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The Impact of Operational and Financial Hedging to the Airline Operating Performance

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Abstract

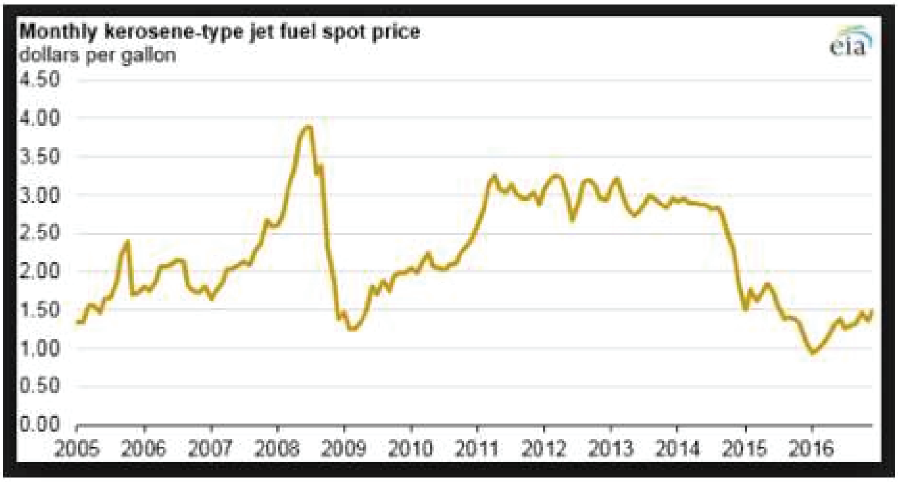
Airline is a low profit margin and high competition industry. Increasing competition makes airline unable to easily charge their costs to customers and raise their fare, so that airlines have a narrow profit margins. One of the major cost in the airline industry is jet-fuel cost. International Air Transport Association (IATA), predict that total global fuel cost for period 2019 will rise to USD 200 billion from about USD 180 billion in 2018. In average, Jet fuel will contribute 24.2 percent of total 2019 Airline's operating cost (IATA [1]). Like most of commodities, jet-fuel price is highly volatile which encourages companies to engage in hedging activities. This paper examines the impact of operational and financial hedging to airline operating performance. We perform an empirical study by using the airline data from 2013 to 2017. To test the impact of hedging in airline operating performance, we regress the operating cost to revenue ratio, operational hedging, financial hedging and other control variables. This study found that financial derivative hedge can reduce the dollar needed to generate airline revenue, while the operational hedging increase it.

Keywords: Fuel Hedging, Operational Hedging, Financial Hedging, Airline Performance

1. Introduction

Travelers today have more choices to fly with and buy a ticket at price that fits their budget. At least there are 291 airline that are registered as a member of International Air Transport Association (IATA [2]). Those airline compete to get passengers all over the world. Increasing competition provides benefit for customer, but does not have the same good effect for the airline. Increasing competition makes airline unable to easily charge their costs to customers and raise their fare, so that airlines have a narrow profit margins. Besides personnel expense, Jet-fuel cost is a major cost for airline industry. International Air Transport Association (IATA), predict that total global fuel cost for period 2019 will be rise to USD 200 billion from about USD 180 billion in 2018. In average, Jet fuel will contribute 24.2 percent of total Airline's operating cost (IATA [1]).

Similar with other commodities, prices for jet fuel are also highly volatile. As we can see in Figure 1, in period 2005-2016 the jet fuel price was up and down and reach its highest price in mid of 2008 when one gallon of jet fuel was approximately amounted for almost four US dollar and then in the next semester, the jet fuel price deeply fall and almost reach only one US dollar per gallon less than a half price from the prior semester (EIA [3]). Airlines are exposed to risks of the fluctuation of jet fuel price. Problems with the fuel jet is not about price but price volatility (Turner and Lim [4]). Due to the large portion of jet fuel consumption in airline operating cost, even a relatively small increase or decrease in the price of jet fuel can have a significant impact to Airline total operating costs, revenues, or to their general business. Volatility of the Fuel price increases a firm's risk.



Source U.S. Energy Information Administration
https://www.eia.gov/todayinenergy/detail.php?id=30012

Figure 1: Monthly Kerosene-type Jet fuel spot price 2005-2016

Using airlines historical data, management can forecast how much jet fuel to be consumed. The challenge is in predicting the cost of jet fuel. To hedge or not to hedge their fuel consumption can be a hard choice for Airline's managers. Since fuel is a huge part of the Airline cost structure, and the price is highly variable, airline management can enter derivative market to lock in its price when they belief the fuel price is likely to rise rather than fall. But if they wrong they forgone profit. Delta Airlines' CEO Ed Bastian admits that they have lost about four billion USD on jet fuel hedge over the last eight years (Hirs [5]).

Airline can hedge its risk by either using financial derivatives instrument (financial hedging) or operational hedging. Different with financial hedging that perform by buying derivative contract (option, forward, future, or swap contract) from counterpart, a company can do operational hedging by managing its daily operational management. As example, airline operational hedging can be done by choosing a newer fleet that consume lower fuel compare the older ones, or by determining the fleet type that they use in their operation. In their study, Kim, Mathur, & Nam [6], found that generally, the company complementary use both financial and operational hedging. Guay and Kothari [7], belief that hedging using financial derivative is only a “fine-tuning” in risk management strategy in covering the company’s risk, and airline’s managers use the operational hedging in their real option to manage the majority of the company’s risk. Furthermore, Treanor et al. [8] concludes that both operational and financial hedging are important means in deducting airline exposure to jet fuel risk, but the economic effect of fuel derivatives is not as large as the hedging effect by managing the operational hedging strategies.

Although some previous studies concluded that hedging (operational and or financial hedging) has significant effect in reducing airline’s exposure, some researchers found reversely. Berghofer & Lucey [9], similar with a study conducted by Treanor et al. [8], they analyzed the impact of financial derivative (financial hedging) and fleet diversity (financial hedging) in reducing airline fuel price risk exposure. Berghofer & Lucey [9] concluded that those hedging activities does not significantly reduce airline fuel price risk exposure. Lim and Hong [10] said that fuel hedging airlines reduce operating cost but this effect is statistically insignificant. Moreover, Lim and Hong [10] found that derivative hedging performed by many company are too small in an economic standpoint to provide some benefits implicit in various research of corporate hedging.

This research will continue the study about the effect of financial hedging and operating hedging in airline industry. Fuel hedging still an interesting topic to be discuss due to there still controversy result among the studies. The author realized that most of hedging studies focused on Airline in North America, so expanding the sample to the global airline industry is expected to be able to describe the impact of hedging activity in the worldwide. And then, Airline is known as a low margin industry, but most of previous study focus to analyze the effect of fuel hedging to airline’s jet fuel risk as dependent variable (Berghofer & Lucey [9]; Treanor et al. [8]; Turner and Lim [4]), or the effect of fuel hedging to airline operating cost (Lim and Hong [10]). The author think that it is important to know the impact of hedging activities to airline’s fuel jet risk, but it also important to know the effects of hedging activities to airline’s performance. So that, this study want to analyze the impact of hedging activities to airline’s total operating cost to total revenue ratio. The purpose of this study is to identify whether operational hedging (fleet diversification and fleet age) and financial derivative hedging performed by airlines are effective in reducing the total operating cost to revenue ratio.

This paper is composed of five sections, start with introduction. In section two, we review the related literature about airline industry, operational and financial hedging activities. The third section describes data, variables and sample of this study. In section four, we report and discuss the result of this study. And finally, we conclude our study and give some recommendations in the last section.

2. Literature Review

2.1. Fuel Price and airline industry

An airline is a firm that provides air transport services for passengers and cargo. Based on its route, an airline can be categorized as domestic, international, regional, or multi-national/global which may be run as scheduled flight or charter. Based on its service, there are two types of airlines, there are: Full service and Low cost carrier. Airlines operate aircraft to provide their service. Sometime the airline will form a partnership or alliance with another airline for codeshare agreements. The airline industry is in an ultra-competitive market place and prizes customer loyalty, at least there are 291 airlines are registered as a member of International Air Transport Association (IATA [2]). Those airlines compete to get passengers all over the world.

Scotti and Volta [11] performed a comprehensive study about the profitability changes in the largest worldwide airline during period 1983-2010. They found that improvement in efficiency and productivity mostly driven by changing in technical aspect and profitability change seems to be mainly driven by input and output price changes. Scotti and Volta [11] also found that in the airline input price change with a similar pattern to output price. But nowadays the output price increase is lower than the input price increase. This research can be an indication that the competition in airline industry is getting tense over time and to get profit the airline should manage its input (lower the cost) and output (increase the revenue). And then due to fuel is one of the major cost in airline industry, the management should manage it properly.

Fuel price not only has impact to airline's financial performance, but also impacts stock returns of a listed airline. A good understanding about the effect of fuel price fluctuation is relevant to help us when making a better economic decision. Positive price shocks in oil prices tend to decrease emerging stock market prices and types of exchange in USD in the short term (Basher and Sadorsky [12] and Basher et al. [13]. In airline industry, Kristjanpoller and Concha [14] said that logically we can predict the effect of oil price on airline stock, meaning that if the price getting higher so then an airline stock price will be decreasing. But their study found that there are astrong positive influence of fuel fluctuation on a daily basis, which means the increases in oil price increase the stock price and it is a signal of economic growth improvement.

2.2. Hedging in airline Industry

To manage the fuel risk, airline will perform hedging. Hedging is an effort to reduce the risk of adverse price fluctuation in an asset. Usually, hedging consists of taking a position of balancing in related security. Hedging activities can be done either on the input (cost) or output (revenue) side. In their book, Eiteman et al. [15], said some reasons of why hedging important is to improve company's planning capability, hedging also helps management to take a better position to recognize disequilibrium in the market. In Airline industry, hedging usually use to protect the foreign exchange transaction and the fuel cost (input side). One objective of hedging is to reduce the exposure of cash flow of an underlying assets (Treanor et al. [16]),

There are two type of hedging that can be choose when the company want to mitigate the fuel risk which are by using financial derivative hedging and operational hedging (Kim, Mathur, & Nam [6], Berghofer & Lucey [9], Treanor et al. [8])

We will review both of this types. The first type is financial hedging. To minimize the effect of rising fuel prices, a firm use derivatives as part of their risk management strategy. In the aviation industries one of the tools that management can use to manage the risks is by using fuel hedging. The main purpose of fuel hedging is to mitigate a firm's exposure to unpredictable changes in the fuel price. Similar with foreign exchange risk, firms tend to compensate the jet-fuel price fluctuations by trading financial derivatives such as forwards, futures, options, or swaps, but not like hedging for foreign exchange, derivative instrument for commodities tends to be more difficult to obtain and illiquid. Treanor et al. [16] on their research found that in a situation that fuel price is at a higher levels, airline usually increase its hedging activity.

In the twenty-first century multinational enterprise, it is a common to use any financial derivatives in its financial management (Eiteman et al. [15]). Derivatives, are one of the financial instruments whose payment and value are drive or depend on its underlying. Derivative can be used for speculation or hedging. For hedging, derivatives are tools that can be used by a firm to minimize its risk exposure. By using derivatives, companies can eliminate unfavorable parts of risk or change risk into different type (Ross et al. [17]).

Many people think that risk is something that is not desirable. People accept risks only if they receive a commensurate return. Therefore, it is natural that companies seek ways to mitigate the risks they have. We call the firm doing hedging when the firm reduce its risk exposure by using derivatives. But not only for mitigate risk, some parties also use derivatives for speculating to get profit from derivative transactions (Eiteman et al. [15]). Hull [18] also the one who agree derivatives can help company reducing its risk but in his book he gives a warning of danger regarding the use of derivative. In his opinion, derivative is a very versatile instrument, it make a problem. It is possible that traders who have an obligation to hedge risks or obey an arbitration strategies become speculators (consciously or unconsciously) and the impact can be disastrous.

As one of the major expenses in airline industry, many airline use derivative hedging to reduce the risk from fuel price fluctuation. Derivative hedging fuel contract means airlines are locking their future fuel price. So airline hedge their fuel to stabilize the fuel cost. Compare to fuel prices, other airline cost are less volatile, so hedge the fuel will stabilize overall airline costs (Morrel and Swan [19]). Usually Airline enter a short-term fuel contracts, which cover 12 months (Morrel and Swan [19]). Airline management usually enter derivative market to lock in its price when they belief the fuel price is likely to rise rather than fall. But if they wrong they forgone profit. Delta Airlines' CEO Ed Bastian admits that they have lost about four billion USD on jet fuel hedge over the last eight years (Hirs [5]). Hedging give both advantage and disadvantage for the Company. Lim and Hong [10], said that by not hedging airlines expose themselves to the risk of fuel spot price increases, and by hedging airlines face the prospect of falling fuel prices in te near term and incurring financial losses in fuel hedging contracts. Moreover, Lim and Hong [10] found that derivative hedging performed by many company are too small in an economic standpoint to provide some benefits implicit in various research of corporate hedging.

Treanor et al. [16] found that in response to higher level of fuel price, airlines is motivated to add their hedging level. However, on their research, Guay and Kothari [7] said that hedging using derivative is only a "fine-tuning" in risk management strategy. They found that derivative owns by most company are too small to give the benefits implied in various research of corporate hedging. Even though an airline firm can mitigate its fuel expense fluctuation, but hedging does not ensure that the firm will pay a price for jet fuel lower than its competitors (Simmons et al. [20]). The newest research about hedging effectiveness of commodities was performed by Chunhachinda et al. [21]. The research said that the combination of equities and commodities hedging reduce more risk than in developed market. But the developed markets give a better investment performance.

The second type of hedging is operational hedging. In general, operational hedging is an activity that hedges a company's exposure using a non-financial instruments, usually through daily operational activities. Operational activities related with managing cost by managing the company output. So the company's ability to tailor its output is the ability of the operational hedge. A different type of operational hedge can involve the company's overseas operation. A company can operate in another country to maintain its currency risk. Each company has their own policies in managing their operations. Also in every industry has difference set of operational hedges that makes incomparable across industries. Moreover, not like financial data, operational data is more difficult to access which makes it is more challenging to study.

Due to overall risk (i.e operating risk) cannot be covered by only using financial hedging, the management should include other means of hedging (i.e operational hedging (Guay and Kothari [7]). Boyabatli and Toktay [22] observed that there was no consistent framework for operational hedging that included operations management and financial management. One of example of operational hedging is by postponing production in an uncertainty situation. Treanor et al. [8] compared two methods of hedging, the operational hedging and financial hedging, and found operational hedging give larger effects in reducing jet fuel exposure coefficient compare to the hedging using financial derivative. Operational hedging can be used if a company has operational flexibility to adjust its cost structures. In their study, Treanor et al. [8], describe two major operational hedging, one is fleet composition (diversity of fleet) and another one is fleet fuel efficiency (which show in fleet age variable) those are significantly reduce jet-fuel risk.

In some industries, it is hard for a company to leave a market when in a bad economic condition and the reenter the market when the situation is better. Airline is one of the industry which in this condition. This industry will still in the market although the company bears huge losses. To minimize the loss related with its operation, an airline can lower its service level for a route by changing a larger fleet with a smaller one. That action will decrease the airline's losses since the smaller aircraft's loss are less than a bigger aircraft. The cost of this option is about spare capacity, and also the additional cost associated with operating in a vary fleet of aircraft such as maintenance and flight crew training. Bruggen and Klose [23] studied the effect of fleet commonality influences low-cost airline operating performance. As the result they found that commonality is positively associated with operating performance.

Another tools for airlines to minimize their fuel exposure is by using a fuel-efficient aircraft. In a same type of aircraft, the newer the more fuel efficient. With less fuel consumption means the fleet have less exposure to fuel prices compare too an older one. But newer aircraft usually is expensive. So that manager need to calculate the tradeoff between fuel cost reducing and the increase of rental expense or depreciation (we depreciate the purchase cost if we buy a fixed assets).

Almost similar with Treanor et al. [8], there are a study performed by Berghofer & Lucey [9], which also analyzed the impact of financial derivative (financial hedging) and fleet diversity (financial hedging) in reducing airline fuel price risk exposure. But Berghofer & Lucey [9] concluded that those hedging activities does not significantly reduce airline fuel price risk exposure which was a different result with treanor et al. [8]. Berghofer & Lucey [9] said their result different with prior result due to: first, the difference could happen due to the difference airlines sample. Like prior study Treanor et al. [8] using use only U.S. airlines for the sample when Berghofer & Lucey [9] use global airline. Same area of the samples means they used single stock market index and fuel index for the calculation of fuel price exposure coefficient which is more homogeny than when using global airline which the fuel price exposure coefficient calculated using stock market index based on related countries and based on its area (Asia, Europe and America), and second, Prior research on fuel hedging use US airlines. Mostly larger airlines use financial hedging when smaller companies are generally contracted with Capacity Purchase Agreements (CPA).

3. Data, Variables and Sample

This research sample are listed airline companies around the world for period 2013-2017. The author use airlines data from Bloomberg Intelligent as the initial data source to determine the list of sample candidates. Then for financial and operational data, the author get the data from several sources such as: Bloomberg, airlines' annual report, and other sources. Only airlines that have adequate data during period will be used in this study. Those selection process result is 45 airlines as the samples.

This paper explicitly examine the role of both operational and financial hedging in the airline industry. More specifically the paper will addresses issue using regression model to answer whether operational hedging (fleet diversification and fleet age) and financial derivative hedging reduces total operating cost to revenue ratio in the airline industry or not.

This study uses operating cost to revenue ratio (COSTE) as its dependent variable. This ratio shows cost to revenue efficiency. It tell about portion of total operating cost needed to generate revenue in the year concern. The author does not only use operating cost as the variable like in Lim and Hong [10] study due to the author want to analyze the effect of hedging to airline performance which should considering the input (cost) and output (revenue). And the reason why the author does not use net profit or profit margin as the performance because increase (decrease) in profit can be result of increase (decrease) revenue, decrease (increase) cost, or combination of them and we do not know the reason without looking the financial summary.

COSTE Calculation as follows:

$$\text{COSTEi}_I = \frac{\text{Operating Costs}}{\text{Revenue}} \quad (1)$$

As independent variable the authors use Aircraft Dispersion Index (ADI) to measure fleet diversity. We calculate ADI based on the Hirschman-Herfindahl concentration index employed by Treanor et al. [8].

ADI calculation as follows

$$\text{ADI} = 1 - \sum_{j=1}^{K} \frac{(\text{No. of Aircraft}_j)^2}{(\text{Total No. of Aircraft}_i)^2} \quad (2)$$

K is the total number of different aircraft models operated by airline i

The total number of aircraft is the active aircraft family operates by airline in the world exclude freighter and charter fleet. The data of all aircraft in the world was taken from airfleet.net [24] which its source data came from aircraft manufactures (such as Boeing, Airbus, CRJ, ATR, etc.). The list contains type of aircraft, Manufacturer Serial Number (MSN), name of airline, first flight, registration code, and also the status of the aircraft whether active or inactive (stored, scraped, and written off). The data that use in this study was outstanding aircraft on March 11, 2019, the author separate which aircraft are an active aircraft for period 2013-2017. For the sample, the author also grouped the airline in the same group (consolidated) but exclude the group member which specialized for cargo and charter only.

Fleet diversity can be used as an operational hedging. In case of high fuel prices and simultaneously slow down economic condition, airline can choose smaller aircraft to adjust with the lower demand. The fleet diversity ranges between zero and one. With one indicating the greatest degree of diversity. And zero is no diversity on the aircraft composition, so if an airline only operate one fleet type, then the ADI value is zero.

Second independent variable is Average Aircraft age (AAGE). AAGE is the weighted average of the ages of different aircraft for airline/airline group. Aircraft age is usually use as indication of fuel efficiency. A newer aircraft provide the same level of service as an older aircraft but at a lower fuel consumption. Due to fuel cost take main portion in airline operating cost, a fleet rejuvenation program become a usual target for reducing airline fuel cost. Garuda Indonesia [25], implement fleet development programs through fleet revitalization on new in order to improve service quality, drive higher operational cost efficiency, lower emissions etc. The Company is targeting an average fleet age of under six years old by the end of 2017 that hopefully help Garuda to improve efficiency significantly.

Aircrafts AAGE data is taken from the same source of ADI data. The AAGE is calculated from the first year of aircraft has been operated. The author use data from third party rather than from airline annual report because many airlines not always report their average aircraft age every year. Treanor et al. [8] also use average aircraft age as the independent variable they use data from annual report, but in condition airlines did not report their fleet age, they use the previous age reported by the airlines.

The last independent is financial hedge variable. Earlier in the research proposal, the author want to use percentage of fuel hedge coverage to Airlines' total fuel consumption for the related year, but due to many airlines do not publish its percentage of jet fuel requirement hedge, so this study uses dummy variable for the use of financial derivative hedging (HEDGE), equal of one if the airline is using derivative fuel hedge and zero if not. The HEDGE are collected from the airlines annual report.

In this study, the author also use several data as control variables, first: Airline's total asset (TASSET). We use TASSET due to there are a positive relationship between firm size and exposure (Treanor et al. [8]). Second, total fleet operate by the airline (TFLEET). TFLEet also use as an indication of firm size. Like discuss before, for the same aircraft type, newer fleet give the same service level but the newer aircraft is more expensive compare with the older one. So that we include total fleet as the control variable, and the last, we also use percentage of propeller aircraft in airline's fleet (PROP). We use this variable due to the smaller turboprop aircraft are not comparable substitutes for larger jet aircraft as they lack the speed and range to service the same routes.

To test the hypothesis that airlines use operational hedge to optimize operating cost to its total revenue. The author use the regression as below.

$$\text{COSTE} = \alpha_0 + \alpha_1 \text{ADI}_{i.y} + \alpha_2 \text{AAGE}_{i,y} + \alpha_3 \text{HEDGE}_{i,y} + \beta_k \text{Control Var}_{i,y} + \varepsilon_{i.y} \quad (3)$$

i represents the firm and y is the year.

The result of the model will allows us to test the following hypotheses:

A diverse aircraft provides an airline the flexibility to respond to changing in market conditions. That is, if fuel prices increase and the demand is low, an airline with a diverse fleet can reduce its operating cost by switching to a smaller aircraft. Thus, the prediction is that the coefficient of ADI in this model (α1) is less than zero. H1: Fleet diversity reduce operating cost to revenue ratio (α1 < 0).

Compare with the older aircraft, a younger fleet give the same level of service (available seat) but consume less fuel. So when the revenue remain same but a decrease in fuel consumption will result smaller total operating cost per revenue ratio. Thus, the prediction is that the coefficient of AAGE in this model (α2) is greater than zero. H2: Fuel-efficient aircraft reduce operating cost to revenue ratio (α2 > 0).

Airlines use financial hedging in order to reduce their fuel cost and optimize the airline operating performance thus the coefficient of HEDGE in this model (α3) is less than zero. H3: The existence of financial derivative hedging, reduce the operating cost to revenue ratio (α3 < 0).

4. Result and Analysis

This study use forty five (45) airline sample for period 2013-2017. The appendix A shows summary data of the samples. Those 45 samples consist of 20 airlines from Asia Pacific area (Asia), 16 airline from North America area

Table 1: Descriptive analytic

Variable	N	Mean	Maximum	Minimum	Std. Dev.
COSTE (Operating cost per revenue ratio) (%)	225	92.66	124.14	70.55	7.80
ADI (Aircraft Dispersion Index) (%)	225	56.58	90.41	0.00	26.52
AAGE (Average Aircraft Age) (year)	225	9.05	24.15	2.50	4.25
HEDGE (Financial Derivative Hedging activities)	225	0.77	1.00	0.00	0.42
TASSET (Total Asset) (Million USD)	225	11839	54005	201	12127
TFLEET (Total Fleet) (Number)	225	225	969	23	221
PROP (Turboprop aircraft in fleet) (%)	225	8.37	100	0	17.63

Operating cost per revenue ratio tell us about how much operating cost needed to generate one hundred million USD revenue (sales). This ratio can be seen as the efficiency of cost in generating revenue. The lower the ratio the better. If the ratio more than 100 percent the airline operation is loss because the cost of operation is higher than its revenue. The component of the operating cost in airline industry included: personnel cost, fuel cost, rental cost, maintenance cost, depreciation cost, general and administration cost, and other operating cost. The mean of COSTE ratio of the sample is 92.7 percent which means, in average the airline sample needs about 92.7 million USD for generating 100 million USD revenue. 26 average airlines' COSTE from 45 samples are above 92.7 percent which means airline sample tend to have low operating profit. The standard deviation of 7.8 percent is below its mean, indicate the sample accurate. In average the sample COSTE spread around 80-100 percent.

In the analysis, the author use aircraft dispersion index (ADI) to measure fleet composition for each airline. The aircraft dispersion index is similar to the Herfindahl-Hirschman concentration index (Treanor et.al., [8]). The average ADI for the sample is 56.58 percent with the maximum 90.41 percent and the minimum is zero. ADI ranges between zero and one. One is the greatest degree diversity and zero is no diversity on the aircraft composition, so if an airline only has one type of aircraft, then the index value is zero. Some airlines which only have one type of fleet are Regional Express (Saab 340), Gol Linhas Aereas Inteligentes (Boeing 737s), Ryanair (Boeing 737s), Air Arabia (Airbus 320), and Southwest Airlines (Boeing 737s). The condition of different ADI used by airline show their different of operational strategy. A vary type of airline gives airline ability to manage its operational to adapt with the unfavourable situation (Treanor et al. [8]). For example when the fuel cost are high, an airline can change a larger aircraft with a smaller one to reduce the cost and minimize its loss. But there is additional cost (i.e. maintenance cost, training cost, etc.) regarding operate a vary type of aircraft.

The other way for airlines to reduce their cost and fuel exposure is by using the fuel-efficient fleet. When analyse the airline annual report, many airline state that in order to reduce its fuel cost, they operate new aircraft that fuel efficient. They believe that the new fleet will improve their operating cost compare to the older aircraft. In average, the fleet age of the sample is 9 years from its first flight. The minimum average fleet age is 2.5 year and the maximum is 24.15 year. Aircraft is a long live fixed assets. In its financial report, Garuda Indonesia [25] estimates the useful lives of an aircraft is 18-27 years. The standard deviation of 4.25 year is below its mean, indicate the sample accurate. Mostly the average fleet age of each sample is about 10 years which can we consider young fleet age (compare to its useful lives).

Financial Derivative Hedging activities shows about whether the airline use financial derivative as a hedging instrument. This data are from airlines annual report for year 2013-2017. The average of 0.77 means about 77 percent of the total data is using financial derivative. The standard deviation of 0.42 is below its mean, indicate the sample accurate. From 45 sample in this study, 32 airlines are consistent using financial derivative hedging, eight airlines are consistent not using financial derivative hedging, and the other 5 airline are only using financial derivative hedging for one or some of the observation period.

Airline need asset to run its business. Total asset usually used as the indicator of company size. The bigger the total asset, the bigger the company. This study use total asset as one of the control variable. The average of sample's total asset is 11.8 billion USD. There is a significant difference of the maximum and the minimum total asset shows that this study using vary airline size. As the impact of variation of the sample, the standard deviation is 12.1 billion USD which is higher than its mean. About 64 percent (29 airlines) of the sample total asset are below the average total asset (11.8 billion USD) and the remaining 16 airlines are above the average.

This study use total fleet number as a control variable. The fleet number also can be seen as the size of an airline company. The quantity of fleet will affect the fuel consumption of the airline so that increase the exposure of the fluctuation of fuel price. At the same time it will increase the airline's available seat and then increase the revenue. The average of samples fleet number is 225 aircraft per Airline Company. The maximum of fleet number is 969 aircraft was owned by China Southern Airlines as of 31 Dec 2017. And the minimum fleet number is 23 was owned by Air Arabia as of 31 Dec 2013. The standard deviation of 221 aircraft is below its mean, indicate the sample accurate. In their paper, Dožic and Krnic [26] divide the airline company by the number of its fleet operation: large (operate more than 100 aircraft), medium (operate 50 to 99 aircraft) and small (operate less than 50 aircraft) airlines. Based on this category, about 62 percent (28 airline) of the samples are large airline, 24 percent (11 airline) are medium airline and the remaining 13 percent (six airlines) are small airlines.

The last control variable in this paper is the percentage usage of Turboprop aircraft. Turboprop is a type of aircraft which uses gas turbine to run a propeller. This type of aircraft usually use for short haul flight and sometimes is used as a feeder aircraft. This study use the percentage of propeller aircraft as a variable because although this type of fleet is lack of speed and range compare to jet aircraft, the smaller turboprop aircraft is consume less fuel compare to the larger jet aircraft. More than 50 percent of the sample do not have any turboprop aircraft (25 airlines). Only one airline which all of its aircraft is turboprop (Regional Express). So that the mean of turboprop aircraft in the sample is 8.37 percent which means in average, there is only 8.37 percent of the total fleet in the sample are turboprop aircrafts.

The author categorized high COSTE and low COSTE based on the average of all sample COSTE. If the airline average operating cost per revenue is above the average, it is categorized as a high COSTE and categorized as a low COSTE if the airline average operating cost per revenue is below the average. Mean of each variable in both categories can be seen at the table below.

Table 2: Summary of High and Low COSTE Airline

Variable	High COSTE airline	low COSTE airline	Difference
COSTE (Operati ng cost per revenue ratio) (%)	97.15	86.52	10.63
ADI (Aircraft Di spersion Index) (%)	62.79	48.09	14.70
AAGE (Average Ai rcraft Age) (year)	8.48	9.84	(1.35)
HEDGE (Financial Deri vative Hedging activities)	0.74	0.81	(0.07)
TASSET (Total Asset) (Mill ion USD)	11,887	11,773	114
TFLEET (Total Fl eet) (Number)	211	244	(33)
PROP (Turboprop ai rcraft in fl eet) (%)	10.22	5.83	4.39
Total data	130	95	35

From the table 2 we can see that there is a difference amounted 10.63 percent between the high COSTE airlines compare to the low COSTE airlines. Aircraft Dispersion Index (ADI) in the high COSTE airlines is greater than in the low COSTE airlines which are 62 percent and 48 percent respectively. It means higher rate of aircraft dispersion will result a higher of operating per revenue ratio. Airline management believe that younger aircraft age will decrease its operating cost. But from the table we can see the higher COSTE airlines has lower average of aircraft age (AAGE) compare to the lower COSTE airlines (8.48 year compare with 9.84 year). ADI and AAGE are a variable of operational hedging performed by airlines. But both higher ADI and lower AAGE does not give a better COSTE which means Variation of aircraft in an airlines and younger aircraft age do not reduce the operating cost per revenue but increase it (unfavourable). On the other hand the financial derivative hedging (HEDGE) variable shows that the lower the HEDGE the higher the COSTE. Which means the existence of HEDGE can reduce the airline's COSTE. Even in a small difference of total assets (amounted 114 million USD or only one percent), a higher amount of airlines' total asset give impact to a higher COSTE. Besides that, a lower average of total fleet contributes a higher COSTE. It is can be happen if, in average, a decrease of aircraft number reduces its operating cost but at the same time also reduce the revenue deeper at previous explanation we know that a propeller aircraft is more efficient than the jet. But from the high and low COSTE table, we see that a higher percentage of propeller increase the airline COSTE.

When running regression of dependent variable (COSTE) against independent variables (ADI, AAGE, and HEDGE). The result are shown in the table 3: the coefficient constant for the equation is 92.79 percent which means if the independent variable are

Table 3: Estimation Result for Regression Model.

Variable	Model 2			
	Estimation without control variable		Estimation with control variable	
	Coefficient	Std. error	Coefficient	Std. error
Constant	92.79	1.83 *	93.83	1.84 *
ADI (%)	0.0638	0.0191 *	0.0737	0.0204 *
AAGE (year)	-0.2935	0.1188 **	-0.4039	0.1269 *
HEDGE (%)	-1.4030	1.2034	-2.4908	1.2274 **
TASSET (million USD)			0.00012	0.00009
TFLEET (number)			-0.0090	0.0046 ***
PROP (%)			0.1098	0.0314 *
R^2	0.0751		0.1568	
Observation	225		225	

* Sig 1%; ** Sig 5%; *** Sig 10%

zero, on average the airline need 92.79 million USD to generate 100 million USD and it is significant in one percent. When the author add some control variables (TASSET, TFLEET, PROP) into the equation, the coefficient constant increased become 93.83 percent and still significant in percent. When running simulation without control variable, Aircraft dispersion index impact to the operating cost to revenue ratio is 0.06 which means every additional one percent of the ADI will increase 0.06 percent of the operating cost to revenue ratio. Addition of control variable increased the positive impact from 0.06 to 0.07. Hypothesis one of this study said that fleet diversity reduce operating cost to revenue ratio ($\alpha 1 < 0$). We expect the fleet diversity can reduce the operating cost to revenue ratio but the result is ADI has significant impact to the COSTE so that this study failed to approve this hypothesis one (H1).

As mention previously at the descriptive statistics section, the component of the operating cost in airline industry included: personnel cost, fuel cost, rental cost, maintenance cost, depreciation cost, general and administration cost, and other operating cost. ADI can improve management flexibility to respond the market need in order to reduce the fuel cost. But at the same time the addition of one type of aircraft will increase the maintenance cost and personnel/crew cost. Cockpit crew need rating certificate to be able role on flight. If the airlines have different aircraft types these mean they need to give more training to their crews which are costly. To cover potential irregularities during daily operation, the airlines prepare standby crew. Usually a crew only has a type rating aircraft certificate which cannot replaceable with another type rating aircraft. This condition makes airlines need to employ more crew compare with the airlines with homogeny aircraft type. If the addition of fleet diversity add the ratio of total cost to revenue, it means the additional cost is higher than the fuel cost efficiency. This result is supported by Bruggen and Klose [23], they found that fleet commonality give significant positive effect to airline operating performance.

The second independent variable (AAGE) result is without added the control variable, the AAGE reduce the operating cost to revenue ratio by 0.29. Which means every one year additional of average fleet age it estimates to reduce 0.29 percent of COSTE. The higher the average age the higher the reduction. This result is opposite of the hypothesis two which said that the coefficient of AAGE should be positive ($\alpha 2 > 0$) so that, this study failed to approve H2 the Fuel-efficient fleets reduce operating cost to revenue ratio. In order to explain why the younger average fleet age reduces smaller operating cost to revenue ratio compare to the older one, the author think about a trade-off between fuel cost efficiency and rental cost. Newer aircraft has higher rental cost compare to the older one. So that if the revenue is remain the same, when the increase of rental cost is higher than the fuel cost efficiency, that will make the newer aircraft has a bigger operating cost to revenue ratio. This rationale supported by Zuidberg [27] which found that airlines that use newer aircraft have higher average operating costs per aircraft movement.

The last independent variable for this model is the existence of financial derivative hedging (HEDGE). Without add any control variable to the equation, the HEDGE variable give negative impact to the operating cost to revenue ratio amounted 1.4 percent but the effect is not significant. When the author add control variables (TASSET, TFLEET and PROP), the result is HEDGE give higher negative impact changes from 1.4 percent to 2.49 percent and the impact is significant in one percent significant level. This means the existence of financial derivative hedging in the airline in average will reduce the total operating cost to revenue ratio amounted 2.49 percent. So that this study success to approved the hypothesis 3 (H3) - The existence of fuel financial derivative hedging, optimize the airline operating performance by reducing the operating cost to revenue ratio ($\alpha 3 < 0$).

The control variable of TASSET give almost none impact to the dependent variable (COSTE) and the impact is not significant. Even though TFLEET has one percent significant statistic result, the impact to COSTE is almost zero. The last control variable in this study is the percentage of propeller aircraft (PROP). The PROP has statistically significant impact to the COSTE. The R-square of this model without control variable is 0.0751 which means without any control variable, the equation can explain 7.51 percent of the fluctuation of dependent variable (COSTE). The R-square improve become 0.1568 when we add three control variable. So that at the end, the equation of the model can explain about 15.56 percent of the COSTE fluctuation.

5. Conclusion and Recommendations

The result of regression of total operating cost to sales (COSTE) against fleet dispersion index (ADI), average fleet age (AAGE), the existence of financial derivative hedging (HEDGE) and some control variables shows that all variable is significant in one percent and five percent significant level. But only HEDGE variable succeed to prove hypothesis. This study failed to prove that fleet diversity and fuel-efficient fleet can reduce the operating cost to sales ratio. It might be happen if the cost related to provide vary aircraft and newer aircraft are bigger than the fuel cost efficiency

For the airline management, this study give empirical information about the result of operational hedging and financial derivative hedging to the airlines' operating performance. Recommendations that can be given to the airline management are as follows: first, From this study result, the author found that both operational and financial hedging have significant impact company's financial performance so when performing any hedging activities the airline management should more careful in calculating the cost and benefit from hedging. When performing any hedging activity especially an operational hedging, the management should consider not only about the fuel cost

efficiency but also all the expense related with it. And, Management should regularly check the result of company's hedging activities whether give a good or bad effect for company. If it is not, it probably better not to do the hedging.

For future study, some recommendation that can be given are as follows: first, this study found that the bigger the airline, the higher its jet fuel risk. So that for next research it would be interesting to study about the impact of hedging to jet fuel risk and operating performance by divided the sample based on its fleet number (big, medium, small airline). Second, from the result, there is an indication that hedging activity does not only impact the airline fuel cost so that for next study can include other expenses such as: rental expense, Aircraft depreciation expense, maintenance expense, or crew expense as the variable.

Appendix

Appendix A: Sample data summary

No.	Airline Name	operating cost/revenue (%)	Average Aircraft dispersion (%)	Average aircraft age (year)	Average Hedging activities (%)	Average total asset (USD Mn)	Average Fleet (number)	Average turbo-prop (%)
1	Qantas Airways	98	69.68	9	100	13,856	167	26.80
2	Regional Express	97	0.00	22	60	221	54	100.00
3	Virgin Australia	104	58.06	9	20	4,564	124	6.29
4	Gol Linhas Aereas Inteligentes	95	0.00	8	100	3,299	110	0.00
5	Air Canada	92	80.38	15	100	10,587	195	0.00
6	WestJet Airlines	89	7.29	7	0	4,276	106	0.00
7	Latam Airlines	95	60.82	7	100	19,842	269	0.00
8	China Eastern Airlines	96	63.41	5	0	29,190	441	0.00
9	China Southern Airlines	94	67.38	6	0	29,820	772	0.00
10	Hainan Airlines	86	74.79	5	0	21,852	426	0.00
11	Finnair	97	78.65	9	100	2,713	66	18.26
12	Air France-KLM	98	88.95	10	100	28,412	503	1.97
13	Deutsche Lufthansa	95	80.47	11	100	38,496	659	5.33
14	Cathay Pacific Airways	97	71.10	9	100	22,720	169	0.00
15	Icelandair	92	51.23	19	100	1,072	36	22.22
16	Jet Airways India	100	51.23	7	0	2,438	97	14.42
17	SpiceJet	101	48.40	6	40	501	56	41.09
18	Garuda Indonesia	101	72.39	5	100	3,383	158	6.13
19	Ryanair	80	0.00	7	100	13,208	322	0.00
20	El Al Israel Airlines	97	54.90	12	100	1,677	30	0.00
21	ANA	93	80.83	8	100	21,002	260	8.40
22	Japan Airlines	86	82.48	8	100	14,462	202	3.76
23	Aeromexico	95	64.52	8	100	3,058	110	0.00
24	Air New Zealand	90	77.06	9	100	5,087	88	46.03
25	Norwegian Air Shuttle	100	18.51	3	100	3,747	89	0.00
26	Avianca	94	69.93	6	100	6,188	132	7.57
27	Copa	84	30.77	7	100	3,969	90	0.00
28	Cebu Air	87	47.12	5	100	1,848	43	18.53
29	Singapore Airlines	96	79.20	7	100	18,368	151	0.00
30	Asiana Airlines	98	69.09	10	0	7,380	100	0.00
31	Korean Air Lines	94	74.23	9	100	21,345	152	0.00
32	China Airlines	97	77.83	8	100	7,189	79	0.58
33	Eva Airways	96	74.84	5	100	6,154	62	20.69
34	Thai Airways	104	82.31	7	100	8,728	102	6.72
35	Air Arabia	92	0.00	3	100	3,095	38	0.00
36	easyJet	88	48.91	6	100	7,371	238	0.00

No.	Airline Name	operating cost/revenue (%)	Average Aircraft dispersion (%)	Average aircraft age (year)	Average Hedging activities (%)	Average total asset (USD Mn)	Average Fleet (number)	Average turbo-prop (%)
37	Alaska Air	81	62.39	9	100	7,827	233	20.26
38	Allegiant Travel	80	49.87	20	0	1,475	74	0.00
39	Delta Air Lines	87	90.06	17	100	52,789	886	0.00
40	Hawaiian	86	50.28	11	100	2,561	40	0.00
41	JetBlue Airways	86	40.14	8	100	8,587	216	0.00
42	SkyWest	96	75.82	13	0	4,778	564	1.60
43	Southwest Airlines	85	0.00	12	100	21,755	628	0.00
44	Spirit Airlines	81	45.77	6	60	2,520	80	0.00
45	United Continental	91	75.16	14	80	39,347	695	0.00

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