DOES LABOUR COSTS MATTER FOR THE AIRLINE INDUSTRY?

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ABSTRACT

The world has entered a new paradigm in air travel which has enabled anyone to travel to any corner of the globe in a matter of hours. The objective of this paper is to examine the technical efficiency level of US (United States) airlines and how internal factors affect the technical efficiency of these airlines. The paper utilized the Cobb Douglas production function to estimate the efficiency level of the US airline industry. The findings reveal that the average technical efficiency of US airlines over the period from 2005 to 2016 was 54.3% with the technical efficiency score steadily decreasing from 56.9% in 2005 to 46.4% in 2016. Labour costs have a significant impact on airline performance due to the relationship between reductions in labour cost and the increase in productivity levels which inherently affectthe overall technical efficiency of US airlines.

Keywords: Internal Factors, Labor Cost, Technical Efficiency, Stochastic Frontier Analysis, Airline Industry.

INTRODUCTION

The US airline industry has raised investor concerns due to its rapid evolution. IATA (2014) stated that from this moment in history, the whole world has entered a new paradigm with air travel having the ability to deliver anyone to any corner of the globe in a matter of hours. Therefore, numerous previous studies have been carried out to examine the relationship between the issues that affect the technical efficiency of the US airline industry. According to the research we conducted, it was found that airline technical efficiency is affected by both external and internal factors. According to the U.S. Department of Transportation, US airline industries collective net profit in the year 2015 had increased to $25.6 billion, higher than the $7.5 billion in 2014. As such, this study seeks to examine the technical efficiency level of US airlines and how internal factors affect the technical efficiency of these airlines.

LITERATURE REVIEW

The whole world has entered a new paradigm with air travel having the ability to deliver anyone to any corner of the globe in a matter of hours (IATA, 2014). In addition to the contribution to tourism, air transport represents an important industry in enhancing the GDP of countries. Premised on this fact it is astute to study the technical efficiency of US airlines as a foundation that can be applied in the operation of airlines.

Carlos et al. (2013) conducted a study by exploring the use of the B-convex model as a tool for assessing the technical efficiency of US airlines, by combining operational and financial data. Carlos et al. (2013) stated that since the terrorist attacks on September 11, 2001, the US airline industry has been in a financial crisis (Lai & Lu, 2005). The result shows a sharp decline in passenger demand as well as substantial increase in costs. Some airlines have merged whereas others like Eastern, TWA, Pan Am, Republic, Piedmont, Ozark and Texas Air have disappeared from the market. After the September 11th terrorist attacks, one of the major difficulties that the airline industry faced came about from regulatory requirements set by the government such as the requirement to pay enormous costs for security precautions. This led to airline prices increasing drastically (Kahn, 2004). Santosuosso (2014) noted that the "*ROA is progressively less dependent on factors that could affect technical efficiency and increasingly influenced by many other firm and market variables.*"

In addition, Return On Equity (ROE), as one the performance models, is a strategic key performance indicator on demonstrating the level of airline technical efficiency. Moreover, being on time is considered as a service quality of airlines and is a significant loyalty factor, according to Choi et al. (2015), integrating service quality would be critically important for various service industries, while we strengthen service quality, it leads to higher level of customer satisfaction, and therefore airlines perform better. Based on research done by Tsionas et al. (2017), we can conclude that there is a cause-effect relationship between technical efficiency and flight delays, higher technical efficiency levels are correlated with lower delays. Besides, customer are willing to pay a higher amount to avoid schedule delays (Zhang, 2012), which implies that customers regard this as important issue. In fact, this factor has a negative effect on customer complaints; it will affect the airline's reputation. Delays therefore can be considered to be an undesirable output within the ambit of airport operations (Tsionas et. al., 2017).

Airlines reduce their labour cost to achieve competitive advantage over their competitors with employees willing to accept a lower real wage. Meanwhile, airlines encourage employees to comply with cost-control strategies (Chang & Shao, 2011). Airlines might control employee working hours to lower the real wage of employees and avoid overtime pay. Consequently, the profit of airline industries will increase through labour cost reduction. A majority of literature reviews conducted on this aspect of the industry applied exogenous variables such as costs and expenditures as inputs, which then influences the performance and efficiency of airlines, as the endogenous variable. Yayla-Kullu & Tansitpong (2013) studied whether labour expenses and operating expenses can be used as inputs to turn them into good quality services, eventually boosting airline technical efficiencies.

METHODOLOGY

In this study we used the Cobb Douglas production function to estimate the technical efficiency level of the US airline industry as follows, where Y_t is the output at the time of t; K_t is capital input of production at the time of t; Lt is the labor input of production at the time of t. They state that A is assumed to be constant while the μt is the error term with the assumption of the random errorterm.

$$Y_t = AK^{\alpha}_t L^{\beta}_t \mu_t \quad (1)$$

Based on the study done by Coelli et al. (2005), Cobb-Douglas production function can be presented in the form of either a short run or long run production function. From the perspective of an economist, short run is explained as a short time horizon and input such as capital is needed to be fixed. While the long run production function is referred to as a long-time horizon with input that is not necessary to be fixed (Coelli, 1998).

By substituting the chosen variable into Cobb-Douglas production function as follows:

$$ln\text{TE}_{it} = \beta_0 + \beta_1 ln\text{OR}_{it} + \beta_2 ln\text{PA}_{it} + \beta_3 ln\text{AS}_{it} + \beta_4 ln\text{OC}_{it} + \alpha_0 ln\text{K}_{it} + \alpha_1 ln\text{L}_{it} + \mu t \qquad (2)$$

Where,

i=1, 2, 3…7 ; t=1, 2, 3……..12, lnTE=Technical efficiency , lnOR=The operating revenue, lnPA=The number of passengers , lnAS=The available seat-miles , lnOC=The operating cost.

Stochastic Frontier Analysis

The unit's inefficiency can result from allocative inefficiency or technical inefficiency. Technical inefficiency and allocative inefficiency are included under economic inefficiency. In general, there are two methods based on effective frontier. The nonparametric method is the Data Envelopment Analysis (DEA) method whereas the parametric method is the Stochastic Frontier Analysis (SFA).

Stochastic Frontier Analysis (SFA) is a parametric method of economic modeling. It was independently introduced by Aigner et al. (1977) and Meeusen & Van denk Broeck (1977) and this econometric theory is used to estimate pre-specified functional form and inefficiency is modeled as an additional stochastic term. The stochastic frontier method treats the deviation of the production function as both the random error (white noise) and the inefficiency (Mortimer & Peacock, 2002). This enables a distinction between a random symmetrical component which accounts for measurement errors and stochastic effects (e.g. due to weather influences) and a symmetric deviation component which represents the inefficiency. The SFA as a parametric approach requires assuming a specific function form a priori, the frontier is estimated econometrically by some variant of last squares or maximum likelihood (Coelli et al., 2005). SFA is based on an econometric regression model; frontier is smooth, curved and appropriate.

The SFA is a model for generating technical efficiency scores and methodologies that seek sources of inefficiency. SFA determines the lowest cost incurred. In order to achieve the high operational efficiency of domestic airlines, airline managers must strive to reduce operating expenses (input) while increasing operating income (output). This can be achieved by implementing the SFA model for efficiency estimation from the airlines' performances in terms of technical efficiency while analysts' attempt to achieve one of the concepts from SFA by requiring that output is produced at the optimal level by using the least amount of input.

Second Stage Analysis

Besides the above, our study will provide a method that contributes to the estimation which is a two-stage analysis where the first stage is to generate the technical efficiency score by inserting the input and output factors; while the second stage is to form a linear regression by using technical efficiency as the dependent variable, the internal and macroeconomic factors as the independent variables which could explain the relationship between the variables.

For the second stage analysis, panel data (fixed and random effect model) were employed to test the relationship between internal factors and the technical efficiency of US airlines. The model is as follows:

$$lnTE_{it} = \propto + \beta_1 lnOTA_{it} + \beta_2 lnLC_{it} + \beta_3 lnROE_{it} + \beta_4 lnROA_{it} + \mu_{it} + \varepsilon_{it} \quad (3)$$

Where,

i=1, 2, 3…7 ; t=1, 2, 3……..12, lnTE= Technical efficiency, lnOTA=The on time arrival, lnLC=The labour cost, lnROE=The return on equity, lnROA=The return on assets, lnMS=1 if i-the airline is a low cost carrier.

RESULTS AND DISCUSSION

Table 1 show that the average technical efficiency score of US airlines over the period from 2005 to 2016 is 54.3%. Thus, on average technical efficiency causes actual airline services to fall below the maximum potential service by slightly less than 50%. The technical efficiency score steadily decreased from 56.9% in 2005 to 46.4% in 2016. Southwest Airlines is one of the airlines with the most fluctuation in terms of technical efficiency score with the lowest mean for technical efficiency among the selected 7 airlines. The highest technical efficiency score obtained by Southwest Airlines was for the observed year of 2005 which scored at 0.7297, and ranked at fourth. For the second observed year 2007 it ranked fourth for technical efficiency. For the following observed years the score mostly fell below a score of 5 or fifth and sixth ranked for technical efficiency which is considered to be an under efficient airline.

The overall technical efficiency decreased in 2012. This is due to Southwest Airlines and other low-cost carriers having brought in negative pressure on setting the airfares in 2012. In addition, according to Field (2016), the legacy carrier faced falling demand from 2009 to 2010 due to the presence of low cost carriers which suppressed airfare prices through an airfare reduction of 24%. This compares to a drop of 3.4% when a second legacy carrier enters the market (Field, 2016). He also indicated that this effect also affected Southwest Airlines within its own market as its own airfare had dropped by an average of 10%. Southwest Airlines' technical efficiency score was at the lowest level indicating inefficiency during this period.

Technical efficiency refers to how productive a business can be given the least amount of inputs or resources which is required to produce the product or to offer the service. It can also be defined as the effectiveness of input to produce the output of a business. Among the airlines, only Frontier Airlines, JetBlue Airlines and US Airways were determined to be at a high level of technical efficiency with the other airlines at low technical efficiency especially Southwest Airline. All the airlines had reduced efficiency scores for the years 2015 and 2016. It means that the input or resources to produce output, which is the flight services, were not at optimal levels.

To conclude the above discussion, after conducting the SFA to determine the technical efficiency score, the results showed that, after the merger and consolidation of passengers, available seat miles and operating costs, the operating revenue has low efficiency across the subsequent years. However, in some years for the respective airlines (Frontier Airlines and JetBlue Airlines), the technical efficiency of airline performance had reached an optimum score of 1.000 due to the adequacy of the inputs. The other airlines should improve the inadequacy in optimizing of these inputs to enhance the level of technical efficiency.

Table 1
THE TECHNICAL EFFICIENCY SCORE OF EACH AIRLINES FROM 2005 TO 2016

	American	Delta	United	US	Southwest	Jetblue	Frontier	Average Yearly
2005	0.302	1.36E-08	0.575	0.913	0.219	0.985	0.986	0.569
2006	0.311	1.32E-08	0.542	0.957	0.174	0.982	1	0.567
2007	0.311	7.18E-09	0.558	0.913	0.15	0.98	0.987	0.557
2008	0.36	1.62E-08	0.646	0.706	0.15	0.98	0.987	0.547
2009	0.417	4.25E-08	0.769	0.791	0.15	0.98	0.987	0.585
2010	0.429	3.09E-08	0.812	0.769	0.13	0.979	0.987	0.587
2011	0.429	2.37E-08	0.887	0.748	0.115	0.978	0.987	0.592
2012	0.429	2.11E-08	0.405	0.726	0.109	0.975	0.987	0.519
2013	0.429	1.94E-08	0.429	0.686	0.1	0.973	0.986	0.515
2014	0.417	1.18E-08	0.442	0.666	0.072	0.971	0.986	0.508
2015	0.189	4.37E-09	0.382	0.975	0.045	0.967	0.985	0.506
2016	0.097	2.24E-09	0.34	0.833	0.038	0.956	0.985	0.464
Average	0.343	1.71825E-08	0.565	0.806	0.121	0.975	0.987	0.543
Rank	5	7	4	3	6	2	1	

Figure 1 shows the technical efficiency score, Frontier airline is on average the most efficient airline, with an average technical efficiency equal to 98.75%. JetBlue airline follows with 97.55% and US airline with 80.69%, while Delta airline with less than 10% is the least efficient.

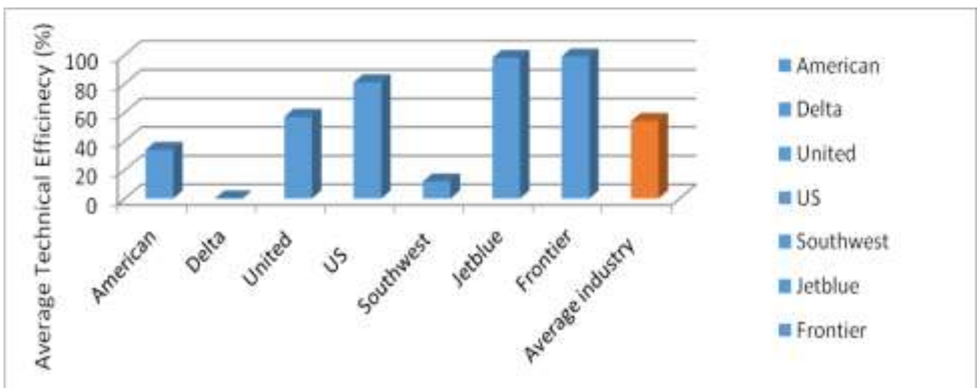

FIGURE 1
AVERAGE TECHNICAL EFFICIENCY BY AIRLINE (%)

Next, Figure 2 suggests that the time period 2005 to 2016 could be separated in two sub periods. First, in the 2005 to 2011 time span, in which there is a steadily increase in technical efficiency from an average 56.9% (2005) to 59.2% (2011), corresponding to an 0.38% average annual increase, and the 2011 to 2016 time span, in which there is a decrease in the technical efficiency from 59.2% (2011) to 46.4% (2016), corresponding to an 2.56% average annual decrease. In the time span 2009 to 2011 we observe the highest values in terms of technical efficiency.

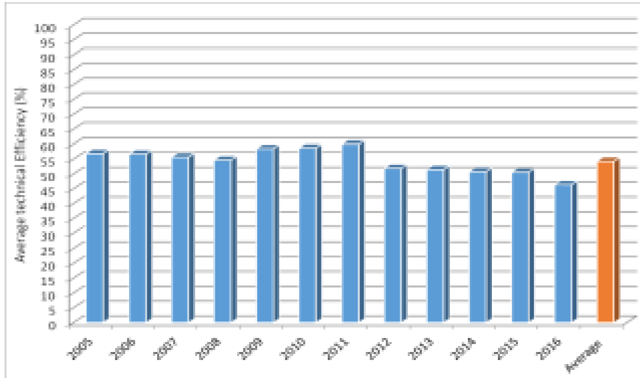

FIGURE 2
AVERAGE ANNUAL TECHNICAL EFFICIENCY (%)

This study also includes the Hausman test to determine which regression model is the most appropriate for the purpose of this study. Based on unit root test analysis, all variables are stationary in level and first difference. We ran the random effect model and fixed effect model to determine which regression model is the best model to explain technical efficiency (Table 2). To determine which regression model is preferred we used the Hausman test. For the internal model, the result of Hausman test indicates that the random effect model is preferred. Thus, we chose the random effect model because 3 of the 4 variables were significant such as labour cost, return on assets, and return on equity.

However, ROA shows a weak significance when explaining the technical efficiency at a 10% significant value. For the other two variables, labour cost and return on equity show strong significance in explaining the model at a 1% of significant value. A majority of literature reviews apply exogenous variables such as costs and expenditures as inputs when measuring performance and technical efficiency of airlines as the endogenous variable. Most airlines like the low cost carriers conduct cost cutting on labour as well as airline operations tend to be more efficient compared to others who do not do the same. It has been proven that by cutting labour costs airlines achieve more efficient performance. ROA as a measure that provides superior annual stability as compared with industry studies. Other measures and identified ROA is particularly valuable in multiple.

Table 2
FIXED EFFECT MODEL AND RANDOM EFFECT MODEL

Variable	Fixed Effect Model	Random Effect Model
LC	-4.42E-06*** (9.58E-07)	-4.80E-06*** (9.53E-07)
OT	4.96E-03* (2.82E-03)	4.20E-03 (2.81E-03)
ROA	1.92E-03** (9.59E-04)	1.82E-03* (9.57E-04)
ROE	-5.66E-03*** (1.85E-03)	-4.99E-03*** (1.84E-03)
C	0.466** (0.204)	0.546** (0.211)
R^2	0.961	0.210
Adjusted R^2	0.956	0.170
F-statistic	181.536	5.262

D-W test statistic	1.2741	0.826
Hausman Test (P-value)	-	1.0000

Notes: *, ** and *** implies that the rejection of the null hypothesis of non-stationary at 10%, 5% and 1% significance level respectively.

CONCLUSION

In a nutshell, internal factors consist of on-time arrival, labour cost, Return on Equity (ROE) and Return on Assets (ROA). After conducting the Hausman test, we can conclude that both the on-time arrival and ROA have a positive relationship with the technical efficiency of the airline. On the other hand, labour cost and ROE is inclined to show opposing directional movement to technical efficiency.

The significance of these internal factors on our measurement of technical efficiency, by order from least to high significance starts from on-time arrival, followed by ROA, labour cost and ROE where both labour cost and ROE have an identical level of significance. The null hypothesis of the Hausman test has been rejected implying that FEM is preferable in explaining the result based on those internal factors. By considering the importance of the technical efficiency level of airlines in the country, policy makers and the government need to play a very important role in developing strategies and policies to stimulate the technical efficiency levels in the airline industry.

As for the internal aspect, governments should take necessary actions to improve the performance of airlines based on the significant criteria that we identified in our study. Firstly, governments should regulate airline schedules within the nation. The government should regulate both routes, from the hub to the destination and back again. This policy will isolate weather issues in certain geographical areas. For instance, by implementing this policy, the weather in Chicago will not affect the rest of routes. Thus, on-time arrival will be improved. On the other hand, the government should regulate the overbooking problem and protect the rights of passengers. Legislators can also write a law to govern airlines where a person who has purchased the ticket cannot be forced off due to overbooking. With this regulation, passengers are legally protected, thereby ensuring that airline services will be consumed. Subsequently, the ROE and ROA of airlines will increase; eventually enhancing airlines' technical efficiency.

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