I. Introduction

Since the deregulation of the late seventies, the U.S. Airline industry has been under close scrutiny by economists. Most of the attention has focused on pricing strategies and cost efficiency of airlines in a deregulated environment. Much has been learned over the past decade on what determines prices. Sources of market power have been unveiled such as airport dominance (see Borentsein 1989) or multimarket contact (Evans and Kessides 1994). Cost efficiency appears to have improved significantly after deregulation (Cave et al. 1987).

One of the main argument for deregulating the industry was the inefficiency that regulation may lead to. Firms not being able to compete in price were competing in terms of service quality, mostly through aircraft size and flight frequency (see Keeler 1972). Since deregulation, airlines can compete using prices, yet capacity competition still remains a major aspect of firms' strategy. The financial stress of the early nineties has been attributed by industry analysts to excess capacity resulting from overexpansion by airlines trying to acquire a dominant position in the mid-eighties.[1] In this paper, we use a measure of rivalry that captures both price and non-price competition. We measure rivalry on a route by the level of market share instability. The idea is that intense competition among oligopolists translates into market share variability. This measure of rivalry has been used before (see Cave and Porter, 1978) but it is only recently that Staiger and Wolack (1992) have provided a formal theoretical foundation for using that measure.

The objective of this paper is two-fold. First, we want to test the relationship between Market Share Instability (MSI) and variables that have been shown to affect pricing like airport dominance, multimarket contact or bankruptcy status. We test that relation on a panel of 400 routes over the period 1987-1993. Our results confirm most of the results found in pricing studies. The second objective is to exploit the time-series aspect of the data to examine how rivalry has changed over time. The results indicate that market share instability was significantly lower in the early nineties when demand was weak. The exact reasons for this decline and the links to demand conditions and capacity competition remain open for investigation.

II. The Empirical Model and Data

The Data

The main source of the data is the Origin and Destination Survey data bank 1-A of the U.S. Department of Transportation. This is a 10% random sample of all tickets used on U.S. airlines. We use the data for the second quarter for the years 1987 to 1993. We restrict our sample to the 400 largest domestic routes: a route is defined as a city pair.[2] A complete description of the data is found in Appendix.

The Empirical Model

It has long been argued that instability in market shares may be the symptom of difficulties encountered by oligopolists in maintaining collusion. Staiger and Wolack (1992) describe this viewpoint using a formal game theory model. They show that markets where collusion is difficult are more likely to experience Market Share Instability (MSI).[3] Yet MSI may also result from external shocks (like demand shifts) that require moving from one equilibrium to another (with the intensity of competition constant).

We estimate a reduced form equation with MSI as the endogenous variable. The explanatory variables we use in the model can arguably affect MSI through either a change in conduct or as a source of short-term disequilibrium. The issue must be taken into account when interpreting the results. We estimate the following equation at the route-time level:

$$\begin{aligned} L[MSI] = {} & \alpha_0 + \alpha_t + \alpha_1 \text{ ENTRY} + \alpha_2 \text{ EXIT} + \alpha_3 \text{ MERGER} \\ & + \alpha_4 \text{ EASTERN} + \alpha_5 \text{ BANK} + \alpha_6 L[\text{HERF}] + \alpha_7 L[\text{HERF}]^2 \\ & + \alpha_8 L[\text{ORIG\_MS}] + \alpha_9 L[\text{ORIG\_H}] + \alpha_{10} L[\text{MMC}] \\ & + \alpha_{11} L[\text{VAR\_COST}] + \alpha_{12} L[\text{GROWTH}] + \alpha_{13} L[\text{DECLIN}] + \zeta \end{aligned}$$

with: L[.] for Log[.]

To measure MSI, we first take for all airlines on a route, the change in the market share from one period (t) to the previous (t-1). This change is squared (to give more weight to larger changes) and normalized by the average market share of the firm over t-1 and t. MSI is the sum of these changes for all airlines flying on the route (at t-1 or t). Formally, we have:[4]

$$MSI_{rt} = \sum_{i \in \text{route } r} \left[\frac{(MSR_{irt} - MSR_{irt-1})^2}{\left(\frac{MSR_{irt} + MSR_{irt-1}}{2} \right)} \right]$$

(i airline, r route and t time)

α_t: a time fixed effect. It captures the effect of all the unobservable variables at the time level (for example, the effect of demand or supply shocks that affect the whole industry).

ENTRY: is a discreet variable equal to the number of firms that enter the market between t-1 and t. ENTRY should increase MSI, as entry by a new firm will have an impact on the market share of other firms (the sum of the market shares being fixed at one). But ENTRY may also upset coordination effort to reduce competition between incumbents. We expect α_1 to be positive.

EXIT: is a discreet variable equal to the number of firms that exit the route between t-1 and t. This variable is also expected to increase MSI for the same reasons as ENTRY.

MERGER: is a discreet variable equal to 1 if two airlines on a route merge between t-1 and t (it takes the value 2 if there are two such mergers). The merger affects MSI as market shares are redefined. It may also change conduct.

Note that the total effect for these three variables should also include the effect on MSI of the change in concentration (HERF - see below) associated with entry, exit or merger.

EASTERN: is a dummy variable equal to 1 if the route includes Eastern Airline and the year is 1989 or 1990. In 1989, Eastern experienced a strike that almost led to its complete shutdown. This created major market share variability that is controlled by this variable.

BANK: is the average number (between t-1 and t) of airlines on the route that operate under protection of Chapter 11 bankruptcy law. There have been concerns in the industry that airlines operating under the protection of Chapter 11 may disturb the competitive process. Some evidence (see Barla and Koo 1995) suggests that the costs and prices of the bankrupt firm decline after bankruptcy and that rivals lower their prices even more than the bankrupt firm (even though they do not enjoy any cost savings) suggesting aggressive pricing. If bankruptcy does increase rivalry on a route, we expect BANK to have a positive and significant coefficient.

HERF: is the average value over t-1 and t of the route Herfindahl concentration index (i.e., the sum of the squared market shares for all airlines flying on the route). We also introduce the square of HERF. The idea is that for low levels of concentration any coordination effort may be impossible. As concentration increases collusion may become possible yet it is instable. As concentration increases further, collusion becomes easier and more stable. If this pattern is true, we expect MSI to increase first with HERF then decline for larger values. To make sure that the relationship between MSI and HERF is not purely technical (both variables are computed with the same market shares), we also test the model with the number of firms on the route as an additional variable.

ORIG_MS: is the average airport market share of the dominant airline. That is, we compute the market shares for all airlines on the route at the endpoint airports (the market shares are computed on the total airport traffic). We take the average value over the two endpoint airports then take the maximum value for the companies on the routes. ORIG_MS is the average value of that variable over t-1 and t. This variable should capture the effect of airport dominance by one airline on route competition.

ORIG_H: is the average value over t-1 and t of the average Herfindahl at both endpoint airports. It is a measure of concentration at the endpoint airports.

We may expect higher ORIG_MS to lower MSI as the existence of a dominant airline may bring stability. Yet as we control at the same time for ORIG_H, an increase in ORIG_MS means that the dominant airline faces smaller and more numerous (and potentially more aggressive) competitors.[5] The effect of ORIG_MS on MSI could then be either positive or negative. We expect higher concentration at the endpoint airports to facilitate collusion and thus reduce MSI (α_9 negative).

MMC: captures significant multimarket contact between the two leaders (i.e., the two airlines with the largest market share on the route). It is measured as the number of routes where these two firms compete against each other and both have the two largest market shares. This measure of network interconnection is computed on a set of routes that include the 1285 largest markets. Extensive MMC may favor tacit collusion between firms and thus reduce rivalry.[6]

VAR_COST: cost differences among competitors may make any coordination effort between firms more difficult. Unfortunately, we do not dispose of any cost data at the route level. The only data publicly available provide cost information for the whole network of an airline. We compute for each firm and every period the operating cost-per-passenger-mile. The variance of that variable among firms on a route serves as a measure of cost heterogeneity. VAR_COST is the average value of the cost variance between t-1 and t. We expect this variable to increase MSI.

Finally, a change in traffic may create instability in the market shares. A variation in traffic may create a short-term disequilibrium (moving from one equilibrium to another). But it may also affect rivalry (see Staiger and Wolack for the effect of unexpected demand shifts on conduct). We test whether an increase in traffic has a different impact than a decline. We would expect that a decline in traffic creates more instability than an increase. We introduce the two variables:

GROWTH: is the percentage growth in traffic on the route from t-1 to t. It is zero if traffic does not grow.

DECLIN: is the percentage decline in traffic on the route from t-1 to t. It is zero if traffic does not decline.

ζ: an error term.

III. The Results

The results are reproduced in Table 1. The variables ENTRY, EXIT, MERGER and EASTERN have the expected positive effect on MSI. The interpretation of these results is difficult as we cannot separate out the mechanical impact of these events from the competitive effect that they may have. BANK increases MSI. This tents to support Barla and Koo (1995) results on the impact of bankruptcy on pricing. Markets where a firm operates under Chapter 11 Protection appear to be more competitive.

Market concentration (HERF) has a non-linear effect on MSI. As concentration increases MSI increases for low values of HERF (that is for HERF lower then 0.27). As HERF continues to increase MSI decreases.[7] This is consistent with the predicted effect of market concentration on the ability to maintain collusion. As ORIG_MS increases, instability increases. A larger market share at the endpoint airports by the dominant airline implies that it has to compete against smaller and more numerous competitors. This appears to make coordination more difficult. Higher concentration at the airports (ORIG_H) lowers MSI. Extensive multimarket contact (MMC) between the leading firms brings market share stability. This result confirms the effect of MMC on prices (higher average prices are observed on routes where the leading airlines have extensive contacts in the rest of their network, see Evans and Kessides 1994, Barla 1994). Cost heterogeneity among airlines on a given route increases instability (VAR_COST).

A change in traffic increases MSI. This increase in instability may be the sign of a short-term disequilibrium resulting for example from a demand shift. However, it may also be that a change in traffic affects rivalry. Here the difference between the effect of a decline in traffic (DECLIN) and an increase (GROWTH) is instructive. A decline in traffic results in significantly more instability than an increase.

Finally, the time fixed effect indicates that MSI was much lower in the early nineties than in the late eighties. This is quite surprising since the early nineties were characterized by weak demand (recession) and some major external shocks (like the Gulf war). One possible explanation is that this generalized level of low demand has reduced the intensity of capacity competition that may have prevailed in the late eighties. The major "price war" of summer 92 (initiated by American Airline) may have just been an adjustment of prices to demand rather than a shift in conduct (no generalized market share instability is observed around that time).

This trend and its interpretation should be contrasted with the effect of the variable DECLIN that increases MSI.[8] DECLIN may be capturing the effect of unexpected demand changes with capacity being fixed while the time trend captures the long term effect (i.e., with capacity being adjustable) of demand variations.[9] For example, an unexpected demand shift leading to a decline in traffic after capacity has been decided means that the airlines face high fixed costs (capacity cost) but a low marginal cost (cost of an extra passenger). This cost structure may favor the breakdown of any coordination effort. On the other hand, generalized low level of demand would decrease the intensity of capacity competition and thus lower MSI. These results and interpretation remain to be confirmed with complete data (for all quarters) and a structural model of price and capacity competition.

V. Conclusions

The results we presented here using a measure of rivalry that captures both price and non-price competition confirm those obtained in pricing studies. Further, we show that market share instability has significantly decreased over time. The next step consists in explaining the source of that decline. Here the role of expected and unexpected demand shifts on price and capacity competition should be analyzed further. This constitutes the next item in our research agenda.

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