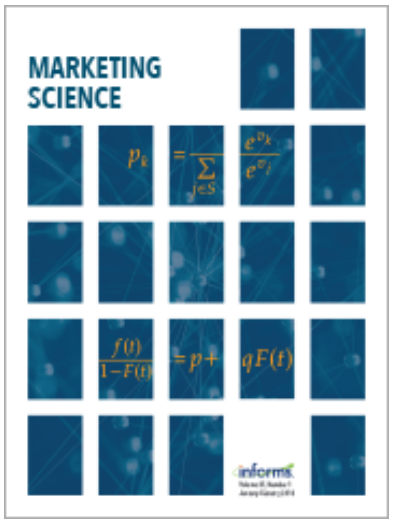

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Heterogeneous Price Effects of Consolidation: Evidence from the Car Rental Industry

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Abstract. We study the price effects of consolidation in the car rental industry using three cross-sections of price data from U.S. airport markets spanning the years 2005 to 2016. The auto rental industry went through a series of mergers during this period, leading to a significant increase in market concentration. We find that the concentration of ownership affects the business (weekday) and leisure (weekend) segments differently. Average weekday prices rose by 2.1% and weekend prices fell by 3.3% with the increase in market concentration. Given the periodic differences in demand from business and leisure travelers, we explain this finding with a model of horizontal product differentiation that allows for heterogeneity in customer types and firms' marginal costs. Consolidation leads to marginal cost savings, but the extent to which these savings are passed onto different customer types depends on the magnitude of switching costs. In particular, weekday customers with high switching costs are charged higher prices because of suppliers' augmented market power whereas the more price-sensitive weekend segment enjoys the lower prices facilitated by efficiency gains. Our findings highlight that consolidation can have differential welfare effects on different customer groups and merger analyses should account for the heterogeneous impact based on firms' price discrimination practices rather than just considering average effects.

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Supplemental Material: Data and the online appendix are available at https://doi.org/10.1287/mksc.2018.1103.

Keywords: market concentration • mergers • market power • cost efficiencies • price discrimination

> When examining possible adverse competitive effects from a merger, the Agencies consider whether those effects vary significantly for different customers purchasing the same or similar products.
>
> — Horizontal Merger Guidelines, U.S. Department of Justice and Federal Trade Commission

1. Introduction

Most industries consolidate as they mature with larger but fewer remaining firms. In their long-term analysis of mergers around the globe, Deans et al. (2002) show that industries generally progress predictably through a clear consolidation process. Recently, there are indications that this trend is accelerating: Globally, the annual number of mergers and acquisitions (M&As) doubled in the past two decades (Institute for Mergers, Acquisitions & Alliances 2017). In the United States, the share of GDP generated by the largest 100 companies increased from 33% in 1994 to 46% in 2013 (Berkeley 2016). In parallel, concentration increased in two thirds of U.S. industries between 1997 and 2012 with the combined share of the top four firms in each sector rising from 26% to 32% (Koen 2016).

Consolidation may potentially improve welfare if merging firms create cost efficiencies when their operations are combined. These are mostly fixed cost efficiencies, such as reductions in overhead, rationalization of assets and production facilities, or promotional and marketing efficiencies (Coate and Heimert 2009). Also, firms can achieve variable cost savings in production, management, and distribution that allow marginal cost reductions, which can be passed on to customers in the form of lower prices. At the same time, however, the drop in the number of market players may increase firms' market power, and prices may increase as a result. A series of studies have documented price effects in both directions for mergers in the airline (Borenstein 1990, Kim and Singal 1993), banking (Focarelli and Panetta 2003), health insurance (Dafny et al. 2012), mortgage (Allen et al. 2014), and retail (Houde 2012, Ashenfelter et al. 2015) industries.

The strategic implication of mergers and acquisitions has been long studied in the marketing literature (e.g., Capron and Hulland 1999, Sorescu et al. 2007, and Swaminathan et al. 2008; see Yu 2013, table 1 for a list of 28 papers that have considered M&As in top marketing journals). Within this literature, a stream of research considers the implications for pricing with changes in

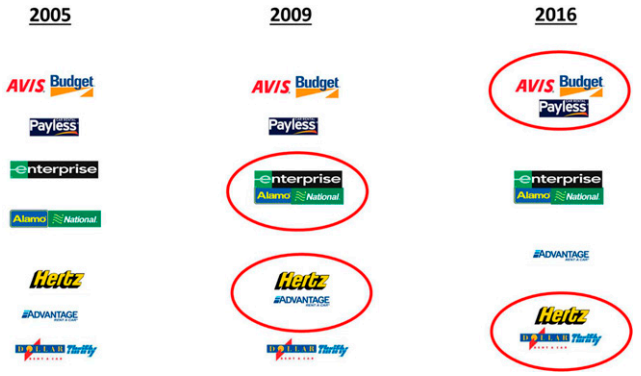
market structure. A change in market structure could include mergers, entry of a new firm or exit of an existing firm, a change in firm policy, or changes in government regulation (e.g., Eliashberg and Jeuland 1986, Balto 2001, Chintagunta et al. 2003, Dube 2005, Homburg and Bucerius 2005, Nijs et al. 2013, Nishida 2014, and Ozturk et al. 2016). Here the changes to pricing resulting from changes in market structure are estimated using policy simulations, surveys, or direct observation. This area of research is of interest to managers and policy makers. For managers, it provides both prescriptive and descriptive information on how prices should change after a change in market structure. We add to the marketing literature by showing the heterogeneous impact of mergers on different consumer segments, therefore suggesting that marketing, with detailed information about consumer preference, should be involved when assessing how the merger will impact the firm's price structure over its distribution of customers.

Our study focuses on an industry with periodic shifts in the composition of customers and in which firms can exploit these shifts to vary the prices offered to different customer segments. Using a simple theoretical model based on extensions of the Salop (1979) model of horizontal product differentiation that allow for heterogeneous marginal costs (Syverson 2004, Vogel 2008, Lin and Wu 2015), we show that the net price effect of a merger may periodically change sign. When serving the customer segment with high switching costs (because of high search costs or higher brand loyalty), the market power effect dominates; firms can profitably increase the price charged to this customer segment as competitive intensity drops. For customers that more easily switch suppliers, on the other hand, the decline in the number of market players does not effectively translate into higher prices, and the price may, in fact, decrease because of cost efficiencies facilitated by the merger.

We document these effects using data from airport car rental markets, focusing on differences in weekday and weekend pricing. Between these two periods, there is a change in the relative demand by business and leisure travelers with the less price-sensitive business travelers increasing in proportion during the weekdays and leisure travelers during the weekends (Stavins 2001, Clemons et al. 2002, Gerardi and Shapiro 2009).

We collect price data from three distinct time periods spanning more than a decade: 2005, 2009, and 2016. The industry went through a major consolidation phase during this period (Figure 1) with two major acquisition events: in 2007, Enterprise acquired Alamo-National and became the second largest player in the airport markets, and in 2012, Hertz, the market leader, acquired Dollar-Thrifty, one of the five largest firms in the industry. Additionally, the sample period covers other ownership changes involving relatively smaller companies: Hertz's acquisition and subsequent divestiture of Advantage (in 2009 and 2012, respectively) as well as Avis-Budget's acquisition of Payless (in 2013). Hence, differently from most of the previous literature that focuses on a single merger event with possibly idiosyncratic effects, we observe rich variation in ownership structure induced by a series of mergers.

Figure 1. (Color online) Ownership Changes



Note. Circles indicate merger events.

Our empirical analysis is based on the differential price effects of the number of independent firms (i.e., owners) in the market versus the number of affiliate firms not independently owned. This approach allows us to flexibly account for any type of market structure change, such as a merger, entry/exit by an independent/affiliate player, or a divestiture. We exploit the panel structure of our data to conduct a difference-in-difference test of the price effects of consolidation, controlling for a rich set of airport-, firm-, and rental period–level fixed characteristics that may make market structure endogenous to price. Given that mergers in our data occur at the national level, they generate local market structure changes that are independent of local profitability shocks.

As the number of owners increases, the market becomes more competitive, and we should expect average markups to fall. At the same time, affiliate firms can also affect prices, either by enhancing competitiveness (by extending the owner's reach to customer segments in which competition was potentially less intense previously) or through cost efficiencies that the combined firm achieves with a larger scale of operation.[1] If there is no price effect of the number of owners, our model predicts that customers' supplier switching costs and, hence, average markups are low. For this case, we conjecture that the market power effect can be ruled out, and the price effect of an affiliate firm, if it exists, reflects the cost efficiencies enabled by affiliation.

In our data, we find that, although the loss of an independent player causes weekday prices to rise by 5.4%, no such effect is observed on weekend prices. However,

weekend prices *do* respond to the number of affiliate firms, which suggests the price-lowering effect of cost efficiency gains. Specifically, we estimate the downward price effect of an affiliate firm to be approximately 3.3% for both the weekday and weekend periods.

Our formulation characterizes a merger between two firms as the change of an independent player of the market into an affiliate firm. Our estimates suggest that this change causes weekday prices to rise by 2.1% (p = 0.05) and the weekend prices to fall by 3.3% (p = 0.01). Thus, postmerger, the less price-sensitive weekday segment faces a price increase in the net (despite the cost efficiency gains). In contrast, the weekend segment, which is immune to market power, enjoys the lower prices facilitated by efficiency gains. We document a parallel effect in the pricing differences between business segment–focused versus leisure segment–focused firms as well as holiday versus regular airports, reinforcing the price-discrimination explanation of our findings.

These empirical results, in line with our theoretical model, provide evidence that the heterogeneity in customers' price sensitivity plays a pivotal role in determining the welfare implications of consolidation in a horizontally differentiated industry. We show that the effect can vary across different customer groups and highlight the importance of taking account of customer heterogeneity in merger analysis, noting that firms can sort customers based on the timing of their demand.

Our data set builds on Singh and Zhu (2008), who conduct a cross-sectional analysis of the effect of market structure on prices in the industry. Data used in Singh and Zhu (2008) correspond to the weekday portion of our 2005 cross-section. Broadly, our study is related to the growing literature on mergers' price effects (e.g., Borenstein 1990; Dafny et al. 2012; Houde 2012; Ashenfelter et al. 2013, 2015). Several of these studies aim to separate the market-power and cost-efficiency effects by making use of temporal (Kim and Singal 1993, Focarelli and Panetta 2003) or geographical (Ashenfelter et al. 2015) differences in their relative magnitudes. The former two papers, which exploit the time variation, compare the mergers' short- and long-term price effects on the conjecture that cost efficiencies would take longer to materialize. In our case, the price variation we focus on is also temporal but periodic (i.e., between the weekday and weekend periods), and our identification relies on the differential price effects of the same market structure change on consumer segments with different price sensitivity.

We explain the difference in mergers' effects on weekday versus weekend pricing through differences in customer switching costs across the periods. This ties our analysis to the stream of theoretical work on the relationship between switching costs and the market's competitiveness (see Klemperer 1995 for a review). This literature shows that switching costs are generally expected to increase firms' market power and hence prices.[2] Our results are also in line with a set of recent studies that document a decrease in price discrimination as markets become more competitive. Gerardi and Shapiro (2009) show that price dispersion in the U.S. airline industry declines with competitive entry, and this change is driven by a decline in the top portion of the price distribution.[3] Similarly, Gaggero and Piga (2011) report evidence from UK airfare data that competition is likely to hinder firms' ability to price discriminate. These papers concentrate on the price effects of firm entries and exits whereas, in the current study, the focus is instead on the ownership changes generated by mergers.[4]

Other than their implications for merging firms and merger regulation, results from the study may be of interest to managers of nonmerging firms operating in consolidating industries. Our findings suggest firms targeting the more price-conscious customers in these industries should prepare for more intense price competition, such as by simplifying their services and rationalizing their cost structure. On the other hand, price increases at the high end may shift the focus of competition in this segment toward quality, urging firms to improve their product/service offerings to justify the higher prices.

The outline of the paper is as follows. Section 2 presents our theoretical model. Section 3 describes our empirical strategy to test the price effects of market and ownership structure. Section 4 provides background information on the industry and introduces the data used in the analysis. In Section 5, we present and discuss our findings, and in Section 6, we conclude with a summary and general discussion.

2. Theory

We make use of a simple illustrative model to lay out the insights that guide our empirical analysis. Building on Salop's model of horizontal product differentiation (Salop 1979), we derive price as an additive function of the firm's marginal cost and market power. Market power, in turn, is determined by customers' switching costs and the market's competitive intensity, that is, number of players. To account for cost efficiency gains for merging firms, we make use of results from extensions of the Salop model that introduce heterogeneity in firms' marginal costs (Syverson 2004, Vogel 2008, Lin and Wu 2015).

We consider a setup in which, based on the timing of their demand, the firm can set different prices to two customer segments with different levels of switching costs (or price sensitivity). In this respect, our setup is similar to Borenstein (1985) and Holmes (1989), who study third-degree price discrimination in oligopoly markets. The model shows that, although consolidation

drives down the marginal cost uniformly, the change in market power depends on segments' switching costs. Therefore, depending on which customer group is predominant in the market, temporal differences are observed in the price impact of consolidation. This result offers an explanation for the weekday versus weekend pricing differentials in the car rental industry.

2.1. Salop Model with Heterogeneous Costs

We assume customers are uniformly located along a circle of unit circumference with linear transport costs $t > 0$. These transport costs may represent any costs associated with switching to a new supplier, such as transaction/contractual costs, learning costs, or accrued loyalty program benefits (Klemperer 1987). Each consumer has inelastic demand for one unit of output and purchases from the supplier that charges the lowest location-adjusted price. Here, supplier denotes an independent price setter (i.e., owner), which may indicate a stand-alone firm or a parent company operating multiple brands. By this, we assume that switching costs are low or null within affiliate brands of the same parent company and essentially take effect when switching across different owners. We assume that there are $n > 1$ such suppliers located equidistantly with each supplier i incurring a constant marginal production cost c_i (uniform across all its brands). For this setup, Lin and Wu (2015) show that a decrease in any one of the supplier's marginal cost leads to a lower equilibrium price for all suppliers, with the expected equilibrium price in the market given by[5]

$$E(p_i) = \frac{t}{n} + E(c_i). \tag{1}$$

Hence, price is a separable function of the average marginal cost and a markup that measures market power. Market power decreases in the number of suppliers and increases with consumers' transport cost t. A decrease in any supplier's marginal cost drives down the equilibrium price.

2.2. Price Effects of Consolidation

Assume that with consolidation, the number of suppliers falls to $n' < n$. Under the consolidated market structure, the new equilibrium price is $E(p_i') = \frac{t}{n'} + E(c_i')$, and the merger-induced price shift can be written as

$$\Delta p = E(p_i') - E(p_i) = t\left(\frac{1}{n'} - \frac{1}{n}\right) + E(c_i') - E(c_i). \tag{2}$$

We denote the demand-side effect (market power effect) as $\Delta d = t(\frac{1}{n'} - \frac{1}{n})$. Because $\frac{1}{n'} - \frac{1}{n} > 0$ and $t > 0$, $\Delta d > 0$; consolidation increases suppliers' market power, inducing upward pressure on prices.

At the same time, because of factors such as learning and cost synergies, we assume that consolidation generates marginal cost savings among merging firms, and consequently, the average marginal cost in the market falls. We denote this drop by $\Delta c = E(c_i') - E(c_i) < 0$.

As the price effect of consolidation is positive on the demand side ($\Delta d > 0$) and negative on the cost side ($\Delta c < 0$), the sign of Δp depends on the relative magnitudes of Δd and Δc.

2.3. Customer Segments and Periodic Demand Shifts

The market is made up of two customer segments denoted high and low, $s \in \{h, l\}$. Customer types h and l differ in their transport costs ($t^h > t^l$), and they demand the good at two distinct periods $w \in \{h, l\}$, in a recurring pattern based on the time of day, week, or year.

$$D^h = \begin{cases} 1 \text{ if } w = h \\ 0 \text{ if } w = l \end{cases}, \quad D^l = \begin{cases} 0 \text{ if } w = h \\ 1 \text{ if } w = l \end{cases}. \tag{3}$$

We assume that suppliers' marginal cost does not vary between the periods. Under these conditions, price movements resulting from consolidation are given by

$$\Delta p = E(p_i') - E(p_i) = \begin{cases} t^h\left(\frac{1}{n'} - \frac{1}{n}\right) + \Delta c & \text{if } w = h \\ t^l\left(\frac{1}{n'} - \frac{1}{n}\right) + \Delta c & \text{if } w = l \end{cases}. \tag{4}$$

We emphasize the following results from the model, which guide our empirical analysis:

(1) Cost efficiencies (Δc) do not depend on the type of customer served and have the same magnitude across $w \in \{h, l\}$.

(2) Given that $t_h > t_l$, the high segment that has high brand switching costs faces a bigger (smaller) price rise (drop); that is, with consolidation, price increases more (or decreases less) in $w = h$.

(3) For any given value of n and n', there exists $\hat{t}$ such that if $t = \hat{t}$, $\Delta p = 0$. For $t_l < \hat{t}$ and $t_h > \hat{t}$, we have $\Delta p = \begin{cases} > 0 & \text{if } w = h \\ < 0 & \text{if } w = l \end{cases}$, whereby, in the net, consolidation causes prices to increase in one period and decrease in the other, depending on the customer segment served.

Translating these results to our empirical setting, by result (1), we expect the cost efficiencies to impact the weekday and weekend prices in the same manner. On the other hand, because the market power varies in strength depending on segments' transport costs, as per result (2), the net price effect of a merger will differ across the two periods. Specifically, for the business segment

with high switching costs, consolidation will have a more adverse (or less beneficial) effect compared with leisure customers. Result (3) states that there is a threshold level of transport costs for which the net price effect of the merger will be zero, implying that if the business customers' loyalty is sufficiently high and the leisure segment's loyalty is sufficiently low, the merger will increase prices for the former customer group (i.e., weekday) and decrease it for the latter (weekend).

3. Empirical Strategy and Predictions

Our empirical analysis of the price implications of market and ownership structure relies on the differential price effects of the number of independent players (owners) in the market versus the number of affiliate firms not independently owned. Given two firms that are co-owned; if both are active in a market, we count them as one owner and one affiliate firm. This approach allows us to flexibly account for any possible market structure change, such as the entry or exit of an independent or an affiliate firm, a merger or a split. The following table summarizes how we account for these changes. A merger of two firms within the market results in an independent player (i.e., owner) becoming an affiliate with the number of owners decreasing and number of affiliates increasing by one.

A market's competitiveness mainly depends on the number of owners, that is, independent price setters. As the number of independent players decreases through mergers, the remaining players will have more market power, and the average markup in the market will go up.

At the same time, an affiliate firm, although not independently owned, can also have a price-lowering effect. This could happen in two ways. First, the affiliate firm can enhance the owner's competitive impact, for instance, by allowing the owner to more effectively target a new customer segment.[6] Second, by facilitating scale economies or learning, affiliation can bring down the joint firm's average marginal costs, enabling price reductions.[7] In this latter case, the affiliate firm count acts as a measure of average merger-induced cost efficiencies in the market (Δc).

For our empirical setting, we make use of the following general regression model to test these effects:

$$\ln(price^{w}_{imct}) = \beta^{w}_{owners} n_{owners,mt} + \beta^{w}_{affi} n_{affi,mt} + \beta^{w}_{m} msize + \beta^{w}_{im} + \beta^{w}_{it} + \beta^{w}_{ct} + +\varepsilon^{w}_{imct}, \tag{5}$$

where i indexes firm, m indexes market (airport), c indexes car type, and t indexes year. Our dependent variable is the log of daily price. We estimate the model separately for the weekday and weekend periods, indexed by w. The market structure variables n_{owners} and n_{affi} denote, respectively, the number of owners and affiliate firms in market m in year t.[8] Our main coefficients of interest are β^{w}_{owners} and β^{w}_{affi}, which measure the weekday- and weekend-specific price response to market structure. We allow for a rich set of controls. Airports' monthly passenger traffic accounts for market size. In addition, we have airport × firm, firm × rental period, and car type × rental period–level fixed effects. Airport–firm fixed effects control for the branch-level (e.g., Avis in ORD airport) unobservables that are constant across the data years.[9] For instance, if the acquiring firm undertakes the merger with a view to strengthen its weaker branches, there could be correlation between the pricing power at a given branch and its probability of "being treated" by the merger. The branch-level fixed effects account for such correlation. Car type × rental period effects account for demand differences for different car types across different rental periods. In our data, such differences may arise as rental dates of the price data in the three cross-sections belong to different calendar months. Finally, firm × rental period fixed effects control for firm-level price changes common to all branches within a rental period, allowing us to focus on the pricing effect of local market structure changes.[10]

We expect both β_{owners} and β_{affi} to be smaller than or equal to zero; that is, price does not rise with the number of active firms. As β_{owners} captures the market power effect, the expectation is that $\beta_{owners} < 0$, that is, markups and, hence, prices decrease in n_{owners}. If $\beta_{owners} = 0$, we infer that price does not respond to changes in n_{owners}. As per our theoretical model, in which the merger-induced change in markup is given by $\Delta d = t(\frac{1}{n'} - \frac{1}{n})$, this suggests that brand switching costs (t) are null/low. Accordingly, firms enjoy no market power, and market prices are at the competitive levels.[11]

Our other coefficient of interest, β_{affi}, could have a nonzero (negative) value, because it captures (i) the additional competitive impact imposed by an affiliate firm on the market's prices and/or (ii) the merger-induced cost efficiency gains. If $\beta_{owners} < 0$ we cannot differentiate between these two mechanisms; given that the number of owners (independent competitors) *does* exert downward pressure on prices, the price effect of affiliate firms can arise both because they contribute to the markets' competitive intensity and because their presence indicates cost efficiencies. On the other hand, in case $\beta_{owners} = 0$, the market power effect is ruled out. Therefore, under the scenario that $\beta_{owners} = 0$ and $\beta_{affi} < 0$, we deduce that β_{affi} reflects the cost efficiencies from merging.

In a market in which the merging firms were both active before the merger, our formulation gives the merger's price effect as the difference in the price effects of an affiliate firm versus an independent player, $\beta_{affi} - \beta_{owners}$ (initially there are two independent players; postmerger there is one independent player and one

affiliate firm). As we expect both terms to be weakly negative, if $|\beta_{owners}| > |\beta_{affi}|$, we deduce that the merger's net price effect is positive; the market power effect dominates any cost efficiencies, and price rises as a result. On the other hand, if $|\beta_{owners}| < |\beta_{affi}|$, the reverse is true; cost efficiencies dominate, and the merger's net price effect is negative.

4. Industry Background and Data

Car rental is a $27.1 billion market in the United States (Auto Rental News 2016). The industry comprises three large parent companies: Hertz Global Holdings Inc., Avis Budget Group Inc., and Enterprise Holdings Inc. These firms, which have grown to their current size through acquisitions, together account for 95% of the market (Duprey 2013). The industry witnessed two major acquisitions in the past decade: in 2007, Enterprise acquired Alamo-National, and in 2013, Hertz acquired Dollar-Thrifty. In both cases, the merging firms were among the sector's five largest companies. Additionally, in this period there were other ownership changes of smaller scale with Hertz's acquisition and subsequent divestiture of Advantage (in 2009 and 2012, respectively), and Avis-Budget's acquisition of Payless in 2013. These market structure changes are summarized in Table 1 and Figure 1.

Because of its potentially adverse effects on prices and consumer welfare, the increasing concentration of ownership in the industry has been a cause for concern:

> Consolidation shrinks the rows on our market data chart in our Fact Book once again. Our 1999 Fact Book, which had 32 rows for 32 separate companies. . . . [T]his year's Fact Book has 11 companies. Amid the continued cries of "oligopoly," the fear is that car rental rates will climb and, with less competition, the customer will suffer. (Brown 2013)

Our data comes from the years 2005, 2009, and 2016 and, in terms of timing, allows us to observe rich variation in firm ownership induced by the industry's consolidation trend. We focus on car rental businesses in 343 U.S. commercial airports.[12] An advantage of focusing on airport markets is that they allow a clean market definition. This is not the case in most other retail industries in which firms and consumers are spread across a contiguous geography and, hence, difficult to assign into distinct markets (Hosken and Tenn 2016). Additionally, with airports, we have a good estimate of market size based on the airport's passenger traffic volume. Price data are collected from Orbitz and Expedia websites and virtually cover all airports at which car rental service is available.[13] Across 343 airports, the panel includes a weekday and a weekend (two dates) price for a range of 27 firms and five car types in 2005, 2009, and 2016 (three years). This results in 54,024 observations that we use for estimation.

Table 1. Data Timeline

Date	Change
March 2005	Price data
August 2007	Enterprise acquired Alamo-National
March 2009	Hertz acquires Advantage
November 2009	Price data
November 2012	Hertz acquires Dollar-Thrifty, divests Advantage
July 2013	Avis-Budget acquires Payless
April 2016	Price data

In terms of customer type, the car rental business is segmented into business and leisure. These segments are roughly of similar size; in 2014, the business segment accounted for 53.8% of all travelers worldwide (Future Market Insights 2015). Compared with leisure customers, business travelers tend to exhibit higher loyalty to a particular airline; surveys show that in their purchase decisions they prioritize rewards programs over price (Boehmer 2012). Given that business customers' demand is less elastic, travel companies attempt to increase their profits by price discriminating between the business and leisure segments (McAfee 2008). A common method to differentiate between the two types of customers is the requirement of a "Saturday-night stay" as the demand of business travelers is concentrated on weekdays and that of leisure travelers on weekends.

For every airport–year pair, our data includes a weekday and a weekend price observation for each firm and car type. Thus, our unit of observation is a firm–airport–year–car type–time of week (weekday or weekend). For instance, the Avis weekend price for a midsized car at the ORD airport in year 2009 would be a representative data point in our sample. The data collection and pickup and drop-off dates for our three cross-sections are shown in Table 2.[14] In total, we observe prices for six rental periods with a weekday and a weekend price for each year of the data. Weekday prices are for a Monday to Tuesday rental, and weekend prices reflect the daily rates for a Friday to Monday rental.[15] We conduct our analyses on price data for five major rental car types. These are economy, compact, midsize, standard, and full. To show the variation in the raw data, in Figure 2 we plot the variation in prices by airport (across firm) and by firm (across airports). Here we show that, in our data, prices do vary within airports and rental car companies.

Table 3 presents the firms' market coverage and the summary statistics of the variables that go into our regressions separately for each year of the data. Compared with weekdays, weekend prices are lower by at least 30% across the different car types. During the sample period, the average number of independent players (owners) per market drops from 4.13 to 3.06, and the affiliate firm count (i.e., the number of firms not

Table 2. Data Dates

		Weekday rental		Weekend rental	
Year	Data collected on	Pickup	Drop-off	Pickup	Drop-off
2005	13-Mar	21-Mar	22-Mar	25-Mar	28-Mar
2009	11-Nov	16-Nov	17-Nov	20-Nov	23-Nov
2016	9-May	16-May	17-May	20-May	23-May

Notes. Data dates read as follows. For instance, the 2005 price data were collected on March 13, 2005, for (1) a weekday rental from March 21, 2005, to March 22, 2005 (Monday to Tuesday) and (2) a weekend rental from March 25, 2005, to March 28, 2005 (Thursday to Monday).

independently owned, calculated as the total number of firms in the market minus the number of owners) increases more than twofold from 1.43 to 2.96. These changes reflect the consolidation trend in the industry; increasingly, markets are served by more firms operated by a smaller owner base. Actually, as of 2016, a large majority of the markets have become a three-player oligopoly (Figure 3).

Table A.1 tabulates the changes in number of owners and affiliate firms. There is high premerger overlap in merging firms' portfolio of markets (Table A.2). Before merging, Enterprise was active in 197 (90.0%) of the markets where Alamo and/or National were present. Likewise, Hertz was active in 118 (96.7%) of the markets where Dollar and/or Thrifty were present. This overlap indicates the large extent of markets affected by a merger. Data shows significant variation in merger- versus entry-/exit-related market structure changes (Figure A.1).

The differences in weekday versus weekend pricing summarized in Figure 4 give an indication of our main results: compared with the weekend period, weekday prices are more responsive to changes in the number of owners. On the other hand, there is no significant difference between weekdays and weekends in the price response to the number of affiliate firms.[16]

5. Results

To measure the competition and ownership effects, our regressions make use of the price variation within an airport–firm pair across the three cross-sections in our data. All our specifications include airport–firm fixed effects, and our standard errors are clustered at this level, allowing for heteroscedasticity and arbitrary correlations in the error term within a branch over car types and data years. Additionally, as explained in Section 3, our regressions control for airports' yearly passenger traffic levels as well as firm × rental period and car type × rental period fixed effects. We analyze the weekday and weekend price movements separately.

Table 4 presents our main results. Specification 1 reported in this table does not account for co-ownership; that is, it treats owners and affiliate firms symmetrically. Under this specification, we find that an additional firm has a price-lowering effect of 4.5% in the weekday period and 1.4% in the weekend period. Overall, weekday prices appear to be more responsive to the market's total firm count.

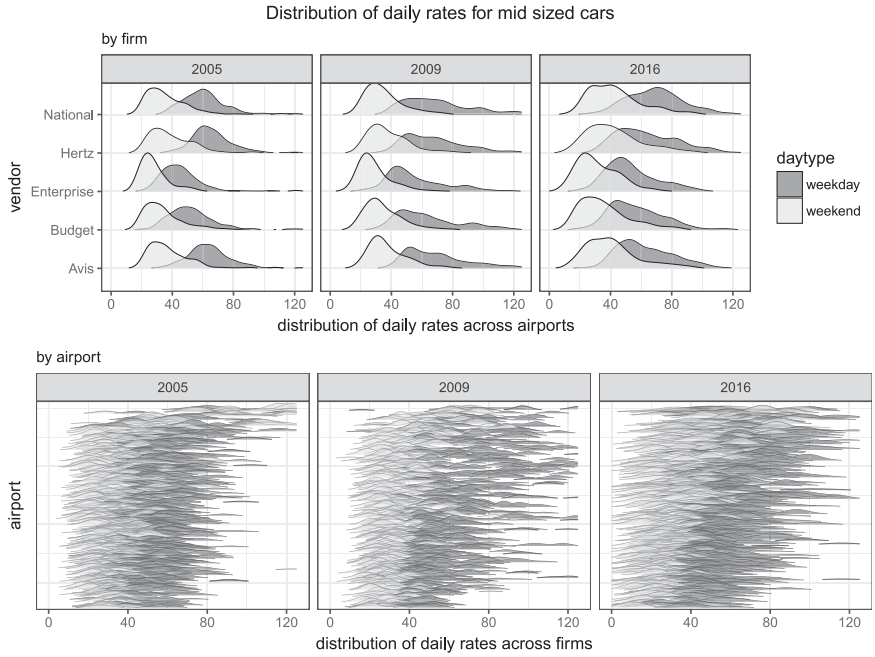
Importantly, we find that co-ownership changes firms' price impact (Table 4, specification 2). In the weekday period, entry by an independent firm draws down the average market price by 5.4%. In comparison, the price impact of an affiliate firm is lower by 2%. For the weekend period, our results again indicate a difference based on ownership: there is a price effect of affiliate firms but not of independent players; the price impact of an owner is measured to be virtually zero, and the estimate is statistically insignificant. In both weekday and weekend, the difference between coefficient estimates of the owner and affiliate firm

Table 3. Data Description

	Firms' market coverage			Summary statistics			
Firm	2005	2009	2016	Variable	2005	2009	2016
Advantage	34	19	38				
Alamo	191	186	195	*Monthly traffic* (millions)	0.16	0.14	0.15
Avis	288	284	298		(0.41)	(0.35)	(0.4)
Budget	226	225	266	*Weekday price* ($)	56.39	66.51	57.98
Dollar	117	108	136		(20.08)	(27.06)	(22.9)
Enterprise	271	243	257	*Weekend price* ($)	37.28	34.58	36.45
Hertz	309	313	306		(19.79)	(13.88)	(20.48)
National	219	210	233	*Number of owners*	4.13	3.13	3.06
Payless	27	19	75		(2.02)	(1.27)	(1.6)
Thrifty	128	109	132	*Number of affiliate firms*	1.43	2.01	2.96
Other	96	46	130		(1.15)	(1.67)	(2.2)

Notes. Sample statistics are computed over 343 airports, 27 firms, and five car types. Figures indicate the variable means. Standard deviations are reported in parentheses.

Figure 2. Distribution of Prices in the Raw Data



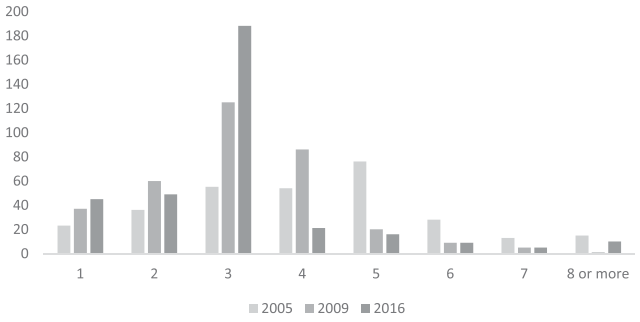
Note. Charts plot the distribution of daily rates by firm (for five major firms) and by 343 airports included in the estimation sample.

count variables is statistically significant at the 1% level. Overall, these findings indicate that accounting for firm co-ownership is important in studying the effect of market structure on prices.

We fail to find an effect of the number of owners on weekend prices, which indicates firms' lack of market power during the weekend period. Our model provides an explanation for this finding; with the leisure segment that easily switches suppliers (i.e., low transport costs t), weekend prices are already close to competitive levels, and an additional player does not contribute significantly to the market's competitiveness.

This result allows us to distinguish between the two possible mechanisms for the price effect of affiliate firms as discussed in the previous section. Based on the weekend findings with the market power explanation ruled out, we conclude that the market's affiliate firm count reflects the cost efficiencies achieved through merging (this corresponds to the case with $\beta_{owners} = 0$, $\beta_{affi} < 0$). Note that our model predicts the extent of cost savings to not vary between weekdays and weekends, so the documented cost savings are relevant to both periods. Figure 5 provides a visualization of our main findings. Consistently across the different car types, it is only in the weekday period that price responds to the number of owners whereas the number of affiliate firms has a price effect both on weekdays and weekends.[17]

Figure 3. Number of Owners per Market



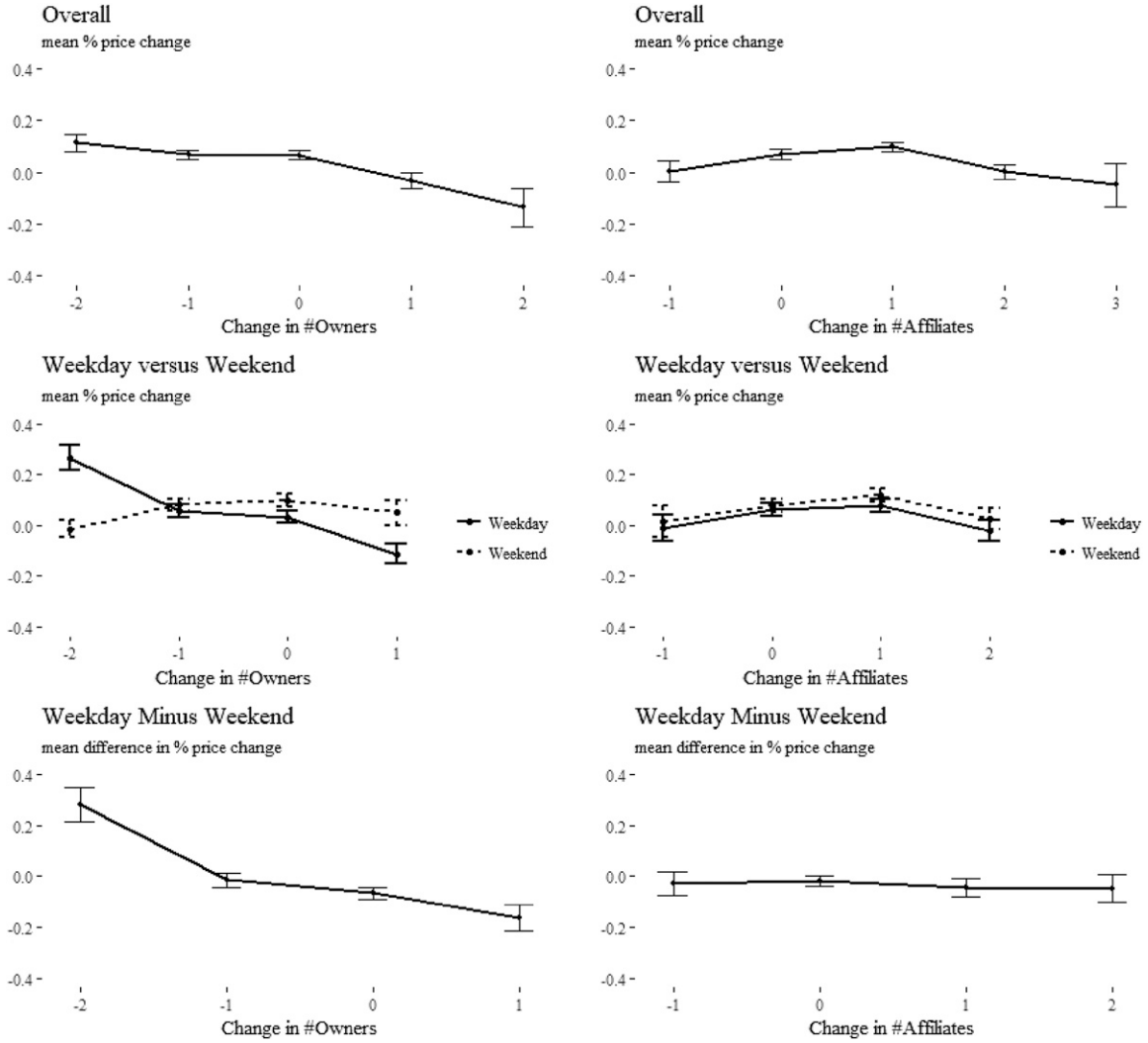
Note. The figure shows the distribution of the number of owners over 343 airport markets across the data years.

In Table 4, specification 3, we allow for differential price effects for large airports (in terms of yearly traffic) by interacting the number of owners and affiliate variables with a top 50 airport dummy. Here, results exhibit the same pattern as in specification 2 with the interaction terms indicating market structure effects of greater magnitude for large airports and, hence, for the average customer who is more likely to travel through these locations.[18] Especially, the affiliate firm interaction term is significant, suggesting larger cost efficiency gains at airports with heavier traffic.

5.1. Differential Price Effects of Ownership Concentration

Our formulation characterizes a merger event as the transformation of an independent player of the market into an affiliate firm. A merger's price impact then corresponds to the difference in the price effects

Figure 4. Model-Free Evidence of Differential Price Effects



Notes. Charts plot the percentage change in the average market price against the change in the number of owners (column (1)) and the number of affiliate firms (column (2)) for 343 airport markets in the estimation sample. Second row plots the weekday and weekend prices separately. Third row plots the difference in percentage change in weekday versus weekend prices. Vertical bars indicate the 95% confidence intervals.

of an owner versus an affiliate firm.[19] Based on this measure of ownership concentration, we find that, in the net, a merger shifts prices in opposite directions in the weekday and the weekend periods. Specifically, average prices increase during weekdays by 2.1% ($p = 0.05$) and decrease during weekends by 3.3% ($p = 0.01$) (Figure 6). Of the two consequences of consolidation, our results suggest that the market power effect dominates in the weekday period, and the cost efficiency effect dominates in the weekend period.

5.2. Robustness Checks

Allowing for Nonlinear Market Structure Effects. Specification 4 in Table 4 allows for nonlinear price effects of market structure with each market type (as determined by its owner count) represented by a separate dummy variable. In this specification, we take a market with eight players (the maximum number of players commonly observed across all three cross-sections) to be the competitive benchmark. Compared with that baseline, the elimination of each additional player from the market causes a steady increase in the price levels. Consistently with our previous findings, the weekend price response to the number of market players is much flatter compared with the weekday period (Figure 7).

Different Data Splits to Identify Leisure vs. Business Travelers. We explain the difference in consolidation-induced price shifts between weekdays and weekends by the change in relative demand by business versus

Table 4. Main Results

	Weekday				Weekend			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Number of Firms	−0.0446***				−0.0145**			
	(0.00567)				(0.00598)			
Number of Owners		−0.0537***	−0.0415***			0.0000772	0.00650	
		(0.00786)	(0.00934)			(0.00739)	(0.00862)	
Number of Affiliate Firms		−0.0330***	−0.0125	−0.0386***		−0.0330***	−0.0221**	−0.0350***
		(0.00716)	(0.00812)	(0.00736)		(0.00812)	(0.00919)	(0.00819)
Number of Owners_Top 50 Airports			−0.0177				−0.00905	
			(0.0143)				(0.0132)	
Number of Affiliate Firms_Top 50 Airports			−0.0492***				−0.0251**	
			(0.0106)				(0.0117)	
Dummy_1owner				0.533***				0.195**
				(0.0703)				(0.0805)
Dummy_2owners				0.507***				0.183***
				(0.0609)				(0.0565)
Dummy_3owners				0.492***				0.120**
				(0.0524)				(0.0484)
Dummy_4owners				0.440***				0.133***
				(0.0492)				(0.0440)
Dummy_5owners				0.307***				0.0917**
				(0.0450)				(0.0408)
Dummy_6owners				0.197***				0.0980***
				(0.0421)				(0.0375)
Dummy_7owners				0.0459				−0.0162
				(0.0419)				(0.0353)
Number of observations	26,772	26,772	26,772	26,772	27,242	27,242	27,242	27,242
Number of clusters	2,255	2,255	2,256	2,255	2,279	2,279	2,279	2,279
Adjusted R^2	0.607	0.607	0.610	0.622	0.669	0.670	0.671	0.672

Notes. Figures indicate results of ordinary least squares regressions where the dependent variable is ln(daily rental rate). Estimation sample includes price data for 2005, 2009, and 2016 over 343 airports, 27 firms, and five car types. All specifications control for monthly passenger traffic and include car type × rental period, firm × rental period, airport × firm fixed effects. Standard errors in parentheses clustered at the airport × firm level.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

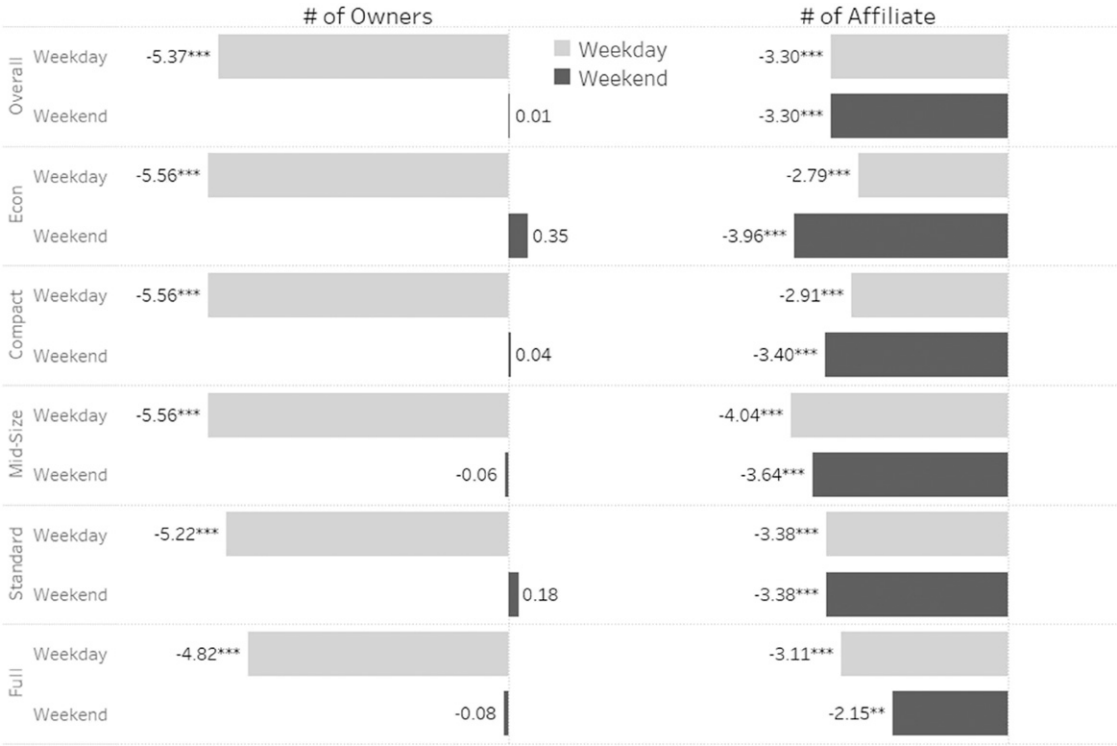
leisure customers. If this is indeed true, we would expect to find parallel price effects when data are split along other dimensions that imply a similar sorting of the two customer types. For instance, at holiday airports with a larger percentage of leisure travelers at any time of the week, we would expect the weekday price increase to be less pronounced (i.e., the market power effect to be relatively weaker) and the weekend price drop to be more substantial. Likewise, we would expect firms charging lower prices, which are, in general, more likely to be preferred by the price-sensitive leisure segment, to exhibit a smaller price rise in the weekday period and a larger decrease in the weekend period. Figure 6 summarizes results based on these splits.

As hypothesized, at holiday airports with a larger proportion of leisure travelers, the market power effect is weak/null (no weekday price increase), and the weekend price decrease is larger compared with regular airports. Leisure travelers, identified as holiday airport customers, on average pay lower prices and are better off with consolidation. On the other hand, business customers, identified as weekday travelers at regular airports, pay higher prices.

Firm-level results in Figure 6 are ordered by firms' relative prices. Also, we group firms depending on their main target customer group (business versus leisure), as indicated in their annual reports. Because with the firm-level split the number of observations per regression decreases substantially, some of the firm-level estimates do not reach significance. The directions of the estimates still suggest a consistent pattern: the top three most expensive firms that mainly target business travelers (Hertz, National, and Avis) generally raise their prices on both weekdays and weekends, such that customers of these firms (less price-sensitive customers comprising mostly business travelers) are worse off overall. On the other hand, the remaining firms, which mainly target the leisure segment, offer lower prices on both weekdays and weekends.

Controlling for Airport-Year–Level Unobservables. Table B.1 reports results from a regression that includes airport–firm–year fixed effects that control

Figure 5. Price Impact of Owners and Affiliate Firms



Notes. Figures indicate the percentage price impact of a unit change in number of owners versus affiliate firms. In both the weekday and weekend price regressions, observations are at the airport–firm–car type–year level. Detailed regression results are presented in Table 4 and Table B.3.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

for unobservable factors that could make a firm's entry (or exit) more likely at an airport for a given year.[20] Note that the within airport-year variation that this specification exploits allows us to identify only the time-of-week differential in the price effects of our variables of interest (i.e., the difference in weekday-period effects over the weekend-period effects). The weekday–weekend effect differences we estimate under this control (column (2)) are very similar to those suggested by our benchmark model with only airport–firm fixed effects (column (1)).

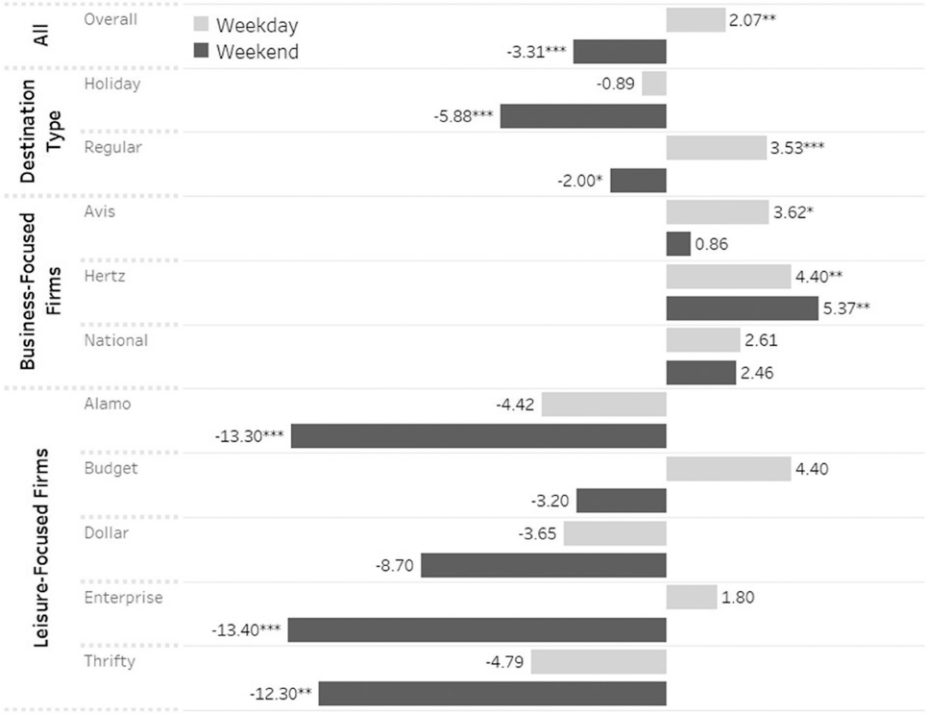
Estimating Mergers' Price Effects Directly. Table B.2 provides results from an alternative regression that estimates the merger price effects directly through a merger count variable, controlling for firm entries/exits. Estimated effects are very similar to those based on our main specification: on average, a merger raises weekday prices by 3.4% ($p = 0.01$) and decreases weekend prices by 3.5% ($p = 0.01$).

Measuring Concentration by the Herfindahl Index. In Appendix C, we provide results from a robustness check that measures market concentration based on the Herfindahl index (HHI), given by the sum of squared market shares of independent players. Because of data limitations we describe in the appendix, we conduct this analysis on a subsample of 38 airports from our actual estimation sample. Results parallel our previous findings with consolidation affecting weekday and weekend prices in opposite directions.

6. Conclusion

Many industries across the world witness an accelerating consolidation trend with ambiguous welfare consequences. While the increase in firms' market power is expected to lead to price increases, mergers also allow cost savings that may allow prices to drop. The present study demonstrates, for a horizontally differentiated industry, the role of customers' supplier switching costs in determining which of these opposing effects dominates. Considering a simple setup of an industry with periodic differences in demand between customer segments with varying supplier switching costs, we show that there can arise periodic shifts in the price effects of consolidation with prices rising only during the period

Figure 6. Price Impact of a Merger



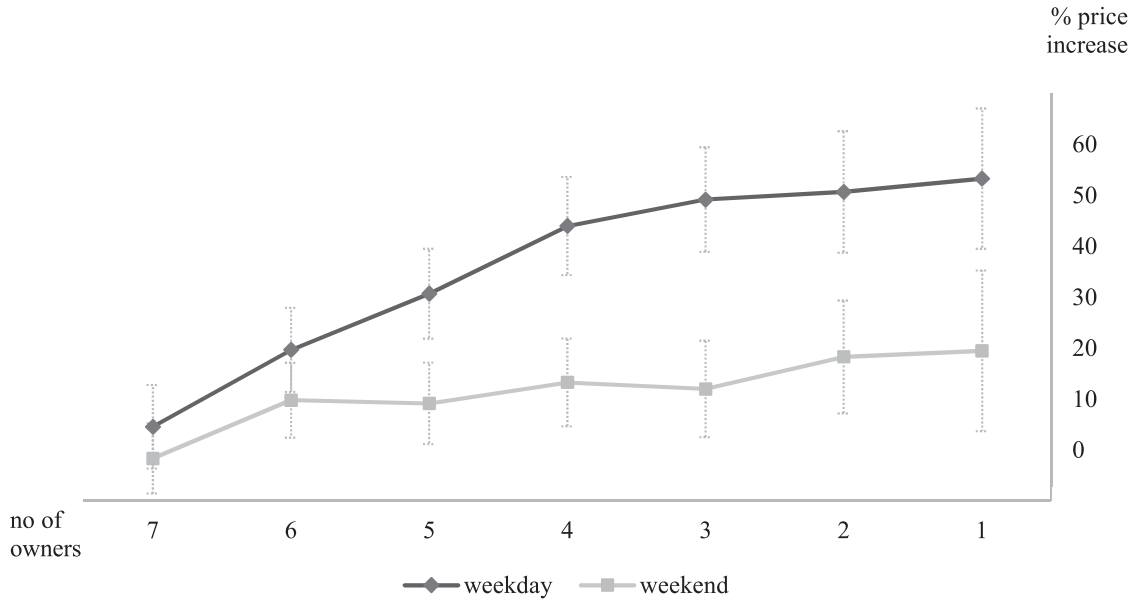
Notes. Figures indicate the percentage price response to a unit increase in the number of affiliate firms, total number of firms held constant. All regressions control for the market's total firm count and include car type × rental period, firm × rental period, airport × firm fixed effects. Detailed regression results by destination type and firm are presented in Table B.4 and Table B.5, respectively.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

when the "high-switching cost" customer segment is predominant in the market and falling otherwise.

Our empirical analysis focuses on the U.S. car rental industry, which went through a major consolidation phase over the past decade. To identify the impact of consolidation on prices, we exploit the rich price variation in the industry observed across years, car types, airports, firms, and especially the weekday and weekend

Figure 7. Price Change with Consolidation



Notes. Vertical bars indicate the 95% confidence intervals. Eight-player market taken as benchmark.

periods. We circumvent empirical challenges related to product and market definition as (1) product types (car types) are standard and directly comparable across firms and (2) the airport markets that we focus on are clearly demarcated in terms of the identity and number of competitors. Controlling for firm-year fixed effects, we focus on local price effects of market structure and ownership changes (for instance, our results would leave out the price effect of an updated IT system that allows the firm to reduce prices in all airports). We find that, on average, weekday prices rise and weekend prices fall with ownership concentration. This is because the market power effect of mergers overrides the cost efficiency effect only during the weekday period when the (more loyal) business customers are higher in proportion. Thus, we show that, under price discrimination, consolidation can affect customer groups differently, helping some customers and hurting others.

Our results are important for policymakers as they show that merger analysis should take account of the possibility of such heterogeneous effects. We believe our results are important to managers as they show that a merger need not result in a fixed (absolute or percentage) price change across all markets. A rental car industry expert commented, in a private conversation, that "the relative lack of commercial leader involvement in [a recent rental car merger] is at least part of the reason it took so long to for [the company] to realize much benefit from the acquisition." Our results argue for marketing involvement early in the merger process.

Appendix A. Additional Preliminary Analysis

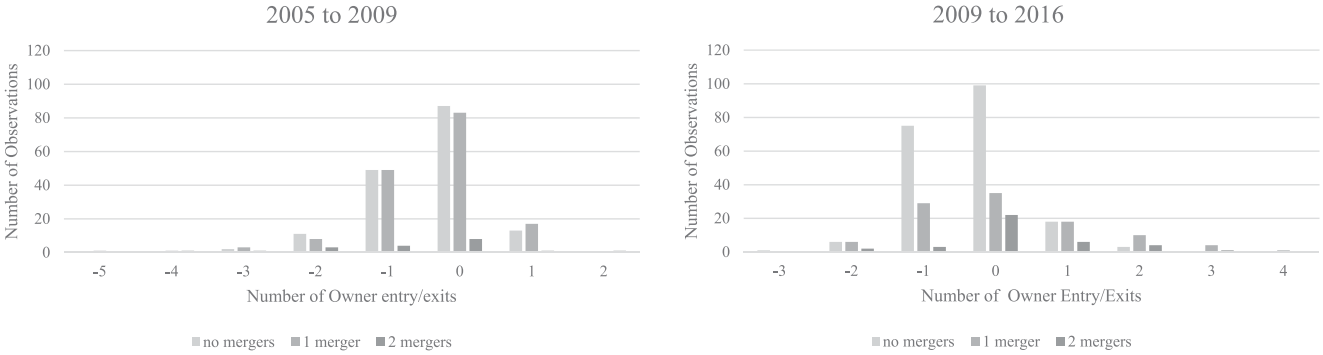
Table A.1. Market Structure Changes

Change in number of owners	Change in number of affiliates								
	−2	−1	0	1	2	3	4	5	Total
−6	0	0	0	1	1	0	0	0	2
−5	0	0	0	1	1	0	0	0	2
−4	0	0	2	1	3	0	0	0	6
−3	0	1	1	9	5	0	0	0	16
−2	1	3	18	41	15	0	0	0	78
−1	0	9	61	103	38	8	0	0	219
0	0	9	174	57	43	6	1	0	290
1	0	3	22	13	9	3	1	1	52
2	0	0	1	5	8	0	1	0	15
3	0	0	0	2	2	0	0	0	4
4	0	0	0	1	0	0	0	0	1
5	0	0	0	1	0	0	0	0	1
Total	1	25	279	235	125	17	3	1	686

Table A.2. Premerger Market Overlap

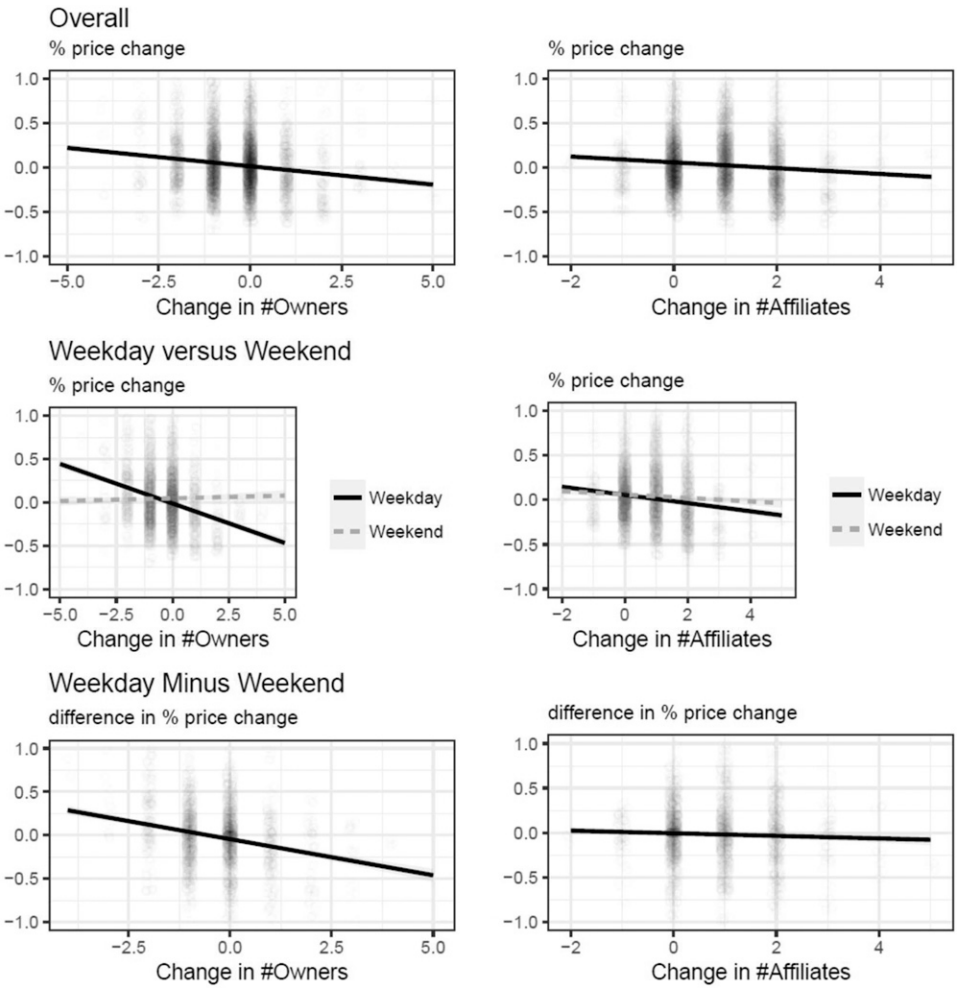
	One if Enterprise is active		
	0	1	Total
One if Alamo and/or National is active			
0	50	74	124
1	22	197	219
Total	72	271	343
One if Dollar and/or Thrifty is active	One if Hertz is active		
0	26	195	221
1	4	118	122
Total	30	313	343

Figure A.1. Distribution of Merger- and Entry-/Exit-Related Market Structure Changes



Notes. Horizontal categories represent the number of market player entries/exits observed across the markets, and the shaded bars indicate the number of mergers observed within each horizontal category. Data shows significant variation in merger- and entry-/exit-related market structure changes.

Figure A.2. Price Response to the Number of Owners vs. Affiliate Firms



Notes. Charts plot the percentage price change in our raw data against the change in the number of owners (column (1)) and the number of affiliate firms (column (2)). Second row plots the weekday and weekend prices separately. Third row plots the difference in percentage change in weekday versus weekend prices.

Appendix B. Additional Regression Results

In this appendix, we present detailed results for the regression analyses that provide input to Figures 5 and 6 and the robustness checks reported in Section 5.2.

Table B.1. Robustness Check—Controlling for Airport-Year Fixed Effects

	(1)	(2)
Number of owners	−0.00226	
	(0.00712)	
Number of owners × weekday	−0.0489***	−0.0506***
	(0.00765)	(0.00852)
Number of affiliate firms	−0.0339***	
	(0.00774)	
Number of affiliate firms × weekday	0.00245	0.00548
	(0.00764)	(0.00712)
Number of observations	54,014	54,014
Number of clusters	2,290	5,679
Adjusted R^2	0.734	0.877

Notes. Figures indicate results of ordinary least squares regressions where the dependent variable is ln(daily rental rate). Estimation sample includes price data for 2005, 2009, and 2016 over 343 airports, 27 firms, and five car types. All specifications control for time-of-week–interacted monthly passenger traffic and include car type × rental period, firm × rental period fixed effects. Column (1) includes airport × firm fixed effects. Column (2) includes airport × firm × year fixed effects. Standard errors in parentheses clustered at the airport × firm (column (1)) and airport × firm × year (column (2)) level.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table B.2. Estimating Mergers' Price Effects Directly

	Weekday	Weekend
Simulated number of owners	−0.0477***	−0.000871
(excludes merger effects)	(0.00858)	(0.00804)
Simulated number of affiliates	−0.0487***	−0.0306***
(excludes merger effects)	(0.0103)	(0.0111)
Merger effect	0.0344***	−0.0352***
	(0.0117)	(0.0125)
Number of observations	26,772	27,242
Number of clusters	2,255	2,279
Adjusted R^2	0.608	0.670

Notes. Figures indicate results of ordinary least squares regressions where the dependent variable is ln(daily rental rate). Simulated number of owners and affiliates variables control for firm entries and exits not related to a merger. Estimation sample includes price data for 2005, 2009, and 2016 over 343 airports, 27 firms, and five car types. All specifications control for monthly passenger traffic and include car type × rental period, firm × rental period, airport × firm fixed effects. Standard errors in parentheses clustered at the airport × firm level.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table B.3. Results by Car Type

	By car type									
	Economy		Compact		Midsize		Standard		Full	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Number of owners	−0.0556***	0.00352	−0.0556***	0.000406	−0.0556***	−0.000576	−0.0522***	0.00179	−0.0482***	−0.000821
	(0.0115)	(0.0104)	(0.0104)	(0.00969)	(0.0102)	(0.00940)	(0.00978)	(0.0101)	(0.00981)	(0.00924)
Number of affiliate firms	−0.0279***	−0.0396***	−0.0291***	−0.0340***	−0.0404***	−0.0364***	−0.0338***	−0.0338***	−0.0311***	−0.0215**
	(0.0101)	(0.0115)	(0.00949)	(0.0108)	(0.00921)	(0.0103)	(0.00940)	(0.0107)	(0.00873)	(0.00973)
Number of observations	5,251	5,333	5,432	5,523	5,479	5,580	5,140	5,239	5,470	5,567
Number of clusters	2,202	2,225	2,238	2,261	2,248	2,273	2,183	2,205	2,247	2,269
Adjusted R^2	0.396	0.495	0.390	0.503	0.386	0.506	0.382	0.466	0.376	0.469

Notes. Figures indicate results of ordinary least squares regressions where the dependent variable is ln(daily rental rate). Estimation sample includes price data for 2005, 2009, and 2016 over 343 airports and 27 firms. All specifications control for monthly passenger traffic and include firm × rental period, airport × firm fixed effects. Standard errors in parentheses clustered at the airport × firm level.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table B.4. Results by Destination Type

	Regular destinations		Holiday destinations	
	Weekday	Weekend	Weekday	Weekend
Number of owners	–0.0579***	0.00150	–0.0364**	–0.0122
	(0.00987)	(0.00886)	(0.0144)	(0.0131)
Number of affiliate firms	–0.0226***	–0.0185**	–0.0453**	–0.0711***
	–0.00799	–0.00913	(0.0188)	(0.0179)
Number of observations	21,224	21,626	5,548	5,616
Number of clusters	1,778	1,793	477	486
Adjusted R^2	0.595	0.660	0.682	0.721

Notes. Figures indicate results of ordinary least squares regressions where the dependent variable is ln(daily rental rate). Estimation sample covers price data for 2005, 2009, and 2016 across 298 regular and 45 holiday airports, 27 firms, and five car types. All specifications control for monthly passenger traffic and include car type × rental period, firm × rental period, airport × firm fixed effects. Standard errors in parentheses clustered at the airport × firm level.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table B.5. Results by Firm

	Hertz		National		Avis		Budget		Alamo		Dollar		Thrifty		Enterprise	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Number of owners	–0.0378**	–0.0256	–0.0368*	0.00688	–0.0397**	0.00386	–0.0873***	–0.0247	–0.0587***	0.0130	–0.0431	0.0261	–0.0607*	0.00203	–0.0655***	0.0168
	(0.0186)	(0.0186)	(0.0192)	(0.0206)	(0.0176)	(0.0164)	(0.0227)	(0.0185)	(0.0222)	(0.0234)	(0.0293)	(0.0262)	(0.0320)	(0.0300)	(0.0221)	(0.0210)
Number of affiliate firms	0.00619	0.0281	–0.0107	0.0315	–0.00350	0.0124	–0.0432**	–0.0566***	–0.103***	–0.120***	–0.0795*	–0.0609	–0.109**	–0.121**	–0.0475**	–0.117***
	(0.0135)	(0.0183)	(0.0177)	(0.0217)	(0.0137)	(0.0161)	(0.0179)	(0.0182)	(0.0291)	(0.0282)	(0.0477)	(0.0477)	(0.0522)	(0.0596)	(0.0196)	(0.0199)
Number of observations	4,347	4,337	3,116	3,198	4,083	4,153	3,418	3,443	2,633	2,746	1,757	1,741	1,770	1,763	3,635	3,739
Number of clusters	322	322	241	241	302	303	271	272	213	215	153	151	156	155	293	296
Adjusted R^2	0.505	0.588	0.556	0.592	0.543	0.648	0.490	0.672	0.479	0.634	0.485	0.707	0.530	0.658	0.526	0.606

Notes. Figures indicate results of ordinary least squares regressions where the dependent variable is ln(daily rental rate). Estimation sample includes price data for 2005, 2009, and 2016 over 343 airports and five car types. All specifications control for monthly passenger traffic and include car type × rental period and airport fixed effects. Standard errors in parentheses clustered at the airport level.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Appendix C. Measuring Concentration by the HHI Index

The merger of two firms may result in different levels of change in market power depending on their initial market shares. To address this issue, this appendix provides results based on the analysis of the price response to the market's Herfindahl index (HHI) given by the sum of squared market shares of independent players.

We obtain airport-level market share data from Auto Rental News (2003). Because of limitations of this data, our HHI-based analysis has certain shortcomings. First, as the data provide market shares for only the eight largest firms in the industry (Alamo, Avis, Budget, Dollar Enterprise, Hertz, National, Thrifty), our HHI measures will omit the impact of smaller firms. Consequently, our HHIs reflect the two larger merger events covered in our data: the Enterprise and Alamo-National merger (in 2007) and the Hertz and Dollar-Budget merger (in 2013). Second, the share data covers only the top 50 airport markets. Third, as we have market share data only for 2003 and not for subsequent years, we assume that throughout our sample period, firm-level shares remained constant at their 2003 levels. Because of these latter two limitations, we are able to focus on 38 airports at which all of the top eight firms were active throughout our sample period.[21]

Overall, the remaining subsample contains 11,637 data points and corresponds to 20.7% of the full estimation sample. For each market–year pair in this subsample, we predict the HHI on an ownership basis, using the 2003 firm-level shares. For instance, before the Enterprise and Alamo-National merger, in a market in which Enterprise, Alamo, and National were all active, contribution of the three firms to the market's HHI is calculated as $Share_{\text{Enterprise}}^2 + (Share_{\text{Alamo}} + Share_{\text{National}})^2$. Postmerger, the combined HHI contribution is calculated as $(Share_{\text{Enterprise}} + Share_{\text{Alamo}} + Share_{\text{National}})^2$. The Hertz and Dollar-Thrifty merger is accounted for in the same manner.

Figure C.1 shows the distribution of the HHI changes induced by the two mergers. Across the subsample markets, market concentration rises steadily during the sample period with the mean HHI increasing from 2,538 (in 2005) to 2,734 (in 2009) and then to 3,371 (in 2016). According to the 2010 Horizontal Merger Guidelines, mergers resulting in highly concentrated markets (with a premerger HHI of above 2500) that involve an increase in the HHI of between 100 points and 200 points potentially raise significant competitive concerns and often warrant scrutiny. Mergers resulting in highly concentrated markets that involve an increase in the HHI of more than 200 points will be presumed to be likely to enhance market power. Based on these criteria, merger-induced concentration changes are expected to enhance market power significantly in a majority of the markets.

To analyze the price impact of HHI changes, we regress market-firm–"car type"–"time of week" level log prices against the market's HHI level, allowing for the full set of market-firm, rental period–car type and rental period–firm level controls as in the main analysis. To reach statistical power with this smaller subsample, we pool weekday and weekend data, additionally allowing for weekend-interacted effects of our controls and the HHI. Results presented in

Figure C.1. Distribution of HHI Changes

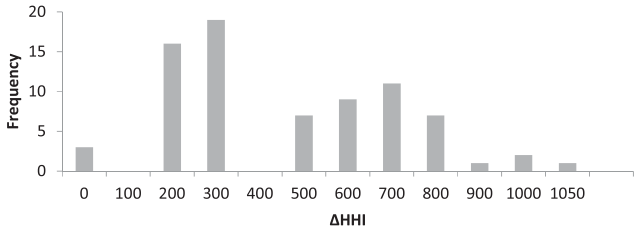


Table C.1. Estimates Based on the HHI Index

	DV: log (price)
HHI	4.351***
	(1.131)
HHI_weekend	−6.548***
	(0.902)
Number of observations	11,050
Number of clusters	473
Adjusted R^2	0.706

Notes. Figures indicate results of ordinary least squares regression where the dependent variable is ln(daily rental rate). The HHI is scaled from zero to one. The model controls for time-of-week interacted monthly passenger traffic and includes car type × rental period and firm × rental period fixed effects. Standard errors in parentheses clustered at the airport × firm level.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table C.1 confirm our previous findings on differential price effects of mergers for weekday and weekend periods. For instance, in response to the median level of a 295-point increase in the Herfindahl index, weekday prices rise by 12.8%, and weekend prices drop by 6.5% in the subsample examined.[22]

Endnotes

[1] For example, these savings can come from centralizing back-office functions, joint fleet management, or joint utilization of car return facilities.

[2] Dubé et al. (2009) document that, in a dynamic context, the firm's customer acquisition motive may cause prices to decrease with the level of switching costs.

[3] Gerardi and Shapiro (2009) highlight the importance of accounting for time-invariant market-firm characteristics in analyzing the price effects of competition. In particular, they show that cross-sectional price data (as used in Borenstein and Rose 1994 and Stavins 2001) without the time dimension may not suffice to control for omitted variables correlated with market structure.

[4] A study that is similar to ours is Allen et al. (2014), who document heterogeneous increases in mortgage rates following a merger between two Canadian banks. They find that, under negotiated prices, market concentration has the opposite effect, not affecting the top end of the market and harming only the more price-sensitive customers.

[5] In a model that endogenizes firms' location choices, Vogel (2008) shows that, irrespective of where firms are located in the product space, firm i's price depends on another firm's marginal cost only through its impact on the average cost $E(c_i)$.

[6] For example, in the car rental industry, market analysts have drawn attention to the fact that merging firms generally focused on different

customer niches, and with consolidation, "each big company is now competing against the others in all segments of the market" (DePillis 2013).

[7] With upward-sloping price response curves, rivals would revise prices in the same direction as the merged firm(s). Accordingly, the presence of the affiliate firm is expected to cause a decrease in all players' prices.

[8] In counting the number of affiliate firms in the market, we do not distinguish between own and other players' affiliates. We do not find a statistically significant difference between these when we allow for differential effects. This is in line with the previous merger literature, which finds nonmerging firms' price movements to closely parallel that of merging firms (Kim and Singal 1993, Ashenfelter et al. 2015, Miller and Weinberg 2017).

[9] This is similar to Ashenfelter et al. (2015) and Miller and Weinberg (2017), which allow product × region fixed effects in their analysis of the price effects of the Miller and Coors merger in the beer industry.

[10] Because of this control, our findings do not reflect the overall efficiency gains that may benefit the firm as a whole and are only indicative of branch-level changes.

[11] We assume away collusive pricing. With collusion, price may be above marginal cost ($\Delta d > 0$) yet not responsive to the number of competitors in the market.

[12] Airport locations account for 55% of the U.S. car rental market (Bachman 2016).

[13] In our sample period from 2005 to 2016, the composition of customers booking online may have changed, potentially implying variation in average price sensitivity. To the extent that this variation is common across airports, rental period fixed effects in our regressions would control for this confound.

[14] As each year's data comes from a different calendar month, we control for time-of-year differences in the demand for different firms and car types through rental-period–interacted fixed effects of these variables.

[15] To obtain an average daily rental price for the weekend period, we divide the three-day rental fee by three.

[16] Figure 4 plots average market prices. We obtain the same pattern with disaggregate firm-level data (Figure A.2).

[17] Separate regression results for different car types are presented in Table B.3.

[18] Previous merger studies from the airline industry (Borenstein 1990, Kim and Singal 1993) report weighted as well as unweighted regression results as, in that industry, carrier-route–level passenger traffic data are available. Although we have data on passenger traffic at the airport level, the unavailability of data on the relative share for the different firms and car types precludes us from applying proper weights. At the same time, given that larger airports contain more firm-/car type–level observations, our sample automatically places greater weight on airports based on size. Borenstein (1990, p. 401) mentions that weighting by passenger count is "appropriate in gauging the impact of price changes on aggregate consumers' welfare, it is not appropriate for a cross-sectional comparison of market power." The purpose of our analysis rather aligns with the second.

[19] Alternatively, the same effect can be measured as the price change from a unit increase in the number of affiliate firms with the market's total firm count held constant. Merger price effects we report are based on this latter specification as it allows us to directly obtain the standard errors for the estimated effect.

[20] Not accounting for these unobserved factors may cause upward bias in our estimates as they would be positively correlated with firm count.

[21] Three airports listed in market share data (Miami, Sanford, and West Palm Beach) are not covered in our price panel. Nine other airports observe entries/exits by at least one of the top firms mentioned herein (Tampa, San Antonio, Albuquerque, Washington National, Oakland, Sacramento, Orange County, Newark, New York JFK, New York LGA). For this latter set of airports, we preferred to refrain from making additional assumptions to determine how the exiting firm's share would be reallocated among remaining (affiliate and rival) firms.

[22] The price effect is calculated as $0.029500 \times (4.351)$ for the weekday and $0.029500 \times (-6.548 + 4.351)$ for the weekend period. Note that these estimates may overestimate mergers' average price effects as, in this exercise, we neglect the impact of smaller firms in obtaining the HHI measures.

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