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The Market Share, Cost and Profit Relationship in the Airline Industry

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ABSTRACT

This paper examines the relationship between airline profits, costs, and market shares in the context of two different economic viewpoints: the structure performance and the efficient structure hypotheses. Both views hold that market concentration and profits are positively correlated. They differ, however, in their explanation of the process by which this is achieved. This paper tests the competing hypotheses using a simultaneous equations model. The results lend some support to the structure performance hypothesis.

INTRODUCTION

The economic literature has well chronicled the controversy between two competing economic viewpoints. The two are the "structure performance" hypothesis and the "efficient structure" hypothesis (see bibliography especially Demsetz [2] and Smirlock, et. al. [9]). Both competing hypotheses support the view that market concentration and firm profits are positively correlated. That is, higher firm sales concentrations result in higher firm profits. The former hypothesis is based on the proposition that market concentration fosters collusion by firms with the result that monopoly rents are achieved by firms in the industry. The dominant firms are thus not the most efficient. The latter view argues the contrary. Concentration emerges from competition and is the result of the more efficient firms being dominant.

Both viewpoints have much to contribute to the debate surrounding the role of anti-trust legislation and deregulation. The former would argue for a greater need of anti-trust policies and regulation, and the latter, exactly the opposite. Anti-trust laws and excess regulation could actually harm the consumer.

Nowhere is this debate more relevant than in air transportation. With just over a decade of deregulatory experience completed, the debate over the success of the experiment still simmers. The purpose of this paper is to apply the theories advanced by such economists as Demsetz [2], Peltzman [7], and Smirlock [9] to the airline sector of the economy. A finding in support of either hypothesis is significant in light of the continued controversy.

Section II of the paper presents the empirical model used to test the competing hypotheses. Section III outlines the data and methodology employed. The empirical results are presented and analyzed in Section IV. Section V summarizes the conclusions found.

EMPIRICAL MODELS

This section outlines the empirical model to be tested. The thrust of the paper is to determine the interaction between air carrier profits, costs, and market shares. These variables are the endogenous variables of the system. The relationship between these variables, however, is rather complex. Obviously, a carrier's profits are related to its costs, as well as to its market share. Conversely, the market share of a carrier is a function of profits as well as costs. Lower costs, for example, will result in higher profits, and a higher market share since not only will the firm seek to expand (a shift of the supply fountain), but there will likely be a surge in demand as well. Air carriers will attempt to lure more travelers by passing on all or some of the cost savings in the form of reduced airfares (causing a move downward on the demand curve). On the other hand, carriers' costs are affected in turn by market share. A larger carrier naturally could take advantage of cost saving methods of operation, as well as being better able to utilize its capacity. Thus, the larger the market share, the greater the cost savings to be expected.

The above relationship indicates a simultaneous interaction among the variables. One variable contributes to the level of another, as well as being affected by it. This relationship can be more comprehensibly expressed in terms of a set of simultaneous equations.

The following expresses the above relationship mathematically.

$$OP = a + b\,MKS + c\,CRM + e\,t + U \quad (1)$$

$$MKS = a_1 + b_1\,OP + c_1\,DP + e_1\,CRM + V \quad (2)$$

$$CRM = a_2 + b_2\,MKS + c_2\,LF + W \quad (3)$$

where,

OP = Operating profit in thousands of dollars
MKS = Market share of a firm in percentages
CRM = Cost per revenue mile
DP = The number of departures
LF = The load factor in percentages
t = The time trend variable

U, V, and W are independently distributed random residuals that satisfy the classical assumptions, (i.e., are normally and independently distributed with a constant variance and zero expected value).

The model is fully identified because each equation satisfies the order condition. Thus, the model can be estimated using either of two techniques; i.e., the Two Stage Least Squares (2SLS), or the Instrumental Variables Estimation Technique (IVT). The sign of the coefficient of the MKS variable in equation (1) is hypothesized to be positive indicating that the higher market share of a carrier, the higher its profits. The sign of the CRM variable is expected to be negative indicating an inverse relationship betweens cost per revenue passenger mile and the profit level. In equation (2), the coefficient of the profit variable could be positive or negative. The number of flights is expected to be positively correlated with market share. The coefficient of CRM is expected to be negative since higher costs per revenue passenger mile should inversely impact market share. In the third equation, the sign of the coefficient of the MKS cannot be unambiguously determined, but the load factor should be negatively correlated to CRM, since it represents capacity utilization.

The trend variable is entered into equation (1) in order to capture the effect of promotional activities, such as the advertising and mileage incentive programs etc., that the airlines have introduced over time. An examination of the data set reveals a definite trend for the airlines under study. The nature of the variables that cause this trend are not theoretically clear. The statistical results can be spurious because of a specification error stemming from missing variables. The trend variable can potentially remedy some of these problems. This variable can also capture the impact of qualitative factors such as brand loyalty (or lack thereof), and negative factors such as poor service and aircraft types flown. Its sign could be positive or negative depending on the relative importance of these variables.

Before estimating the model, however, several tests were necessary. First, a cluster analysis was performed in order to detect the possible presence of significant differences in the size of air carrier profits. At least three size catagories emerged based on this analysis. Carriers were catagorized as either small, medium, or large.

Second, a subsequent test was then employed to statistically validate the hypothesis that the carriers' mean operating profits were statistically different from zero.

HO: $MOP_i = 0$ $\quad i = 1,2,3$
Ha: $MOP_i \neq 0$

MOP is defined as the mean (for the period under study) of the operating profits of each airline divided by its passenger revenue miles.

Third, an ANOVA was performed to test the hypothesis that the means of these three groups were statistically different from each other.

HO: $MOP_i = MOP_j$ $\quad$ i and j = 1,2,3 $\quad$ (1)
Ha: $MOP_i \neq MOP_j$

Finally, a second ANOVA was conducted on the raw data to test the hypothesis that individual carriers' mean profits were statistically different. The null and alternative hypotheses are similar to those above (with (i) and (j) values of 1 through 12).

The data used in the design of the model consist of the quarterly observations of the variables for twelve major carriers for the period of the first quarter of 1978 through the third quarter of 1986. This pooled time-series cross-sectional data set provides four hundred and twenty observations, a sufficiently large data set. Only the domestic operations of the major carriers are considered for this study. The carriers included are:

American
Continental
Delta
Eastern
Northwest
Pan American
Piedmont
Republic
Transworld
United
USair
Western

Data are from various issues of Air Carrier Financial Statistics and Air Carrier Traffic Statistics (formerly published by the Civil Aeronautics Board and now available through the ASI).

METHODOLOGY

Simultaneous equations systems are frequently utilized in financial and economic research. The application of the ordinary least squares estimation technique (OLS) will generally result in biased and inconsistent estimation results. The reason is that in simultaneous equation models, the endogenous variables in one equation act as the explanatory variables in the other equations. The error term is thus correlated with the explanatory variables and the OLS estimates are biased and inconsistent (8, 132). While a full explanation of the various techniques useful in estimating simultaneous equation models is beyond the scope of this paper, two of these techniques are briefly outlined (5 & 6).

The first method is the Instrumental Variables Technique (IVT). IVT uses a set of appropriate exogenous variables that are correlated with already existing explanatory variables but are uncorrelated with the error term. The exogenous variables of the system of simultaneous equations system usually provide the most appropriate set of instruments (5, 341).

The second method is the Two Stage Least Squares Estimation Technique (2SLS). This approach calls for applying OLS once to estimate the endogenous variables of the model. In the second stage, the predicted endogenous variables are used to estimate each equation (see Johnston 5).

In the models proposed in section II, the load factor, the number of departures, and the trend variable (t), are eligible exogenous variables useful in both the IVT and 2SLS techniques. Market share, cost per revenue mile, and profit per quarter are all endogenous variables. The results of both techniques are expected to be identical. The built-in command of the TSP (Time Series Processor) was used to perform the IVT. To perform 2SLS, the OLS was run twice with an adjustment for the standard errors of the final estimated coefficients.

EMPIRICAL RESULTS

This section reports the results of the tests just described. The results of ANOVA tests are presented in Table 1. In the top portion of the table,

TABLE 1

The Results of Analysis of Variance

ANOVA by Clusters Source of variation Explained by	Sum of Squares	DF	F
Cluster	0.001	2	
Residual	0.122	428	2.32
Total	0.123	430	
ANOVA for Individual Firms			
Explained by firm	0.06	11	
Residual	0.063	419	35.99
Total	0.123	430	

the airlines are clustered, using cluster analysis, into three size groups according to available seat miles. The normalized mean operating profits are then used to test hypothesis (1) above. The value of the F ratio is 2.32, and is not statistically significant. Therefore, one cannot reject the hypothesis of the equality of the normalized average operating profits in favor of the alternative hypothesis in (1).

The bottom portion of Table 1 shows the ANOVA results on the standardized mean returns for the airlines under study. The F value for the hypothesis (1) is 35.99. It exceeds the critical value of the F ratio. The null hypothesis is thus rejected in favor of the alternative hypothesis. The latter indicates that the mean standardized profits of the individual airlines do differ significantly from each other. The simultaneous model, equations (1) through (3), is constructed to explain this difference. The Time Series Processor (TSP) is used to estimate the model. Since the results of 2SLS and the IVT were virtually identical, only the results of the IVT are reported here. Tables 2, 3, and 4 present the estimated equations.

As evident from Table 2, the coefficient of the variable MKS (market share) is positive, thus indicating that the higher the carrier's market share, the higher its profits. This result is consistent with both the structure-performance hypothesis and the efficient structure hypothesis. According to the structure- performance hypothesis, the higher profits are a result of monopoly or oligopoly power and not greater efficiency (as suggested by the efficient structure hypothesis). To clarify this issue, one can examine the relation between CRM and the MKS. Note from Table 4 that market share and costs per revenue passenger mile are positively correlated. This indicates that firms with higher market shares are not necessarily the most efficient firms, at least not in this sample.

Equation (2) also verifies that market share in turn increases as profits increase and is not statistically correlated to the number of departures, a proxy for the number of flights. This finding is interesting since one would expect that market share would be significantly correlated with the number of flights. Furthermore, one would expect that market shares would decline for those carriers with higher costs per revenue passenger mile. Equation (2) does not corroborate this hypothesis. The coefficient of the CRM variable i (Table 3) is positive, although statistically insignificant. Thus, cost per revenue passenger mile does not inversely affect the market share of a carrier. Equation (3) in Table 4 indicates that the cost per passenger mile is significantly and inversely correlated with the load factor,a measure of capacity utilization.

The results presented in Tables 2 through 4 suggest several findings. First, as expected, in this sample load factors are inversely correlated with the cost of operations. Second, larger market shares do not necessarily equate with lower cost of operation. Third, the larger the market share, the

TABLE 2

The Instrumental Variables Estimation of Equations (1)

Dependent Variable	Independent Variables	Estimated Coefficient
OP	MKS	33412
		(8.47)**
	CRM	−239789.6
		(−2.16)*
	t	−0.704888
		(−0.643)

$R^2 = 0.10$

Note: t-values are in parentheses.

*Significant at 5 percent level.

**Significant at 1 percent level.

TABLE 3

The Instrumental Variables Technique Estimates of Equation (2)

Dependent Variables	Independent Variables	Coefficient Estimates
MKS	OP	0.000038 (2.29)*
	DP	0.0000041 (−0.51)
	CRM	9.97 (1.39)

Note: Due to the computational techniques, the R-squared in this case is negative and thus not reported.
t-values are in parentheses.
*significant at 5 percent

TABLE 4

The Instrumental Variables Technique Estimates of Equation (3)

Dependent Variable	Independent Variables	Coefficient Estimates
CRM		
	MKS	0.0067 (2.28)*
	LF	−0.32 (−14.3)**

$R^2 = 0.32$
*significant at 5 percent.
**significant at 1 percent.

higher the profit level. The second and third conclusions suggest that the larger carriers manage to generate higher profits in spite of higher costs per revenue passenger mile. This can only occur if these firms are capable of passing these higher costs on to consumers. The latter finding lends support to the advocates of the structure-performance hypothesis.

SUMMARY AND CONCLUSIONS

This paper has examined the relationship between air carrier market shares, profits, and costs within the context of two diametrically opposed economic viewpoints, the structure performance and the efficient structure hypotheses. A three equation simultaneous model was constructed to test the validity of these hypotheses. The data base consisted of a pooled time series and cross-sectional set of financial and operating statistics for twelve carriers for years, 1978-1986. The Instrumental Variables Estimation Technique (IVT) was employed to estimate the model.

The study found some support for the structure performance hypothesis. While carrier profits do increase with increasing market share (as suggested by both theories), the larger airlines do not tend to be the most efficient. In this study, the dominant tended to have higher operating costs per revenue mile. This may indicate that these firms are experiencing diseconomies of scale and that the oligopoly power they seem to posses may allow them to pass on their higher costs in the form of higher prices in the long run.

If the structure performance hypothesis does truly describe the evolving situation in air transportation, an important public policy ramification flows from the acceptance of this viewpoint. The advocates of the structure performance hypothesis would call for the use of either anti-trust legislation and/or regulation to control possible abuses [9]. Many within the industry and in the public sector have echoed these solutions. The authors, however, feel that a return to regulation is not the answer. Perhaps a better solution is to enforce existing anti-trust laws, especially as they might apply to airline mergers, in order to forestall the problems that appear to be developing in this industry.

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ENDNOTES

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