Multi-Unit Ownership and Market Power: A Study of the Lodging Industry in Texas

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Abstract

As franchisees in the retail and service industries become experienced and acquire local market knowledge, they are likely to own multiple franchised units. Given non (or weak) exclusive clauses in franchising contracts or industry norms, some of these multi-unit owners are affiliated with multiple franchisors. Agency and transaction cost theories, the classic theoretical framework to analyze franchising, cannot explain this type of multi-franchisor affiliation since this type of ownership would create incentive problems across franchisors. Conversely, this paper investigates whether this type of the multi-unit ownership can be explained by the exercise of market power by these franchisees when their units are geographically clustered. This paper uses data on hotels near the interstate highway exits in Texas to test this hypothesis. The results of this paper show that multi-unit owners have contracts with more than one franchisor and that multi-unit owners charge higher prices than single-unit owners. Counterfactual analysis shows that without multi-unit ownership, prices would decrease by 3.91%, on average. This price increase is associated with a volume increase of 7.52%. These results help explain why franchisors might be willing to engage in franchising contracts with franchisees that operate units associated with different franchisors.

1 Introduction

Franchising is a widely used business governance format in the U.S. retail and service industries. In a franchising contract, franchisees sell franchisors' products or use their brand names (trademarks) at a given location for a certain period time. In return, franchisors receive an initial installment (franchise fee) in addition to sales-based fees (royalties). With initial and ongoing support from franchisors, franchisees

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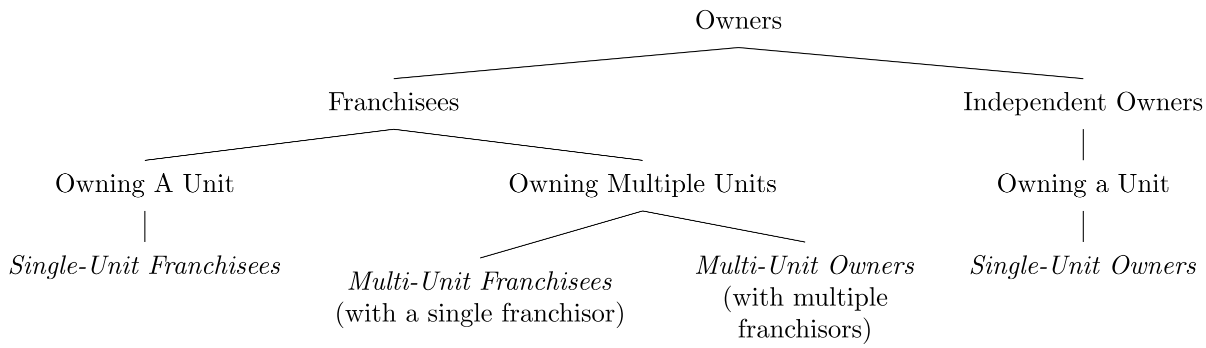


Figure 1: Ownership Types in Franchising

can take advantage of established management skills, or national/regional marketing campaigns that are not possible for individual franchisees to achieve otherwise. As franchisees become experienced and more efficient in the operation in their local markets, some franchisees tend to expand their business by owning additional units; this is known as *multi-unit franchising*. Multi-unit franchisees are not rare, although the majority of franchisees remain single unit owners. Various studies in franchising show the prevalence of multi-unit franchising. Kalnins and Lafontaine (2004) indicate that among franchised units of the seven major fast food chains in Texas in 1995, 49% of franchisees operated more than one unit; these owners accounted for 84% of total franchised units in the fast food chains.It has been argued that this type of ownership is due to weak exclusive clauses in franchising contracts (Blair and Lafontaine, 2005; Wilson, 2011).

In many cases, these multiple units are associated to the same franchisor; we will henceforth refer to this type of owners as *multi-unit franchisees*.In other cases, some franchisees own units that are affiliated with multiple franchisors. In this paper, we will refer to these owners as *multi-unit owners*. Figure 1 summarizes the types of ownership in the context of franchising, in particular as they pertain to this paper. Franchisees can operate either one unit or multiple units. If franchisees own a single unit, they are referred to as *single-unit franchisees* or *single-unit owners* in this paper. Franchisees that own more than one unit, they are divided into either *multi-unit franchisees* or *multi-unit owners*, as explained above.The focus of this paper will be on multi-unit owners, as the analyzed market does rarely contain multi-unit franchisees. [1]

Traditional theories of franchising, which are based on transaction costs and agency-based frameworks, cannot explain the emergence and prevalence of multi-unit ownership (of the two types noted in Figure 1) in franchising. Agency-based frameworks suggest franchising is beneficial since the costs of the separation between owners (franchisors) and operators (franchisees) are minimized: as residual claimers,

[1] In my data set, out of 240 hotels operated by franchisees operating more than one unit, only 2 hotels are owned by a multi-unit franchisee. More generally, multi-unit franchisees and multi-unit owners are not mutually exclusive sets. For example, a multi-unit franchisee become multi-unit owners by associating with more than on franchisors and vice-versa.

franchisees have an economic incentive to invest more effort than managers hired by franchisors. As franchisees add more units to their operation, however, this advantage would disappear since the franchisees might start to manage multiple units by hiring managers, defeating the purpose of reducing agency problems. In addition, if multi-unit owners are affiliated with multiple franchisors, the costs for franchisors to monitor and control these franchisees would be higher. The transaction-cost perspective provides reasonable arguments for multi-unit franchising but not for multi-unit owners. In multi-unit franchising, franchisors can reduce transaction costs, such as monitoring or training, with multi-unit franchisees since these franchisees are usually more experienced in local retailing and tend to invest more resources (effort, monetary) than single-unit owners. However, it is not clear that franchisors can reduce such transaction costs if franchisees have franchising contracts with multiple franchisors.

Rather than relying on the classic literature that explains franchising structurally, this paper explores whether a framework of market power helps explain why franchisees are affiliated with multiple franchisors. Specifically, I empirically test whether and how multi-unit owners exercise market power. The lodging industry is suited to this empirical test for several reasons. First, in the lodging industry franchising is one of the widely used business formats, and multi-unit owners are prevalent (**?**). Hotel chains with multiple brands tend to operate multiple hotels in small geographic areas where consumer demand is high such as central business districts and tourist destinations. At the same time, when multi-unit owners are observed, they are likely to confine the operation of their units in the same small geographic area.

I use data on hotels and motels near interstate highway exits in Texas, where hotels tend to be closely located near exits, thereby creating distinct and well-defined clusters (markets) away from other (large and more difficult to define) geographic markets. In these clusters, as opposed to metropolitan areas, franchisees tend to have strong control over their operational and pricing decisions. This results from franchisees being distant from the national/regional headquarters of the franchisors (Perryman and Combs, 2012; Cochet et al., 2008). Another reason for this increased control by franchisees is that franchisors of economy and mid-scale hotel brands (typically found near highway exits) are, as a general rule, more likely to provide discretion over management and pricing to franchisees vis-à-vis franchisors of upscale and luxury hotels (Turner et al., 2016). Given these conditions, this paper focuses on markets and franchisees have control over pricing and management, a feature that motivates and is reflected by the structural model that I use in this paper. In order to analyze the behavior of franchisees, it is required to precisely identify the owners (franchisees) of individual hotels in the markets. To determine franchisees' identities, I use each hotel's tax identification number registered in hotel occupancy tax fillings at the Texas Comptroller's Office.

To measure the market power of multi-unit owners in these markets, I follow the approach of Berry et al. (1995). First, a random coefficients logit model is used to estimate demand parameters. With the estimated demand parameters, marginal costs are recovered under the assumption that multi-unit owners optimize their pricing decisions by maximizing the joint profits across all owned units; I call this exercise the *pre-scenario*. Using demand estimates and the recovered marginal costs, I conduct a counterfactual analysis in which all multi-unit owners maximize their profits as single-unit owners (the post-scenario). Comparison between the pre- and post-scenarios allows testing whether multi-unit owners exercise market power. The results of this paper show that firms with multi-units charge higher prices, thereby supporting the hypothesis that multi-unit ownership associated with multiple franchisors implies the exercise of market power. In addition, in the absence of multi-unit ownership rooms sold would increase thereby improving consumer welfare.

This paper is one of the first papers to analyze the effects of multi-unit ownership using a structural approach. Most studies in the franchising literature have only focused on the issues of multi-unit franchising, even though there is evidence that franchisees associated with multiple franchisors are common in various industries, such as hotel and restaurant ones (Blair and Lafontaine, 2005). Using data on taxpayer information from hotel occupancy tax receipts, I separate upstream (franchisors) and downstream(franchisees) firms, and then analyze the effects of the behavior of the downstream firms. Moreover, I limit the sample of this paper to hotels and motels near the interstate highway exits in Texas to minimize the possibilities that franchisors have strong controls over day-to-day operation, or pricing at their franchised hotels.[2]. Another benefit of choosing these remote markets is that it allows for a straightforward definition of markets, thereby circumventing the possibilities of cross-market competition (i.e., a hotel in a highway exits is unlikely to compete with other hotels at other, distant, exits.).

The rest of the paper proceeds as follows: Section 2 reviews the relevant literature. Section 3 discusses the multi-unit ownership in franchising and the characteristics of the U. S. hotel industry in the current study. Section 4 presents the models of demand estimation and counterfactual analysis. Section 5 summarizes the data and estimation strategies. Section 6 covers the results of the demand estimation and the counterfactual analysis. Section 7 concludes the paper.

2 Literature Review

Most studies in the literature have viewed franchising as representing a type of organization that lies somewhere between vertical separation and vertical integration (e.g., Lafontaine (1992); Dahlstrom and Nygaard (1999); Blair and Lafontaine (2005)). These studies have examined issues that arise in the interaction between upstream and downstream firms as they relate to conflicts, incentive alignment, control, or monitoring. To analyze these issues, the usual approach has been to use classical frameworks of transaction costs (e.g., Dahlstrom and Nygaard (1999)) and agency cost theories (e.g., Kidwell et al. (2007)). In addition, the majority of empirical studies in economics and management focus on franchisors' decisions – double distribution channels (corporate owning and franchising), and optimal franchising proportions – while only a handful of studies analyze the decisions of local owners

[2]Major hotel chains tend to have strong control over franchised hotels in larger markets, such as metropolitan areas through regional quality control, or revenue managers.

or franchisees. The majority of these latter studies analyze, from the viewpoint of franchisees, the trade-offs between being an independent and a franchised unit (e.g., Mazzeo, 2004; Kosová et al., 2011, 2013; Chaudey and Fadairo, 2008).

Rather than relying on these theoretical frameworks, this paper focuses on cases in which franchisees have more discretion in day-to-day operations and management, with less control from franchisors. As such, these cases are considered to be closer to vertical separation.

The findings of this paper are consistent with the literature on multi-unit franchising (Kalnins and Lafontaine, 2004; Thomadsen, 2005), entry/exit (Davis, 2006a; Kalnins, 2004b; Mazzeo, 2002b) and brand proliferation (Wilson, 2011). Using Texas fast food chains as a case study, Kalnins and Lafontaine (2004) show that units owned by multi-unit franchisees are close to each other, or are located in demographically similar markets. This enables multi-unit franchisees to transfer local knowledge and experience across their units. Thomadsen (2005) simulates mergers between units of fast food chains in small geographic markets. His results show that simulated mergers increase prices, similar to my results. His analysis, however, focuses on multi-unit franchisees, not on multi-unit owners (as in this paper).

In the literature on encroachment and entry/exit, Kalnins (2004b) finds empirical evidence for why franchisees have contracts with different franchisors. He shows that cannibalization effects (revenue reduction by entry of firms with the same brands) are greater than business-stealing effects (revenue reduction by entry of firms with different brands) in the Texas hotel industry, supporting the notion that franchisees associated with different franchisors generate positive benefits. However, Kalnins, without considering the role of the hotel owners, assumes that hotel franchisors, or more generally multi-brand firms, make the entry/exit decisions. Conversely, in this paper I use detailed information on the identity of individual hotels to apply a structural approach to multi-unit owners.

Similar to Kalnins (2004b), Wilson (2011) analyzes the effect of brand proliferation of hotel chains from the viewpoint of franchisors. Wilson finds that revenue reductions due to new entrants do occur, but the magnitude of these reductions is smaller if the entry is made by different branded hotels under the same hotel chain, or by branded hotels under different chains. He also examines the effect of multi-unit franchising by using a reduced-form model, but the results are insignificant, which might be driven by insufficient data. I circumvent these issues by incorporating several data sets and employing a structural approach.

Even though multi-unit franchising are prevalent in many industries, few studies have empirically analyzed the effect of multi-unit franchising. Kalnins and Mayer (2004) employ survival analysis to franchised units of fast food chains in Texas. They find that multi-unit franchising lowers failure rates if owners accumulate local knowledge and experience and can transfer that knowledge to the operation/management of their units (hotels). Moreover, Kalnins and Lafontaine (2004) argue that multi-unit franchising utilizes local specific knowledge of well-performing franchisees and reduces free-riding issues between franchisees (i.e. franchisees in the same market have low incentives to invest brand-promotion efforts). Moreover, with multi-unit franchising occurring in the same market, franchisors can fend off criticism from incumbent franchisees when new franchised units are added since the owners of these units are the same.

Kalnins (2004a) and Thomadsen (2005) show new units under multi-unit franchisees tend to be located close to existing units or in demographically similar markets. While these studies focus on knowledge transfer between units under the same ownership, in this paper I focus on how multi-unit owners compete, providing a different view on the motivation for multiple ownership. One exception is Kalnins (2004a) who analyzes multi-market contacts between franchisees in fast food chains in Texas, rather than between franchisors. Since multi-unit franchisees have contact with other franchisees within and across franchisors, this creates possible conditions of mutual forbearance. Kalnins finds that in markets with high uncertainty, franchisors tend to assign new units to franchisees with higher levels of multi-market contacts. This effect of multi-market contact requires an analysis of multiple markets, which is beyond the (within) market competition approach of this paper.

Studies in entry and exit (or encroachment) are quite similar the issues that I study in this paper in that these studies examine the effects of inter- and intra-firm competition (Davis, 2006b; Mazzeo, 2002a; Kalnins, 2004b). Even though these studies assume firms make decisions by taking into account strategic interactions among competitors, there is little consideration on the ownership structure at the local market level. Without considering ownership, it is hard to analyze competition unless firms are perfectly separated in a vertical structure.

3 The U.S. Lodging Industry and Multi-Unit Ownership

The U.S. lodging industry provides vertically and horizontally differentiated products. Although there are different ways to measure hotel quality at the brand or property levels, most hotels are rated by popular hotel rating systems (*AAA*, *TripAdvisor*, or major online travel agencies). These provide relatively consistent measures of product quality that consumers trust and can easily access before consumption. Major hotel chains also provide a range of hotel brands with different levels of quality. In some geographic areas, a hotel chain provides multiple hotels with different qualities, resulting in higher market concentration than if the hotels were owned by different chains (Mazzeo, 2002a; Kalnins, 2004b; Wilson, 2011).

In addition to vertical differentiation, hotels are differentiated by location, even within a geographic area (like cities). Depending on travel distances to tourist destinations or other preferred places, consumers may consider the same brand hotels to be different products. Also, hotels of the same brand can be perceived differently if they offer different sets of amenities, or services. Variations in these sets of amenities and services differentiate one hotel from the others, even within the same geographic area. Thus, hotels in metropolitan areas typically face only a limited set of competitors. For example, Kalnins (2006) shows that, on average, hotel managers recognize only four to five competitors in their markets. Thus, hotels face limited competition, thereby marking markets more likely to be oligopolies.

Agglomeration is a widely observed market phenomenon. Hotels tend to locate close to other competing hotels since consumer demand is high for certain desired destinations within a city. In these areas, hotels try to differentiate from other competitors, vertically or horizontally. Mazzeo (2002b) supports this notion for vertical differentiation of hotels and motels near highway exits in the United States. In addition, Kalnins (2004b) shows that if hotels face competition from other hotels that exhibit different product qualities, their revenues or profits are higher than if the competition comes from hotels of similar qualities.

Most branded hotels are under vertical contracts with their franchisors. As mentioned earlier, franchising, one of the most popular forms of the vertical contracts, allows franchisees to use brand names, management formats, or centralized reservations systems, while paying to franchisors initial franchise and royalty fees.[3] The average length of a franchising contract in the lodging industry is about 20 years, which is longer than in other industries. Most franchisors have established their own centralized reservation systems and management standards to control the quality of products and services.

Franchising contracts are more prevalent among low- or mid-quality hotels since operations at these hotels are more standardized. Conversely, management contracts, another form of vertical contract, are more widely used by upscale hotels. Management contracts allow franchisees limited control over day-to-day hotel operations. On the other hand, franchisors, as operators of the hotels, supervise all operations. This is highly related to the complexity of operating upscale hotels and the difficulties of maintaining the service standards required by hotel chains.

Since this paper analyzes hotels near interstate highway exits, hotels have at most a three-0star rating out of the maximum of five given by the standard *TripAdvisor*'s rating system. This is largely because demand for hotels near interstate highway exits is likley different than that observed in large cities, and, also, likley not large enough to accommodate four to five star hotels. Thus, most branded hotels in these locations are likely to be under franchising contracts. Under franchising contracts, local hotel owners become residual claimants of revenues after paying the franchising and royalty fees to franchisors. Franchisees in these markets also have more control over their business, including pricing policies, while following the business standards set by the franchisors.

It is common in markets with high demand that a single hotel chain operates hotels under different brands to attract different types of travelers. This might create some conflicts between franchisors and franchisees, such as cannibalization effects (Kalnins, 2004b) and free-riding over other franchisees (Wilson, 2011).[4]

To prevent these conflicts, most franchising contracts include exclusive clauses which prevents either franchisees or franchisors from engaging in any actions against their counter parties. Exclusive territory clauses grant franchisees the right to be

[3] Franchise fees are a one-time lump sum payment due to franchisors when franchising contracts are signed. Royalty fees, an ongoing payment to franchisors, are generally a combination of fixed and variable terms; the variable terms are normally based on volume sales.

[4] Franchisees have less incentive to sustain the franchisors' quality standard if they can benefit from efforts by other nearby franchisees.

the sole provider in a certain geographic area. Non-compete clauses, another type of exclusivity clause frequently included in franchising contracts, prevents franchisees from engaging in similar (competing) businesses during and after the franchising contracts. However, these clauses are negotiable or not strictly enforced in many cases (especially in the hotel industry). For example, if the franchised hotels locate in high demand markets, these clauses might be loosened, allowing other franchisees to enter the market with the same or a different brand name. If the franchisees are experienced and have accumulated local knowledge in a certain area, adding additional units by these franchisees would be beneficial for both franchisees and franchisors (multi-unit franchising).

Multi-unit franchising has become more popular in service industries, especially in the restaurant industry (Blair and Lafontaine, 2005); in the hotel industry, multi-unit franchising also occurs, but there is a larger tendency for owners to own single units due to financial constraints (Wilson, 2011). In general, franchisees tend to own both land and physical properties, including the building and equipment in rooms. These high initial costs may deter current hotel owners from adding new units (hotels). However, as management of the low- or medium- quality hotels across hotel chains has become more standardized, it is increasingly more common to see local hotel owners add additional units in the same market or geographically close markets. For example, this paper finds that 240 hotels out of 5,186 hotels located near the interstate highway exits in Texas were owned by franchisees with more than one unit. While this figure suggests that multi-unit franchising might not be widespread, my estimates suggest their economic effect is not negligible.

4 Model

4.1 Demand

To estimate demand, I use a random coefficients logit model, which allows for flexible substitution patterns by accounting for consumer heterogeneity in preferences over product characteristics (Berry, 1994; Berry et al., 1995; Nevo, 2000).

The indirect utility of consumer i purchasing product j at market t is

$$u_{ijt} = \alpha_i p_{jt} + X_{jt}\beta_i + \xi_{jt} + \epsilon_{jt}, \tag{1}$$

where p_{jt} is the price of product j in market t, X_{jt} represents observed product characteristics, including the distance to the highway exit, the number of activities, the number of room types, and the number of services provided for business travelers.[5] ξ_{jt} is an unobserved product characteristic, and ϵ_{ijt} is a random shock that is assumed to follow a type I extreme value distribution.

To control the characteristics of local markets, location fixed effects (highway exits) are included. In Equation (1), I assume that the coefficients of price and product

[5]Hotel rating and hotel age were tested, but they showed high correlation with other product attributes. Thus, these variables are not included in the final specification.

characteristics (α_i and β_i) have normal distributions with an average preference, α and β, respectively, and idiosyncratic terms: $\sigma_p v_i^p$ and $\sigma_k v_i^k$. Term σ measures the standard deviation in consumer preference and v_i represents the idiosyncratic preference. Thus, the coefficients of prices and product characteristics are rewritten as: $\alpha_i = \alpha + \sigma_p v_i^p$ and $\beta_i = \beta + \sigma_k v_i^k$.

The utility of the outside option is

$$u_{i0t} = \xi_0 + \sigma_0 v_i^0 + \epsilon_{iot},$$

where the utility from the outside option is normalized to zero. This completes the specification of the utility function.

Given the assumptions of the random coefficients, the utility function can be divided into two parts: the mean utility and the deviation from the mean as follows:

$$u_{ijt} = \delta_{jt}(X_{jt}, p_{jt}, \xi_{jt}; \theta_1) + \mu_{ijt}(x_{jt}, p_{jt}, v_i; \theta_2) + \epsilon_{ijt}, \tag{2}$$

$$\delta_{jt} = \alpha p_{jt} + X_{jt}\beta + \xi_{jt},\ \mu_{ijt} = p_{jt}\sigma_i^p v_i^p + x_{jt}\sigma^k v_i^k. \tag{3}$$

where $\theta_1 = [\alpha, \beta]$ and $\theta_2 = [\sigma^p, \sigma^k]$. Based on the framework of McFadden (1989), the choice probability of individual i choosing j in market t is the following (under assumed distribution for ϵ_{ijt}):

$$s_{ijt} = \frac{\exp(\delta_{jt} + \mu_{jt})}{1 + \sum_{l=1}^{j} \exp(\delta_{lt} + \mu_{lt})}.$$

Aggregating the probability of the individual consumer probabilities, market share can be written as:

$$s_{jt}(\delta, \theta) = \int s_{ijt} dF(v) = \int \frac{\exp(\delta_{jt} + \mu_{jt})}{1 + \sum_{l=1}^{j} \exp(\delta_{lt} + \mu_{lt})} dF(v). \tag{4}$$

There is no closed from solution for the integral in Equation (4), so this is numerically approximated. This paper uses Halton draws (5,000) for numerical approximation, which creates a lower simulation error (Reynaert and Verboven, 2014; Brunner et al., 2017). Estimated market shares can be obtained as follows:

$$s_{jt} = \frac{1}{NS} \sum_{i=1}^{NS} \frac{\exp(\delta_{jt} + \mu_{jt})}{1 + \sum_{l=1}^{j} \exp(\delta_{lt} + \mu_{lt})}. \tag{5}$$

4.2 Supply

I assume that firms play a Bertrand-Nash game by setting prices of their products to maximize profits. The focus of this study is whether franchisees can exercise market power by owning multiple units. Even though it would be interesting to analyze the effect of multi-unit franchisees and multi-unit owners separately, my data only allows me to focus on multi-unit owners.[6] Thus, the results of the paper relate to the

[6] In the data set of this paper, there is only one multi-unit franchisee.

multi-unit franchising sub-case in which franchisees operate units associated with multiple franchisors.

As explained earlier, I focus on franchisees in markets where franchisors have less control over their franchisees. Since in my setup franchisees have control over their decisions, I use the term *firms* to refer to franchisees. If firms (franchisees) own multiple units (hotels), optimal pricing behavior implies a jointly maximization of across owned units. For single-unit firms, on the other hand, pricing and profit maximization is done over a single hotel. The profit function is as follows:

$$\max_{p_{jt}, j \in F_f} \pi_f = \sum_{j \in F_f} (p_{jt} - mc_{jt}) M_t s_{jt}(p) - C_f, \tag{6}$$

where firm f has product j in F_f(a set of products of firm f), mc_{jt} is the marginal cost, $s_j(p)$ is the market share of product j, M_t is the market size, and C_f is the fixed cost of firm f.

From the profit function, the first-order condition is derived and can be written in matrix form as:

$$p - mc = [\Omega^{pre}]^{-1} s(p) \tag{7}$$

where

$$\Omega^{pre}_{j,h} = \begin{cases} -\partial s_j / \partial p_k & \text{if } j, k \in F_f \\ 0 & \text{otherwise.} \end{cases}$$

The ownership structure matrix, Ω captures the existence of multi-unit firms in the market. From Equation (7), the marginal costs are estimated as $\hat{mc} = p - \Omega^{pre} \cdot s(p)$. These marginal costs rely on demand estimates and the Bertrand-Nash assumption of the supply-side. If the demand estimates or the assumptions of the supply side change, marginal costs would change accordingly. For the counterfactual analysis, I assume that marginal costs are constant. Later in the paper, I relax this assumption to check the robustness of the counterfactual analysis.

I conduct the counterfactual analysis using the demand estimates and the estimated marginal costs. New equilibrium prices under a counterfactual scenario (the *post-scenario*), in which all firms own single units, are estimated as follows:

$$p^* = \hat{mc} + [\Omega^{post}]^{-1} s(p^*), \tag{8}$$

where $\hat{mc}$ represents the marginal costs estimated under the multi-unit ownership.

To obtain the equilibrium prices in this post-scenario, I make two assumptions. First, the cost structure is the same across pre- and the post-scenarios. As mentioned in Nevo's (2000) merger simulation analysis, multiple-brand firms (or merged ones) could enjoy a cost efficiency. To allow for this possibility and to check for the robustness of the baseline post-scenario, different assumptions on marginal costs are also considered in a robustness checks section. Second, to obtain Ω^{pre} and Ω^{post}, I use the same demand estimates, even though firms may change their product characteristics and consumers may have their preferences (both observed and unobserved ones) across scenarios. I do not deal with this limitation but note that both of these changes are likely to occur in the medium and long-run; as such, my counterfactual simulation reflects the effects of multi-unit franchising as they pertain to franchisees' short-run pricing decisions.

4.3 Consumer Welfare

I use the compensating variation to capture the change in consumer welfare, which is calculated as follows:

$$CV_i = \frac{\ln[\sum_{j=0}^{J} \exp(V_{ij}^{post})] - \ln[\sum_{j=0}^{J} \exp(V_{ij}^{pre})]}{\alpha_i} \tag{9}$$

where $V_{ij} = \alpha_i p_j + X_j \beta_i + \xi_j$. When calculating V_{pre} and V_{post}, the price (p^{pre} and p^{post}) varies, while other components, including ξ_j, remain unaltered. The average CV at the market level is given by:

$$CV_t = M_t \int CV_i dP_v(V) = M_t \cdot \frac{1}{ns} \sum_{i}^{ns} CV_i \tag{10}$$

where P_v is the distribution function of v. M_t is the market size at market t. Market size is the number of rooms sold in the market plus the number of consumers opting for the outside good. Since prices and market shares are determined on a daily basis, to capture the annual level of consumer welfare, CV is converted to the annual level by multiplying by 365. The results concerning the counterfactual analysis (including the CV calculation) are based on the sub-sample of 116 markets where with multi-unit owners are present.

5 Data and Estimation

5.1 Data

Data for this paper comes from three sources. First, prices, quantities (rooms sold), capacity (total number of rooms), and chain affiliation comes from the *Texas Hotel Performance Fact book* provided by Source Strategic, Inc, a Texas-based consulting firm. Second, taxpayer identification numbers, which are used to identify hotel owners, are collected from *Hotel Occupancy Tax* provided by the Texas Comptroller's Office. Third, amenities and services at hotels are collected from from *TripAdvisor*.

The market definition used in this paper is purposefully narrow: a market is comprised of hotels located within a half-mile radius from an interstate exit in Texas. If hotels in one exit are close to other exits, or if hotels are located in metropolitan areas, they are excluded from the analysis. A consequence of this choice is that hotels included in the analysis are located in remote areas and that markets are narrow (Vis-à-vis hotel markets in metropolitan areas). Even though this sample might not be representative of all multi-unit owners in Texas, using this restricted definition of markets creates two major advantages. First, with this definition, the study minimizes the possibility of cross-market competition. Second, selecting these remote and isolated markets is consistent with the assumption that franchisees have more control over their pricing policies than franchisors. Since these hotels are far from the national/regional headquarters of their franchisors or other hotels under the same brand, franchisors face high controlling or monitoring costs. Thus, franchisors tend to engage franchising contracts that do not require high levels of oversight of the franchisee. As already indicated, most branded hotels and motels in these markets are of medium or low-quality, which typically operate under a franchising contracts (rather than management contracts). Given these characteristics of the sample, the assumption of franchisees having control over their pricing does not seem unreasonable (Cochet et al., 2008; Perryman and Combs, 2012).

This paper uses quarterly data set from 2008 to 2014 and defines a market as an exit-quarter pair. The resulting sample contains 5,186 hotels in 1,595 markets. In this sample, 240 hotels can be identified as being owned by multi-unit owners. These multi-unit owners exist in 116 of the identified markets.

To estimate demand parameters, the market share of the outside goods needs to be specified. The most common way of defining outside options is to use demographic information from the geographic area, such as the population of the market (Berry et al., 1995; Nevo, 2000). However, this approach is not reasonable in this industry since most consumers staying at hotels are not residents of local area. Instead, this paper uses unsold rooms in the markets to determine the share of consumers choosing the outside option. Table 1 reports descriptive statistics.[7]

Table 1: Descriptive Statistics of Key Variables

	Mean	SD	Min.	25%.	Median	75%	Max.
Price (\$100s)	0.681	0.329	0.134	0.436	0.615	0.857	2.736
Market Shares (Rooms Sold)	0.182	0.152	0.011	0.077	0.135	0.233	0.973
Distance to Exit	0.276	0.112	0.026	0.186	0.282	0.356	0.499
No. of Activities /10	0.267	0.117	0.100	0.200	0.300	0.400	0.500
No. of Room Types /10	0.384	0.141	0.100	0.300	0.400	0.500	0.700
No. of Service for Business /10	0.201	0.087	0.100	0.100	0.200	0.300	0.300
No. of Obs.	5186						
No. of Markets	1595						

5.2 Estimation

Following Berry et al. (1995), I estimate the demand parameters as outlined in Section 4. Similar to Nevo (2000), I include fixed effects of highway exits and hotel chains which accounts for a portion of unobserved product characteristics associated with the markets and hotel chains. To avoid the high dimensional fixed effect issue, the fixed effect absorption approach is used (Correia, 2016; Luoa et al., 2017). The error term (ξ_{jt}), captures the unobserved product-specific deviation from the mean valuation of the unobserved product characteristics. This deviation is assumed to

[6] As indicated earlier, all multi-unit franchising observed in the sample comes from multi-unit owners.

[7] Details of variables can be found in the appendix.

be correlated with prices. To deal with this price endogeneity, I employ a nonlinear generalized method of moments (GMM) estimation. Given the initial guess of the unknown parameters, the resulting error term is calculated and then interacted with a set of the instruments to form the following the population moment condition:

$$E[\xi \cdot Z] = 0, \tag{11}$$

where Z is a set of instruments which are discussed below. In order to construct the sample moment conditions of the GMM objective function, the mean utility δ is needed. To obtain δ, the contraction mapping approach is used. This approach retrieves δ by equating the estimated market shares with the observed market shares given a value of parameters:

$$s_{jt}^{pred}(x, p_{jt}, \delta_{jt}, \theta_2) = s_{jt}^{obs}, \tag{12}$$

where s^{pred} and s^{obs} are the predicted and observed market shares, respectively. Unlike the logit and nested logit models, random coefficient models do not have a closed form solution for δ. This is numerically solved; specifically, δ is retrieved using the following fixed point iteration:

$$\delta_{jt}^{k+1} = \delta_{jt}^{k} + \ln s_{jt}^{obs} - \ln s_{jt}^{pred}(x.p, \delta_{jt}^{k}; \theta_2) \tag{13}$$

where δ^k is δ at the kth iteration. In this paper, the criteria for convergence is set at $\delta^{k+1} - \delta^k < 10^{-8}$. Given the estimated δ obtained upon convergence, θ_1 is estimated via instrumental variable regression.Given this, ξ are obtained:

$$\xi_{jt} = \delta_{jt} - (\alpha p_{jt} + X_{jt}\beta).$$

Once ξ is obtained, θ_2 is estimated by using the following GMM objective function:

$$Q(\theta_2) = \xi(\theta)' Z W^{-1} Z' \xi(\theta), \tag{14}$$

where $W = 1/n \sum \xi(\theta_1)\xi(\theta_1)^{-1} Z'Z$ is the weighting matrix. This paper uses the continuously updating weighting matrix, which provides more efficient estimates (Hansen et al., 1996; Baum et al., 2007). The GMM convergence tolerance is 1^{-8}. Since the computation burden is high in the contraction mapping, to speed converge, I use the squared polynomial extrapolation method (SQUAREM)(Reynaerts et al., 2012). SQUAREM speeds up the fixed point iteration and produces more robust convergence results.

I use the optimal instrument approach to obtain efficient demand estimates, especially non-linear ones. Reynaert and Verboven (2014) show how using the optimal instrument approach adds additional moment conditions. These additional conditions, increase the consistency and efficiency of parameter estimates. To implement this procedure, I first estimate demand parameters without optimal instruments. With these estimates, optimal instruments are formed as the expected Jacobian of the moment condition: $E(D_j(z_t)|z_t)\Phi^{-1}$ where Φ is an identity matrix since only demand side enters the estimation.[8] Second, I estimate the demand parameters with both these obtained optimal instruments as well as the initial instruments.

Even though the optimal instrument approach is used, one must still find valid instruments to deal with price endogeneity. Valid instruments should be correlated with price, but not correlated with unobserved product characteristics. BLP-type instruments (Berry et al., 1995), which are based on the similarity of products are one option. Another option are Hausman-type instruments (Hausman, 1996), which capture common components of costs of the same brands across markets. However, these instruments would be inapplicable here as a large number of markets in the data set have only one or two hotels. In addition, hotel prices are largely determined by local demand and local hotel attributes, rather than by common costs shared by hotels of the same brand.

Thus, within a brand, variation in prices is high across markets. Instead, I use the approach of Berry and Jia (2010) who employ the characteristics of the market as instruments; these instruments are meant to measure competition when firms face capacity constraints and entry is not exogenous. I tested the number of restaurants as well as the number of gas stations as possible instruments, but this did not resolve the endogeneity issue. Instead, I employ instruments that capture competition and costs. To measure competition, I use the distance to the closest rival within the same exit, as well as the sum of the rooms of rival hotels. To measure costs, I use the number of rooms. In addition, interaction terms between the above variables are included whenever such interactions do not give rise to collinearity issues.[9]

6 Estimated Results

6.1 Preliminary Analysis: The effect of Multi-Unit Ownership on Prices

This section includes a descriptive analysis of single- vs. multi-unit units and a reduced-form analysis. This reduced form analysis provides initial suggestive evidence that motivates the subsequent structural model and counterfactual analyses. This reduced-form analysis focuses on examining the association between multi-unit ownership and market prices. Prior to presenting this reduced-form results, we first summarize the characteristics of markets with and without multi-unit ownership, which is shown in Tables 2 and 3. As it can be seen, out of 1,595 markets, 116 markets have multi-unit owners (240 hotels).

For the reduced form models, I include fixed effects. To capture these fixed effects, the following indicator variables are included as regressors: 1) multi-unit

[8] In cases where demand and supply are jointly estimated, optimal instruments are defined as $E(D_j(z_t)\Phi^{-1}|z_t)$, where Φ is a covariance matrix of error terms(ξ, ω).

[9] The results of the first stage estimation, can be found in the appendix.

[10] Recall that only 2 hotels in the sample are owned by multi-unit owners

[11] Hotel ratings collected from *TripAdvisor* are originally provided by *Expedia*, an online travel agency. See the following website for details of its rating system (https://www.expedia.com/Hotel-Star-Rating-Information).

Table 2: Multi-Unit Ownership (All Markets)

Ownership Type	Markets	Hotels
Single-unit (franchisee or independent owner)	1,479	4,946
Multi-unit (with a franchisor or franchisors)[10]	116	240
Total	1,595	5,186

Table 3: Hotel Characteristics in Markets with Multi-Unit Ownership

		Single-Unit	Multi-Unit
Mean price ($)		81.68	84.62
Standard Deviation of prices		38.33	37.50
No. of Hotels (Units)			
Rating [11]	1	5	3
	2	104	69
	2.5	214	168
	3	32	0
Total		355	240

ownership, 2) same-brand, and 3) same-chain. The value of the dummy variable of multi-unit ownership (Multi-Owner) is one if the hotel owner also owns other units under a different franchisor. Second, if, within a market, a branded hotel faces competition from the same branded hotels, the value of this dummy variable (Same-Brand) is equal to one; otherwise, the variable takes a value of zero. Third, if a branded hotel faces competition from other branded hotels with different brand name but under the same hotel chain (franchisor), the value of this dummy variable (Same-Chain) is equal to one.

In addition to these variables, some models include the market concentration index (HHI) and the interaction term of HHI and Multi-Owner. These models explore whether concentration in the presence of multi-unit ownership is associated with prices. The Herfindahl-Hirschman Index is calculated by assuming that hotels belonging to a single franchisee are one entity.

In Table 4, column 1 shows the reduced-form results of the role that multi-unit ownership plays one price. The coefficient is significant and positive, suggesting that multi-unit owners, as hypothesized, may charge higher prices than single-unit owners.The presence of other same-brand franchisees in the market (column 2) has positive coefficient; the same is true for the presence of other same-chain franchisees in the market (column 3). However, these effects are not statistically significant. These last two results provide suggestive evidence that pricing decisions are unlikely to be dictated at the chain (or franchisor) level, an observation that was pointed out earlier.

Market concentration seems be associated with higher prices, although it is not significant (column 4). The interaction term between HHI and Multi-Owner (column 5), however, is significant. This result suggests that the effect of multi-unit ownership on prices is more pronounced in concentrated markets.

The results of the preliminary regression analysis are only suggestive because multi-unit ownership and multiple hotels under the same brand or the same chain are, for example, likely to be observed in markets with high demand; this, in turn, may be associated with higher prices. This endogeneity concern may prevent us to learn about the true effects of multi-unit ownership on prices. The structural approach below addresses this shortcoming.

Table 4: Effect of Multi-Unit Ownership (Market Structure) on Prices

Dep.Var: Price($100)	(1)	(2)	(3)	(4)	(5)
Multi-Owner	0.091***				
Same-Brand		0.020			
Same-Chain			0.007		
HHI				0.403	0.398
Multi-Owner * HHI					0.278***
Distance to Exit	−0.034	−0.059	−0.062	−0.057	−0.049
No. of Activities	0.790***	0.767***	0.764***	0.766***	0.789***
No. of Room Types	0.231***	0.218***	0.216***	0.219***	0.224***
No. of Service Bus.	1.024***	1.053***	1.060***	1.054***	1.025***
Constant	0.031	0.040	0.041	−0.150	−0.150
Fixed Effects (Market)	Yes	Yes	Yes	Yes	Yes
Observations	5,186	5,186	5,186	5,186	5,186
Adjusted R^2	0.545	0.543	0.543	0.543	0.544

*p<0.1; **p<0.05; ***p<0.01

6.2 Demand Estimates

This section reports demand estimates using the model discussed in Section 4. The section also reports key measures that are derived from these estimates, including price elasticities of demand, marginal costs, and markups.

Table 5 summarizes demand estimation results of the model that uses the optimal instruments. The top panel reports the means of the demand parameters (α, β). The bottom panel shows the standard deviations (σs) of the price variable.[12] These standard deviations capture heterogeneity in consumer preferences.

All means of taste parameters (βs) are significant, except the one for the number of room types provided by hotels. All these coefficients have the expected signs. Consumers, on average, prefer to stay close to highway exits. As hotels add more amenities and activities, such as bar, restaurant, and pool, consumer utility increases on average. As expected, consumers favor more room type options, while providing

[12] Different sets of random coefficients were tested; the table reports the preferred specification.

Table 5: Results of Demand Estimation

Variable	Coefficient	Std. Err.	p value
Mean (α, β)			
Price ($100)	-9.982	1.558	0.000
Distance to Exit	-1.193	0.461	0.010
No. of Activities	3.249	0.807	0.000
No. of Room Types	0.738	0.443	0.096
No. of Service for Business	3.469	0.959	0.000
Standard Deviation (σ)			
Price ($100)	3.331	0.847	0.000
Fixed Effects: Location, Chain			
GMM Object Value: 0.000011			

amenities targeted at business travelers at hotels— basic office equipment, meeting rooms and conference facilities— also increases consumer utility.

The mean price coefficient (α) is statically significant with a negative sign. The standard deviation of this coefficient (σ), which is significant, measures the consumer heterogeneity in their willingness to pay for hotel rooms. The inclusion of this heterogeneity allows the estimation of more flexible and reasonable substitution patterns.

To check the economic plausibility of the demand estimates, I calculate the following estimates: own price elasticities of demand, marginal costs, and markups. Figure 2 shows the distribution of the own-price elasticities (mean:-4.289; S.D.: 2.081). Even though there are instances where demand is estimated to be inelastic demand, these results are by and large reasonable.[13]

Table 6 and Figure 3 show, respectively, the descriptive statistics and the distribution of marginal costs and markups. Both marginal costs and markups appear to be within reasonable ranges, thereby validating the demand estimation procedure.

Table 6: Descriptive Statistics of Marginal Costs and Markups

	Mean	Std.	25%	50%	75%
Marginal Costs ($)	50.61	31.41	27.93	44.75	66.23
Markups ($)	17.64	9.67	12.19	14.97	18.86

[13] These ”inelastic” markets appear to be related to highly concentrated markets.

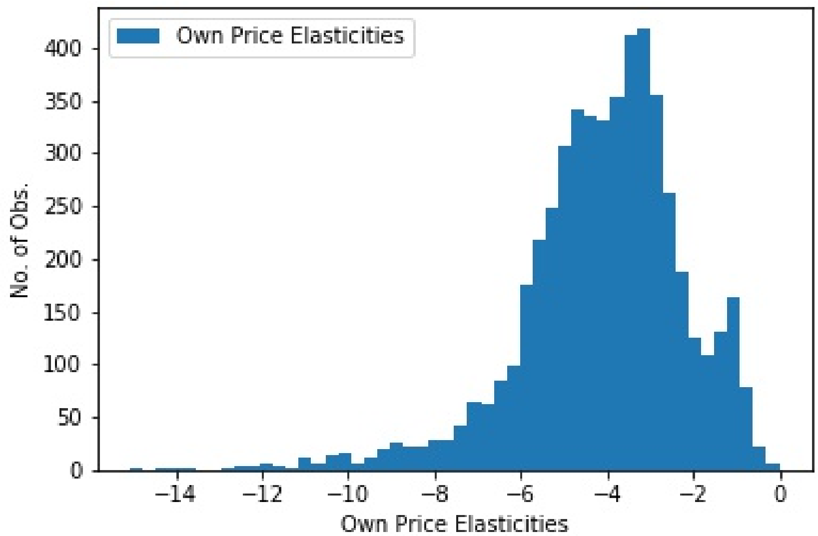
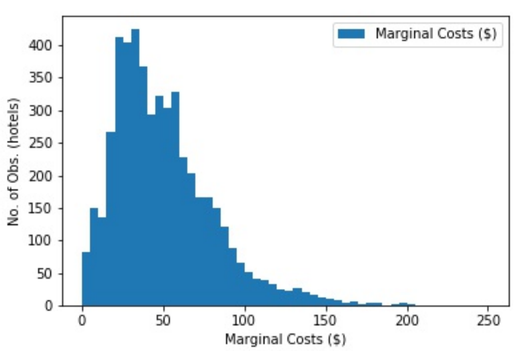
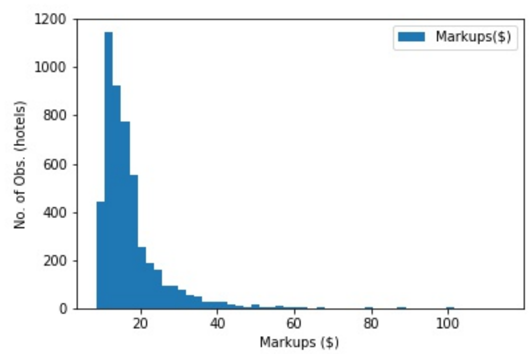


Figure 2: Distribution of Own Price Elasticities



(a) Marginal Costs



(b) Markups

Figure 3: Marginal Costs and Markups under the Pre-Scenario

6.3 Counterfactual Analysis

6.3.1 Changes in Prices, and Market Shares

The purpose of the counterfactual analysis is to examine whether multi-unit owners exercise market power. To perform this analysis, I create two different scenarios related to changes in ownership structures: 1) pre-scenario, and 2) post-scenario. The pre-scenario reflects the staus quo (a mix of single- and multi-unit owners), whereas in the post-scenario all firms are assumed to be single-unit profit-maximizers. Under the post-scenario, I estimate equilibrium prices by using demand estimates and the modified singe-unit ownership structure.

By comparing the estimated prices under the post-scenario with the observed prices, I empirically measure the market power associated multi-unit ownership. As mentioned earlier, in this baseline counterfactual exercise, I assume that marginal costs, which are recovered under the pre-scenario, are constant under the post-scenario. Later, I relax, and study the consequence of modifying, this baseline assumption.

Table 7: Changes in Prices and Market Share in Counterfactual Analysis

Variable	Ownership (Pre-Scenario)	Pre[1]	Post [2]	$\frac{\text{Post}-\text{Pre}}{\text{Pre}}$
Price($)	All	82.86	79.62	-3.91%
	Multi	84.62	77.01	-8.99%
	Single	81.68	81.39	-0.36%
Share(%)	All	12.5	13.44	7.52%
	Multi	16.46	20.78	26.25%
	Single	9.82	8.48	-13.65%

1: Both single and multi-unit owners.

2: Single-unit owners

Table 7 shows that prices, on average, decrease if all firms were single-unit owners (the post-scenario). The magnitude of the price decrease is higher for multi-unit owners, while single-unit owners do not change their prices significantly. This results confirms that multi-unit owners, ceteris paribus, are able to charge higher price because of joint profit maximization. Put differently, the estimates provide empirical support for the hypothesis that multi-unit owners exercise market power. As a result of the price reductions observed in the counterfactual exercise, multi-unit owners would increase their market share in a world in which they were asked to stop from engaging in multi-unit ownership.

6.3.2 Robustness Checks of Price Changes Under Post-Scenario

In this section, the constant marginal cost assumption is relaxed. Since multi-unit owners are likely to be more efficient than single-unit owners, probing this assumption seems to be relevant. To relax this assumption, I adjust the marginal costs of multi-unit owners obtained under the pre-scenario upwards, while keeping marginal costs of single unit owners stay constant. In particular, I scale up the recovered marginal costs of multi-unit owners by a series of factors (ranging from 5% to 10%) as depicted in Table 8. Figure 4 and 8 show how marginal costs vary under the different marginal costs assumptions. With these new series of marginal costs, I then proceed to re-estimate equilibrium prices in the post-scenario (once for each upward scaling factor considered).

Table 8: Additional Counterfactual Analysis with Different MC

	Pre		Post		Estimate Price
Model	Single-Unit	Multi-Unit	Single-Unit	Multi-Unit	(p_c^*)
Baseline	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	p^*
Model 1	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$ * 1.05	p_1^*
Model 2	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$ * 1.06	p_2^*
Model 3	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$ * 1.07	p_3^*
Model 4	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$ * 1.08	p_4^*
Model 5	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$ * 1.09	p_5^*
Model 6	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$	$\hat{mc}$ * 1.1	p_6^*

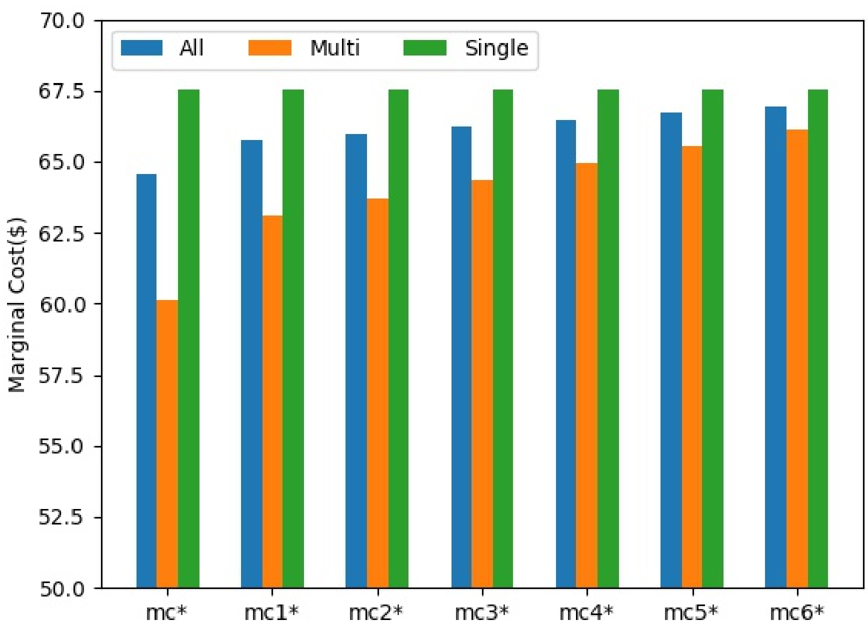


Figure 4: Various Marginal Cost Assumptions

The results of these additional counterfactual analyses are summarized in Table 9 and Figure 5. As upward scaling factor for the marginal cost of multi-unit owners

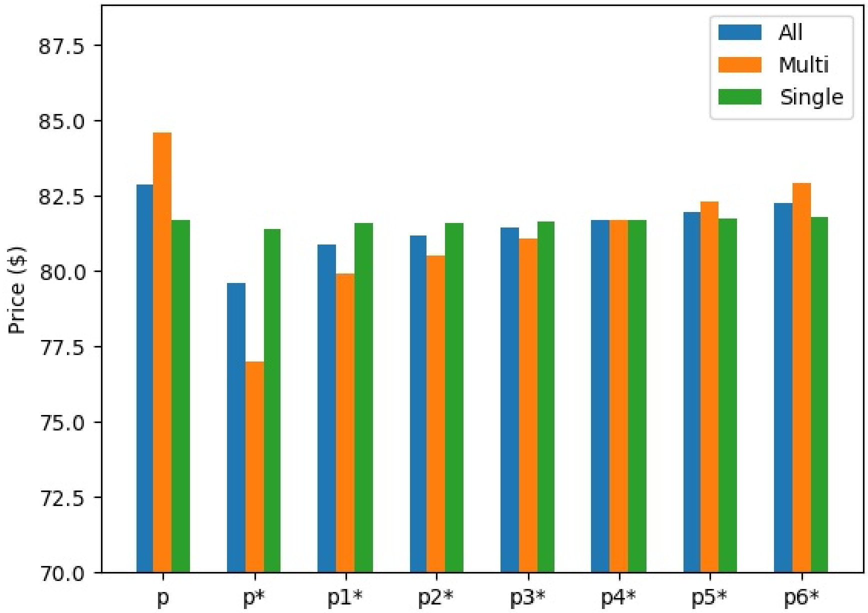


Figure 5: Price Variations

increases, one observes counterfactual prices ($p_1*, \cdots, p_6^*$) that are higher than those observed in the baseline counterfactual reported in the prior section (p^*). However, the estimated counterfactual average price ($p_c^*; c = 1, \cdots, 6$) remains below the average of observed prices (p). These results suggest that even under a scenario in which multi-unit ownership is associated with a 10% reduction in marginal costs, the exercise of market power (i.e. higher prices) would overcome such efficiency gain.

In sum, market power seems to be a likely and quantitatively important explanation (vis-á-vis efficiency) for the increase in price that one observes in multi-unit operation.

Table 9: Changes in Average Prices($p*$) with Different Marginal Costs

Ownership	p	p^*	p_1^*	p_2^*	p_3^*	p_4^*	p_5^*	p_6^*
All								
Mean	82.865	79.621	80.9	81.162	81.426	81.692	81.96	82.23
(%)	0.00%	-3.91%	-2.37%	-2.06%	-1.74%	-1.42%	-1.09%	-0.77%
Multi								
Mean	84.623	77.012	79.911	80.502	81.097	81.695	82.298	82.905
(%)	0.00%	-8.99%	-5.57%	-4.87%	-4.17%	-3.46%	-2.75%	-2.03%
Single								
Mean	81.677	81.386	81.568	81.607	81.648	81.689	81.731	81.773
(%)	0.00%	-0.36%	-0.13%	-0.09%	-0.04%	0.01%	0.07%	0.12%

p: the observed prices, p^*, p_c^*: estimated prices; %: Percentage changes (%) from the observed prices

6.3.3 Consumer Welfare

To measure changes in consumer welfare, I calculate the market-level compensating variation(CV). Total annual CV for all markets is \$ 43,998,262.12, which is equivalent to 5.22% of total consumer annual spending. Thus, without multi-unit ownership, consumers would spend 5.22% less than what they actually do, holding their utility constant. This result is a direct effect from the reduction in prices observed in the counterfactual analysis.

Figure 6 shows how average compensating variation varies depending on the marginal costs assumption (Section 6.3.2).[14] As estimated marginal costs increase for multi-unit owners, the average compensating variations decreases accordingly, indicating that consumer welfare decreases, but consumers are still better off without multi-unit ownership even if that means erasing some efficiency gains.

7 Conclusion

This paper investigates the effects of multi-unit ownership on prices, market shares, and consumer welfare by analyzing data on hotels near interstate highway exits in Texas to answer the following question: Why do franchisees have multiple units that are associated with more than one franchisor? Using data of prices, quantities, ownership, and hotel characteristics, I first identify hotels owned by multi-unit owners in narrowly defined, geographical markets. I then conduct reduced-form model analysis and find evidence suggesting that multi-unit ownership is associated with higher prices.

[14] $CV*$ represents CV calculated with price $p*$. All other CVs are calculated with the corresponding counterfactual prices. For example, $CV1*$ is obtained with price p_1^*, and so on

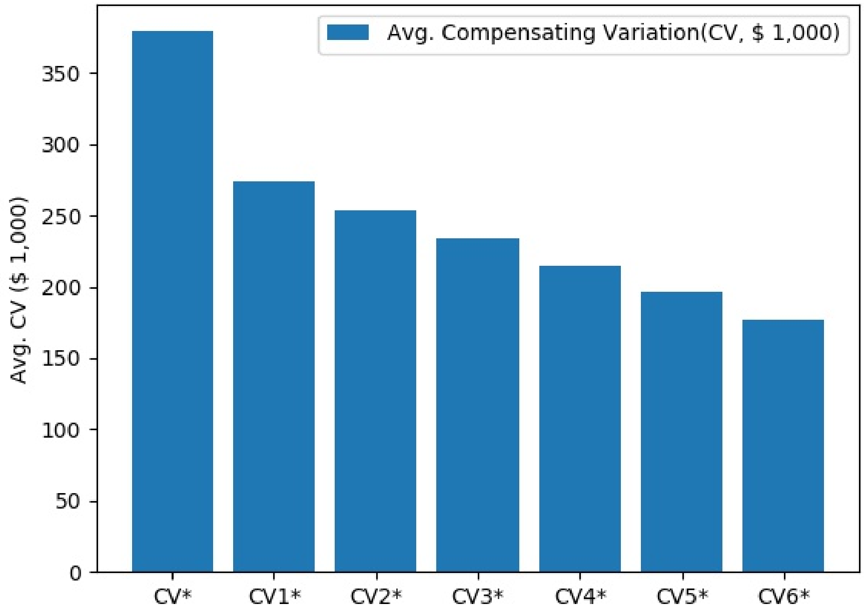


Figure 6: Changes in Average CVs with Different Marginal Costs

Motivated by the results of the reduced-form analysis, I estimate demand parameters using a random coefficient logit model. With the estimated parameters, I conduct a counterfactual analysis to analyze how firms would have charged prices in the absence of multi-unit ownership(the post-scenario). I measure the market power of multi-unit owners by comparing observed prices in the markets with estimated prices under the post scenario. The results support the hypothesis that multi-unit owners exercise market power: in the post scenario, prices, on average, decrease by 3.91 %, with the price decreases being larger for multi-unit owners (8.99%). This result is consistent with additional counterfactual analyses under the different assumptions of marginal costs. The market shares of all owners increase by approximately 7.52%, on average, while most increases in market of the multi-unit owners are larger (26.25%). Finally, welfare analysis indicates that under under the counterfactual scenario, consumers would increase welfare with the respect to the multi-unit ownership status quo.

The findings of this paper provide a unique view on franchising, especially the role of franchisees. Franchising is seen as an intermediate point between vertical separation (i.e., two independent firms at each vertical level) and vertical integration(i.e., an integrated firm controlling both vertical levels). The market that is analyzed here provides a set up where the upstream unit (franchisors) may have limited control over the downstream (franchisees) decisions. In this scenario, and using the lodging industry as an example, this paper finds that some franchisees have multiple franchising contracts with more than one franchisors and that this multi-unit onwership causes prices to be higher. This evidence provides one explanation for why owners might want to operate multiple units in local markets and why franchisors would have an incentive to permit this.

Some limitations need to be considered when interpreting the results of this study. First, the narrow market definition in this paper might exclude many markets where multi-unit owners exist (i.e. cities, especially metropolitan areas). While these large markets could in principle be studied, the lack of a clear market definition (that clearly excludes cross-market competition) creates a hurdle in being able to credibly and precisely identify reliable substitution patterns across firms in a market (a crucial ingredient in the counterfactual analysis). Second, multi-unit owners might operate units in different markets in which the owners exercise market power through different mechanisms, such as multi-market contact. Even though this is beyond the scope of this paper, analyzing other operational/management aspects of multi-unit owners decision-making appears to be a fruitful avenue for future research.

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A Appendix

A.1 Multi-Unit Owners in Texas

Table 10: Multi-Unit Owners in Different Market Definitions

(Unit: Hotel)

Market Definition		Period	Total	MUO Hotels[0]	Avg. MUO Hotels
State[1]	All		18,050	2,494 (13.8%)	623.50
	MSA	4[5]	14,318	2,165 (15.1%)	541.25
	Non-MSA		3,732	245 (6.6%)	61.25
City[2]	All		18,050	1,391 (7.7%)	347.75
	MSA	4[5]	14,318	1,266 (8.8%)	316.50
	Non-MSA		3,732	125 (3.3%)	31.25
Highway[3]		28[6]	5,186	240 (4.6%)	8.57

0: Hotels owned by multi-unit owners
1: State as a single market
2: Cities as markets
3: The definition of market in this paper
4: 4 periods (2014Q1 to 2014Q4)
5: 28 periods (2008Q1 to 2014Q4); The one that this paper uses

Table 11: Market Size by Market Types

Type	No. of Markets	No. of Hotels in the Market					
		Mean	St. Dev.	Min	25 %	75 %	Max
All	1,595	3.251	2.297	1	2	4	12
Single & Multi[1]	116	5.129	2.656	2	3	9	10
Single[2]	1,479	3.104	2.200	1	2	4	12

1: Markets with both single- and multi-unit owners
2: Markets with only single-unit owners

Table 12: Descriptive Statistics by Ownership Types in All Markets

Statistic	N	Mean	St. Dev.	Min	25 %	75 %	Max
Price							
All	5,186	68.101	32.930	13.379	43.589	85.742	273.621
Multi[1]	240	84.623	37.503	22.800	60.006	98.645	223.530
Single[2]	4,946	67.300	32.483	13.379	43.017	85.227	273.621
Room							
All	5,186	62.594	26.910	9	46	74	200
Multi[1]	240	67.046	23.854	24	52	97	105
Single[2]	4,946	62.378	27.033	9	45	74	200
Rating							
All	5,186	2.125	0.536	1	2	2.5	3
Multi[1]	240	2.337	0.272	1	2.	2.5	2.5
Single[2]	4,946	2.115	0.544	1	2	2.5	3

1:Multi-Unit Owners, 2:Single-Unit Owners

Table 13: Descriptive Statistics of Owners in Markets with Multi-Unit Owners

Statistic	N	Mean	St. Dev.	Min	25 %	75 %	Max
Price							
All	595	82.865	37.994	22.800	58.066	96.403	223.530
Multi[1]	240	84.623	37.503	22.800	60.006	98.645	223.530
Single[2]	355	81.677	38.330	26.518	55.420	94.766	210.890
Room							
All	595	73.613	35.609	24	52	96	200
Multi[1]	240	67.046	23.854	24	52	97	105
Single[2]	355	78.054	41.165	25	55	96	200
Rating							
All	595	2.361	0.312	1	2	2.5	3
Multi[1]	240	2.337	0.272	1	2	2.5	2.5
Single[2]	355	2.377	0.336	1	2	2.5	3

1:Multi-Unit Owners, 2:Single-Unit Owners

A.2 Variable Definitions

- Prices of hotels (p_{jt}): Average Daily Room Rate ($100)
- Distance to Exit: Distance to the nearest highway exits (Miles)
- Shares of hotels: Rooms sold / total rooms available in the market
- No. of Activities: Restaurant, bar, lounge, pool, gym, spa, and kid-activities
- No. of Room Types: No. of Room types available in hotels
- No. of Services for Bus.: Meeting room, conference facility, business center, fax/office support.

A.3 Results of First Stage IV

Table 14: Results of First Stage IV

Dep. Var.: Price	Coef. (Std.Err.)
Exogeneous Var.	
Distance to Exit	-0.099^{***} (0.036)
No. of Activities	0.361^{***} (0.044)
No. of Room Types	0.090^{***} (0.034)
No. of Services Bus	0.367^{***} (0.061)
Instruments	
Distance to Rival	-0.031^{*} (0.018)
No. of Rooms	-0.110^{***} (0.016)
Sum of Rivals' Rooms	0.056^{***} (0.005)
No. of Rooms * Distance to Rival	0.002 (0.028)
Sum of Rivals' Rooms * Distance to Rival	0.010^{*} (0.005)
Fixed Effect:	Location, Chain
Observations	5,186
Adjusted R^2	0.641
F Statistic	129.654^{***}

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$