8-2016

An Analysis of Delta Air Lines' Oil Refinery Acquisition

Wilfred S. Manuela Jr.
Ateneo de Manila University

Dawna L. Rhoades
Embry Riddle Aeronautical University, rhoadesd@erau.edu

Tamilla Curtis
Embry-Riddle Aeronautical University, curtist@erau.edu

AN ANALYSIS OF DELTA AIR LINES' OIL REFINERY ACQUISITION

Wilfred S. Manuela Jr.[1], Ateneo de Manila University, wilfredm@yahoo.com, wmanuela@ateneo.edu
Dawna L. Rhoades, Embry-Riddle Aeronautical University, rhoadesd@erau.edu
Tamilla Curtis, Embry-Riddle Aeronautical University, curtist@erau.edu

Delta Air Lines acquired an oil refinery in April 2012 as a strategic move to hedge against higher fuel prices. Our paper analyzes the oil refinery acquisition, a backward integration strategy, on the airline's financial and operational performance, for the period Q1 2010 to Q2 2015. The methodology involves descriptive statistics and short-term stock performance as well as an econometric model that estimates the impact of the oil refinery acquisition on Delta Air Lines' net income. The data set consists of quarterly financial and airline operations metrics data. The results indicate that it is too early to ascertain whether Delta Air Lines' oil refinery acquisition has any positive impact on its financial performance since the variable of interest is insignificant in predicting Delta Air Lines' net income. Despite the apparent lack of positive impact of its oil refinery acquisition, however, the stock market has rewarded Delta Air Lines' strategy resulting in its share prices outperforming the S&P 500 and the XAL, an index of major airline stocks, in the 60-trading day period following the announcement of its acquisition.

Keywords: Airline financial performance; Fuel hedging; Vertical integration

JEL Classification: L25, L93, C36

[1] Corresponding author; please send all correspondence to wilfredm@yahoo.com. We presented our initial results at the Air Transport Research Society 2015 World Conference in Singapore on 2–5 July 2015.

Introduction

Firms are faced with many decisions related to the sourcing of goods and services used within the organization. The decision to source internally or buy from outside the firm has implications for the organizational structure, resources, and control of operations, as well as on the firm's overall operational performance and productivity. Firms that choose internal sourcing or ownership of key supplies are vertically integrated while firms that deal at arm's length with outside suppliers have chosen to outsource these activities. While the decision to make-or-buy has been widely researched in the management literature (Lafontaine and Slade, 2007), the financial implications are not always clear (David and Han, 2004).

In April 2012, Delta Air Lines shocked the aviation industry by announcing its plan to acquire the oil refinery in Trainer, Pennsylvania (PA), which was formerly owned by Phillips 66. This refinery had accounted for up to one-third of the jet-kerosene capacity of the East Coast in the United States (US) before its closure (Mouawadi, 2012). Delta Air Lines paid USD 150 million for the facility and expected to invest an additional USD 100 million to upgrade the plant. With oil over USD 90 a barrel and 2011 fuel costs of USD 11.8 billion or 36 percent of its operating expenses, Delta Air Lines made a compelling argument for the unusual acquisition (EconMatters, 2012). The purchase appeared to be a modest one compared with the projected annual fuel savings of USD 300 million. Further, Delta Air Lines CEO Richard H. Anderson noted that the airline would have to buy 60 new generation narrow-body aircraft at roughly USD 2.5 billion to achieve similar savings (Mouawadi, 2012).

Operating new and fuel-efficient aircraft is one way to manage fuel costs while fuel hedging is another. Southwest Airlines, the first low-cost carrier (LCC) to operate in the US, led the industry in fuel hedging as a way for airlines to manage the increasingly volatile price of fuel. When fuel was trading over USD 90 a barrel in 2007 Southwest Airlines was enjoying long-term contracts to buy oil at USD 51 a barrel through 2009 and watching as competitors began posting growing operational losses (Bailey, 2007). Unfortunately, even a master at hedging like Southwest Airlines does not always play the market right as 2014 proved—Southwest Airlines was caught off guard by falling prices resulting in a net liability of USD 236 million (Schlangenstein and Murtaugh, 2014). Airlines are again rethinking hedging in 2016 amid falling oil prices. Southwest Airlines has announced that its outstanding hedges may result in a loss of USD 1.8 billion through 2018 (Dastin, 2016).

With this history of ‘managing’ fuel costs, analysts are still uncertain about the recent action by Delta Air Lines. While market analysts have given Delta Air Lines credit for this ‘innovative approach’, the strategy has provoked a number of questions. The Trainer, PA oil refinery was an older facility that relied on an expensive grade of crude oil and had been closed because the crack spread, the difference between the price of a barrel of oil and the sale price of the refined product, did not make economic sense for Phillips 66. Many observers are unclear on how Delta Air Lines would change this situation. Other questions raised by the acquisition include how Delta Air Lines projected its fuel savings, what effect lower fuel prices might have on the operations of the oil refinery, and whether the airline would have been better off pursuing a hedging strategy rather than vertical integration (EconMatters, 2012; Kemp, 2014). The refinery did report its first overall profit in the third quarter (Q3) of 2013, posted a USD 19 million profit for Q3 2014 and a USD 75 million profit for the fourth quarter (Q4) of 2014 (Loyd, 2014). While the airline reported an adjusted jet fuel price of USD 2.90 per gallon in 2014, eight cents lower than rival American Airlines, total fuel costs were higher due to increased consumption and hedging losses, and the fuel price for Delta Air Lines was not different from the pre-refinery price (Kemp, 2014; Loyd, 2014). Moreover, the oil refinery does not blend renewable fuels and must purchase renewable fuel credits, a further expense to this strategy (Anderson, 2014; Reuters, 2013). In short, the success of this strategy is not clear based on the complexities involved in operating an oil refinery.

While airline financial performance has been the subject of a great deal of research exploring issues from airline safety (Adrangi et al., 1997; Graham and Bowes, 1979) to outsourcing (Raghavan and Rhoades, 2008) to mergers or acquisitions (Manuela Jr. and Rhoades, 2013 and 2014; Manuela Jr. et al., 2016; Singal, 1996) to hedging (Lim and Hong, 2014; Morell and Swan, 2006), there has yet to be any research focusing on the financial implications of oil refinery purchase since Delta Air Lines is the first carrier to pursue this audacious strategy. The purpose of this study is to analyze the impact of the oil refinery acquisition on the financial and operational performance of the airline using financial ratios and short-term stock performance as well as an econometric model that includes financial and airline operations variables, e.g., fuel cost per available seat mile (ASM), to provide additional evidence of the viability of this vertical integration acquisition.

Make-or-Buy

While different theories exist to explain organizational vertical integration decisions, the notion of vertical integration can be traced back to the early arguments of Adam Smith and the division of labor, although organization theory traces its roots to the Coase (1937) article on the role of transaction costs in shaping the structure of an industry. Williamson (1975 and 1991) went on to develop the argument that arm's-length contracts may under certain circumstances impose costs on the firm that could be alleviated through ownership and that frequency, uncertainty, and asset specificity were expected to determine the extent to which vertical integration (ownership) would reduce transaction costs. Harrigan (1984) argues that the major advantages of vertical integration include reduced cost due to the elimination of duplicate overhead, improved coordination of activities, improved access to inputs and services, superior control of a firm's economic environment, and synergies created by the coordination of vertical activities, although vertical integration could lead to increased overhead for the coordination of the vertical firm, excess capacity due to unbalanced economies of scale, creation of mobility (or exit) barriers, and loss of information from suppliers. Thus, vertical integration may have as many disadvantages and advantages. Harrigan (1985: 398) notes that firms "may enjoy benefits of vertical integration without transferring all of their output internally" and argues that there are a number of conditions under which vertical integration makes greater sense—the demand for the product is uncertain, the industry is stable (low competition, low exit barriers, low rate of technological change), the bargaining power with suppliers is low, and premium prices offset the high cost of excess capacity.

Empirical studies on vertical integration have not resolved the question of when ownership should be pursued over contractual outsourcing. David and Han (2004) report on a review of 63 empirical papers on transaction cost economics (TCE) that found mixed results despite the fact that TCE was one of the most frequently examined issues in the make-or-buy literature. Parmigiani (2007) argues that sourcing decisions should be viewed from multiple theoretical points of view rather than just TCE and presents results that support a strategy of concurrent sourcing (making-and-buying) as a third option for firms.

If TCE argues for the benefits of a vertically integrated firm, then the resource-based view (RBV) of the firm is seen as an argument for focusing on what you do best and outsourcing the rest. According to RBV, internal resources and capabilities are the source of sustained competitive advantage and should drive the decision making on what form the organizational structure should take (Barney, 1991 and 1996). Firms should focus on their core competencies as a means of achieving sustained competitive advantage and outsource activities to other firms with expertise in their non-core activities, since outsourcing may result in reduced costs, reduced investment, and less fixed costs (Prahalad and Hamel, 1990). While outsourcing has been the dominant trend for several decades, there is limited and conflicting research on firm profitability. Gilley and Rasheed (2000) have argued that the cost savings of outsourcing may be overestimated as the transaction costs may be significant and outsourcing requires a shift in overhead allocation, and that short-run cost improvements may create an outsourcing spiral that eventually erodes the resources and capabilities of the firm.

Thus, the extensive research on make-or-buy and the best organizational structure reports mixed results on financial and operating performance outcomes. The tension between these two competing ideas—vertical integration and outsourcing—continues to affect the organizational structure of various industries including the airline industry, which has shifted from a high level of integration to increasing outsourcing of activities.

Following the Inference to the Best Explanation (IBE) principle, which can be applied to the context of discovery and justification of scientific theories (Mackonis, 2013), a third theoretical perspective that explains vertical integration decision, which appears to be the most consistent with Delta Air Lines' oil refinery acquisition decision, is the Resource Dependence Theory (Aldrich and Pfeffer, 1976; Pfeffer and Salancik, 2003). Considered as a foundation for theoretical reasoning, IBE first observes some phenomena, link the observed phenomena to existing and already accepted scientific knowledge, and then argue for the plausibility of the theory that explains the phenomena (Mackonis, 2013). Thagrad (1978) argues that the IBE principle consists in accepting a hypothesis that provides a better explanation than alternative hypotheses, which seems to justify a selected hypothesis on the grounds that the hypothesis provides the best explanation for the observed phenomena. As such, the Resource Dependence Theory (RDT), which was formalized in the work of Pfeffer and Salancik "The External Control of Organizations: A Resource Dependence Perspective" (1978), provides an alternative argument to the many economic theories regarding mergers, acquisitions, and contracts (Pfeffer, 2003). Moreover, RDT adds the not-always rational concept of power and autonomy to the discussion of organizational structure and dependence. When a firm is dependent on another partner for some key resource, the firm loses autonomy and cedes power to that organization causing pressure to build to correct these conditions.

The RDT emphasizes three core ideas, arguing that social context matters, organizations have strategies to enhance their autonomy and pursue their interests, and that power is important for understanding the internal and external actions of organizations (Davis and Cobb, 2009). The theory suggests that one approach to manage resource dependency is to incorporate resources within the organization through mergers and acquisitions (M&As). This strategy can take three forms: (1) vertical integration by buying and controlling suppliers or buyers, which extends organizational control over vital exchanges; (2) horizontal integration by buying competitors to increase organizational dominance and market power by reducing competition; and (3) diversification or conglomerate merger strategies, which decrease the primary organization's dependency on other organizations (Pfeffer and Salancik, 1978).

In the context of this study, Delta Air Lines would be driven to find a governing relationship that minimizes its uncertainty and dependence on its oil exchange partners and maximizes its own autonomy. Fuel is a critical resource for an airline and volatile fuel expenses can be the difference in profit or loss. While fuel hedging has been used for a number of years in the airline industry, Morrell and Swan (2006) argue that fuel hedging has very limited value for airlines or investors and while hedging may reduce swings in profitability, fuel hedging strategy cannot improve overall airline performance. Given these airline issues with fuel and hedging, the literature on resource dependence provides a number of other organizational responses to reduce dependence and uncertainty with organizational growth, alliances, and associations with other business groups (Scott and Davis, 2007), co-opting strategies (Pfeffer, 1987), cooperation and competition or co-opetition (Brandenberger and Nalebuff, 1996), and ownership providing a range of actions from the least to the most constraining (Pfeffer and Salancik, 2003; Thompson, 1967). Casciaro and Piskorski report that mutual interdependence (rather than dependence) is a better predictor of M&As and argue that the existence of power imbalances actually curtails M&As, suggesting that a merger or acquisition is more likely when the power imbalance between firms is less. Moreover, Davis and Cobb (2010) argue that RDT applies to situations or periods marked by economic crisis, dissatisfaction with political leadership, and increased social activism. The airline industry has certainly experienced a number of crises in recent years that would incline airline management teams to look favorably at options that would give them greater autonomy and power.

Industry Structure

In the early years of the aviation industry, William Boeing dreamed of a truly integrated company that would include an airframe and engine manufacturer as well as an airline. The Air Mail scandal put an end to this dream when the US government forced the United Aircraft and Transport Corporation to split into three separate entities (Bauer, 2006). Although the separation between the supplier of the essential component of an airline (airframe and engine) from the airline itself has continued, however, there has been experimentation within the industry between vertical integration and outsourced contractual agreements on other supplied components and services. While government regulations would limit the extent to which some activities could be outsourced for safety reasons, airlines have experimented with ownership and outsourcing of a number of activities including catering (King, 2001), baggage-handling (Keeney, 2015), maintenance (Al-Kaabi et al., 2007), distribution channels (Cheng, 2009), and regional aircraft operations (Forbes and Lederman, 2010). Since the three largest cost items for airlines are fuel, labor, and distribution, activities that reduce the costs of fuel and distribution or the number of direct airline employees have received a great deal of attention (Rhoades, 2014).

The distribution channel is an important part of any firm value chain. Prior to the 1990s, all computer reservation systems were owned or affiliated with one or more airlines, giving owner airlines unfair advantage over competitors, which resulted in government regulation. With airlines offering commissions to travel agents for tickets sold, distribution costs represent the third largest expense for airlines, but with the Internet and the spread of electronic commerce airline distribution dramatically changed, shortening the value chain and changing the dynamics of the distribution channels. Travel agents lost much of their power and profit while airlines and new Internet travel sites moved to capture market share (Bloch and Segev, 1997). In 2001 five major US carriers formed Orbitz, an online distribution company, to compete with Expedia and Travelocity. Evidence indicates, however, that this effort at vertical integration did not improve efficiency, making things even worse for the airlines (Cheng, 2009). Cendant, a company with a number of online travel booking brands, eventually acquired Orbitz in 2004 (Reed, 2004).

Following the Airline Deregulation Act of 1978, US airlines moved to establish a hub-and-spoke network of routes where smaller aircraft served to concentrate passengers in key cities to fill larger aircraft traveling between major airline hubs. Should airlines own the operators of these smaller aircraft (often referred to as regional airlines) or simply deal with these operators on a contractual basis? Forbes and Lederman (2010) report that major carriers are more likely to use owned regional carriers on routes where operational uncertainties such as weather are present and when the route is more integrated to their network, allowing them to more efficiently re-optimize their networks when a schedule readjustment is necessary. Despite the general efficiency reported by Forbes and Lederman (2010), Delta Air Lines has alternated between ownership of and contract with its regional airline partners—Atlantic Southeast Airlines and Comair were contract carriers that became wholly-owned subsidiaries before reverting to contractual arms of the airline (Expressjet, 2015).

Since 2002, jet fuel prices have risen five-fold to become the single largest expense of airlines. Airlines do not generally have long-term contracts with fuel suppliers and have sought ways of dealing with volatile oil prices because the outcomes are significant. American Airlines notes that every 10 percent increase in fuel prices can reduce operating margins by 1.7 percent (Morell and Swan, 2006). Airlines have sought to address oil price fluctuations by either increasing fuel efficiency, passing increases on to customers, or engaging in hedging strategies, usually within a twelve-month window. Jet fuel hedging, a risk management corporate strategy (Compart, 2012; Lim and Hong, 2014; Morrell and Swan, 2006), creates value either by reducing the expected costs of underinvestment or reducing the expected financial distress costs, providing greater tax benefits from increased leverage, or increasing the firm's holdings of corporate securities, which can increase risk aversion (Carter et al., 2006).

Airlines investment strategies are positively correlated with jet fuel costs and jet fuel hedging is positively related to the firm value of the airline, since higher fuel prices invariably lead to lower cash flows (Carter et al., 2006). While investors usually place higher valuation on hedging companies when hedging provides positive payoffs, the literature does not indicate whether firm value is positively correlated with the amount of hedging, although hedging can provide an exceptional value for airlines close to bankruptcy (Morrell and Swan, 2006). Since the theoretical justification for fuel hedging is weak and the expected value of a fuel hedge is zero, hedging strategies do not improve airline profits, but tend to reduce swings in profits, suggesting that investors should not reward reduced profit volatility with higher stock prices (Morrell and Swan, 2006). Using US airline data from 2000 to 2012, Lim and Hong (2014) report that fuel hedging airlines have about nine to 12 percent lower operating costs, although this effect was not statistically significant, and suggest that while the perceived benefit of fuel hedging is cost reduction, airline strategy should focus more on lowering fuel expenses. Since the overall goal of hedging is to reduce uncertainty in jet fuel prices and because uncertainty in fuel prices has been decreasing over the past few years, use of hedging strategies is becoming less effective than in the past (Berghöfer and Lucey, 2014).

Given the mixed theoretical and practical issues surrounding hedging, other options for managing fuel volatility are under consideration. According to Delta Air Lines, the ownership and reconfiguration of the Trainer, PA oil refinery to produce more jet fuel has lowered prices five to 10 cents overall for the industry and will eventually produce company-specific benefits in time as the oil refinery supplies an increasing share of Delta Air Lines' jet fuel needs (Kemp, 2014). Critics contend that buying a refinery is not a good way to 'hedge' against fuel prices since the cost are driven by the price of oil, not the margins of the refiners, and suggest that Delta Air Lines would have been better served by waiting for oil prices to drop and maintaining capacity controls that allow them to pass on higher fuel prices to consumers (Helman, 2015;

Kemp, 2014). Thus, industry observers are once again divided on the strategic value of airline action to deal with fuel costs.

Empirical Framework

Firm size (Hansen and Wernerfelt, 1989; Jensen, 1986; Lee and Hooy, 2012) and industry competition (Olson and Slater, 2002; Porter, 2008) usually predict firm performance or profitability since larger firms tend to have more resources and perhaps more and better capabilities, allowing them to compete favorably against their competitors, while industries with fewer competitors and high entry barriers tend to be less competitive, enhancing the incumbent firms' chances of making a profit (Besanko et al., 2013; Porter, 2008; Stanley and Olson, 2002). Specifically, capacity (Ayres, 1988; Mantin and Wang, 2012; Manuela Jr., 2011; Pearson et al., 2015), load factor (Mantin and Wang, 2012; Antoniou, 1992), number of passengers (Manuela Jr., 2011), number of routes or route structure (de Arantes Gomes Eller and Moreira, 2014; Manuela Jr., 2011), freight revenues (Antoniou, 1992), operating costs and newer aircraft (Antoniou, 1992; de Arantes Gomes Eller and Moreira, 2014), employee productivity (Mantin and Wang, 2012), and management quality (de Arantes Gomes Eller and Moreira, 2014) tend to have an impact on airline profits. We use a number of these variables in Equation 1 to estimate the impact of Delta Air Lines' oil refinery acquisition on its financial performance and argue that the acquisition should have a positive impact on Delta Air Lines' financial performance in the long term, especially when oil prices are high.

We used the US personal consumption expenditures (PCE) as proxy for the impact of a growing economy on Delta Air Lines' net income because PCE tracks closer to the behavior of the airline's net income from the first quarter (Q1) of 2010 to the second quarter (Q2) of 2015 than the US gross domestic product (GDP) and the transportation and warehousing (TW) growth rates. Due to the endogeneity of the passenger, frequency, and fuel cost per ASM variables in the profit equation, the econometric model is estimated using instrumental variables. In the 2SLS estimation, we used the number of seats, TW, passenger revenue per revenue passenger mile (PRRPM), and passenger revenue per ASM (PRASM) as instruments to estimate the passenger variable while the load factor, total revenue passenger miles (RPMs) of the US airline industry excluding Delta Air Lines' RPMs, and total revenue ton miles (RTMs) of the US airline industry excluding Delta Air Lines' RTMs were used as instruments to estimate the frequency variable. We used the average age of Delta Air Lines' aircraft, GDP, jet fuel price per gallon, and operating cost as instruments to estimate fuel cost per ASM in the 2SLS estimation. The RPMs and RTMs of the US airline industry represent the impact of Delta Air Lines' competitors on its departure frequency and route network decisions, which impact its revenues and net income.

Equation 1

$$\text{PROFIT}(t) = \beta_0 + \beta_1 \text{ PASSENGER}(t) + \beta_2 \text{ FREQUENCY}(t) + \beta_3 \text{ ROUTE}(t) + \beta_4 \text{ PCE}(t) + \beta_5 \text{ FUEL}(t) + \beta_6 \text{ REFINERY}(t) + \varepsilon$$

Where for each quarter t,

PROFIT	net income in billion USD
PASSENGER	number of enplaned passengers in millions
FREQUENCY	number of departures in thousands
ROUTE	number of city pairs served
PCE	growth rate of personal consumption expenditures
FUEL	fuel cost per ASM
REFINERY	dummy variable representing Delta Air Lines' oil refinery acquisition, which assumes a value of "1" from Q2 2012 to Q2 2015 and "0" otherwise
ε	error term

Delta Air Lines' profit or net income should respond positively with an increase in the number of enplaned passengers, number of routes served, a growing economy that results in higher personal consumption expenditures, and its acquisition of the oil refinery while profits should decrease with frequency and fuel cost per ASM. The PCE serves as a control variable so we do not inappropriately attribute any changes in Delta Air Lines' profitability to its oil refinery acquisition.

In addition to the econometric model, we use descriptive statistics using graphs to help explain the estimation results and show how the major variables of interest behave over time. We also show the graphs of the abnormal returns of Delta Air Lines against the Standard and Poor's (S&P) 500 and the NYSE ARCA Airline Index (XAL), an index of major airline stocks, ± 60 trading days around the announcement of the oil refinery acquisition, and compare Delta Air Lines' share price performance against major US airlines.

Data and Method

We collected and estimated quarterly data for all variables in Equations 1 and 6 and the instrumental variables used in the estimation from Q1 2010 to Q2 2015. All airline financial and operations data, as well as the financial market data, come from the US Bureau of Transportation Statistics, masFlight, and the websites of Delta Air Lines, Yahoo! Finance, and Bloomberg. The GDP quarterly growth rates come from the US Federal Reserve of St. Louis while the PCE and TW growth rates come from the US Bureau of Economic Analysis. We conducted internet searches for information on Delta Air Lines' oil refinery acquisition.

We estimated the econometric model using the two-stage least squares (2SLS) with instrumental variables for the endogenous variables in Equations 1and 6 and the autoregressive moving average (ARMA) model to address autocorrelation (Cameron and Trivedi, 2009; Greene, 1997) in the time series quarterly data. In the 2SLS estimation, we used regressors that include ARMA terms while the instruments include lagged regressors with ARMA terms.

We also computed for the abnormal returns of Delta Air Lines ± 60 trading days around 5 April 2012, the announcement date of its oil refinery acquisition, for a total of 121 trading days, which is relatively shorter compared with the event studies analyzed by McWilliams and Siegel (1997), who argue that shorter event windows tend to capture the impact of an event on share prices. Abnormal returns are stock price returns that are significantly different from returns using a model that generates 'normal' returns (Brown and Warner, 1980; McWilliams and Siegel, 1997), while the abnormal return over an event window is a measure of the impact of the event on the share price of the firm (Campbell et al., 1997) and event studies using daily stock returns and the market-adjusted returns model based on standard parametric tests are well-specified (Brown and Warner, 1980 and 1985; Khotari and Warner, 2006).

Equation 2 shows the market-adjusted returns model, a linear model that relates stock returns to market returns whose error term has an expectation of zero and a variance equal to $\sigma_{\varepsilon it}^2$ (Campbell et al., 1997; MacKinlay, 1997; McWilliams and Siegel, 1997).

Equation 2: $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad where \quad E_{\varepsilon_{it}} = 0 \quad and \quad Var_{\varepsilon_{it}} = \sigma_{\varepsilon_{it}}^2$

We used Equations 3, 4, and 5, based on the market-adjusted returns model (Brown and Warner, 1985), to compute for the daily abnormal returns of Delta Air Lines and major US airlines.

Equation 3: $A_{it} = R_{it} - R_{mt} \;\; for \;\; i = 1 \;\; to \;\; n$

A_{it} is the excess or abnormal return of security *i* at time *t*, R_{it} is the return on stock *i* at time *t*, and R_{mt} is the return on the market index at time *t*.

Equation 4: $R_{it} = [(P_{it} - P_{it-1}) \div (P_{it-1})] \times 100\%$

Equation 5: $R_{mt} = [(I_{mt} - I_{mt-1}) \div (I_{mt-1})] \times 100\%$

Results and Analysis

Table 1 shows the estimation results of the profit equation using Delta Air Lines' quarterly net income as the dependent variable. Only two variables are statistically significant although the adjusted R^2 of the estimated equation is 0.6563, which is relatively high. An alternative equation is presented in Appendix A where the dependent variable is operating income, which is somewhat similar to the definition of profitability by Mellat-Parast et al. (2015) using the ratio of operating income to operating revenue. The adjusted R^2 (0.7615) of the operating income equation is higher than the net income equation's adjusted R^2 (0.6563). Moreover, the estimation results of the alternative equation differ slightly in that two other variables, FREQUENCY and PCE, are significant but with the reverse sign (see Appendix A).

Table 1 Profit equation estimation results

	Coefficient	Std. Error	t-Statistic
Constant	-0.7707	2.86	-0.27
PASSENGER	0.3415	0.14	2.47 **
FREQUENCY	-0.0340	0.03	-1.18
ROUTE	-0.0010	0.01	-0.09
PCE	-0.0689	0.12	-0.60
FUEL	-25.5875	6.82	-3.75 ***
REFINERY	0.2470	0.34	0.72
Adjusted R^2		0.6563	
Included observations		22	

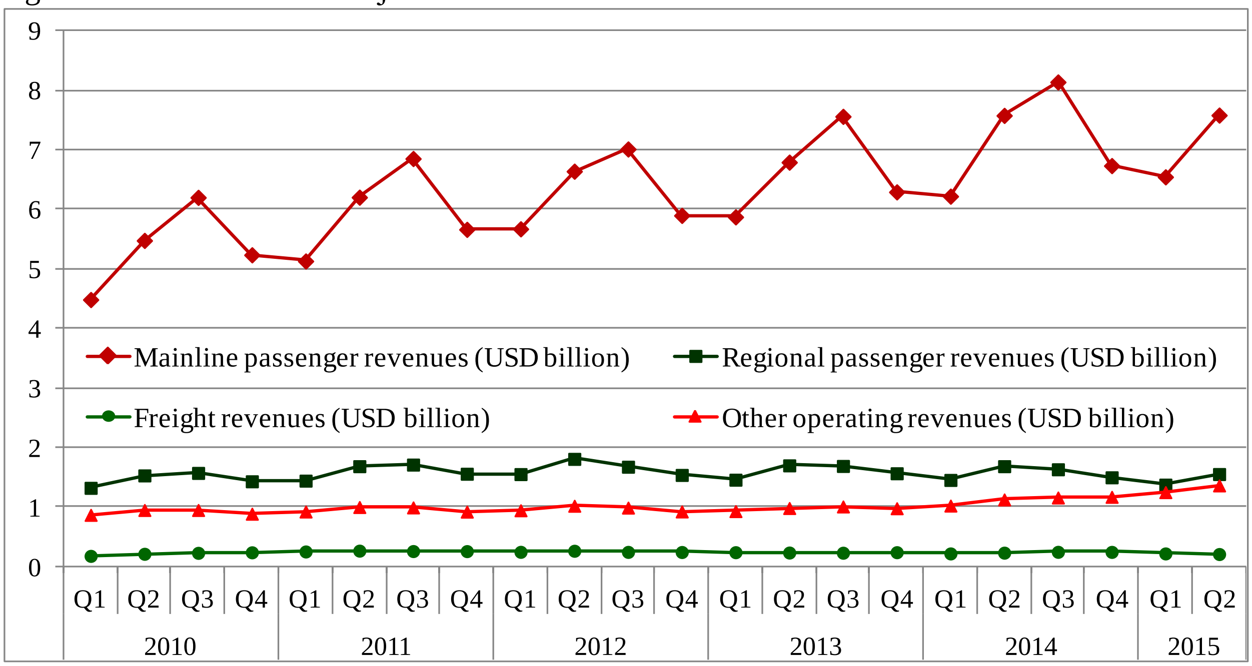
Two asterisks (***) indicate significance at the 1% level and two asterisks (**) at the 5% level, while without an asterisk is insignificant.

The estimation results of the profit equation in Table 1 indicate that only the number of enplaned passengers (PASSENGER) and Delta Air Lines' fuel cost per ASM (FUEL) tend to predict Delta Air Lines' profitability at least for the period Q1 2010 to Q2 2015. Both variables have the correct sign, indicating that more passengers have a positive impact on the airline's net income while a higher fuel cost per ASM, which is largely a function of Delta Air Lines' aircraft size and technology, the average age of its fleet, and the price of jet fuel, invariably results in a lower net income. The other control variables such Delta Air Lines' route network (ROUTE), departure frequency (FREQUENCY), and PCE are insignificant in predicting the airline's profitability.

The variable of interest, REFINERY, is insignificant, however, indicating that any positive impact of Delta Air Lines' oil refinery acquisition on its net income may take longer than the period considered in this paper. The insignificance of Delta Air Lines' oil refinery acquisition may be attributed to the short time series used in this study or to the lower oil prices since Delta Air Lines' acquired the oil refinery.

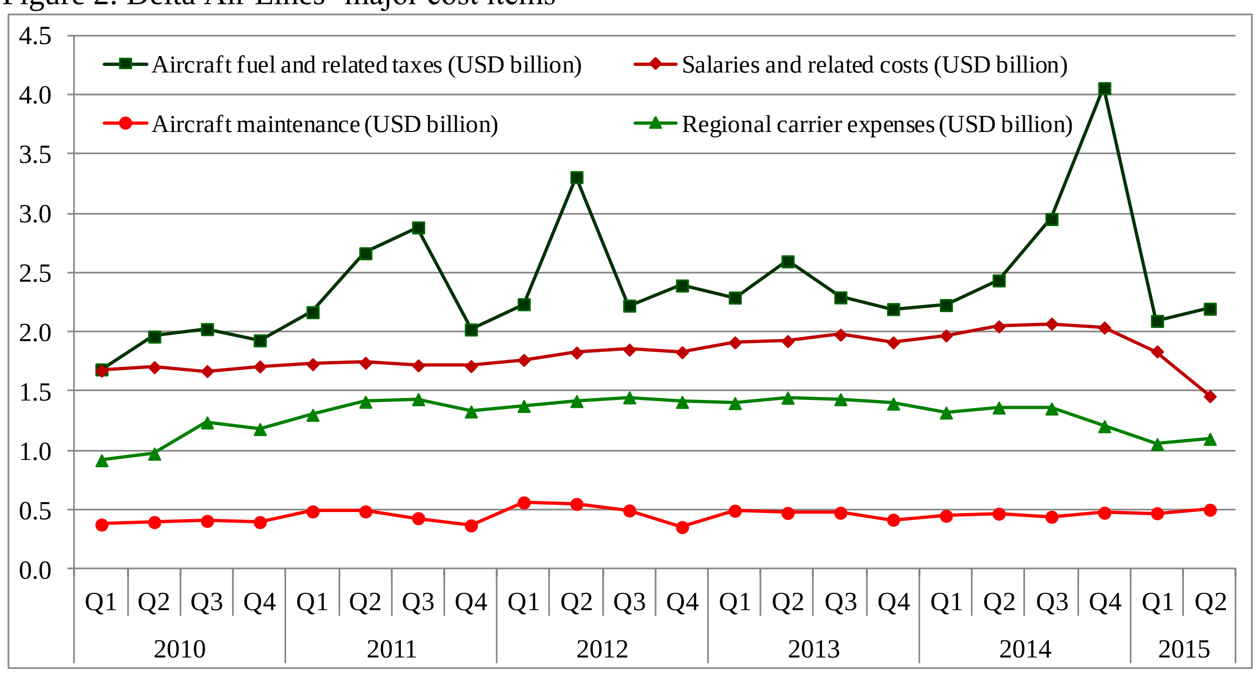
Figure 1 shows the airline's major sources of revenues, indicating that passenger revenues from its mainline and regional operations account for most of Delta Air Lines' operating revenues. The number of passengers not only increases Delta Air Lines' passenger revenues but also its 'other operating revenues' that usually include passenger-related ancillary revenues from in-flight internet and entertainment, food and beverage, as well as rebooking and cancelation fees, which invariably result in higher net income, hence, the inclusion of the PASSENGER variable in the profit equation.

Figure 1: Delta Air Lines' major sources of revenues



Source: masFlight, Bloomberg, and Delta Air Lines.

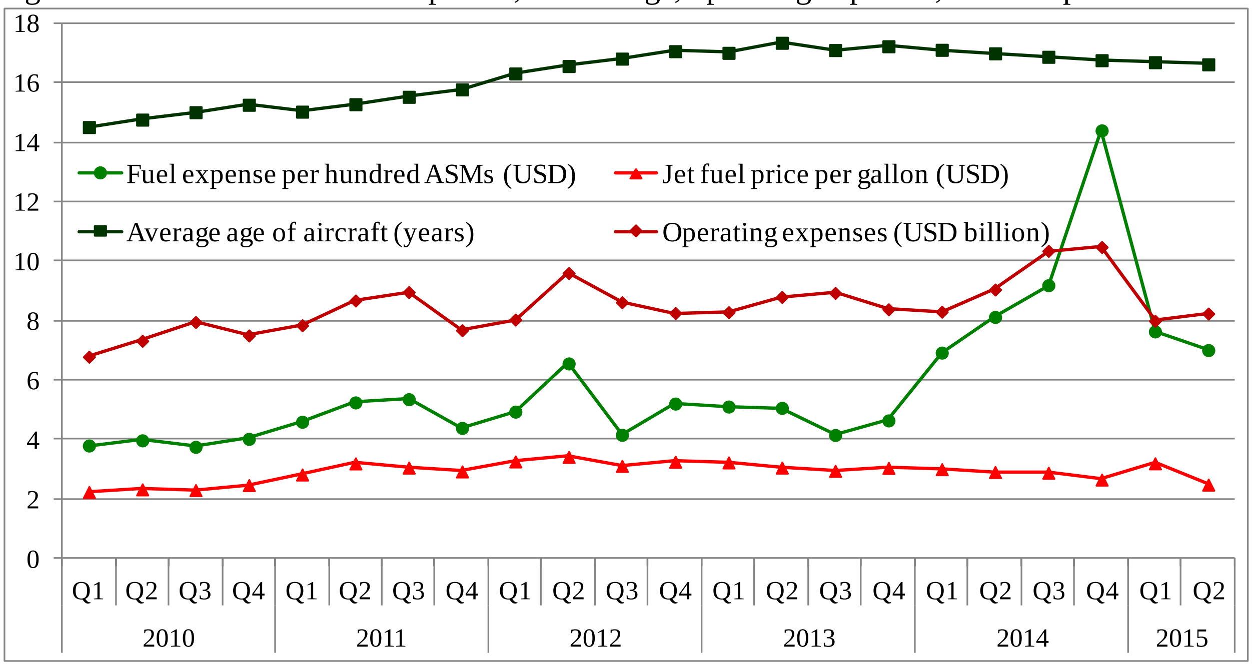
Figure 2: Delta Air Lines' major cost items



Source: masFlight, Bloomberg, and Delta Air Lines

Figure 2 shows the major cost items of Delta Air Lines, indicating that fuel-related expenses are highly variable and account for most of Delta Air Lines' cost of operations, thus, its decision to purchase an oil refinery to reduce its fuel expenses and exposure to oil price volatility. The spike in fuel-related expenses in Q3 and Q4 2014 is due the airline's increased fuel consumption and hedging losses in the same period.

Figure 3: Delta Air Lines' fuel expenses, aircraft age, operating expenses, and fuel prices

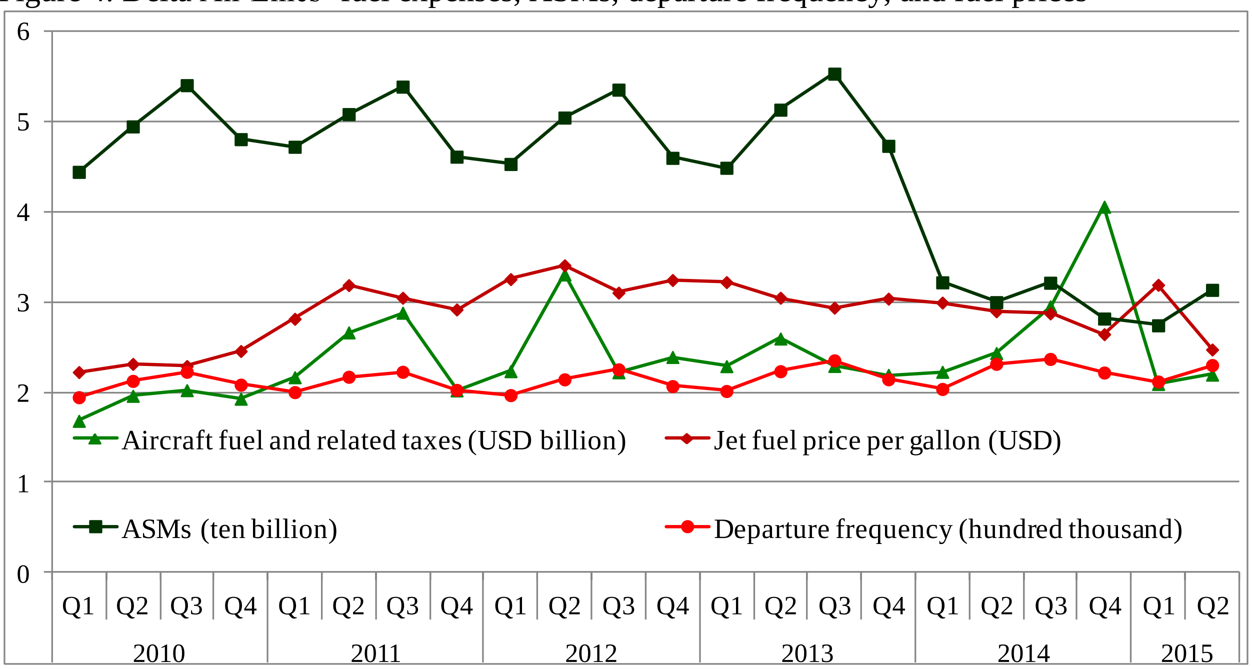


Source: masFlight and Delta Air Lines

Figure 3 indicates that the trend of Delta Air Lines' operating expenses is similar to the trend of its fuel expense per hundred ASMs and the average age of its aircraft, indicating that lower fuel costs as well as operating relatively younger and more efficient aircraft tend to reduce its cost of operations. Delta Air Lines has been retiring its older Boeing 757 aircraft as the airline accepts delivery of Boeing 737-900 and Airbus 321 aircraft, which are more fuel-efficient. Moreover, its order consisting of Airbus 330 and Airbus 350 aircraft, which will be delivered later in this decade, will replace its Boeing 747 fleet and some of its older Boeing 767s, resulting in still lower fuel cost per ASM. Thus, Delta Air Lines' use of newer aircraft will invariably result in lower fuel costs and operating costs, in general, thereby diminishing any gains the airline initially intended to have from its oil refinery purchase.

Figure 3 also indicates that Delta Air Lines' fuel expense per hundred ASMs exhibits an erratic behavior despite stable jet fuel prices, suggesting that Delta Air Lines' fuel hedging strategy may not have been effective and the airline cannot fully depend on the market to reduce its jet fuel expense per ASM and should look at other sources to reduce its operating costs. Given such circumstances, Delta Air Lines' oil refinery acquisition may be a good strategy in the long term since jet fuel prices are expected to increase as demand for air travel increases, not just in a growing US economy, but also in emerging markets, specifically in Asia and Latin America, where Delta Air Lines has expanded its service.

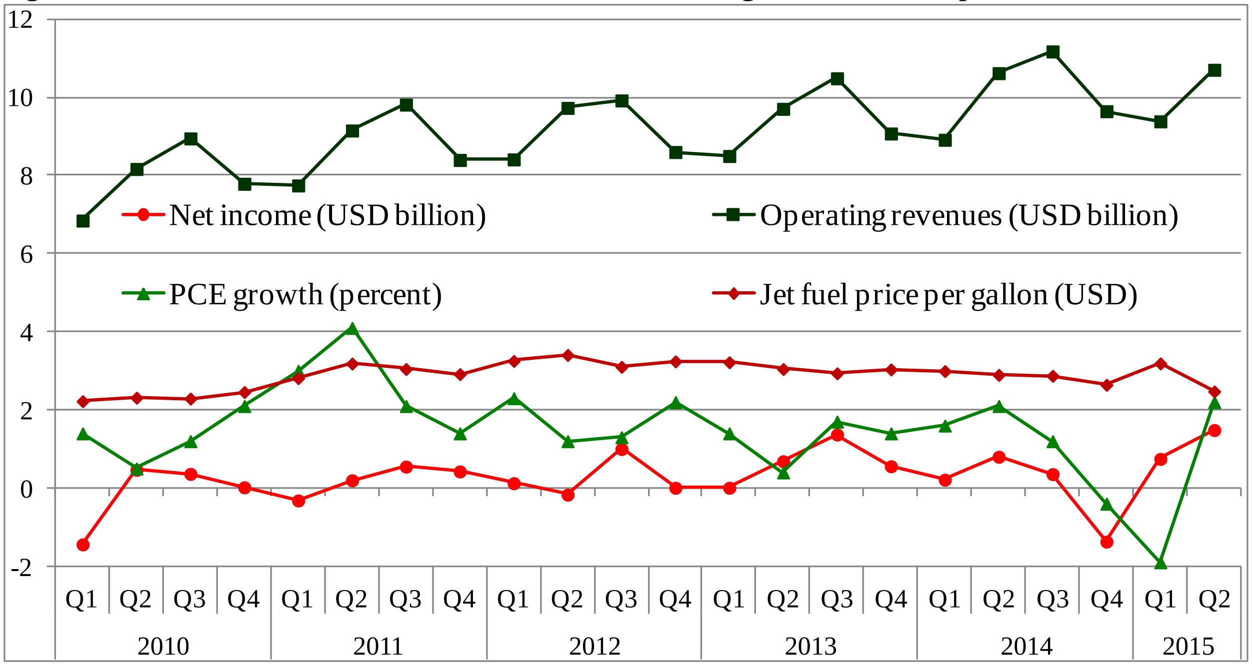
Figure 4: Delta Air Lines' fuel expenses, ASMs, departure frequency, and fuel prices



Source: masFlight, Bloomberg, and Yahoo! Finance

Figure 4 shows that the decline in Delta Air Lines' aircraft fuel-related expenses from Q2 2013 to Q1 2014 is due to the reduction of its departure frequency, partly due to its use of Boeing 717 aircraft that replaced inefficient smaller aircraft, resulting in lower ASMs, and not due to lower jet fuel prices, which remained relatively stable in the same period. This indicates that Delta Air Lines' fuel hedging strategy is not effective when jet fuel prices are stable and when the airline reduces departure frequency as a result of capacity control decisions to boost airfares or due to weaker demand.

Figure 5: Delta Air Lines' revenues and net income, PCE growth, and fuel prices



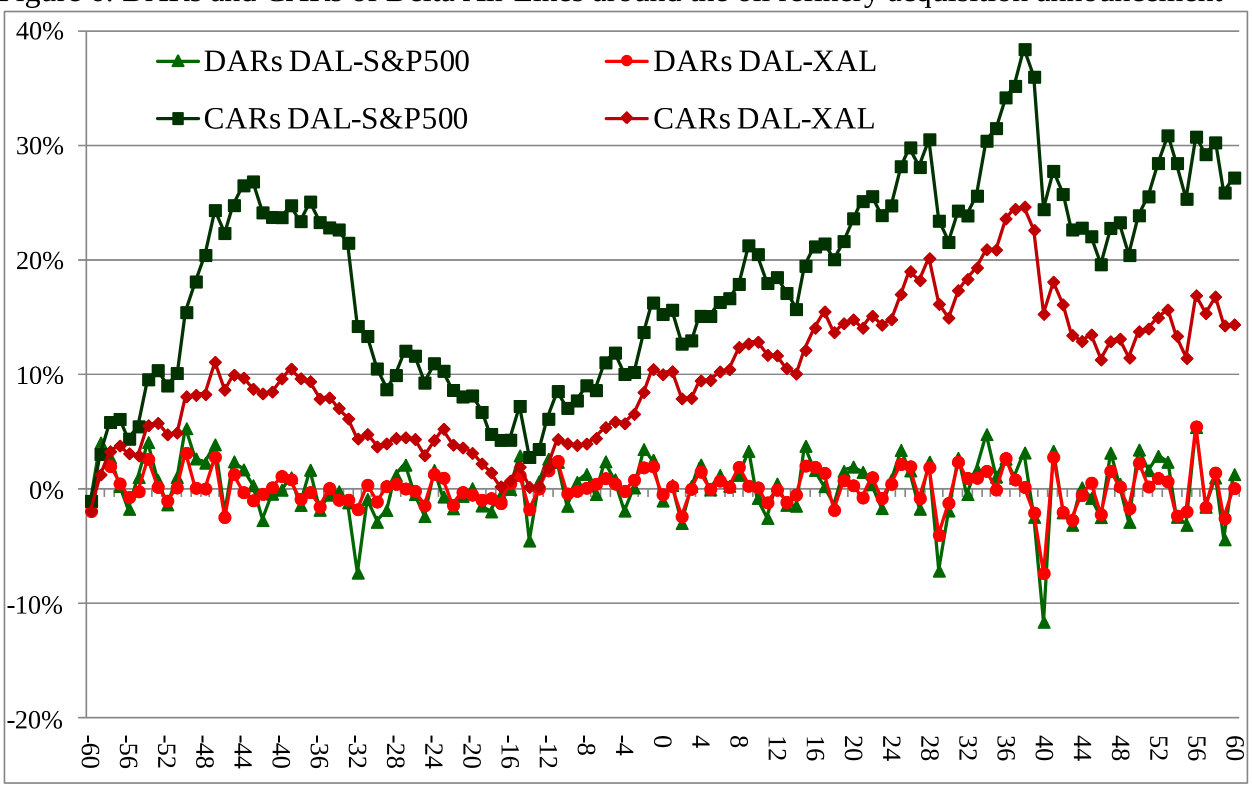
Source: US Bureau of Economic Analysis, masFlight, Yahoo! Finance, and Bloomberg

Figure 5 shows the behavior of Delta Air Lines' operating revenues and net income against the PCE growth rate and the price of jet fuel from Q1 2010 to Q2 2015. Delta Air Lines' net income tends to stabilize starting Q2 2011 as jet fuel prices stop increasing and remain relatively stable from 2011 to 2014. The spike in jet fuel prices and declining PCE growth rate from Q4 2014 to Q1 2015, as well as the slowing demand for airline travel in the winter, resulted in Delta Air Lines' USD 1.371 billion loss in Q4 2014.

We computed the abnormal returns of Delta Air Lines' share prices in the 121-trading day period to show its share price performance against its industry and the broader market (Manuela Jr. and Rhoades, 2013 and 2014). Figure 6 shows the stock performance of Delta Air Lines against the S&P 500 and the XAL using daily abnormal returns (DARs) and cumulative abnormal returns (CARs), the sum of daily abnormal returns over a period of *n* days.

Despite the apparent lack of a statistically significant positive impact of Delta Air Lines' oil refinery acquisition on its net income, the stock market has rewarded Delta Air Lines' bold move in its quest to control its fuel expenses. Figure 6 shows Delta Air Lines' stock price performance against the S&P 500 and the XAL. While the DARs tend to fluctuate around zero, the CARs show a positive trend after the announcement of Delta Air Lines' oil refinery acquisition. The airline's CARs tend to approach zero leading to the announcement date but eventually outperformed the S&P 500 and the XAL around 12 trading days before the announcement date. Overall investors tend to agree that Delta Air Lines' bold move should benefit the airline in the long term because the airline's stock prices outperformed both the S&P 500 and the XAL in the 60-trading day period following its announcement to acquire an oil refinery to boost its fuel hedging strategy. As mentioned earlier, the oil refinery reported a profit of USD 19 million in Q3 2014, followed by a USD 75 million profit in Q4 2014 (Loyd, 2014).

Figure 6: DARs and CARs of Delta Air Lines around the oil refinery acquisition announcement

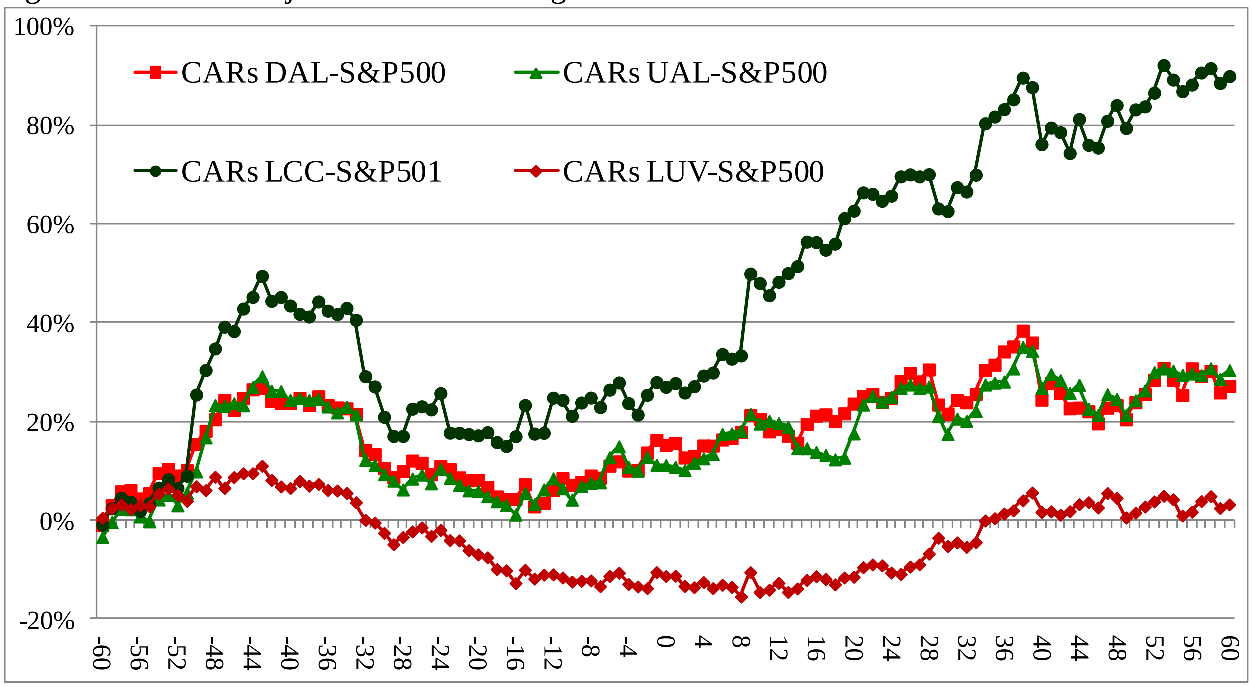


Source: Yahoo! Finance.

When compared with the stock performance of other US-domiciled major airlines, however, Delta Air Lines' share price performance lags the US Airways Group's (stock ticker symbol: LCC) when the benchmark index is either the S&P 500 (see Figure 7) or the XAL (see Figure 8) while its share price performance is almost similar to United Airlines' CARs (stock ticker symbol: UAL) and outperforms Southwest Airlines' CARs (stock ticker symbol: LUV). The share price performance of American Airlines is not included in the analysis because the New

York Stock Exchange delisted its shares on 29 December 2011, a month after the airline filed for Chapter 11 Bankruptcy Protection and Reorganization (Manuela Jr. et al., 2016; Mehta, 2011).

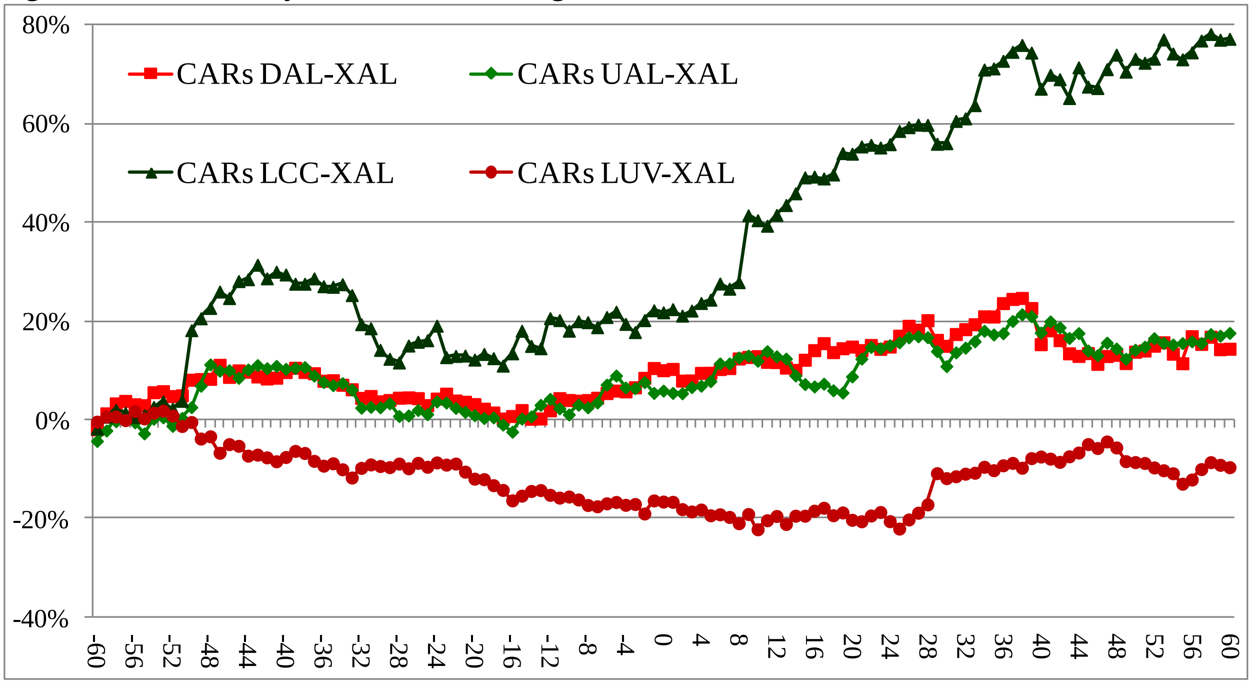
Figure 7: CARs of Major US Airlines Using the S&P 500 as Benchmark Index



Data source: Yahoo! Finance.

The share price performance of the US Airways Group between 10 January and 2 July 2012, the observation window for the DARs and CARs in Figures 5, 6, and 7, is largely due to its announcement to acquire the bankrupt American Airlines in January 2012 (Joyce, 2012) and its improving financial performance since America West Airlines acquired the bankrupt US Airways, forming the US Airways Group (Manuela Jr. et al., 2016), while the stock performance of United Airlines is due to its improving financial performance since its merger with Continental Airlines in October 2010 (Manuela Jr. et al., 2016). Therefore, the share price performance of Delta Air Lines may be attributed to its oil refinery acquisition announcement to better control is fuel costs in the long term than an industry-wide above-average performance of the US airline industry during the observation window because at least one major airline (Southwest Airlines) underperformed the S&P 500 and the XAL in the same period while Delta Air Lines' income before income taxes in Q1 and Q2 2012 is low and negative, respectively (see Figure 9).

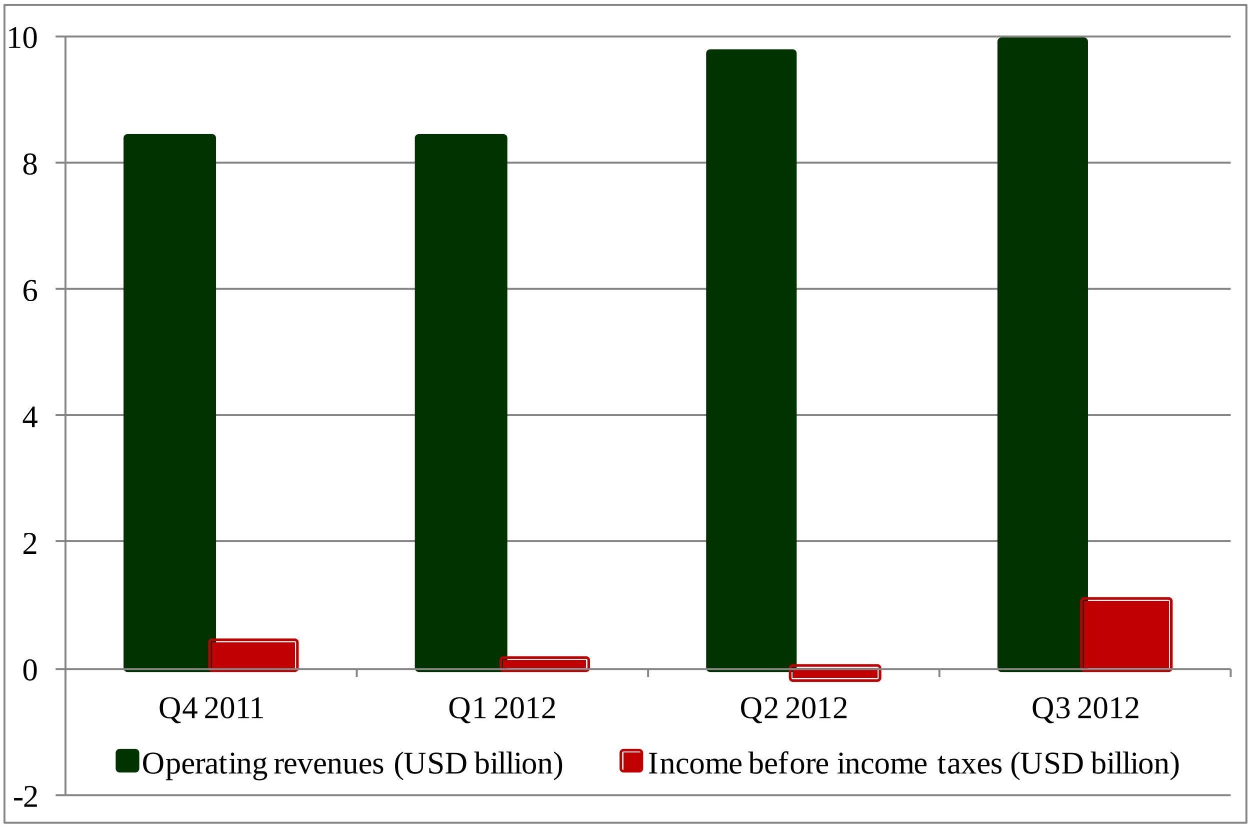
Figure 8: CARs of Major US Airlines Using the XAL as Benchmark Index



Data source: Yahoo! Finance.

The positive DARs of Delta Air Lines are statistically significant on four trading days against the S&P 500 and five trading days against the XAL in the 60-trading day period before the announcement while its positive CARs are statistically significant on 13 and nine trading days against the S&P 500 and the XAL, respectively, in the same period. After the announcement, Delta Air Lines' positive DARs are statistically significant three and five trading days against the S&P 500 and the XAL, respectively, while its positive CARs are statistically significant on 11 and 12 trading days against the S&P 500 and the XAL, respectively, in the same period. The statistically significant DARs and CARs suggest that Delta Air Lines' abnormal returns are due to its oil refinery acquisition. Appendix B shows the t-statistics of Delta Air Lines' DARs while Appendix C shows the t-statistics of its CARs.

Figure 9 Delta Air Lines' Financial Performance, Q1 2011 to Q4 2013



Source: masFlight, Bloomberg, and Delta Air Lines

Conclusion

This paper discussed three theoretical perspectives on organizational form—transaction costs economics, resource-based view, and resource dependence theory. Each theory seeks to explain, even predict, when organizations will take action to alter organizational form in order to better achieve their goals and objectives. Transaction costs economics suggests that vertical integration improves the ability of the firm to coordinate activities and is useful when demand conditions are uncertain and bargaining power with suppliers is low. In the case of the airline industry, the costs of overhead and managing an unfamiliar business such as an oil refinery, which is not noted for its stability, may not be worth the benefits in economic terms. The resource-based view of the firm would seem to argue that airlines stick to what they know best, trying to manage complex networks in a highly technical, operationally focused industry. As an organizing concept, however, the resource dependence theory does offer the best intuitive explanation for the oil refinery acquisition of Delta Air Lines. In an industry that is subject to every whim of the global economy, heavily reliant on a resource (oil) that has become as unpredictable as airline financial performance itself, the idea of owning and controlling this volatile resource must have seemed quite compelling.

Moreover, this paper has estimated the impact of Delta Air Lines' oil refinery acquisition on its financial and operational performance using quarterly data from Q1 2010 to Q2 2015. The estimation results indicate that it may be too early to ascertain whether Delta Air Lines' oil refinery acquisition has any positive impact on its financial and operational performance, although Loyd (2014) reports that the refinery posted a profit of USD 19 million and USD 75 million in Q3 and Q4 2014, respectively. Lower jet fuel prices since Q3 2013 appear to have complicated the impact of Delta Air Lines' oil refinery acquisition on its financial and operational performance, as well as the airline's move to replace its older Boeing 747s, 757s, and 767s with new and more fuel-efficient aircraft. Overall the results indicate that the number of enplaned passengers, invariably resulting in higher load factors, and fuel cost per ASM tend to predict Delta Air Lines' financial performance. Despite the apparent lack of positive impact on its net income, however, investors tend to agree that Delta Air Lines' oil refinery acquisition may be a good strategy in the long term, resulting in share prices that outperformed the S&P 500 and the XAL in the 60-trading day period following the announcement of its oil refinery acquisition.

Whether greater autonomy and control prove to be worth the cost of purchasing the oil refinery and the new complexity and overhead of running the facility remain uncertain, Delta Air Lines' oil refinery acquisition will be a story worth following in the future.

References

Adrangi, B., Chow, G., Raffiee, K., 1997. Airline deregulation, safety, and profitability in the US. Transportation Journal 36(4), 44–51.

Aldrich, H.E., Pfeffer, J., 1976. Environments of organizations. Annual Review of Sociology 2, 79–105.

Al-Kaabi, H., Potter, A., Naim, M., 2007. An outsourcing decision model for airlines' MRO activities. Journal of Quality in Maintenance Engineering 13(3), 217–227.

Anderson, J., 2014. Delta refinery reports profit; Stung by RIN market. Accessed March 3, 2015 at http://breakingenergy.com/2014/10/28/delta-refinery-reports-profit-stung-by-rin-market/.

Antoniou, A., 1992. The factors determining the profitability of international airlines: Some econometric results. Managerial and Decision Economics 13(6), 503–514.

Ayres, I., 1988. Determinants of airline carrier product. International Review of Law and Economics 8, 187–202.

Bailey, J., 2007. Southwest Airlines gains advantage by hedging on long-term oil contracts, New York Times. Accessed January 25, 2016 at http://www.nytimes.com/2007/11/28/business/worldbusiness/28iht-hedge.4.8517580.html?_r=0.

Barney, J.B., 1991. Firm resources and sustained competitive advantage. Journal of Management 17, 99–129.

Barney, J.B., 1996. Gaining and Sustaining Competitive Advantage, Addison-Wesley, New York.

Bauer, E.E., 2009. Boeing: The First Century and Beyond, TABA Publishing, Inc., Issaquah, WA.

Berghöfer, B., Lucey, B., 2014. Fuel hedging, operational hedging and risk exposure—Evidence from the global airline industry. International Review of Financial Analysis 34, 124–139.

Besanko, D., Dranove, D., Schaefer, M., Shanley, M., 2013. Economics of Strategy, 6th edition, John Wiley & Sons, Hoboken, NJ.

Brandenburger, A.M., Nalebuff, B.J.,1996. Co-opetition, Doubleday, New York.

Brown, S.J., Warner, J.B., 1980. Measuring security price performance. Journal of Financial Economics 8(3), 205–258.

Brown, S.J., Warner, J.B., 1985. Using daily stock returns: The case of event studies. Journal of Financial Economics 14(1), 3–31.

Cameron, A.C., Trivedi, P.K. 2009. Microeconometrics: Methods and Applications, Cambridge University Press, New York, NY.

Campbell, J., Lo, A., MacKinlay, A.C., 1997. The Econometrics of Financial Markets, Princeton University Press, Princeton, NJ.

Casciaro, T., Piskorski, M.J., 2005. Power imbalance, mutual dependence, and constraint absorption: A closer look at resource dependence theory. Administrative Science Quarterly 50, 167–199.

Carter, D.A., Rogers, D.A., Simkins, B.J., 2006. Does hedging affect firm value? Evidence from the US airline industry. Financial Management 35(1), 53–86.

Cheng, K., 2009. Vertical integration in airline ticket distribution: A transaction cost analysis, Doctoral dissertation, Golden Gate University, San Francisco, CA. Accessed January 25, 2016 at http://gateway.proquest.com/openurl?url_ver=Z39.88-2004&res_dat=xri:pqdiss&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&rft_dat=xri:pqdiss:3360665.

Coase, R.H., 1937. The nature of the firm. Economica 4(16), 386–405.

Dastin, J., 2016. US airlines rethink hedges as oil plunges, Reuters. Accessed January 25, 2016 at http://www.reuters.com/article/us-usa-airlines-fueloil-idUSKCN0V017B.

David, R.J., Han, S.K., 2004. A systematic assessment of the empirical support for transaction cost economics. Strategic Management Journal 41, 1750–1762.

Davis, G.F., Cobb, J.A., (2010. Resource dependence theory: Past and future. Research in the Sociology of Organizations 28(1), 21–42.

de Arantes Gomes Eller, R., Moreira, M., 2014. The main cost-related factors in airlines management. Journal of Transport Literature 8(1), 8–23.

EconMatters, 2012. When an airlines buys an oil refinery. Accessed March 3, 2015 at http://www.econmatters.com/2012/05/when-airline-buys-oil-refinery.html.

Expressjet, 2015. History. Accessed March 12, 2015 at http://www.expressjet.com/media/history/

Forbes, S.J., Lederman, M., 2010. Does vertical integration affect firm performance? Evidence from the airline industry. The Rand Journal of Economics 41(4), 765–790.

Gilley, K.M., Rasheed, A., 2000. Making more by doing less: an analysis of outsourcing and its effect on firm performance. Journal of Management 26, 763–90.

Graham, D.R., Bowes, M., 1979. Do finances influence airline safety, maintenance, and services (CRC-386), The Public Research Institute, Alexandria, VA.

Greene, W. H., 1997. Econometric Analysis, 3rd edition, Prentice-Hall, Inc., Upper Saddle River, NJ.

Hansen, G.S., Wernerfelt, B., 1989. Determinants of Firm Performance: The relative importance of economic and organizational factors. Strategic Management Journal 10 (5), 399–411.

Harrigan, K.R., 1984. Formulating vertical integration strategies. Academy of Management Review, October, 638–652.

Harrigan, K.R., 1985. Vertical integration and corporate strategy. Academy of Management Journal 28(4), 397–425.

Helman, C., 2015. How cheap oil has Delta Air Lines get fooled. Accessed March 3, 2015 at http://www.forbes.com/sites/christopherhelman/2015/01/21/how-cheap-oil-has-delta-air-lines-jet-fooled/.

Jensen, M.C., 1986. Agency costs of free cash flow, corporate finance, and takeovers. The American Economic Review 76(2), 323–329.

Joyce, M., 2012. US Airways CEO confirms interest in American Airlines, January 26, 2012. Accessed February 26, 2016 at http://www.bizjournals.com/charlotte/news/2012/01/26/us-airways-ceo-confirms-interest-in.html.

Keeney, L., 2015. United Airlines moves to outsource labor at 28 airports, The Denver Post. Accessed March 21, 2015 at http://www.denverpost.com/business/ci_27305607/united-airlines-moves-outsource-labor-at-28-airports.

Kemp, J., 2014. Benefits remain elusive from Delta's US oil refinery. Accessed March 3, 2015 at http://www.reuters.com/article/2014/01/22/usa-refining-delta-idUSL5N0KW39I20140122.

Khotari, S.P., Warner, J.B., 2006. Econometrics of event studies. In: Eckbo, B.E. (Ed.), Handbook of Corporate Finance: Empirical Corporate Finance, Volume A, Handbook in Finance Series, Elsevier/North-Holland, Chapter 1.

King, T., 2001. Inflight catering. Tourism and Hospitality Research, September, 181–184.

Lafountaine, F., Slade, M., 2007. Vertical integration and firm boundaries: The evidence. Journal of Economic Literature 45, 725–762.

Lee, C.-H., Hooy, C.-W., 2012. Determinants of systematic financial risk exposures of airlines in North America, Europe and Asia. Journal of Air Transport Management 24, 31–35.

Lim, S.H., Hong, Y., 2014. Fuel hedging and airline operating costs. Journal of Air Transport Management 36, 33–40.

Loyd, L., 2014. Delta's Trainer refinery profit rising; airline stocks soar on falling oil prices. Accessed March 12, 2015 at http://articles.philly.com/2014-12-13/business/56993717_1_monroe-energy-l-l-c-trainer-refinery-fuel-costs.

MacKinlay, A.C., 1997. Event studies in economics and finance. Journal of Economic Literature 35, 13–39.

Mackonis, A., 2013. Inference to the best explanation, coherence, and other explanatory virtues. Synthese 190, 975–995.

Mantin, B., Wang, J.-H.E., 2012. Determinants of profitability and recovery from system-wide shocks: The case of the airline industry. Journal of Airline and Airport Management 2(1), 1–21.

Manuela Jr., W.S., 2011. Factors affecting airline profits: Evidence from the Philippines. Journal of Applied Business Research 27(6), 17–22.

Manuela Jr., W.S., Rhoades, D.L., 2013. Southwest's acquisition of AirTran: An analysis of short-term stock performance. World Review of Intermodal Transportation Research 4(4), 227–246.

Manuela Jr., W.S., Rhoades, D.L., 2014. Merger activity and short-run financial performance in the US airline industry. Transportation Journal 53(3), 345–375.

Manuela Jr., W.S., Rhoades, D.L., Curtis, T., 2016. The U.S. Airways Group: A post-merger analysis. Journal of Air Transport Management, http://dx.doi.org/10.1016/j.jairtraman.2016.04.022

McWilliams, A., Siegel, D., 1997. Event studies in management research: Theoretical and empirical issues. Academy of Management Journal 40(3), 626–657.

Mehta, N. 2011. AMR delisted from NYSE a month after bankruptcy filing, December 30, 2011. Accessed February 26, 2016 at http://www.bloomberg.com/news/articles/2011-12-29/amr-delisted-from-nyse-a-month-after-bankruptcy-filing-1-.

Mellat-Parast, M., Golmohammadi, D., McFadden, K.L., Miller, J.W., 2015. Linking business strategy to service failures and financial performance: Empirical evidence from the U.S. domestic airline industry. Journal of Operations Management 38, 14–24.

Morrell, P., Swan, W., 2006. Airline jet fuel hedging: theory and practice. Transport Reviews 26(6), 713–730.

Mouawadi, J., 2012. Delta buys refinery to get control of fuel costs. Accessed March 3, 2015 at http://www.nytimes.com/2012/05/01/business/delta-air-lines-to-buy-refinery.html?_r=0.

Parmigiani, A., 2007. Why do firms both make and buy? An investigation of concurrent sourcing. Strategic Management Journal 28, 285–311.

Pearson, J., O’Connell, J.F., Pitfield, D., Ryley, T., 2015. The strategic capability of Asian network airlines to compete with low-cost carriers. Journal of Air Transport Management, 47, 1–10.

Pfeffer, J. Salancik, G.R., 2003. The External Control of Organizations: A Resource Dependence Perspective. Stanford University Press, Stanford, CA.

Pfeffer, J., 2003. Introduction to the classic edition. In: Pfeffer, J., Salancik, G.R. (Eds.), The External Control of Organizations: A Resource Dependence Perspective, Classic Edition, Stanford University Press, Stanford, CA.

Pfeffer, J., 1987. A resource dependence perspective on interorganizational relations. In: Muzruchi, M.S., Schwartz, M. (Eds.), Intercorporate Relations: The Structural Analysis of Business, Cambridge University Press, Cambridge, UK, pp. 25–55.

Porter. M.E., 2008. On Competition. Harvard Business School Press, Cambridge, MA.

Prahalad, C.K., Hamel, G., 1990. The core competence of the corporation. Harvard Business Review, May/June, 79–91.

Raghavan, S., Rhoades, D.L., 2008. Core competencies, competitive advantage, and outsourcing in the US airline industry, International Journal of Strategic Management 8(2), 125–135.

Reed, D., 2004. Cendant to buy Orbitz for $1.25B, USA Today, September 28. Accessed March 12, 2015 at http://usatoday30.usatoday.com/money/biztravel/2004-09-28-cendant-orbitz_x.htm.

Reuters, 2013. Delta's refinery turns a small profit for first time. Accessed March 3, 2015 at http://www.reuters.com/article/2013/10/22/delta-refinery-idUSL1N0IC11W20131022.

Rhoades, D.L., 2014. Evolution of International Aviation: Phoenix Rising, 3rd edition, Ashgate, Surrey, UK.

Schlangenstein, M. and Murtaugh, D., 2014. Southwest adjusts fuel hedges as oil rout adds uncertainty, BloombergBusiness. Accessed January 25, 2016 at http://www.bloomberg.com/news/articles/2014-12-12/southwest-resets-fuel-hedges-as-oil-collapse-creates-instability.

Scott, W.R., Davis, G.F., 2007. Organizations and Organizing: Rational, Natural, and Open System Perspectives, Pearson Prentice Hall, Upper Saddle River, NJ.

Singal, V., 1996. Airline mergers and competition: an integration of stock and product price effect, Journal of Business 69(2), 233–268.

Stanley, F.S., Olson, E.M., 2002. A fresh look at industry and market analysis: Understanding markets beyond the five competitive forces model. Business Horizons, 45(1), 15–22.

Thagard, P., 1978. The best explanation: Criteria for theory choice, Journal of Philosophy 75(2), 76–92.

Williamson, O.E., 1975. Markets and Hierarchies, Free Press, New York.

Acknowledgments

We would like to thank the two anonymous reviewers and the guest editors for helping us improve our paper. We would also like to thank Brian Sherman, Siddhartha Bharani, and Robert F. Moss Jr., our research assistants, for helping us with the data collection and other information related to our research.

Appendix A

The results of the alternative equation, operating income, are shown in Table 2. We used the 2SLS to estimate the equation using the same set of instrumental variables for the endogenous variables and the ARMA model to address autocorrelation. All variables in Equation 6 are as defined in Equation 1.

Equation 6

OPERATING INCOME (t) = β_0 + β_1 PASSENGER (t) + β_2 FREQUENCY (t) + β_3 ROUTE (t) + β_4 PCE (t) + β_5 FUEL (t) + β_6 REFINERY (t) + ε

Table 2 Operating income equation estimation results

	Coefficient	Std. Error	t-Statistic	
Constant	3.4086	2.33	1.46	
PASSENGER	0.5297	0.11	4.70	***
FREQUENCY	-0.0879	0.02	-3.74	***
ROUTE	0.0080	0.01	0.84	
PCE	-0.1842	0.09	-1.97	*
FUEL	-29.1084	5.56	-5.24	***
REFINERY	-0.0219	0.28	-0.08	
Adjusted R^2		0.7615		
Included observations		22		

Two asterisks (***) indicate significance at the 1% level and one asterisk (*) at the 10% level, while without an asterisk is insignificant.

The estimation results in Table 2 indicate that the PASSENGER and FUEL COST variables have the same sign as the corresponding variables in Table 1 (profit or net income equation), which suggests that these two variables impact operating income and net income (see Equation 1) similarly, although the impact of these variables on operating income is greater (compare Table 1 and Table 2). While two other variables are significant in the operating income equation, these variables have the reverse sign, suggesting that the FREQUENCY variable may indicate the impact of Delta Air Lines' unprofitable flights on the airline's net income while the negative sign of the PCE variable may indicate that Delta Air Lines is not the airline of choice when the economy is improving, i.e., higher PCE.

Appendix B Statistical Significance of Delta Air Lines' Daily Abnormal Returns

Date	DAL-S&P 500		Trading Day	DAL-XAL	
	DAR	t-Statistic		DAR	t-Statistic
10-Jan-12	-1.01%	-0.48	-60	-1.90%	-1.23
11-Jan-12	4.08%	1.50*	-59	3.19%	1.87**
12-Jan-12	2.79%	1.00	-58	2.02%	1.16
13-Jan-12	0.27%	0.02	-57	0.50%	0.23
17-Jan-12	-1.71%	-0.75	-56	-0.68%	-0.49
18-Jan-12	1.07%	0.33	-55	-0.19%	-0.19
19-Jan-12	4.10%	1.51*	-54	2.63%	1.53*
20-Jan-12	0.79%	0.22	-53	0.21%	0.05
23-Jan-12	-1.32%	-0.60	-52	-0.99%	-0.68
24-Jan-12	1.07%	0.33	-51	0.15%	0.02
25-Jan-12	5.32%	1.98**	-50	3.16%	1.85**
26-Jan-12	2.68%	0.96	-49	0.13%	0.00
27-Jan-12	2.32%	0.82	-48	0.06%	-0.04
30-Jan-12	3.91%	1.43*	-47	2.82%	1.65*
31-Jan-12	-2.00%	-0.86	-46	-2.43%	-1.55*
01-Feb-12	2.43%	0.86	-45	1.31%	0.72
02-Feb-12	1.73%	0.58	-44	-0.26%	-0.23
03-Feb-12	0.34%	0.05	-43	-0.97%	-0.66
06-Feb-12	-2.70%	-1.14	-42	-0.41%	-0.32
07-Feb-12	-0.38%	-0.24	-41	0.16%	0.03
08-Feb-12	-0.03%	-0.10	-40	1.15%	0.63
09-Feb-12	1.04%	0.32	-39	0.86%	0.45
10-Feb-12	-1.38%	-0.62	-38	-0.85%	-0.59
13-Feb-12	1.71%	0.58	-37	-0.26%	-0.23
14-Feb-12	-1.79%	-0.78	-36	-1.52%	-0.99
15-Feb-12	-0.47%	-0.27	-35	0.10%	-0.01
16-Feb-12	-0.18%	-0.16	-34	-0.92%	-0.63
17-Feb-12	-1.15%	-0.54	-33	-0.91%	-0.63
21-Feb-12	-7.27%	-2.92***	-32	-1.75%	-1.14
22-Feb-12	-0.86%	-0.42	-31	0.38%	0.16
23-Feb-12	-2.84%	-1.19	-30	-1.08%	-0.73
24-Feb-12	-1.82%	-0.80	-29	0.27%	0.09
27-Feb-12	1.23%	0.39	-28	0.47%	0.21
28-Feb-12	2.15%	0.75	-27	0.06%	-0.03
29-Feb-12	-0.44%	-0.26	-26	-0.15%	-0.16
01-Mar-12	-2.35%	-1.00	-25	-1.42%	-0.93
02-Mar-12	1.67%	0.56	-24	1.32%	0.73
05-Mar-12	-0.64%	-0.34	-23	1.00%	0.53
06-Mar-12	-1.67%	-0.74	-22	-1.39%	-0.92
07-Mar-12	-0.58%	-0.31	-21	-0.25%	-0.23
08-Mar-12	0.09%	-0.05	-20	-0.47%	-0.36
09-Mar-12	-1.42%	-0.64	-19	-0.92%	-0.63
12-Mar-12	-1.94%	-0.84	-18	-0.78%	-0.55

13-Mar-12	-0.51%	-0.29	-17	-1.22%	-0.81
14-Mar-12	0.01%	-0.08	-16	0.51%	0.24
15-Mar-12	2.95%	1.06	-15	1.21%	0.66
16-Mar-12	-4.47%	-1.83**	-14	-1.76%	-1.14
19-Mar-12	0.69%	0.18	-13	0.06%	-0.04
20-Mar-12	2.66%	0.95	-12	1.64%	0.93
21-Mar-12	2.39%	0.84	-11	2.47%	1.43*
22-Mar-12	-1.44%	-0.65	-10	-0.37%	-0.30
23-Mar-12	0.63%	0.16	-9	-0.14%	-0.16
26-Mar-12	1.31%	0.42	-8	0.13%	0.01
27-Mar-12	-0.43%	-0.25	-7	0.47%	0.21
28-Mar-12	2.43%	0.86	-6	0.96%	0.51
29-Mar-12	0.86%	0.25	-5	0.49%	0.23
30-Mar-12	-1.86%	-0.81	-4	-0.16%	-0.17
02-Apr-12	0.16%	-0.03	-3	0.83%	0.43
03-Apr-12	3.50%	1.27	-2	1.91%	1.09
04-Apr-12	2.57%	0.91	-1	2.00%	1.14
05-Apr-12	-0.99%	-0.47	0	-0.45%	-0.34
09-Apr-12	0.36%	0.05	1	0.26%	0.09
10-Apr-12	-2.96%	-1.24	2	-2.37%	-1.51*
11-Apr-12	0.27%	0.02	3	0.03%	-0.05
12-Apr-12	2.15%	0.75	4	1.53%	0.86
13-Apr-12	-0.02%	-0.10	5	0.03%	-0.05
16-Apr-12	1.23%	0.39	6	0.75%	0.39
17-Apr-12	0.30%	0.03	7	0.19%	0.05
18-Apr-12	1.27%	0.41	8	1.94%	1.11
19-Apr-12	3.35%	1.22	9	0.30%	0.11
20-Apr-12	-0.76%	-0.38	10	0.16%	0.02
23-Apr-12	-2.51%	-1.06	11	-1.15%	-0.77
24-Apr-12	0.50%	0.11	12	-0.04%	-0.10
25-Apr-12	-1.36%	-0.62	13	-1.12%	-0.75
26-Apr-12	-1.43%	-0.64	14	-0.47%	-0.36
27-Apr-12	3.80%	1.39*	15	2.06%	1.18
30-Apr-12	1.68%	0.57	16	1.94%	1.11
01-May-12	0.26%	0.01	17	1.42%	0.79
02-May-12	-1.38%	-0.62	18	-1.81%	-1.17
03-May-12	1.59%	0.53	19	0.78%	0.40
04-May-12	1.98%	0.68	20	0.34%	0.13
07-May-12	1.51%	0.50	21	-0.72%	-0.51
08-May-12	0.43%	0.08	22	1.05%	0.56
09-May-12	-1.66%	-0.73	23	-0.78%	-0.55
10-May-12	0.85%	0.24	24	0.47%	0.21
11-May-12	3.42%	1.24	25	2.20%	1.26
14-May-12	1.64%	0.55	26	2.00%	1.14
15-May-12	-1.70%	-0.75	27	-0.78%	-0.55
16-May-12	2.41%	0.85	28	1.92%	1.09

17-May-12	-7.10%	-2.85***	29	-3.98%	-2.50***
18-May-12	-1.85%	-0.81	30	-1.20%	-0.80
21-May-12	2.74%	0.98	31	2.39%	1.38*
22-May-12	-0.43%	-0.25	32	0.98%	0.52
23-May-12	1.73%	0.59	33	1.00%	0.54
24-May-12	4.80%	1.78**	34	1.60%	0.90
25-May-12	1.10%	0.34	35	-0.03%	-0.09
29-May-12	2.67%	0.95	36	2.71%	1.58*
30-May-12	1.01%	0.31	37	0.84%	0.44
31-May-12	3.21%	1.16	38	0.20%	0.05
01-Jun-12	-2.41%	-1.03	39	-2.04%	-1.31*
04-Jun-12	-11.57%	-4.59***	40	-7.32%	-4.53***
05-Jun-12	3.36%	1.22	41	2.81%	1.64*
06-Jun-12	-2.02%	-0.87	42	-1.98%	-1.28
07-Jun-12	-3.10%	-1.29*	43	-2.68%	-1.70**
08-Jun-12	0.16%	-0.02	44	-0.52%	-0.39
11-Jun-12	-0.76%	-0.38	45	0.57%	0.28
12-Jun-12	-2.44%	-1.04	46	-2.18%	-1.40*
13-Jun-12	3.19%	1.16	47	1.59%	0.90
14-Jun-12	0.47%	0.10	48	0.23%	0.07
15-Jun-12	-2.85%	-1.20	49	-1.66%	-1.08
18-Jun-12	3.46%	1.26	50	2.30%	1.33*
19-Jun-12	1.65%	0.56	51	0.24%	0.07
20-Jun-12	2.92%	1.05	52	0.98%	0.52
21-Jun-12	2.40%	0.85	53	0.68%	0.34
22-Jun-12	-2.41%	-1.03	54	-2.30%	-1.47*
25-Jun-12	-3.11%	-1.30*	55	-1.93%	-1.25
26-Jun-12	5.42%	2.02**	56	5.48%	3.26***
27-Jun-12	-1.53%	-0.68	57	-1.56%	-1.02
28-Jun-12	1.02%	0.31	58	1.45%	0.81
29-Jun-12	-4.37%	-1.79**	59	-2.53%	-1.61*
02-Jul-12	1.31%	0.42	60	0.09%	-0.02

Appendix B shows the significance of the daily abnormal returns (DARs) of Delta Air Lines (DAL) ±60 trading days around the oil refinery acquisition announcement on 5 April 2012. Three asterisks (***) indicate that the DAR is significant at the 1%, two asterisks (**) at the 5%, and one asterisk (*) at the 10% level.

Appendix C Statistical Significance of Delta Air Lines' Cumulative Abnormal Returns

Date	DAL-S&P 500		Trading Day	DAL-XAL	
	CAR	t-Statistic		CAR	t-Statistic
10-Jan-12	-1.0%	-2.22**	-60	-1.90%	-2.03**
11-Jan-12	3.1%	-1.76**	-59	1.29%	-1.49*
12-Jan-12	5.9%	-1.44*	-58	3.31%	-1.14
13-Jan-12	6.1%	-1.40*	-57	3.81%	-1.06
17-Jan-12	4.4%	-1.60*	-56	3.13%	-1.17
18-Jan-12	5.5%	-1.48*	-55	2.94%	-1.21
19-Jan-12	9.6%	-1.01	-54	5.58%	-0.76
20-Jan-12	10.4%	-0.92	-53	5.78%	-0.72
23-Jan-12	9.1%	-1.07	-52	4.79%	-0.89
24-Jan-12	10.1%	-0.95	-51	4.94%	-0.87
25-Jan-12	15.4%	-0.34	-50	8.10%	-0.33
26-Jan-12	18.1%	-0.03	-49	8.23%	-0.31
27-Jan-12	20.4%	0.24	-48	8.29%	-0.30
30-Jan-12	24.4%	0.69	-47	11.11%	0.18
31-Jan-12	22.4%	0.46	-46	8.68%	-0.23
01-Feb-12	24.8%	0.74	-45	9.99%	-0.01
02-Feb-12	26.5%	0.93	-44	9.73%	-0.05
03-Feb-12	26.9%	0.97	-43	8.76%	-0.22
06-Feb-12	24.2%	0.66	-42	8.36%	-0.29
07-Feb-12	23.8%	0.62	-41	8.52%	-0.26
08-Feb-12	23.7%	0.62	-40	9.66%	-0.07
09-Feb-12	24.8%	0.73	-39	10.52%	0.08
10-Feb-12	23.4%	0.58	-38	9.67%	-0.06
13-Feb-12	25.1%	0.77	-37	9.42%	-0.11
14-Feb-12	23.3%	0.57	-36	7.90%	-0.36
15-Feb-12	22.8%	0.51	-35	8.00%	-0.35
16-Feb-12	22.7%	0.49	-34	7.08%	-0.50
17-Feb-12	21.5%	0.36	-33	6.17%	-0.66
21-Feb-12	14.2%	-0.47	-32	4.42%	-0.96
22-Feb-12	13.4%	-0.57	-31	4.80%	-0.89
23-Feb-12	10.5%	-0.90	-30	3.73%	-1.07
24-Feb-12	8.7%	-1.11	-29	3.99%	-1.03
27-Feb-12	9.9%	-0.97	-28	4.46%	-0.95
28-Feb-12	12.1%	-0.72	-27	4.52%	-0.94
29-Feb-12	11.7%	-0.77	-26	4.38%	-0.96
01-Mar-12	9.3%	-1.04	-25	2.96%	-1.20
02-Mar-12	11.0%	-0.85	-24	4.28%	-0.98
05-Mar-12	10.3%	-0.92	-23	5.28%	-0.81
06-Mar-12	8.7%	-1.11	-22	3.89%	-1.05
07-Mar-12	8.1%	-1.18	-21	3.64%	-1.09
08-Mar-12	8.2%	-1.17	-20	3.16%	-1.17
09-Mar-12	6.8%	-1.33*	-19	2.24%	-1.32*
12-Mar-12	4.8%	-1.55*	-18	1.46%	-1.46*

13-Mar-12	4.3%	-1.61*	-17	0.24%	-1.66**
14-Mar-12	4.3%	-1.61*	-16	0.75%	-1.58*
15-Mar-12	7.3%	-1.27	-15	1.96%	-1.37*
16-Mar-12	2.8%	-1.79**	-14	0.20%	-1.67**
19-Mar-12	3.5%	-1.71**	-13	0.26%	-1.66**
20-Mar-12	6.2%	-1.40*	-12	1.90%	-1.38*
21-Mar-12	8.5%	-1.13	-11	4.37%	-0.96
22-Mar-12	7.1%	-1.29*	-10	4.00%	-1.03
23-Mar-12	7.7%	-1.22	-9	3.86%	-1.05
26-Mar-12	9.1%	-1.07	-8	3.99%	-1.03
27-Mar-12	8.6%	-1.12	-7	4.45%	-0.95
28-Mar-12	11.1%	-0.84	-6	5.41%	-0.79
29-Mar-12	11.9%	-0.74	-5	5.90%	-0.70
30-Mar-12	10.1%	-0.95	-4	5.75%	-0.73
02-Apr-12	10.2%	-0.93	-3	6.57%	-0.59
03-Apr-12	13.7%	-0.53	-2	8.48%	-0.27
04-Apr-12	16.3%	-0.24	-1	10.47%	0.07
05-Apr-12	15.3%	-0.35	0	10.03%	0.00
09-Apr-12	15.7%	-0.31	1	10.29%	0.04
10-Apr-12	12.7%	-0.65	2	7.92%	-0.36
11-Apr-12	13.0%	-0.62	3	7.96%	-0.36
12-Apr-12	15.1%	-0.37	4	9.49%	-0.10
13-Apr-12	15.1%	-0.37	5	9.52%	-0.09
16-Apr-12	16.4%	-0.23	6	10.27%	0.04
17-Apr-12	16.7%	-0.20	7	10.47%	0.07
18-Apr-12	17.9%	-0.05	8	12.41%	0.40
19-Apr-12	21.3%	0.33	9	12.71%	0.45
20-Apr-12	20.5%	0.25	10	12.87%	0.48
23-Apr-12	18.0%	-0.04	11	11.72%	0.28
24-Apr-12	18.5%	0.02	12	11.68%	0.28
25-Apr-12	17.1%	-0.14	13	10.56%	0.09
26-Apr-12	15.7%	-0.31	14	10.09%	0.01
27-Apr-12	19.5%	0.13	15	12.15%	0.36
30-Apr-12	21.2%	0.32	16	14.09%	0.69
01-May-12	21.4%	0.35	17	15.51%	0.93
02-May-12	20.1%	0.19	18	13.70%	0.62
03-May-12	21.7%	0.38	19	14.47%	0.75
04-May-12	23.6%	0.60	20	14.81%	0.81
07-May-12	25.1%	0.78	21	14.09%	0.69
08-May-12	25.6%	0.83	22	15.14%	0.86
09-May-12	23.9%	0.64	23	14.35%	0.73
10-May-12	24.8%	0.73	24	14.83%	0.81
11-May-12	28.2%	1.13	25	17.02%	1.18
14-May-12	29.8%	1.31*	26	19.02%	1.52*
15-May-12	28.1%	1.12	27	18.24%	1.39*
16-May-12	30.5%	1.40*	28	20.15%	1.71**

17-May-12	23.4%	0.58	29	16.17%	1.04
18-May-12	21.6%	0.37	30	14.97%	0.83
21-May-12	24.3%	0.68	31	17.36%	1.24
22-May-12	23.9%	0.63	32	18.34%	1.41*
23-May-12	25.6%	0.83	33	19.34%	1.58*
24-May-12	30.4%	1.38*	34	20.93%	1.85**
25-May-12	31.5%	1.51*	35	20.91%	1.84**
29-May-12	34.2%	1.82**	36	23.62%	2.30**
30-May-12	35.2%	1.93**	37	24.46%	2.45***
31-May-12	38.4%	2.30**	38	24.66%	2.48***
01-Jun-12	36.0%	2.02**	39	22.62%	2.13**
04-Jun-12	24.4%	0.70	40	15.30%	0.89
05-Jun-12	27.8%	1.08	41	18.11%	1.37*
06-Jun-12	25.8%	0.85	42	16.12%	1.03
07-Jun-12	22.7%	0.49	43	13.45%	0.58
08-Jun-12	22.8%	0.51	44	12.93%	0.49
11-Jun-12	22.1%	0.42	45	13.50%	0.59
12-Jun-12	19.6%	0.14	46	11.31%	0.21
13-Jun-12	22.8%	0.51	47	12.91%	0.48
14-Jun-12	23.3%	0.56	48	13.14%	0.52
15-Jun-12	20.4%	0.24	49	11.48%	0.24
18-Jun-12	23.9%	0.63	50	13.78%	0.63
19-Jun-12	25.5%	0.82	51	14.02%	0.67
20-Jun-12	28.5%	1.16	52	14.99%	0.84
21-Jun-12	30.9%	1.44*	53	15.68%	0.96
22-Jun-12	28.5%	1.16	54	13.38%	0.56
25-Jun-12	25.3%	0.80	55	11.44%	0.24
26-Jun-12	30.8%	1.42*	56	16.92%	1.17
27-Jun-12	29.2%	1.25	57	15.36%	0.90
28-Jun-12	30.3%	1.37*	58	16.81%	1.15
29-Jun-12	25.9%	0.86	59	14.29%	0.72
02-Jul-12	27.2%	1.01	60	14.38%	0.74

Appendix C shows the significance of the cumulative abnormal returns (CARs) of Delta Air Lines (DAL) ±60 trading days around the oil refinery acquisition announcement on 5 April 2012. Three asterisks (***) indicate that the CAR is significant at the 1% level, two asterisks (**) at the 5% level, and one asterisk (*) at the 10% level.