Has The "Golden Rule" Lost Its Aura? Revisiting Multimarket Contact in the U.S. Domestic Airline Industry

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Abstract

A seminal work in the mid-nineties finds that airlines charge higher fares in markets where they engage in extensive multimarket contact, thus empirically attesting to industry expert claims that airlines live by the "golden rule" (i.e., avoid undercutting in jointly contested routes). Our research revisits this hypothesis by including two hitherto ignored airlines Southwest Airlines and JetBlue Airways who are practitioners of the everyday low price (EDLP) strategy. We find that this golden rule is violated when airlines engage in multimarket contact with these two airlines, and identify firm-specific differences in the overall pricing strategy as the source of this anomaly.

Keywords: Multimarket competition, airline industry, Southwest Airlines

1. Introduction

Research in industrial organization and economics over the last decade has brought to light the fact that most firms do not simply create one product or participate in a single market; instead, they invariably compete in multiple markets, often with the same set of firms. Confronting the same rivals in multiple markets implies that when a firm sets prices in the local market, it may need to take into consideration the response or even potential retaliation by its competitors in other jointly contested markets. There is rich empirical evidence attesting to the fact that when a firm engages in multimarket competition, it can "*potentially strengthen oligopolistic coordination within specific markets*" (Evans and Kessides, 1994; p. 342). The embedded mechanism in such competition has alternatively been referred to as mutual forbearance, where firms refrain from aggressively undercutting their competitors in local markets for fear of punitive responses in other markets. This leads to a form of tacit collusion and results in higher prices when firms engage in multimarket contact.

Similarly, when firms offer a range of products, they rarely price each individual product fully independent of the others in their offering. The literature in marketing suggests that firms often employ specific price images to govern the pricing of their entire portfolio of products, e.g., 99-cent price endings (Anderson and Simester 2003). Another important manner in which multiproduct firms convey price images is by following a price format for their portfolio of products. The two well-known formats are the "everyday low price" (EDLP) and promotional pricing (PROMO or HI-LO) (Hoch et al. 1994; Bell and Lattin 1998; Shankar and Bolton 2004). Of particular interest in a multimarket contact environment is the EDLP strategy, which emphasizes price consistency and relatively low prices. A firm's pursuit of this strategy might be at odds with the dictates of multimarket competition findings, i.e., the need to raise/vary prices in acknowledgement of mutual forbearance.

There has been extensive documentation in the economics and management literatures about multimarket effects in various industries, such as the airline (Evans and Kessides 1994; Baum and Korn 1996; Gimeno and Woo 1996; Singal 1996; Baum and Korn 1999; Gimeno and Woo 1999), banking (Whitehead 1978; Alexander 1985; Rhoades and Heggestad 1985; Strickland 1985; Mester 1987) and cellular telephone (Parker and Röller 1997; Busse 2000). However, these studies remain silent about the impact of a multiproduct firm's overall pricing strategy. Of particular interest to this work is the study by Evans and Kessides (1994) (henceforth referred to as EK94) on the nature of multimarket contact in the airline industry, where they observe major airlines following the "golden rule" of not undercutting each other. We revisit EK94 on account of two changes: First, their study does not include airlines such as Southwest Airlines and JetBlue Airways, which account for nearly 20 percent of the U.S. domestic market today – in fact, Southwest is the second largest airline today in terms of domestic market share. More importantly, these airlines actively pursue the everyday low price strategy distinct from the major airlines studied in the extant research. Second, numerous technological innovations have changed the face of the travel industry since the mid-nineties, not the least of which is the purchase of tickets online. We include online tickets in addition to the Department of Transportation's Origin and Destination Survey Data Bank (DB1B) that is standard in economics literature. Besides serving as a robustness check for analysis using DB1B data, the online dataset contains time attributes of the requested tickets that allow us to control for the effects of two common devices that airlines use for consumer segmentation, namely advance purchase and Saturday stay-over requirements.

1.1. Everyday low price, golden rule and airline pricing

The definition of a product market has varied from sector in sector in the different studies on multimarket competition – non-overlapping geographical markets as in the case of banking and cellular phone service (e.g., Parker and Röller 1997), origin-destination city pair as in airlines (e.g., Evans and Kessides 1994) and distinct functional areas such as in business software (Chellappa et al. 2010). The consensus amongst much of the empirical work that examines this type competition is that prices in a market are positively correlated with the extent to which firms compete in multiple markets. These studies suggest that inter-market contacts create interdependence among firms and lead to mutual forbearance which, in turn, results in a collusive outcome exemplified by higher prices in the market.

While the precise manner in which multimarket contact creates opportunities for tacit cooperation remains somewhat ambiguous in most empirical settings, the theoretical work by Bernheim and Whinston (1990) provides distinct insights into the multimarket conditions that may sustain tacit collusion. Their game-theoretic formalization of multimarket competition shows that when firms and market conditions are symmetric there is no scope for tacit collusion. On the other hand, in the airlines industry, EK94 observed that opportunities were rife for tacit collusion due to significant variance in route and firm conditions across markets served by major airlines. In fact, these differences that EK94 observe still exist in the airline sector, e.g., American Airlines maintain hub operations at Dallas/Fort Worth (DFW), Miami (MIA), and

Chicago O'Hare (ORD), while major hubs for Delta are in Atlanta (ATL), Detroit (DTW), and Minneapolis (MSP). Since hubs can provide important strategic and operational advantages to airlines (such as more efficient use of aircrafts, economies of scale, and control over scarce resources such as gates and runways at the hub airports (Borenstein 1989; Berry 1990; Berry et al. 1997), there can be significant variations in the regional cost advantages and spheres of influence for airlines operating on routes where the endpoint airport is a hub versus those that are not. Further, the overall competitive conditions also vary substantially across markets. For example, on the Dallas (DAL) – Houston (HOU) route, the 12th busiest route by average daily passengers transported, Southwest is the sole operator; on the other hand, the Newark (EWR) – San Francisco (SFO) route (the next busiest route) is served by over 10 carriers. It should also be noted that there are extensive market overlaps among the airlines; American and Delta overlap in 453 markets and other major network carriers including Continental, Northwest, United, and US Airways on average meet with each other in over 400 markets. In sum, it appears that there are still ample opportunities for airlines to tacitly collude; particularly in the face of various technological advancements that allow for perfect monitoring (Stigler 1961) – another element considered to be necessary for collusion (price changes are observable to each other).

Two airlines ignored in the extant research on multimarket contact are Southwest Airlines and JetBlue Airways. These two airlines are of particular relevance to our work not only because they account for nearly 20 percent of the domestic air-travel market, but also because of two important distinctions: First, they practice what is commonly known as the "everyday low price" strategy that fundamentally departs from the promotional pricing commonly observed amongst all the major airlines in the industry. In this regard, the literature on price formats suggests that firms use prices themselves as signals to attract different consumer segments (Lal and Rao 1997; Bell and Lattin 1998). Price format refers to a pricing strategy of setting prices of not just a single product but a firm's portfolio of products over time – they primarily vary from a promotional format (HILO) that seeks to attract consumers through constant price manipulation and promotions to a more consistent pricing approach that also simultaneously emphasizes its on-an-average low price image (EDLP). Firms are known to strategically place themselves on the HILO-EDLP continuum so as to be attractive to different consumer segments – HILO is known to be attractive to deal-seekers while the EDLP format appeals to consumers less prone to searching (Lal and Rao 1997; Bell and Lattin 1998). Recent empirical research (Hoch, Dreze et al. 1994; Chellappa et al. 2011) observes that Southwest and JetBlue fares are indeed significantly more consistent across their portfolios of routes, and on an average lower than their counterparts such as American, Continental, United, etc. Such observations are also confirmed by the initial insights from our data sample: prices offered by Southwest and JetBlue are both lower (with mean price at $235.57 vs. $386.34) and more consistent (with standard deviation of $89.20 vs. $137.70) compared to those offered by other major carriers.

Second, recent research on airline pricing that includes Southwest and/or JetBlue in the analysis shows that their presence has pronounced effects on competitors' responses. Specifically, Goolsbee and Syverson (2008) find that Southwest's entry into a market triggers substantial fare reductions by the incumbents, of which at least half is attributed to preemptive price cuts that occur even before Southwest actually starts flying the particular route. Chellappa et al. (2011) observe that the presence of Southwest and JetBlue prompts their competitors to reduce variance in prices, leading to an overall lower market-level price dispersion. These latest findings cast sufficient doubts as to whether tacit collusion would indeed emerge in markets when the major carriers come into contact with these two airlines.

While the mutual forbearance hypothesis suggests that greater opportunities for tacit cooperation and higher prices arise when firms are sufficiently different, our work argues that this may not be the case when the differences between them stem from pricing itself. Unfortunately, little is known about when a firm's own pricing strategy might be in conflict with the recommendations of multimarket contact findings. Given Southwest's and JetBlue's faithful adherence to their pricing principle, it is not clear how such airlines would react when the opportunity for tacit collusion arises. While raising prices may imply losing out on both the consistency and low price image that these firms have cultivated, not subscribing to the "golden rule" might imply retaliation from competitors in other jointly contested markets.

To illustrate our argument, we first follow EK94's analysis with a new dataset, one that includes Southwest and JetBlue prices. Subsequently, we develop decomposed multimarket measures to separately identify multimarket contacts with major airlines considered in the extant research (e.g., Delta, American, United) and those that are with Southwest and JetBlue. While EK94 uses a market-level measure of multimarket, for reasons to be elaborated later, we conduct additional analysis with an alternative measure of multimarket that is at the firm-in-market level. Further, we conduct similar empirical investigation using data from offered tickets (which we acquired through reservation requests submitted to major online travel agents and airlines' own websites) in addition to transacted tickets that have traditionally been used in airline research. Taken together, our work offers a robust analysis with two datasets and two measures of multimarket contact in understanding the multimarket effects in the airline industry.

2. Data

For our analyses, we construct two datasets – one a set of transacted prices (purchased tickets) and another, a set of posted prices online (prices at which airlines offer their tickets on the Internet). The first dataset is constructed from the most commonly used source in extant airline research in economics (Borenstein 1989; Berry 1990; Evans and Kessides 1994; Hayes and Ross 1998), the Department of Transportation's Origin and Destination Survey (DB1B). This is a 10% sample of all U.S. domestic airline tickets sold by the reporting carriers, and include origin, destination and other itinerary details of passengers transported. We obtain itinerary details and prices for the third quarter of 2004 for the top 500 U.S. domestic routes where a route is defined by its origin and destination airports. In this sample, Southwest and JetBlue maintain a presence in 124 markets; the busiest route being between Los Angeles and New York (LAX-JFK), with an average of 4,310 daily passengers, while the least busiest route is between Tallahassee and Tampa, Florida (TLH-TPA) where on average only 27 passengers are transported on a given day. This sample accounts for over 86% of all domestic passenger enplanements in the specified quarter.

We restrict our sample to fourteen largest carriers (Alaska, Northwest, Continental, United, American, Delta, US Airways, Southwest, JetBlue, Frontier, America West, AirTran, ATA, Spirit)[1], and coach class, non-refundable, roundtrip tickets with at most one stop on each way. From these, we construct the average logged ticket prices for each carrier-route combination, and map these prices to a dataset containing airlines' operational details (e.g. cost per available seat mile, equipment size, etc.), carrier-route (e.g. weekly flight frequency, hub airport, etc.) and route-specific information (e.g. origin-destination distance, etc.) that we assemble using the Air Carrier Statistics (Form 41 Traffic and 298C Summary Data) from the U.S. Bureau of Transportation Statistics.

[1] Alaska has been dropped from a subsequent analysis due to its small number of observations in the EDLP markets.

For our second dataset, we construct a sample of online prices posted by the airlines considered in the DB1B sample. The rationale for including this dataset in our research is twofold: First, a vast majority of airline tickets are now purchased online and our intention is to ascertain if any different form of pricing is at play given lower consumer search costs online. Second, these tickets are posted or offered tickets, a subset of these tickets eventually clear in the marketplace, i.e., these are the strategic prices set by the firms based on their own objective functions and the market conditions. Therefore if any pricing strategy is pursued by the firm and if the same is successful in the marketplace, we should find evidence of the same in both datasets. Additionally this dataset possess more granular information such as advance purchase period and Saturday-night restriction information. Both these factors are known to affect ticket prices, although the DB1B lacks information on such specific attributes (and hence ignored in extant works). Note that our online prices are obtained from online travel agents like Orbitz, Expedia, and Travelocity as well as individual Web sites of the different airlines in consideration like aa.com, delta.com, southwest.com, etc.

Our online and DB1B datasets respectively include 1,083,581 and 447,722 unique ticket observations from the fourteen largest carriers in the top 500 domestic markets. All ticket prices in our sample are final prices and include all applicable taxes and fees. We construct the average logged ticket prices at the carrier-route level for both the datasets, and merge them with the corresponding carrier- and route-specific attributes to form a complete profile with all relevant variables. This results in 2,064 and 2,057 carrier-route level observations from the online and DB1B datasets, respectively.

3. Empirical Specifications

The econometric specification of our model is the form given below:

$$\begin{aligned} \ln\ price_{km} &= X_{km}\beta + Z_m\gamma + \mu_k + \nu_m + \varepsilon_{km} \\ \nu_m &\sim N\ 0,\tau \\ \varepsilon_{km} &\sim N\ 0,\psi \end{aligned} \qquad (1)$$

where, $price_{km}$ is the average fare charged by airline k on route m, X_{km} are variables that vary by the airline's identity within a given route, and Z_m are route characteristics. The three-part error structure consists of a carrier effect μ_k , a route effect ν_m that is common to all carriers on an observed route, and a white-noise error that is specific to the observation at the carrier-route level ε_{km} . Since prices offered by different airlines on a given route are likely to be correlated due to the common underlying demand characteristics, competitive forces and cost structure for that route, carrier-route level random errors are correlated (within route) and heteroscedastic (across routes), thus violating two critical assumptions of OLS. Hence, consistent with the extant empirical studies on airline pricing where the dependent variable is measured at the carrier-route level (e.g. Borenstein (1989), Borenstein and Rose (1994), Hayes and Ross (1998)), we treat the airline effects as fixed and the route effects as random[2].

An additional advantage of the random-effects specification is that it allows us to incorporate market characteristics into the model while still producing accurate estimates of route-level effects and valid tests of confidence intervals (Mendro et al. 1995). A fixed-effects approach uses dummy variables to "absorb" all inter-route heterogeneities; as a result, route characteristics are confounded with the group fixed-effects and are to be excluded from the model. This implies that market-specific attributes cannot be explicitly accounted for, thus limiting our ability to draw inferences on the moderating role of the route being served by an EDLP carrier on the multimarket effects among HILO carriers. While an alternative is to incorporate interactions among the variables of interest and route dummies, it is impractical given the large number of routes in our sample.

The variables that we include in the X vector are: $direct_{km}$, the percentage of tickets offered by airline k on route m that are direct flights; hub_{km}, a variable that indicates if at least one endpoint airport on the observed route is a hub for airline k; and $RTshare_{km}$, the market share of airline k on route m. We use hub in lieu of airport market share to capture the relative market powers of airlines at the two endpoints of the observed route. Since airport market share is highly correlated with route market share (0.82), including both variables in the model will likely cause multicollinearity problems[3]. EK94 also observe that the estimate for route market share becomes statistically insignificant once airport market share is introduced into the model (p. 347-348). Finally, we include the following variables in the Z vector: $\ln distance_m$,

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[2] A Hausman test fails to reject the equality between fixed- and random-effects estimates; the resulting test statistic is 29.21, which falls below the critical value of 33.41 at the 99 percent confidence level for a Chi-square with 17 degrees of freedom. Moreover, as airlines practice portfolio pricing, prices across routes for a given airline are likely to be correlated.

[3] The highest VIF drops from 7.34 to 4.52 after replacing airport market share with hub .

the natural logarithm of distance (in miles) between the origin and destination airports on the observed route; $\left[\ln \textit{distance}_m\right]^2$, the square of $\ln \textit{distance}_m$ to capture the non-linear effects of distance on prices due to economies of scale from fuel efficiency on long-distance flights; $RTherf_m$, the Herfindahl index for route *m*; and $EDLPmkt_m$, a variable that indicates if at least one of the airlines that operate in the observed market is an EDLP carrier.

Aside from the conventional control variables in extant airline pricing literature (Borenstein 1989; Borenstein and Rose 1994; Evans and Kessides 1994; Berry, Carnall et al. 1997; Hayes and Ross 1998), we also include two additional controls for ticket types in our online sample: *Saturday*, the percentage of tickets involving a Saturday night stay-over, and *TWOwk*, the percentage of tickets that require a minimum of two weeks advance purchase. Advance purchase and Saturday night stay-over requirements are important strategic devices by which airlines employ to differentiate business from leisure travelers (Stavins 2001; Clemons et al. 2002), and hence it is essential to control for their effects in understanding the relationship between multimarket contact and airlines' pricing. These two variables, however, are omitted from the analysis on the DB1B tickets due to lack of time-identifying attributes of the tickets in the sample.

Finally, our measure of multimarket contact is included in either the *X* vector or the Z vector, depending on the unit of measurement. There are many measures of multimarket contact in literature; in the following subsection we specifically discuss two measures relevant to our investigation. Table 1 summarizes the variables incorporated in our model.

<Table 1 about here>

3.1. Measuring Multimarket Contact

Our starting point for measures of multimarket contact is the metric used in EK94. Employing the same measure in our analysis allows us to attribute any differences between our results (from that of EK94) to the variables we have introduced, particularly the ones that correspond to a firm's inherent pricing strategy. On the other hand, later literature points that multimarket contact can be measured at different levels, e.g., firm level, market level, and firm-in-market level. An extensive review of multimarket measures observes the need to align the levels of the multimarket measure with that of the dependent variable of interest (Gimeno and

Jeong 2001). EK94 uses a market level metric, i.e. it measures the extent of multimarket contact in a market as the sum of contacts, both external and focal market, among all airlines that operate in the observed route:

$$MMCEK_m = \frac{1}{f_m\left(f_m - 1\right)/2}\sum_k \sum_{j=k+1} a_{kj} D_{km} D_{jm}$$
$$\text{where } a_{kj} = \sum_m \left(D_{km} \times D_{jm}\right)$$

k,j indicate the identity of two firms. Hence a_{kj} calculates the total number of contacts between k and j across all markets. The numerator, $\sum_k \sum_{j=k+1} a_{kj} D_{km} D_{jm}$ is the total number of cross-market contacts between pairs of firms that are active in market m. In the denominator, f_m is the number of firms that are active in market m. $f_m\left(f_m - 1\right)/2$ is the number of firm pairs in market m.

While this is indeed one measure of multimarket contact, note that in both EK94 and our work, price is actually measured at the firm-in-market level $\left(p_{km}\right)$. Therefore, consistent with recent work (Gimeno and Jeong 2001) that advocates alignment of levels on both sides of the estimation, we also include a firm-in-market level measure of multimarket contact. Also note that it might be preferable to do so since we are interested in teasing out the impact of firm-strategy. While a market-level multimarket contact measure averages number of external contact among airlines operating on the observed route, a firm-in-market allows one to control specifically for the multimarket effects that are of relevance to the airline of interest.

This view also finds support in a recent comprehensive review of measures by Gimeno and Jeong (2001), wherein the firm-in-market level measure demonstrates the highest statistical reliability among all measures considered. For this purpose, we employ the metric used by Baum and Korn (1996) (BK96 hereafter) and others, given by:

$$MMCBK_{km} = \frac{\sum_{j \neq k} \sum_m \left(D_{km} \times D_{jm}\right)}{\sum_m D_{km} \times N_{mmc}} \quad \forall j \text{ s.t. } \sum_m \left(D_{km} \times D_{jm}\right) > 1$$

where m denotes the observed (focal) market in a set of potential markets M, $D_{km}\left(D_{jm}\right)$ is an indicator variable set equal to 1 if firm k (j) is active in market m and to 0 otherwise.

The numerator $\sum_{j \neq k} \sum_{m} D_{km} \times D_{jm}$ counts the total number of contacts between firm k and firm j across all markets, in which both firms meet at least once outside the focal market. For firms that firm k encounters only in the observed market, $\sum_{m} D_{km} \times D_{jm}$ equals 1, hence their contacts with firm k will be excluded from the calculation of $MMCBK_{km}$.

In the denominator, $\sum_{m} D_{km}$ denotes the total number of markets in which firm k operates. This is a proxy measure of "firm size". N_{mmc} denotes the number of firms that are active in market m which also contact firm k in markets outside the focal market. In other words, $MMCBK_{km}$ is a relative measure of multimarket contact, which is scaled by the size of firm k and the number of competitors; it measures the relative importance of market m to firm k, taking into account the potential influence that firm i's competitors may have on its cross-market performance.

Our discussion in section I.A. on the impact of price-formats on multimarket contact calls for the need to investigate the multimarket effects on a firm's pricing decision when such a contact is with firms pursuing EDLP. We first decompose the measures of multimarket contact such that we can examine the impact on prices when an airline repeatedly interacts with an airline pursuing EDLP strategy versus otherwise. For notational purposes, when an airline has multimarket contact with HILO firms (e.g., American, Delta, United, etc.) we term it hMMC with suffix EK or BK for the market level and firm-in-market level measures; similarly when a firm has multimarket contact with an EDLP airline (Southwest or JetBlue), it is called eMMC with corresponding suffixes.

In the HILO-subset (tickets only from non-EDLP airlines) analysis we use a dummy variable $EDLPmkt$ to identify markets in which EDLP carriers operate. Extant research suggests that markets with Southwest and JetBlue exhibit depressed prices and this variable will help isolate the impact from the mere presence of these airlines (Morrison 2001; Goolsbee and Chevalier 2002).

3.2. Endogeneity issues

It is reasonable to expect that an airline's share of passenger on a route $RTshare$, as well as the Herfindahl index constructed from this variable $RTherf$, to be endogenous to the price that it charges. While EK94 suggests that this may not be an issue, much of the literature on airline pricing as well as the Hausman specification test performed on our sample do reject exogeneity of $RTshare$ and $RTherf$. We resolve this issue using instrumental variable and the two-stage least square approach. Following Borenstein (1989) and Borenstein and Rose (1994), we use the geometric share of enplanements of an observed carrier at the endpoints of a given route[4] as the instrument for its market share, and construct the instrument for $RTherf$ using the square of the fitted value $RTshare$ from the first-stage regression.

4. Discussion of Results

Columns (1) and (2) of Table 2 present the results from estimating specification (1) using the average logged fares of tickets written by a carrier k on the observed route m from DB1B, while columns (3) and (4) represent the same using online tickets as robustness checks.

<Table 2 about here>

The results of the DB1B data analysis (Columns 1 and 2) are consistent with those presented by extant literature. First, we find that the airlines that dominate one/both of the endpoint airports (through maintaining a hub) and those that enjoy higher market power on the route receive a price premium. Second, the positive signs for the coefficient estimates of distance and direct connection indicate prices are higher with distance (typically due to the fact that an airline's cost of transporting a passenger increases with the distance); and direct flights come at a premium compared to those with connections. These results echo the work of Borenstein (1989), Berry (1990), and Evans and Kessides (1994).

However, note that the route Herfindahl index is negative, i.e., when markets are dominated by a few large firms it appears that prices in those markets are lower. While this might appear somewhat counter to intuition, Borenstein (1989) points to the possibility of such

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[4] Defined as $GENPSH_i = \frac{\sqrt{ENP_{i1} \cdot ENP_{i2}}}{\sum_j \sqrt{ENP_{j1} \cdot ENP_{j2}}}$; where j indexes all airlines; ENP_{j1} and ENP_{j2} are airline j's average daily passenger enplanements at the two endpoint airports on the observed route during the second quarter of 2004.

a result in the airline industry. On the one hand, a dominant firm may exercise their market power and charge higher prices, thus creating an umbrella effect that allows other smaller firms in the concentrated market to follow suit; on the other hand if a dominant firm on the route "has a competitive advantage… it could possibly lower the profit-maximizing price for other firms in the market." (p. 351). Though it might appear that the latter reasoning is at work here, we should caution that EK94 finds the coefficient for route Herfindahl to be positive; i.e. prices are higher when markets are more concentrated. Hence further investigation is warranted, and we shall further elaborate on this point in a later analysis.

Columns 3 and 4 present the results from the same model with the online dataset. Note that with the additional control variables that capture variation in prices associated with ticket restrictions, the coefficients for $direct_{km}$, hub_{km}, $RTshare_{km}$ and $RTherf_{m}$ have now become insignificant (their signs are nonetheless consistent with those presented in Columns 1 and 2). We find that tickets that are purchased more than two weeks prior to departure are 31% cheaper than those for more immediate departure. This finding confirms the general intuition that airlines use advance purchase requirement as a tool to discriminate between business travelers (who have higher opportunity cost of time and willingness to pay) and leisure travelers.

The covariates of interest in this work which determine the impact of multimarket contact on an airline's price are the *MMCEK* and *MMCBK* coefficients. The positive signs of the MMC measures for both types of tickets suggest that prices charged by an airline is positively correlated with the extent to which it meets the same competitors in other markets, an observation suggestive of mutual forbearance and consistent with that reported in extant literature. In particular, consumers pay an extra 21.5%[5], or $64.5 on the median ticket price of $300 in markets that can be attributed to tacit collusion that arises from multimarket contact. The effect is roughly equivalent to the premium that a firm commands for each percentage point increase in its market share. Overall the results from EK94 appear to hold while looking at this analysis

However, as elaborated in an earlier section, measures are needed to separately identify the impact of multimarket contact with the everyday low price carriers. We therefore use the

[5] Calculated as exp(.325)-1 multiplied by the mean value of *MMCBK* (0.56) in the sample. The rest of the percentages presented in this section follow similar logic.

decomposed measures of *hMMC* and *eMMC* now in the model specified in equation 1 and present results in Table 3.

<Table 3 about here>

At the route (market) level what was $MMCEK_m$ in Table 3 now disaggregated into $eMMCEK_m$ (which is the extent of repeated contact with EDLP airlines in a given route) and $hMMCEK_m$ (which calculates the extent of repeated contact with non-EDLP carriers in a given route). Likewise, $MMCBK_{km}$ is decomposed into $eMMCBK_{km}$ and $hMMCEK_m$. As with the previous models, we conduct the analysis using both posted and transacted ticket prices. Columns (1) and (2) summarize the estimations based on DB1B tickets, while columns (3) and (4) represent the same based on online tickets.

Observe the coefficients of the two decomposed measures now; hMMC is positive, whereas eMMC is negative. This is true for both datasets as well as for both types of multimarket measures. The results tell us that when the multimarket contact is with the non-EDLP or HILO airlines, i.e., the major airlines considered in extant research by EK94, the impact is the same, i.e., we continue to observe evidence of collusive behavior reflected by higher prices in these markets. On the other hand, when such repeated contact is with the carriers practicing everyday low price strategy, we actually see that it leads to lower prices. It is important to interpret these coefficients carefully; for a given airline in a given market multimarket contact with HILO carriers implies an extra 8.9% it can charge while the same multimarket contact with EDLP carriers results in a fare that is 1.7% lower. Given that a carrier has multimarket contacts with both EDLP and non-EDLP carriers, e.g., Delta airlines has multimarket contact with both American and Southwest, if one were to compute the net impact of multimarket contact it would amount to a price that is 7.2% higher or about $21.6 higher than the median ticket price of $300. Note that this decomposed effect is $2/3^{rd}$ smaller as compared to the case when airlines were not identified by their pricing strategy (as in Table 2). In other words, failing to identify the nature of multimarket impact when airlines of asymmetric pricing strategy are present may result in an overestimation of their effect.

Even though the decomposed measures point to the differential impact of multimarket, this analysis is in itself incomplete in its assessment. While indeed multimarket contact with everyday low price airlines appear to lead to lower prices, the analyses does not tell us if the impact is due to multimarket contact or if it is more a function of the mere presence of an EDLP airline in that market. In simple terms, independent of multimarket contact, will prices always be lower in a market with EDLP airlines? To shed light on this issue, we deepen our initial analysis by including other important independent variables as informed by prior studies on airline pricing (Borenstein 1989; Chellappa, Sin et al. 2011), though absent in EK94. Specifically, we include $freq_{km}$, the weekly average flight frequency between the endpoint airports on a given route by the observed carrier (a control for the market power enjoyed by the airline through frequency flyer programs), and $EQUIPsize_{km}$ the average size of aircrafts operated by the observed carrier (a control for equipment-related operational expenses) into the X vector.

For this analysis, we consider all tickets of non-EDLP airlines with the additional price covariates – a dummy variable $EDLPmkt$ that identifies markets in which Southwest and JetBlue offer services, and an interaction term $hMMCBK \times EDLPmkt$ that can be interpreted as the multimarket contact (with major carriers) impact in markets where there is an EDLP carrier. Note also that we now incorporate a proxy $COSTctrl$ that serves as a control for the cost of operating in a given airport-pair or route. This variable is quite relevant to this analysis in that it may help eliminate any cost-based reasoning for why fares may be lower/higher in a market as opposed to the impact of a firm's proactive pricing strategy. Based on Goolsbee and Syverson (2008), we construct the variable using the passenger-weighted average fares of the observed airline on other routes involving the same airports on one end but different airports on the other.

For parsimony, we present only results with the firm-in-market multimarket contact measures $eMMCBK, hMMCBK$ in Table 4.

<Table 4 about here>

Table 4 corresponds to an analysis performed using all tickets offered by HILO airlines, i.e., fares from American, Delta, etc., most of which are examined in EK94. Results from this table help us understand a more complete story: First, we can see that hMMC is positive and significant, i.e., tacit collusion is at work as evidenced by the higher prices *when* the non-EDLP airlines repeatedly engage each other. We already know that engagement with EDLP airlines causes a depression in prices and we can see that much of it perhaps can be explained by the fact prices are automatically lower in markets with EDLP presence ($EDLPmkt_m$ is negative and significant) – independent of any multimarket impact. Further, the non-significant coefficient of $hMMCBK \times EDLPmkt_{km}$ suggests that when the non-EDLP airlines meet each other in these markets with EDLP carrier, they do not price any differently; i.e., the mere presence of EDLP carriers in a market is enough to eschew any opportunity for tacit collusion even if the non-EDLP carriers continue to avail of it otherwise.

Note that the average ticket of a non-EDLP carrier in a market served by Southwest or JetBlue is about $33 lower than its median ticket prices. While this value may appear trivial, its economic implication is quite substantial: going by the 1,475,490 passengers transported by non-EDLP carriers in the EDLP markets in the 4^{th} quarter in 2004 alone, this saving corresponds to an increase in consumer surplus of $49 million in a single quarter!

An important conclusion from these analyses is that EDLP airlines wield far more influence on prices than the so far examined forces of market competition. In order to understand how these airlines have come to exercise this degree of power, we need to take a closer look at their pricing fundamentals. Perhaps nowhere is a firm's control of its pricing absolute as in a market where it is a monopoly – a question of interest is how Southwest and JetBlue exercise their monopoly power. To answer this question, we identify markets where these airlines are a monopoly (defined as an airline possessing over 90% of the route share (Caves 1962; Borenstein and Rose 1994)). As discussed earlier, the EDLP airlines are wedded to the idea of consistent and on-an-average low prices, while economic principles of monopolistic pricing dictates fares to be close to surplus extracting prices. Thus in examining fares in markets where Southwest and JetBlue are monopolies, we can ascertain whether they exercise market power or if they are disciplined in their pursuit of everyday low prices.

Table 5 provides the results of this analysis where there are 59 routes in which one of the EDLP airlines is a monopoly. Note that two variables $RTshare, RTherf$ have been dropped from the model due to their obvious collinearity with the monopoly identifier.

<Table 5 about here>

We can see that the $monopoly_m$ variable is insignificant, i.e., there is no difference in the way an EDLP airline sets prices for routes where it competes with other airlines and ones where it is a monopoly. While one possible explanation is that Southwest and JetBlue practice limit pricing in these markets, a more plausible explanation that is also consistent with prior work (Chellappa, Sin et al. 2011) is that these firms avoid creating variance in their prices – even in monopolistic markets. In other words, if monopoly power does not cause these airlines to significantly deviate from low and consistent pricing, perhaps multimarket contact is not going to entice them to avail opportunities for tacit collusion with their competitors. Thus their "golden rule" appears to be "practice EDLP irrespective of what our competitors may do" rather than the one identified in EK94.

Also note that we had earlier raised the point about the negative correlation between market concentration and price, as reflected by a negative and significant $RTherf_m$ (Table 2). However, when we examine only the HILO airlines' fares, we see the sign for the Herfindahl index becomes positive (Table 4). This disparity can now be reconciled by our understanding of Southwest's and JetBlue's pricing strategy (Table 5): Since EDLP airlines do not seem to alter their pricing behavior even in markets where they are monopolies, it is unlikely that they will exercise market power when they dominate a market. Our results suggest that when we consider the same set of firms and same type of markets as those considered by Evans and Kessides (1994), prices are generally higher in markets that are highly concentrated, consistent with EK94. However, when we consider the prices of these firms in an EDLP market, an additional effect comes into play and exerts a downward pressure on prices of these airlines; an observation that echoes the work by Goolsbee and Syverson (1998). Taken together, the positive impact of market concentration on prices is dominated by the price depression effects associated with operating in a market where Southwest and/or JetBlue are present.

5. Conclusion

The phenomenon of multimarket contact has received much attention in the IO and strategic management literature and with good reason. What might intuitively appear to be an intensely competitive environment, since firms repeatedly engage each other in multiple markets, has really been shown to provide opportunities for tacit collusion. These findings, although primarily empirical in origin, receive full recognition and explanation from the important work by Bernheim and Whinston (1990). The primary understanding provided by this game-theoretical work is when sufficient differences exist across markets, firms and other conditions, aggressive action in one market by a firm (perhaps where it is powerful) might receive an aggressive response in another market (where possibly a competitor is more well-suited). Evans and Kessides (1994) rightly identify the airline industry as a backdrop to study this kind of competition, as the very nature of the airline industry is characterized by variances in competitiveness, market power, and cost advantages, pricing consideration, along with a host of other operational differences across firms and markets. They go on to provide an academic understanding of what was commonly known in the industry parlance as the "golden rule" of oligopolistic coordination.

Our research seeks to reexamine these results that are derived from the airline industry in the nineties, primarily in view of major technological developments and the arrival and recent dominance of later entrants such as Southwest and JetBlue that practice a pricing strategy called everyday low price that is unique and distinct from that practiced by other major carriers. Both changes (technology induced lowered search costs and practice of a special price format) can have an impact on price and therefore these have to be reconciled with any impact of multimarket contact.

We put together two comprehensive datasets that both in terms of scope and nature, go above and beyond what has been traditionally available for analyzing airline pricing. Specifically, the sample that we gathered through the online channel not only serves to validate the robustness of our findings, but also allows us to derive specific insights on how the multimarket effects are manifested in the ways in which different airlines *set* prices for their tickets.

Two key results stand out from our empirical investigation. First, we continue to find evidence of collusive pricing when we examine fares of only the major airlines considered in Evans and Kessides (1994). This finding in itself is not surprising, because the very conditions (namely, sufficient asymmetries across firms and markets) identified in EK94 as crucial to attain a collusive outcome still largely exist today. Moreover, one other condition identified in Bernheim and Whinston (1990) as important for sustaining mutual forbearance, namely the ability to monitor competitors' actions, has only enhanced due to technology. Tickets are created on platforms called Global Distribution Systems (GDSs; formerly known as the "Computerized Reservation Systems" (CRSs)) that are accessible to all airlines and any price change initiated by a competitor is easily observable. And price transparency has only increased with online and thus one can expect tacit collusion opportunities to be even higher.

Second, in markets where these major carriers repeatedly meet Southwest and JetBlue, we observe no collusive pricing; i.e. the "Golden rule" is ignored! Our research seeks to explain this anomalous finding, and identifies the overall price-format adopted by these two airlines as a main reason. Southwest and JetBlue adhere to a form of pricing that relies on establishing a low price image to the consumers through consistent and on-an-average low prices. Departing from this, whether due to multimarket contact opportunities or otherwise, is less than optimal strategy to these airlines. In fact, we show that even when endowed with monopolstic power, these two airlines do not deviate from their pricing strategy. In other words, from Southwest's and JetBlue's perspective, the tension between adhering to their overall pricing strategy and responding to competitive market forces is resolved in favor of the former. And since these airlines have chosen this path, their competitors are behooved to follow suit – this can perhaps explain why Goolsbee and Syverson (2008) observes significant preemptive fare cuts by the incumbents in markets facing even merely the threat of Southwest's entry.

Another interesting empirical observation is that the two EDLP airlines avoid competing in the same markets – there are only 5 routes in which Southwest and JetBlue meet each other[6], which represents 19% and 5% of the markets in which these airlines operate respectively (compared with an average of 75% for the other carriers). While we do not fully explore the within EDLP competition in this paper, the limited extent to which Southwest and JetBlue overlap does raise questions about the number of sustainable EDLP operators in a marketplace. It is also quite surprising that these airlines, while providing "on-an-average low prices", can continue offer prices that are not necessarily the lowest in the market; given that the advancement of technology has significantly reduced consumer search cost via the internet, one could only expect that consumers can easily discover better deals from other carriers, thus damaging the "low price" impression that these airlines have strived to maintain. The results from our study therefore call for deeper investigation towards understanding portfolio pricing of multiproduct firms in a multimarket competitive environment.

[6] These 5 routes are those that connect Las Vegas (LAS), Buffalo (BUF), Phoenix (PHX), Seattle (SEA) and San Diego (SAN) with Tampa Bay in Florida (TPA).

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Table 1: Description of Variables

Nature	Variable	Definition	Mean (Std. dev.)
Ticket Characteristics	Price $Price_{km}$	Average round-trip ticket price for airline k on route m	DB1B sample: 315.82 (99.23) Online sample: 377.28 (139.93)
	Direct flights $Direct_{km}$	Percent of tickets offered by airline k on route m that are direct flights.	DB1B sample: 0.30 (0.39) Online sample: 0.22 (0.34)
	Saturday night stay-over $Saturday_{km}$	Percent of tickets offered by airline k on route m that require a Saturday night stay-over *(online sample only).*	0.50 (0.11)
	Advance purchase $TWOwk_{km}$	Percent of tickets offered by airline k on route m that require advance purchase at least two weeks prior to departure *(online sample only).*	0.74 (0.08)
Airline Characteristics	Hub hub_{km}	An indicator variable equals to 1 if at least one of the endpoint airports on a given route is a hub for the observed airline; 0 otherwise.	0.34 (0.47)
	Market Share $RTshare_{km}$	The observed carrier's share of passengers on the observed route.	0.23 (0.29)
	Frequency $freq_{km}$	The observed carrier's weekly average number of flights scheduled for departure from the origin to the destination on a given route.	11.10 (20.45)
	Aircraft Size $EQUIPsize$	Average number of seats in aircrafts operated by the observed airline on a given route.	141.68 (20.04)
Route Characteristics	Non-stop distance $distance_m$	One-way non-stop distance (in miles) between the origin and destination airports on the observed route.	1173.05 (627.97)
	Herfindahl Index $RTherf_m$	Herfindahl index for all passengers on the observed route.	0.49 (0.20)
	EDLP market $EDLPmkt_m$	An indicator variable equals to 1 if at least one EDLP airline (Southwest or JetBlue) operates in the market; 0 otherwise.	0.19 (0.39)

Multimarket Contact Measures	Average Route Contact $MMCEK_m$	Route level measure of multimarket contact, based on Evans and Kessides (1994).	130.94 (50.04)
	Multimarket Contact $MMCBK_{km}$	Carrier-route level measure of multimarket contact, based on Baum and Korn (1996).	0.56 (0.17)

Table 2: All Carrier Prices and Multimarket Impact

	DB1B Prices		Online Prices	
Independent Variable	(1) Market Level MMC	(2) Firm-in-Market Level MMC	(3) Market Level MMC	(4) Firm-in-Market Level MMC
INTERCEPT	2.5660*** (0.7805)	2.5834*** (0.7861)	-1.5329 (1.0508)	-1.8775* (1.0569)
$\ln\ distance_m$	0.5891** (0.2383)	0.6089** (0.2402)	1.9453*** (0.3218)	2.0964*** (0.3228)
$\left[\ln\ distance_m\right]^2$	-0.0257 (0.0180)	-0.0285 (0.0181)	-0.1228*** (0.0244)	-0.1354*** (0.0244)
$direct_{km}$	0.0742*** (0.0204)	0.0825*** (0.0204)	0.0215 (0.0243)	0.0285 (0.0243)
$Saturday_{km}$			0.0337 (0.0367)	0.0322 (0.0368)
$TWOwk_{km}$			-0.3738*** (0.0500)	-0.3733*** (0.0501)
hub_{km}	0.0378** (0.0150)	0.0393*** (0.0151)	0.0161 (0.0133)	0.0177 (0.0134)
$RTshare_{km}$	0.3773*** (0.0382)	0.3567*** (0.0382)	0.0562 (0.0379)	0.0416 (0.0379)
$RTherf_m$	-0.1349** (0.0547)	-0.1681*** (0.0544)	-0.0082 (0.0736)	-0.0795 (0.0718)
$MMCEK_m$	0.0014*** (0.0002)		0.0010*** (0.0002)	
$MMCBK_{km}$		0.3255*** (0.0461)		0.1382*** (0.0506)
N	2,057	2,057	2,064	2,064
BIC	-414.2	-404.9	-453.2	-450.4

Table 3: All Carrier Prices with Decomposed Multimarket Measures

	DB1B Prices		Online Prices	
Independent Variable	(1) Market Level MMC	(2) Firm-in-Market Level MMC	(3) Market Level MMC	(4) Firm-in-Market Level MMC
INTERCEPT	2.0904*** (0.7935)	2.4404*** (0.7724)	-2.1384** (1.0529)	-1.5511 (1.0235)
$\ln\ distance_m$	0.7705*** (0.2419)	0.6933*** (0.2353)	2.1595*** (0.3217)	2.0030*** (0.3115)
$[\ln\ distance_m]^2$	-0.0401** (0.0183)	-0.0351** (0.0178)	-0.1393*** (0.0243)	-0.1280*** (0.0236)
$direct_{km}$	0.0769*** (0.0204)	0.0802*** (0.0204)	0.0242 (0.0243)	0.0243 (0.0243)
$Saturday_{km}$			0.0335 (0.0367)	0.0262 (0.0369)
$TWOwk_{km}$			-0.3745*** (0.0500)	-0.3658*** (0.0503)
hub_{km}	0.0403*** (0.0150)	0.0402*** (0.0150)	0.0178 (0.0133)	0.0186 (0.0134)
$RTshare_{km}$	0.3636*** (0.0386)	0.3461*** (0.0381)	0.0437 (0.0381)	0.0414 (0.0379)
$RTherf_m$	-0.1692*** (0.0549)	-0.1544*** (0.0536)	-0.0339 (0.0726)	-0.0068 (0.0702)
$eMMCEK_m$	-0.0033*** (0.0010)		-0.0045*** (0.0013)	
$hMMCEK_m$	0.0010*** (0.0002)		0.0006*** (0.0002)	
$eMMCBK_{km}$		-0.2320*** (0.0331)		-0.2292*** (0.0398)
$hMMCBK_{km}$		0.1258*** (0.0370)		0.0590* (0.0327)
N	2,057	2,057	2,064	2,064
BIC	-384.7	-432.7	-442.7	-465.1

Table 4: Non-EDLP Carrier Prices in All Markets

Independent Variable	(1) DB1B Prices	(2) Online Prices
INTERCEPT	4.5317*** (0.8406)	0.6577 (1.1271)
$\ln\ distance_m$	0.0005 (0.2551)	1.2908*** (0.3434)
$[\ln\ distance_m]^2$	0.0187 (0.0192)	-0.0725*** (0.0260)
$COSTctrl_m$	0.3692*** (0.1081)	0.2157 (0.1455)
$direct_{km}$	0.0473** (0.0220)	0.0964*** (0.0270)
$Saturday_{km}$		0.0306 (0.0364)
$TWOwk_{km}$		-0.3815*** (0.0496)
hub_{km}	0.0375** (0.0158)	0.0056 (0.0141)
$freq_{km}$	0.0002 (0.0005)	-0.0006 (0.0005)
$EQUIPsize_{km}$	-0.0004 (0.0004)	-0.0009*** (0.0004)
$RTshare_{km}$	0.4246*** (0.0654)	0.0607 (0.0604)
$RTherf_m$	-0.0399 (0.0579)	0.1940** (0.0776)
$hMMCBK_{km}$	0.1544*** (0.0468)	0.0919* (0.0494)
$EDLPmkt_m$	-0.1177** (0.0499)	-0.2009*** (0.0536)
$hMMCBK \times EDLPmkt_{km}$	-0.0805 (0.0681)	0.0414 (0.0682)
N	1,933	1,940
BIC	-375.4	-485.2

Table 5: EDLP Carrier Prices in Monopolistic Markets

Independent Variable	(1) DB1B Prices	(2) Online Prices
INTERCEPT	1.3631* (0.7590)	1.4029 (1.0243)
$\ln distance_m$	0.7237*** (0.2301)	0.9159*** (0.3256)
$[\ln distance_m]^2$	-0.0302* (0.0175)	-0.0412* (0.0246)
$COSTctrl_m$	-0.0240 (0.0862)	0.1093 (0.1132)
$direct_{km}$	-0.1514*** (0.0437)	-0.4194*** (0.0476)
$Saturday_{km}$		0.0199 (0.3007)
$TWOwk_{km}$		-0.0803 (0.4176)
hub_{km}	0.1337*** (0.0267)	0.0780** (0.0339)
$freq_{km}$	-0.0007 (0.0004)	0.0002 (0.0006)
$EQUIPsize_{km}$	0.0042*** (0.0012)	-0.0004 (0.0017)
$monopoly_m$	0.0459 (0.0281)	0.0028 (0.0348)
N	124	124
BIC	-137.32	-78.1