Does Competition Benefit Complements?
Evidence from Airlines and Hotels

by

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and

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Abstract

We analyze how changes in the market structure of one industry – airlines – affect the performance of firms in a complementary industry – hotels – using an instrumental variables strategy to account for potential correlation between unobserved shocks to both markets. We find that more intense airline competition boosts hotel performance across all standard measures: price, occupancy rate, and revenue per available room. Spillovers vary across hotel quality and passenger type: lower-quality branded hotels serving more price-sensitive travelers, most likely brought into the market because of more intense airline competition, benefit the most. However, performance spillovers do not translate into higher hotel entry.

Keywords: Competition, spillovers, complements

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1. Introduction

How changes in economic conditions and industry market structure, in particular, transmit across firms and industries has long been of interest to academics, policymakers, and managers. There is also a growing debate about whether a rise in industry concentration spills over to the rest of the economy, with possible implications for suppliers, labor markets, and productivity.[1]

We aim to complement this debate by analyzing empirically how changes in the market structure of one industry affect the performance of firms in another industry when these firms sell complementary products. Increased competition and lower prices in one industry raise the demand in related industries which produce complements and thus benefit sellers in those industries. In settings with heterogeneous consumers, however, more intense price competition may also draw new consumers into the market who have a lower willingness to pay for both products than existing consumers – possibly dampening the positive demand effect on complementary products. Already Porter (1979) raised the importance of understanding the nature of inter-industry interactions, but we do not have much systematic empirical evidence on these patterns yet.

We analyze empirically how changes in the market structure and competition of the airline industry affect the performance of firms in a complementary industry – hotels. The airline industry has undergone significant changes in its market structure, not only in the U.S. but worldwide (Borenstein and Rose, 2014). We study the period from 2001 to 2008, and during this time the airline industry experienced the expansion of low-cost carriers (LCCs) which increased airline competition and brought lower fares and higher passenger volumes (e.g., Goolsbee and Syverson, 2008, Berry and Jia, 2010). Air travel is an important complementary product for the hotel industry: according to the 1995 American Travel Survey, 61 percent of plane trips that spanned multiple days involved a hotel stay. Hence, changes in airline market structure may spill over to the hotel industry.

Airline demand is typically segmented into demand from business and leisure travelers.[2] Business travelers have a higher willingness to pay for air travel and its associated amenities (e.g., upgrades, lounges, and frequent flyer miles). They also have a higher willingness to pay for hotel stays and tend to stay in higher-quality hotels. Since more competitive markets usually have lower

[1] See, for example, Basu (2019), Berry, Gaynor, and Scott Morton (2019), Syverson (2019), De Loecker, Eeckhout, and Unger (2020), and Autor, Dorn, Katz, Patterson, and Van Reenen (2020).

[2] For example, Berry and Jia (2010) estimate a model of airline demand with two types of consumers, "business" and "tourist". They find that tourist (or leisure) travelers are substantially more price elastic than business travelers.

prices, they are likely to attract a higher proportion of more price-sensitive travelers. This may dampen the positive effect of competition on hotel demand, especially for higher-quality hotels and in markets that cater primarily to business travelers.

To study how changes in airline market competition affect the performance of hotels, we use an instrumental variables strategy to account for the potential correlation between unobserved shocks to hotel and airline markets. We combine detailed performance data from a unique panel data set for U.S. hotel properties from 2001-2008 with measures of airline competition at the nearest airports. Our final sample covers 22,062 hotels across 5,260 different zip codes. Our data include standard industry measures of hotel performance – average revenue per available room (RevPAR), room price, and occupancy rate – and time-varying hotel and county characteristics. These data also include information on the quality segment in which the hotel operates. Since the hotel industry is characterized by high fixed costs and low marginal costs, changes in revenues to a large extent also reflect changes in hotel profits.[3] As such, our analyses capture the impact on both operational as well as financial hotel performance.

We combine our hotel data with information on airline competition at nearby airports. Since spillovers from airline competition may diminish with hotel distance from the airport, we focus our analysis on hotels that are located within 50 miles of an airport.[4] We further test whether even in such geographic proximity the competition spillovers to hotel performance are still impacted by the distance between the hotel's zip code and the airport. Our preferred measure of competition is the Herfindahl-Hirschman Index (HHI), but we also present regressions using the number of airlines flying on routes to a given airport as an alternative measure of competition. To construct our competition measures, we first calculate the HHI and the number of airlines at the route level. We then aggregate these measures to the arrival-city airport(s) level by taking population-weighted averages over all routes arriving at the airport(s), using origin-city populations as the weights. In all our regressions, we control for time-varying hotel and market characteristics as well as hotel fixed effects and hotel-quality segment-specific year effects.

However, the HHI and the number of airlines on routes to a given arrival city could be endogenous to the performance of hotels in and near the arrival city due to unobserved demand or

[3] See also Kosová and Sertsios (2018) on this.

[4] Based on a survey of airline passengers in the San Francisco Bay Area, Ishii, Jun, and Van Dender (2009) report that the average driving time from the initial origin to the airport is 24 minutes (with a standard deviation of 20 minutes) for business passengers and 30 minutes (with a standard deviation of 23 minutes) for leisure passengers.

supply shocks that could affect both airline competition and hotel performance (e.g., different usage of online booking across cities). Hence, in our estimations, we instrument for the HHI using a Bartik-style instrument (Bartik, 1991). Applied to our context, we construct this instrument using airline market shares on each route in the year before the beginning of our sample, combined with national growth rates of each airline to calculate predicted market shares for each airline on each route. We use these predicted market shares to compute predicted HHIs and aggregate them from the route level to the arrival city airport(s) level following the same aggregation method as for actual HHIs. This instrument satisfies the exclusion restriction, as airline route market shares are predetermined, and the other instrument components exploit time variation in the airline network at the national (rather than a local) level. Hence, conditional on all our controls including hotel fixed effects and segment-year effects, the instrument should be uncorrelated with unobserved performance shocks at the hotel level in a given year. At the same time, given its nature, this instrument should be correlated with the HHI, and it performs well in all our first-stage regressions.

For our alternative competition measure, the number of airlines, we use a weighted average of the number of carriers serving the origin cities of routes being flown to the arrival city airport(s) as an instrument. Berry (1992) found that endpoint presence is predictive of route entry.[5] Since this instrument is based on the number of carriers serving the *origin* city, it should be uncorrelated with unobserved shocks to hotel performance at the *destination* city and thus satisfy the exclusion restriction.[6] Like Berry, we find that the number of carriers serving the origin is predictive of the number of airlines serving routes to the destination in our first stage regressions.

We begin our analysis by estimating benchmark hotel fixed effects regressions without instruments, followed by instrumental variables fixed effects regressions. In all specifications, we find that more intense airline competition boosts hotel performance across all three measures: the room price, the occupancy rate, and RevPAR. These results are consistent for both competition measures, the HHI and the number of airlines.

We then test whether airline competition generates heterogeneous spillovers to hotels in different types of locations. We find some evidence that the effect of airline competition on hotel performance declines with the hotel-airport distance even in our 50-mile radius. This is consistent with most airline travelers staying in hotels close to the airport so changes in airline market

[5] Goolsbee and Syverson (2008) use endpoint presence to proxy for the threat of entry.
[6] We use origin vs. departure and destination vs. arrival interchangeably throughout the paper.

structure have the strongest effect on those hotels. We do not find evidence of heterogeneous responses among hotels in urban areas or destinations with highly seasonal airline traffic.

We also analyze whether there is heterogeneity across passenger types, comparing destination cities with high versus low shares of business travelers. To do so, we utilize data from the American Travel Survey on the respondents' travel purpose and estimate whether the HHI impact on hotel performance differs between destinations with above and below-median shares of business travelers. We find that airline competition significantly increases hotel revenues in both types of destinations. However, while hotels in destinations with a higher share of business travelers raise their prices significantly more, hotels in locations dominated by leisure travelers benefit mostly through higher occupancy rates. These findings suggest that the effect of airline competition on hotel performance varies with the share of price-sensitive travelers in a market.

As such, intensified airline competition is likely to be most beneficial for hotels that primarily cater to relatively more price-sensitive travelers. To explore whether this is the case, we take advantage of a unique feature of the hotel industry context – information on the quality segment in which each hotel operates. We split our sample into three subsamples: high-quality branded hotels, lower-quality branded hotels, and unbranded hotels. The results show that the performance spillovers from airline competition are entirely due to branded hotels. We find no significant effects among unbranded hotels. This suggests that airline travelers, who typically live far from their destination and may have limited information about the quality of unbranded hotels in that location, prefer to stay in branded hotels. These hotels belong to chains with national or international recognition, for which uniformity in product offerings and common quality standards across outlets within each brand are the key to overall chain success and revenue generation (see Blair and Lafontaine, 2005).

Among branded hotels, we find evidence that more intense airline market competition generates a higher revenue increase in lower-quality hotels than in higher-quality hotels. Moreover, for a given increase in airline competition, lower-quality hotels experience a larger occupancy increase, but a smaller price increase than high-quality hotels. These results suggest that more intense airline competition increases the overall number of hotel stays, but also increases the share of travelers who are price-sensitive and therefore more likely to stay in lower-quality hotels. Though our results consistently show that airline competition has positive spillovers on hotel performance, we do not find evidence that these spillovers translate into more hotel entry.

From a policy and managerial perspective, our paper shows that more intense competition in one industry (in our case airlines) positively affects performance in a complementary industry (in our case hotels). Moreover, the impact differs across product segments in the complementary industry, with firms that cater to more price-sensitive consumers benefitting the most. To our knowledge, we are among the first to empirically demonstrate these effects.

More broadly, we contribute to several streams of literature focusing on various sources of inter-industry spillovers across different settings. First and perhaps closest to our setting are a few recent studies that also exploit the hotel or broader hospitality industry context. Hubbard and Mazzeo (2019) study how demand increases associated with highway completion affected the employment, number, and size of hotels and motels during the 1960s to 1980s. They find that increased demand intensified quality competition in the form of fixed investments and led to a decrease in the number of firms. Kadiyali and Kosová (2013) utilize data on hotel rooms sold to study the inter-industry employment spillovers from U.S. tourism inflows, while Kim, Proserpio, and Basuroy (2020) analyze spillovers from Airbnb entry on local restaurant revenues.

Second, there is a growing body of literature (e.g., Brueckner, 2003, Blonigen and Cristea, 2015, Sheard, 2019) studying the role of air services for the local economy (e.g., employment, GDP, population growth). These studies show positive spillovers from aviation expansion on urban development. We differ from these studies by focusing on firm outcomes rather than on macro-level effects as they do. Giroud (2013) shows that shorter travel times between a firm's headquarters and its production plants increase plant-level investment and productivity.

Third, several studies in international and development economics focus on the spillovers from foreign direct investment on various performance outcomes – such as firm productivity, growth, survival, or employment – of domestic firms (e.g., Aitken and Harrison, 1999, Javorcik, 2004, Kugler, 2006, Kosová, 2010, Ayyagari and Kosová, 2010). This literature finds positive inter-industry spillovers via input-output linkages between domestic and foreign firms. Inter-industry spillovers and co-movements across sectors have been also studied to better understand economic business cycles (e.g., Shea, 2004, Foerster, Sarte, and Watson, 2011, and Foerster, Hornstein, Sarte, and Watson, 2021).

The rest of the paper is organized as follows: Section 2 provides the institutional and conceptual framework, explaining the complementarity between the airline and the hotel industries. Section 3 describes our data sources and aggregate data patterns. Section 4 presents our methodology. Section 5 presents and discusses our results. Section 6 concludes.

2. Conceptual Framework: Hotels, Airlines, and Inter-Industry Spillovers

2.1. Institutional Background

The hospitality, travel, and tourism sector represents an important part of the U.S. economy. In 2017, this sector generated over $1.6 trillion in sales, about 2.8 percent of GDP. It also accounted for nearly a third of all U.S. services exports and about 11 percent of all U.S. exports.[7] Accommodation and air travel represent the largest two industries within this sector. In 2017, accommodation accounted for 19 percent ($300 billion) and air travel for 17 percent ($270 billion) of total travel and tourism spending. Both industries also play an important role in terms of U.S. employment, with 2.1 million jobs in accommodations and 0.9 million jobs in air travel.

The fact that many hotel guests arrive via air travel makes these two industries and their products complementary. Some travelers purchase plane tickets and hotel accommodations from travel agencies as a bundle for a single price, which obfuscates how fees are split between the airfare and the hotel room. In addition, there are business linkages between airlines and hotels, such as joint customer loyalty programs. Airlines also regularly contract for hotel rooms for their crew or passengers stranded due to overbooking, mechanical delays, or unexpected weather (Fogarty, 2015). These inter-industry linkages raise the question of the extent to which changes in the airline industry spill over to hotels.

The U.S. airline industry has experienced substantial changes in market structure since its deregulation in 1978 (e.g., Borenstein and Rose, 2014). After deregulation removed entry restrictions and price controls, major network carriers, such as American Airlines, Delta, and United Airlines, developed hub-and-spoke networks which took advantage of economies of density to connect destinations more efficiently than during the regulated era (Brueckner, Dyer, and Spiller, 1992, Brueckner and Spiller, 1994). At the same time, these hub-and-spoke networks led to significant market power for hub airlines, creating barriers to entry and resulting in high fares at hubs (Borenstein, 1989 and 1991).[8] All of the major network airlines, also known as legacy

[7] See https://www.selectusa.gov/travel-tourism-and-hospitality-industry-united-states.

[8] Another feature which emerged after deregulation was substantial price discrimination (e.g., Borenstein and Rose, 1994, Dana, 1998, Gerardi and Shapiro, 2009).

carriers, have been involved in mergers with other network carriers over time and, today, only three of them still exist. During our sample period, nine major airlines operated in the U.S., and this period pre-dates the recent mergers between several of these carriers.[9]

Southwest Airlines and a few other carriers pursued a very different business model than the major legacy airlines – a model which has been labeled as "low-cost" (e.g., Gittell, 2003).[10] Low-cost carriers (LCCs) offered substantially cheaper fares and fewer amenities for passengers than other airlines. While some of the original LCCs have failed and exited the market, several new entrants have successfully followed the low-cost business model. LCCs expanded their domestic market share in the U.S. from 14.5 percent in 2001 to 28.6 percent in 2008.

Overall, LCC expansion increased airline competition, reduced average airline prices, and brought higher passenger volumes. Entry by Southwest, in particular, has been analyzed by several studies. For example, Windle and Dresner (1995) find that Southwest entry onto a route reduced the average price by 48 percent, while passenger traffic increased by 200 percent. Dresner, Lin, and Windle (1996) find similar effects of entry by Southwest and other LCCs, not only at the same airport but also at other airports in the same city. Moreover, Goolsbee and Syverson (2008) find that Southwest helped to reduce average airfares not only by its direct expansion but also by threatening entry into new markets. Incumbent airlines on threatened routes cut fares, increasing the number of passengers flying those routes. Hüschelrath and Müller (2012) conclude that during 1995-2009 airfares decreased substantially while demand increased by 37 percent, mostly due to increased competition from LCCs.

While the total number of U.S. airlines, including legacy carriers and LCCs, is reasonably large at the national level during our sample period (18 carriers in 2001 and 16 in 2008), at the individual route level, market concentration is usually quite high. In our sample, the median route-level HHI is 0.524, the 25th percentile is 0.368, and the 75th percentile is 1.

The market structure of the U.S. hotel industry was relatively stable during our sample period.[11] The industry has been dominated by branded hotels that operate under nationally (or even

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[9] The legacy airlines in our sample are American, Aloha, Alaska, Continental, Delta, Hawaiian, Northwest, United, and US Airways. The low-cost airlines are JetBlue, Frontier, AirTran, America West, Spirit, Sun Country, American Trans Air, and Southwest. America West merged with US Airways in 2006. In addition, Delta and Northwest announced their merger in 2008, but it did not fully come into effect until 2009.
[10] Recently, major network carriers have imitated the LCC model, e.g., by unbundling services such as checked bags (see Brueckner, Lee, Picard, and Singer, 2015).
[11] In recent years, services such as Airbnb have greatly expanded the availability of cheaper accommodation alternatives to hotels. However, this business model started only after the end of our sample period.

globally) recognized brand names belonging to large parent hotel companies (e.g., Hilton Worldwide, InterContinental Hotels Group, Marriott International).[12] As Rushmore and Baum (2001) point out, hotel chain affiliation rose from 35 percent in 1970 to over 80 percent in 2000. Kalnins (2006) further notes that the 10 largest brands (all owned by different parent companies) control about 50 percent of the market. The quality and service offerings of branded hotels are benchmarked into standardized quality tiers (or segments) and individual hotels within the same brand are often indistinguishable from a customer's perspective. Unbranded hotels, on the other hand, are typically local properties, owned and operated by independent owners without nationwide recognition. Their quality tends to vary to a large extent across individual operators (hence, it is not benchmarked as for branded hotels).

2.2 Theoretical Background

As the prior literature discussed above has documented, more intense airline market competition lowers airfares and increases the total number of airline passengers. Since air travel and hotel rooms are complements, demand for hotel rooms and facilities (e.g., conference spaces) should increase and thus raise hotel revenues via the following channels: (a) higher hotel occupancy rates (given that hotel capacity is fixed), (b) higher hotel prices, or (c) both.

Airline markets are segmented into business and leisure travelers. Business passengers are typically less price-elastic than leisure passengers for various reasons, including a higher average income for business passengers, the necessity of traveling to a given destination during certain times due to work reasons, and the fact that many business passengers do not pay for travel expenses out of their own pockets.

If more intense competition between airlines reduces airfares, then the market may attract a higher share of more price-elastic leisure passengers. Since air travelers also need accommodation at their destination, this change in the airline passenger mix will likely spill over to hotel markets. This implies that hotels catering to more price-sensitive travelers (i.e., hotels in lower-quality segments) may experience a bigger revenue increase than hotels that attract more price-inelastic business travelers (i.e., hotels in higher-quality segments).

[12] As Kosová and Sertsios (2018) note, during 2000-2008 33 hotel parent companies were operating in the US; 27 with U.S. headquarters and 6 foreign ones.

Moreover, the positive demand spillovers from more intense airline market competition to hotels may operate through different channels for higher-quality and lower-quality hotels. Specifically, lower-quality hotels which attract more price-sensitive travelers may choose to raise their prices only modestly or not at all (depending on how elastic their demand is), and utilize the additional passengers brought by more intense airline competition to fill spare room capacity and boosts their revenues mainly through increases in occupancy.[13] Higher-quality hotels on the other hand, given their less elastic demand, are more likely to respond via relatively larger price increases, as a result of both overall shifts in the hotel demand and the opportunity for more intense price discrimination of their customers who value extra hotel services.[14] If this is the case, then we would expect a correspondingly greater quantity response (via the occupancy rate) for lower-quality hotels than for higher-quality hotels.

3. Data

3.1. Data Sources

To analyze spillovers from airlines to hotels, we exploit a unique panel data set for US hotel properties from 2001 to 2008 that we obtained from the Smith Travel Research (STR) Company.[15] The STR database covers over 98 percent of existing U.S. hotel properties, including branded and unbranded hotels. Branded hotels represent about 55 percent of observations.

For each hotel, the database provides a unique identifier, the number of rooms, opening date, the hotel's county and zip code, as well as information on the hotel's organizational form (franchised, company managed, and independent) and hotel industry segments. The segments distinguish unbranded from branded hotels, and further classify branded hotels into five categories, depending on the amenities and quality of service offered: luxury and upper-upscale, upscale, midscale with food & beverage (F&B), midscale without F&B, and economy.[16] Appendix A.1 describes product quality differences across segments and provides examples of brands associated

[13] In our sample, the average occupancy rate is 67.7 percent for high-quality hotels, 58.8 percent for low-quality hotels, and 56.7 percent for unbranded hotels. See the next section for more details on hotel quality and Section 5.5. for analyses by hotel quality.

[14] A recent Travelport survey suggests that about 55 percent of global travelers are willing to pay more (even from their own funds) for extras such as larger hotel rooms or rooms that come with extra services and privileges.

[15] STR is a market research firm that collects information about hotels in the U.S. and internationally. Its Hotel Census Database is the most comprehensive data source on the hotel industry available. We obtained access to all STR data under a confidentiality agreement.

[16] Since there are only a few luxury hotels, we merged luxury and upper-upscale hotels into one category. In our empirical analyses, we use a single segment dummy for this category.

with each segment. The information on segments allows us to assess whether spillovers from the airline industry vary by hotel quality.

In addition to hotel census information, STR collects monthly information on hotel revenues, hotel rooms available, and rooms sold for almost all branded hotels and some unbranded ones. Using these data, we construct annual averages of standard performance measures used in the hotel industry, namely: revenue per available room (RevPAR), occupancy rate, and room price (average daily room rate) for each hotel year (see Appendix A.1 for more details).[17] Using annual averages allows us to smooth out outliers and avoid seasonality in monthly values. Other variables that we rely on as controls in our analyses are also reported only annually.

To control for time-varying market characteristics, we use data from the Census Bureau, the Bureau of Labor Statistics (BLS), and the Federal Housing Finance Agency (FHFA). These provide annual information on county population (from the Census Bureau's annual population estimates), unemployment rate (from the BLS), median household income (from the Census Bureau), an annual house price index (HPI), compiled by Bogin, Doerner, and Larson (2019), to control for real estate values (from FHFA), and employment in hotel-related industries: Accommodation/Lodging (not just hotels), Arts, Entertainment & Recreation, and Food & Beverage (all from the Census Bureau's County Business Patterns data). We use county-level data because this is the lowest level of aggregation at which time-varying market characteristics are regularly reported on an annual basis.

Since spillovers from airline competition may diminish with hotel distance from the airport, we focus our analysis on hotels that are located within 50 miles of an airport. We determine the airport closest to each hotel by using the centroid of the hotel's zip code as a proxy for its location.[18] Our number of observations is 143,966, including 22,062 hotels in 5,260 different zip codes.

We construct measures of airline market competition based on information from the Department of Transportation's Database 1B (DB1B). The DB1B provides a 10 percent sample of all domestic airline tickets and allows us to calculate the number of annual passengers for each airline on each route.[19] We define the number of passengers on a route as the sum of all nonstop

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[17] RevPAR combines the effect of the room price and occupancy rate, as conceptually it is the product of the two.
[18] To preserve hotel confidentiality, we do not have hotel names, addresses, or other details besides the hotel zip code.
[19] The database also includes ticket prices, but not any other ticket characteristics such as advance booking, length of stay, or frequent flyer status.

and one-stop passengers. We exclude airline-route combinations with very few observations to avoid one-time routings or miscodings (see Appendix A.2. for more details).

We define airline markets – or routes – as directional city pairs.[20] For example, the city pair Chicago – Washington, DC, includes two airports in Chicago (O'Hare and Midway) and three airports in Washington (Dulles, Reagan National, and Baltimore). Under this market definition, all passengers traveling between any Chicago airport and any Washington airport are part of the same market. We consider airports to be in the same 'city' if they are no more than 50 miles apart. Appendix Table A.1 provides a list of cities with multiple airports.

We calculate two separate measures of competition. Each of these is initially constructed at the route-year level and then aggregated to the destination city-year level. If a destination city has multiple airports, all its airports have the same values of the (aggregate) competition measures. We match the destination city competition measures from the closest airport to each hotel.

Our first competition measure is the Herfindahl-Hirschman Index (HHI). To construct it, we first calculate an airline's market share on each route as the airline's share of all passengers on the route. Then, we calculate the route level HHI as the sum of squared market shares of all airlines. Next, we aggregate the route level HHI to the destination city level by taking a weighted average across all routes arriving at that destination city, using the departure city populations as weights. For example, if destination city A has flights only from city B (population 2 million) and city C (population 1 million), then we calculate the aggregate HHI at destination city A as:

$$HHI_A = \frac{2}{3} * HHI_{BA} + \frac{1}{3} * HHI_{CA}$$

where HHI_{BA} and HHI_{CA} are the route level HHIs for routes BA and CA, respectively.

Since some airports are not located in major metropolitan areas, we calculate the origin city population as the total population of all counties located within 50 miles of the departure airport. For cities with multiple airports, we use the total population of all counties that are within 50 miles of at least one of the airports in the city.

Our second competition measure is the number of airlines offering service on a route. Again, we include nonstop and one-stop service. As with the HHI, we first calculate this measure at the

[20] Brueckner, Lee, and Singer (2014) provide a detailed discussion of this market definition, which is widely used in the literature (e.g., Berry, 1992, Goolsbee and Syverson, 2008, Gerardi and Shapiro, 2009, and Berry and Jia, 2010).

route-year level and then aggregate it to the destination city-year level using the same aggregation method. Appendix Table A.2 shows summary statistics of both competition measures by year.

3.2. Descriptive Statistics and Aggregate Data Patterns

Appendix A.1 summarizes definitions and measurements of our variables, and Table 1 shows descriptive statistics. A hotel in our sample has on average 136 rooms and is 19 years old. The average room price is $82 per night, with an average room occupancy rate of 60.6 percent, yielding $52 in revenues per available room (RevPAR).[21]

We have 143,966 hotel-year observations in our sample. 20.5 percent of these observations belong to company-operated hotels, 66.8 percent to franchised hotels, and the remaining 12.7 percent represent hotels operated by independent owners. The distribution across the six hotel quality segments is as follows: 8.6 percent are ‘luxury and upper-upscale’ hotels, 12.2 percent are ‘upscale’ hotels, 13.9 percent are ‘midscale with food and beverage’, 28.0 are ‘midscale without food and beverage’, 29.4 percent are ‘economy’ and 8.1 percent are unbranded hotels.

Since we have restricted our sample to hotels that are no more than 50 miles from the nearest airport, the average distance to the closest airport is 16.3 miles. 12.8 percent of hotel observations are in an urban location. An average hotel in our sample operates in a county with a population of 1.05 million people, median household income of $50,100, an unemployment rate of 5.1 percent, and average employment in three related industries of 8,978 in arts, entertainment, and recreation, 7,720 in accommodation/lodging, and 35,954 in food and beverage, per year. The average house price index (with the base year 2000) is equal to 137, with a standard deviation of 34.

Turning to airline market characteristics, the mean HHI is 0.486 and the average number of airlines on a route is 4.55. This is consistent with the typical airline market having one or two airlines with large market shares and a few other airlines with small market shares. The mean seasonality index is 1.49, which indicates that during our sample period, on average the quarter with the largest number of passengers has 49 percent more passengers than the quarter with the fewest passengers.

[21] For 5 observations, the occupancy rate is above 100 percent. This can occur for example due to late hotel booking cancellations when a one-night charge is applied while the same room is also re-booked and sold to another customer, or if extra beds are added to a standard room by customer request (e.g., for families with children).

4. Empirical Methodology

4.1. Hotel Fixed Effects Regressions

To analyze how competition in airline markets affects hotel performance, we estimate a general empirical specification as follows:

$$y_{iszct} = \beta Competition_{zt}^{a} + \mathbf{M}'\boldsymbol{\Gamma}_{it} + \mathbf{Q}'\boldsymbol{\Omega}_{ct} + \theta_{st} + \delta_i + \varepsilon_{iszct} \quad (1)$$

The dependent variable *y* is one of the three hotel performance measures: The log of revenue per available room (RevPAR), the log of the average room price, or the occupancy rate (in percent) of hotel *i* in segment *s*, operating in zip code *z* and county *c* in year *t*. Our variables of interest are measures of airline competition in arrival city *a*, located closest to the hotel's zip code *z* in year *t*.

$\boldsymbol{\Gamma}$ represents a vector of time-varying hotel specific controls: hotel age and size (number of rooms), both in logs, and organizational form dummies (see Section 3.1 and Appendix A.1).[22] $\boldsymbol{\Omega}$ represents a vector of time-varying county-level characteristics to control for differences in economic conditions in which hotels operate and which could potentially be correlated with our airline competition measures. Population (in logs), median household income (in logs), and the unemployment rate capture the market size, costs of living, and level of local disposable income. They also help us to control for differences in the hotel clientele that might be attracted to different areas (e.g., business travelers often stay in richer or more highly populated areas). The house price index controls for changes in the costs of real estate.

To further control for changes in tourism intensity, local demand, and potential competition in the hotel market that could affect hotel performance, we include annual employment in three related industries (all in logs): Arts, Entertainment and Recreation (AE&R), Food and Beverage (F&B), and overall Accommodations and Lodging (Accom.). Given that these industries source from the same labor market as hotels, they also help us capture possible changes in local labor market conditions. Our results are robust to including the number of hotels in a county as an additional control (results available upon request).

In addition, we include hotel segment-year dummies, θ_{st}. These control for (to us) unobserved macroeconomic or policy shocks that may affect hotel performance and airline competition and

[22] A sufficient number of hotels change their organizational form over time so that we can include these dummies together with hotel fixed effects.

allow for potentially different impacts of such shocks across the eight years and six hotel segments in our sample (see Section 3.1. and Appendix A.1 for more detail on the hotel segments). Finally, to control for (to us) unobserved hotel heterogeneity (e.g., the specifics of the location), we control in all our estimations for hotel fixed effects, δ_i. We also estimate modified versions of equation (1) in which we interact the competition measures with time-invariant hotel characteristics. In all estimations, we cluster the standard errors at the hotel zip code level, the same level at which we match our airline market variables to the hotel data.

4.2. Instrumental Variable (IV) Estimations

The HHI and the average number of airlines on routes to a given arrival airport may be endogenous to the performance of hotels in and near the arrival city due to unobserved demand or supply shocks that could affect both airline competition and hotel performance, such as differential trends in the use of online booking across arrival cities.[23] Therefore, as our main specifications, we estimate equation (1) instrumenting for the HHI and the number of airlines at each airport, respectively. We use a Bartik-style instrument for the HHI (see, for example, Bartik, 1991 and Goldsmith-Pinkham, Sorkin, and Smith, 2020).[24]

We construct our instrument Z_{at} for the HHI at arrival city *a* based on predicted market shares of each airline on each route *r* and then aggregate to arrival city *a*. We predict route-level airline market shares for the years 2001-2008 based on the airlines' route-level market shares in the year 2000 (period 0) and aggregate national trends over the subsequent years. We calculate $\hat{s}_{crt}$, carrier *c*'s predicted market share on route *r* in year *t*, as:

$$\hat{s}_{crt} = s_{cr0} * g_{ct} \quad (2)$$

where s_{cr0} is airline *c*'s market share on route *r* in period 0 and g_{ct} is airline *c*'s national passenger growth rate (across all routes) between years 0 and *t*.

To construct our instrument, we first calculate the route-level HHIs that would result from these predicted market shares in each year $t > 0$.[25] Then, we aggregate the route-level HHIs to the

[23] Orlov (2011) shows that Internet penetration reduced airline fares, especially in more competitive markets.
[24] Sheard (2019) and Butters (2020) use similar Bartik-style instruments for characteristics of the airline network and for airline and hotel demand volatility, respectively.
[25] We normalize predicted market shares so that they sum to one.

level of the arrival city *a* by taking a weighted average across all routes arriving at *a* using the departure city populations as weights as explained in Section 3.1 above. In regressions which include the interaction of *Competition* and time-invariant hotel characteristics such as distance, we also interact the instrument with the hotel characteristic.

The identification of our instrument comes from two sources. The first source is *predetermined* market shares from the year 2000, which should be uncorrelated with unobserved shocks to hotel *i*'s performance at time *t* conditional on all the controls, which include hotel fixed effects and hotel-segment specific year effects. The second source is time variation in airlines' national growth rates which are driven by national trends, but not by local market shocks (at the city or hotel zip code level). Therefore, our instrument is plausibly exogenous to the performance of a hotel *i* operating in zip code *z* near city *a* in year *t*, but at the same time correlated with the airline HHI in city *a* in year *t*.

Goldsmith-Pinkham, Sorkin, and Smith (2020) point out that in canonical applications the identification of the Bartik instruments comes primarily from cross-sectional variation in pre-period industry shares, which results in different levels of exposure to subsequent industry-level shocks. The same is true in our setting where the distribution of market shares in the year 2000 (period 0) explains most of the variation in predicted market shares in our sample period (2001-2008). To illustrate this, consider a simple OLS regression of predicted market shares on pre-period market shares at the carrier-route-year level. The regression results in an R-squared of 0.82, showing that a large fraction of the variation in predicted market shares is explained by pre-period market shares. Our instrument is identified by the differential exposure to aggregate carrier-year level shocks based on variations in the carriers' pre-period market shares.

As mentioned above, the instruments are valid if pre-period *airline* market shares are not correlated with future changes in *hotel* performance conditional on all our controls. This assumption is plausible for several reasons. First, as Goldsmith-Pinkham, Sorkin, and Smith (2020) discuss, this is typically the case if one includes unit – in our case hotel – fixed effects, there is a pre-period, and shares are fixed. All these hold in our setting. Second, airlines decide which routes to enter and how many flights to offer based on overall network considerations such as their hub locations and the presence of competitors. Third, our dependent variables are at the individual hotel level rather than the overall hotel industry level. As a result, the fixed effects in our model let us control for unobserved hotel and market characteristics at a highly disaggregated level. Fourth, barriers to entry in airline markets are low and airlines can adjust schedules quickly in response to shocks. Therefore, it is unlikely that airlines would adjust their market shares years in advance of a future shock that may be unobserved by the econometrician but correctly anticipated by the airlines. Finally, one source of important shocks to both airline and hotel markets were the 9/11/2001 terrorist attacks and the subsequent recovery. The incidence of these shocks was almost surely unrelated to airline market shares in 2000. Moreover, we capture the impact of such shocks on average hotel performance by including hotel-segment year dummies in all our estimations.

The following two examples demonstrate how pre-period market shares and national growth rates affect the instruments. First, consider the route Jacksonville, FL, to Philadelphia, PA. On this route, US Airways has the largest market share (measured by the number of passengers) in 2000, with 77 percent, while Delta and Frontier have market shares of 13 percent and 10 percent, respectively. At the national level, US Airways experiences negative growth during most of our sample period while Frontier experiences positive growth. US Airways' predicted market share in 2006 is 61 percent, while Frontier's is 26 percent and Delta's is 12 percent. On this route, the predicted HHI in 2006 is lower than the HHI in the pre-period. The second example is the route from Austin, TX, to Raleigh-Durham, NC. On this route, Southwest has the largest market share in 2000, with 47 percent, followed by American (29 percent), Delta (15 percent), and Continental (9 percent). Among these four airlines, Southwest experiences the highest growth over our sample period. Consequently, Southwest's predicted market share in 2006 has increased to 52 percent, while the predicted shares are 30 percent for American, 10 percent for Delta, and 9 percent for Continental. In this market, the carrier with the largest pre-period market share has the highest growth rate at the national level, resulting in a predicted HHI for 2006 which is higher than the HHI in the pre-period. Appendix Table A.3 shows summary statistics on pre-period market shares and passenger growth by carrier.

Recall that we define our second competition measure as a weighted average of the number of airlines serving routes to a given arrival airport. To construct an instrument for this competition measure, we first calculate the number of carriers that had a presence in the departure city of each route in the previous period. We define departure city presence as the airline serving at least one other route out of the departure city. For example, assume that arrival city A has flights from two different departure cities, B and C. Then we would first calculate the number of airlines that serve at least one route other than B-A out of departure city B and, separately, the number of airlines which serve at least one route other than C-A out of departure city C. The next step is to aggregate these numbers from the route level to the arrival city level by calculating a weighted average using departure city populations as weights. For example, if city B has a population of 2 million and city C has a population of 1 million, we would calculate a weighted average using the weights 2/3 for city B and 1/3 for city C. This is the same aggregation method as for the competition measure itself.

This instrument uses findings by Berry (1992), which showed that an airline's presence at one or both endpoints of a route has a positive effect on the probability that the airline enters the route itself. Since this instrument relies on endpoint presence in the origin cities, not the destination cities nearby which the hotels are located, the instrument should be uncorrelated with unobserved local shocks in the arrival city (given our set of controls) and thus satisfy the exclusion restriction. Like Berry, we find that the number of carriers with departure city presence is predictive of the number of carriers serving the route in our first stage. Overall, our instruments perform quite well across all the specifications; we provide details when discussing the results.

5. Results

5.1. Hotel Fixed Effects Regressions

In Table 2, we present the results from hotel fixed effects regressions in which we treat the airline market HHI as exogenous. For each dependent variable –log(RevPAR), log(Price), and the occupancy rate – we present two specifications. The first one includes the airline HHI and the control variables (as described in Section 4). The second specification adds an interaction term between HHI and the hotel's distance to the nearest airport. The direct effect of *Distance* is absorbed by the hotel fixed effect and thus not included as a regressor.

We find that the airline HHI has a negative effect on all three hotel performance measures, and all three effects are statistically significant at the 1 percent level. This finding implies that a decrease in airline market concentration – proxying for more intense airline market competition – is associated with better hotel performance.

The interaction term between HHI and the hotel's distance to the closest airport is always positive and statistically significant. The estimates of the direct effect of HHI remain significant, maintain their negative sign, and increase in magnitude (in absolute terms) for all hotel outcomes. This shows that performance spillovers from airline competition diminish with distance and hotels located closer to an airport respond more strongly to changes in airline competition. This is consistent with the notion that airline travelers stay at hotels near their arrival airport rather than hotels located further away.

5.2. Instrumental Variable (IV) Fixed Effects Regressions

Airlines and hotels might be exposed to similar unobserved shocks, making measures of airline competition potentially endogenous to hotel performance. We address this concern by estimating instrumental variables (IV) regressions with hotel fixed effects, as described in Section 4.2 above. The first-stage regressions for our two competition measures, the airline market HHI and the number of airlines, are shown in Appendix Table A.4. The instruments perform well in terms of statistical significance of the estimates and F-statistics; they also have the expected positive signs.

Table 3 shows the results from specifications that mirror those from the fixed effects regressions in Table 2. As before, we find across all specifications that the effect of the airline market HHI on hotel performance is negative and statistically significant. When we include the interaction between the airline market HHI and the hotel's distance to the closest airport, the coefficients on the interaction term remain positive but shrink in magnitude and are no longer statistically significant in any specification. (Appendix Table A.5. provides a full set of results including controls).

The point estimates of the airline market HHI are larger (in absolute value) in the IV-fixed effects regressions compared to the OLS with fixed effects estimates in Table 2, suggesting that unobserved shocks to hotel performance are negatively correlated with the HHI. This could be, for example, a result of negative shocks to both markets leading to airline exit (and thus higher concentration in airline markets) and worse hotel performance. As we further discuss in Section 5.5., unlike in the airline or other industries, exit is rare for hotels due to their high levels of fixed capital. Another reason behind higher IV estimates might be the heterogeneity in responses in our pooled sample.[26] We explore this possibility below.

The coefficient on HHI (-0.53) in Column 1 of Table 3 implies that a one percent decrease in the airline HHI (or a change of -0.00486 at the sample mean) increases RevPAR for the average hotel by 0.258 percent. This translates into $4,062 of additional annual revenue for an average

[26] IV estimates the local average treatment effect, while OLS gives the average treatment effect over the entire population.

hotel in our sample.[27] The within-unit standard deviation in HHI is 0.0394, and a change of this magnitude would imply a change in hotel revenue of almost $33,000 per year. The estimates in Columns 3 and 5 further show that this revenue boost arises through both the price and occupancy channels, via an increase in the average hotel room price by about 0.087 percent and an increase in the occupancy rate by 0.087 percentage points, or 0.143 percent.

To put these magnitudes in perspective, we calculate the implied effect of the same change in the HHI on the number of passengers traveling to the destination city, based on the findings in other studies. Specifically, Borenstein (1989) estimates the semi-elasticity of median airfares with respect to the route level HHI to be 0.1822.[28] Berry and Jia (2010) report that the price elasticity of airline demand was 1.55 in the year 1999 and 1.67 in the year 2006. Combining these estimates, we calculate that a decrease in the HHI of one percent from our sample mean (or a change of -0.00486) would increase the number of airline passengers by 0.137 percent in 1999 and 0.148 percent in 2006. This lines up very closely with our estimated effect on the hotel occupancy rate of 0.143 percent. Also, note that airfares are predicted to fall as a result of the decrease in the HHI. We find that hotel revenues increase by more than the occupancy rate due to increasing hotel prices, which is consistent with lower airfares increasing travelers' willingness to pay for hotel rooms.

In Table 4, we estimate the same specifications using our alternative measure of competition, the number of airlines. We instrument for this competition measure as described in Section 4.2. While the HHI is an inverse measure of competition – a higher HHI proxies for less competition – the number of airlines is positively related to the degree of competition. Therefore, we expect the signs on the estimated effects in Table 4 to be the opposite of the signs on the estimates in Table 3. We find that this is indeed the case.

The number of airlines has a positive effect on hotel performance across all specifications. The interaction of the airline HHI with the hotel's distance to the airport has a negative effect, which again implies that hotels that are located closer to an airport respond more strongly to changes in airline competition than hotels further away. The effects are statistically significant in all specifications, except in Column 5 which estimates the impact of the airline HHI on the hotel occupancy rate without the distance interaction. The point estimates in Columns 1 and 3 imply that

[27] As shown in Table 1, average RevPAR is $52. So, the increase in annual hotel revenues is: $52*0.00258(our estimated increase)*136 rooms per day*0.61(occupancy rate)*365 days = $4,062.
[28] Borenstein (1989), Table 2, Column 2.

a one percent increase in the number of competing airlines (or a change of 0.045) would increase hotel RevPAR by about 0.135 percent and the average room price also by 0.140 percent. If the number of competitors increased by the within-unit standard deviation of 0.38, we would predict an increase in RevPAR of 1.14 percent and an increase in the room price of 1.18 percent.

5.3. Are Spillovers from Airline Competition higher in Urban or more Seasonal Locations?

In Table 5, we estimate the specifications from Table 3 including an interaction between the airline HHI and a dummy for whether a hotel is in an urban location. The direct effect of the *Urban* dummy is absorbed by the hotel fixed effects. We include this interaction to test whether spillovers from airline market competition are stronger among hotels that can more easily attract airline travelers, such as hotels in downtown areas or other urban locations. We find across all specifications that this interaction is statistically insignificant. Hence, hotels in urban locations are not affected differently by airline competition than hotels in other locations.

In Table 6, we similarly estimate the specifications from Table 3 but now add an interaction between the airline HHI and the degree of seasonality of the airline market. Again, the direct effect of the seasonality index is absorbed by the hotel fixed effects. We measure seasonality at the airline-route level by breaking down the total number of passengers on the route by quarters for each year and averaging over all years in our sample. For each route, we then take the ratio of the average number of passengers in the quarter with the most passengers divided by the passengers in the quarter with the fewest passengers. A higher ratio indicates a larger amount of variation between the busiest and least busy quarter of the year on a given route. We aggregate this measure from the route level to the arrival city level by taking a weighted average across routes, using the departure city populations as weights.

We include the seasonality interaction to test whether airline competition spillovers vary in markets with larger fluctuations in arriving airline passengers. Hotels in such locations may have higher occupancy rates in the peak season but may give larger price discounts in the off-season. We find that the interaction has no statistically significant effect on annual hotel performance in any of our specifications.

5.4. Do Spillovers Vary Across Business and Leisure Passengers?

The impact of airline market competition may vary between business and leisure travelers. Business travelers tend to be less price-sensitive than leisure passengers, and as a result, an increase in airline competition may have a different effect on hotels depending on whether the change occurs in a market with a high or low share of business travelers. To investigate this, we use a business travel index based on the American Travel Survey (ATS) from 1995 (see Borenstein, 2010). The ATS reports the purpose of over 100,000 trips on commercial airlines during 1995 and is the latest survey of this nature available. We use the index as a proxy for the business vs. leisure orientation of each airport. The ATS data include the traveler's destination state and, if available, the destination Metropolitan Statistical Area (MSA).[29] We use the index at the MSA level if available and at the state level otherwise.

To estimate whether the impact of airline competition varies with the share of business travelers, we create two indicator variables, *HighBiz* and *LowBiz*, which are equal to one if the arrival city's business travel index is above or below the median, respectively. We then interact these dummy variables with the HHI and present the results in Table 7. We find that the impact of the airline HHI on hotel RevPAR is significantly negative for both passenger types. Though the effect is slightly larger in magnitude (in absolute terms) for hotels in cities with a high share of business travelers, the difference in the coefficients is not statistically significant. The price response is large in magnitude and statistically significant among hotels with a high share of business travelers. For hotels in cities dominated by more leisure travelers, the effect of the airline HHI on the average room price is close to zero and statistically insignificant. However, our point estimates suggest that these hotels experience a larger change in occupancy rates than hotels in more business-oriented destinations, with estimated coefficients of -27.7 and -12.0, respectively. The t-test of equality of these two coefficients shows that the difference is marginally significant (p-value 0.108). The mean occupancy rates for the two types of hotels are very similar (61.6 percent in cities with a high share of business travelers and 59.6 percent in cities with a low share of business travelers).

Hence, our results show that in markets with a larger share of relatively price-insensitive business travelers, hotels respond to an increase in airline market competition by raising their prices as well as increasing their quantity. This behavior may be the result of increased demand as

[29] Some airports are located outside an MSA. These have no MSA-level index, but the state-level index is available.

well as the opportunity for hotels (esp. high-quality ones that cater to more business passengers) to engage in more intense price discrimination of their business customers who also have a higher willingness to pay for hotel amenities. In contrast, hotels in markets with a larger share of more price-sensitive leisure travelers do not respond to an increase in airline market competition by raising their prices. Instead, given their more elastic demand, these hotels use the additional passengers brought to the market to fill spare room capacity and thus experience a larger occupancy rate increase than hotels in more business-oriented locations.

5.5. Do Spillovers Vary by Hotel Quality Segment?

In this section, we analyze how the spillovers from airline market competition vary across hotels in different quality segments. If an increase in airline competition lowers ticket prices and brings more price-sensitive passengers or leisure-oriented passengers (e.g., families) to the arrival city, these passengers may sort into lower-quality or unbranded hotels and thus affect these hotels more strongly. To test this, we split hotel observations into three groups based on their quality segment: high-quality branded hotels (luxury, upper-upscale, and upscale segments), lower-quality branded hotels (midscale and economy), and unbranded hotels (quality not benchmarked).

We estimate separate regressions for these subsamples. We do not pool the regressions because about thirteen percent of hotels in our sample switch between these three groups during the sample period. Separate sub-sample analyses allow for the regression coefficients on all control variables, including the hotel fixed effects, to vary as hotels switch between groups and thus provide more reliable and robust estimates.

Table 8 shows the results for the three subsamples, presented in Panels A, B, and C. Each panel shows the effect of the airline HHI on the three measures of hotel performance. In Panels A and B, we find that for both high-quality and lower-quality branded hotels the effect of the airline HHI on all three measures of hotel performance is significantly negative, as it was in the full sample in Table 3. This implies that all branded hotels benefit from increased airline competition.

The magnitude of the spillovers and channels through which the spillovers are generated vary across the two hotel quality groups. For hotel RevPAR, the coefficient on the airline HHI is larger in magnitude for lower-quality than for high-quality branded hotels. Thus, lower-quality branded hotels experience a greater revenue boost for a given increase in airline competition. Columns 2 and 3 of Panels A and B show that the estimated magnitudes of the price and quantity responses vary across the two groups of branded hotels. For high-quality branded hotels, which tend to cater to less price-sensitive customers, we estimate a larger percentage increase in the average room price than for their lower-quality counterparts. In turn, lower-quality branded hotels experience a greater improvement in their occupancy rate than high-quality hotels. This pattern is consistent with the hypothesis that airline markets with more intense competition attract a larger proportion of more price-elastic travelers who choose to stay in lower-quality branded hotels.

Interestingly, for unbranded hotels in Panel C, we find that while the estimated coefficients on the airline HHI are all negative, none of the effects are statistically significant. This suggests that spillovers from airline competition mainly benefit branded hotels. Such hotels belong to large hotel chains with national or international recognition and are either operated by the parent company or franchised. The brand owners push for uniformity in product and service offerings and common quality standards across outlets within each brand, which are key to their success and overall chain revenue generation (see Blair and Lafontaine, 2005). Hence airline passengers, who typically travel a long distance and have less information about the quality of unbranded hotels in their arrival city, may prefer to stay in branded hotel properties with more predictable quality.

5.6. Do Spillovers Affect Hotel Entry?

In the final part of our analysis, we explore whether hotel performance spillovers from changes in airline competition go beyond hotel financial and operational performance. To do so, we estimate whether airline competition affects hotel entry rates. We can infer entry from the opening year reported for each hotel in our data. However, because some hotels do not appear in the data set every year after they are open, we cannot derive a valid measure of hotel exit. As Freedman and Kosová (2012) discuss, entry rates in the hotel industry are generally low compared to other industries. One reason is that hotels hardly exit. Instead, they downgrade their quality or get disaffiliated with their brand and are sold to independent operators.[30] As a result, the difference between gross entry rates and net entry rates is likely small.

We calculate annual hotel entry rates at the county level - defined as the number of new hotels opened in a given county per year, divided by the number of incumbent hotels in the same county

[30] As Povel, Sertsios, Kosová, and Kumar (2016) point out, conversions into offices, apartments, or retirement homes are also quite rare, and only 0.5-1 percent of the existing property stock is demolished per year.

and year. The mean entry rate is 3.7 percent, and the modal entry rate is zero. However, 72.9 percent of counties experience hotel entry in at least one year during our sample period.

Using entry rates as the dependent variable, we estimate fixed effects and IV-fixed effects regressions at the county level including as controls one-year lags of county population, income, the unemployment rate, employment in three related industries (AE&R, F&B, and Accommodation), the house price index, and year fixed effects. The competition variables and their instruments are also one-year lags, reflecting the fact that decisions about new hotel development are made before hotel entry is observed.[31] As competition measures, we use the HHI in Columns 1 and 2 and the number of competing airlines in Columns 3 and 4. For each competition measure, we first present the direct effect (Columns 1 and 3) and then add its interaction with our seasonality measure (Columns 2 and 4). We do so because in locations with a high degree of seasonality hotels likely reach high occupancy only during the peak season. As a result, the entry response may be weaker in these locations compared to less seasonal destinations.

We present the results in Table 9. Panel A shows the standard fixed effects regressions, and Panel B shows results from IV regressions with fixed effects. In both sets of regressions, we find no statistically significant effects of airline market competition on hotel entry rates. Even though our earlier results consistently show that airline competition generates positive spillovers to hotel performance, we do not find evidence that these spillovers translate into higher hotel entry rates. However, the nature of barriers to entry and sunk costs is quite different for the airline and hotel industries. Barriers to entry and market-level fixed investments are comparatively low in airline markets, and as a result airline competition can change fairly quickly.[32] In contrast, as noted earlier, the sunk costs of capital investments in hotel properties are higher as these are less easily converted to alternative uses. Consequently, hotel investors may be reluctant to commit to building new hotels in response to – possibly short-lived – changes in airline market structure.

[31] Hotel construction times are increasing over time, but in the US a new hotel can be built relatively quickly. Before 2018 the average time was about 2 years (Duan, 2020). Note, we lose one year of observations in IV regressions when using the number of airlines as competition measure as the instrument for this variable was already lagged.

[32] During our sample period, four U.S. airports (John F. Kennedy and LaGuardia in New York, Reagan National in Washington, DC, and O'Hare in Chicago) were subject to takeoff and landing restrictions, or "slot controls". Since then, slot controls were dropped at O'Hare.

6. Conclusion

We analyze whether and how changes in the market structure of the airline industry spill over into the hotel industry, given that the two industries sell complementary goods. We combine detailed data on hotel performance with measures of airline competition at the nearest airports. Our analyses consistently show that more intense airline competition has a positive effect on hotel performance via increased hotel revenue per available room, room prices, and occupancy rates.

However, we find that the degree of spillovers and the channels through which the spillovers are generated vary with hotel quality and across business vs. leisure travelers. Hotels in cities with a higher share of arriving business travelers raise their prices significantly more and experience a smaller increase in occupancy rates than hotels in locations dominated by leisure travelers. We also find evidence that lower-quality hotels, which cater to the more price-sensitive travelers likely brought into the market by increased airline competition, experience the largest revenue boost, primarily due to increased occupancy rates. At the same time, we find no evidence of performance spillovers from airline competition to unbranded hotels, which have no wide recognition and whose quality would likely be unknown to many airline travelers.

We also explore whether the impact of airline competition varies with other characteristics of a hotel's location, namely operating in an urban area and the seasonality of airline travel. We do not find heterogeneity in airline competition effects across these dimensions. Some of our results show, however, that spillovers from airline competition diminish with a hotel's distance to the nearest airport. Despite the consistently positive effects of airline competition on hotel performance, we do not find that hotel entry rates respond to airline competition. This may be due to the different nature of barriers to entry and sunk costs across these two industries. While estimating the impact on welfare is beyond the scope of this paper, our finding of a positive effect of airline competition on hotel rooms sold implies that total welfare in the hotel industry likely increased as well.

From a policy and managerial perspective, our paper has important implications. First, more intense competition in one industry (in our case airlines) boosts demand and performance in a complementary industry (in our case hotels). Second, the magnitude of the spillovers varies across product segments – with relatively larger benefits for firms that cater to consumers with lower willingness to pay. Antitrust and competition policy is often focused solely on the effects of market structure changes within the same industry. Our results imply that policymakers should also consider the spillover effects to related industries. For example, antitrust authorities consider how airline mergers affect route-level competition and may challenge mergers of airlines with substantial route overlap or require divestitures before approving a merger. As a result of that, as well as of the continued expansion of LCCs after 2008, we calculate that on routes in our sample, the passenger-weighted average HHI did not increase between 2008 and 2018. This is despite several large mergers during this period which reduced competition at the national level. Our findings suggest that preserving market-level competition in the airline industry not only benefitted airline passengers but also the hotel industry via competition spillovers. More broadly, spillovers may also exist between vertically related industries, and they may affect demand as well as supply.

References

Aitken, Brian J. and Ann E. Harrison. 1999. Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela. *American Economic Review,* 89 (3): 605-17.

Autor, David, David Dorn, Lawrence F. Katz, Christina Patterson, and John Van Reenen. 2020. The Fall of the Labor Share and the Rise of Superstar Firms. *Quarterly Journal of Economics* 135(2), 645-709.

Ayyagari, Meghana and Renáta Kosová. 2012. Does FDI Facilitate Domestic Entry? *Review of International Economics*, 18(1): 14-29.

Bartik, Timothy. 1991. *Who Benefits from State and Local Economic Development Policies?* W.E. Upjohn Institute.

Basu, Susanto. 2019. Are Price-Cost Markups Rising in the United States? A Discussion of the Evidence. *Journal of Economic Perspectives* 33(3), 3-22.

Berry, Steven. 1992. Estimation of a Model of Entry in the Airline Industry. *Econometrica* 60(4), 889-917.

Berry, Steven and Panle Jia. 2010. Tracing the Woes. An Empirical Analysis of the Airline Industry. *AEJ: Microeconomics*, 2: 1-43.

Berry, Steven, Martin Gaynor, and Fiona Scott Morton. 2019. Do Increasing Markups Matter? Lessons from Empirical Industrial Organization. *Journal of Economic Perspectives* 33(3): 44–68.

Blair, Roger, D. and Francine Lafontaine. 2005. *The Economics of Franchising,* Cambridge Univ. Press.

Blonigen, Bruce and Anca D. Cristea. 2015. Air Service and Urban Growth: Evidence from a Quasi-Natural Policy Experiment. *Journal of Urban Economics*, 86: 128–146.

Bogin, Alexander N., William M. Doerner, and William D. Larson. 2019. Local House Price Dynamics: New Indices and Stylized Facts. *Real Estate Economics,* 47(2): 365-398.

Borenstein, Severin. 1989. Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry. *RAND Journal of Economics* 20(3): 344-365.

Borenstein, Severin. 1991. The Dominant-Firm Advantage in Multiproduct Industries: Evidence from the U.S. Airlines. *Quarterly Journal of Economics* 106(4): 1237-1266.

Borenstein, Severin. 2010. An Index of Inter-City Business Travel for Use in Domestic Airline Competition Analysis. *National Bureau of Economic Research*.

Borenstein, Severin and Nancy Rose. 1994. Competition and Price Dispersion in the Airline Industry. *Journal of Political Economy* 102(4): 653-83.

Borenstein, Severin and Nancy Rose. 2014. How Airline Markets Work …or Do They? Regulatory Reform in the Airlines Industry. *Economic Regulation and Its Reform: What Have We Learned?* Edited by: Nancy Rose, Chicago Press: 63-135.

Brueckner, Jan, Nichola Dyer, and Pablo Spiller. 1992. Fare Determination in Airline Hub-and-Spoke Networks. *RAND Journal of Economics* 23(3): 309-333.

Brueckner, Jan, and Pablo Spiller. 1994. Economics of Traffic Density in the Deregulated Airline Industry. *Journal of Law and Economics* 37(2): 379-415.

Brueckner, Jan. 2003. Airline Traffic and Urban Economic Development. Urban Studies, 40(8): 1455-69.

Brueckner, Jan, Darin Lee, and Ethan Singer. 2014. City-Pairs Versus Airport-Pairs: A Market-Definition Methodology for the Airline Industry. *Review of Industrial Organization* 44: 1-25.

Brueckner, Jan, Darin Lee, Pierre Picard, and Ethan Singer. 2015. Product Unbundling in the Travel Industry: The Economics of Airline Bag Fees. *Journal of Economics and Management Strategy* 27: 457-484.

Butters, Andrew 2020. Demand Volatility, Adjustment Costs, and Productivity: An Examination of Capacity Utilization in Hotels and Airlines. *American Economic Journal: Microeconomics* 12(4), 1-44.

Dana, James. 1998. Advance-Purchase Discounts and Price Discrimination in Competitive Markets. *Journal of Political Economy* 106(2): 395-422.

De Loecker, Jan, Jan Eeckhout, and Gabriel Unger. 2020. The Rise of Market Power and the Macroeconomic Implications. *Quarterly Journal of Economics* 135(2), 561-644.

Dresner, Martin, Jiun-Sheng Chris Lin, and Robert Windle. 1996. The Impact of Low-Cost Carriers on Airport and Route Competition. *Journal of Transport Economics and Policy* 30(3): 309-328.

Duan. 2020. Hotels Are Taking Longer to Build (https://www.costar.com/article/126212996).

Foerster, Andrew, Pierre-Daniel Sarte, and Mark Watson. 2011. Sectoral versus Aggregate Shocks: A Structural Factor Analysis of Industrial Production. *Journal of Political Economy* 119(1), 1-38.

Foerster, Andrew, Andreas Hornstein, Pierre-Daniel Sarte, and Mark Watson. 2021. Aggregate Implications of Changing Sectoral Trends. *Federal Reserve Bank of San Francisco Working Paper*.

Fogarty, Allison. 2015. Airports Hotels: Laying the Foundation for a Synergistic Relationship. *Boston Hospitality Review,* Summer: 10 -17.

Freedman, Matthew, and Renáta Kosová. 2012. Agglomeration, Product Heterogeneity and Firm Entry. *Journal of Economic Geography*, 12: 601-626.

Gerardi, Christopher and Adam Hale Shapiro. 2009. Does Competition Reduce Price Dispersion? New Evidence from the Airline Industry. *Journal of Political Economy* 117(1): 1-37.

Giroud, Xavier. 2013. Proximity and Investment: Evidence from Plant-Level Data. *Quarterly Journal of Economics* 128, 861-915.

Gittel, Jody H. 2003. *The Southwest Airlines Way*. New York: McGraw-Hill Press.

Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift. 2020. Bartik Instruments: What, When, Why, and How. *American Economic Review* 110(8), 2586-2624.

Goolsbee, Austan and Chad Syverson. 2008. How Do Incumbents Respond to the Threat of Entry? Evidence from the Major Airlines. *Quarterly Journal of Economics*, 123(4): 1611–33.

Hubbard, Thomas N. and Michael Mazzeo. 2019. When Demand Increases Cause Shakeouts. *AEJ: Microeconomics*, 11(4):216-249.

Hüschelrath, Kai and Kathrin Müller. 2012. Low Cost Carriers and the Evolution of the Domestic U.S. Airline Industry. *Competition and Regulation in Network Industries,* 13(2): 133-159.

Ishii, Jun, Sunyoung Jun, and Kurt Van Dender. 2009. Air travel choices in multi-airport markets. *Journal of Urban Economics* 65, 216-227.

Javorcik, Beata 2004. Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages. *American Economic Review*. 94 (3), 605-627.

Kadiyali, Vrinda and Renáta Kosová. 2013. I*nter-Industry Employment Spillovers from Tourism Inflows. Regional Science and Urban Economics*, 43(2): 272-281.

Kalnins, Arturs 2006. Markets: The U.S. Lodging Industry. *Journal of Economic Perspectives* 20(4): 203-218.

Kim Yongseok, Davide Proserpio, and Suman Basuroy. (2020). Sleeping with strangers: Estimating the impact of Airbnb on the local economy. *Proceedings of the European Marketing Academy,* 49, 64673.

Kosová, Renáta. 2010. Do Foreign Firms Crowd Out Domestic Firms? Evidence from the Czech Republic. *The Review of Economics and Statistics*. 92(4), 861-881.

Kosová, Renáta and Giorgio Sertsios. 2018. An Empirical Analysis of Self-Enforcement Mechanisms: Evidence from Hotel Franchising. *Management Science,* 64(1): 43–63.

Kugler, Maurice. 2006. Spillovers from Foreign Direct Investment: Within or Between Industries? *Journal of Development Economics*, 80(2): 444-477.

Orlov, Eugene. 2011. How Does the Internet Influence Price Dispersion? Evidence from the Airline Industry. *Journal of Industrial Economics* 59(1), 21-37.

Porter, Michael. 1979. How Competitive Forces Shape Strategy. *Harvard Business Review*.

Povel, Paul, Sertsios, Giorgio, Kosová, Renáta, and Kumar, Praveen 2016. Boom and Gloom. *Journal of Finance* 71(5): 2287–2332.

Rushmore, Stephen and Erich Baum. 2001. *Hotels and Motels: Valuation and Market Studies*. Chicago: Appraisal Institute.

Shea, John. 2004. Complementarities and Comovements. *Journal of Money, Credit and Banking*, 34(2): 412-433.

Sheard, Nicolas. 2019. Airport Size and Urban Growth. *Economica,* 86(342): 300-335.

Syverson, Chad. 2019. Macroeconomics and Market Power: Context, Implications, and Open Questions. *Journal of Economic Perspectives* 33(3): 23-43.

Windle, Robert and Martin Dresner. 1995. The Short and Long Run Effects of Entry on U.S. Domestic Air Routes. *Transportation Journal* 35(3): 14-25.

Table 1: Summary Statistics, 2001-2008

Variable	Mean	Std. Dev.	Min	Max
Hotel Characteristics				
Revenue per available room (RevPAR)	51.98	36.79	0.96	798.67
Occupancy Rate	60.64	15.17	2.04	102.76
(Room) Price	82.00	47.58	14.90	1,490.26
Rooms	136.20	133.34	4	3437
Age	18.86	16.80	1	348
Distance to airport (in miles)	16.28	12.73	0.31	49.98
Urban Indicator	0.128	0.334	0	1
County Characteristics				
(Median HH) Income	50,091	12,135	23,818	111,582
Unemployment Rate (%)	5.06	1.34	1.9	14.4
Population	1,053,844	1,633,815	4,281	9,808,494
AE&R employment	8,978	14,160	0	85,996
Accommodation employment	7,7201	14,723	0	185,226
Food & Beverage employment	35,954	49,878	0	309,550
House Price Index	137.17	34.19	90.56	268.65
Airline Competition & Market Variables				
Herfindahl-Hirschman Index (HHI)	0.486	0.161	0.267	1
HHI Instrument	0.393	0.188	0.088	1
No. airlines	4.55	2.03	1	9.70
No. airlines Instrument	14.58	0.91	10.10	18.16
Seasonality Index	1.49	0.31	1.17	4.29

The number of observations is 143,966.

Table 2: Hotel Fixed Effects Regressions

	(1) Log(RevPAR)	(2) Log(RevPAR)	(3) Log(Price)	(4) Log(Price)	(5) Occupancy rate	(6) Occupancy rate
HHI	-0.099***	-0.21***	-0.050***	-0.086***	-2.66***	-7.28***
	[0.025]	[0.045]	[0.011]	[0.020]	[1.00]	[1.76]
HHI*Distance		0.0061***		0.0020**		0.25***
		[0.0019]		[0.00087]		[0.067]
R^2	0.930	0.930	0.971	0.971	0.804	0.804
Observations			143,966			
No. hotels			22,062			
No. zips			5,260			

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include hotel- and county-level controls as in Appendix Table A.5, hotel fixed effects, segment-year dummies, and hotel organizational dummies.

Table 3: Instrumental Variables (IV) Fixed Effects Regressions

	(1) Log(RevPAR)	(2) Log(RevPAR)	(3) Log(Price)	(4) Log(Price)	(5) Occupancy rate	(6) Occupancy rate
HHI	-0.53***	-0.58***	-0.18***	-0.24**	-17.9***	-21.4***
	[0.10]	[0.20]	[0.050]	[0.10]	[3.70]	[7.11]
HHI*Distance		0.0025		0.0028		0.19
		[0.0076]		[0.0037]		[0.27]
Observations			143,966			
No. hotels			22,062			
No. zips			5,260			

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include hotel- and county-level controls, hotel fixed effects, segment-year dummies, and hotel organizational dummies. See the full set of results in Appendix Table A.5. *HHI* is instrumented by a Bartik-style instrument – the first stage regressions are reported in Appendix Table A.4 (col. 1).

Table 4: IV Fixed Effects Regressions, Alternative Measure of Competition

	(1) Log(RevPAR)	(2) Log(RevPAR)	(3) Log(Price)	(4) Log(Price)	(5) Occupancy rate	(6) Occupancy rate
No. airlines	0.030**	0.13***	0.031***	0.054***	0.23	4.49***
	[0.012]	[0.020]	[0.0061]	[0.0098]	[0.48]	[0.78]
No. airlines* Distance		-0.0073***		-0.0016***		-0.30***
		[0.00097]		[0.00045]		[0.039]
Observations	143,966					
No. hotels	22,062					
No. zips	5,260					

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include hotel- and county-level controls as in Appendix Table A.5, hotel fixed effects, segment-year dummies, and hotel organizational dummies. *No. airlines* is instrumented by the lagged number of carriers which serve the origin city – the first stage regressions are reported in Appendix Table A.4 (col. 2).

Table 5: IV Fixed Effects Regressions: Are Competition Spillovers higher in Urban Areas?

	(1) Log(RevPAR)	(2) Log(RevPAR)	(3) Log(Price)	(4) Log(Price)	(5) Occupancy rate	(6) Occupancy rate
HHI	-0.56***	-0.65***	-0.18***	-0.23**	-19.8***	-25.2***
	[0.11]	[0.23]	[0.055]	[0.11]	[3.97]	[8.14]
HHI*Distance		0.0041		0.0026		0.28
		[0.0083]		[0.0039]		[0.29]
HHI*Urban	0.37	0.41	-0.074	-0.048	19.5	22.2
	[0.41]	[0.44]	[0.18]	[0.19]	[16.2]	[17.3]
Observations	143,966					
No. hotels	22,062					
No. zips	5,260					

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include hotel- and county-level controls as in Appendix Table A.5, hotel fixed effects, segment-year dummies, and hotel organizational dummies. *HHI* is instrumented by a Bartik-style instrument – the first stage regressions are reported in Appendix Table A.4 (col. 1).

Table 6: IV Fixed Effects Regressions: Do Competition Spillovers vary with Seasonality?

	(1) Log(RevPAR)	(2) Log(RevPAR)	(3) Log(Price)	(4) Log(Price)	(5) Occupancy rate	(6) Occupancy rate
HHI	-0.59***	-0.63***	-0.20***	-0.25**	-20.1***	-23.4***
	[0.12]	[0.21]	[0.061]	[0.11]	[4.23]	[7.45]
HHI*Distance		0.0021		0.0027		0.18
		[0.0076]		[0.0037]		[0.27]
HHI* Seasonality	0.049	0.049	0.013	0.013	1.75	1.75
	[0.045]	[0.045]	[0.019]	[0.019]	[1.54]	[1.52]
Observations	143,966					
No. hotels	22,062					
No. zips	5,260					

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include hotel- and county-level controls as in Appendix Table A.5, hotel fixed effects, segment-year dummies, and hotel organizational dummies. *HHI* is instrumented by a Bartik-style instrument – the first stage regressions are reported in Appendix Table A.4 (col. 1).

Table 7: IV Fixed Effects Regressions: High vs. Low Share of Business Passengers.

	(1) Log(RevPAR)	(2) Log(Price)	(3) Occupancy rate
HighBiz*HHI	-0.56***	-0.29***	-12.0***
	[0.13]	[0.074]	[4.00]
LowBiz*HHI	-0.47**	0.0031	-27.7***
	[0.21]	[0.092]	[8.39]
Observations		143,966	
No. hotels		22,062	
No. zips		5,260	

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include hotel- and county-level controls as in Appendix Table A.5, hotel fixed effects, segment-year dummies, hotel organizational dummies. *HighBiz* (*LowBiz*) is equal to one if the arrival city's business travel index is above (below) the median and zero otherwise. *HighBiz*HHI* and *LowBiz*HHI* are instrumented by Bartik-style instruments.

Table 8: IV Fixed Effects Regressions, by Hotel Segment

Panel A: High Quality Branded

	(1) Log(RevPAR)	(2) Log(Price)	(3) Occupancy rate
HHI	-0.46^{***}	-0.21^{***}	-14.6^{**}
	[0.15]	[0.079]	[5.68]
Observations		29,838	
No. hotels		4,930	
No. zips		1,978	

Panel B: Lower Quality Branded

	(1) Log(RevPAR)	(2) Log(Price)	(3) Occupancy rate
HHI	-0.57^{***}	-0.19^{***}	-19.3^{***}
	[0.12]	[0.053]	[4.46]
Observations		102,540	
No. hotels		16,041	
No. zips		4,644	

Panel C: Unbranded

	(1) Log(RevPAR)	(2) Log(Price)	(3) Occupancy rate
HHI	-0.34	-0.18	-7.90
	[0.23]	[0.15]	[8.96]
Observations		11,588	
No. hotels		3,541	
No. zips		1,968	

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. All specifications include hotel- and county-level controls as in Appendix Table A.5, hotel fixed effects, segment-year dummies, hotel organizational dummies. *HHI* is instrumented by a Bartik-style instrument.

Table 9: Hotel Entry Rate, at the County Level

Panel A: Fixed Effects Regressions.

	(1) Entry rate	(2) Entry rate	(3) Entry rate	(4) Entry rate
HHI (lagged)	-0.32	-0.64		
	[2.69]	[6.59]		
HHI (lagged)* Seasonality		0.22		
		[4.28]		
No. airlines (lagged)			0.097	1.40
			[0.38]	[1.21]
No. airlines (lagged)* Seasonality				-0.82
				[0.72]
R^2	0.144	0.144	0.144	0.145
Observations	7255			
No. counties	948			

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at the county level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The regressions are fixed effects estimations at the county level, including as controls lagged values of: Population, Income, Unemployment Rate, Employment in three related industries: AE&R, F&B, Accommodation, House Price Index, and year dummies.

Panel B: IV Fixed Effects Regressions.

	(1) Entry rate	(2) Entry rate	(3) Entry rate	(4) Entry rate
HHI (lagged)	12.3	11.3		
	[11.0]	[12.5]		
HHI (lagged)* Seasonality		0.87		
		[4.42]		
No. airlines (lagged)			1.18	3.54
			[2.67]	[4.37]
No. airlines (lagged)* Seasonality				-1.20
				[1.14]
Observations	7255	7255	6356	6356
No. counties	948	948	945	945

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at the county level. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The regressions are fixed effects IV estimations at the county level, including as controls lagged values of: Population, Income, Unemployment Rate, Employment in three related industries: AE&R, F&B, Accommodation, House Price Index, and year dummies. The airline competition variables are instrumented: *HHI* by a Bartik-style instrument (similarly as in Table 3) and *No. airlines* by the lagged number of carriers which serve origin city (similarly as in Table 4).

Appendix A.1: Variable Definitions.

Variable	Definition
Hotel Characteristics	
RevPAR	Revenue Per Available Room (in $) – total hotel revenues earned from all room nights sold divided by the number of room nights available.
Occupancy Rate	Occupancy Rate (in percent) – hotel rooms sold as a percentage of hotel rooms available.
(Room) Price	Price per room (in $) – total hotel room revenues divided by room nights sold.
Age	Number of years since the year of hotel opening – defined as current year minus year of opening plus one.
Rooms	Hotel size/capacity - number of rooms in a hotel in a given year.
Urban Indicator	= 1 if the hotel is in an urban location (according to STR data).
Distance to the Airport	Straight line distance between the airport and the hotel zip code's centroid.
Organizational form/ Operation type	Indicators whether the hotel is company-managed (operated by hotel company managers & employees); franchised (operated by franchisees, belonging to the franchised chain), or independent (operated by independent (mostly unaffiliated) operators)
Hotel/Quality Segments: (see Freedman & Kosová, 2012 (Table 1)).	
Branded Hotels	
Luxury/Upper Upscale	Elegant, distinctive, highest quality decor, upscale restaurants, full range of first-class amenities, and customized services. Since there are very few luxury hotels, we combine luxury (e.g., Four Seasons, Fairmont, Ritz-Carlton) and Upper Upscale hotels (e.g., Marriott, Wyndham, Sheraton).
Upscale	Well-integrated decor, quality furnishings, premium guestroom amenities and facilities, high staff to guest ratio. Example: Courtyard, Residence Inn, Crowne Plaza.
Midscale w/ F&B	Nicely appointed rooms, range of facilities, good-quality amenities, some special services available, restaurants. Example: Holiday Inn, Best Western.
Midscale w/o F&B	Nicely appointed rooms, range of facilities may be limited, good-quality amenities. Example: Comfort Inn, Hampton Inn, Holiday Inn Express.
Economy	Clean and comfortable, minimum of services and amenities. Example: Microtel Inn, Motel 6, Days Inn.
Unbranded Hotels	No brand affiliation or corporate support, no quality benchmark, heterogeneous quality, and range of amenities and services.

Variable	Definition
County/Market Characteristics:	
Population	Annual county population.
(Median HH) Income	Annual Median Household Income in the county.
Unemployment Rate	Annual unemployment rate in the county (in percent).
AE&R Employment	Annual county employment in the arts, entertainment & recreation industry.
F&B Employment	Annual county employment in the restaurants, food & beverage services industry.
Accommodation Employment	Annual county employment in accommodation establishments in the lodging industry, not just hotels.
House Price Index (HPI)	Annual House Price Index (based/normalized to the year 2000) at the county level from the database, compiled by Bogin, Doerner, and Larson (2019) – accessible via the Federal Housing Finance Agency (FHFA).
Airline Competition & Market Variables:	
HHI	Herfindahl-Hirschman Index. Calculated at the route level as the sum of squared market shares (using nonstop and one-stop passengers). Then, aggregated from the route level to the arrival city level using departure city populations as weights.
No. airlines	Number of airlines. Calculated at the route level as the sum of all airlines serving the route either nonstop or with one stop. Then, aggregated from the route level to the arrival city level using departure city populations as weights.
Seasonality Index	Ratio of the number of passengers in the quarter of the year with the most passengers to the number of passengers in the quarter of the year with the fewest passengers. (See Section 5.3. for more details)

Appendix A.2: DB1B Passenger Sample.

We use passenger data from the U.S. Department of Transportation's Database 1B (DB1B), which is a 10 percent sample of domestic airline tickets. In constructing our passenger sample, we impose several restrictions. We drop observations if the origin and destination are less than 25 miles or more than 6000 miles apart and if either endpoint is in U.S. territories or the state of Alaska. We also drop tickets if the fare is less than $25 or more than $5000. Similarly, we drop very small carriers with fewer than 500,000 passengers per year (fewer than 0.3 percent of all passengers), as well as airports with fewer than 30 passengers per day and routes with fewer than five passengers per day.

The DB1B contains only limited information for the third quarter of 2001, the quarter of the terrorist attacks. We keep the other three quarters of 2001 and adjust the passenger numbers for these quarters by a factor of 4/3 to get an annual estimate.

Appendix Table A.1: Cities with Multiple Airports

City	Airport Codes
Boston	BOS, MHT, PVD
Chicago	ORD, MDW
Cleveland	CLE, CAK
Dallas	DFW, DAL
Houston	HOU, IAH
Los Angeles	LAX, BUR, LBG, ONT, SNA
McAllen	MFE, HRL
Miami	MIA, FLL, PBI
New York	JFK, LGA, EWR, HPN, ISP
Norfolk	ORF, PHF
Pensacola	PNS, VPS
Philadelphia	PHL, ACY
San Francisco	SFO, OAK, SJC
Tampa	TPA, SRQ
Washington, DC	DCA, IAD, BWI

Appendix Table A.2: Summary Statistics for Competition Measures, by Year

Panel A: Herfindahl-Hirschman Index

Year	Mean	SD	Min	Max
2001	0.496	0.169	0.278	1
2002	0.503	0.168	0.274	1
2003	0.496	0.163	0.271	1
2004	0.485	0.157	0.272	1
2005	0.483	0.152	0.284	1
2006	0.478	0.152	0.276	1
2007	0.477	0.159	0.280	1
2008	0.475	0.163	0.267	1
Total	0.486	0.161	0.267	1
Between		0.157		
Within		0.039		

Panel B: Number of Airlines

Year	Mean	SD	Min	Max
2001	4.620	2.214	1	9.702
2002	4.260	1.894	1	8.719
2003	4.390	1.967	1	9.377
2004	4.447	1.911	1	8.648
2005	4.583	1.999	1	8.786
2006	4.680	2.073	1	9.054
2007	4.721	2.078	1	9.255
2008	4.653	2.014	1	8.653
Total	4.549	2.026	1	9.702
Between		2.011		
Within		0.380		

Notes: “Between” refers to between-units standard deviation, and “within” refers to within-units standard deviation.

Appendix Table A.3: Summary Statistics on Instrument Components

Panel A: Market Shares in 2000, Carrier-Route Level

Carrier	Mean	SD	Min	Max
AirTran	0.232	0.270	0.002	1
Alaska	0.553	0.324	0.015	1
Aloha	0.524	0.243	0.03	1
America West	0.345	0.290	0.002	1
American	0.371	0.314	0.004	1
ATA	0.146	0.170	0.003	0.937
Continental	0.333	0.302	0.002	1
Delta	0.479	0.368	0.002	1
Frontier	0.144	0.212	0.003	1
Hawaiian	0.539	0.295	0.006	1
JetBlue	0.133	0.126	0.019	0.427
Midwest	0.517	0.336	0.028	1
Northwest	0.519	0.375	0.002	1
Southwest	0.462	0.316	0.003	1
Spirit	0.275	0.280	0.006	1
Sun Country	0.218	0.191	0.006	1
TWA	0.434	0.343	0.006	1
United	0.355	0.313	0.002	1
US Airways	0.564	0.361	0.005	1

Panel B: National Growth Rates Between Year 0 and Year t, for 2001-2008

Carrier	Mean	SD	Min	Max
AirTran	0.863	0.728	-0.066	1.836
Alaska	0.117	0.088	0.006	0.211
Aloha	-0.478	0.22	-0.905	-0.174
America West	0.014	0.145	-0.19	0.206
American	0.056	0.154	-0.125	0.226
ATA	-0.106	0.512	-0.902	0.536
Continental	0.02	0.133	-0.146	0.267
Delta	-0.155	0.085	-0.278	-0.045
Frontier	1.042	0.766	-0.029	1.993
Hawaiian	-0.243	0.123	-0.391	-0.071
JetBlue	9.709	4.967	1.831	15.067
Midwest	0.443	0.445	-0.048	0.998
Northwest	-0.052	0.084	-0.184	0.033
Southwest	0.18	0.193	-0.044	0.433
Spirit	0.418	0.219	0.082	0.721
Sun Country	-0.47	0.202	-0.871	-0.312
TWA	-0.186	0.059	-0.281	-0.118
United	-0.149	0.093	-0.273	-0.012
US Airways	-0.254	0.184	-0.438	0.016

Notes: Panel A has one observation per carrier route in 2000. Panel B has one observation per carrier-year.

Appendix Table A.4: First Stage Regressions (Full Sample)

	(1)	(2)
Instrumented Var.	HHI	No. airlines
HHI instrument	0.24***	
	[0.020]	
No. airlines instrument		0.21***
		[0.0080]
Log(Rooms)	0.0010	-0.053*
	[0.0030]	[0.029]
Log(Age)	0.00021	-0.0092
	[0.0011]	[0.012]
Log(Population)	-0.019	-0.27
	[0.016]	[0.37]
Log(Income)	-0.021	0.57***
	[0.015]	[0.17]
Unempl. Rate	-0.0036***	0.0069
	[0.00094]	[0.0076]
Log(AE&R empl.)	-0.00012	0.0041
	[0.00044]	[0.0039]
Log(F&B empl.)	-0.00075	0.0075
	[0.00074]	[0.0052]
Log(Accom. empl.)	0.0037***	-0.030***
	[0.00064]	[0.0057]
HPI (with 2000 base)	0.000093***	-0.00019
	[0.000033]	[0.00034]
Hotel Fixed Effects	Yes	Yes
Org. form dummies	Yes	Yes
Segment-Year dummies	Yes	Yes
F-Stat on IV	137.25	707.23
R^2	0.119	0.190
Observations	143,966	
No. hotels	22,062	
No. zips	5,260	

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at the hotel zip-code level.
Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A.5: Full Set of Estimates for Table 3

	(1) Log(RevPAR)	(2) Log(RevPAR)	(3) Log(Price)	(4) Log(Price)	(5) Occupancy rate	(6) Occupancy rate
HHI	-0.53***	-0.58***	-0.18***	-0.24**	-17.9***	-21.4***
	[0.10]	[0.20]	[0.050]	[0.10]	[3.70]	[7.11]
HHI*Distance		0.0025		0.0028		0.19
		[0.0076]		[0.0037]		[0.27]
Log(Rooms)	-0.16***	-0.16***	-0.022**	-0.022**	-6.82***	-6.82***
	[0.023]	[0.023]	[0.011]	[0.011]	[0.85]	[0.85]
Log(Age)	0.28***	0.28***	0.018***	0.018***	12.4***	12.4***
	[0.0063]	[0.0063]	[0.0025]	[0.0025]	[0.23]	[0.23]
Log(Population)	0.38***	0.38***	0.25***	0.25***	7.84**	7.89**
	[0.094]	[0.094]	[0.039]	[0.039]	[3.25]	[3.25]
Log(Income)	0.41***	0.42***	0.29***	0.29***	7.37***	7.61***
	[0.048]	[0.048]	[0.028]	[0.028]	[1.69]	[1.70]
Unempl. Rate	-0.049***	-0.049***	-0.012***	-0.012***	-2.21***	-2.21***
	[0.0031]	[0.0032]	[0.0016]	[0.0016]	[0.11]	[0.11]
Log(AE&R employment)	0.0000081	-0.000026	0.00033	0.00029	-0.065	-0.068
	[0.0020]	[0.0020]	[0.0011]	[0.0011]	[0.056]	[0.056]
Log(F&B employment)	0.0023	0.0024	0.0015	0.0016	0.12	0.12
	[0.0025]	[0.0025]	[0.00098]	[0.00098]	[0.11]	[0.10]
Log(Accom. employment)	0.0053**	0.0052**	0.0021**	0.0020*	0.12	0.12
	[0.0023]	[0.0023]	[0.0011]	[0.0010]	[0.083]	[0.082]
House Price Index	0.00055***	0.00055***	0.00075***	0.00074***	-0.013***	-0.014***
	[0.00010]	[0.00010]	[0.000054]	[0.000056]	[0.0039]	[0.0039]
Hotel Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Org. form dummies	Yes	Yes	Yes	Yes	Yes	Yes
Segment-Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	143,966					
No. hotels	22,062					
No. zips	5,260					

Robust standard errors in brackets, adjusted for heteroskedasticity and clustered at hotel zip-code level.
Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *HHI* is instrumented by a Bartik-style instrument – the first stage regressions are reported in Appendix Table A.4 (col. 1).