The Impact of Gulf Carrier Competition on U.S. Airlines

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Abstract:
Gulf carriers, such as Emirates Airline, Etihad Airways, and Qatar Airways, have expanded aggressively and are creating an increasingly dense global network. These carriers' future growth prospects, however, hinge on their ability to gain access to markets in Europe and America, for example. Existing bilateral agreements stifle the Gulf carriers' ambitious expansion plans in some instances, and incumbent carriers lobby to restrict further market access. To contribute to this debate, the objective of this research is to empirically examine the effects of Gulf carrier competition on U.S. carriers' passenger volumes and fares in international route markets. Based on data obtained from the U.S. Department of Transportation, the empirical results suggest that greater competition by Gulf carriers in U.S. international markets is associated with 1) significant growth in U.S.-Middle East traffic volumes and 2) small but statistically significant traffic losses and fare reductions for U.S. carriers in route markets connecting the U.S. with Africa, Asia, Australia and Europe.

1. Introduction

The rise of the Gulf carriers, most significantly Emirates Airline, Etihad Airways and Qatar Airways, has had a profound impact on the aviation industry (e.g., Durgahee, 2013). Founded in 1985, 2003 and 1993, respectively, the business model of the these carriers focuses on transporting passengers between Africa, Asia, Australia, Europe, the Middle East and the Americas via their hubs in Dubai, Abu Dhabi and Doha. Hence, the Gulf airlines compete head-to-head with European, Asian and American carriers in international markets (Kindergan, 2014). Indeed, the Gulf airlines' explosive growth—their combined passenger numbers nearly doubled between 2008 and 2013 (see also Figure 1)—has made the Gulf carriers the "new force […] in the world of air travel" (The Economist, 2010) and reaffirms the Gulf as a key nexus of global travel and trade flows (Hooper et al., 2011).
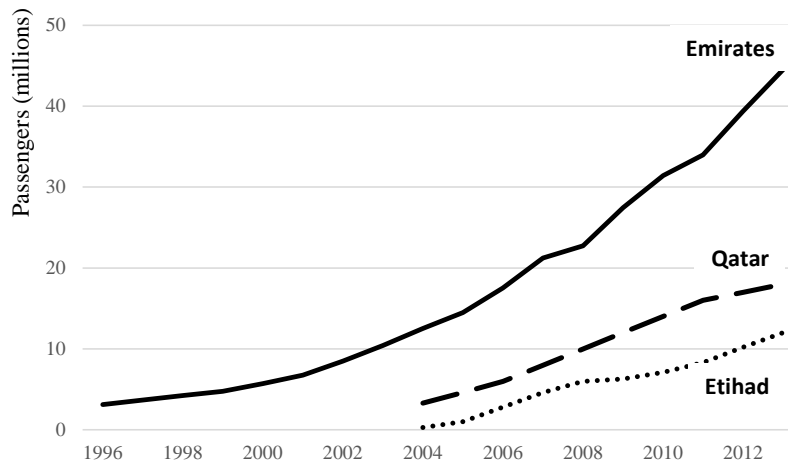

Figure 1. Time series of Gulf carrier passenger counts[1]

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[1] The data were retrieved from annual reports and figures released by the respective carriers. Qatar Airways data prior to 2004 were not available. Etihad Airways commenced operations in 2003, with 2004 being the first full year of operations.

As the Gulf carriers have significantly increased their capacity to the U.S. and elsewhere in recent years (Cameron, 2011), incumbent airlines have responded in an effort to defend their stake in their lucrative international air passenger markets (Bachman, 2014).[2] Claims that Gulf carriers have an unfair competitive advantage and harm local markets and airlines have resulted in "a barrage of legal and political challenges to the Gulf carriers" (Carey and Michaels, 2013) and calls to restrict further Gulf carrier access to markets in Europe and Canada, for example (de Wit, 2013; Parker, 2012).

While the growth of the Gulf carriers has received significant attention in the trade press, relatively few academic studies have examined its effects on the air travel market. A notable exception is the work by Squalli (2014) who studied the relationship between the openness of air travel markets and the performance of Emirates Airline. Based on an analysis of 155 route markets originating in Dubai, Squalli (2014) concluded that further liberalization of the UAE market (and, by extension, other Gulf carriers' markets) leads to greater passenger volumes, lower fares and, ultimately, welfare gains. Similarly, Hazledine (2010) studied trans-Tasman air markets and concluded that Emirates offered significantly lower fares but did not exert much pricing pressure on incumbent carriers Air New Zealand and Qantas. Based on an exploratory analysis of route markets connecting Germany and Asia, Grimme (2011) also concluded that competition by Gulf carrier such as Emirates contributed to growth in overall passenger demand and was not associated with any losses in transfer passengers at German hub airports.

The current study contributes to this nascent stream of research by examining how Gulf carrier competition has affected U.S. carriers' traffic volumes and fare levels in international route markets. This effect is twofold: First, Gulf carrier competition directly impacts route markets

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[2] See also, for example, http://www.lufthansagroup.com/fileadmin/downloads/en/policy-brief/03_2014/epaper/#/6 (last accessed on Sep 14, 2014).

connecting the U.S. to the Middle East, such as the Washington Dulles to Dubai route, served by both Emirates and United Airlines. Moreover there is a secondary effect since Gulf carriers transport passengers through their Middle East hubs to beyond markets (i.e., sixth freedom traffic), thus impacting affects U.S. carrier operations to cities in Africa, Asia, Australia, and Europe. This secondary effect is significant since the majority of the Gulf carriers' passengers connect to beyond markets.[3] Drawing on data from the U.S. Department of Transportation (DoT), our research offers empirical analyses of both the direct and secondary impacts of Gulf carrier competition on U.S. airlines' international passenger numbers and fare levels.

In theoretical terms, our work bears similarity to studies on the effects of low-cost carrier competition in the U.S. airline industry. Following deregulation in the late 1970s, much academic research has investigated the effects of competition on air fares, passenger demand, and airline profitability (e.g., Borenstein, 1989; Brueckner et al., 1992; Fu et al., 2010). Within this stream of research, a substantial number of studies examined how different types of carriers, namely network and low-cost carriers, differentially compete and impact market outcomes (e.g., Hofer et al., 2008; Alves and Barbot, 2009; Ciliberto and Tamer, 2009; Borenstein, 2011; Murakami, 2011). Morrison (2001), for example, examined the effects of competition by Southwest Airlines on network carriers in both actual and adjacent route markets. Our research differs from the previous studies in that we focus on beyond markets, as well as direct traffic markets. Moreover, we study international markets and competition from foreign-based firms, so that competition can negatively impact domestic airlines and thus national welfare. Our study, thus, contributes to the ongoing policy debate regarding the rise and perceived threat of the Gulf carriers and, therefore, should be of great interest to both policymakers and airline managers.

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[3] See e.g., http://www.ainonline.com/aviation-news/ain-air-transport-perspective/2012-11-05/emirates-keeps-profiting-dubais-hub-power (last accessed on Sep 12, 2014).

2. Effects of Gulf Carrier Entry on Aggregate Passenger Traffic Between the U.S. and the Middle East

The purpose of our first analysis is to investigate how Gulf carrier entry impacts aggregate passenger flows between the U.S. and the Middle East.[4] Emirates' service between Dubai and New York (JFK) in 2004 marked the first foray of one of the "super-connectors" (The Economist[5]) into the U.S. market. Since then, all three Gulf carriers have expanded their services to the U.S. and now operate to numerous cities throughout the U.S. from hubs in Dubai, Doha and Abu Dhabi. These entry events enable us to observe the effects of new Gulf Carrier competition on total passenger volumes in U.S.-Middle East route markets.

The empirical analysis draws on data obtained from the U.S. DoT's T-100 database, which provides route market-level passenger data for both U.S. and foreign carriers. These data were retrieved for the period from the first quarter of 2003—more than one year prior to the arrival of the first Gulf carrier in the U.S.—to the third quarter of 2011, which was the most recent available data at the time the data were collected. For the purpose of this analysis, we aggregated passenger numbers across four regions of the U.S. (Midwest, Northeast, South, West) as shown in Figure 2 and across two types of carriers, incumbent[6] and the new Gulf entrants. Aggregate passenger traffic statistics are shown in Table 1.

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[4] There are multiple definitions of the term Middle East and the countries it includes. For the purpose of this study, the following airports (with services to/from the U.S.) are considered to be in the Middle East, in accordance with the geographic definition of the United Nations (http://www.un.org/Depts/Cartographic/english/htmain.htm; last accessed on Jun 12, 2013): AMM, AUH, DOH, DXB, JED, KHI, KWI, RUH, TLV.

[5] http://www.economist.com/blogs/gulliver/2014/07/middle-eastern-airlines; last accessed on Oct 23, 2014.

[6] Incumbent carriers include Continental Airlines, Delta Airlines, El Al, Kuwait Airways, Malaysia Airlines (which operated DXB-EWR flights until October 2004), Pakistan International Airlines, Royal Jordanian Airlines, Saudi Arabian Airlines, United Airlines, and U.S. Airways.
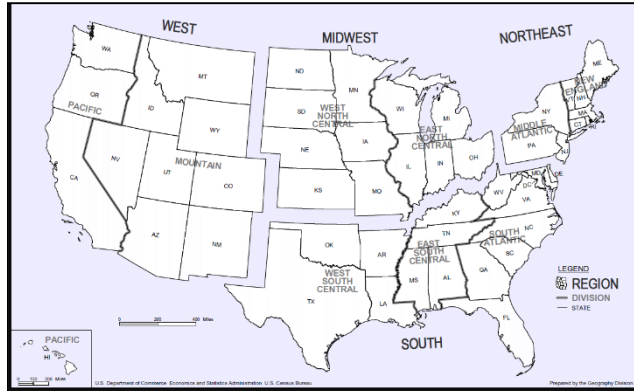
Figure 2. Census Regions and Divisions of the United States (source: U.S. Census Bureau)

Region	Carrier Group	From[7]	To	Months	Average	Total
US Midwest	Incumbent	06/2003	10/2011	101	10,164	1,026,554
	Gulf	09/2009	10/2011	26	14,408	365,252
US Northeast	Incumbent	01/2003	10/2011	106	104,635	11,091,279
	Gulf	06/2004	10/2011	89	44,069	3,922,156
US South	Incumbent	04/2006	10/2011	67	41,510	2,781,143
	Gulf	07/2007	10/2011	52	34,978	1,818,868
US West	Incumbent	07/2006	10/2011	64	7,234	455,721
	Gulf	10/2008	10/2011	37	29,545	1,093,172

Table 1. Passenger volumes between U.S. regions and the Middle East by carrier group

The graphs presented in Figure 3 plot aggregate monthly passenger numbers between the respective U.S. regions and the Middle East. The initial entry by a Gulf carrier is marked by a vertical line. In several instances, structural breaks in passenger flows are visually discernible; that is, with the arrival of Gulf carriers, a significant increase in the level or growth of passenger numbers is observed. In addition, accelerated market growth is evident subsequent to Gulf carrier entry into the U.S. Midwest and U.S. West markets.

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[7] The time series begin either in 01/2003 or with initial entry of an incumbent carrier in the respective U.S. to Middle East markets.

Middle East to US-West ($R^2 = 0.58$)

Middle East to US-Northeast ($R^2 = 0.88$)

Middle East to US-Midwest ($R^2 = 0.60$)

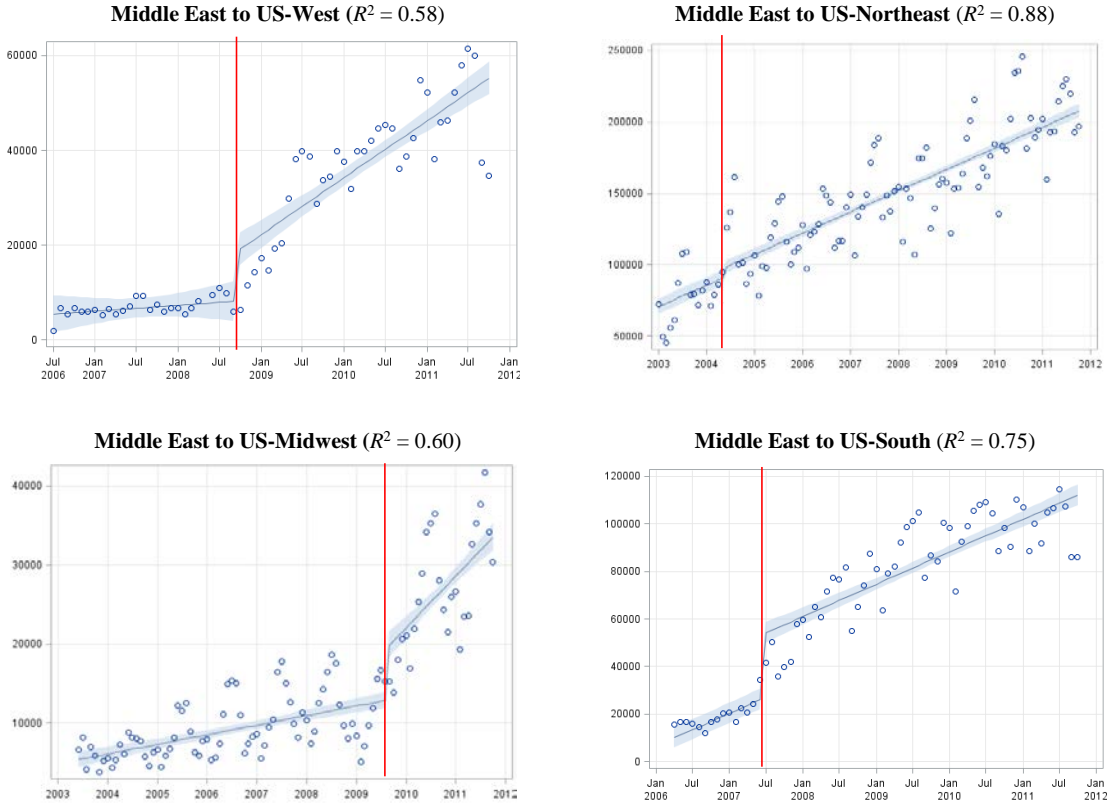**Middle East to US-South** ($R^2 = 0.75$)

Figure 3. The Effect of Gulf Carrier Entry on Size and Growth of U.S.-Middle East Markets

To verify the structural breaks in the data, we formulate an unobserved components model:

$$y_t = \alpha + \beta\, t + \gamma\, g + \delta\, t * g + \sum \theta_s I_s + \varepsilon_t \,,$$

where y_t represents aggregate passenger numbers in month t between a U.S. region and the Middle East and α and β are the intercept and average monthly growth of passenger traffic prior to Gulf carrier entry. The change in the intercept upon Gulf carrier entry (captured by the binary variable g) is estimated by γ. Similarly, the change in market growth after initial Gulf carrier entry is estimated by δ. Seasonal variations in aggregate passenger traffic, finally, are captured via monthly fixed effects (I_s), while ε_t denotes the error term.

The estimations, using a maximum likelihood procedure, were implemented for each set of aggregate passenger time series data between the four U.S. regions and the Middle East. We

first test whether there is a significant change in the level of passengers from a region in the U.S. to the Middle East after the initial entry of a Gulf carrier, assuming a constant rate of passenger growth over the time period of study. The level change, as assessed by γ in the first column of the results in Table 2 for each of the regions, is significant for routes from the Midwest and the South of the U.S. In the second column for each of the regions, we test whether there is an increase in growth rates in passenger volumes following Gulf carrier entry. In this case, we find significant increases in the U.S. Midwest and U.S. West regions.[8] Therefore, for three of the four U.S. regions, we find either an increase in the level of passengers or an increase in the growth rate in passengers (or both) on routes to the Middle East following the entry of the Gulf carriers.

Parameters	US-Midwest Level only Coeff.	US-Midwest Level & slope Coeff.	US-Northeast Level only Coeff.	US-Northeast Level & slope Coeff.	US-South Level only Coeff.	US-South Level & slope Coeff.	US-West Level only Coeff.	US-West Level & slope Coeff.
Level (α)	16,563**	15,504**	200,710**	292,661**	85,063**	72,067**	44,936**	11,960
Slope (β)	118**	101**	1,238**	2,186**	1,136**	916**	759**	104
ΔLevel (γ)	**11,629****	-26,734**	**6,879**	112,174	**27,053****	-21563	**5,924**	-259,760**
ΔSlope (δ)		443**		-954		225		897**
R^2	0.46	0.60	0.88	0.87	0.75	0.71	0.40	0.58
N	101	101	106	106	67	67	64	64

Table 2. The Effect of Gulf Carrier Entry on Aggregate Passenger Numbers

Note: The dependent variable is the total number of passengers between a given U.S. region and the Middle East in a particular month. ** and * denote significance at 1% and 5%, respectively. Seasonality parameter estimates (θ) are omitted due to space constraints.

Only in the U.S. Northeast region, the most developed and mature market with respect to traffic to the Middle East, was Gulf carrier entry not associated with a significant shift or growth in passenger volumes. Overall, these findings provide evidence that the arrival of Gulf carriers to

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[8] Note that the γ coefficients have a different interpretation for the regressions in the second columns for the regions. For each of the four regressions, γ provides an indication in the change in Y-intercept due to the growth rate change following Gulf carrier entry. Therefore, if the growth rate increases, the regression line predicting passengers over time will become steeper, thus changing the Y-intercept compared to the intercept, α, for the passenger forecast line prior to Gulf carrier entry.

the U.S. was associated with substantial expansion of direct passenger traffic between the U.S. and the Middle East. However, the growth in the U.S.-Middle East market may come at the expense of traffic losses in (broadly) adjacent international route markets. In addition, Gulf carrier competition may affect not only traffic volumes but also air fares. We further explore these possibilities in the next section.

3. Effects of Gulf Carrier Competition on U.S. Carriers' Fares and Passenger Volumes

Since substantial numbers of passengers connect via the Gulf carriers' Middle Eastern hubs to destinations in, for example, Africa, Asia, and Oceania, there are secondary effects of Gulf carrier competition beyond the U.S.-Middle East market. Hence, we conduct a separate analysis to obtain further insights into the effects of Gulf carrier competition on U.S. carriers. Specifically, the purpose of this analysis is to further explore how Gulf carrier competition, measured in terms of Gulf carrier passenger traffic between the U.S. and the Middle East, affects U.S. airlines' fares and passenger volumes in route markets between the U.S. and various regions of the world. The unit of analysis, thus, is a given U.S. carrier's direct international route market originating or terminating in the U.S in a given time period. Further information on the data set and relevant variables is provided below, followed by sample descriptive statistics, a discussion of methodological issues, and the empirical results.

3.1. Data

The U.S. DoT's International DB1B database provides a 10% sample of all international tickets sold by U.S. carriers, and for each ticket, specific itineraries and associated air fares are recorded. These data are similar to the DoT's domestic DB1B data but record international rather

than domestic air travel. Unlike the domestic database, access to the international database is restricted and tightly controlled by the DoT.

We obtained the international DB1B data for the period from the first quarter of 2008 to the second quarter of 2013 and then aggregated these data to identify average air fares and total passenger volumes transported by a given U.S. carrier offering scheduled international services between a given U.S. airport and a given international airport (or vice versa) in a given quarter. Route markets in which Gulf carriers potentially compete are of particular interest here. Hence, observations pertaining to U.S. carriers' direct services between the U.S. and destinations in North America, Central America, the Caribbean, and South America were excluded from further consideration since Gulf carriers do not operate or sell tickets from the U.S. to these markets. The resulting dataset contains 10,136 observations at the (U.S.) carrier-route-quarter level, where a route market is defined at the airport-to-airport level. To evaluate the effects of Gulf carrier competition on U.S. carriers, passenger data for non-U.S. carriers from the T-100 database were matched into this dataset.

3.2. Variables and Measurement

There are two dependent variables of interest in this study: U.S. carriers' fares and passenger numbers. The *Price* variable represents a U.S. carriers' average one-way fare[9] in a given airport-to-airport route market in a given quarter and is measured in U.S. dollars. The *ODPax* variable, in turn, captures the carrier's total quarterly passenger volume in that same route market.

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[9] Based on round-trip ticket purchases.

The key independent variable is the total number of passengers carried by Gulf airlines in a given quarter between a U.S. region[10] and the Middle East (Dubai, Doha, Abu Dhabi). The aggregation of *TotalGulfPax* by U.S. region, allows us to capture the effects of indirect or adjacent competition. A Gulf carrier's entry into New York (JFK), for example, may have an effect on U.S. carriers operating out of Newark (EWR) or Philadelphia (PHL). While Gulf carriers' onward connections beyond the Middle East are not identified in the T-100 database, it is reasonable to assume that the majority of passengers connected to destinations throughout the Middle East, Africa, Asia, Europe, and Oceania. As such, the *TotalGulfPax* variable serves as a proxy for the degree of Gulf carrier competition in a broad array of international route markets originating or terminating in the respective U.S. regions.

Several additional variables are expected to impact U.S. carriers' fares and passenger counts. Specifically, the level of competition in a market is a major determinant of ticket prices (e.g., Borenstein, 1989). Cho et al. (2012), for example, find that both direct competition in airport-to-airport route markets as well as indirect competition in adjacent route markets are associated with lower fares. In the context of our study, this suggests that Delta Airlines' service between New York JFK and Zurich, for example, competes with a broad set of services offered by other airlines, both U.S. and international, between the U.S. Northeast region and Europe. This includes the JFK-ZUR route operated by Swiss, as well as Qatar Airways' GVA-EWR service[11] and even Iberia's BOS-MAD service.[12] Accordingly, we evaluate the competitiveness of air travel markets at the aggregate region-to-region level. Based on data obtained from the U.S. DoT's T-100

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[10] Let the focal observation be American Airlines' service from ORD to DEL. ORD is in the U.S. Midwest region (see Figure 2). Hence, the *TotalGulfPax* value pertaining to this observation aggregates all Gulf carriers' traffic volumes from any U.S. airport in the U.S. Midwest region to the Middle East (AUH, DXB, DOH).

[11] Qatar Airways operated this service in 2007 and 2008.

[12] Carriers, such as Iberia (in cooperation with codeshare partners), offer onward connections at either endpoints such that a passenger traveling on BOS-MAD, for example, may originate in New York City and fly to Zurich via Boston and Madrid.

database, we calculate the share in total traffic between a given U.S. region and a given world region for all carriers operating in these markets. The associated Herfindahl-Hirschman Index (HHI), the sum of the squared aggregate market shares between regions i and j for each carrier k in quarter t, defines the *RegRegHHI* variable used in this research $\left(\sum_{k=1}^{n} \left(\frac{\sum PAX_{ijtk}}{\sum PAX_{ijt}} \cdot 100 \right)^2 \right)$. U.S. regions were defined as shown in Figure 2, while international airports were assigned to specific geographic regions based on classifications published by the United Nations.[13]

Other key determinants of air fares are distance and fuel prices (e.g., Hofer et al., 2005). The former is measured as the nonstop mileage between a route market's origin and destination airports (*Distance*) while the latter is based on U.S. DoT data on U.S. carriers' average cost per gallon of kerosene on international routes in a given quarter (*Fuel*).[14] Both of these measures affect carriers' production costs and, therefore, enter as control variables in the estimation of air fares.

The magnitude of trade flows between the U.S. and a given country is used as a predictor of passenger demand for air travel between two countries. The *Trade* variable is measured as the sum of total imports and exports, measured in U.S. dollars between the origin and destination countries of a given international route market and serves as a control variable in the demand (*ODPax*) equation. These data were obtained from the United Nation's Comtrade database.[15]

All variables with the exception of *Fuel* were log-transformed prior to the empirical analysis to facilitate the interpretation of the resulting coefficient estimates. Descriptive statistics and bivariate correlations for the data sample are reported in Tables 3 and 4, respectively.

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[13] See http://www.un.org/Depts/Cartographic/english/htmain.htm (last accessed on Jun 12, 2013). The relevant world regions considered here include East Asia, Europe, Northeast Africa, Oceania, South Asia, Southeast Asia, Southwest Africa.
[14] http://www.transtats.bts.gov/fuel.asp (last accessed on Jul 21, 2014).
[15] http://comtrade.un.org/ (last accessed on Jul 21, 2014).

Variable	Mean	Std. Dev.	Min	Max
Price ($)	854.6	352.0	195.1	3733
Distance (miles)	4927.8	1404.1	2593.0	10210
ODPax	15934.6	12437.0	2.0	101241
RegRegHHI	1519.1	1329.9	795.3	10000
TotalGulfPax	74605.1	30804.4	2229.0	132284
FuelCost ($/gallon)	2.7	0.6	1.7	3.8
Trade (billion $)	114	128	0.2	582

Table 3. Descriptive Statistics (n=10,136)

	1	2	3	4	5	6
1 lnPrice						
2 lnODPax	0.229					
3 lnDistance	0.562	-0.195				
4 lnRegRegHHI	0.448	-0.178	0.700			
5 lnTotalGulfPax	-0.199	0.012	-0.282	-0.310		
6 Fuel	0.282	0.030	-0.006	0.003	0.220	
7 lnTrade	0.273	0.130	0.216	-0.127	-0.189	0.082

Table 4. Pairwise Correlations (n=10,136)

3.3. Empirical Estimation Method and Results

The empirical model consists of two simultaneous equations with fares (*lnPrice*) and passengers (*lnODPax*) as dependent variables, respectively, which are specified as follows:

(1) $lnPrice_{rkt} = \alpha_0 + \alpha_1\, lnODPax_{rkt} + \alpha_2\, lnRegRegHHI_{rt} + \alpha_3\, lnDistance_r + \alpha_4\, Fuel_t +$

$\alpha_5\, lnTotalGulfPax_{rt} + \Sigma\alpha\, Time_t + \varepsilon_{rkt}$

(2) $lnODPax_{rkt} = \beta_0 + \beta_1\, lnPrice_{rkt} + \beta_2\, lnTrade_{rt} + \beta_3\, lnTotalGulfPax_{rt} + \Sigma\beta\, Time_t + \varepsilon_{rkt}$

where *r*, *k* and *t* denote airport-to-airport routes, carriers and time (quarters), respectively. All variables are defined as outlined above, and binary dummy variables (*Time_t*) for all 49 (*n-1*)

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quarters are added to capture aggregate time effects. The term ε_{rkt} represents an idiosyncratic error term which varies across carrier-routes and across time.

The estimation of these equations poses a series of econometric challenges. First, the number of passengers is a predictor of prices, while the latter is, at the same time, a key factor impacting passenger demand. In addition to this simultaneity between *lnPrice* and *lnODPax*, the panel nature of our dataset raises potential concerns of serial correlation and heteroskedasticity. We discuss and address these concerns in Section 3.3.1 before presenting the primary estimation results in Section 3.3.2.

3.3.1. Econometric Issues

To illustrate how the above mentioned concerns regarding simultaneity and non-independence of observations affect the empirical results, we estimate equations (1) and (2) using various alternative statistical estimation techniques (Table 5). First, we present ordinary least squares results in Panel A of Table 5. Panels B and C, in turn, present the results for fixed and random effects panel analyses, respectively. The next set of results—shown in Panels D, E and F—are obtained via instrumental variable (2SLS) procedures. Specifically, Panel D reports the first and second stage estimation results for a pooled instrumental variable regression, while Panels E and F pertain to fixed and random effects instrumental variable regressions, respectively.

Turning to the OLS estimates presented in Panel A of Table 5, the coefficient of the *lnPrice* variable in the passenger model (with *lnODPax* as the dependent variable) is positive and significant, suggesting that higher prices are associated with greater passenger demand. This result is inconsistent with economic theory and prior empirical research (e.g., Borenstein, 1989) and, thus, illustrates the effect of simultaneity bias. This same bias is also apparent in Panels B and C,

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which summarize the results of panel-level analyses with fixed effects and random effects, respectively.

To address the endogeneity between *lnPrice* and *lnODPax*, the right-hand portion of Table 5 presents the instrumental variable regression results. In these models, *lnPrice* is regressed on all exogenous variables in the first stage (left-hand side of Panels D, E and F, respectively), and fitted values of *lnPrice* ($\widehat{lnPrice}$) are then employed in the second-stage regressions with *lnODPax* as the dependent variable (right-hand side of Panels D, E and F, respectively). It is noteworthy that *lnPrice* has the expected negative coefficient in the passenger models (where *lnODPax* is the dependent variable) in the pooled (Panel D), fixed effects (Panel E[16]) and random effects (Panel F) results. Moreover, the estimation results for the variables of interest are qualitatively consistent across all three estimations. Specifically, the *lnTotalGulfPax* variable carries negative and statistically significant coefficient estimates in both the *lnPrice* and *lnODPax* models in Panels D, E and F.

While the 2SLS procedure effectively addresses endogeneity concerns, it is a sequential rather than simultaneous estimation procedure. As such, it does not fully capture and model the simultaneity between *lnPrice* and *lnODPax*. To do so, we implement a three-stage least squares (3SLS) procedure, which combines a 2SLS approach with the seemingly unrelated regressions procedure (Zellner and Theil, 1962). As noted by Kennedy (2003), 3SLS estimators, while more sensitive to model misspecification, are asymptotically more efficient than and consistent with 2SLS estimators.

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[16] The estimation results in Panels B and E show an unexpectedly negative and large coefficient estimate for the *Distance* variable in the models with *lnPrice* as the dependent variable. This is due to the high correlation between *Distance* and route-carrier fixed effects in these fixed effects models. Specifically, each route-carrier fixed effect is associated with a specific distance value. Conversely, each distance value is associated with one or few route-carrier fixed effects. The resulting multicollinearity leads to biased coefficient estimates for the *Distance* variable in fixed effects models.

Panel A: OLS Regression Estimates

lnPrice	Coef.	Std. Err.		lnODPax	Coef.	Std. Err.
Constant	-4.235	0.461 **		Constant	-1.207	1.287
lnODPax	0.109	0.007 **		lnPrice	0.821	0.115 **
lnRegRegHHI	0.083	0.027 **		lnTrade	0.248	0.060 **
lnDistance	0.720	0.039 **				
Fuel	1.526	0.134 **				
lnTotalGulfPax	-0.097	0.012 **		lnTotalGulfPax	0.095	0.027 **
Number of obs.		10,136		Number of obs.		10,136
F		115.41 **		F		10.79 **

Panel B: Fixed Effects Regression Estimates

lnPrice	Coef.	Std. Err.		lnODPax	Coef.	Std. Err.
Constant	354.506	226.497		Constant	7.096	1.793 **
lnODPax	0.023	0.006 **		lnPrice	0.177	0.049 **
lnRegRegHHI	0.104	0.047 *		lnTrade	0.049	0.071
lnDistance	-41.231	26.761				
Fuel	0.175	0.013 **				
lnTotalGulfPax	-0.028	0.008 **		lnTotalGulfPax	-0.047	0.022 *
Number of obs.		10,136		Number of obs.		10,136
F		142.80 **		F		42.02 **

Panel C: Random Effects Regression Estimates

lnPrice	Coef.	Std. Err.		lnODPax	Coef.	Std. Err.
Constant	-2.916	0.380 **		Constant	5.682	0.819 **
lnODPax	0.054	0.005 **		lnPrice	0.246	0.046 **
lnRegRegHHI	0.095	0.022 **		lnTrade	0.056	0.029
lnDistance	0.688	0.041 **				
Fuel	1.047	0.099 **				
lnTotalGulfPax	-0.033	0.007 **		lnTotalGulfPax	-0.036	0.021
Number of obs.		10,136		Number of obs.		10,136
χ^2		4,193.32 **		χ^2		1013.82 **

Panel D: Instrumental Variable Regression Estimates

lnPrice	Coef.	Std. Err.		lnODPax	Coef.	Std. Err.
Constant	0.635	0.366		Constant	15.651	2.045 **
lnTrade	0.046	0.006 **		lnPrice	-1.435	0.233 **
lnRegRegHHI	0.110	0.023 **		lnTrade	0.209	0.030 **
lnDistance	0.539	0.045 **				
Fuel	0.137	0.010 **				
lnTotalGulfPax	-0.085	0.013 **		lnTotalGulfPax	-0.204	0.074 **
Number of obs.		10,136		Number of obs.		10,136
F		139.62 **		χ^2		138.74 **

Panel E: Fixed Effects Instrumental Variable Regression Estimates

lnPrice	Coef.	Std. Err.		lnODPax	Coef.	Std. Err.
Constant	388.146	170.302 *		Constant	24.344	6.244 **
lnTrade	0.044	0.020 *		lnPrice	-2.589	0.973 **
lnRegRegHHI	0.094	0.027 **		lnTrade	0.167	0.088
lnDistance	-45.322	20.126 *				
Fuel	0.278	0.011 **				
lnTotalGulfPax	-0.030	0.006 **		lnTotalGulfPax	-0.132	0.039 **
Number of obs.		10,136		Number of obs.		10,136
F		227.40 **		χ^2		2,900,000 **

Panel F: Random Effects Instrumental Variable Regression Estimates

lnPrice	Coef.	Std. Err.		lnODPax	Coef.	Std. Err.
Constant	0.029	0.547		Constant	12.032	1.245 **
lnTrade	0.035	0.011 **		lnPrice	-0.782	0.157 **
lnRegRegHHI	0.087	0.022 **		lnTrade	0.102	0.033 **
lnDistance	0.612	0.068 **				
Fuel	0.108	0.008 **				
lnTotalGulfPax	-0.026	0.006 **		lnTotalGulfPax	-0.062	0.018 **
Number of obs.		10,136		Number of obs.		10,136
χ^2		5,758.00 **		χ^2		1254.36 **

** and * denote significance at $p<.01$ and $p<.05$, respectively. Time fixed effects are omitted due to space constraints.

Table 5. Results for Different Estimation Techniques

The 3SLS procedure (as implemented in the statistical software package STATA) estimates the model for pooled datasets only and, as such, does not fully control for the lack of independence of observations in our panel dataset. Comparing the results for the pooled 2SLS estimation (Panel D in Table 5) and fixed and random effects models (Panels E and F, respectively), it is evident that the coefficient estimates for the variable of interest (*lnTotalGulfPax*) are greater in magnitude in the pooled estimation relative to the panel estimation methods. This suggests that pooled estimations may result in positively biased estimates such that we can consider the pooled 3SLS results shown and discussed below as upper bound estimates of the effects of Gulf carrier competition on U.S. carriers' fares and passenger volumes in international route markets. We will later compare these estimates to those obtained via panel 2SLS procedures.

3.3.2. Empirical Results and Discussion

In line with prior research (e.g., Hofer and Eroglu, 2010), the simultaneous estimation of the key parameters in equations (1) and (2) was conducted using the three-stage least squares procedure in STATA. We account for the lack of independence of by clustering the standard errors at the route-carrier level and by controlling for time effects. The associated estimation results are shown in Table 6 below. The panel on the left shows the results with *lnPrice* as the dependent variable, while the panel on the right displays the estimation results for *lnODPax* as the dependent variable.

Turning to the price regression first, we note that the model as a whole is highly significant and the coefficient estimates are largely in line with expectations; that is, greater passenger demand is associated with higher prices. Moreover, greater levels of market concentration and longer distances also imply higher air fares. The coefficient of the *Distance* variable, for example,

indicates that a 10% increase in the mileage between origin and destination airports results in an 8.3% increase in prices. The result for the *Fuel* variable, while positive as expected, is statistically insignificant. With respect to the variable of primary interest, there is evidence that Gulf carrier competition (*lnTotalGulfPax*) leads to lower fares.

lnPrice	Coef.	Std. Err.	**lnODPax**	Coef.	Std. Err.
Constant	-3.212	0.361 **	Constant	16.305	0.740 **
lnODPax	0.282	0.017 **	lnPrice	-1.485	0.078 **
lnRegRegHHI	0.119	0.009 **	lnTrade	0.210	0.012 **
lnDistance	0.825	0.020 **			
Fuel	0.052	0.042			
lnTotalGulfPax	-0.065	0.007 **	lnTotalGulfPax	-0.227	0.030 **
Number of obs.		10,136	Number of obs.		10,136
χ^2		7,223 **	χ^2		580.46 **

** and * denote significance at p<.01 and p<.05, respectively. Time fixed effects are omitted due to space constraints.[17]

Table 6. Empirical Results

The results for the passenger model are also consistent with expectations. In line with basic economic theory, we find that the higher the ticket price, the lower the carrier's passenger numbers. Moreover, the estimates indicate that a 10% increase in trade flows (*lnTrade*) between the origin and destination countries results in an increase in passenger demand of, on average, 2.1%. Finally, there is statistical evidence that greater Gulf carrier passenger volumes adversely affect U.S. carriers' international passenger counts, all else equal.

In addition to the direct negative effects of *TotalGulfPax* on prices and U.S. carrier passenger counts, there is a secondary effect whereby lower ticket prices (resulting from greater

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[17] The coefficient estimates of the time fixed effects are mostly either insignificant or negative and significant in both the fare and passenger models in the earlier years of the time period studied (about 2008-2010) and then positive and statistically significant in the later years (about 2011-2013). This finding is, of course, likely attributable to the economic recession and subsequent recovery during these years.

Gulf carrier competition) stimulate passenger demand for U.S. carriers. Higher demand then leads to higher ticket prices. Given this interdependence of passenger demand and fares, the total effect of Gulf carrier competition on U.S. carriers' fares and passenger demand in international route markets can be described as follows:

(3) $\Delta Price = \alpha_1 \Delta ODPax + \alpha_5 \Delta TotalGulfPax$

(4) $\Delta ODPax = \beta_1 \Delta Price + \beta_3 \Delta TotalGulfPax$

Substituting (4) in (3) and (3) in (4), respectively, yields

(5) $\Delta Price = \Delta TotalGulfPax \left(\frac{\alpha_1 \beta_3 + \alpha_5}{1 - \alpha_1 \beta_1} \right)$ and

(6) $\Delta ODPax = \Delta TotalGulfPax \left(\frac{\alpha_5 \beta_1 + \beta_3}{1 - \alpha_1 \beta_1} \right).$

Based on our empirical results, we find that a 1% increase in Gulf carrier traffic between various U.S. regions and the Middle East results, on average, in U.S. carriers' fare changes of -0.0913%., (95% confidence interval: -0.1061% to -0.0738%). Similarly, the 1% increase in Gulf carrier traffic equates to a 0.0917% reduction in passenger numbers for U.S. carriers (95% confidence interval: -0.1095% to -0.0677%). As noted previously in Section 3.3.1, these figures represent upper bound estimates of the effects of Gulf carrier competition on U.S. carriers' fares and passenger volumes in international route markets. The estimates obtained via fixed effects and random effects instrumental variable regressions, summarized in Table 7 below, are about 40% to 70% smaller than the associated 3SLS estimates.

1% increase in Gulf carrier traffic to/from U.S.	3SLS	2SLS fixed effects	2SLS random effects
Effect on price (%)	-0.0913	-0.0301	-0.0381
Effect on passengers (%)	-0.0917	-0.0543	-0.0418

Table 7. Marginal estimates of the effects of a 1% increase in Gulf carrier traffic to/from the U.S. on U.S. carriers' prices and passengers on international route markets[18]

In general, our findings indicate that the entry of Gulf carriers into U.S. markets has created gains for consumers in terms of lower fares. The resultant equilibrium following Gulf carrier entry can be characterized by a shift outwards of the supply curve in U.S. international markets and, thus, a movement down the demand curve. The lower fares and higher quantity demanded resulting from the Gulf carrier entry represents an increase in consumer surplus. In contrast, U.S. carriers have lost traffic not only on routes to the Middle East, but also on routes to other regions served by the Gulf carriers, such as Africa, Asia and Oceana. With their conveniently located hubs and geographic proximity to high-growth regions such as South Asia, Gulf carriers have benefited from and contributed to the growth in global air travel. The resulting capacity growth and increase in competition brought on by the Gulf carriers have put pressure on fares and caused U.S. carriers (and, presumably, other airlines) to experience a downward trend in average yields. The lower fares on U.S. carriers' international routes may, thus, have eroded their profits and decreased the producer surplus derived by U.S. carriers.

The net gain to the U.S. can be determined by the net of the consumer surplus gain and the producer surplus loss. Although it is not clear whether U.S. society is better or worse off following

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[18] The effects on price were obtained via 2SLS regressions with *lnODPax* as the dependent variable in the first stage and *lnPrice* as the dependent variable in the second stage. These results are not shown in this manuscript but are available from the authors upon request. The effects on passengers were calculated based on the regression results shown in Panels E and F in Table 5.

the entry of the Gulf carriers, their entry has likely resulted in a more competitive market-based equilibrium that indicates, on a global basis, a net gain to society.

4. Conclusion

The purpose of this study is to explore the effects of Gulf carrier competition on U.S. carriers. Drawing on U.S. DoT data, we first investigate how the size of international route markets, as measured in terms of total passenger volumes, changed as a result of Gulf carrier entry. The results indicate that passenger counts increased significantly following such entry events in several U.S. regions. In some instances, there is also evidence that Gulf carrier entry stimulated accelerated market growth. In a second analysis, we further studied and quantified the effect of Gulf carrier competition on U.S. carriers' fares and passenger counts in international route markets connecting the U.S. with Africa, Asia, Australia and Europe. The empirical results suggest that these effects are small but statistically significant; that is a 1% growth in total Gulf carrier traffic to or from the U.S. is associated with a less than 0.1% drop in U.S. carriers' international passenger traffic and a less than 0.1% decrease in air fares. From a consumer perspective, the latter is, of course, a desirable outcome of increased competition in international aviation markets. U.S. carriers, however, are likely worse off following Gulf carrier entry. Future research could seek to quantify the welfare effects of the Gulf carrier operations to determine their net welfare impact on the U.S. (or on other countries).

A limitation of this study is that our data restricted our analysis to U.S. international routes. In addition, our data limited fare analysis to U.S. carriers operating on international routes. To the extent that European and Asian carriers are impacted to a greater degree by the Gulf carriers, other datasets that contain passenger and fare information on these carriers could be analyzed to further

gauge the impacts of the Gulf carriers. At the same time, future research may expand the scope of

the analysis to include carriers such as Turkish Airlines, which pursues a growth strategy that is

comparable to that of Emirates, Etihad and Qatar Airways (Burghouwt, 2012).

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