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In-House and Arm's Length: Productivity Heterogeneity and Variation in Organizational Form

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Abstract
This paper analyzes how firms are organized in the U.S. hotel management industry. For most hotel brands, properties with intermediate room occupancy rates are relatively more likely to be managed by company employees rather than by independent franchisees. Properties with the lowest and the highest occupancy rates tend to be managed by franchisees, at arm's length from the hotel chain. This variation in organizational form is consistent with a model in which the incentives embodied in management contracts vary with property-level productivity. We infer that most hotel chains franchise low productivity relationships to keep property-level fixed costs low and franchise the most productive relationships to create high-powered incentives for franchisees. Franchisees of high-productivity properties work harder than the managers of both chain-managed properties and low-productivity franchises because the performance incentives in franchise contracts are proportional to hotel revenues and complement the incentives arising from having control over the property.

Key words: firm heterogeneity, firm structure, incomplete contracts, outsourcing
JEL Codes: D23; F12; L23; D22

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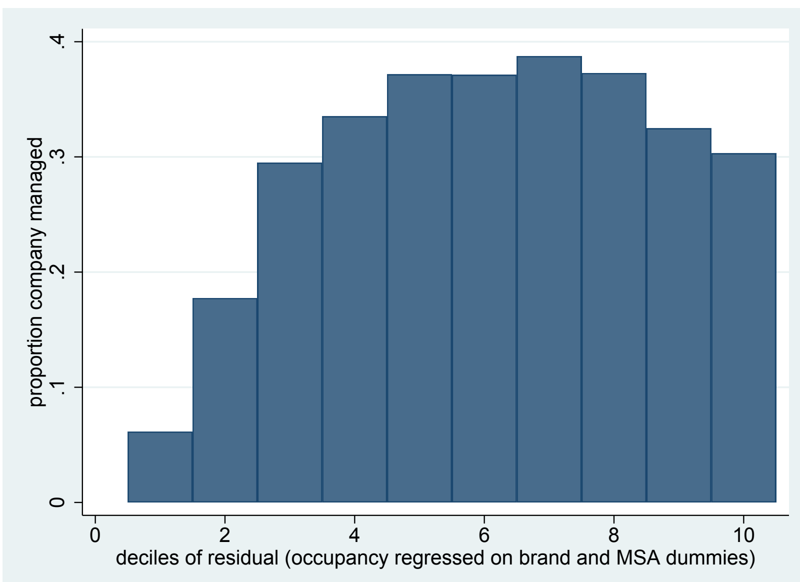
1 Introduction

In the U.S. hotel industry, 30% of hotel properties are managed by hotel chain employees and 70% are managed by franchisees. Most hotel brands franchise management of some properties while managing other properties themselves, with some brands opting to franchise more often than others. This paper examines these organizational form choices, analyzing data from over 9,000 hotel properties affiliated with 38 different hotel brands. We report a new empirical finding: within a hotel brand, hotel properties with either low or high occupancy rates are more likely to be managed by franchisees (outsourced), while properties with intermediate occupancy rates are more likely to be managed by company employees (vertically integrated).

Figure (1) controls for hotel chain and property location and shows the share of hotel properties that are chain managed in each decile of the occupancy rate distribution. The share of chain managed hotels in a brand is increasing with occupancy decile up to the seventh decile, in which just under 40% of properties are chain managed. The share of chain managed hotels falls in each successive higher-occupancy decile.

Figure 1: The Share of Chain-Managed Properties, by Occupancy Rate Decile



In choosing whether to operate a given hotel property at arm's length or in-house, hotel brands face the classic "make or buy" decision at the heart of theory of the firm that started with Coase (1937). Hotel management requires relationship-specific investments from a property-level manager and from a brand-level chain headquarters. The firm headquarters specifies the services to be offered by the manager—either an independent franchisee or a chain employee—and also provides them with an operating system, brand identity, and support (International Franchise Association, 2018). The manager runs the property on a day-to-day basis and is responsible for all aspects of the guests' stay. When contracts between the headquarters and manager are incomplete, both parties may face inefficiently weak incentives to invest in the relationship. Against this backdrop, the headquarters choice of whether to make or buy the required management services can shape both parties incentives and mitigate the incomplete contracting problem.

Accordingly, this paper draws on two theories of the firm to analyze hotel organizational form choice. First, in property rights theory, organizational form determines who retains the residual value of the relationship if it breaks down, and thereby determines who has relatively stronger ex ante incentives to invest.[1] This theory generates a tradeoff between inputs from the firm and from the supplier. In a vertically integrated relationship, the firm retains control and underinvests less in the relationship, but this exacerbates underinvestment by the supplier. Due to this tradeoff, vertical integration is relatively efficient when the headquarters' input is used more intensively in production, and outsourcing is efficient otherwise.

Second, a separate strand of the literature, on managerial agency, examines how performance incentives—that is, enforceable ex ante commitments to reward costly effort via state-contingent payments—can mitigate an agent's underinvestment (Fama and Jensen, 1983; Brickley and Dark, 1987). A supplier's incentives to exert effort are greater when his ex ante claims on the relationship proceeds are larger. The firm's decision to offer such incentives is often related to its organizational form choice. For firm employees, performance incentives take the form of bonuses. For third-party contractors, outsourcing (franchising, in our setting) can allow the firm to extract all the relationship surplus upfront and make the supplier the residual claimant of all relationship proceeds; thus "selling the project to the agent" to eliminate agency problems.

We present a model where each hotel chain headquarters is an upstream firm that derives market power from a trade name and organizes each property in order to maximize its own payoffs, following previous studies of the hotel industry (Lafontaine, 1992). The hotel chain takes both incentives mechanisms into account. While franchising incurs lower fixed costs, it weakens the headquarters' own incentives to invest in the relationship and increases those of the supplier, by the usual logic of property rights models. In addition, the headquarters can offer explicit performance incentives to each property manager.

[1] Much of the existing empirical literature on outsourcing decisions draws from the property rights theory of the firm and, in particular, from Grossman and Hart (1986) and Hart and Moore (1990).

Critically, we assume there is exogenous variation in hotel property-level productivity.[2] In line with the recent literature in international economics on productivity and supplier-firm relationships, productivity then shapes the tradeoffs at the heart of the headquarters organizational decisions.[3]

In particular, the model predicts that the hotel headquarters will sort its properties by productivity into vertically integrated and non-integrated relationships. For low-productivity relationships, hotel chains franchise primarily because it incurs lower fixed costs. This benefit dominates investment incentives considerations because low productivity reduces both the potential efficiency loss from depriving the headquarters of residual control rights and the potential efficiency gain from providing stronger performance incentives for the supplier.

This tradeoff changes as productivity increases. When production of hotel services is at least moderately intensive in the headquarters investment, the potential efficiency gains from allocating residual control rights to the headquarters—via vertical integration—increase rapidly with productivity. As a result, at intermediate levels of productivity, these efficiency gains outweigh both the fixed cost advantage of franchising and the costs of underinvestment by the supplier, and vertical integration is preferred.

The tradeoffs again change as productivity increases further. For high productivity properties the hotel chain chooses to franchise management because it creates the highest powered incentives for suppliers. The model reveals that reducing the supplier's fear of hold up and strengthening her residual claims on relationship proceeds enhance her investment incentives in a mutually reinforcing way: mitigating the franchisee's concerns about future holdup enhances the marginal return on the inputs targeted by performance incentives. The associated efficiency gains outweigh the losses from lower headquarters investment in a franchised property due to headquarters own lack of residual control.

To underscore the importance of these complementarities, we show that a version of the model without performance incentives—in essence, a simple property rights model—predicts that the efficiency gains from allocating residual control rights to the headquarters (whose investment is as-

[2]The existence of persistent productivity heterogeneity is a well-established empirical fact, both within industries (Ravenscraft, 1983; Schmalensee, 1985; Syverson, 2011; Ichniowski and Shaw, 2010) and within multi-unit firms (Shelton, 1967; Darr et al., 1995; Griffith et al., 2006).

[3]As evidenced by the hotel industry (Kalnins, 2004 and 2006), and at the product level in papers in the international trade literature (Antras, 2003; Yeaple, 2006; Nunn and Trefler, 2008), there is often substantial variation in the organizational form governing the transaction of narrowly defined products or services. Following Melitz's 2003 study of firm productivity and exporting behaviour, the international economics literature has explored in depth how productivity shapes firms organizational choices vis-a-vis suppliers. Antras and Helpman (2004) demonstrates how heterogeneous firms can sort (by productivity) into importers and non-importers and into vertically integrated and non-integrated relationships. We use a simple version of this model as our starting point for the model in this paper. We then include performance incentives similar to Grossman and Helpman (2004).

sumed to be more important) increase monotonically with productivity. As a result, the probability of vertical integration increases monotonically with productivity—in contrast to the inverted-U relationship that emerges when we allow the firm to include performance incentives.

How do the data square with the predictions of the model? Following prior empirical studies of the hotel industry, we measure property productivity using occupancy rate (Butters, 2016), defined as room nights sold divided by room nights available. As shown in Figure 1, for many hotel brands, low- and high-productivity properties are franchised, while intermediate-productivity properties are vertically integrated. Through more formal econometric work, we confirm that the non-monotonic relationship between the occupancy rate and the likelihood of vertical integration obtains for hotel brands within the economy hotel tier (e.g., Econolodge), mid-scale tier (e.g., Holiday Inn), and upscale tier (e.g., Courtyard).

A simple property rights model that includes ownership incentives but not performance incentives cannot explain the non-monotonic relationship. The data are consistent with the model presented here, where outsourcing includes performance incentives that are incentive compatible with maximal supplier effort only at high productivity levels. This fits with the hotel setting, where typical franchising contract creates performance incentives for a franchisee to exert maximum effort only when property revenues are high—that is, in high occupancy rate properties. Contracts usually include a fixed fee to be paid by the franchisee and then a revenue sharing agreement under which the franchisee retains a share of revenues. Lafontaine (1992) notes that this share is typically fixed across all properties within a brand. Because properties vary in occupancy rate, retaining a constant share of revenues leads to potentially very different payoffs to hotel managers.[4] We conclude that residual control rights and fear of holdup are important but not exclusive determinants of organizational choices in this industry; revenue-sharing performance incentives—as well as complementarity between the two incentives mechanisms—appear empirically relevant as well.

Recent work including Legros and Newman (2012) has shown that organizational form can be influenced by a variety of factors, some of which could be correlated with productivity, output, and occupancy rate.[5] To address the associated endogeneity issues in our setting, our primary empirical

[4]While franchising contracts specify how revenues are to be shared, the contract remains incomplete even for high productivity relationships because it is impractical to write an enforceable contract governing all actions that affect the level of revenues in all relevant states of the world. For example, the chain can encroach on a property's territory by operating nearby competing properties (Kalnins, 2004). On the other side of the agreement, the franchisee sets property-level prices and is unlikely to consider the external impact on other properties owned by the chain (Kalnins, 2016).

[5]Legros and Newman (2012) model relationship productivity heterogeneity as a result of variation in the endogenously determined market price. In their model, vertical integration improves coordination and increase relationship output but also imposes additional costs, and this organizational form is preferred at intermediate levels of prices.

specification controls for metropolitan area fixed effects and brand fixed effects. In addition, we show that there is a non-monotonic relationship between occupancy rate and organizational form over time when controlling for property fixed effects and time fixed effects. For those hotels that switch from being franchised to chain managed or vice versa, franchising is more likely during time periods of low and high relative occupancy.

While the existing literature has analysed variation in organization form across firms and across geographic areas, we believe that this is the first empirical analysis of a franchise-intensive industry's organizational heterogeneity within brands and within narrowly defined geographic areas.[6] By controlling for both brand effects and metropolitan area effects, our empirical analysis controls for determinants of organizational form that have already been explored relatively intensively by the existing literature. Thus, the paper examines organizational heterogeneity that has so far received little attention. It sheds new light on how various incentives mechanisms jointly shape organizational form—in ways that are, at times, complementary.

These contributions are made possible by the fact that a hotel chain's property-level "forward integration" decision about how to organize hotel management yields data for many similar supplier relationships for each brand and for each metropolitan area. We assume that organizational choices reflect the chain's wish to maximize its own payoffs from each property, and the chain's payoffs are determined by each party's inputs, which are, in turn, shaped by the incentives of the chosen organizational form. This logic allows us to infer the interplay of each party's incentives at different property productivity levels, and assess the roles of various incentives mechanisms embodied in organizational form choice.

We also assess how taxes affect organizational choices. Most hotel chains in the data have properties distributed across US states, and corporate tax rates vary across states. The model predicts that the productivity range for which chain management is relatively preferred over outsourcing is shifted up and widened at higher rates of tax. Using state tax data, we confirm that the probability a property is chain managed is greatest at higher occupancy rates in states with high marginal

[6] Lafontaine and coauthors have conducted extensive empirical work on variation across firms in the firm-level propensity to franchise in hotels and other franchise-intensive industries (Lafontaine, 1992; Lafontaine and Bhattacharyya, 1995; Kalnins and Lafontaine, 2004; Lafontaine and Shaw, 2005). Other studies find evidence that the average propensity to outsource in this industry is, for example, positively related to distance from HQ (Brickley and Dark, 1987) and negatively related to property size and the local concentration of same-brand properties (Kehoe, 1996). Our study also relates to two empirical papers about the "make or buy" decision that also explore general propositions from property rights models of firm boundaries. Lileeva and Van Biesebroeck (2010)'s model varies the relative technological intensities of the inputs provided by the buyer and different suppliers. Second, Feenstra and Hanson's 2005 model of Chinese export processing shows that control over inputs is more likely to be allocated to the supplier when the relationship specificity of human capital is low. They use variation in observed organizational forms across different Chinese provinces to estimate variation in human capital relationship-specificity.

corporate tax rates for the midscale and economy quality tier brands.

The paper proceeds as follows: Section 2 presents the model of organizational form choice. Section 3 describes the data used in the study. Section 4 documents the key empirical relationships and relates them to the predictions from the model. Section 5 concludes.

2 A Simple Model of Organizational Form

We present a partial equilibrium model of a single firm-supplier organizational form choice where there is heterogeneity in firm-supplier relationship productivity and incomplete contracting. The starting point for the model is a simplified version of Antras and Helpman (2004) (AH). As in their paper, all parties are risk neutral and the supply of local suppliers is assumed to be infinitely elastic.[7] We use the terminology H for the firm and S for the supplier in the model to illustrate its general nature. In our empirical application, HQ is the hotel chain, and S is a franchisee or chain-employed manager.

The environment

The firm headquarters (H) incurs a fixed market entry cost f_E, matches with a potential supplier (S), and makes a productivity draw, θ, from a known distribution $F(\theta)$. H then chooses an organizational form—either vertical integration (V) with the supplier or outsourcing (O), in which HQ and S remain independent. Outsourcing entails a fixed cost for H of f^O. The fixed cost to H of vertical integration is supplier-specific, stochastic, and denoted by f^V, drawn from a known distribution $H(f^V)$. On average, vertical integration entails higher fixed costs, that is, $E(f^V) > f^O$.

Under both V and O, H and S must each produce relationship-specific inputs to generate output. The inputs are x_H and x_S, respectively, and their levels cannot be verified by a third party.[8] Each of the inputs generates quadratic disutility costs—$\Gamma_H(x_H) = \frac{1}{2}(x_H)^2$, and $\Gamma_S(x_S) = \frac{1}{2}(x_S)^2$.

We now extend this framework, drawing from Grossman and Helpman (2004) to allow H the option of including an explicit performance-related incentive to mitigate supplier underinvestment in each of the O and V organizational form choices. Implicitly, this requires the additional assumption

[7] In their model, firms also choose whether to locate production in a foreign country. In our setting, there is no location choice.

[8] In our empirical setting, x_H represents investment by the hotel brand (firm) in the relationship-specific human capital of the operator of the property (supplier)—for example, teaching the operator about the company's policies and procedures. x_S represents complementary investments by the operator in his/her own relationship-specific human capital—for example, learning how to use the company's IT systems.

that H can observe an ex post relationship outcome that is correlated with the supplier's input and write a state-contingent supplier claim into the contract.[9] To do this, we allow S's input choice to be two dimensional in that x_S can be of high or low quality, where the quality of x_S—but not its level—is observable ex post. This important assumption means that H can write a performance contract allowing S to claim a bonus in the event that its input is high quality. We assume that x_S contributes to the value of the relationship only when it is high quality.

The supplier can increase the probability that his input is high quality by exerting costly relationship-specific effort. The effort level is chosen ex ante and reflects the anticipated payoffs under successful production. Effort costs the supplier E.[10] We assume that if S does not exert effort, then the probability of high-quality x_S is equal to $p_0 > 0$. If S exerts effort, the probability of high-quality x_S is equal to $p_E > p_0$.

When both x_H and x_S are positive and x_S is high quality, the value of realized production is: $Y = F(x_H, x_S, \theta) = \theta(hx_H + x_S)$. The parameter h measures the relative importance of H's input, so that a production function is intensive in H's input whenever $h > 1$. If x_S is low quality, final output is $Y = \theta(hx_H)$. The expected final output, prior to production taking place, can therefore be summarized as follows:

$$EY = F(x_H, x_S, \theta, p(\cdot)) = \theta(hx_H + x_S p(\cdot)) I \tag{1}$$

where $p(\cdot)$ is equal to either p_0 or p_E and I is an indicator variable that takes on the value of 1 if $x_H > 0$, and $x_S > 0$.[11]

H and S bargain with each other ex ante about the divisions of relationship surplus. The organizational form choice of O or V affects each party's bargaining power in the negotiation because it determines their outside options. Under O, failure to reach agreement on the division of surplus leaves both parties with zero income, since x_H and x_S are specific to the relationship. H is unable to capture any value from S's inputs, and vice versa, if negotiation breaks down. Under V, however,

[9] We note that the supplier's input levels remain unobservable and non-contractible, however, it is reasonable in our setting to assume that the hotel chain can observe some outcomes that are related to supplier input, for example, room average daily rates are observable, which together with occupancy rates, determine hotel revenues. The chain can also monitor aspects of guest experience.

[10] We note that supplier input and effort are both ex ante decisions. The distinction between the two is expositional, and is motivated by the fact that the latter is assumed to be correlated with an observable and contractible ex post outcome. In practice, it reflects the idea that H can write a contract based on some, but not all, aspects of measured property-level performance.

[11] This indicator variable captures the facts that these two relationship-specific variables are worthless outside the relationship and that they are complementary only in the sense that a positive amount of each one must be provided in order to realize any output. Once this condition is met, there are no further production complementarities. This assumption mirrors the model in Acemoglu et al. (2010), and differs from Lileeva and Van Biesebroeck (2010).

if negotiations break down, H can fire the supplier, recover x_S, and realize a fraction μ of the final output. The supplier receives no income from the bargaining game in this case. That is, under O, H and S face symmetric outside options, but H's outside option is greater than S's under V. Using A_i^k to denote party i's expected outside (alternative) value under organizational form k, we have: $A_H^O = 0$, $A_H^I = E\left(\mu\theta\left(hx_H + x_S p\left(\cdot\right)\right)\right)$, and $A_S^O = A_S^I = 0$.

Utility and bargaining game payoffs

H's and S's expected utilities under organizational form $k \in O, V$ are, respectively:

$$E\left(U_H^k\right) = y_H^k - \frac{1}{2}\left(x_H^k\right)^2 - f_E - f^k + T^k - b^k p\left(\cdot\right)^k \tag{2}$$

$$E\left(U_S^k\right) = y_S^k - \frac{1}{2}\left(x_S^k\right)^2 - T^k + b^k p\left(\cdot\right)^k - e^k \tag{3}$$

where y_H^k and y_S^k are H's and S's payoffs from the Nash bargaining game, defined below. T^k denotes an ex ante transfer payment to H from S.[12] The effects of allowing H to include a performance contract related to the quality of S's input generates the terms b^k and e^k, where b^k is the bonus payment made in the event that x_S is high-quality, which happens with probability $p(\cdot)$, and e^k is the supplier effort cost related to supplier input quality.

The bargaining process is a symmetrical Nash bargaining game, from which each party obtains its expected outside value plus one-half of the expected quasi rents. Any performance-related bonus payment received by the supplier ex post comes out of the share of the quasi rents going to H in this bargaining game. Once the investments are sunk, as long as $I = 1$, that is, if both x_H and x_S are positive, the expected quasi rents are equal to expected output less the two parties' expected outside options:

$$E\left(r^k\right) = EY - A_H^k - A_S^k$$

$$E\left(r^k\right) = \theta\left(hx_H + x_S p\left(\cdot\right)\right) - A_H^k.$$

Note that the two parties bargain over the quasi rents ex post under both organizational forms;

[12]We assume that each potential S is credit constrained, placing a limit, l, on the size of the ex ante transfer, T^k, that H can extract from S. The constraint is more likely to bind in equilibrium for relationships with a high-productivity draw, precisely when the high-powered performance and ownership incentives that are feasible under outsourcing are more valuable. H cannot extract an upfront payment from an employed manager. These assumptions match the hotel industry setting, where franchisees, but not managers, pay a fee to the brand headquarters.

thus, party i's expected payoff from the Nash bargaining game can be written as:

$$E\left(y_i^k\right) = \frac{1}{2}E\left(r^k\right) + A_i^k \tag{4}$$

Equilibrium choice of Organizational Form as a function of θ

For each organizational form, H chooses a bonus, b^k to be paid to the supplier if his input is high quality. A sufficiently high bonus ensures that the supplier exerts effort to increase quality, while a low bonus makes such effort incentive incompatible.[13] The endogenously determined levels of relationship-specific investments x_H, x_S, and supplier quality effort, as well as the payoffs to each party under each of these choices are derived for the outsourcing contracts without and with effective performance incentives in Appendix A and in Appendix B for the two analogous vertical integration contracts. Table (1) summarizes the input levels for each possible contract.

Table 1: Input levels

Organizational Form	x_H	$x_S p(\cdot)$	$x_S p(\cdot)$ with effective performance incentives
Outsourcing	$\frac{1}{2}\theta h$	$\frac{1}{2}\theta p_0$	$\frac{1}{2}\theta p_E$
Vertical Integration	$\frac{1}{2}(1+\mu)\theta h$	$\frac{1}{2}(1-\mu)\theta p_0$	$\frac{1}{2}(1-\mu)\theta p_E$

Because organizational form determines control rights, it introduces a trade off between the equilibrium levels of H's and S's inputs. H invests more and S invests less under V, and vice versa under O. We note here the complementarity between the effort exerted by S and the level of x_S. Since $p_E > p_0$, S's input is higher under both O and V when effective performance incentives are included so that the probability of high quality input is p_E rather than p_0. There is no corresponding reduction in H's input when performance incentives are included for the supplier.

Table (2) summarizes the payoffs to HQ under each of the four possible contracts as a function of the equilibrium input levels. $F_O = f_e + f^O - l$ and $F_V = f_e + f^V$, and are the costs that do not vary with θ under O and V, respectively (note that $F_V > F_O$ because $f_V > f_O$ and $l > 0$). $B_O = \left(\frac{E}{p_E - p_0} - \frac{\theta^2(p_E^2 - p_0^2)}{8(p_E - p_0)}\right)$ and $B_V = \left(\frac{E}{p_E - p_0} - \frac{\theta^2(p_E^2 - p_0^2)(1-\mu)^2}{8(p_E - p_0)}\right)$ are the incentive compatible bonus payments to S under O and V, respectively, paid in the event that supplier input is high quality.

Because each of H's payoff functions in Table (2) is monotonically increasing in θ and also take

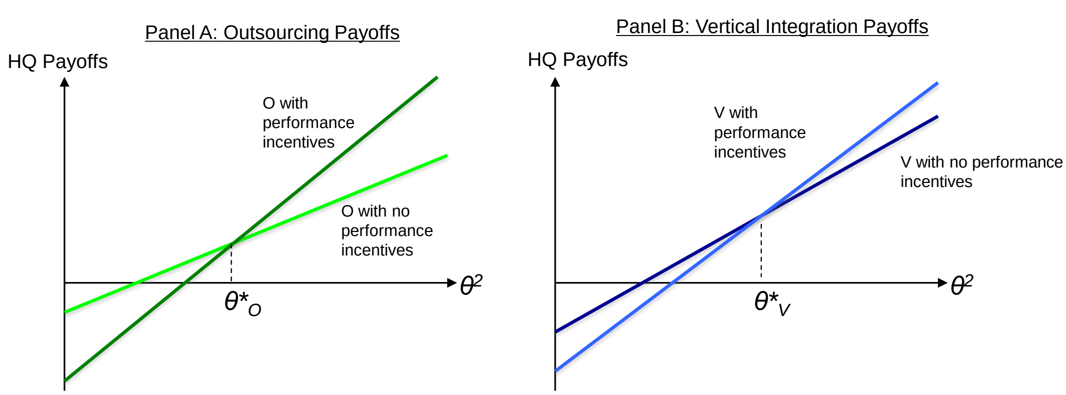
[13] We later discuss how the terms of a typical franchise contract make supplier effort incentive incompatible or compatible. We note that receiving a fixed share of hotel revenues corresponds to a higher bonus payment when a property had higher revenues.

Table 2: HQ payoffs

Contractual Form	$E(U_H^k)$
(i) Outsourcing no effective performance incentives	$\frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_0^2 - F_O$
(ii) Outsourcing with effective performance incentives	$\frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_E^2 - F_O - p_E B_O$
(iii) VI no effective performance incentives	$\frac{1}{8}\theta^2 h^2 (1+\mu)^2 + \frac{1}{4}\theta^2 p_0^2 (1-\mu^2) - F_V$
(iv) VI with effective performance incentives	$\frac{1}{8}\theta^2 h^2 (1+\mu)^2 + \frac{1}{4}\theta^2 p_E^2 (1-\mu^2) - F_V - p_E B_V$

on different values when $\theta = 0$, each of the four payoff functions intersects at most once with each of the other three. Appendix A shows that there is a threshold θ above which outsourcing with performance contracts is preferred over outsourcing without sufficient performance incentives. Figure (2), Panel A, illustrates the payoffs to outsourcing as a function o θ^2. The lowest value of θ^2 where performance incentives are included is $\theta_O^{2*} = \frac{8p_E E}{(p_E^2 - p_0^2)(3p_E - 2p_0)}$. Appendix B presents the equivalent analysis for HQs payoffs from vertical integration. The threshold value of θ^2 above which H includes performance incentives is $\theta_V^{2*} = \frac{8p_E E}{\left(p_E^2 - p_0^2\right)(3p_E - 2p_0 - \mu^2(p_E - 2p_0) - 2\mu p_E)}$. Figure (2) Panel B illustrates these payoffs.[14]

Figure 2: Illustrative payoffs to HQ under the four contracts



To find the contractual form that yields the highest payoffs to HQ at each level of θ across all four possible contracts, we consider Panels A and B of Figure (2) together. When θ is zero, and given that $F_O < F_V$, it is clear from Table (2) that outsourcing with no performance incentives

[14]We note that $\theta_O^{2*} < \theta_V^{2*}$, and Appendix C shows that the difference in the slopes of the payoffs functions from including performance incentives is greater for outsourcing. This reflects two facts: First, without performance incentives, payoffs to outsourcing increase in θ at a lower rate than for vertical integration (when $h > p_0$). Second, with performance incentives, payoffs to outsourcing increase in θ at a faster rate than for vertical integration. The bonus needed to incentivize supplier quality effort—a cost to HQ—is lower under outsourcing at each level of θ because of the complementarity between S's input x_S and S's effort to ensure the input is high quality.

yields the highest payoffs. We focus on the payoffs to vertical integration without performance incentives (the less steep function in Panel B) and relate it to the two payoff functions in Panel A. For vertical integration to be the preferred organizational form for an intermediate range of θ values—matching the patterns observed in the data—it must be that the lowest value of θ at which vertical integration is preferred to outsourcing with no performance incentives, denoted $\underline{\theta}$, is smaller than the lowest value of θ at which when outsourcing with performance incentives is preferred to vertical integration, denoted $\overline{\theta}$.

Appendix C derives $\underline{\theta}$ and $\overline{\theta}$ in equations (19) and (20). They are:

$$\underline{\theta} = \sqrt{\frac{8(F_V - F_O)}{\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)}},$$

and:

$$\overline{\theta} = \sqrt{\frac{8p_E G - 8(F_V - F_O)}{\left(J\left(2 + \frac{p_E}{K}\right) - \mu\left(h^2(2+\mu) - 2\mu p_0^2\right)\right)}}$$

where $J = (p_E^2 - p_0^2)$, $K = (p_E - p_0)$ and $G = \frac{E}{(p_E - p_0)}$, all positive constants by assumption.

$\overline{\theta}$ is greater than $\underline{\theta}$ whenever:

$$(F_V - F_O) < \frac{p_E E}{(p_E^2 - p_0^2)(3p_E - 2p_0)}\mu\left(h^2(2+\mu) - 2\mu p_0^2,\right)$$

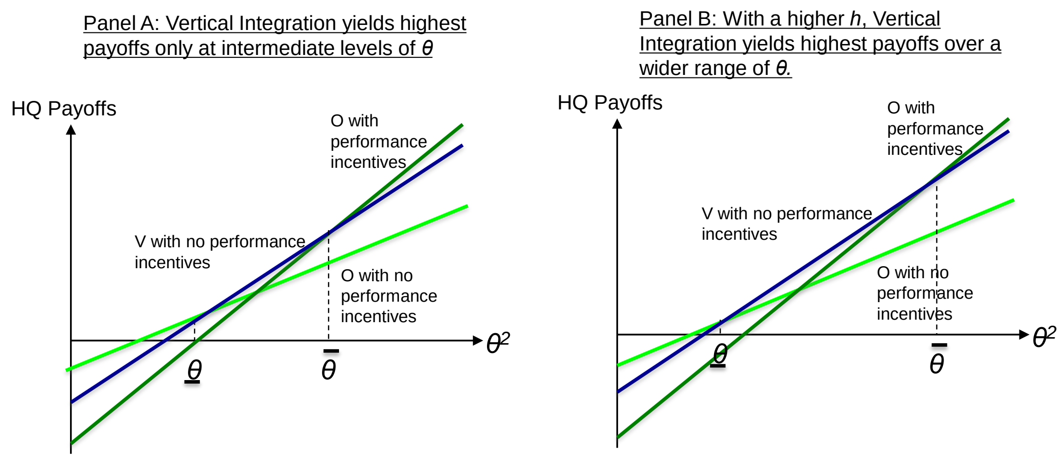
which is equivalent to stating that $\overline{\theta} \geq \underline{\theta}$ whenever $\theta_O^* \geq \underline{\theta}$. This is the case when:

$$8(F_V - F_O) < \theta_O^* \mu\left(h^2(2+\mu) - 2\mu p_0^2,\right) \tag{5}$$

This condition therefore requires that the lowest level of θ at which V is preferred over O without performance incentives is less than the lowest level of θ at H opts to include effective performance incentives in an outsourcing contract. It requires that the relative fixed costs of V are not too large compared to the increase in variable payoffs under V, and that the output benefits of S's effort with performance incentives (related to $p_E - p_0$) are not large relative to S's effort cost, E. Figure (3) Panel A illustrates a case when this condition holds.

At this point, it is worth noting that a model that does not include the performance incentives aspect of outsourcing contracts cannot generate an intermediate range of θ values over which V is preferred to O. For example, the model in Antras and Helpman (2004) would generate payoffs to H

Figure 3: Vertical Integration is preferred for $\theta \in (\underline{\theta}, \overline{\theta})$.



that are increasing in θ under both O and V and there would be a single crossing point where payoffs to each organizational form were equal. This would be analogous to comparing the two less steep payoff functions in each panel of Figure (**??**). The fact that, in this model, the payoffs to O are more convex in θ than the payoffs to V is a consequence of H's decision to include performance incentives in the O contract above a certain θ level, θ_O. It is this aspect of the O contract that produces the scenario in Figure (3) Panel A where V is preferred only over an intermediate productivity range.

Empirical predictions

Within-brand variation in organizational form

Viewing the firm that owns the hotel brand as H and the franchisee or manager of a hotel property S, the model can explain the non-monotonic empirical relationship presented in the introduction. Under the parameter restrictions implied in inequality (5), the model predicts that properties with the lowest and highest productivity levels are franchised while those at intermediate productivity levels are managed by headquarters.

Across-brand variation in organizational form

We next assume that hotel brands vary in the intensity with which H's relationship-specific investment is used in production. In the model, this characteristic of a hotel brands production function is measured by h, and the magnitude of h affects the predicted relationship between property productivity and organizational form choice for a hotel brand. Appendix C shows that the derivative of $\underline{\theta}^2$ with respect to h^2 is negative and the derivative of $\overline{\theta}^2$ with respect to h^2 is positive. This means that at higher levels of h, $\underline{\theta}$ is lower and $\overline{\theta}$ is higher, holding all other model parameters fixed. That is, the range of θ for which vertical integration is preferred over either form of outsourcing is larger for hotel brands where HQ's investment is used intensively in production. This situation is illustrated in Figure (3), Panel B. Intuitively, this case arises when the variable output gains from V are large enough to outweigh the complementarities between effort and x_S under franchising even at high productivity levels.

Variation in organizational form when taxes are included

So far, there has been no role for government in this framework. Extending the model to include taxes on H's and S's payoffs shows that the relationship between productivity and organizational form choice varies with the tax rate. We assume that H would be taxed on its net payoffs—its share of quasi-rents less transfers and bonuses to and from the supplier and less fixed costs.[15] Similarly, we assume that the outsourced supplier would be taxed on its net payoffs—its share of quasi-rents plus any bonus received less any transfers paid to H. The tax rate affects equilibrium input levels from each party and the range of property productivity levels for which V is preferred to O.

Both $\underline{\theta}$ and $\overline{\theta}$ are increasing in the tax rate, here labeled τ:

$$\underline{\theta}_\tau = \sqrt{\frac{8(F_V - F_O)}{(1-\tau)\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)}}, \tag{6}$$

$$\overline{\theta}_\tau = \sqrt{\frac{\frac{8p_E E}{(1-\tau)^2(p_E - p_0)} - \frac{8(F_V - F_O)}{(1-\tau)}}{\frac{(p_E^2 - p_0^2)(3p_E - 2p_0)}{(p_E - p_0)} - \mu\left(h^2(2+\mu) - 2\mu p_0^2\right)}} \tag{7}$$

At the end of Appendix C we show that $(\overline{\theta}_\tau - \underline{\theta}_\tau)$ is also increasing in τ. Taken together, these results suggest that in the presence of higher taxes, H prefers V over both forms of O over a higher and larger range of values of θ. The intuition for this finding is that introducing a tax reduces the convexity in θ of each of H's payoff functions. However, the tax on the bonus payment to the supplier when performance incentives are included has a particularly damaging effect on H's payoffs

[15] While H may not be located in the same tax location as the property, it's corporate taxes are apportioned based on the location where profits are earned (Suarez Serrato and Zider, 2016). We simplify the relevant tax rules to assume all of H's property-level revenues and costs are incurred in the same location as the actual property. As described in Suarez Serrato and Zidar (2016), state-specific rules that govern how national profits of multi-state firms are allocated for tax purposes are referred to as apportionment rules. For the sake of this paper, we assume all payoffs associated with a property are subject to the state-specific local corporate tax rate.

because H must compensate for S's higher tax when ensuring the bonus is high enough to make quality effort incentive compatible for S. This is what gives the results that $\overline{\theta}$ increases in the tax rate at a faster rate than $\underline{\theta}$.

3 Data

The data used in the paper comes from large multi-unit hotel chains in the United States. There were 38 chains with variation in organizational form across chain properties between 2004 and 2009. We analyze property-level information collected by the hospitality market research firm Smith Travel Research (STR) for over 9,300 hotels that are affiliated with one of these brands. We divide the properties into two groups: Properties whose organizational form did not change over the data period—around 92% of the total—and the 8% whose organizational form changed at least once during the six-year period.

Table 3, Panel A summarizes the 8616 hotel properties whose organizational form was unchanged between 2004 and 2009 and were affiliated with a brand that employs both organizational forms. Among these hotels, the typical property has 151 rooms and an average daily rate of $93.11 USD. Of these hotel properties, 70 percent are managed by franchisees and 30 percent are managed by the hotel brand. This variable refers to the day-to-day management of the hotel property.[16]

STR segments these 38 hotel brands into four tiers: economy, midscale, upscale, and upper upscale. Brands are grouped into quality tiers by STR based on average room rate, and the higher quality tier brands tend to have larger properties. STR also collects data from properties in a luxury tier (e.g., Four Seasons), but there is very little within-brand variation in organizational form for brands in this tier—almost all properties are vertically integrated. Accordingly, we exclude them from the empirical work. While STR requires that the complete list of the names of the brands in each tier remain confidential, representative brands for the different tiers studied here are Motel 6, Holiday Inn, Radisson, and Marriott, respectively.

Columns 2 to 5 of Table 3, Panel A, document the tier-level information. In the economy tier, there are six brands with variation in organizational form and 1385 properties. Of these properties, 71 percent are hotel brand-managed, but this reflects that fact that for one of the largest brands,

[16] In the case of chain-managed properties, the asset could be owned by headquarters or a third party. In the case of franchised properties, the asset is likely to be owned by the franchisee managing the hotel but could, alternatively, be owned by a different third party. This is one reason why we have focused on occupancy rate, which is a measure of asset-use intensity, as our measure of productivity. The asset in question is the right to manage the hotel (and specifically, the hotel room) rather than ownership rights over the physical property.

96% of properties are brand-managed. For the other brands, the share is much lower. The midscale tier has thirteen brands with variation in organizational form. 15 percent of the 3704 properties in this tier are hotel brand-managed. The upscale tier includes ten brands with at least one property of each organizational form, and a total of 2405 properties, of which 33 percent are hotel brand-managed. The upper upscale tier includes 1122 properties under nine brands, and 46 percent of the properties are managed by employees of the hotel brand rather than by franchisees.

For each hotel property, we observe the monthly occupancy rate from January 2004 to December 2009.[17] To construct the productivity measure for properties that do not change their organizational form, we compute the average occupancy rate for each property over all months in the data. This measure is comparable across hotels of very different sizes. The overall average monthly occupancy rate for the properties in the data is 64.6%, and the standard deviation is 28.7%. The mean occupancy rate varies from 60.6 percent to 68.0 percent across tiers, and the standard deviation in occupancy rate across tiers varies from 9.5 percent to 12.2 percent.

Table 3, Panel B, presents summary statistics about the 752 hotels from the same 38 hotel brands that switched from being chain managed to franchised, or vice versa, in the time period studied. There were 521 instances of switching from company owned to franchised and 261 instances of switching from franchised to company owned. Among the 752 properties, 24 switched organizational form twice, and 2 properties switched four times. For each of these properties, we use the average occupancy rate in each quarter to investigate within-property variation in occupancy rate and organizational form.

Finally, we also observe the location of each property; hotels are dispersed among all 50 states. The think tank the Tax Foundation collects and publishes data on state-level corporate income taxes for recent years.[18] We use the 2009 marginal corporate tax rate for each state as a correlate of hotel brand's cost of providing franchisees with explicit performance incentives. The tax rates vary from zero in Nevada, South Dakota, Texas, and Wyoming and only 0.26% in Ohio, to 12% in Iowa, 9.99% in Pennsylvania, 9.975% in the District of Columbia, and 9.8% in Minnesota.

[17]This measure could alternatively be interpreted as a quantity-based measure of property output—or nights' stays—per hotel room. The appendix shows that the empirical predictions from the previous section are robust to this interpretation because there is a monotonic predicted relationship between productivity and output in the model.

[18]These data are available at: http://taxfoundation.org/article/state-corporate-income-tax-rates

4 Empirical Analysis

4.1 Within-brand variation in Organizational Form

Empirical Strategy

This section focuses on the main sample of hotel properties summarized in Table 3 Panel A that have the same organizational form throughout the sample period. The dependent variable is equal to one if the property is chain-managed and to zero if the property is franchised. This discrete organizational form choice can be seen as reflecting a threshold rule for an underlying latent variable y^*, so that $y = 1$ if $y^* > 0$ and $y = 0$ if $y^* \leq 0$. In this case, the latent variable y^* is the difference between the hotel brand's payoffs from chain management and from franchising a property, relating to the payoff functions described in Table (2). The payoff difference is unobserved in the data, so we use the outcome of chain management or franchising to infer the effects of the parameters in the underlying model determining headquarter payoffs.

We assume that y^* is a function of the set of explanatory variables generated by the underlying model, $\mathbf{x}$, for which we use a linear approximation $y^* = \beta'\mathbf{x} + \varepsilon$, and normalize the variables so that ε has a standard logistic distribution with mean zero and variance one.

The theoretical model in Section 2 assumed that productivity varies across properties, but the other parameters of the property-level production function are fixed for hotel properties affiliated with a given brand. It also assumed that the contracting environment is fixed within brands and within metropolitan areas.

In practice, some model parameters are likely to vary systematically across brands and market location in a way that affects both productivity and organizational form. Significant variation in the contracting environment seems less likely since all properties are in the United States and there is limited within-brand variation in the franchising contracts offered to franchisees (Lafontaine, 1992), but it cannot be ruled out.[19] To control for these factors, we include fixed effects for hotel brands and for metropolitan statistical areas (MSAs).[20]

[19]Prior studies exploiting variation in the tasks required by suppliers and, hence, the contracting environment, to examine propositions related to different models of firm boundaries include Shepard (1993), Baker and Hubbard (2003), Azoulay (2004), and Forbes and Lederman (2009). A third empirical strategy relies on cross-industry variation in the parameters of the production function, such as asset intensity, to evaluate different model predictions. Acemoglu et al. (2010) and Lileeva and Van Biesebroeck (2010) are recent examples of this strategy.

[20]MSAs are defined by the U.S. Office of Management and Budget and used by the U.S. Census Bureau and other U.S. government agencies for statistical purposes. There are 366 in the U.S. An MSA is defined as one or more adjacent counties or county equivalents that have at least one urban core area of at least 50,000 population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. The most populous MSA is the New York-Northern New Jersey-Long Island, NY-NJ-PA MSA, with nearly 19

Given these assumptions, the probability that the i'th hotel of the b'th brand in the l'th MSA is chain-managed ($y_{ibl} = 1$) can be written as:

$$\Pr(y^*_{ibl} > 0|\mathbf{x}_{ibl}, \beta) = \Pr(\beta'\widetilde{\mathbf{x}}_{ibl} + \alpha_b + \gamma_l + \varepsilon_{ibl} > 0) = F(\beta'\widetilde{\mathbf{x}}_{ibl} + \alpha_b + \gamma_l) \quad (8)$$

where α_b is a brand-specific parameter common to all other properties in brand b; γ_l is an MSA-specific parameter common to all properties in MSA l; and $\widetilde{\mathbf{x}}_{ibl}$ includes variables related to average property-level occupancy rate, Q_{ibl}. We estimate reduced form quadratic models of the following type using maximum likelihood estimation:

$$y^*_{ibl} = \delta + \alpha_b + \gamma_l + \beta_1 Q_{ibl} + \beta_2 Q^2_{ibl} + \varepsilon_{ibl} \quad (9)$$

where δ is a constant term.

When the estimated coefficient β_1 is positive and the estimated coefficient β_2 is negative, the implied relationship between the probability of being chain managed and occupancy rate takes on an inverted U-shape, as shown in the raw data in Figure (1). To further investigate whether this is consistent with a non-monotonic relationship in the data, these coefficients should be such that $\frac{dy^*}{dQ} > 0$ for low values of Q and $\frac{dy^*}{dQ} < 0$ for high values of Q in the sample. If so, then the relationship between occupancy rate and the likelihood of vertical integration actually reverses within the sample and the estimated coefficients indicate more than just a diminishing rate of increase in the relative profitability of chain management as occupancy rates increases. Instead, franchising actually becomes relatively more profitable at sufficiently high occupancy rates. We find the occupancy rate at which the expected probability of vertical integration is maximized in the data—the value of Q where $\frac{dy^*}{dQ} = 0$, which occurs when $Q = \frac{-\beta_1}{2\beta_2}$—and compare it to the empirical distribution of occupancy rates.

Results

The data reveal a highly significant non-monotonic relationship between the probability of chain management and the occupancy rate. Estimating Equation (9) including brand and MSA fixed effects leaves us with 8359 properties from 38 brands with variation in organizational form.[21] The

million inhabitants in the 2010 census, and the least populous MSA is Carson City, NV with just over 55 thousand inhabitants.

[21]The remaining 257 of the 8616 properties in the data are located in MSAs where there is no observed variation in organizational form.

first column of Panel A of Table 4 shows that $\widehat{\beta}_1$ is positive and $\widehat{\beta}_2$ is negative, and both are significant at the one percent level.[22] Turning to Panel B of Table 3, the estimated coefficients from this specification predict that the maximum probability of chain management occurs at an occupancy rate of 76 percent. The 90th percentile of the occupancy rate distribution in the data is 78 percent. That is, at least ten percent of all properties lie to the right of the estimated maximum probability of vertical integration and the predicted reversal occurs well within sample.

One possible omitted variable that could be correlated with both occupancy rate and propensity to chain manage is hotel age. For example, there may be time trends in both the average propensity to outsource hotel management and in current occupancy rates. We re-estimate our baseline specification given in Equation (9) including the age of the property as an additional independent variable. The results in Table 3 Column 2 show that age is positively and significantly correlated with the probability of being chain-managed in all specifications. That is, newer hotels are relatively likely to be franchised. Nonetheless, the non-monotonic relationship between occupancy and probability of chain management for the overall data set and for the upscale, midscale, and economy tiers is robust to the inclusion of this control.

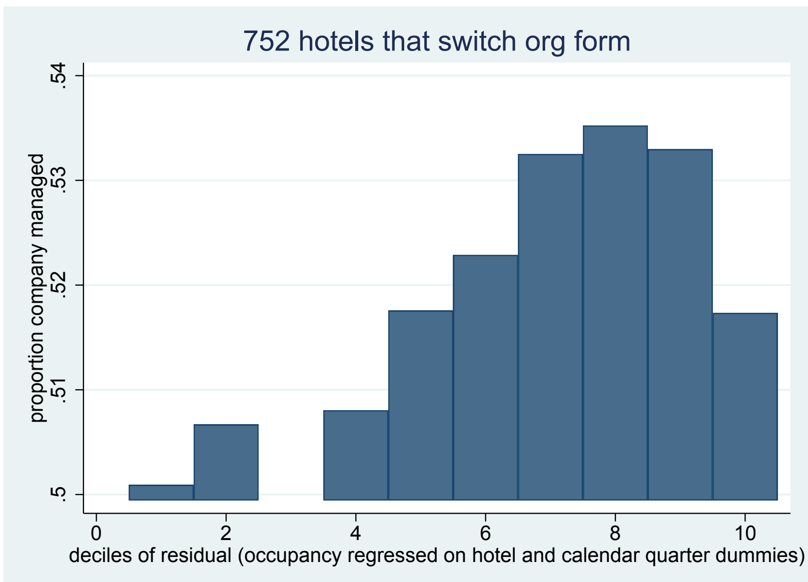
We next address the potential inconsistency problem associated with estimating non-linear probability models with fixed effects (Chamberlain, 1980). This problem is particularly severe when including many group-level fixed effects with few observations per group. Out of the 38 brands, only two brands have fewer than 30 properties and only 12 brands have fewer than 100 properties, which suggests that the incidental parameters problem arising from the brand fixed effects is small. There is a much larger variance in the number of properties across each of the 211 MSAs in the data that contain variation in organizational form. Only 49 MSAs contain more than 40 properties. We repeat the specification given in Equation (9) on the subset of 5624 properties located in MSAs with at least 40 properties and belonging to brands with at least one property of each organizational form. These findings, given in Table 4 Column 3, are very similar to the results in the previous columns.

[22] We present results with unclustered standard errors and standard errors clustered at the brand level for consistency across specifications. While clustering may be appropriate to allow for correlated errors within brands in the pooled data that include all 38 brands, the clustered standard errors may be misleading in the tier-level analysis with fewer brand groups in each specification.

4.2 Changes in Organizational Form

752 properties switch from being chain managed to franchised, or vice versa, between the start of 2004 and the end of 2009. In Figure (4) we explore whether variation in occupancy rate at the property level is consistent with the predictions of the model. In this histogram, an observation is at the property-quarter level, with a maximum of 24 observations per property. We regress the property-level average occupancy rate in the quarter on property fixed effects and quarter fixed effects. The residuals from this regression are then grouped into deciles. The histogram shows the share of observations in each residualized occupancy rate decile that are chain managed (noting that the range of the y-axis is 0.5 to 1). Figure (4) shows that observations in the lowest and

Figure 4: The share of chain-managed property-quarters by occupancy rate decile, for properties with variation in organizational form



highest decile of residualized occupancy rates are less likely to be from quarters where hotels are chain managed relative to the observations in the seventh, eight, and ninth residualized occupancy deciles.

While we do not have an explanation for a property's organizational form change, and they are a small share of total properties, at 8.7%, we infer that within-hotel occupancy rates vary with organizational form as the model would predict. Column 4 of Table 4 shows the results of a regression similar to Equation (9) using the sample of switching properties and including property fixed effects. The non-monotonic relationship between variation in the monthly occupancy rate and in the share of properties that are chain managed is preserved in this regression, with the estimated coefficient $\widehat{\beta}_1$ (for occupancy rate) positive and significant at the 5% level and the $\widehat{\beta}_2$ coefficient (for occupancy rate squared) negative and significant at the 10% level. Panel B shows that the occupancy rate with the highest predicted share of chain managed properties occurs within the 90th percentile of the distribution.

4.3 Across-brand variation in Organizational Form.

Earlier empirical work has analyzed across-brand differences in franchising rates (Lafontaine, 1992; others). Table 3 reveals that higher quality tier hotel brands are more likely to be chain-managed on average, but the model set out in Section 2 suggests that the relationship between property productivity and organizational form may vary systematically across hotel brands. The model shows that the predicted range of productivity levels within a brand over which vertical integration is preferred, $(\underline{\theta}, \overline{\theta})$, is increasing in the model parameter h, which is the intensity with which H's input is used in the production function. We assume that higher quality brands, as defined by the data provider, STR, to mean more expensive hotels, are more intensive in H's input. For these brands, investments in service quality and training are substantial.[23] This generates across-brand variation in the nature of the production function, as well as within brand variation due to property-level variation in productivity, whereby vertical integration is preferred by the hotel chain for a larger range of hotel productivity levels when the hotel brand is higher quality.

To evaluate this prediction, we re-estimate Equation (9) separately for each quality tier. Table 5 shows that the non-monotonic relationship between the probability of vertical integration and occupancy is present for the economy, midscale and upscale tiers. That is, the estimated parameter $\widehat{\beta}_1$ is positive and $\widehat{\beta}_2$ is negative for each of these tiers, shown in Columns 1 to 3, respectively for these quality tiers.

The maximum likelihood of chain management in each tier occurs within sample, as seen in the first three columns of Panel B of Table 5. For the economy tier, the predicted maximum probability of chain management occurs at 69 percent. This is below the 90th percentile occupancy rate in the data. For the midscale chain, the maximum predicted probability of chain management occurs at around 76 percent occupancy, within the 90th percentile of occupancy rates observed in the data. For the upscale chain, the maximum predicted probability of chain management occurs at around 73 percent occupancy, again within the 90th percentile. For these quality tiers, HQ increasingly prefers outsourcing to chain management at high levels of productivity, suggesting that these relationships

[23] The higher quality the brand, the more likely it is that hotel chain values consistency in training across different hotel properties (Applegate et al. 2008).

generate higher payoffs to HQ.

The estimated coefficients look quite different for the highest quality tier of hotels in these data, the upper upscale tier. As shown in Table 5 Column 4, the estimated coefficient $\widehat{\beta}_1$ (for occupancy rate) is positive and the $\widehat{\beta}_2$ coefficient (for occupancy rate squared) is negative, but both estimated coefficients are insignificantly different from zero. There is therefore no evidence of the non-monotonic relationship between occupancy and the probability of vertical integration for this high-quality tier.

Table 5 Column 5 repeats the specification leading to Table 4 Column 4, analyzing only those properties that switched organizational form during the sample and including property fixed effects. This specification, however, includes only the brands in quality tiers other than the upper upscale tier. The estimated coefficients suggest a stronger non-monontonic relationship than was revealed among all properties that switched organizational form. The estimated coefficients are both significant at the 1% level, and Panel B shows that the maximum probability of chain management is estimated to be just above the 50th percentile of the occupancy rate distribution.

Returning to the main data sample of properties that did not change organizational form during the sample, Table 6 presents the results by tier including age of property (Panels A and B) and then only within large MSAs (Panels C and D), mirroring Columns 2 and 3 in Table 4. The results by tier are robust across these specifications. The non-monotonic relationship is absent from the upper upscale quality tier. In the overall data, and in the upscale, midscale and economy tiers, properties with low and high occupancy rates are relatively more likely to be managed by franchisees. The variation in organizational form in the upper upscale tier does not show this variation, and can be related to a version of the model in Section 2 where the brand-level production function is intensive in the chain's relationship-specific investment, increasing the payoffs to property chain management at all productivity levels.

Table 7 presents an additional robustness test. The data are limited to those hotel brands where at least 10% of properties are chain managed and at least 10% are franchisee managed. It shows that the results, overall, and by tier, are not driven by brands with a very low incidence of either organizational form.

4.4 Across-location variation in Organizational Form.

A simple extension to the main theoretical framework in Section 2 showed that taxing both parties reduced the convexity of the hotel chain's payoffs in property productivity under each organizational forms. This led to the observation that higher tax rates shifted up the range of property productivity over which vertical integration was preferred, and also increased the size of the range over which it was preferred. In the data, the hotel properties are distributed across all 50 U.S. states, and therefore face varying state corporate tax rates. Twelve of the 38 hotel chains operate across 40 to 50 states, ten are in 30 to 39 states, eight in 20 to 29, five in 11 to 19, and only three hotel chains are in fewer than 10 states.

We test whether the relationship between organizational form and occupancy within a given brand varies with state corporate tax rates. We split the data into properties located in states with a marginal tax rate below the 2009 median level of 6.5% and those that are located in states with higher marginal tax rates. We then estimate Equation (9) separately for each subsample. Table 8 presents the results for the pooled data, and then for each tier, for the sub-sample of properties located in states where the marginal rate of state corporate tax is lower than the median rate of 6.5%. The adjacent column for the pooled data set and for each tier, presents the equivalent coefficient estimates for properties in states where the marginal tax rate exceeds 6.5%.[24]

The model predicts that the maximum predicted probability of chain management occurs at a higher occupancy rate in states with high marginal corporate tax rates. The results for the economy and midscale tiers offer some evidence that is consistent with this prediction. In each of these two tiers, the maximum predicted probability of chain management occurs at a higher occupancy rate in states with higher marginal state taxes. Panel B of Table 7 shows that the frequency distribution of hotels of different occupancy rates is similar across properties of the same brand in low- and high-tax states. However, for the economy quality tier, the predicted maximum probability of chain management occurs at 67% in low tax states and 71% in high tax states. For the midscale quality tier, the predicted maximum probability of chain management occurs at 74% occupancy in low tax states and at 79% occupancy in high tax states. These findings are consistent with a given brand continuing to prefer vertical integration at higher productivity levels in states where outsourcing generates lower relative profits for HQ. The results for the upscale tier in Table 7 do not provide any evidence consistent with the prediction. While the results for the properties in high-tax states exhibit the non-monotonic relationship, the estimation for the properties in low-tax states does not yield a $\widehat{\beta}_2$ that is significantly different from zero.

To further investigate this prediction, we also estimate the following specification, which includes

[24] Splitting up the data into the high and low tax subsamples causes us to exclude some of the observations in Tables 4 and 5—those properties from brands with no within-group variation in organizational form in one of the two subsamples. This leaves us with fewer observations in each specification.

interactions of property-level Q and Q^2 with the state-level marginal tax rate, T_s:

$$y^*_{ibls} = \delta + \alpha_b + \gamma_l + \beta_0 T_s + \beta_1 Q_{ibl} + \beta_2 Q^2_{ibl} + \beta_3 Q_{ibl} T_s + \beta_4 Q^2_{ibl} T_s + \varepsilon_{ibl} \tag{10}$$

In this specification, the value of Q where $\frac{dy^*}{dQ} = 0$ is given by $Q = \frac{-(\beta_1+\beta_3 T_s)}{2(\beta_2+\beta_4 T_s)}$.[25] We ask whether the predicted maximum probability of chain management occurs at a lower occupancy rate for properties of a given brand located in states at the 10th percentile of the distribution of T_s than at the 90th percentile.

Table 9 presents the results of the specification set out in Equation (10); it shows how the maximum predicted probability of chain management varies with the marginal corporate tax rate. Table 9 Panel B uses the coefficients estimated in Panel A to calculate the occupancy rate where the predicted probability of vertical integration is maximized at the 10th percentile tax rate and the 90th percentile tax rate. Consistent with the models predictions, for midscale and economy brands the maximum predicted probability of chain management occurs at higher occupancy rates in states at the 90th percentile tax rate.

5 Conclusion

For upscale, midscale, and economy U.S. hotel brands, hotel properties with intermediate levels of occupancy are relatively more likely to be chain-managed. Low- and high-occupancy hotels are relatively more likely to be franchised. In addition, the occupancy rate range of vertically integrated properties in lower quality tiers is shifted up in states with high marginal corporate tax rates.

The model developed in the paper to rationalize these findings is quite general, and applies to the question of why some intermediate inputs are made in-house and others are bought from an arm's length supplier. The data validate a key insight from the model—even when the firm's investment is used relatively intensively in production, the effect of performance incentives on supplier investment can lead to outsourcing at high productivity levels. A property rights model that includes ownership incentives but not performance incentives cannot explain the non-monotonic relationship observed for the majority of firms in the industry studied here. Combining both the property rights and performance incentives mechanisms in one model reveals that ownership and performance incentives for the supplier can be complementary means to mitigate underinvestment

[25] The coefficient β_0 is identified using variation in organizational form within the small number of MSAs that span state boundaries.

at some levels of productivity.[26]

We view our findings as evidence that firms use all the tools at their disposal to mitigate underinvestment problems due to incomplete contracts. As Gibbons (2005) notes, ownership can be viewed as one of the instruments in an incentive-system theory of the firm (Holmstrom and Milgrom, 1994). Incentives related to measured performance are one other instrument that can be employed when some aspect of supplier input is observable and, hence, contractible. Specifically, when firms have the ability to write performance contracts based on an observable outcome correlated with input levels, the complementarity between the performance incentives and ownership incentives at high levels of productivity can lead firms to choose outsourcing when ownership incentives alone would favor vertical integration.

[26] A franchisee is less concerned than an employed manager about future holdup and, hence, earns higher marginal returns from increased effort on all tasks as productivity increases under a performance contract. This is the source of the complementarity of the two types of incentives. In contrast, incentives can be complementary in Holmstrom and Milgrom (1994) and Baker and Hubbard (2003, 2004), in part because time-constrained workers choose how to divide their time between different activities.

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Appendix A: H's payoffs under Outsourcing

The outsourcing contract specifies the upfront fee to be paid by the supplier (S) to H, T^O (up to the capital constraint l) and a bonus payment b^O to be paid to S only in the event that S's input is observed to be high-quality ex post. H chooses T^O and b^O so as to maximize its own utility given that it can predict how S will respond to the terms of the contract and subject to the S's participation and capital constraints.

The discrete nature of e^k and the probability function $p(\cdot)$ allows us to specify the payoffs to H under each effort level.[27],[28] When the capital constraint does not bind, H can provide incentives for the entrepreneur to exert the efficient level of effort through the bonus payment b^O. H can then capture all of the rents through the upfront fee T^O. However, when the capital constraint does bind and positive effort is optimal, H must either accept suboptimal effort levels or share rents with the entrepreneur.[29]

Under organizational form $k = O$, and using equation (4), H's expected utility from an outsourcing contract is:

$$\begin{aligned} EU_H^O &= Ey_H^O - \frac{1}{2}(x_H)^2 - f_E - f^O + T^O - b^O p(\cdot)^O \\ &= \frac{1}{2}[\theta(hx_H + x_S p(\cdot))] - \frac{1}{2}(x_H)^2 - f_E - f^O + T^O - b^O p(\cdot)^O \end{aligned}$$

H chooses x_H to maximize this expected utility, which gives: $x_H = \frac{1}{2}\theta h$.

Under $k = O$, outsourcing, S's expected utility is:

$$\begin{aligned} EU_S^O &= Ey_S^O - \frac{1}{2}(x_S)^2 - T^O + b^O p(\cdot)^O - e^k \\ &= \frac{1}{2}[\theta(hx_H + x_S p(\cdot))] - \frac{1}{2}(x_S)^2 - T^O + b^O p(\cdot)^O - e^k \end{aligned}$$

The level of x_S that maximizes S's expected utility is: $x_S = \frac{1}{2}\theta p(\cdot)$. We note that H's input, x_H, is

[27] We require that $p_0 > 0$, so that $p_0 x_S > 0$. Even if x_S is low-quality with a high probability, positive output will be realized as long as x_H and x_S are positive. We also note that effort is specific to the relationship.

[28] The model allows for only two possible effort levels: zero effort and positive effort. In Grossman and Helpman (2004), effort is a continuous variable. Our intent is to generate the non-monotonic relationship between productivity and the probability that a property is vertically integrated using the simplest possible specification.

[29] An alternative way to allow for H to include performance incentives might be to allow them to contract on bargaining weights. Supplier input would then be affected by bargaining weights under outsourcing, and by both bargaining weights and the the fraction of output recovered by H under vertical integration. The setup presented here—which has fixed bargaining weights but allows for a contractable bonus payment related to output—allows the different types of incentives to affect two different types of supplier input, and allows us to illustrate the separate roles of each incentive type. We believe the alternative setup would generate similar empirical predictions (at the cost of obscuring some of the mechanisms at work in Antras-Helpman (2004) and Grossman-Helpman (2004)).

independent of supplier effort whereas supplier input x_S is an increasing function of the probability that the input is high quality. This is the source of the complementarity discussed in the main body of the paper.

a) Outsourcing without performance incentives

In this equilibrium, $x_S = \frac{1}{2}\theta p_0$, $x_H = \frac{1}{2}\theta h$ and the effort cost is 0, so no bonus payment is required, $b^O = 0$. To ensure that S's participation constraint is met, his expected payoff must be at least zero (his outside option), so

$$0 \le \frac{1}{2}[\theta\left(hx_H + x_S p_0\right)] - \frac{1}{2}\left(x_S\right)^2 - T^O + b^O p_0 - e^k$$

The upfront fee $T^* = \frac{1}{4}\theta^2 h^2 + \frac{1}{8}\theta^2 p_0^2$ is the optimal transfer from H's point of view, the highest upfront fee at which S's participation constraint binds. If $T^* > l$ this optimal transfer exceeds S's capital constraint; then $T^O = l$, otherwise $T^O = T^*$.

To ensure that S does not deviate and exert positive effort, we assume that for the range of θ where this organizational form is chosen: $\frac{E}{p_E^2 - p_0^2} \ge \frac{1}{8}\theta^2$.[30]

If S's capital constraint does not bind, allowing H to specify $T^O = T^*$, HQ's expected payoffs are:

$$\begin{aligned} EU_H^O &= \frac{1}{2}[\theta\left(h\frac{1}{2}\theta h + \frac{1}{2}\theta p_0^2\right)] - \frac{1}{2}\left(\frac{1}{2}\theta h\right)^2 - f_E - f^O + T + \theta^2 \\ &= \frac{3\theta^2}{8}\left(h^2 + p_0^2\right) - f_E - f^O \end{aligned}$$

and, if the capital constraint binds, $T^O = l$, expected H payoffs are:

$$EU_H^O = \frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_0^2 - f_E - f^O + l. \tag{11}$$

[30]Note that if S does deviate, the marginal benefit of his own relationship-specific investment also changes, so a different level of x_S will be chosen. If S deviates to $e^k = E$, re-solving the optimal x_S choice for the supplier gives: $x_S^* = \frac{1}{2}\theta p_E$ (x_H will not change under this deviation).

b) Outsourcing with performance incentives

In this equilibrium, $x_S = \frac{1}{2}\theta p_E$, $x_H = \frac{1}{2}\theta h$. The cost of effort is E, and a bonus payment is required, b^O. To ensure that S's participation constraint is met:

$$0 \leq \frac{1}{2}[\theta\left(hx_H + x_S p_E\right)] - \frac{1}{2}\left(x_S\right)^2 - T^O + b^O p_E - E$$

where $T^* = \frac{1}{4}\theta^2 h^2 + \frac{1}{8}\theta^2 p_E^2 + b^O p_E - E$ is the optimal transfer from H's point of view. If $T^* > l$, so that this optimal transfer exceeds S's capital constraint, then $T^O = l$, otherwise $T^O = T^*$.

If S were to deviate to $e = 0$, then re-solving the optimal x_S choice for S gives $x_S^* = \frac{1}{2}\theta p_0$. To ensure incentive compatibility, not wanting to deviate to $e^k = 0$ given T^O and x_H requires:

$$\frac{1}{4}[\theta^2 h^2 + \theta^2]p_E^2] - \frac{1}{8}\left(\theta p_E\right)^2 - T^O + b^O p_E - E \geq \frac{1}{4}[\theta^2 h^2 + \theta^2 p_0^2] - \frac{1}{8}\left(\theta p_0\right)^2 - T^O + b^O p_0$$

This implies the following restriction on the relationship between the specified bonus, effort levels and the probability of high-quality x_S:

$$b^O\left(p_E - p_0\right) \geq E - \frac{1}{8}\theta^2(p_E^2 - p_0^2)$$

Therefore, H will set b^O at the lowest value that this inequality is satisfied:

$$b^O = \frac{E}{\left(p_E - p_0\right)} - \frac{\theta^2(p_E^2 - p_0^2)}{8\left(p_E - p_0\right)}.$$

Note that the bonus required to incentivize S's effort is decreasing in θ.

If the capital constraint does not bind, the expected bonus payment $\left(b^O p_E\right)$ drops out of the payoffs since H can extract it from S upfront. H's expected payoff is:

$$\begin{aligned} EU_H^O &= \frac{1}{2}\left[\theta\left(h\frac{1}{2}\theta h + \frac{1}{2}\theta p_E^2\right)\right] - \frac{1}{2}\left(\frac{1}{2}\theta h\right)^2 - b^O p_E - f_E - f^O + T^O + \theta^2 \\ &= \frac{3\theta^2}{8}\left(h^2 + p_E^2\right) - f_E - f^O - E \end{aligned}$$

and, in the event that the capital constraint binds, H's expected payoff is:

$$EU_H^O = \frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_E^2 - p_E\left(\frac{E}{\left(p_E - p_0\right)} - \frac{\theta^2(p_E^2 - p_0^2)}{8\left(p_E - p_0\right)}\right) - f_E - f^O + l \tag{12}$$

Finding θ above which performance incentives are included in an O contract

When expression (12) is greater than expression (11), H prefers the outsourcing contract that includes performance incentives. This is the case when:

$$\frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_E^2 - p_E\left(\frac{E}{(p_E - p_0)} - \frac{\theta^2(p_E^2 - p_0^2)}{8\,(p_E - p_0)}\right) - f_E - f^O + l > \frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_0^2 - f_E - f^O + l$$

Simplifying:

$$\frac{1}{4}\theta^2 p_E^2 - p_E\left(\frac{E}{(p_E - p_0)} - \frac{\theta^2(p_E^2 - p_0^2)}{8\,(p_E - p_0)}\right) > \frac{1}{4}\theta^2 p_0^2$$

so performance incentives are preferred for relatively high productivity levels:

$$\theta_O^* > \sqrt{\frac{8p_E E}{(p_E^2 - p_0^2)\,(3p_E - 2p_0)}} \tag{13}$$

Appendix B: H's payoffs under Vertical Integration

The contract sets out the required effort level and a bonus payment, b^V, to be paid if the manager's investment is high-quality. There is no upfront transfer T^I from S to H because H cannot specify a negative wage for a chain-employed property manager. As outlined above, the surplus generated, r^V, reflects the fact that H's outside value is non-zero under vertical integration.

Under organizational form $k = V$, and using equation (4), H's expected utility under vertical integration is:

$$EU_H^V = y_H^V - \frac{1}{2}\,(x_H)^2 - f_E - f^V - b^V p\,(\cdot)$$

$$EU_H^V = \frac{1}{2}[\theta\,(hx_H + x_S p(\cdot)) - \mu\theta\,(hx_H + x_S(\cdot))] - \frac{1}{2}\,(x_H)^2 - f_E - f^V - b^V p\,(\cdot) + \mu\theta\,(hx_H + x_S p(\cdot))$$

H chooses x_H to maximize this expected utility, giving $x_H = \frac{1}{2}\,(1+\mu)\,\theta h$.

Under organizational form $k = V$, and using equation (4), S's expected utility under vertical integration is:

$$\begin{aligned} EU_S^V &= y_S^V - \frac{1}{2}\,(x_S)^2 + b^V p\,(\cdot) - e^V \\ &= \frac{1}{2}[\theta\,(hx_H + x_S p(\cdot)) - \mu\theta\,(hx_H + x_S p(\cdot))] - \frac{1}{2}\,(x_S)^2 + b^V p\,(\cdot) - e^V \end{aligned}$$

The supplier chooses x_S and effort levels to maximize this expected utility. This gives $x_S =$

$\frac{1}{2}(1-\mu)\,\theta p(\cdot)$. As under outsourcing, H's input, x_H, is independent of supplier input and effort, and supplier input, x_S, is an increasing function of supplier effort.

c) Vertical integration without performance incentives

In this equilibrium, $x_H = \frac{1}{2}(1+\mu)\,\theta h$. If the manager exerts the desired effort, then $x_S = \frac{1}{2}(1-\mu)\,\theta p_0$. S's expected utility is:

$$\begin{aligned}
EU_S^V &= Ey_S^V - \frac{1}{2}(x_S)^2 \\
&= \frac{1}{2}[\theta(hx_H + x_S p_0) - \mu\theta(hx_H + x_S p_0)] - \frac{1}{2}(x_S)^2 \\
&= \frac{1}{4}\theta^2(1-\mu)\left[h^2(1+\mu) + \frac{1}{2}(1-\mu)\,p_0^2\right]
\end{aligned}$$

This expected payoff satisfies the participation constraint (because p_0 and μ are between 0 and 1). To ensure that the manager does not want to deviate and exert effort, we need that for the range of θ where this contract is preferred: $E \geq \frac{\theta^2(1-\mu)^2}{8}\left[p_E^2 - p_0^2\right]$.

H's expected payoff is:

$$\begin{aligned}
EU_H^V &= y_H^V - \frac{1}{2}(x_H)^2 - f_E - f^V - b^V p(\cdot) \\
&= \frac{1}{2}Er^V + A_i^V - \frac{1}{2}(x_H)^2 - f_E - f^V - b^I p(\cdot) \\
&= \frac{\theta}{2}(1+\mu)\left[h\frac{1}{2}(1+\mu)\,\theta h + \frac{1}{2}(1-\mu)\,\theta p_0^2\right] - \frac{1}{2}\left(\frac{1}{2}(1+\mu)\,\theta h\right)^2 - f_E - f^V
\end{aligned}$$

$$EU_H^V = \frac{\theta^2 h^2}{8}(1+\mu)^2 + \frac{\theta^2}{4}\left(1-\mu^2\right)p_0^2 - f_E - f^V \tag{14}$$

d) Vertical integration with performance incentives

In this equilibrium, $p(\cdot) = p_E$. The expected payoff to S if he doesn't deviate is:

$$EU_S^V = \frac{1}{4}\theta^2(1-\mu)\left[h^2(1+\mu) + \frac{1}{2}(1-\mu)\,p_E\right] + b^V p_E - E$$

If S were to deviate to $e = 0$:

$$EU_S^V = \frac{1}{4}\theta^2(1-\mu)\left[h^2(1+\mu) + \frac{1}{2}(1-\mu)\,p_0^2\right] + b^V p_0$$

Thus, the lowest bonus payment required to ensure that the S does not deviate is:

$$b^V = \frac{E}{(p_E - p_0)} - \frac{\theta^2 (1-\mu)^2}{8 (p_E - p_0)} \left[p_E^2 - p_0^2\right].$$

We note that the bonus required is decreasing in θ, but at a lower rate than under O with incentives, since $(1-\mu)^2 \leq 1$. The expected payoff to S is:

$$EU_S^V = \frac{1}{4}\theta^2 (1-\mu) \left[h^2 (1+\mu) + \frac{1}{2} (1-\mu) p_E^2\right] + p_E \left[\frac{E}{(p_E - p_0)} - \frac{\theta^2 (1-\mu)^2}{8 (p_E - p_0)} \left[p_E^2 - p_0^2\right]\right] - E,$$

which our restrictions ensure is positive.

The expected payoff to H is:

$$EU_H^V = \frac{\theta}{2} (1+\mu) \left[h x_H + x_S p_E\right] - \frac{1}{2} (x_H)^2 - f_E - f^V - b p_E$$

$$EU_H^V = \frac{\theta^2 h^2}{8} (1+\mu)^2 + \frac{\theta^2}{4} \left(1-\mu^2\right) p_E^2 - f_E - f^V - p_E \left[\frac{E}{(p_E - p_0)} - \frac{\theta^2 (1-\mu)^2}{8 (p_E - p_0)} \left[p_E^2 - p_0^2\right]\right] \quad (15)$$

Finding θ above which performance incentives are included in a V contract

When expression (15) is greater than expression (14), H prefers the vertical integration contract that includes performance incentives. This is the case when:

$$\frac{1}{4}\theta^2 (1+\mu)(1-\mu) p_E^2 - p_E \left(\frac{E}{(p_E - p_0)} - \frac{\theta^2 (1-\mu)^2 (p_E^2 - p_0^2)}{8 (p_E - p_0)}\right) > \frac{1}{4}\theta^2 (1+\mu)(1-\mu) p_0^2$$

$$\theta^2 \geq \frac{8 p_E E}{(p_E^2 - p_0^2)(3p_E - 2p_0 - \mu^2 (p_E - 2p_0) - 2\mu p_E)}$$

Hence, H chooses to include performance incentives and share rents with the supplier under V whenever the relationship productivity is sufficiently high—that is, when:

$$\theta_V^* \geq \sqrt{\frac{8 p_E E}{(p_E^2 - p_0^2)(3p_E - 2p_0 - \mu^2 (p_E - 2p_0) - 2\mu p_E)}} \quad (16)$$

The lowest productivity at which H chooses to include performance incentives in O is given by inequality (13), this is a lower productivity than the threshold given in (16) if the denominator of (16) is smaller, i.e. when:

$$\left(p_E^2 - p_0^2\right)\left(3p_E - 2p_0\right) > \left(p_E^2 - p_0^2\right)\left(3p_E - 2p_0 - \mu^2(p_E - 2p_0) - 2\mu p_E\right)$$

$$p_E(2 + \mu) - p_0 2\mu > 0,$$

which is always true because $0 < \mu < 1$ and $p_E > p_0$ by assumption. That is, performance incentives become preferred under O at a lower level of θ than under V. Both thresholds are increasing in the effort cost E and decreasing in the difference between p_E and p_0, related to the marginal benefit of effort.

Appendix C: Maximum payoffs to H as a function of θ

Each of H's four payoff functions shown in Table (2) and derived in Appendices A and B is monotonically increasing and differently convex in θ. Table (10) presents the degree of convexity for each payoff function. Comparing the convexities of the payoff functions shows that the payoffs with

Table 3: Table 10: H payoffs, Convexity in θ

Contractual Form	$\frac{\delta^2 E(U_H^k)}{\delta\theta\delta\theta}$
(i) Outsourcing no performance incentives	$\frac{1}{4}h^2 + \frac{1}{2}p_0^2$
(ii) Outsourcing with performance incentives	$\frac{1}{4}h^2 + \frac{1}{2}p_E^2 + \frac{p_E(p_E^2 - p_0^2)}{4(p_E - p_0)}$
(iii) VI no performance incentives	$\frac{1}{4}h^2(1+\mu)^2 + \frac{1}{2}p_0^2(1-\mu^2)$
(iv) VI with performance incentives	$\frac{1}{4}h^2(1+\mu)^2 + \frac{1}{2}p_E^2(1-\mu^2) + \frac{p_E(1-\mu)^2(p_E^2 - p_0^2)}{4(p_E - p_0)}$

performance incentives are more convex in θ than those without. For outsourcing, the difference is:

$$\frac{1}{4}h^2 + \frac{1}{2}p_E^2 + \frac{p_E(p_E^2 - p_0^2)}{4(p_E - p_0)} - \frac{1}{4}h^2 + \frac{1}{2}p_0^2 > 0$$

which is equivalent to:

$$\frac{(p_E^2 - p_0^2)\left(3p_E - 2p_0\right)}{4(p_E - p_0)} > 0 \tag{17}$$

and holds because $p_E > p_0$ by assumption. For vertical integration, the difference is:

$$\frac{1}{4}h^2(1+\mu)^2 + \frac{1}{2}p_E^2(1-\mu^2) + \frac{p_E(1-\mu)^2(p_E^2-p_0^2)}{4(p_E-p_0)} - \frac{1}{4}h^2(1+\mu)^2 + \frac{1}{2}p_0^2(1-\mu^2) > 0$$

which is equal to:

$$\frac{(p_E^2-p_0^2)\,(3p_E - 2p_0 - [\mu^2(p_E - 2p_O) + 2\mu p_E])}{4(p_E-p_0)} > 0 \qquad (18)$$

and this also holds because the final term in round parentheses is positive since $0 < \mu < 1$.

These comparisons also reveal that overall payoffs to outsourcing are more convex in θ than those to vertical integration. This is clear from the fact that the slope of outsourcing payoffs with no performance incentives is less convex than all other payoff functions and the difference in convexity associated with adding performance incentives is greater for outsourcing. To see this, note that the term in the square brackets in inequality (18) is positive and so the left hand side of (18) is smaller than the left hand side of inequality (17).

We now turn to find threshold values of θ at which the preferred organizational form changes from O to V, or vice versa. The lowest θ at which H chooses vertical integration with no performance incentives over outsourcing with no performance incentives, $\underline{\theta}$ is:

$$\frac{\theta^2 h^2}{8}\left(1+\mu\right)^2 + \frac{\theta^2}{4}\left(1-\mu^2\right)p_0^2 - F_V \quad = \quad \frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_0^2 - F^O$$

$$\underline{\theta^2} = \frac{8(F_V - F_O)}{\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)}$$

$$\underline{\theta} = \sqrt{\frac{8(F_V - F_O)}{\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)}} \qquad (19)$$

We note that the numerator of this expression is (8 times) the difference in the fixed costs between the two contracts (the difference in the payoffs when θ is zero) and is positive by assumption. The denominator is (8 times) the difference between the rate of growth of H's payoffs from the two contracts with respect to θ^2. Hence, this threshold is the level of productivity where the increase in variable profits from vertical integration is exactly equal to the associated increase in fixed costs.

The highest θ at which H chooses vertical integration with no performance incentives over outsourcing with performance incentivees, $\overline{\theta}$ is:

$$\frac{1}{8}\theta^2 h^2 + \frac{1}{4}\theta^2 p_E^2 - p_E\left(\frac{E}{(p_E - p_0)} - \frac{\theta^2(p_E^2 - p_0^2)}{8\,(p_E - p_0)}\right) - F_O \quad = \quad \frac{\theta^2 h^2}{8}\,(1+\mu)^2 + \frac{\theta^2}{4}\left(1-\mu^2\right)p_0^2 - F_V$$

Setting $J = (p_E^2 - p_0^2)$, $K = (p_E - p_0)$ and $G = \frac{E}{K}$, all positive constants by assumption, this can be written:

$$\overline{\theta} \quad = \quad \sqrt{\frac{8p_E G - 8(F_V - F_O)}{\left(J\left(2 + \frac{p_E}{K}\right) - \mu\left(h^2(2+\mu) - 2\mu p_0^2\right)\right)}} \tag{20}$$

We note that the numerator of this expression is (8 times) the difference between H's payoff from outsourcing with performance incentives and vertical integration without them when $\theta = 0$ (it is the difference in fixed costs, including the bonus payment for the outsourcing contract). It is positive whenever the intercept for this vertical integration contract lies between those for the two outsourcing contracts. The denominator is (8 times) the difference between the growth rates in θ of H's payoffs from outsourcing with and without performance incentives less the difference between the growth rates in θ of H's payoffs from vertical integration and outsourcing without performance incentives (this second term is also the denominator in $\underline{\theta}$).

For there to be a range of θ where H prefers vertical integration with no performance incentives to both forms of outsourcing, given that payoffs to outsourcing are convex in θ, it must be that $\underline{\theta} < \bar{\theta}$. This is true when:

$$\frac{8(F_V - F_O)}{\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)} < \frac{8p_E G - 8(F_V - F_O)}{\left(J\left(2 + \frac{p_E}{K}\right) - \mu\left(h^2(2+\mu) - 2\mu p_0^2\right)\right)}$$

Simplifying and substituting back in for G, J, and K gives:

$$(F_V - F_O) < \frac{p_E E}{(p_E^2 - p_0^2)(3p_E - 2p_0)}\mu\left(h^2(2+\mu) - 2\mu p_0^2,\right).$$

When this inequality holds, V is preferred at intermediate levels of θ, for $\theta \in (\underline{\theta}, \bar{\theta})$.

Comparative statics with respect to h

How does variation in the production function parameter h impact the range $(\underline{\theta}, \bar{\theta})$? The derivative of $\underline{\theta}$ with respect to h^2 is:

$$\frac{\delta \underline{\theta}^2}{\delta h^2} = \frac{-8(F_V - F_O)\mu(2+\mu)}{\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)^2} < 0$$

and the derivative of $\overline{\theta}$ with respect to h^2 is:

$$\frac{\delta \overline{\theta}^2}{\delta h^2} = \frac{(8p_E G - 8(F_V - F_O))\mu(2+\mu)}{\left(J\left(2+\frac{p_E}{K}\right) - \mu\left(h^2(2+\mu) - 2\mu p_0^2\right)\right)^2} > 0$$

This second derivative is positive when $8p_E G - 8(F_V - F_O) > 0$, which is the sorting condition we need for V without performance incentives to yield payoffs to H between those of outsourcing without and with performance incentives when $\theta = 0$. Because $\underline{\theta}$ falls with h^2 and hence with h and $\overline{\theta}$ increases with h^2 and h, vertical integration is predicted over a larger range of θ values at higher levels of h.

Comparative statics with respect to the tax rate, τ

Taxing each party's payoff at the rate τ affects each party's input levels, the bonus required (if any) to ensure supplier incentive compatibility, and H's payoffs. For outsourcing with no performance incentives, H's and S's expected payoffs are, respectively:

$$EU_H^O = (1-\tau)\left[\frac{\theta}{2}(hx_H + x_S p_0) - F_O\right] - \frac{1}{2}(x_H)^2$$

$$EU_S^O = (1-\tau)\left[\frac{\theta}{2}(hx_H + x_S p_0) - T^O - T(O)\right] - \frac{1}{2}(x_S)^2$$

The first-order conditions relating to input levels give $x_H = \frac{(1-\tau)h\theta}{2}$ and $x_S = \frac{(1-\tau)\theta p_0}{2}$. The payoffs to HQ, after substituting in for x_H, x_S are therefore:

$$EU_H^O = (1-\tau)^2\theta^2\left(\frac{h^2}{8} + \frac{p_0^2}{4}\right) - (1-\tau)F_O. \tag{21}$$

For vertical integration with no performance incentives, introducing taxes leads to $x_H = \frac{(1-\tau)(1+\mu)h\theta}{2}$

and $x_S = \frac{(1-\tau)(1-\mu)\theta p_0}{2}$. Substituting these values into HQ's payoffs gives:

$$EU_H^I = (1-\tau)^2\theta^2\left(\frac{h^2}{8}(1+\mu)^2 + \frac{p_0^2}{4}(1+\mu)(1-\mu)\right) - (1-\tau)F_V \tag{22}$$

For outsourcing with performance incentives, introducing taxes leads to $x_H = \frac{(1-\tau)h\theta}{2}$ and $x_S = \frac{(1-\tau)\theta p_E}{2}$. The incentive compatibility constraint needed to ensure S opts to exert effort is:

$$b^O = \frac{E}{(1-\tau)(p_E - p_0)} - \frac{(1-\tau)\theta^2(p_E^2 - p_0^2)}{8(p_E - p_0)}$$

We note that the higher is the tax, the higher is the required bonus, for two reasons: It is more costly to cover effort costs and the required bonus required falls by less as θ increases. The payoffs to H, after substituting in for x_H, x_S, and b^O, are:

$$EU_H^O = (1-\tau)^2\theta^2\left(\frac{h^2}{8} + \frac{p_E^2}{4}\right) - (1-\tau)p_E\left(\frac{E}{(1-\tau)(p_E - p_0)} - \frac{(1-\tau)\theta^2(p_E^2 - p_0^2)}{8(p_E - p_0)}\right) - (1-\tau)F_O. \tag{23}$$

Because the payoffs to H from each of the three contractual forms described above vary differently with taxes, the range of θ at which vertical integration is preferred $(\underline{\theta}, \overline{\theta})$ is given by the two thresholds:

$$\underline{\theta}_\tau = \sqrt{\frac{8(F_V - F_O)}{(1-\tau)\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)}}, \tag{24}$$

$$\overline{\theta}_\tau = \sqrt{\frac{\frac{8p_E E}{(1-\tau)^2(p_E - p_0)} - \frac{8(F_V - F_O)}{(1-\tau)}}{\frac{(p_E^2 - p_0^2)(3p_E - 2p_0)}{(p_E - p_0)} - \mu\left(h^2(2+\mu) - 2\mu p_0^2\right)}} \tag{25}$$

The tax reduces the denominator of the lower bound $\underline{\theta}$ by $(1-\tau) < 1$ within the square root. The impact of the tax on $\overline{\theta}$ is not quite as straightforward. The first term in the numeratoris divided by $(1-\tau)^2$ and not just $(1-\tau)$. This is because the tax increases the required bonus directly.

Taking the derivatives of ($\underline{\theta}$ and $\overline{\theta}$) with respect to $(1-\tau)$ gives:

$$\frac{\delta\underline{\theta}^2}{\delta(1-\tau)} = \frac{-8(F_V - F_O)}{(1-\tau)^2\mu\left(h^2(2+\mu) - 2p_0^2\mu\right)^2} < 0$$

$$\frac{\delta\overline{\theta}^2}{\delta(1-\tau)} = \frac{-\frac{8p_E E}{(p_E-p_0)}(2-2\tau) - 8(F_V - F_O)}{(1-\tau)\left(\frac{(p_E^2-p_0^2)(3p_E-2p_0)}{(p_E-p_0)} - \mu\left(h^2(2+\mu) - 2\mu p_0^2\right)\right)} < 0$$

We know the denominator of each derivative is positive, and we also know that $\frac{8p_E E}{(p_E-p_0)} > 8(F_V - F_O)$, and $(2-2\tau) > 1$, therefore the sign of each derivative is determined by the negative sign in each numerator. Since each threshold is decreasing in $(1-\tau)$, we know that $\frac{\delta\underline{\theta}^2}{\delta\tau} > 0$ and $\frac{\delta\overline{\theta}^2}{\delta\tau} > 0$.

We can also write down the condition under which the range $(\underline{\theta} - \overline{\theta})$ is larger in magnitude when there is a positive tax relative to the no tax case. The difference between $\underline{\theta}^2$ and $\overline{\theta}^2$ without taxes can be written as:

$$\overline{\theta}^2 - \underline{\theta}^2 = \frac{A-B}{C-D} - \frac{B}{D}$$

where A, B, C and D are all positive terms, defined as per Equations (19) and (20). Using the same notation, the differences between the analogous cutoffs accounting for taxes, 25 and 24, can be use to write:

$$\overline{\theta}_\tau^2 - \underline{\theta}_\tau^2 = \frac{\frac{A}{(1-\tau)^2} - \frac{B}{(1-\tau)}}{C-D} - \frac{\frac{B}{(1-\tau)}}{D}$$

And $(\overline{\theta}_\tau^2 - \underline{\theta}_\tau^2) > (\overline{\theta}^2 - \underline{\theta}^2)$ whenever:

$$\frac{AD}{(1-\tau)} - BC > (1-\tau)(AD - BC).$$

This holds whenever $0 < \tau < 1$ (because $\frac{AD}{(1-\tau)} - BC > AD - BC > (1-\tau)(AD - BC)$). Hence, when taxes are introduced, both $\underline{\theta}$ and $\overline{\theta}$ increase and the range $(\underline{\theta} - \overline{\theta})$ also increases in magnitude.

Appendix D: The relationship between productivity and output in equilibrium

In Section 4, we treated the property-level occupancy rate as a direct measure of property productivity, corresponding to the parameter θ in the theory developed in Section 2. This follows tradition in the work on hotel industry. However, it is appropriate to consider an alternative interpretation of the occupancy rate—as being a measure of variable output quantity, closer to the theoretical construct of $Y - F_k$ in Section 2. Under this interpretation, the occupancy rate is endogenous to both the property-level productivity parameter θ and the input levels from each of the contracting parties, which are, in turn, endogenous to θ and the hotel brand's choice of organizational form.

This perspective implies that the data reveal a non-monotonic relationship between variable output and organizational form choice as the result of an indirect association. Since, in the theory, organizational form choice is non-monotonic in θ, if there is a strict increasing monotonic relationship between variable output conditional on organizational form choice and θ, then the theory implies an indirect relationship between output and organizational form choice that is similar to the predicted direct relationship between productivity and organizational form choice.

To explore the variation in variable output with θ, we present the expected variable output levels as a function of θ under the three organizational forms of interest: outsourcing without performance incentives, vertical integration without performance incentives, and outsourcing with performance incentives. Output in each case is given by $E(Y) = \theta(hx_H + p(\cdot)x_S)$, where $x_H = \frac{1}{2}\theta h$ for both outsourcing contracts and $x_H = \frac{1}{2}(1+\mu)\theta h$ for the vertical integration contract. Turning to S's input, $x_S = \frac{1}{2}\theta p_0$ for outsourcing without performance incentives, $x_S = \frac{1}{2}(1-\mu)\theta p_0$ for vertical integration without performance incentives, and $x_S = \frac{1}{2}\theta p_E$ for outsourcing with performance incentives. We also note that $p(\cdot) = p_0$ for the first two contracts and $p(\cdot) = p_E$ for the third.

Substituting these endogenous input values to expected output, and comparing across the three contracts, tells us, first, that output is increasing the θ under each contract and is zero when $\theta = 0$. Therefore, to establish that there is a monotonic relationship between productivity and output as organizational form varies with productivity, we need to establish that the slope of H's payoffs under the V contract is greater than the slope of H's payoffs under O with no performance incentives and less than the slope of H's payoffs under O with performance incentives. Then at the threshold values of $\underline{\theta}$ and $\overline{\theta}$ at which we predict changes in organizational form, output is discontinuous and exhibits a positive jump in each case.

Under the parameter restriction that $h^2 \geq p_0^2$, output under vertical integration with no performance incentives greater than under outsourcing with no performance incentives for all values of $\theta > 0$. Hence, at the threshold level at which H opts for V for the first time, $\underline{\theta}$, there will be jump up in output. Similarly, the parameter restriction that is needed to ensure H's payoffs to outsourcing with performance incentives is more convex in θ than H's payoffs from the V contract is $p_E^2 - p_0^2 \geq \mu(h^2 - p_0^2)$. The left hand side of this inequality is (twice) the difference between the rate of increase in output in θ^2 by adding performance incentives under outsourcing. The right hand side is (twice) the difference in the rate of increase in θ^2 of H's payoffs from V and O without performance incentives. Combined, then, we require:

$$p_E^2 - p_0^2 \geq \mu(h^2 - p_0^2) \geq 0$$

When this holds, there is a range of model parameters where the model predicts a monotonically increasing relationship between expected output and productivity whenever it predicts a non-monotonic relationship between productivity and organizational form. The empirical work remains a valid test of the relationship between productivity and organizational form choice by evaluating the existence of the indirect predicted relationship between (endogenous) variable output and organizational form choice.

Table 3: Summary Statistics

Source: STR data

PANEL A: Properties that did not change organizational form during sample	Property-level observations, averaged by property over monthly observations 2004-2009				
Quality Tier	Total	Economy	Midscale	Upscale	Upper Upscale
Number of brands with at least one franchised property and one chain managed property	38	6	13	10	9
Number of properties across all brands with at least one property of each organizational form	8616	1385	3704	2405	1122
Proportion of properties that are chain managed	30.0%	70.6%	14.7%	22.7%	46.0%
Mean property-level occupancy rate across all brands	64.6%	60.6%	63.0%	68.0%	67.8%
Standard deviation in occupancy rate across all brands	28.7%	13.5%	12.2%	10.8%	9.5%
Minimum monthly occupancy rate	10.1%	10.1%	11.9%	18.9%	20.3%
Maximum monthly occupancy rate	97.4%	93.8%	97.4%	96.5%	90.5%
Mean ADR across all brands, USD	93	48	86	108	139
Standard deviation in ADR across all brands, USD	35	11	20	20	41
Minimum ADR, USD	29	29	37	62	73
Maximum ADR, USD	780	118	248	274	780
Mean number of rooms	151	97	110	138	382
Standard deviation of number of rooms	146	38	56	65	280
Minimum number of rooms	14	14	29	60	37
Maximum number of rooms	2843	607	652	770	2843

PANEL B: Properties that did change organizational form during sample	Property-level observations, averaged by property over monthly observations 2004-2009				
Quality Tier	Total	Economy	Midscale	Upscale	Upper Upscale
Number of brands with at least one franchised property and one chain managed property	38	6	13	10	9
Number of properties across all brands with at least one property of each organizational form	752	156	205	218	173
Proportion of properties that are chain managed	n/a	n/a	n/a	n/a	n/a
Mean property-level occupancy rate across all brands	68.2%	70.2%	63.9%	70.1%	68.3%
Standard deviation in occupancy rate across all brands	11.3%	14.9%	10.6%	9.3%	8.7%
Minimum monthly occupancy rate	23.1%	29.6%	28.0%	23.1%	40.0%
Maximum monthly occupancy rate	92.6%	91.0%	92.4%	92.6%	91.5%
Mean ADR across all brands, USD	93	39	84	106	135
Standard deviation in ADR across all brands, USD	43	14	20	22	41
Minimum ADR, USD	23	23	47	52	79
Maximum ADR, USD	324	93	179	285	324
Mean number of rooms	187	120	137	158	326
Standard deviation of number of rooms	155	25	67	96	231
Minimum number of rooms	41	41	56	62	107
Maximum number of rooms	2897	212	485	1066	2897

Table 4: The Relationship between Organizational Form and Output

Panel A: Estimation Output

	(1) Total	(2) Controlling for Age of Property	(3) Subsample of MSAs with at least 40 properties	(4) Properties that Switched Organizational Form
Occupancy	31.20**	27.88**	25.32**	1.344*
Unclustered standard errors	(3.28)	(3.36)	(3.57)	(0.62)
Standard errors clustered at brand level	(6.34)	(6.31)	(6.04)	(1.37)
Occupancy Squared	-20.59**	-18.34**	-16.26**	-0.783+
Unclustered standard errors	(2.54)	(2.60)	(2.76)	(0.48)
Standard errors clustered at brand level	(5.08)	(4.87)	(4.85)	(1.03)
Age of Property		0.93**		
Unclustered standard errors		(0.04)		
Standard errors clustered at brand level		(0.13)		
Constant	-13.96**	-14.34**	-11.67**	-4.497**
Unclustered standard errors	(1.14)	(1.17)	(1.24)	(0.77)
Standard errors clustered at brand level	(2.22)	(2.46)	(1.97)	(0.53)
N	8359	8359	5624	44132 property months, 752 properties
Brand fixed effects	Y	Y	Y	N
Property fixed effects	N	N	N	Y
City fixed effects	Y	Y	Y	N

+ p<0.1, * p<0.05, ** p<0.01

Panel B: Occupancy Rate where Predicted Probability of Chain Management is Highest, compared to Distribution of Occupancy Rate in Sample

	Total	Controlling for Age of Property	Subsample of MSAs with at least 40 properties	Properties that Switched Organizational Form
Occupancy Rate where Probability of Chain Management is Highest*	0.76	0.76	0.78	0.86
50th percentile of Occupancy Rate Distribution	0.66	0.66	0.66	0.78
90th percentile of Occupancy Rate Distribution	0.78	0.78	0.78	0.88
95th percentile of Occupancy Rate Distribution	0.81	0.81	0.81	0.92

**This is the occupancy rate at which the first derivative of Equation (9) with respect to occupancy is equal to zero.*

Table 5: The Relationship between Organizational Form and Output by Hotel Brand Quality Tier

Panel A: Estimation Output

	(1)	(2)	(3)	(4)	(5)
	Economy	**Midscale**	**Upscale**	**Upper Upscale**	**Properties that Switched Organizational Form, excl. Upper Upscale Brands**
Occupancy	43.76**	40.25**	47.07**	6.93	1.219+
Unclustered standard errors	(6.67)	(8.61)	(9.78)	(7.76)	(0.68)
Standard errors clustered at brand level	(12.62)	(11.58)	(11.23)	(8.11)	(1.50)
Occupancy Squared	-31.55**	-26.50**	-32.28**	-1.27	-0.865+
Unclustered standard errors	(5.36)	(6.70)	(7.14)	(5.98)	(0.52)
Standard errors clustered at brand level	(9.73)	(9.48)	(8.96)	(5.59)	(1.12)
Constant	-14.26**	-17.70**	-20.81**	-3.11	-3.873**
Unclustered standard errors	(2.13)	(2.80)	(3.50)	(2.44)	(0.77)
Standard errors clustered at brand level	(4.07)	(4.08)	(4.58)	(3.53)	(0.57)
N	1005	3039	2037	985	33126 property months, 579 properties
Brand fixed effects	Y	Y	Y	Y	N
Property fixed effects	N	N	N	N	Y
City fixed effects	Y	Y	Y	Y	N

+ p<0.1, * p<0.05, ** p<0.01

Panel B: Occupancy Rate where Predicted Probability of Chain Management is Highest, compared to Distribution of Occupancy Rate in Sample

	Economy	**Midscale**	**Upscale**	**Upper Upscale**	**Properties that Switched Organizational Form, excl. Upper Upscale Brands**
Occupancy Rate where Probability of Chain Management is Highest*	0.69	0.76	0.73	2.74	0.71
50th percentile of Occupancy Rate Distribution	0.61	0.65	0.70	0.69	0.70
90th percentile of Occupancy Rate Distribution	0.76	0.77	0.80	0.78	0.89
95th percentile of Occupancy Rate Distribution	0.81	0.80	0.82	0.81	0.92

**This is the occupancy rate at which the first derivative of Equation (9) with respect to occupancy is equal to zero.*

Table 6: The Relationship between Organizational Form and Output by Hotel Brand Quality Tier controlling for Property Age, and in the Subsample of MSAs with At Least 40 Properties

Panel A: Estimation Output including controls for property age	(1)	(2)	(3)	(4)
	Economy	**Midscale**	**Upscale**	**Upper Upscale**
Occupancy	42.11**	31.58**	39.15**	-0.51
Unclustered standard errors	(6.95)	(9.09)	(10.30)	(8.05)
Standard errors clustered at brand level	(11.91)	(12.44)	(12.15)	(7.20)
Occupancy Squared	-29.54**	-20.50**	-27.36**	3.76
Unclustered standard errors	(5.62)	(7.08)	(7.52)	(6.17)
Standard errors clustered at brand level	(9.00)	(9.80)	(9.43)	(4.89)
Age of Property	0.77**	2.01**	1.10**	0.50**
Unclustered standard errors	(0.09)	(0.15)	(0.08)	(0.08)
Standard errors clustered at brand level	(0.11)	(0.42)	(0.15)	(0.19)
Constant	-15.46**	-17.83**	-18.39**	-1.39
Unclustered standard errors	(2.25)	(2.99)	(3.69)	(2.52)
Standard errors clustered at brand level	(4.11)	(4.73)	(4.96)	(3.82)
N	1005	3039	2037	985
Brand fixed effects	Y	Y	Y	Y
City fixed effects	Y	Y	Y	Y

+ p<0.1, * p<0.05, ** p<0.01

Panel B: Occupancy Rate where Predicted Probability of Chain Management is Highest, compared to Distribution of Occupancy Rate in Sample

	Economy	**Midscale**	**Upscale**	**Upper Upscale**
Occupancy Rate where Probability of Chain Management is Highest*	0.71	0.77	0.72	0.07
50th percentile of Occupancy Rate Distribution	0.61	0.65	0.70	0.69
90th percentile of Occupancy Rate Distribution	0.76	0.77	0.80	0.78
95th percentile of Occupancy Rate Distribution	0.81	0.80	0.82	0.81

**This is the occupancy rate at which the first derivative of Equation (9) (when including property age) with respect to occupancy is equal to zero. When the estimated occupancy coefficient is negative but the coefficient on occupancy squares is positive (as is the case for the upper upscale properties), this is the occupancy rate where the probability of chain management is minimized.*

Panel C: Estimation Output for the subsample of properties in MSAs with at least 40 properties

	Economy	**Midscale**	**Upscale**	**Upper Upscale**
Occupancy	32.15**	35.32**	43.39**	3.31
Unclustered standard errors	(6.61)	(9.20)	(10.52)	(7.54)
Standard errors clustered at brand level	(11.27)	(11.86)	(9.09)	(6.69)
Occupancy Squared	-23.12**	-22.71**	-29.76**	1.24
Unclustered standard errors	(5.37)	(7.13)	(7.67)	(5.84)
Standard errors clustered at brand level	(8.58)	(9.61)	(7.16)	(4.70)
Constant	-10.22**	-15.88**	-19.21**	-1.87
Unclustered standard errors	(2.12)	(3.00)	(3.74)	(2.35)
Standard errors clustered at brand level	(3.65)	(4.06)	(3.96)	(2.98)
N	764	2320	1567	873
Brand fixed effects	Y	Y	Y	Y
City fixed effects	Y	Y	Y	Y

+ p<0.1, * p<0.05, ** p<0.01

Panel D: Occupancy Rate where Predicted Probability of Chain Management is Highest, compared to Distribution of Occupancy Rate in Sample

	Economy	**Midscale**	**Upscale**	**Upper Upscale**
Occupancy Rate where Probability of Chain Management is Highest*	0.70	0.78	0.73	-1.33
50th percentile of Occupancy Rate Distribution	0.61	0.65	0.70	0.69
90th percentile of Occupancy Rate Distribution	0.76	0.77	0.80	0.78
95th percentile of Occupancy Rate Distribution	0.81	0.80	0.82	0.81

**This is the occupancy rate at which the first derivative of Equation (9) with respect to occupancy is equal to zero. When the estimated coefficients on occupancy rate and occupancy rate squared are both positive (as is the case for the upper upscale properties), this is the occupancy rate where the probability of chain management is minimized.*

Table 7: Robustness test. Brands with at least 10% chain managed and at least 10% franchised properties.

Panel A: Estimation Output for the subsample of properties in brands with at least 10% chain-managed but less than 90%

	(1)	(2)	(3)	(4)
	Economy	**Midscale**	**Upscale**	**Upper Upscale**
Occupancy	43.59**	45.34**	49.89**	6.4
Unclustered standard errors	(6.82)	(10.53)	(10.38)	(7.81)
Standard errors clustered at brand level	(13.36)	(14.68)	(11.42)	(8.31)
Occupancy Squared	-31.31**	-31.19**	-34.26**	-0.781
Unclustered standard errors	(5.46)	(8.21)	(7.56)	(6.01)
Standard errors clustered at brand level	(10.32)	(11.64)	(9.18)	(5.71)
Constant	-14.25**	-19.09**	-21.79**	-2.978
Unclustered standard errors	(2.18)	(3.42)	(3.70)	(2.45)
Standard errors clustered at brand level	(4.30)	(5.21)	(4.68)	(3.62)
N	912	830	1601	948
Brand fixed effects	Y	Y	Y	Y
City fixed effects	Y	Y	Y	Y

+ p<0.1, * p<0.05, ** p<0.01

Panel B: Occupancy Rate where Predicted Probability of Chain Management is Highest, compared to Distribution of Occupancy Rate in Sample

	Economy	**Midscale**	**Upscale**	**Upper Upscale**
Occupancy Rate where Probability of Chain Management is Highest*	0.70	0.73	0.73	4.10
50th percentile of Occupancy Rate Distribution	0.62	0.65	0.71	0.69
90th percentile of Occupancy Rate Distribution	0.77	0.77	0.81	0.78
95th percentile of Occupancy Rate Distribution	0.81	0.80	0.83	0.81

**This is the occupancy rate at which the first derivative of Equation (9) with respect to occupancy is equal to zero.*

Table 8: Organizational Form, Occupancy, and State Marginal Corporate Tax Rate. Split Sample above and below Median Tax Rate

Panel A: Estimation Output

	Total		Economy		Midscale		Upscale		Upper Upscale	
Marginal Tax Rate	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**
Occupancy	26.39**	35.98**	43.02**	49.14**	41.38**	39.68**	24.69+	64.03**	-2.99	17.74
	(4.66)	(4.71)	(10.50)	(8.95)	(11.46)	(13.51)	(13.71)	(14.47)	(10.81)	(12.21)
Occupancy Squared	-16.97**	-24.06**	-32.25**	-34.58**	-27.98**	-25.15*	-14.8	-45.17**	5.69	-8.34
	(3.66)	(3.60)	(8.65)	(7.05)	(8.99)	(10.40)	(10.27)	(10.40)	(8.55)	(9.17)
Constant	-12.74**	-15.68**	-13.70**	-16.62**	-17.30**	-18.04**	-12.96**	-39.26	0.54	-6.93+
	(1.88)	(1.61)	(3.20)	(3.12)	(3.83)	(4.41)	(4.65)	(806.30)	(3.32)	(3.93)
N	3676	4471	411	538	1382	1466	896	1106	406	550
Brand fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
City fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Unclustered standard errors in parentheses.
+ p<0.1, * p<0.05, ** p<0.01

Panel B: Occupancy Rate where Predicted Probability of Chain Management is Highest, compared to Distribution of Occupancy Rate in Sample

	Total		Economy		Midscale		Upscale		Upper Upscale	
Marginal Tax Rate	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**	**<6.5%**	**>6.5%**
50th percentile of Occupancy Rate Distribution	0.66	0.67	0.61	0.63	0.65	0.65	0.69	0.70	0.69	0.69
90th percentile of Occupancy Rate Distribution	0.78	0.79	0.74	0.78	0.77	0.77	0.79	0.81	0.78	0.78
95th percentile of Occupancy Rate Distribution	0.80	0.82	0.78	0.83	0.79	0.80	0.81	0.83	0.81	0.81
Occupancy Rate where Probability of Chain Management is Highest*	0.78	0.75	0.67	0.71	0.74	0.79	0.83	0.71	0.26	1.06

**This is the occupancy rate at which the first derivative of Equation (9) with respect to occupancy is equal to zero.*

Table 9: Organizational Form, Occupancy, and State Marginal Corporate Tax Rate, including Interactions.

Panel A: Estimation Output

	Total	Economy	Midscale	Upscale	Upper Upscale
Occupancy	32.49**	56.30**	50.29**	0.37	-0.37
	(7.60)	(17.32)	(16.24)	(17.32)	(17.91)
Occupancy Squared	-21.36**	-43.85**	-34.75**	3.84	1.50
	(5.93)	(14.03)	(12.78)	(12.95)	(14.39)
Marginal Corporate Tax Rate	5.40	45.61	44.03	-275.60**	-57.40
	(35.50)	(74.93)	(81.54)	(94.12)	(83.90)
Occupancy x Marginal Tax Rate	-21.80	-181.9	-189.10	766.00**	140.70
	(110.80)	(242.70)	(256.70)	(273.90)	(266.50)
Occupancy Squared x Marginal Tax Rate	12.88	182.10	155.00	-589.20**	-63.27
	(85.85)	(195.60)	(201.00)	(200.90)	(211.20)
Constant	-14.29**	-17.28**	-20.06**	-4.13	0.12
	(2.46)	(5.28)	(5.17)	(5.87)	(5.57)
N	8359	1005	3039	2037	985
Brand fixed effects	Y	Y	Y	Y	Y
City fixed effects	Y	Y	Y	Y	Y

Unclustered standard errors in parentheses
+ p<0.1, * p<0.05, ** p<0.01

Panel B: Occupancy Rate where Predicted Probability of Chain Management is Highest at the 10th and 90th percentile of the State Marginal Corporate Tax Rate Distribution

	Total	Economy	Midscale	Upscale	Upper Upscale
Occupancy Rate where Probability of Chain Management is Highest at 10th Percentile Tax Rate*	0.76	0.64	0.73	-0.51	0.00
Occupancy Rate where Probability of Chain Management is Highest at 90th Percentile Tax Rate*	0.76	0.73	0.81	0.70	1.45

Notes:
The 10th percentile tax rate is 0.003, the 90th percentile tax rate is 0.094.
The coefficient on the marginal corporate tax rate is identified using within-MSA variation where the MSA spans state boundaries.

**This is the occupancy rate at which the first derivative of Equation (10) with respect to occupancy is equal to zero.*

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