Simkins 2006; Petersen and Thiagarajan 2000; Tufano 1998; Carter, Pantzalis, and Simkins 2006; Jin and Jorion 2006). This study most closely follows Allayannis, Ihrig, and Weston (2001), who test whether the use of both financial and operational hedges protects multinational firms against exchange rate exposure. Their study finds that multinational firms' operational and financial hedges are complements rather than substitutes. Allayannis, Ihrig and Weston's conclude that a risk management policy which includes both operational and financial hedges enhances the value of the firm. However, their results is not conclusive as other studies find that operational and financial hedges are substitutes (Kim, Mathur, and Nam 2006; Petersen and Thiagarajan 2000).

This paper differs from Allayannis, Ihrig, and Weston's (2001) article in that several different operational hedges are examined, while their article examines only the firm's foreign operations as an operational hedge. Furthermore, the sample for this study is restricted to the US airline industry. Using a homogenous sample (the airline industry) controls for biases that occur when using a cross-section of industries. For instance, it is difficult to discern which currencies a multinational firm is exposed to and the degree to which a firm uses financial and operational hedges to protect against those currencies to which it is exposed. Furthermore, as many multinational firms are conglomerates, the measurement for which Allayannis, Ihrig, and Weston (2001) use to proxy the relationship between a firm's value and its hedging activity is biased because both the hedging behavior and the firm's value vary across industries.

Similar to the Allayannis, Ihrig, and Weston (2001) study, I find evidence that financial and operational hedges are complements in the airline industry. Contrary to the finding of other studies, the use of both operational hedges and financial hedges does not increase the value of the airline (Allayannis, Ihrig, and Weston 2001; Kim, Mathur, and Nam 2006). The evidence indicating a benefit exists in financial hedges is mixed. That is financial fuel derivatives increase the airlines value, while fuel contracts which lock in the price of fuel reduce the airlines value. Furthermore, the use of operational hedges alone actually reduces the value of the airline.

I examine three operational hedges used by airlines: 1) the diversity of its fleet, 2) the airline's use of operating leases to manage its fleet, and 3) the use of fuel-efficient aircraft. The diversity of an airline's fleet and the use of a leased fleet give airlines the ability to respond quickly to changing market conditions by adjusting the number of seats flown. A newer, fuel-efficient fleet protects the airline by reducing its exposure to the price of jet fuel. I find that airlines with diverse fleets tend to exhibit a greater use of financial hedges than do their counterparts. The evidence also shows that a diverse fleet; a newer fuel-efficient fleet; and the use of operating leases all reduce an airline's value.

The rest of this paper is as follows: Section 2 reviews the hedging literature. Section 3 presents the methodology and the procedures used in our analysis. Section 4 presents the results of our empirical tests and Section 5 concludes.

LITERATURE REVIEW

The objectives of this section are to examine the theoretical and empirical motivations for a firm to manage its risks. The first part of this section reviews the seminal theories which show the benefits of risk management to the firm. Next, we discuss the possible ways a firm can manage its risk, specifically the use of financial and operational hedging techniques. Finally, we survey the empirical literature concerning whether risk management is value-enhancing to the firm.

Risk Management Theory

The theoretical literature on hedging by value maximizing firms focuses on four primary rationales for a firm to hedge. These rationales are: 1) to reduce cash-flow uncertainty; 2) to reduce the probability of financial distress; 3) to reduce expected taxes; and 4) to increase debt capacity.

Hedging can increase firm value by reducing the variance of the firm's cash flows. Because of cash flow uncertainty, firms may pursue investment strategies that reduce value because of cash flow uncertainty. One way this can happen is the case of a firm that forgoes investments in positive net present value projects when cash flows are low (see Froot, Scharfstein, and Stein, 1993). Firms that hedge can reduce the variance of cash flows and thus avoid the problem of underinvestment. Géczy, Minton, and Schrand (1997) find evidence suggesting that firms use currency derivatives to reduce cash flow variation, allowing them to take advantage of growth opportunities.

A second way hedging can help to maximize firm value is by reducing the probability of financial distress (Smith and Stulz, 1985). The firm can reduce the uncertainty of cash flows by hedging, thus reducing the probability of bankruptcy and the costs associated with financial distress. Firms with a higher probability of financial distress would be most likely to benefit from hedging. This implies that firms with greater leverage, and hence a greater probability of experiencing bankruptcy, are more likely to use derivatives to hedge.

Smith and Stulz (1985) and Nance, Smith, and Smithson (1993) argue that firms hedge because the progressive nature of the U.S. tax code produces a convex relation between a firm's effective tax rate and its pretax income. Firms that hedge can reduce expected tax liabilities by reducing the variability of cash flows. However, Graham and Rogers (2002) find no evidence that firms hedge in response to tax convexity.

Finally, Ross (1997) and Leland (1998) find that the most important benefit of debt financing is the tax deductibility of the interest payments. Hedging can reduce the likelihood of low cash flow states leading to default which allows the firm to increase debt capacity and ultimately, the tax benefits of interest deductions (Stulz, 1996). Graham and Rogers (2002) find support for the notion that hedging allows firms to increase their debt capacity.

Financial versus Operational Hedging

As discussed above, hedging is a means to reduce the volatility of a firm's present and future cash flows; thus the goal of a financial or operational hedge is to meet this objective. To meet this objective, the firm can use financial hedges such as interest rate, foreign-exchange, and commodity derivatives (e.g., futures, options, swaps, etc.) to reduce the volatility of its cash flows. Alternatively, the firm can use operational hedges, which stem from the operating and investment activities of the firm, to reduce cash flow uncertainty.

Many financial contracts can be used to hedge or protect against a particular risk. The most obvious is the use of derivatives, such as futures, options, and swaps. However, operational hedges are a consequence of the real options a firm owns. The different types of real options are too numerous to list, however, a commonality of real options is that they give the owner of the option greater operational flexibility. For example, a multinational firm locating manufacturing facilities in foreign markets is an example of a real option that provides an operational hedge against currency fluctuations. A firm's ability to adjust output and thus cost is another important real option that functions as an operational hedge.

Several studies examine whether there is empirical evidence that a firm's foreign operations provide an operational hedge against currency risk (Allayannis, Ihrig, and Weston 2001; Carter, Pantzalis, and Simkins 2006; Pantzalis, Simkins, and Laux 2001; Williamson 2001). Williamson (2001) finds that Japanese automotive manufacturers experience less exposure to the dollar in the latter part of his sample period. He attributes this decrease to the increase in foreign automobiles manufactured in the U.S.

Allayannis, Ihrig, and Weston (2001) investigate operational hedging for U.S. multinational firms and hypothesize that the greater the number of geographic regions a firm's subsidiaries are located in, the greater is its operational hedge. However, they are unable to find the expected negative and significant relationship between a firm's geographic dispersion and its exposure to currency rates. Alternatively, Pantzalis, Simkins, and Laux's (2001) results suggest that the number of regions a firm has subsidiaries in is a significant factor in reducing a firm's risk to currency fluctuation.

Carter, Pantzalis, and Simkins (2006) examine whether multinational firms with greater geographic dispersion are less (more) exposed during adverse (favorable) conditions. Their findings suggest that widely dispersed multinational firms that are positively exposed to the appreciation of the dollar (typical of importers) do experience significant (insignificant) exposure to the dollar during strong (weak) dollar states. However, for firms with a negative exposure to currency movement (typical of exporters) geographic dispersion is not a significant determinant of their exposure in either weak or strong dollar states.

Some empirical studies show that a firm's real option to adjust its production is an operational hedge (Kallapur and Eldenburg 2005; Haushalter, Heron, and Lie 2002; Petersen and Thiagarajan 2000; Tufano 1998). Tufano (1998) finds some evidence that real options are used to lower a gold mining firm's exposure to gold prices because a gold mine has the option to suspend production if the price of gold drops below a certain threshold.

Petersen and Thiagarajan (2000) investigate the hedging behavior of two gold mining firms: one which uses financial derivatives extensively and the other that does not. They find that the operating cost of the firm which does not use financial derivatives (Homestake Mining) falls with declining gold prices. This is not true for the firm which hedges (American Barrick). They contend that Homestake Mining's ability to adjust operating costs in response to changes in gold prices is due to its ability to close mines with higher operating costs and vary the mix of ore extracted (i.e., an operational hedge). However, American Barrick's ability to adjust production is more restricted.

A final issue is whether financial and operational hedges are substitutes or complements? That is, are financial and operational hedges substitutes which a firm can use interchangeably, or do financial and operational hedges protect the firm against different risks and thus complement each other? Several authors have suggested that operational hedges (financial hedges) are used to protect against long (short) term risks (Carter, Pantzalis, and Simkins 2006; Triantis 2000). The Petersen and Thiagarajan (2000) study argues that financial and operational hedges are substitutes and suggests that one reason Homestake chose not to use financial derivatives was its ability to adjust operating costs in response to movements in gold prices. However, American Barrick didn't have this luxury. To explicitly test the question of substitutes versus complements, Allayannis, Ihrig, and Weston (2001) hypothesize that if operational and financial hedges are substitutes (complements) then the probability of a firm's using financial derivatives decreases (increases) with its geographic dispersion index because the more disperse the subsidiaries of a multinational firm, the better is that firm's operational hedge. The authors find a positive and significant relationship between the probability that a firm uses derivatives and its geographic dispersion index, thus, suggesting financial and operational hedges are complements.

Hedging and Firm Value

Given that many firms hedge, an important empirical question is whether hedging does, in fact, add value. In, perhaps the earliest examination of the relation between hedging and value, Allayannis and Weston (2001) examine whether the use of foreign currency derivatives increases the value of the firm. In their study, the Tobin Q of firms with foreign sales which hedge is 4.5% higher than that of non-hedging firms. Guay and Kothari (2003) criticize the conclusions of Allayannis and Weston, as well as several prior studies that conclude hedging has economically significant effects on firm value because they find that firms hold derivatives positions that are small compared to the risks they face. Instead, they argue that operational hedging is likely the primary form of corporate risk management, while hedging with derivatives is used to fine-tune risk management policy.

Allayannis, Ihrig, and Weston (2001) examine whether the use of operational and financial hedges is value-enhancing to the firm. While they do not find a positive association between the value of a multinational firm and its use of operational hedges they do find that the implementation of both operational and financial hedges does account for a 16.7% premium to a firm's market to book. This result suggests that a risk management policy that uses both operational and financial hedges is value-enhancing to the firm.

Jin and Jorion (2006) and Carter, Rogers, and Simkins (2006) are industry-level studies that investigate the relation between hedging and value. Jin and Jorion investigate the oil and gas industry but do not find a positive relation between the firm's value and its hedging activities, thus, suggesting hedging does not increase the value of oil and gas firms. Carter, Rogers, and Simkins examine hedging and value in the U.S. airline industry and find a positive and significant relationship between an airline's Tobin's Q and the percent of next year's jet fuel that is hedged. The hedging premium for the average airline's Tobin's Q is 10.2%. This roughly represents a $130 million hedging premium to an airline.

If hedging does add value to the firm, then what is the source of the hedging premium? Allayannis and Weston (2001) argue that the hedging premium is attributed to the tax saving resulting from an increase in a firm's debt tax shield, a reduction in its bankruptcy cost, and mitigation of the under-investment problem. Carter, Rogers, and Simkins (2006) explicitly test the underinvestment problem for the airline industry and find that increasing the percent of the next year's jet fuel hedged by one percent increases the airline capital expenditures-to-sales ratio by 7.4%. Furthermore, they report that the hedging premium attributed to the protection of the airline's capital expenditures is 21%. This result suggests that the underinvestment problem is significant to the firm's value and commands the attention of a firm's risk management program.

EMPIRICAL METHODS

In this section, we discuss our measures of operational and financial hedges, the data sources, and the model we use to investigate the relation between hedging and value, and financial and operational hedging.

Measuring Financial and Operational Hedges

We use three measures of operational hedging: fleet composition, fleet fuel efficiency, and the use of operating leases. These measures are discussed in more detail below.

Financial Hedging

To measure the degree to which the airline uses financial hedges, we use the percentage of the airline's jet fuel hedged for next year. To capture the impact of fuel contracts which lock in an airline's fuels cost, we included an indicator variable for whether the airline has entered into a fuel pass-through agreement. Fuel pass-through agreements are typically contracts between a regional airline and a mainline airline. These contracts cover a regional airline's fuel costs for the service that it provides to the mainline carrier. The percent of jet fuel costs that are hedged and the use of fuel pass-through agreements are used by Carter, Rogers, and Simkins (2006) in their investigation of hedging and value. This proxy is from the airline's 10-K filing over the period 1994 to 2006.

Fleet Composition (Diversity of Fleet)

A diverse fleet gives the airline the flexibility to adjust the level of its capacity to meet the condition of a dynamic market. Dixit and Pindyck (1994) analyze the choice between flexibility and scale using real option analysis. Furthermore, using real options which a diverse fleet provides acts as an operational hedge by reducing an airline's losses during unfavorable periods. To illustrate, when fuel prices are at such a level that operating a given route is unfavorable, the airline has a choice to whether quit servicing the particular route and wait until fuel prices fall or maintain service at a loss. When exit or reentry costs are prohibitively expensive, the airline will choose to maintain operations and not exercise its options to exit. Under this scenario, it is optimal for the airline to cut capacity to such a level where the airline is able to avoid the exit or reentry cost. With a diverse fleet, the airline has this option. For instance, when fuel prices are high, the airline increases the use of its smaller aircraft, resulting in a lower level of losses relative to a larger aircraft.

We measure the diversity of an airline's fleet using a proxy similar to the Hirchman-Herfindhal concentration index, which we refer to as the aircraft dispersion index (ADI). The aircraft dispersion index is constructed as shown in Equation (1):

$$ADI = 1 - \sum_{j=1}^{K} \left(\frac{\text{No. of Aircraft}_{\text{j}}}{\text{Total No. of Aircraft}_{\text{i}}} \right)^2 , \tag{1}$$

where K is the total number of different models that airline i operates and j represents the aircraft model. This index range is between zero and one, with one indicating the greatest degree of diversity. If the airline operates only one type of aircraft, such as Southwest, then the index value is equal to zero. Fleet composition data is obtained from the airlines' annual 10-K filings.

Fleet Fuel Efficiency

A large cost factor to airlines is jet fuel. This fact suggests that airlines benefit from hedging against fluctuation in fuel prices. An airline choosing to operate a newer fleet, more fuel-efficient fleet, has less exposure to the price of jet fuel. To measure the airline's decision to use a fuel-efficient fleet as an operational hedge, we use the logarithm of average age of the airline's fleet, where the average age of an airline's fleet is a weighted average of the age of the different aircraft models the airline operates. The fleet age is reported annually and rounded to the nearest integer. The two reasons for rounding to the nearest integer are that (1) many airlines only report the age of the fleet in round years and (2) it reduces possible biases created by smaller aircraft since smaller aircraft are usually younger. When the age of the fleet is not reported, the nearest / earliest possible reported age is used. For instance, Mesa Airlines reported its fleet in 1998 but not 1999. In this case, the age of Mesa's fleet in 1998 is used for 1999. The average age of the fleet is taken from the airlines 10-K.

Operating Leases

Operating leases provide airlines the opportunity to frequently adjust their fleet to changing conditions. For instance, as the demand for a particular route changes, the airline can replace its current aircraft with those that are better suited for that market (Brigham and Ehrhardt 2005). Moreover, many airlines stagger the life of their leases so that their fleet size can adjust to changing market conditions. In addition to staggering the life of its leases, many leasing contracts contain options clauses which allow the airline to purchase the aircraft at the end of the leasing agreement and/or to cancel its leasing obligation prior to the end of the lease. Finally, leasors sometimes renegotiate the terms of a lease.

To proxy for the airline's ability to use operating leases as a hedge, we use the percentage of the airline's fleet that is leased. This proxy is calculated as the total number of aircraft the airline leases divided by the total number of aircraft owned and leased. This proxy includes spare parts aircraft, aircraft not yet in service, and those that are subleased to other airlines. The leasing data is obtained from the airlines' annual 10-K filings.

Table 1 reports the summary statistics of the operational and financial hedging variables, as well as Tobin's Q, our measure of firm value, and control variables, such as size, etc.

TABLE 1
SUMMARY STATISTICS

Table 1 reports the mean, median, standard deviation, minimum, and maximum for the following variables from 1994–2006: the Aircraft Dispersion Index, Fleet Age, Percent of Fleet Leased, Percent of Next Year's Jet Fuel Hedged, Commuters. An indicator for whether the airline has a Fuel Purchase Agreement (FuelPass), Capacity Agreement, or whether the airline is a regional carrier is obtained from the airlines' 10-K reports. All other variables are obtained from COMPUSTAT.

Variables	**Mean**	**Median**	**Min.**	**Max.**	**Std. Dev.**
Tobin's Q	0.9542	0.7815	0.0145	3.9752	0.5684
Ln (Total Assets)	6.9943	6.6746	2.6207	10.3994	1.9373
Dividend Yield	0.1571	0.0000	0.0000	5.0000	0.5551
Cash Flow / Sales	0.0448	0.0714	-1.1692	1.2287	0.1470
Capital Expenditure / Sales	0.1243	0.0778	-0.0095	2.2333	0.1845
Long-Term Debt to Assets	0.2790	0.2757	0.0000	1.3005	0.1961
Z Score	1.9829	1.6945	-4.7181	7.3858	1.7552
Cash / Sales	0.1733	0.1445	0.0000	0.6830	0.1290
Next Year's Percent of Fuel Hedge	0.1317	0.0000	0.0000	0.9600	0.2213
Fuel Pass-Through Agreement	0.2270	0.0000	0.0000	1.0000	0.4196
Exchange Rate Derivatives	0.2366	0.0000	0.0000	1.0000	0.4257
Interest Rate Derivatives	0.2903	0.0000	0.0000	1.0000	0.4547
Aircraft Dispersion Index	0.5326	0.5946	0.0000	0.8768	0.2792
Ln (Fleet Age)	2.1486	2.1972	0.0000	3.3322	0.6264
Percent of Fleet Leased	0.6577	0.6940	0.0000	1.0000	0.2465
Regional Airline	0.3010	0.0000	0.0000	1.0000	0.4595
Capacity Purchase Agreements	0.1973	0.0000	0.0000	1.0000	0.3986
Commuters	0.2145	0.0000	0.0000	1.0000	0.3129
Annual Average Price of Fuel	84.0980	68.6959	40.2688	192.2859	47.8910
Carryforward / Carryback Dummy	0.3110	0.0000	0.0000	1.0000	0.4637

Complements vs. Substitutes

We use a model similar to that of Allayannis, Ihrig, and Weston (2001) to test whether operational and financial hedges are complements or substitutes. We regress the airlines' use of financial derivatives against the three operational hedging measures as shown in Equation (2):

$$\begin{aligned} Hedge_{i,t} = \alpha_0 &+ \beta_{diversity}(Fleet\ Diversity_{i,t}) + \beta_{age}(Age_{i,t}) + \beta_{lease}(Leased\ Fleet_{i,t}) + \\ &+ \beta_{Dhedge}(OtherHedgeDummy_{i,t}) + \beta_{control}(Control\ Variables_{i,t}) + \varepsilon_{i,t}, \end{aligned} \tag{2}$$

where:
Hedge is the percent of next year's fuel requirement hedged for airline i in period t,
Fleet Diversity is the aircraft dispersion index in period t,
Age is the logarithm of the average age of the airline's fleet,
Leased Fleet is the percent of the airline's fleet that is leased,
OtherHedgeDummy is one if the airline uses currency derivatives, interest rate derivatives or has entered into a fuel pass-through agreement, otherwise zero,
and ε is the standard error term.

Table 2 briefly lists the variables and the predicted signs of the coefficients in the model.

TABLE 2
COMPLEMENTS AND SUBSTITUTES (HYPOTHESES)

Table 2 reports the predicted results of Equation (2). The model tests whether operational and financial hedges are complements or substitutes. The model is:

$Hedge_{i,t} = \alpha_0 + \beta_{Diversity}(Fleet\ Diversity_{i,t}) + \beta_{Age}(Age_{i,t}) + \beta_{Lease}(Leased\ Fleet_{i,t}) + \beta_{Dhedge}(OtherHedgeDummy_{i,t}) + \beta_{Control}(Control\ Variables_{i,t}) + \varepsilon_{i,t}$

where: *Hedge* is the percent of next year's fuel requirement hedge for airline *i* in period *t*; *Fleet Diversity* is the aircraft dispersion index in period *t*; *Age* is the logarithm of the average age of the airline's fleet; *Fleet Leased* is the percent of the airline's fleet that is leased; *OtherHedgeDummy* is 1 if the airline uses currency derivatives, interest rate derivatives, or has entered into a fuel pass-through agreement, otherwise 0; and ε is the standard error term.

	Predicted Coefficient Signs		
Variables	**Complements**	**Substitutes**	**Hedging Theory**
Fleet Diversity	+	–	
Ln (Fleet Age) (*Age*)	–	+	
Leased Fleet	+	–	
Long-Term Debt to Assets (*LTDA*)			+
Ln (Total Assets) (*Size*)			+
Dividend Yield (*DIV*)			+
Z Score			+
Cash Flow / Sales (*CFTS*)			–
Cash to Sales (*Cash*)			–
Tobin's Q			+
Dummy (Exchange, Interest, FuelPass) (*OtherHedgeDummy*)			+
Regional Airline (*REG*)			?
Capacity Purchase Agreement (*CAP*)			?
Commuter			?
Annual Average Price of Fuel (*AvgPrice*)			?
Carryforward / Carryback Dummy (*NOL*)			+

The variable *Hedge* is defined as the airline's percentage of next year's fuel requirements hedged. An alternative fuel hedge variable (*HedgDum*) is defined as one if the airline hedges its fuel costs using derivatives, otherwise zero. The percent of fuel hedged is preferred since a dummy variable does not capture the degree to which a firm uses financial derivatives (Triki 2005). Furthermore, the decision to hedge conveys different information from the degree to which a firm engages in hedging (Haushalter 2000). For the above mentioned reasons, both the *Hedge* and the *HedgDum* variables are used to measure the airlines' financial hedging activity.

If airlines are using financial and operational hedges as complements, then a positive relationship exists between the diversity of the airlines' fleets and their use of financial derivatives ($\beta_{diversity}>0$). This relationship is expected if airlines use the diversity of their fleet to hedge against the uncertainty in long-term fuel price fluctuations, against which financial derivatives provide little protection. The financial derivatives are then used to protect against short-term price fluctuations (Carter, Pantzalis, and Simkins 2006). Conversely, a negative relationship suggests that operational and financial hedges are substitutes ($\beta_{diversity}<0$). As with the diversity of the fleet, a positive (negative) relationship between the percent of the airline's fleet which is leased and the use of financial derivatives suggests that the two types are complements (substitutes).

A positive coefficient for the age of an airline's fleet ($\beta_{age}>0$) suggests that operational and financial hedges are substitutes. An airline with an older fleet has greater exposure to fuel prices and uses financial derivatives to lower this risk. Similarly, an airline with a newer fleet has lower exposure to fuel costs and has less incentive to hedge its fuel risk with financial derivatives. A negative relationship between the age of an airline's fleet and its use of financial derivatives suggests that operational and financial hedges are complements (β_{age}<0).

The *OtherHedgeDummy* variable is an indicator for whether the airline uses any other type of financial contract to manage its risk. The *OtherHedgeDummy* is coded as 1 if the airline uses currency derivatives or interest rate derivatives or has a fuel pass-through agreement, otherwise 0. This variable is included to control for the relationships which exist between the airline's fleet and its use of financial derivatives. For instance, airlines with international operations are more likely to use both fuel and currency derivatives. Furthermore, these airlines are more likely to operate a diverse fleet, due to their greater flight distances. Thus, exclusion of this variable will cause the diversity variable to be biased.

The other control variables are the logarithm of the airline's total assets (*Size*), long term debt ratio (*LTDA*), dividend yield (*DIV*), Z-Score, cash flow to sales (*CFTS*), cash to sales (*Cash*), the logarithm of Tobin's Q, capital expenditures to sales (*CAPTS*), and a net operating loss carryforward and carryback dummy variable (*NOL*). We obtain the data to construct these variables from COMPUSTAT. The dummy variable for whether the airline is a regional airline (*REG*) and the *Commuter* variable are gathered from the airlines' 10-K filings. The annual average price of jet fuel (*AvgPrice*) is from the Department of Energy and is the average of the daily Gulf Coast fuel price per year. The variable *Size* is used to control for the fact that larger firms tend to hedge (Nance, Smith, and Smithson 1993).

The variable *LTDA* is included in the model to control for the fact that hedging theory suggests that firms hedge to increase their debt capacity by reducing their chances of financial distress (Graham and Rogers 2002; Smith and Stulz 1985). Furthermore, there is a positive relationship between the extent to which a firm leases its assets and its use of debt (Ang and Peterson 1984). The Z-Score variable is included because firms near financial distress tend not to hedge so they might exploit any upside potential at the bondholders' expense (Stulz 1996). Outliers of the Z-Score at the first and ninety-ninth percentiles are removed from the sample this because Hawaiian Airlines reported a Z-Score of -80.6 and -71.33 in 2003 and 2004 respectively. The next lowest Z-Score is -6.17. Nance, Smith, and Smithson (1993) contend that firms with higher dividends have a greater incentive to hedge as a way to avoid financial distress. Furthermore, firms with greater cash flow and higher cash levels are less likely to fall under financial distress and thus have less incentive to hedge.

The logarithm of Tobin's Q and the CAPTS variables are proxies for a firm's growth potential, as firms will protect their future growth options through hedging. A dummy variable for whether the airline is a regional carrier (REG) controls for differences between mainline and regional carriers. The REG variable is coded as one if the airline provides service to a mainline airline, otherwise zero[2]. The variable NOL is predicted to be positive, as hedging increases firm value when firms face convexity in their tax schedule.

Airlines which operate turbo-props typically have a diverse fleet. However, these short haul commuter aircraft do not provide the flexibility which a regional jet does. That is, turbo-props lack the nautical distance and fuel efficiency that a regional jet offers and which allows regional jets to act as substitutes for larger aircraft. Thus, the control variable *Commuter* which is the percent of an airline's fleet that is turbo-props is added to the model.

Many mainline airlines have entered into capacity purchase agreements with regional carriers. Under these contracts, the mainline airline is responsible for revenue, fuel costs, and scheduling. In return, the regional airline is guaranteed a set profit margin plus a performance bonus. Under some of these contracts, the mainline airline subleases aircraft to the regional carrier for the duration of the contract. Under these types of contracts, the mainline airline benefits from the flexibility a diverse fleet offers without actually operating one. Thus, the control variable *CAP* is included in the model which is coded as 1 if the mainline airline has entered into a capacity purchase agreement, otherwise 0.

As the price of fuel rises, airlines will exercise their options by increasing the use of their smaller and/or more fuel efficient aircraft. Also, there is a greater probability airlines will upgrade to a newer fuel efficient fleet when fuel prices are high. To control for this relationship and any other relationship between the price of fuel and an airline's tendency to hedge, the *AvgPrice* variable is included in the model.

Hedging and Firm Value

To test whether the use of operational and financial hedges increases the value of the firm, we regress Tobin's Q against the operational and financial proxies and their products as shown in Equation (3):

$$
\begin{aligned}
\text{Log(Tobin's } Q_{i,t}) = \alpha &+ \beta_{hedge}{*}Hedge_{i,t} \\
&+ (\beta_{diversity} + \beta_{diversity/hedge}Hedge_{i,t}) {*}(\text{Fleet Diversity}_{i,t}) \\
&+ (\beta_{age} + \beta_{age/hedge}Hedge_{i,t}){*}\beta_{age}(Age_{i,t}) \\
&+ \beta_{leases}(\text{Leased Fleet}_{i,t}) + \beta_{fuelpass}(FuelPass_{i,t}) \\
&+ \beta_{der\_FX}(Der\_FX_{i,t}) + \beta_{Der\_IR}(Der\_IR_{i,t}) \\
&+ \beta_{control}(Control\_Variables_{i,t}) + \varepsilon_{i,t}.
\end{aligned} \qquad (3)
$$

where:

Hedge is the percent of next year's fuel requirement hedged for airline i in period t,
Fleet Diversity is the aircraft dispersion index in period t,
Age is the logarithm of the average age of the airline's fleet,
Leased Fleet is the percent of the airline's fleet that is leased,
FuelPass indicates whether the airline has entered into a fuel pass through agreement,
Der_FX and *Der_IR* indicate whether the airline uses currency or interest rate derivatives respectively, and
ε is the standard error term.

Our measure of value is Tobin's Q, which we calculate using the method suggested by Chung and Pruitt (1994).

Table 3 briefly reports the predicted signs of the coefficients of the above model and the hypotheses. The hypotheses are:

H_1: Financial hedges increase the value of the airline ($\beta_{hedge} > 0$, $\beta_{fuelpass} > 0$, $\beta_{Der_fx} > 0$and $\beta_{Der\_IR} > 0$). *Hedge*, *FuelPass*, *Der_FX* and *Der_IR* proxy for the firm's hedging activity. The predicted sign of the hedging variables is positive since hedging increases the firm's value. The variables *Der_FX* and *Der_IR* are coded as one if the airline uses foreign exchange rate derivatives (*Der_FX*) or interest rate derivatives (*Der_IR*), otherwise the variables are coded as zero.

H_2: Operational Hedges are value-enhancing to an airline ($\beta_{diversity} > 0$, $\beta_{age} < 0$, $\beta_{Fleet\_Leased} > 0$). The prediction is that a diverse fleet / leased fleet provides an airline an operational hedge which increases the airline's value. A newer fuel-efficient fleet reduces an airline's exposure to fuel prices and thus enhances the airline's value.

*H_3: A comprehensive hedging program that uses **both** operational and financial hedges increases an airline's value ($\beta_{diversity/hedge} > 0$, $\beta_{age/hedge} < 0$).* The prediction is that using operational and financial hedges together provides the airline additional value beyond the value gained by solely using an operational or financial hedge. In the case of a diverse fleet, increasing the diversity of the fleet by 0.10 increases the effectiveness of the financial hedge by $0.10{*}\beta_{diversity/hedge}$[3]. In the case of the age of the fleet, reducing the age of an airline's fleet by one divided the age of its fleet increases the effectiveness of the financial hedge by $\beta_{age/hedge}$. A positive $\beta_{age/hedge}$, suggests that using financial derivates offsets the additional exposure gained by using a less fuel-efficient fleet and thus increases the value of the airline.

The control variables that are from COMPUSTAT that are similar to those proposed by Allayannis and Weston (2001) and Carter, Rogers, and Simkins (2006), are the logarithm of assets (*Size*), dividend yield (*DIV*), cash flow to sales (*CFTS*), cash to sales (*CTS*), long term debt ratio (*LTDA*), capital expenditures to sales *CAPTS*, and Z-Score. The control variables from the airlines' 10-K filings are the regional airline dummy variable (REG), capacity purchase agreement dummy variable (CAP), and the percent of the fleet which is turbo-prop (*Commuter*). The annual average price of fuel (*AvgPrice*) is from the Department of Energy.

The variable *Size* controls for the fact that larger firms are more likely to use financial derivatives. The variable *DIV* controls for a firm's access to the capital markets. The predicted sign of *DIV* is ambiguous since firms that pay dividends might forgo profitable projects, which causes their Tobin's Q to be higher. However, firms which pay dividends due to their excess cash flow will have fewer forgone investments, causing their Tobin's Q to be lower. The variable *CFTS* variable measures the firm's profitability. Profitable firms have higher Tobin's Q ratios. The variable *CAPTS* controls for the fact that firms with greater growth prospects have higher Tobin's Q.

The variable *LTDA* controls for any relationship between a firm's value and the degree to which it is leveraged. The Z-Score represents the fact that firms near financial distress are more likely to incur deadweight costs associated with bankruptcy. Z-Scores in the first or the ninety-ninth percentile are removed.

The variable *CAP* controls for the fact that capacity purchase agreements are similar to operating a diverse fleet. The inclusion of the variable Commuter controls for the fact that turbo-props are incapable of acting as a substitute for larger aircraft. The expected sign for the coefficient of the variable *AvgPrice* is negative as the value of a firm declines as its input prices rise.

TABLE 3
HEDGING AND AIRLINE VALUES (HYPOTHESES)

Table 3 reports the predicted results of Equation (3). The model tests whether operational and financial hedges are value-enhancing to the airlines. The model is:

$\text{Log(Tobin's } Q_{i,t}) = \alpha + \beta_{Hedge} * \text{Hedge}_{i,t} + (\beta_{Diversity} + \beta_{Diversity/Hedge}\text{Hedge}_{i,t}) * (\text{Fleet Diversity}_{i,t}) + (\beta_{Age} + \beta_{Age/Hedge}\text{Hedge}_{i,t}) * \beta_{Age}(\text{Age}_{i,t}) + \beta_{Leases}(\text{Leased Fleet}_{i,t}) +_{FuelPass}(\text{FuelPass}_{i,t}) + \beta_{Der\_FX}(\text{Der\_FX}_{i,t}) + \beta_{Der\_IR}(\text{Der\_IR}_{i,t}) + \beta_{Control}(\text{Control Variables}_{i,t}) + \varepsilon_{i,t}$

where *Tobin's Q* is Chung and Pruitt's (1994) proxy for Tobin's Q; *Hedge* is the percent of next year's fuel requirement hedged for airline *i* in period *t*; *Fleet Diversity* is the aircraft dispersion index in period *t*; *Age* is the logarithm of the average age of the airline's fleet; *Fleet Leased* is the percent of the airline's fleet that is leased; *FuelPass* indicates whether the airline has entered into a fuel pass-through agreement; *Der_FX* and *Der_IR* indicate whether the airline uses currency or interest rate derivatives, respectively; and ε is the standard error term.

	Predicted Values	Hypothesis
Percent of Next Year's Fuel Hedged (*Hedge*)	+	**Financial Derivatives increase firm value**
FuelPass	+	
Foreign Currency Derivative Dummy (*Der_FX*)	+	Financial Derivatives increase firm value
Interest Rate Derivative Dummy (*Der_IR*)	+	Financial Derivatives increase firm value
Aircraft Dispersion (*Fleet Diversity*)	+	**Operational Hedging increases firm value**
(*Fleet Diversity*) × (*Hedge*)	+	**Operational & Financial Hedging increase firm value**
Ln (Fleet Age) (*Age*)	–	**Operational Hedging increases firm value**
Ln (Fleet Age) × (*Hedge*)	–	**Operational & Financial Hedging increase firm value**
Leased Fleet	+	**Operational Hedging increases firm value**
Ln (Total Assets) (*Size*)	?	
Dividend Yield (*DIV*)	?	
Long-Term Debt to Assets (*LTDA*)	?	
Cash Flow / Sales (*CFTS*)	+	
Capital Expenditures to Sales (*CAPTS*)	+	
Z Score	+	
Cash to Sales (*Cash*)	?	
Regional Airline (*REG*)	?	
Capacity Purchases Agreements (*CAP*)	+	
Annual Average Price of Fuel (*AvgPrice*)	–	
Commuter	?	

RESULTS

Table 4 reports the results for whether operational and financial hedges are complements or substitutes. Tables 5 and 6 present the results for whether operational and financial hedges are value enhancing to the airline.

Complements vs. Substitutes

Table 4 reports the results from the estimation of Equation (2), in which we regress the airline's financial hedging activity against the different operational hedges. Column (1) of Table 4, Panel A is a Tobit random effects model with the dependent variable as the percent hedged (*Hedge*). Column (2) uses a Logit random effects model with the dependent variable defined as one if the airline's percent hedged is greater than zero, otherwise zero (*HedgDum*). All columns of Panel B use a Tobit random effects model with the dependent variable as *Hedge*. Each model of Panel A and B includes year dummy variables, which are not reported.

The coefficient for Fleet Diversity is positive and significant at the 10% level in five of the columns from both Panel A and B. That is, airlines that operate a diversity fleet are more likely to use financial derivatives to hedge fuel prices. There is no significant relationship between the fuel-efficiency of the fleet (*Age*) and the degree to which an airline hedges. Similarly, there is no significant relationship between the percent of the fleet which is leased (*Leased Fleet*) and the degree to which an airline hedges.

The AvgPrice variable is significant in most models, at least at the 5% level. That is, airlines tend to increase their hedging activity as the price of fuel increases. As predicted, larger airlines (*Size*), airlines which have greater growth potential (logarithm of Tobin's Q), and airline that use financial hedges (*OtherHedgeDummy*) are more likely to hedge next year's fuel requirements. The other predicted values are insignificant.

TABLE 4
COMPLEMENTS AND SUBSTITUTES

Panel A reports the results of model 3.17.

$Hedge_{i,t} = \alpha_0 + \beta_{Diversity}(Fleet\ Diversity_{i,t}) + \beta_{Age}(Age_{i,t}) + \beta_{Leases}(Leased\ Fleet_{i,t}) + \beta_{Dhedge}(OtherHedgeDummy_{i,t}) + \beta_{Control}(Control\ Variables_{i,t}) + \varepsilon_{i,t}$.

Column 1 dependent variable (*Hedge*) is the percent of next year's fuel hedged. The regression is a Tobit-random effects model. Column 2 uses a logit-random effects model. Column 3 dependent variable (*HedgDum*) is 1 if the airline's percent of fuel hedged is greater than 0, otherwise 0. A year dummy is included in each model but not reported.

Panel A

	Column 1 Tobit / Random Effects	Column 2 Logit / Random Effect
	Hedge	HedgDum
Constant	-1.1393**	-4.8429
	(0.5230)	(5.0705)
Fleet Diversity	0.3642*	4.9410*
	(0.2079)	(2.5311)
Age	-0.0433	-0.4105
	(0.0715)	(0.8538)
Leased Fleet	-0.0963	-1.2147
	(0.2110)	(2.1801)
LTDA	0.0103	0.2748
	(0.2641)	(2.6987)
Size	0.0889**	0.1300
	(0.0425)	(0.4380)
DIV	-0.2470	-2.2426
	(0.1645)	(2.0062)
Z Score	0.0349	-0.5835
	(0.0496)	(0.5524)
CFTS	0.0446	14.4933**
	(0.1971)	(5.7243)

TABLE 4
COMPLEMENTS AND SUBSTITUTES

Panel A (Cont.)		
	Column 1 Tobit / Random Effects	Column 2 Logit / Random Effect
	Hedge	HedgDum
Cash	0.0964	5.2970
	(0.3173)	(3.9864)
Log of Tobin's Q	0.1650*	1.7809*
	(0.0935)	(1.0043)
CAPTS	0.1674	0.9830
	(0.2454)	(3.2712)
Dummy (Exchange, Interest, FuelPass)	0.1542**	0.5381
	(0.0762)	(0.8837)
REG	-0.4355**	-7.4492***
	(0.1804)	(2.5428)
CAP	-0.1443**	-0.0975
	(0.0712)	(0.8134)
Commuter	-0.1473	3.2660
	(0.2213)	(2.4223)
AvgPrice	0.0028***	0.0387**
	(0.0011)	(0.0170)
NOL	-0.0034	-0.1257
	(0.0680)	(0.7677)
Number of Observations	228	228
# Censored	110	
Log Likelihood	-58.402	-84.076

* = 10% significance, ** = 5% significance, *** = 1% significance.

TABLE 4 (Cont.)
COMPLEMENTS AND SUBSTITUTES WITH INDIVIDUAL OPERATIONAL HEDGES

Panel B

Panel B reports the results of the estimation of Equation (2).
The regression is a Tobit-random effects model. The model includes a year dummy variable that is not reported. Columns 1-5 are different combinations of the operational hedges.

	Column 1 Fleet Diversity	Column 2 Age	Column 3 Leased Fleet	Column 4 Fleet Diversity & Leased Fleet	Column 5 Age & Leased Fleet	Column 6 Fleet Diversity & Age
Constant	-1.4919***	-1.2741***	-1.4089***	-1.3785***	-1.3264***	-1.2929***
	(0.3449)	(0.3953)	(0.4043)	(0.4184)	(0.5023)	(0.4097)
Fleet Diversity	0.34751*			0.3579*		0.3360*
	(0.1955)			(0.1953)		(0.1996)
Age		-0.0052			0.0009	-0.0283
		(0.0594)			(0.0664)	(0.0620)
Leased Fleet			0.0183	-0.0470	0.0344	
			(0.1774)	(0.1837)	(0.1957)	
LTDA	0.0642	0.0541	0.1003	0.0349	0.0584	0.0389
	(0.2283)	(0.2458)	(0.2312)	(0.2408)	(0.2505)	(0.2591)
Size	0.1061***	0.1168***	0.1266***	0.1012**	0.1190***	0.0987***
	(0.0376)	(0.0354)	(0.0380)	(0.0404)	(0.0389)	(0.0380)
DIV	-0.2416	-0.2731	-0.2633	-0.2399	-0.2751	-0.2531
	(0.1577)	(0.1776)	(0.1707)	(0.1594)	(0.1789)	(0.1657)
Z Score	0.0323	0.0160	0.0183	0.0347	0.0161	0.0294
	(0.0403)	(0.0449)	(0.0380)	(0.0409)	(0.0460)	(0.0489)
CFTS	0.0606	0.0792	0.0924	0.0565	0.0768	0.0475
	(0.1963)	(0.1966)	(0.1964)	(0.1966)	(0.1968)	(0.1968)
Cash	0.1343	0.0380	0.0805	0.1384	0.0383	0.1057
	(0.3123)	(0.3074)	(0.3077)	(0.3125)	(0.3090)	(0.3177)
Log of Tobin's Q	0.1540*	0.1502*	0.1383*	0.1611**	0.1536*	0.1666*
	(0.0795)	(0.0888)	(0.0764)	(0.0797)	(0.0903)	(0.0937)
CAPTS	0.2543	0.1282	0.1609	0.2357	0.1432	0.1956
	(0.2313)	(0.2303)	(0.2291)	(0.2326)	(0.2434)	(0.2365)
Dummy (Exchange,	0.1553**	0.1708**	0.1720**	0.1540**	0.1722**	0.1583**
Interest, FuelPass)	(0.0754)	(0.0748)	(0.0753)	(0.0762)	(0.0751)	(0.0755)
REG	-0.4660***	-0.3943**	-0.4651***	-0.4696***	-0.3940**	-0.4191**
	(0.1739)	(0.1706)	(0.1691)	(0.1724)	(0.1736)	(0.1790)
CAP	-0.1355*	-0.1489**	-0.1463**	-0.1456**	-0.1471**	-0.1455**
	(0.0704)	(0.0703)	(0.0707)	(0.0713)	(0.0706)	(0.0711)
Commuter	-0.0910	-0.0228	0.0230	-0.1055	-0.0181	-0.1402
	(0.2178)	(0.1986)	(0.1977)	(0.2176)	(0.1996)	(0.2212)
AvgPrice	0.0028***	0.0026**	0.0025**	0.0027**	0.0026**	0.0027***
	(0.0010)	(0.0010)	(0.0011)	(0.0011)	(0.0010)	(0.0010)
NOL	-0.0070	-0.0025	-0.0129	-0.0130	-0.0016	-0.0009
	(0.0668)	(0.0668)	(0.0663)	(0.0672)	(0.0670)	(0.0678)
Number of Observations	252	229	246	246	228	229
# Censored	134	111	128	128	110	111
Log Likelihood	-61.240	-60.162	-61.757	-59.968	-60.063	-58.594

* = 10% significance, ** = 5% significance, *** = 1% significance.

Hedging and Firm Value

Table 5 reports the results of the estimation of Equation (3). Columns (1-4) include both the operational and financial hedges, while column (5) excludes the operational hedges. Column (5) is included as a comparison with prior research. Column (1) reports the results using OLS with robust standard errors. Columns (2, 3, and 5) use FGLS to adjust for heteroskedasticity, while column (4) uses a fixed effects model with heteroskedastic robust standard errors. Each model includes a year dummy variable which is not reported.

Table 6 in Appendix A reports the results of the estimation of Equation (3) using different combinations of the operational hedges. All models of Table 6 use FGLS. Panel A of Table 6 reports the estimated coefficients for Equation (3) using only the aircraft dispersion index (Fleet Diversity), while Panel B reports the results using only the Age variable. Panel C reports the result the estimated coefficients for Equation (3) with different combinations of the variables *ADI*, *Age*, and *Leased Fleet*. The first column of Panel A and B includes all the operational hedges and is included as a comparison.

The results concerning the benefits to the airline for using financial hedges is mixed. The coefficient for *Hedge* is positive and significant in most models. However, the use of fuel pass-through agreements (*FuelPass*) significantly reduces the value of the airline, this result is significant in most models. For instance, Column (2) of Table 5, the *FuelPass* coefficient is -0.3005 and significant at the 1% level. Using the mean Tobin's Q of 0.95, entering into a fuel pass-through agreement reduces the airline's Tobin's Q by about 0.29 (0.95*0.30) or 30%. An argument for a negative *FuelPass* variable is that the variable proxies for regional airline carriers. However, the coefficient for regional airline (*REG*) is positive in most models and significant in the complete model of Column (2) of Table 5, and Column (1) of Table 6, Panel A. Further complicating the results concerning the benefits of hedging, the variable *Der_IR* is negative and significant in Columns (2 and 5) of Table 5.

For the operational hedges, Fleet Diversity is negative and significant at least at the 5% level in all models. To illustrate the reduction in value, an airline which does not use fuel hedges and operates a diverse fleet with a mean aircraft dispersion index of 0.53, has a Tobin's Q that is 17% (-0.3237*0.53) less than an airline operating an uniform fleet. Furthermore, if this hypothetical airline chose to hedge next year's fuel requirements at the industry mean for airlines which hedge (0.30), then its reduction in value compared to a uniform fleet with similar hedging activities would be 22.6% (See Equation (4) below).

$$d\ln(Q) = -0.3237 \times d(\text{Fleet Diversity}) - 0.3442 * (\text{Mean hedged by hedgers}) \times d(\text{Fleet Diversity}) \tag{4}$$

$$\%\Delta\text{Q} = 22.6\% = -0.3237 \times (0.53) - 0.3442 * (0.30) \times (0.53)$$

The result showing that a diverse fleet reduces value is surprising since the results in the prior chapter found that the diversity and the fuel efficiency of the fleet are effective operational hedges against jet fuel costs. However, this section illustrates that though operational hedges are effective at reducing a firm's exposure, the cost of implementing such a hedge outweighs its benefits.

Column (2) of Table 5 shows *Age* to be 0.1313 and significant at the 1% level. The positive value for the age of the fleet means that operating an older less fuel-efficient fleet increases the value of the airline. The results of Table 5 suggest that for an airline with a fleet age of 10 years (the industry average, Table 1), reducing the age of its fleet by one year causes the airline's Tobin's Q to decline by 1.3% (0.1331/10). The result that a newer aircraft reduces an airline value is confirmed by Table 6 Panel C column (4), which excludes the cross-products of operational hedges and the percent of fuel hedged. The cross-product of *Age* and *Hedge* is insignificant in all models (Table 5 and 6). Thus, there is no evidence that using a fuel-efficient fleet with fuel hedges affects an airline's value.

The coefficient for *Leased Fleet* is negative in all models, suggesting a leased fleet is harmful to an airlines value. This result holds when the cross-products are excluded from the model (Table 6 Panel C

Column (4)). To illustrate, increasing the percent of the fleet which is leased by 1% reduce the airlines Tobin's Q by 0.25% (Table 6 Panel C Column (4)).

The result that the combined use of both financial and operational hedges does not increase the value of the firm is surprising. Table 5 and Table 6 shows that the cross-product of Fleet Diversity (*ADI*) and *Hedge* is negative and the cross-product of the *Age* and *Hedge* is insignificant. This results contradicts the finding of Allayannis, Ihrig, and Weston (2001) and Kim, Mathur, and Nam (2006) who find that operational and financial hedges increase a firm's value. However, for both of these studies, their proxy of the operational hedge is ineffective at reducing the firm's exposure to currency rates. Therefore, the relationship between the firms' values and their operational hedges possibly suffers from measurement error.

TABLE 5
HEDGING AND AIRLINE VALUE

The table reports the results of the estimation of Equation (3).

$Log(Tobin's\ Q_{i,t}) = \alpha + \beta_{Hedge} * Hedge_{i,t} + (\beta_{Diversity} + \beta_{Diversity/Hedge}(Hedge_{i,t})) * (Fleet\ Diversity_{i,t}) + (\beta_{Leases} + \beta_{Leases/Hedge}(Hedge_{i,t})) * (Leased\ Fleet_{i,t}) + (\beta_{Age} + \beta_{Age/Hedge}(Hedge_{i,t}))* \beta_{Age}(Age_{i,t}) + \beta_{FuelPass}(FuelPass_{i,t}) + \beta_{Der\_FX}(Der\_FX_{i,t}) + \beta_{Der\_IR}(Der\_IR_{i,t}) + \beta_{Control}(Control\ Variables_{i,t}) + \varepsilon_{i,t}.$

Column 1 uses OLS with robust standard errors. Columns 2, 3, and 5 use FGLS to control for heteroskedasticity. Column 4 uses fixed effects. Column 3 excludes foreign currency (Der_FX) and interest rate derivatives (IR_FX). Column 5 excludes the operational hedges. All models include a year dummy variable that is not reported.

	Column 1 OLS with Robust Errors	Column 2 FGLS	Column 3 FGLS	Column 4 Fixed Effect	Column 5 FGLS
Constant	-0.7418	-1.1325***	-0.9809***	-1.3819	-0.7257***
	(0.4547)	(0.2790)	(0.2498)	(1.0323)	(0.1639)
Size	-0.0065	0.0065	-0.0083	0.0809	-0.0339**
	(0.0288)	(0.0197)	(0.0160)	(0.1194)	(0.0166)
DIV	-0.0078	0.0057	-0.0023	0.0037	0.0185
	(0.0254)	(0.0225)	(0.0223)	(0.0327)	(0.0305)
LTDA	1.3696***	1.4983***	1.4908***	1.5107***	1.5431***
	(0.2989)	(0.1325)	(0.1214)	(0.4034)	(0.1261)
CFTS	0.9239	0.4583**	0.3792*	0.8174*	0.5503***
	(0.6162)	(0.2127)	(0.2074)	(0.4519)	(0.2148)
CAPTS	0.1309	0.2714*	0.2440*	0.1203	0.3303**
	(0.1876)	(0.1428)	(0.1400)	(0.2240)	(0.1580)
Z Score	0.2291***	0.2699***	0.2778***	0.2109***	0.2436***
	(0.0370)	(0.0224)	(0.0220)	(0.0465)	(0.0206)
Cash	-0.2299	-0.3987**	-0.3934**	-0.5169	-0.1127
	(0.2824)	(0.1723)	(0.1669)	(0.3707)	(0.1986)
Hedge	0.5075	0.6566*	0.7417**	-0.1300	0.2486**
	(0.4445)	(0.3631)	(0.3534)	(0.4707)	(0.1037)
FuelPass	-0.2899***	-0.3005***	-0.2833***	0.6326*	-0.2225***
	(0.0655)	(0.0611)	(0.0593)	(0.3826)	(0.0646)
Der_FX	-0.0566	-0.0096		-0.0300	-0.0876
	(0.0798)	(0.0557)		(0.1144)	(0.0614)
DER_IR	-0.0099	-0.0825**		-0.0536	-0.0811*
	(0.0580)	(0.0391)		(0.0749)	(0.0490)

TABLE 5 (Cont.)
HEDGING AND AIRLINE VALUE

	Column 1 OLS with Robust Errors	Column 2 FGLS	Column 3 FGLS	Column 4 Fixed Effect	Column 5 FGLS
Fleet Diversity	-0.4565***	-0.3237***	-0.3403***	-0.8111**	
	(0.1581)	(0.0846)	(0.0797)	(0.3427)	
Fleet Diversity ×	-0.2088	-0.3442**	-0.3811**	-0.3867	
Hedge	(0.2461)	(0.1711)	(0.1689)	(0.2780)	
Age	0.1004	0.1313***	0.1265***	0.0452	
	(0.0752)	(0.0479)	(0.0477)	(0.1212)	
Age ×Hedge	-0.1045	-0.1558	-0.2011	0.2482	
	(0.2068)	(0.1690)	(0.1643)	(0.2475)	
Leased Fleet	-0.2101	-0.1530	-0.2144**	-0.0899	
	(0.1909)	(0.1108)	(0.1083)	(0.3407)	
REG	0.1432	0.1829*	0.1342*	0.1570	-0.1102
	(0.1225)	(0.1012)	(0.0801)	(0.5405)	(0.0673)
CAP	-0.0273	-0.0565	-0.0317	-0.0403	
	(0.0671)	(0.0542)	(0.0522)	(0.0766)	
AvgPrice	-0.0015	-0.0007	-0.0008	-0.0015	-0.0011
	(0.0011)	(0.0007)	(0.0006)	(0.0015)	(0.0007)
Commuter	0.0055	-0.0360		0.5326	
	(0.1436)	(0.1130)		(0.3986)	
Number of Observations	236	227	227	227	258
F-Statistic / Wald	17.19	1,065.31	1,121.14	21.52	531.74
R^2	0.6764				

* = 10% significance, ** = 5% significance, *** = 1% significance.

CONCLUSION

This paper analyzes three operational hedges that are at the disposal of an airline to determine if operational and financial hedges are complements or substitutes. Furthermore, the question of whether operational and financial hedges increase the value of the firm is addressed. The three operational hedges are the diversity of the airline's fleet, the leasing of the airline's fleet and the use of a newer fuel-efficient fleet. A diverse fleet and the leasing of an airline's fleet, provide the airline with the option to adjust its capacity during periods of high fuel prices. A newer fuel-efficient fleet reduces the airline's overall exposure to the price of jet fuel.

The evidence presented in this paper shows that airlines that use operational hedges to manage their risk are more likely to also use financial hedges. That is, airlines which operate a diverse fleet are more likely to use financial derivatives. This makes sense, as changing the operations of a firm is costly and is only done once a certain threshold as been reached. For instance, it is costly for an airline to mothball an aircraft, and thus the airline will delay this decision until market conditions have deteriorated enough to justify such an action. Financial hedges are less costly to implement once the fixed cost of a hedging program has been established and thus are better suited for the fine tuning of a firm's current needs.

A surprising result of this study shows that the use of operational hedges actually decreases the value of the firm, while there is no consistent conclusion for value that financial hedges provide an airline. In the airline industry, fuel derivatives are beneficial to the airline's value. However, the use of fuel pass-through agreements actually reduces the value of the airline. Similar to a fuel pass-through agreement, operational hedges reduce the value of the airline. That is, a diverse fleet, a newer fuel-efficient fleet and the leasing of its fleet diminishes the airline's value.

ENDNOTES

1. Operational and financial hedges are substitutes if the firm uses one to manage its risks and not the other. Operational and financial hedges are complements if the firm uses both types of hedges to manage similar risks.
2. Alaska Airlines is not coded as a regional airline.
3. Restated another way, increasing the percent of fuel hedged by 10% increases the effectiveness of a diverse fleet by $0.10^*\beta_{diversity/hedge}$

REFERENCES

Adam, T.R., & Fernando, C.S. (2006). Hedging, speculation, and shareholder value. *Journal of Financial Economics* 81 (2):283-309.

Adler, M., & Dumas, B. (1984). Exposure to currency risk: Definition and measurement. *Financial Management* 13 (2):41-50.

Allayannis, G., & Ihrig, J. (2001). Exposure and markups. *The Review of Financial Studies* 14 (3):805-835.

Allayannis, G., Ihrig, J., & Weston, J.P. (2001). Exchange-rate hedging: Financial versus operational strategies. *The American Economic Review* 91 (2):391-395.

Allayannis, G., & Ofek, E. (2001). Exchange rate exposure, hedging, and the use of foreign currency derivatives. *Journal of International Money and Finance* 20 (2):273-296.

Allayannis, G., & Weston, J.P. (1999). The use of foreign currency derivatives and industry structure. In *Corporate risk: Strategies and management*, edited by G. W. Brown and D. H. Chew. London: Risk Books.

Allayannis, G., & Weston, J.P. (2001). The use of foreign currency derivatives and firm market value. *Review of Financial Studies* 14 (1):243-276.

Almeida, H., Campello, M., & Weisbach, M.S. (2004). The cash flow sensitivity of cash. *Journal of Finance* 59 (4):1777-1804.

Ang, J., & Peterson, P.P. (1984). The leasing puzzle. *The Journal of Finance* 39 (4):1055-1065.

Bartov, E., & Bodnar, G.M. (1994). Firm valuation, earnings expectations, and the exchange-rate exposure effect. *The Journal of Finance* 49 (5):1755-1785.

Bernard, V.L. (1986). Unanticipated inflation and the value of the firm. *Journal of Financial Economics* 15 (3):285-321.

Bodnar, G.M., Dumas B., & Marston, R.C. (2002). Pass-through and exposure. *The Journal of Finance* 57 (1):199-231.

Boyabaitli, O., & Toktay, L.B. (2004). Operational hedging: A review with discussion, Working Paper, INSEAD.

Brennan, M.J., & Schwartz, E.S. (1985). Evaluating natural resource investments. *The Journal of Business* 58 (2):135-157.

Brigham, E.F., & Ehrhardt M.C. (2005). *Financial management: Theory and practice*. 11th ed, *The Harcourt College Publishers series in finance*. Mason, Ohio: South-Western/Thomson Learning.

Brown, G.W., Crabb P.R., & Haushalter, D. (2006). Are firms successful at selective hedging? *Journal of Business* 79 (6):2925-2949.

Brown, G.W. (2001). Managing foreign exchange risk with derivatives. *Journal of Financial Economics* 60 2-3:401-48.

Carter, D.A., Pantzalis C., & Simkins, B.J. (2006). Asymmetric exposure of U.S. MNCs, Working Paper, Oklahoma State University.

Carter, D.A., Rogers, D.A., & Simkins, B.J. (2006). Does hedging affect firm value? Evidence from the U.S. airline industry. *Financial Management* 35 (1):53-86.

Carter, D.A., Rogers, D.A., & Simkins, B.J. (2006). Hedging and value in the U.S. airline industry. *Journal of Applied Corporate Finance* 18:21-33.

Chen, C.R., & Chan, A. (1989). Interest rate sensitivity, asymmetry, and the stock returns of financial institutions. *The Financial Review* 24 (3):457-473.

Choi, J.J., & Elyasiani, E. (1997). Derivative exposure and the interest rate and exchange rate risks of U.S. banks. *Journal of Financial Services Research* 12 (2,3):267-286.

Chung, K.H., & Pruitt, S.W. (1994). A simple approximation of Tobin's Q. *Financial Management* 23 (3):70-74.

DaDalt, P.J., Donaldson, J.R., & Garner, J.L. (2003). Will any q do? *Journal of Financial Research* 26 (4):535-551.

DeMarzo, P.M., & Duffie D., (1995). Corporate incentives for hedging and hedge accounting. *Review of Financial Studies* 8 (3):743-771.

Dixit, A.K., & Pindyck, R.S. (1994). *Investment under uncertainty*. Princeton, N.J.: Princeton University Press.

Fama, E.F. (1975). Short-term interest rates as predictors of inflation. *The American Economic Review* 65 (3):269-282.

Fama, E.F., & Miller, M.H. (1972). *The theory of finance*. Hinsdale, IL.: Dryden Press.

Faulkender, M. (2005). Hedging or market timing? Selecting the interest rate exposure of corporate debt. *The Journal of Finance* 60 (2):931-962.

Flannery, M.J., & James, C.M. (1984). The effect of interest rate changes on the common stock returns of financial institutions. *The Journal of Finance* 39 (4):1141-1153.

French, K.R., Ruback, R.S., & Schwert, G.W. (1983). Effects of nominal contracting on stock returns. *The Journal of Political Economy* 91 (1):70-96.

Froot, K.A., Scharfstein, D.S., & Stein, J.C. (1993). Risk management: Coordinating corporate investment and financing policies. *Journal of Finance* 48 (5):1629-1658.

Geczy, C., Minton, B.A., & Schrand. (1997). Why firms use currency derivatives. *Journal of Finance* 52 (4):1323-1354.

Graham, J.R., & Rogers, D.A. (2002). Do firms hedge in response to tax incentives? *The Journal of Finance* 57 (2):815-839.

Graham, J.R., & Smith, C.W. (1999). Tax incentives to hedge. *Journal of Finance* 54 (6):2241-2262.

Greene, W.H. (2003). *Econometric analysis*. 5th ed. Upper Saddle River, N.J.: Prentice Hall.

Guay, W.R., & Kothari, S.P. (2003). How much do firms hedge with derivatives? *Journal of Financial Economics* 70 (3):423-461.

Guay, W.R. (1999). The impact of derivatives on firm risk: An empirical examination of new derivative users. *Journal of Accounting and Economics* 26 (1-3):319-351.

Haushalter, G.D., Klasa, S., & Maxwell, W.F. (2007). The influence of product market dynamics on a firm's cash holdings and hedging behavior. *Journal of Financial Economics* 84 (3):797-825.

Haushalter, G.D. (2000). Financing policy, basis risk, and corporate hedging: Evidence from oil and gas producers. *The Journal of Finance* 55 (1):107-152.

Haushalter, G.D., Heron, R.A., & Lie E. (2002). Price uncertainty and corporate value. *Journal of Corporate Finance* 8 (3):271-286.

He, J., & Ng, L.K. (1998). The foreign exchange exposure of Japanese multinational corporations. *Journal of Finance* 53 (2):733.

Hentschel, L., & Kothari, S.P. (2001). Are corporations reducing or taking risks with derivatives? *The Journal of Financial and Quantitative Analysis* 36 (1):93-118.

Hill, R.C., & Adkins, L.C. (2001). A companion to theoretical econometrics. In *Blackwell companions to contemporary economics*, edited by B. H. Baltagi. Malden, MA.: Blackwell.

Jin, Y., & Jorion, P. (2006). Firm value and hedging: Evidence from U.S. oil and gas producers. *The Journal of Finance* 61 (2):893-919.

Jorion, P. (1990). The exchange-rate exposure of U.S. multinationals. *Journal of Business* 63 (3):331-345.

Jorion, P. (1991). The pricing of exchange rate risk in the stock market. *The Journal of Financial and Quantitative Analysis* 26 (3):363-376.

Kallapur, S., & Eldenburg, L. (2005). Uncertainty, real options, and cost behavior: Evidence from Washington state hospitals. *Journal of Accounting Research* 43 (5):735-752.

Kim, Y.S., Mathur, I., & Nam, J. (2006). Is operational hedging a substitute for or a complement to financial hedging? *Journal of Corporate Finance* 12 (4):834-853.

Kwan, S.H. (1991). Re-examination of interest rate sensitivity of commercial bank stock returns using a random coefficient model. *Journal of Financial Services Research* 5 (1):61-76.

Mackay, P., & Moeller, S.B. (2007). The value of corporate risk management. *Journal of Finance* 62 (3):1379-1419.

Mello, A.S., & Ruckes, M.E. (2005). Financial hedging and product market rivalry, Working Paper, University of Wisconsin.

Modigliani, F., & Miller, M.H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review* 48 (3):261-297.

Myers, S.C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics* 5 (2):147-175.

Nain, A. (2004). The strategic motives for corporate risk management, Working Paper, University of Iowa - Henry B. Tippie College of Business.

Nain, A. (2005). Corporate risk management in an industry setting: An empirical investigation, Working Paper, University of Iowa - Henry B. Tippie College of Business.

Nance, D.R., Smith, C.W., & Smithson, C.W. (1993). On the determinants of corporate hedging. *Journal of Finance* 48 (1):267-284.

Pantzalis, C., Simkins, B.J., & Laux, P.A. (2001). Operational hedges and the foreign exchange exposure of U.S. multinational corporations. *Journal of International Business Studies* 32 (4):793-813.

Perfect, S.B., & Kenneth K.W. (1994). Alternative constructions of Tobin's Q: An empirical comparison. *Journal of Empirical Finance* 1 (3-4):313-341.

Petersen, M.A., & Thiagarajan, S.R. (2000). Risk measurement and hedging: With and without derivatives. *Financial Management* 29 (4):5-29.

Pulvino, T.C. (1998). Do asset fire sales exist? An empirical investigation of commercial aircraft transactions. *The Journal of Finance* 53 (3):939-978.

Rajgopal, S. (1999). Early evidence on the informativeness of the SEC's market risk disclosures: The case of commodity price risk exposure of oil and gas producers. *The Accounting Review* 74 (3):251-280.

Schrand, C.M. (1997). The association between stock-price interest rate sensitivity and disclosures about derivative instruments. *The Accounting Review* 72 (1):87-109.

Scott, W.L., & Peterson , R.L. (1986). Interest rate risk and equity values of hedged and unhedged financial intermediaries. *Journal of Financial Research* 9 (4):325-329.

Smith, C.W., & Wakeman, L. (1985). Determinants of corporate leasing policy. *The Journal of Finance* 40 (3):895-908.

Smith, C.W., & Stulz, R.M. (1985). The determinants of firms' hedging policies. *Journal of Financial and Quantitative Analysis* 20 (4):391-405.

Stone, B.K. (1974). Systematic interest-rate risk in a two-index model of returns. *The Journal of Financial and Quantitative Analysis* 9 (5):709-721.

Stulz, R.M. (1996). Rethinking risk management. *Journal of Applied Corporate Finance* 9 (3):8-25.

Sweeney, R.J., & Warga, A.D. (1986). The pricing of interest-rate risk: Evidence from the stock market. *The Journal of Finance* 41 (2):393-410.

Triantis, A.J. (2000). Real options and corporate risk management. *Journal of Applied Corporate Finance* 13 (2):64-73.

Triki, T. (2005). How good are tests of corporate hedging theories?: Reflexions on previous research, Working Paper, IESEG School of Management.

Tufano, P. (1996). Who manages risk? An empirical examination of risk management practices in the gold mining industry. *Journal of Finance* 51 (4):1097-1137.

Tufano, P. (1998). The determinants of stock price exposure: Financial engineering and the gold mining industry. *The Journal of Finance* 53 (3):1015-1052.

Williamson, R. (2001). Exchange rate exposure and competition: Evidence from the automotive industry. *Journal of Financial Economics* 59 (3):441-475.

APPENDIX A

TABLE 6
HEDGING AND AIRLINE VALUE (FLEET DIVERSITY)

The table reports the results of the estimation of Equation (3).
$\text{Log (Tobin's } Q_{i,t}) = \alpha + \beta_{Hedge} * Hedge_{i,t} + (\beta_{Diversity} + \beta_{Diversity/Hedge}(Hedge_{i,t})) * (\text{Fleet Diversity}_{i,t}) + (\beta_{Leases} + \beta_{Leases/Hedge}(Hedge_{i,t})) * (\text{Leased Fleet}_{i,t}) + (\beta_{Age} + \beta_{Age/Hedge}(Hedge_{i,t}))* \beta_{Age}(Age_{i,t}) + \beta_{FuelPass}(FuelPass_{i,t}) + \beta_{Der\_FX}(Der\_FX_{i,t}) + \beta_{Der\_IR}(Der\_IR_{i,t}) + \beta_{Control}(\text{Control Variables}_{i,t}) + \varepsilon_{i,t}$.
Columns 1 – 5 use FGLS to control for heteroskedasticity. Columns 2 – 5 are Equation (3) with the inclusion of the Aircraft Dispersion Index (Fleet Diversity) and different combinations of the operational hedges. Column 1 includes all operational hedges and is included as a comparison. All models include a year dummy that is not reported.

Panel A

	Column 1 Complete Model	Column 2 Fleet Diversity	Column 3 Fleet Diversity × Hedge	Column 4 Fleet Diversity & Lease Fleet	Column 5 Fleet Diversity × Hedge & Leased Fleet
Constant	-0.9809***	-0.4530***	-0.4888***	-0.3095*	-0.3967**
	(0.2498)	(0.1549)	(0.1492)	(0.1881)	(0.1845)
Size	-0.0083	-0.0110	-0.0191	-0.0239	-0.0258
	(0.0160)	(0.0144)	(0.0141)	(0.0167)	(0.0162)
DIV	-0.0023	-0.0025	-0.0008	-0.0082	-0.0057
	(0.0223)	(0.0363)	(0.0346)	(0.0389)	(0.0374)
LTDA	1.4908***	1.4373***	1.4835***	1.4158***	1.4667***
	(0.1214)	(0.1123)	(0.1105)	(0.1147)	(0.1132)
CFTS	0.3792*	0.4710**	0.4690**	0.4802**	0.4841**
	(0.2074)	(0.2130)	(0.2103)	(0.2155)	(0.2125)
CAPTS	0.2240*	0.2156**	0.2144**	0.1690	0.1860*
	(0.1400)	(0.1097)	(0.1082)	(0.1089)	(0.1077)
Z score	0.2778***	0.2112***	0.2057***	0.2172***	0.2080***
	(0.0220)	(0.0228)	(0.0222)	(0.0238)	(0.0234)
Cast	-0.3934**	-0.1879	-0.1455	-0.1926	-0.1546
	(0.1669)	(0.1787)	(0.1734)	(0.1774)	(0.1732)
Hedge	0.7417**	0.3053***	0.5206***	0.2343***	0.4382***
	(0.3534)	(0.0864)	(0.0997)	(0.0892)	(0.1065)
FuelPass	-0.2833***	-0.3148***	-0.2710***	-0.3206***	-0.2834***
	(0.0593)	(0.0715)	(0.0701)	(0.0755)	(0.0745)

TABLE 6
HEDGING AND AIRLINE VALUE (FLEET DIVERSITY)

Panel A (Cont.)					
	Column 1 Complete Model	Column 2 Fleet Diversity	Column 3 Fleet Diversity × Hedge	Column 4 Fleet Diversity & Lease Fleet	Column 5 Fleet Diversity × Hedge & Leased Fleet
Fleet Diversity	-0.3403***	-0.5735***	-0.4173***	-0.5179***	-0.3979***
	(0.0797)	(0.0750)	(0.0844)	(0.0805)	(0.0871)
(Fleet Diversity) × (Hedge)	-0.3811**		-0.5984***		-0.5529***
	(0.1689)		(0.1815)		(0.1792)
Age	-0.1265***				
	(0.0477)				
Age × (Hedge)	-0.2011				
	(0.1643)				
Leased Fleet	-0.2144**			-0.2094**	-0.1455
	(0.1083)			(0.1037)	(0.1034)
REG	0.1342*	0.0711	0.0404	0.0670	0.0475
	(0.0801)	(0.0767)	(0.0758)	(0.0805)	(0.0793)
CAP	-0.0317	-0.0398	-0.0227	-0.0493	-0.0331
	(0.0522)	(0.0540)	(0.0535)	(0.0531)	(0.0527)
AvgPrice	-0.0008	-0.0020***	-0.0020***	-0.0015**	-0.0016**
	(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Number of Observations	227	248	248	242	242
F-Statistic / χ^2	1,121.14	813.82	906.50	856.45	933.84

* = 10% significance, ** = 5% significance, *** = 1% significance.

TABLE 6 (Cont.)
HEADING AND AIRLINE VALUE (AGE)

Panel B					
	Column 1 All OPs	Column 2 Age of Fleet	Column 3 Age & Hedge × Age	Column 4 Age & Leased Fleet	Column 5 Age, Hedge × Age & Leased Fleet
Constant	-0.9809***	-0.2522***	-1.3515***	-0.3266	-0.4381
	(0.2498)	(0.2226)	(0.2323)	(0.2877)	(0.2959)
Size	-0.0083	-0.0213	-0.0177	-0.0685***	-0.0636***
	(0.0160)	(0.0147)	(0.0148)	(0.0164)	(0.0165)
DIV	-0.0023	0.0266	0.0293	0.0001	0.0008
	(0.0223)	(0.0362)	(0.0361)	(0.0296)	(0.0290)
LTDA	1.4908***	1.5702***	1.5590***	1.4128***	1.3993***
	(0.1214)	(0.1297)	(0.1291)	(0.1282)	(0.1279)
CFTS	0.3792*	0.3287	0.3369	0.4336**	0.4512**
	(0.2074)	(0.2090)	(0.2096)	(0.2104)	(0.2121)
CAPTS	0.2440*	0.4570***	0.4283***	0.2863*	0.2510
	(0.1400)	(0.1573)	(0.1574)	(0.1553)	(0.1574)
Z Score	0.2778***	0.3151***	0.3158***	0.3254***	0.3256***
	(0.0220)	(0.0213)	(0.0213)	(0.0202)	(0.0203)
Cash	-0.3934**	-0.3710*	-0.3670*	-0.4122**	-0.4297**
	(0.1669)	(0.2054)	(0.2031)	(0.1897)	(0.1891)
Hedge	0.7417**	0.2446**	0.7234*	0.2102**	0.7008*
	(0.3534)	(0.0981)	(0.4068)	(0.0907)	(0.3864)
FuelPass	-0.2833***	-0.2553***	-0.2658***	-0.2174***	-0.2255***
	(0.0593)	(0.0649)	(0.0654)	(0.0584)	(0.0590)
Fleet Diversity	-0.3403***				
	(0.0797)				
(Fleet Diversity) ×	-0.3811**				
(Hedge)	(0.1689)				
Age	0.1265***	0.0768*	0.1097**	0.0081	0.0435
	(0.0477)	(0.0457)	(0.0515)	(0.0482)	(0.0544)
Age × (Hedge)	-0.2011		-0.2250		-0.2328
	(0.1643)		(0.1864)		(0.1786)
Leased Fleet	-0.2144**			-0.5445***	-0.5446***
	(0.1083)			(0.1043)	(0.1056)
REG	0.1342*	-0.0161	0.0134	-0.1124	-0.0736
	(0.0801)	(0.0781)	(0.0809)	(0.0729)	(0.0777)
CAP	-0.0317	-0.0902	-0.0851	-0.0252	-0.0240
	(0.0522)	(0.0568)	(0.0566)	(0.0562)	(0.0561)
AvgPrice	-0.0008	-0.0001	-0.0002	-0.0002	-0.0002
	(0.0006)	(0.0008)	(0.0008)	(0.0007)	(0.0007)
Number of Observations	227	228	228	227	227
F-Statistic / χ^2	1,121.14	888.89	871.95	1,071.43	1,008.19

* = 10% significance, ** = 5% significance, *** = 1% significance.

TABLE 6 (Cont.)
HEADING AND AIRLINE VALUE (LEASED FLEET)

Panel C						
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
	Fleet Diversity, Age	Fleet Diversity, Hedge × (Fleet Diversity) & Age	Fleet Diversity, Age & Hedge × Age	Fleet Diversity, Age, Leased Fleet	Aircraft Dispersion, Hedge × Fleet Diversity, Age, Leased Fleet	Fleet Diversity, Age, Hedge × Age & Leased Fleet
Constant	-1.2232***	-1.2067***	-1.2986***	-0.8539***	-0.8989***	-0.9450***
	(0.1870)	(0.1865)	(0.1919)	(0.2476)	(0.2460)	(0.2504)
Size	0.0096	0.0045	0.0133	-0.0117	-0.0120	-0.0074
	(0.0131)	(0.0130)	(0.0132)	(0.0162)	(0.0160)	(0.0162)
DIV	0.0012	0.0021	0.0030	-0.0061	-0.0036	-0.0045
	(0.0223)	(0.0208)	(0.0228)	(0.0234)	(0.0218)	(0.0240)
LTDA	1.5270***	1.5497***	1.5071***	1.4864***	1.5130***	1.4611***
	(0.1200)	(0.1178)	(0.1206)	(0.1224)	(0.1206)	(0.1231)
CFTS	0.3315	0.3527*	0.3398*	0.3574*	0.3684*	0.3680*
	(0.2053)	(0.2037)	(0.2059)	(0.2083)	(0.2068)	(0.2091)
CAPTS	0.3256**	0.3309**	0.2988**	0.2521*	0.2762**	0.2189
	(0.1351)	(0.1335)	(0.1363)	(0.1381)	(0.1379)	(0.1401)
Z Score	0.2797***	0.2720***	0.2804***	0.2848***	0.2757***	0.2859***
	(0.0213)	(0.0209)	(0.0212)	(0.0222)	(0.0221)	(0.0221)
Cash	-0.4634***	-0.4122**	-0.4548***	-0.4305**	-0.3960**	-0.4259**
	(0.1732)	(0.1686)	(0.1724)	(0.1708)	(0.1684)	(0.1699)
Hedge	0.2420***	0.3819***	0.6848*	0.1932**	0.3253***	0.6857*
	(0.0781)	(0.0908)	(0.3535)	(0.0806)	(0.0965)	(0.3533)
FuelPass	-0.3069***	-0.2702***	-0.3226***	-0.2953***	-0.2668***	-0.3132***
	(0.0571)	(0.0567)	(0.0582)	(0.0588)	(0.0581)	(0.0601)
AvgPrice	-0.0008	-0.0010	-0.0008	-0.0006	-0.0008	-0.0007
	(0.0007)	(0.0006)	(0.0007)	(0.0006)	(0.0006)	(0.0006)

TABLE 6 (Cont.)
HEADING AND AIRLINE VALUE (LEASED FLEET)

	Panel C (Cont.)					
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
	Fleet Diversity, Age	Fleet Diversity, Hedge × (Fleet Diversity) & Age	Fleet Diversity, Age & Hedge × Age	Fleet Diversity, Age, Leased Fleet	Aircraft Dispersion, Hedge × Fleet Diversity, Age, Leased Fleet	Fleet Diversity, Age, Hedge × Age & Leased Fleet
Fleet Diversity	-0.5110***	-0.3983***	-0.5113***	-0.4270***	-0.3398***	-0.4252***
	(0.0640)	(0.0752)	(0.0642)	(0.0719)	(0.0801)	(0.0721)
(Fleet Diversity) × (Hedge)		-0.4341***			-0.3995**	
		(0.1683)			(0.1691)	
Age	0.1451***	0.1355***	0.1707***	0.1005**	0.0978**	0.1323***
	(0.0389)	(0.0393)	(0.0425)	(0.0432)	(0.0430)	(0.0475)
Age × (Percent Hedged)			-0.2094			-0.2336
			(0.1626)			(0.1638)
Leased Fleet				-0.2485**	-0.2052*	-0.2542**
				(0.1079)	(0.1075)	(0.1086)
Regional Airline	0.1667**	0.1363*	0.1909***	0.1232	0.1055	0.1556*
	(0.0729)	(0.0733)	(0.0744)	(0.0784)	(0.0778)	(0.0803)
CAP	-0.0653	-0.0445	-0.0632	-0.0465	-0.0308	-0.0452
	(0.0524)	(0.0522)	(0.0524)	(0.0525)	(0.0522)	(0.0524)
AvgPrice	-0.0008	-0.0010	-0.0008	-0.0006	-0.0008	-0.0007
	(0.0007)	(0.0006)	(0.0007)	(0.0006)	(0.0006)	(0.0006)
Number of Observations	228	228	228	227	227	227
F-Statistic / χ^2	1,008.49	1,107.29	1,005.67	1,051.24	1,102.60	1,051.11

* = 10% significance, ** = 5% significance, *** = 1% significance.