Hedging and Value in the U.S. Airline Industry

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If we don't do anything, we are speculating. It is our fiduciary duty to hedge fuel price risk.

Scott Topping, Vice President Treasurer, Southwest Airlines[1]

In the past few years, a growing number of companies have devoted major resources to implementing risk management programs designed to hedge financial risks, such as interest rate, currency, and commodity price risk. Because of the increasing reliance on such programs, it is important to ask the question: "Does hedging add value to corporations?"[2] And if it does, the obvious follow-up question is: "How does it add value?"

Finance theorists have proposed a number of ways that hedging and, more generally, risk management can increase corporate market values. Stated briefly, risk management has the potential to add value by (1) reducing corporate income taxes; (2) reducing the probability and expected costs of financial distress; and (3) preserving management's ability and incentives to carry out all positive-NPV projects (incentives that can otherwise be distorted by the pressure for near-term cash flow faced by financially troubled firms).[3]

To answer the questions of whether hedging adds value and, if so, how, we conducted a study of the fuel price hedging of 28 airlines over the period of 1992-2003 that was published in *Financial Management* in 2006.[4] The aim of this article is to summarize and evaluate the practical import of the findings of that study.

We chose to investigate the relation between hedging and value in the airline industry for a number of reasons. First, the industry is by and large competitive and remarkably homogeneous. Second, by studying airlines, we were able to focus on the hedging of a single, volatile input commodity—jet fuel—that represents a major economic expense for the industry. Although fuel costs have historically been a distant second to labor costs, the two have almost converged in recent years.[5] Third, jet fuel prices are not only highly volatile (our estimate of annualized jet fuel price volatility during 1992-2003 was about 27%, as compared to about 10% for major currencies),[6] but the *levels of volatility* are themselves highly variable. The notable variation in both price and volatility levels during the period we studied allowed us to examine more closely the source of potential value from hedging, and how that value is reflected under different price conditions. Fourth, fuel-price increases cannot be easily passed through to customers (see Box 1) because of competitive pressures in the airline industry. Fifth, and finally, airlines face significant "costs" associated with financial trouble. Perhaps most important, airlines facing a sharp downturn in operating cash flow are likely, especially when faced with a material probability of default, to "underinvest" in their future, making cutbacks in discretionary expenditures on everything from advertising to

1. Quote made by Scott Topping on April 29, 2003 in a presentation at Oklahoma State University.

2. Although the answer is far from definitive, the initial evidence would appear to support a guarded "yes." George Allayannis and James Weston presented the first empirical work regarding the value effect of hedging by looking at the relationship between the use of foreign currency derivatives and value for a sample of large U.S. nonfinancial firms. (See George Allayannis and James Weston, "The Use of Foreign Currency Derivatives and Firm Market Value," *Review of Financial Studies* 14 (2001), pp. 243-276.) Additionally, a recent survey by Charles Smithson and Betty Simkins of the empirical literature on the relation between hedging and firm value finds that most evidence is consistent with the notion that hedging adds value. Charles Smithson and Betty Simkins, "Does Risk Management Add Value? A Survey of the Evidence," *Journal of Applied Corporate Finance* 17 (2005), pp. 8-17.

3. Other possible motives for hedging discussed in the literature include reducing the cost of capital, asymmetric information, and managerial incentives.

4. See David Carter, Daniel Rogers, and Betty Simkins, "Does Hedging Affect Firm Value? Evidence from the U.S. Airline Industry," *Financial Management* 35 (2006), pp. 53-86.

5. In 2005, labor costs and fuel costs at the 10 major U.S. airlines averaged 27.5% and 25% of revenues, respectively. And for some airlines, fuel costs exceeded labor costs for the first time.

6. Guay and Kothari report that the annualized volatility of major currencies is only 11% (measured over 1988-1997). See Wayne Guay and S.P. Kothari, "How Much Do Firms Hedge with Derivatives?" *Journal of Financial Economics* 70 (2003), pp. 423-461.

Competition, Fuel Costs, and Consumer Prices

Fuel prices are an external factor that airlines cannot control. What can they do to react and minimize the damage? A comparison with other modes of transportation is revealing. Fuel represents a roughly comparable proportion of expenses for railroads and many trucking companies (in the mid-teens percent range), but they have not been hurt by higher fuel prices to nearly the same degree.

Part of the difference is due to more active hedging programs by these freight transportation companies, but most is due to the fact that many of their contracts with corporate customers allow them to pass through higher fuel costs in the form of surcharges. Airlines have tried repeatedly to raise fares in response to high fuel costs, but with little success. [T]he problem comes back to a lack of pricing power in a very competitive market.

PHILIP BAGGALEY, Managing Director, Standard & Poor's (June 3, 2004), testimony before the U.S. House of Representatives Committee on Transportation and Infrastructure.

maintenance.[7] Hedging fuel costs, as the results of our study suggest, can help the airlines manage this potential underinvestment problem while also limiting other costs of financial trouble.

Some Background on the Companies

We analyzed all publicly held U.S. passenger airline companies (SIC codes 4512 and 4513) for which information was available for at least two years during the period 1992-2003. That fuel price risk is a major risk factor for the airlines is clear from the disclosures about their hedging programs that appear in many of their annual financial statements. At the same time, a number of other airlines that say nothing about hedging *future* jet fuel purchases draw attention to their use of other risk-management tactics, such as fuel pass-through agreements with major carriers or charter arrangements that allow for fuel costs to be passed along to the organization chartering the flight.[8]

Table 1 provides descriptive data on our sample of 28 airlines. The second and third columns list the airline classification (major carrier, national carrier, or regional/commuter) and the years for which information about the airline was available.[9] As shown in the fourth column of Table 1, fuel costs averaged about 13.75% of operating expenses for all years, with a range of 8.5% (for Mesaba Holdings) to 18.8% (Airtran Holdings). The last three columns in the table report three pieces of information about the companies' fuel hedging programs: (1) the calendar years in which fuel hedges were in place at the fiscal year-end; (2) the maximum maturity of the hedge (expressed in years); and (3) the percentage of next year's fuel requirements hedged.

The major airlines, as can be seen in the table, are much more likely to hedge future jet fuel purchases than the smaller firms. Only AMR and Southwest Airlines had hedges in place at the end of every year for which we have data. But other fairly regular and extensive hedgers included Continental, Delta, Alaska Air, and JetBlue. Of the 28 airlines, 18 (or 64%) reported hedging jet fuel in at least one year.

But among those airlines that hedged, there was considerable variation in the amount of fuel hedged. While the average percentage of next year's fuel consumption hedged was only about 15%, some airlines—notably Southwest—have often hedged up to 80% of the next year's fuel requirements. And in an interesting development, a few major airlines such as Southwest and AMR have been increasing the maximum length of hedging horizons in recent years.

But, as the case of Delta Air Lines makes clear, fuel hedging is not a panacea. For much of our sample period, Delta maintained fairly high levels of fuel hedging. At the end of 2002, the company had hedged 65% of its fuel requirements for 2003, and this level was fairly representative of its hedging policy from 1998 through 2003. But Delta drastically increased its leverage in the post-9/11 environment, perhaps in the belief the industry downturn would be short-lived. By the end of 2003, Delta's long-term debt as a percentage of total assets had grown to 48% (up from 27% at the end of 2000), with about $1 billion coming due in 2004. Meanwhile, during the years of 2001–2003, Delta reported

7. Kenneth Froot, David Scharfstein, and Jeremy Stein, "Risk Management: Coordinating Corporate Investment and Financing Policies," *Journal of Finance* 48 (1993), pp. 1629-1658.

8. It should be noted that fuel pass-through and charter agreements do not lock in a price for future jet fuel, as is the case when airlines hedge future fuel purchases. Rather, users of these operational-type hedging mechanisms experience higher fuel costs as fuel prices increase, but have some flexibility to pass some or all of the higher jet fuel cost to another party, such as the partner airline or the chartering client.

9. Airline carrier classifications are based on the Air Transport Association of America definitions. Major carriers are defined as an airline with annual revenue of more than $1 billion, and national carriers are airlines with annual revenues between $100 million and $1 billion. Regional carriers are airlines with annual revenues of less than $100 million whose service generally is limited to a particular geographic region.

Table 1 **Fuel Usage and Derivatives Hedging by Sample Airlines (1992-2003)**

Airline	Airline Classification	Sample Years	Jet Fuel as a Percentage of Operating Expenses (Average Over Sample Period)	Years Jet Fuel Hedged	Maximum Maturity of Hedge (Years)	Average Percentage of Next Year Hedged
Airtran Holdings	National	1993-2003	18.84%	1999-2003	1.0	14%
Alaska Air Group	Major	1992-2003	13.92%	1992-96, 2000-03	3.0	22%
America West Holdings	Major	1992-2003	13.30%	1997-2003	<1.0	11%
AMR Corp	Major	1992-2003	11.97%	1992-2003	3.0	28%
Amtran	National	1992-2003	18.44%	1998-2001	0.75	3%
Atlantic Coast Airlines	National	1994-2003	12.73%	1997-2000	1.0	5%
CCAir	Regional	1994-1998	8.69%	None		
Comair Holdings	National	1994-1999	10.19%	None		
Continental Airlines	Major	1992-2003	15.14%	1992-93, 1996-2002	1.0	18%
Delta Air Lines	Major	1992-2003	12.20%	1996-2003	3.0	34%
Express Jet Holdings	National	2002-2003	11.62%	None		
Frontier Airlines	National	1994-2003	15.58%	2002-03	2.0	2%
Great Lakes Aviation	National	1994-2003	15.28%	None		
Hawaiian Airlines	National	1994-2002	17.11%	1997-2002	2.0	8%
Jetblue Airways	National	2002-2003	16.07%	2002-03	1.25	43%
Mesa Air Group	National	1994-2003	15.09%	None		
Mesaba Holdings	National	1993-2003	8.45%	None		
Midway Airlines	National	1995-2000	12.52%	None		
Midwest Express Holdings	National	1994-2003	16.53%	1997-2002	0.75	4%
Northwest Airlines	Major	1992-2003	13.57%	1997-2002	1.0	11%
SkyWest	National	1994-2003	12.20%	None		
Southwest Airlines	Major	1992-2003	14.51%	1992-2003	6.0	43%
Tower Air	National	1994-1998	18.36%	1998	N/A	0%
TransWorld Airlines (TWA)	Major	1994-1999	13.00%	1998-1999	2.0	1%
UAL Corp	Major	1992-2003	12.30%	1995-2003	1.0	19%
US Airways Group	Major	1992-2003	9.69%	1994-97, 2000-03	2.0	12%
Vanguard Airlines	Regional	1995-2001	17.61%	None		
World Airways	National	1994-2003	9.97%	None		
Average			**13.75%**			**15%**

operating losses of almost $3 billion while servicing $1.9 billion of interest expense. Delta's S&P credit rating declined steadily from BBB– before September 11, 2001 to BB– by the end of 2003. By March of 2004, its credit rating had been cut further to B–. In February of 2004, Delta liquidated its existing fuel hedge contracts to raise $83 million of cash, leaving the company completely exposed to further price shocks.

Hedging and Value in the Airline Industry

To investigate whether and how the jet fuel hedging activities of airlines affect their values, we estimated the empirical relationships between a number of measures of the extent of a firm's jet fuel hedging activities and a widely used measure of value added called "Tobin's Q" ratio. Tobin's Q, in brief, is the ratio of the firm's market value to its replacement cost—and we used the following simplified version:

[market value of equity + liquidation value of preferred stock + the book values of long-term debt and current liabilities – current assets + book value of inventory] divided by total assets.[10]

We used a number of different measures of fuel hedging activity, including the percentage of next year's fuel require-

10. Because of data limitation, we used a simple approximation of Tobin's Q rather than a more rigorous construction. See Kee Chung and Stephen Pruitt, "A Simple Approximation of Tobin's Q," *Financial Management* 23 (1994), pp. 70-74. Prior research has documented that a simple Q calculation is preferable in most empirical applications because of the ease of computation, data availability, and because the simple approximation is highly correlated with more rigorous calculations. Peter DaDalt, Jeffrey Donaldson, and Jacqueline Garner, "Will Any Q Do? Firm Characteristics and Divergences in Estimates of Tobin's Q," *Journal of Financial Research* 26 (2003).

Southwest Airlines: An Example of a Successful Hedging Program

Southwest Airlines is both the most active hedger of fuel costs and the most profitable among U.S. airlines. At the end of 2005, Southwest posted a profit for its 33rd consecutive year. This success is unprecedented in an industry that has collectively failed to turn a profit for the past five years. Southwest attributes much of that success to its fuel hedging program. As they point out in their 2005 10K report: "This performance was driven primarily by strong revenue growth, as the Company grew capacity, and effective cost control measures, including a successful fuel hedge program." And, in the words of Scott Topping, Southwest's vice president and treasurer, "Fuel hedging will continue to play a strategic role in the industry and be a potential source of competitive advantage."

In 2005, Southwest's fuel costs totaled $1.342 billion and represented 19.8% of operating expenses. Their fuel hedging program resulted in an estimated reduction of "Fuel and oil expense" during 2005 of $892 million. The airline paid an average of $1.03 per gallon after hedging gains and used 1.3 billion gallons of fuel for the year. The following insert summarizes Southwest's hedging program objectives, commodities used and instruments considered, and other considerations.

Hedging Program Objectives

- Strategically manage the second largest expense category on P&L statement
- Integral to unit cost management
- Manage upside risk and participate on the downside (requires an investment)
- Be opportunistic

Commodities Used in Hedging

- Crude Oil, Heating Oil, Unleaded Gasoline, and Jet Fuel
- Considerations in choice of commodities include expected performance of the hedge, basis risk, liquidity, and accounting issues (i.e., FAS 133)

Hedging Instruments Considered

- Swaps—no initial cost but highest risk
- Differential swaps—restructure hedge to manage basis risk
- Collars—can be structured at no cost or premium collars; carries a moderate risk. Premium collars are often used.
- Call options—highest cost, lowest risk, and can create synthetically (swap plus put option)

Considerations in Hedging and Operations

- Point in commodity price cycle—swaps look more favorable at low prices, collars in the mid-range, and options at high prices.
- Uncertainty beyond fundamentals
- Cost/budget
- Other portfolio management objectives or market opportunities (example: volatility)
- Counterparties—prefer OTC trading and counterparties must be investment grade
- FAS 133—goal is to maintain hedge accounting without sacrificing opportunity

Examples of Protection at $1.20 per Gallon using Swap, Call Option, and Collar

Table 2 **Regression Analysis of the Relation Between Firm Value and Jet Fuel Hedging Behavior for Airlines (1992-2003)[a]**

Panel A Relation Between Value and Jet Fuel Hedging

	Constant	Firm Size	Percentage of Next Year's Fuel Req'ts Hedged	LTD to Asset Ratio	R^2	Wald X^2
Model 1 Pooled OLS Dep. Var. = ln(Q) (n = 228)	-0.085 (0.908)	-0.174 *** (0.003)	0.348 * (0.069)	0.710 * (0.074)	0.463	-
Model 2 FGLS Dep. Var. = ln(Q) (n = 228)	-0.557 (0.179)	-0.115 *** (0.000)	0.332 *** (0.005)	0.819 *** (0.000)	-	340.97 ***

Panel B Relation Between the Change in Value and the Change in Jet Fuel Hedging

	Constant	Δ Firm Size	Δ Percentage of Next Year's Fuel Req'ts Hedged	Δ LTD to Asset Ratio	R^2	Wald X^2
Model 3 Pooled OLS Dep. Var. = Δln(Q) (n = 200)	-0.164 (0.341)	-0.298 ** (0.049)	0.188 * (0.068)	0.897 *** (0.006)	0.439	-

a. Models 1 and 3 were estimated with OLS using robust standard errors that account for the clustered sample. Model 2 was estimated using time-series feasible generalized least squares with heteroskedastically consistent standard errors. Control variables listed in the text and year dummy variables were included in all regressions, but not reported. p-values are reported in parentheses below the coefficients.

* indicates significance at the 10 percent level.

** indicates significance at the 5 percent level.

***indicates significance at the 1 percent level.

ments hedged and a fuel hedging "indicator" variable (that received a value of 1 if the airline hedges its jet fuel exposure and 0 if it does not). In addition to variables measuring hedging behavior, we also included several other control variables in our analysis, including: firm size (measured by the natural logarithm of total assets), a dividend indicator, long-term debt-to-asset ratio, cash flow-to-sales ratio, capital expenditures-to-sales ratio, advertising-to-sales ratio, S&P credit rating score, and Altman's Z-score.[11] We also included indicator variables to proxy for the possible effects on firm value of other risk management techniques, such as fuel pass-through agreements, charter operations, and interest-rate or foreign-exchange hedging.[12] Finally, we included the ratio of cash to sales as a measure of liquidity, since excess cash can serve as a partial substitute for hedging and risk management.[13]

Table 2 summarizes the results of our analysis of the relation between Tobin's Q and fuel hedging, as measured by the percentage of next year's fuel requirements hedged. We tested this relationship using three different models.[14] Our results when using Models 1 and 2 provide evidence of a link between hedging and value for airlines. The estimated coefficients for the percentage of next year's fuel requirements hedged were 0.348 for Model 1 and 0.332 for Model 2 (both statistically significant at the 10% level). In the case of Model 1, the coefficient of 0.348 can be interpreted as saying that an airline that hedges 100% of its jet

11. Altman's Z-score is a measure of the likelihood of bankruptcy. A score above 3.0 indicates that bankruptcy is unlikely, while a score below 1.8 indicates bankruptcy is likely.

12. See footnote 8.

13. Prior research notes that airlines with greater liquidity demonstrated less stock price sensitivity in response to the September 11, 2001 attacks. See David Carter and Betty Simkins, "The Market's Reaction to Unexpected Catastrophic Events: The Case of Airline Stock Returns and the September 11th Attacks," *Quarterly Review of Economics and Finance* 44 (2004), pp. 539-558.

14. We used pooled ordinary least squares regression (OLS) with robust standard errors to estimate Models 1 and 3 and a feasible generalized least squares regression (FGLS) with heteroskedastically consistent standard errors to estimate Model 2. Model 3 differs from Model 1 in that we used changes in our variables to explore the effect of changes in jet fuel hedging behavior on the change in firm value. We also included year dummy variables in all regressions. Because all airlines did not operate in all years of our sample, we had a total of 251 firm-year observations.

Lufthansa Airlines: An Example of a Successful Hedging Program by an International Airline

A successful fuel-hedging program is simply one that accomplishes its hedge objectives, like systematic reduction of risk, catastrophe insurance or budget protection.

—Helmut Fredrich, Vice President of Corporate Fuel Management, Lufthansa[26]

German airline Lufthansa is not new to risk management. The company began hedging jet fuel price risk in 1990 and was one of the first airlines to do so. In 1997, Lufthansa became fully privatized and listed its shares on the stock market when the German government sold off its remaining stake in the company. In 2003, *Energy Risk* named Lufthansa "Energy Risk Manager of the Year—End User."

In 2005, fuel consumption accounted for approximately 14% of operating expenses. Like Southwest, Lufthansa has also hedged its fuel cost risk with options, including collars, as well as differential swaps.

Commodities Used in Hedging

- Crude Oil, Gasoil, Kerosene

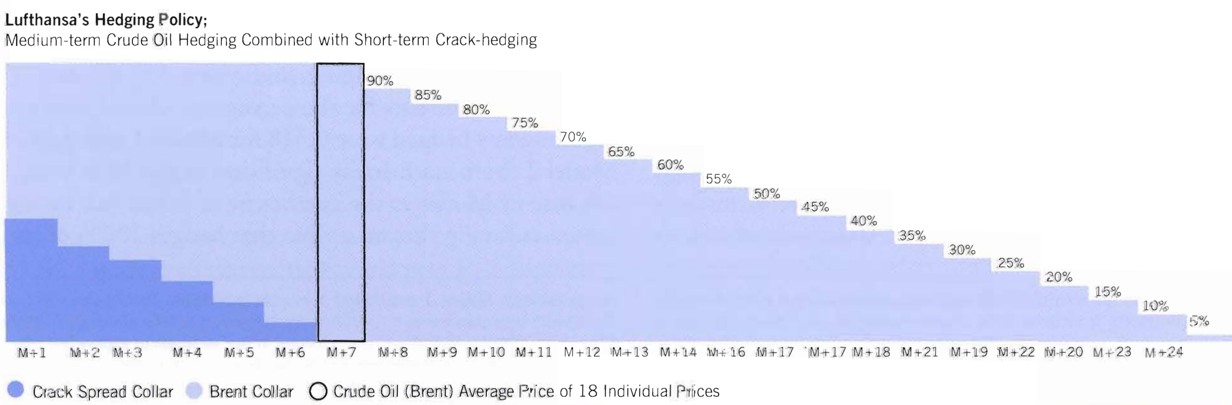
Hedging Instruments Considered

- Swaps including differential swaps
- Crack spread collars
- Options and combinations of options such as collars

Lufthansa hedges up to 90% of its planned fuel requirements on a revolving basis over a period of 24 months ahead. As the figure below illustrates, beginning 24 months into the future (see M+24 in figure), they start hedging 5% of their requirements using Brent Crude Oil Collars each month, incrementally increasing the level to 90% at seven months into the future (see M+7 in figure). To minimize basis risk (i.e., the price difference between crude oil and kerosene), Lufthansa also hedges using crack spread collars. A crack spread collar involves the use of a pair of options (such as buying a call option and selling a put option where the hedge locks in a price range) on the crack spread (the difference in value between crude oil and the products such as kerosene refined from it). Since hedging kerosene for longer periods is expensive, Lufthansa combines the hedging of crude oil with short-term hedging of the crack spread. Lufthansa starts implementing the crack hedging strategy six months ahead (see M+6 in figure) at a monthly rate of 7.5%. As a result, 45% of basis risk is hedged using crack spread collars by the time the fuel is used (see M+1).

Accounting rules are also an important concern. As Helmut Fredrich states: "We have to follow the IASB (International Accounting Standards Board) rules, to make sure our instruments are seen as just hedges and not trading. But as we go more towards the U.S. GAAP regulations, it is more difficult to stay within the rules, especially if you want to do more intelligent hedges."[27]

Example of Lufthansa's Current Hedging Policy: Medium-term Crude Oil Hedging Combined with Short-Term Crack Spread Hedging[28]



26. Source: "Energy Risk Manager of the Year—End User," *Energy Risk*, Volume 7, No. 12 (March 2003).
27. See "Energy Risk Manager of the Year—End User," previously cited.
28. Source: Lufthansa Investor Relations public documents on hedging and other public sources.

Hedging and Investment Behavior: The Case of Southwest and ATA

To illustrate how hedging affects an airline's ability to preserve cash flow for investment, look at what occurred after ATA's Chapter 11 bankruptcy filing on October 27, 2004. Rising jet fuel prices contributed to ATA's deteriorating financial condition as spot prices for Gulf Coast jet fuel rose from below $1.00 per gallon at the start of 2004 to an average of more than $1.50 per gallon during October 2004—a ten-month period during which ATA was not hedged against fuel price increases. At the time of its bankruptcy filing, ATA announced that Airtran had agreed to purchase its Chicago Midway operation along with some additional gates and landing slots at other airports for $87.5 million in cash. In contrast to ATA, Airtran hedged about 29% of its 2004 fuel commitments as of the end of 2003, and increased its hedged position to 35% during the first quarter of 2004. However, the Midway operation was to be put up for auction, and even at the time of the bankruptcy filing, it was speculated that other bidders would emerge.

Southwest Airlines ultimately won the bidding for ATA's Chicago Midway property with a $117 million bid on December 17, 2004. Southwest had over 80% of its 2004 fuel commitments hedged at the end of 2003; and in its 2005 10-K filing, the airline reported that its gains from fuel hedging amounted to $455 million during 2004. Thus, one interpretation of these events is that Southwest's fuel hedging provided the cash flow that gave management the confidence to bid aggressively for the distressed ATA assets.

fuel requirements would be expected to command a value premium of almost 35% over an airline that hedges none of its jet fuel requirements. For those airlines in our sample that hedged, the average percentage of next year's fuel requirements hedged was 29.4%. Thus, our findings suggest that an average hedging airline exhibits a value premium of around 10% (0.35 x 29.4%).[15]

Models 1 and 2 are concerned with the relation between levels of hedging activity and levels of value. Another way of estimating the value consequences of hedging is to measure the change in values when companies change their hedging policies. Our results using Model 3 show that changes in jet fuel hedging are positively related to changes in the value of the firm. The estimated coefficient for a change in the percentage of next year's fuel requirements hedged was 0.188 (which was also statistically significant at the 10% level). This result implies that a change from a policy of no hedging to the average level of hedging (for hedging firms) of 29.4% is associated with an increase in value of approximately 5.5% (0.188 x 29.4%).[16]

How Does Hedging Add Value for Airlines?

Having found evidence that hedging adds value for airlines, we now ask, "How?" In his recent book on *Risk Management and Derivatives* (2003),[17] René Stulz offered a variation on the M&M irrelevance proposition that he called the "risk management irrelevance proposition." Like the famous M&M theorems, Stulz's proposition says that, under a set of artificial conditions known as "perfect financial markets" (i.e., no asymmetric information, no taxes, and no transactions (including bankruptcy) costs), hedging should not affect the value of the firm.

But in the real world, where most if not all the assumptions of perfect financial markets are violated, the question becomes: "Under what conditions might hedging add value?" As mentioned earlier, the ways in which hedging can add value can be reduced to three main categories: (1) reducing taxes; (2) reducing the costs associated with reorganizing financially troubled companies; and (3) preserving (or strengthening) managers' incentives to invest in the company's future. In what follows, we briefly describe how airline hedging of jet fuel price risk might affect firm value in the context of risk management theory.

Preserving Managers' Normal Investment Incentives

In a paper published in the *Journal of Financial and Quantitative Analysis* in 1985, Cliff Smith and René Stulz argued that one of the most important benefits of corporate risk management was its role in limiting the probability and costs of financial distress. Such costs can take the form of direct, out-of-pocket costs, such as the costs of reorganizing a company that defaults. Or they can be indirect, such as the tougher terms exacted by the suppliers and employees—not to mention the reluctance of consumers—when dealing

15. We also estimated the same models using Tobin's Q, total assets, leverage, and capital expenditures adjusted for operating leases. While not shown in this article, the results continue to suggest a statistically significant hedging premium.

16. In a simple analysis of stock returns (i.e., not controlling for size or other factors), hedgers outperformed non-hedgers in seven of the ten years we studied. Furthermore, for two of the years that the hedgers did not outperform non-hedgers (2001-2002), the weaker performance of hedging airlines was most likely due to factors other than hedging. The stock market heavily punished large airlines (almost all of which hedge) in the post 9-11 period since they were more likely targets of terrorist attacks.

17. See *Risk Management and Derivatives* by René M. Stulz, South-Western/Thomson Publishing, 2003.

Table 3 **S&P Credit Ratings for Senior Debt of Sample Airlines**

Airline	Median Rating (1988-2004)	May 2004 Rating
Airtran Holdings	B-	B-
Alaska Air Group	BB+	BB-
America West	B+	B-
AMR	BBB-	B-
Amtran	B	CCC
Atlantic Coast Airlines	B	B-
Continental Airlines	B+	B
Delta Air Lines	BBB-	B-
Midway Airlines	B-	Bankrupt
Northwest Airlines	BB	B+
Southwest Airlines	A-	A
Tower Air	CCC	Bankrupt
Trans World Airlines	CCC	Purchased by AMR
UAL	BB+	Bankrupt
US Airways Group	B+	CCC+

with financially troubled companies. But potentially the greatest of these indirect costs, at least for companies with significant growth opportunities, is the tendency of managers to underinvest when facing pressure to meet interest payments (and analysts' forecasts). Risk management, by helping to ensure a minimal level of cash flow or capital, can preserve management's incentives and ability to invest in all positive-NPV projects.[18]

In a 1993 article in the *Journal of Finance*, Ken Froot, David Scharfstein, and Jeremy Stein proposed an interesting variation on this argument that maintained that the value of hedging is likely to depend heavily on the *correlation* between a company's investment opportunities and the cash flow effects associated with hedgeable risks.[19] For example, if an airline's investment opportunities tend to dry up when jet fuel prices are high and operating cash flow (in the absence of hedging) is down, the case for hedging is relatively weak; the firm doesn't really need much excess capital under those circumstances. On the other hand, if investment opportunities are greatest when industry cash flows are depressed by high fuel costs, the case for hedging becomes much stronger. In this event, hedging ensures that the firm will have sufficient capital for investment at a time when raising outside capital would likely be very expensive.

In support of this version of the underinvestment hypothesis, our study provides evidence that investment by the airline industry was *not negatively* correlated with jet fuel costs, as one might expect—and, indeed, was positive during parts of the period we studied.[20] That is to say, investment opportunities and, as discussed later, actual airline capital spending was greater in periods when fuel prices were high or rising. Consistent with our findings, other studies have shown that periods of economic downturn result in failure and/or asset sales by financially weak airlines. In such cases, the more profitable airlines may be in a position to buy the assets at "fire sale" prices.[21]

Managing Other Costs of Financial Distress

In addition to its role in managing the corporate underinvestment problem, hedging can also be used to manage other costs associated with financial distress, everything from the fees incurred in reorganizing debt claims to the higher costs of attracting and keeping concerned suppliers, customers, and employees. But this raises an interesting question about the real underlying objectives of airline hedging. If the fundamental purpose of hedging is really to preserve value by avoiding a costly reorganization and reassuring creditors, then we might expect the smaller, and more highly leveraged, airlines to be the most active hedgers. To the extent there are major costs associated with financial distress, such costs would likely represent a higher percentage of firm value for the smaller airlines. On the other hand, if the main purpose of hedging is to enable the strongest airlines to buttress their already strong strategic positions by acquiring assets at fire-sale prices, then it may make sense that the most consistent hedgers are also the largest, most successful operators. (And, as discussed below, to the extent that hedging and strategic risk management require an upfront investment in "learning," the largest most successful firms are also likely to be the first, if not the main, users.)

In order to investigate the extent of financial distress costs in the industry, we began by examining the airlines' credit ratings and how they have changed over time. For the period 1988-2004, Table 3 reports the median S&P ratings of the senior debt of the 15 sample airlines with ratings reported in the Compustat database. As shown in the table, in 1988 six airlines had investment grade ratings. During the next 17 years, three airlines filed Chapter 11 and one was purchased after filing bankruptcy. As of this writing, only one airline had an investment grade credit rating—Southwest. And as these credit ratings suggest, the airline industry's access to external capital markets has been diminishing over time.

One major reason for this decline in ratings can be seen in Figure 1, which shows the heightened volatility of airline profit margins. Moreover, there is a clear negative correlation between net profit margins and jet fuel prices.[22]

18. Clifford Smith, Jr., and René Stulz, "The Determinants of Firms' Hedging Policies," *Journal of Financial and Quantitative Analysis* 20 (1985), pp. 391-405.

19. See Kenneth Froot, David Scharfstein, and Jeremy Stein, "Risk Management: Coordinating Corporate Investment and Financing Policies," *Journal of Finance* 48 (1993), pp. 1629-1658.

20. See page 63 of our article in *Financial Management*.

21. See Todd C. Pulvino, "Do Asset Fire Sales Exist? An Empirical Investigation of Commercial Aircraft Transactions," *Journal of Finance* 53 (1998), pp. 939-978 and Todd C. Pulvino, "Effects of Bankruptcy Court Protection on Asset Sales," *Journal of Financial Economics* 52 (1999), pp. 151-186.

Table 4 **Random Effects Tobit Regression Analysis of the Relation Between Amount of Jet Fuel Hedged and Underinvestment Hypothesis Variable for Airlines (1992-2003)[a]**

	Tobin's Q	Long-term Debt-to-Assets	Ln(Assets)	Credit Rating
Model 1 No adjustments for operating leases Dep. Var. = Amt. of fuel hedged (n = 215)	0.1367** (0.0.017)	-0.0848 (0.579)	0.0532* (0.056)	-0.0226*** (0.000)
Model 2 Adjustments for operating leases Dep. Var. = Amt. of fuel hedged (n = 206)	0.2249*** (0.007)	-0.2729 ** (0.043)	0.0492** (0.032)	-0.0214*** (0.000)

[a] The dependent variable in each regression is the percentage of next year's jet fuel requirements hedged as of the end of the fiscal year. The results shown above are a subset of the full regressions and are taken from Table V on page 69 of our *Financial Management* article entitled, "Does Hedging Affect Firm Value? Evidence from the US Airline Industry."

* indicates significance at the 10 percent level.

** indicates significance at the 5 percent level.

*** indicates significance at the 1 percent level.

The combination of volatile cash flow and limited access to capital (especially during weak industry conditions) might provide an incentive for airlines to protect cash flow against a spike in fuel prices.

More Evidence on How Fuel Hedging Adds Value

In an additional effort to determine the motives for airline hedging, we conducted a series of multivariate regressions designed to test the relation of the percentage of jet fuel requirements hedged with a number of other potentially important variables, the results of which are summarized in Table 4.[23] One of the variables was the credit ratings themselves. As reported in Table 4, the airlines with the higher credit ratings (i.e., the lower S&P credit rating numbers), and those with the least debt (when counting operating leases as debt) as a percentage of book value of total assets hedged the largest proportions of their future fuel requirements. And as we also noted earlier—and as shown in Table 4—it is also the larger airlines that tend to hedge a larger percentage of their fuel requirements.

Both of these results are somewhat surprising, at least to the extent that one expects smaller, riskier airlines to have the highest expected costs of financial distress (as a percentage of firm value). But there are at least two possible explanations. One is that the smaller airlines have lacked either the resources to invest in acquiring a hedging capability or the strategic foresight to make that kind of investment. A second, and more intriguing possibility, is that the larger, stronger airlines actually have larger costs of financial distress (even as a percentage of firm value) in the form of more growth opportunities that could be lost as a result of high leverage and financial risk. Recall the positive relation between Tobin's Q and hedging activity that we noted earlier (and reported in Table 2). To the extent that an airline's Tobin's Q serves as a proxy for the market's assessment of its value from growth opportunities (which is standard interpretation of Tobin's Q in the finance literature), this result is consistent with the underinvestment hypothesis. That is, if it is mainly just the largest airlines that are able to buy distressed assets during periods of weak industry cash flows, then such firms may also have the most to gain from hedging and the most to lose from high leverage.

For the smaller airlines, it's true that the probability of getting into financial trouble may be quite high. But it also may well be true that the financial distress costs for such organizations are relatively low. For example, to the extent that the airlines are able to operate efficiently in Chapter 11 (and the "stay" on creditors' claims provided by the bankruptcy court may have a stabilizing effect), there may be relatively little disruption of normal operating routines. What is likely to be lost in Chapter 11, however, is the ability to invest in major growth opportunities.

Hedging and Investment Opportunities

Consistent with the possibility that the primary aim of airlines in hedging fuel costs is to protect their ability to invest, our study also found a strong correlation between firm value and the interaction of hedging activity with the level of capital expenditures for individual airlines. More specifically, we re-estimated the models of the relation between hedging and value reported in Table 2 while adding a term measuring the interaction between airline hedging and capex.

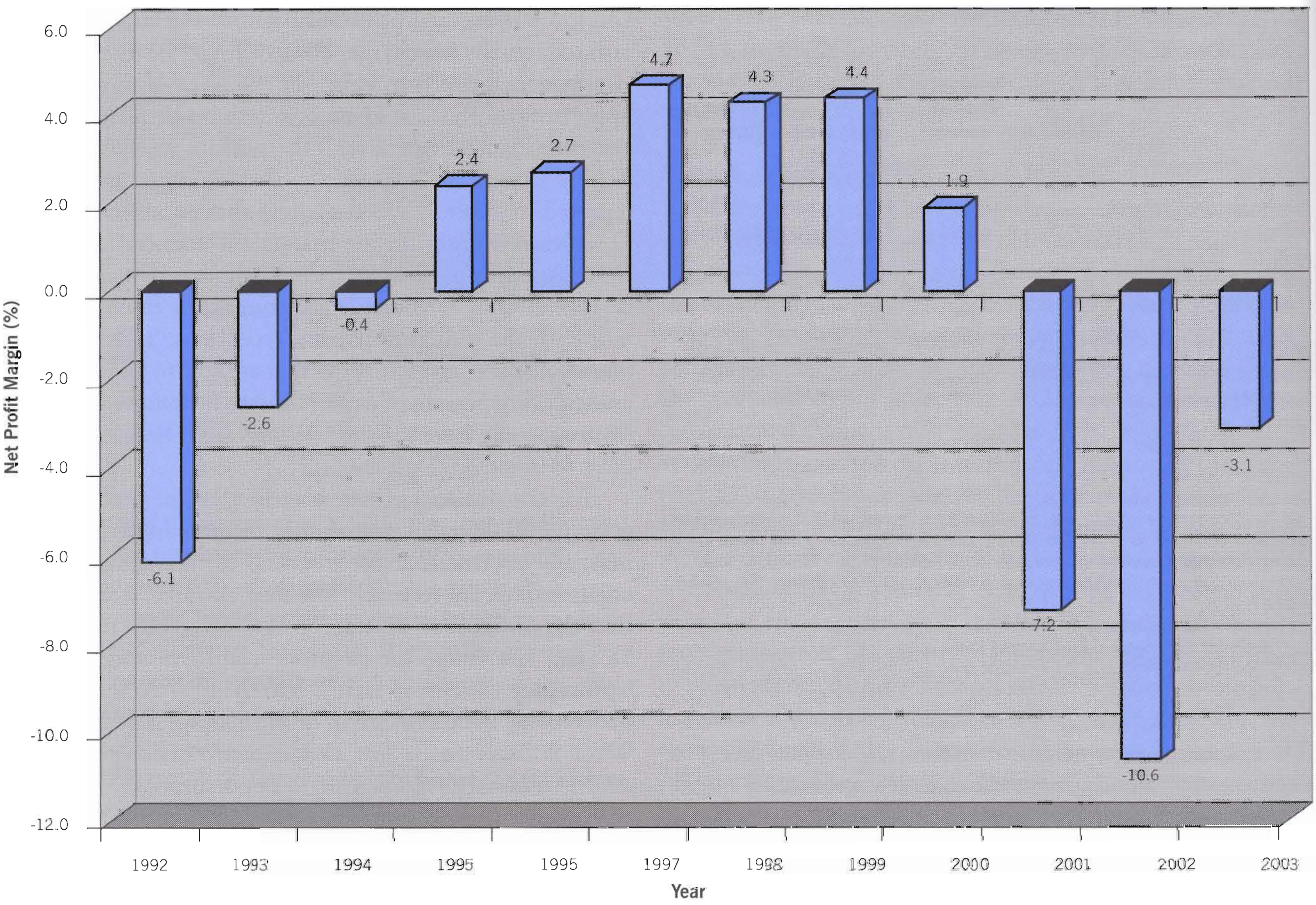
While the results of this test (reported in Table 5) show no significant relation between firm value and fuel hedging, the coefficient on the interaction of capital expenditures and hedging was positive (e.g., 1.825 in Model 1) and statistically significant in both models. Moreover, it seems plausible to interpret this result as saying that, for those airlines that hedge future fuel purchases, the higher capital spending made possible in part by hedging is an important contributor to the higher firm value.

To interpret the value premium associated with hedging for the average hedging airline, we used the estimated

22. The Pearson Correlation Coefficient over the period 1992-03 is -42 percent.

23. Table 4 reports a subset of the results from the complete random effects Tobit regressions reported in our *Financial Management* article. For the complete set of results and discussion, see pages 66-71 of that article.

Figure 1 **Net Profit Margin (%) of the U.S. Airline Industry over 1992-2003**



Source: Air Transport Association Economic Reports

coefficients for the percentage of next year's fuel requirements hedged (0.036) and the interaction between hedging and capital expenditures (1.825) along with the average level of capital expenditures-to-sales (11.7%) and average hedge ratio for hedgers (29.4%). Using these values, the average hedging airline is expected to be valued around 7% higher than a non-hedging airline [(1.825 x 0.117 x 0.294) + (0.036 x 0.294)]. This hedging premium consists of two components. The first term in parentheses corresponds to the portion of the hedging premium associated with capital expenditures, and accounts for approximately 86% of the total. The second term is the hedging premium associated only with hedging, which suggests that most of the value premium (86% in this case) is due to investment opportunities.

While not a direct test that jet fuel hedging reduces underinvestment for airlines, this finding does suggest that investors place a higher value on capital spending by hedgers than non-hedgers. In other words, investors may believe that hedgers are able to invest more and such investment tends to be value-adding. One explanation for such investor behavior is that hedging makes future capital spending less vulnerable to future increases in jet fuel prices. In such cases, investors view today's capital expenditures as a more reliable proxy for tomorrow's.

The Hedging Premium Over Time

Prior research has shown the hedging value premium for companies with foreign currency exposure is highest during years in which the U.S. dollar appreciates.[24] This suggests, as might be expected, that the market places higher values on companies that hedge during periods when the hedging instruments produce positive payoffs.

As part of our study, we investigated whether the jet fuel hedging premium changes over time by re-estimating Models 1 and 2 from Table 2 and including a term that interacts the percentage of next year's fuel requirements hedged with year indicator variables. As reported in (Panel A) of Table 6, our

Table 5 **Regression Analysis of the Relation Between Firm Value and the Interaction Between Capital Expenditures and Jet Fuel Hedging Behavior for Airlines (1992-2003)[a]**

	Constant	Firm Size	Percentage of Next Year's Fuel Req'ts Hedged	Percentage of Next Year's Fuel Req'ts Hedged X Capital Exp.	R^2	Wald X^2
Model 1						
Pooled OLS						
Dep. Var. = ln(Q)	-0.048	-0.174 ***	0.036	1.825 *		
(n = 228)	(0.947)	(0.003)	(0.889)	(0.063)	0.469	-
Model 2						
FGLS						
Dep. Var. = ln(Q)	-0.438	-0.125 ***	0.060	1.772 ***		
(n = 228)	(0.269)	(0.000)	(0.707)	(0.003)	-	572.25 ***

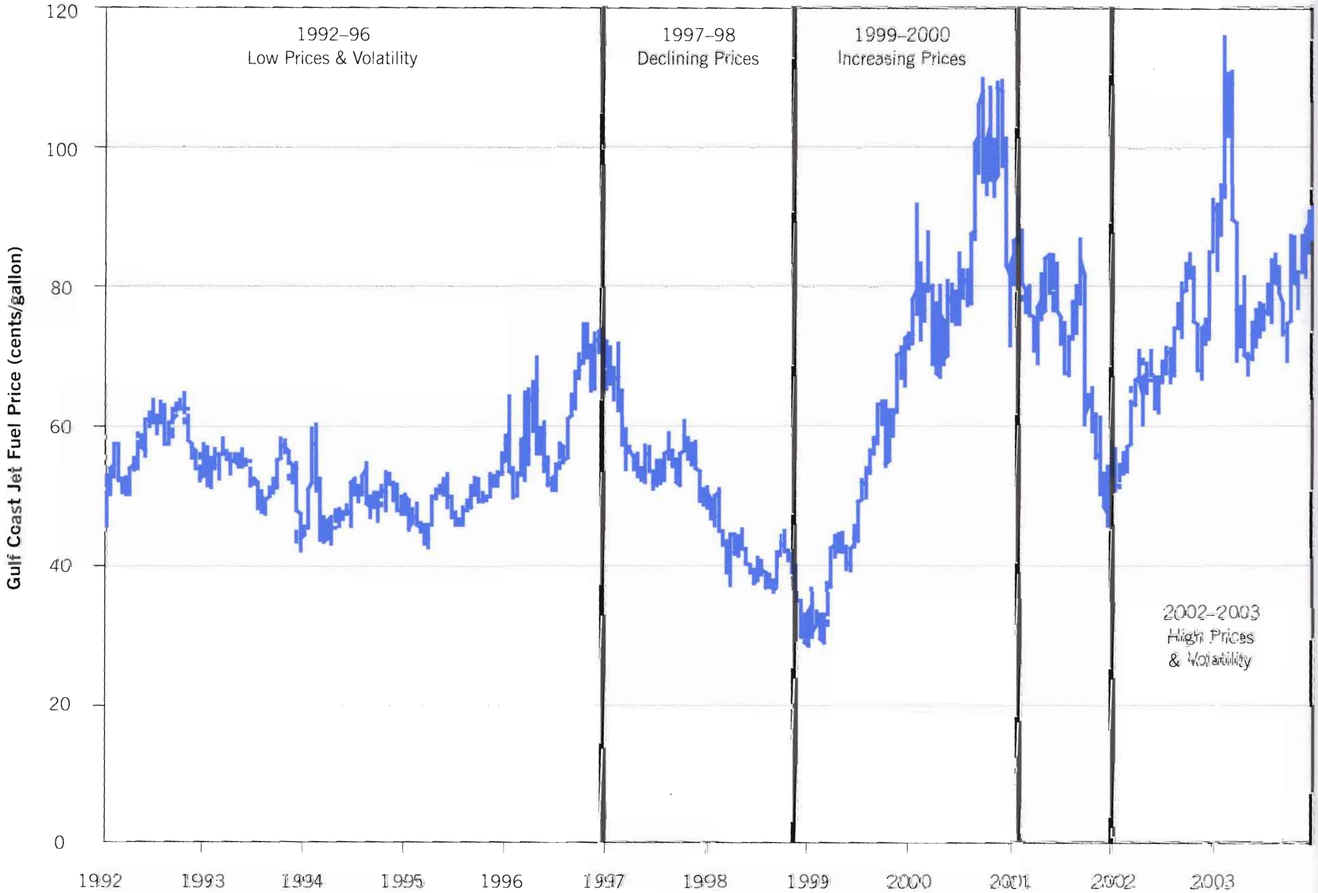
[a] Model 1 was estimated with OLS using robust standard errors that account for the clustered sample. Model 2 was estimated using time-series feasible generalized least squares with heteroskedastically consistent standard errors. Control variables listed in the text and year dummy variables were included in all regressions, but not reported. P-values are reported in parentheses below the coefficients.
* indicates significance at the 10 percent level.
** indicates significance at the 5 percent level.
*** indicates significance at the 1 percent level.

Table 6 **Jet Fuel Hedging Premium Over Time (1992-2003)[a]**

	Estimated Coefficients on the Percentage of Next Year's Fuel Req'ts Hedged X Year (or Regime) Indicator Variable	
	Model 1 Pooled OLS Dep. Var. = ln(Q)	Model 2 FGLS Dep. Var. = ln(Q)
Panel A Hedging Premiums by Year		
1994	-0.027	-0.294
1995	-0.768	-0.834
1996	0.509	0.299
1997	0.087	0.185
1998	0.111	0.307 *
1999	0.249	0.252
2000	0.632	0.606 **
2001	0.337	0.428 *
2002	1.191 **	0.936 ***
2003	0.575 *	0.467 **
Panel B Hedging Premiums by Fuel Price Regime		
1992 - 1996 (low prices & volatility)	-0.290	-0.129
1997 - 1998 (declining prices)	0.049	0.135
1999 - 2000 (increasing prices)	0.257	0.134
2002 - 2003 (high prices & volatility)	0.772 **	0.713 ***

[a] Model 1 was estimated with OLS using robust standard errors that account for the clustered sample. Model 2 was estimated using time-series feasible generalized least squares with heteroskedastically consistent standard errors. Control variables listed in the text and year dummy variables were included in all regressions, but not reported.
* indicates significance at the 10 percent level.
** indicates significance at the 5 percent level.
*** indicates significance at the 1 percent level.

Figure 2 **Jet Fuel Prices over 1992-2003**



Source: Energy Information Administration. Spot prices are for U.S. Gulf Coast.

results show an increase in the hedging premiums over the time period studied. The largest hedging premiums occurred in 2002 in both models, a year in which fuel prices were both high and volatile. (In addition, the premiums are statistically significant in both models for 2002 and 2003.)

Moreover, as shown in Figure 2, we classified jet fuel prices into four different "regimes"—(1) low prices and volatility (1992-1996), (2) declining prices (1997-1998), (3) increasing prices (1999-2000), and (4) high prices and volatility (2002-2003)—and then estimated hedging value premiums during each of these periods. As reported in Panel B of Table 6, we found that the premium value for hedging generally increased over these four time periods, with the highest premiums occurring in 2002-2003, the period covered by our study that experienced the highest prices and volatility. And if we were to create a fifth period running from 2004 to the time of this writing (October 2006)—a period in which the level and volatility of fuel costs have continued to rise—our best guess is that the hedging value premium would have continued to grow along with them.

Conclusions

In response to the question posed at the beginning of the article: "Does hedging add value to corporations?" our response is a definite "yes" for the 28 airlines in our sample. Those airlines that hedge their fuel costs have Tobin's Q ratios that are 5-10% higher than those of airlines that choose not to hedge. Our results also suggest that the main source of value added by hedging is its role in preserving the firm's ability to take advantage of investment opportunities that arise when fuel prices are high and airline operating

24. See Allayannis and Weston (2001), cited earlier.

cash flows and values are down. Specifically, we find that the value premium associated with hedging increases with the level of the firm's capital investment.[25]

We also find that the more active hedgers of fuel costs among the airlines are the larger firms with the least debt and highest credit ratings. This result is somewhat surprising, at least to the extent the smaller airlines might be expected to have larger financial distress costs (as a percentage of firm value), and hence greater motive to hedge. One explanation is that the smaller airlines have lacked either sufficient resources or the strategic foresight to acquire a derivatives hedging capability. A second possibility, however—one that is consistent with our main findings—is that the largest airlines also have highest costs of financial distress (even as a percentage of firm value) in the form of more growth opportunities that could be lost as a result of high leverage and financial risk. Conventional wisdom says it is mainly just the largest airlines that are able to buy distressed assets during periods of weak industry cash flows—and to the extent this is so, such firms may also have the most to gain from hedging.

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25. Interpreted more broadly, our study provides evidence that the use of commodity hedging by commodity *users* increases firm value. This is in contrast to other studies that have found little or no value gain from hedging by commodity *producers*. For an example of the latter, see Yanbo Jin and Philippe Jorion, "Firm Value and Hedging: Evidence from U.S. Oil and Gas Producers," *Journal of Finance* 61 (2006), pp. 893-919.