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Entry Deterring Capacity in the Texas Lodging Industry

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ENTRY DETERRING CAPACITY IN THE TEXAS LODGING INDUSTRY*

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Abstract

This paper empirically tests whether capacity is used to deter entry and whether the amount invested in entry deterring capacity is related to market concentration and market presence. We use a unique dataset containing all lodging properties in Texas from 1991 through 1997. For each of the 3,830 properties, we have information on occupancy rate, number of rooms, location and ownership. This information is augmented by market level information such as tax rates, travel expenditures and retail wages. We find that there is higher investment in capacity relative to demand (i.e. idle capacity) in markets with larger Herfindahl index and by firms with larger share of market capacity. These results are consistent with the entry deterrence literature that suggests firms in more concentrated markets and firms with larger market share have greater incentive to invest in entry deterring capacity.

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ENTRY DETERRING CAPACITY IN THE TEXAS LODGING INDUSTRY

I. INTRODUCTION

There is an extensive theoretical literature on firms strategically investing in capacity to deter entry. However, empirical tests of this hypothesis are quite limited. This is because of data availability, and more critically, because of the difficulty in distinguishing between alternative explanations for why firms might have idle capacity. Besides to deter entry, firms may have idle capacity because of expected future demand growth, high demand in the past, and demand fluctuations. Firms may also have idle capacity if collusion increases and this increase was not foreseen by the firms when making prior capacity decisions.[1] In an effort to distinguish between these alternative explanations and the entry deterrence explanation for idle capacity, we turn to a stream of literature that provides insights on how firms' incentives to invest in entry deterring capacity are affected by market concentration and how a particular firm's incentive to invest depends on its market presence. By testing whether the propensity to invest in entry deterring capacity is a function of market concentration and market presence, we are indirectly testing whether firms invest in entry deterring capacity.

The industry we use for this empirical exercise is the Texas lodging industry. In this industry, demand explanations for having idle capacity seem especially plausible because capacity in this industry is "lumpy" and irreversible. There is also substantial demand variability by day of week and season of year. Therefore, how do we test whether idle capacity in this industry is the result of strategic investment in entry deterring capacity? Using the insights from the literature on the effect of concentration on firms' incentives to invest in entry deterring capacity, we find that there is higher investment in capacity relative to demand (i.e. idle capacity) in more concentrated markets and by firms with larger market presence.

While the positive correlations between idle capacity and market concentration and between idle capacity and market presence are implications of the theoretical literature pertaining to the investment in entry deterring capacity, there are other possible explanations. For example, expected demand growth,

perhaps resulting in more idle capacity today, may be greater in highly concentrated markets and greater if a firm has a larger share of a particular market. Or, the amount of idle capacity may be positively correlated with demand variability which in turn may be greater in highly concentrated markets and greater for firms with a large market presence. Or, collusion in more concentrated markets is greater than expected when the firms were making capacity decisions and the unforeseen level of collusion depends on a firm's market presence. While unable to explicitly rule out these alternative explanations, we believe investment in entry deterring capacity is the more likely explanation for our empirical results.

The dataset used to test whether idle capacity depends on market concentration and market presence consists of annual information from 1991 to 1997 of 3,830 lodging properties in Texas. For each property, we have annual information on the number of rooms, occupancy rate, geographic location and ownership. The dataset contains all lodging properties in Texas with gross annual revenue over $13,000. An advantage of using the lodging industry, to test whether firms invest in entry deterring capacity, is that capacity determination is straightforward (i.e., number of rooms). In addition, capacity in the lodging industry cannot be moved to a different geographical market as is the case in numerous industries (such as the airline industry).

The rest of the paper is organized in the following manner. Section II provides an overview of the existing theoretical literature on entry deterring capacity. This literature is divided into models of a single incumbent firm versus multiple incumbent firms that select entry-deterring capacity noncooperatively. This section also contains a summary of the empirical literature. Section III describes the lodging industry data and provides descriptive statistics. Sections IV contains the results of two specifications that consider the relationship between idle capacity and market concentration as well as how a firm's market presence affects its propensity to invest in entry deterring capacity. Section V presents conclusions of the analysis.

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[1] Note that these alternative explanations do not provide predictions of the effect of market concentration on idle capacity nor of which firms are more likely to have more idle capacity in particular markets.

II. EXISTING THEORETICAL AND EMPIRICAL LITERATURE

The majority of the theoretical literature on entry deterrence considers a single incumbent firm. The more widely cited papers include Spence (1977), Dixit (1980), Spulber (1981), and Bulow, Geanakoplos and Klemperer (1985). Much of this work specifically considers the use of capacity as an entry deterrent. Dixit (1980) argues that a single incumbent firm will invest in capacity to deter entry but that after investing in this capacity the firm will use the capacity. Even though the incumbent firm invests in capacity to deter entry, the firm produces at an output equal to capacity and thus does not possess idle capacity. By relaxing Dixit's linear demand restriction, Bulow, Geanakoplos and Klemperer (1985) prove that if the marginal revenue for the incumbent firm and the potential entrant are decreasing in the other's output, the incumbent firm may hold idle capacity after investing in the entry deterring capacity. The general conclusion of the work modeling a single incumbent firm is that the firm may invest in capacity to deter entry and this can result in idle capacity.

The more recent entry deterrence literature has considered markets with multiple firms who behave noncooperatively. (See Bernheim (1984), Gilbert and Vives (1986), Eaton and Ware (1987), Waldman (1987, 1991), and McLean and Riordan (1989).) While all these papers consider entry deterrence by incumbent firms, they reach different conclusions on how market concentration affects the incentive to take actions that deter entry. The Gilbert and Vives (1986) model predicts that the total amount firms invest in entry deterrence will increase as the number of firms in the market increases. This result is driven by the fact that the entry deterring action, credibly committing to an output level, not only deters entry, which benefits the firm, but also earns revenue for the firm. The theoretical model in Bernheim (1984) predicts that the amount invested in entry deterrence should not change with the number of firms in the market.[2] Waldman (1987, 1991) notes that the Bernheim result is driven by the fact that the benefit of incumbent firms from entry deterring investment occurs at a single critical point. Entry is deterred with probability one if an incumbent firm invests more than this critical level; entry occurs with probability one if an incumbent firm invests less than this critical level. By introducing uncertainty,

Waldman eliminates this critical level of capacity and demonstrates that a free-rider problem exists in entry deterrence. The free-rider problem causes the total level of investment in entry deterrence to decrease with an increase in the number of firms.[3]

The models of Bernheim and Waldman assume a very general profit function where a firm's profits decrease with entry and with entry deterring investment. Due to lodging properties employing sophisticated yield management techniques, this generalized profit function results in these models being more applicable to the lodging industry than Gilbert and Vives' model.[4] By introducing uncertainty, Waldman's model corresponds better to the hotel industry than Bernheim's model because incumbents are not likely to know the exact capacity investment required to deter entry with certainty.

Waldman's model does not allow firms to be heterogeneous. In the lodging industry, firms not only have different cost structures but there exists both vertical and horizontal differentiation. Firms' cost structures differ due to capacity, amenity and accommodation selections. In addition, a single firm may own multiple properties; often in the same geographic area. While not explicitly allowing heterogeneous firms, Waldman does provide insight regarding what type of firms in the market are more likely to invest in entry deterring capacity. If Waldman's model allowed for heterogeneous firms, it would predict that firms with larger market presence would invest more in entry deterrence if a firm's benefit from deterring entry increases with its market presence and the change in the probability of entry decreases with entry deterring capacity investment.[5]

The empirical literature testing whether firms invest in capacity to deter entry is very limited. This is perhaps due to the difficulty in obtaining adequate data and in determining whether the idle capacity is the result of firms' incentives to deter entry. Firms could hold idle capacity for a number of reasons besides entry deterrence. Because capacity is lumpy, idle capacity may exist as firms hold capacity today to satisfy future demand. In addition, because capacity is often not liquid, firms may have

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[2] Eaton and Ware (1987) also predict that the number of firms should not affect investment in entry deterrence.
[3] This free-rider problem also arises in McLean and Riordan (1989).
[4] Gilbert and Vives assume that firms compete as Cournot competitors.
[5] In the empirical specifications, we interpret market presence to mean the share of market capacity.

idle capacity today because demand was high in the past. If demand fluctuates, a firm may not produce at capacity, and thus hold idle capacity, during times of low demand.[6] Through its impact on quantity, the level of collusion will also affect idle capacity.[7] To empirically address whether firms use capacity to deter entry, one must consider these alternative explanations of idle capacity.

The existing empirical papers that test whether capacity is used as an entry deterrent include Lieberman (1987), Hilke (1984), Mathis and Koscianski (1996), and Ghemawat (1984). Using annual information on 38 chemical product industries, Lieberman considers whether incumbent firms increase capacity pre-emptively to deter entry by new firms. By regressing whether a new plant is built by an incumbent firm and/or by a new entrant on industry growth rate, average plant size, number of plants, and average number of plants, the paper finds no evidence that capacity is used as an entry deterrent. Using information from 16 manufacturing industries, Hilke regresses the change in market share of imports between 1950 and 1966 on industry measures of profitability, growth, barriers to entry and idle capacity. Assuming that import penetration is a reasonable proxy for entry, the ordinary least squares regression results suggest that there exists a weak negative relationship between entry and idle capacity. Mathis and Koscianski conclude that idle capacity in the United States titanium metal industry reduced entry from 1962 to 1991. Ghemawat presents a case study of the titanium dioxide industry in the 1970's. The primary conclusion is that Dupont, the lowest cost producer, preempted expansion by its competitors by adding new capacity.[8]

While several of these papers conclude that idle capacity reduces entry, data limitations prevent them from distinguishing between the alternative explanations for this relationship. Furthermore, none of these papers test whether market concentration or a firm's market presence affects the amount invested in

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[6] See Jordan (1983) and Dana (1999a, 1999b) for models pertaining to peak-load pricing.

[7] Firms may also hold idle capacity for strategic reasons other than entry deterrence. For example, a firm may hold idle capacity to enforce a collusive arrangement with its competitors. See Brock and Scheinkman (1984) for a theoretical model that considers capacity and collusion in a repeated game. In a separate paper (Conlin and Kadiyali, 1999) we use this same dataset to empirically test whether capacity affects collusion.

[8] There exist numerous empirical papers testing whether firms undertake strategic behavior, not involving capacity, in an effort to deter entry. For example, Ellison and Ellison (2000) test whether pharmaceutical incumbents strategically distort their "investment" in advertising, product proliferation and pricing prior to patent expiration in an effort to deter entry.

entry deterring capacity. The only empirical research we are aware of that considers the effect of market concentration on entry deterring capacity is Masson and Shaanan (1986). Using data from 26 United States industries, Masson and Shaanan's results suggest that entry is less likely in industries with low price-cost margins and high idle capacity. They find no statistically significant relationship between idle capacity and concentration, and conclude that there is no evidence that firms strategically add capacity to deter entry.

III. DATA DESCRIPTION

We have gathered data from five sources: a private consulting firm in San Antonio called Source Strategies Incorporated, the State of Texas Comptroller's office, the Texas Department of Economic Development's Tourism Division, the United States Census Bureau and various lodging publications.

Source Strategies Incorporated publishes the *Texas Hotel Performance Factbook* which reports the annual revenue, number of rooms (i.e., capacity), and locations of all lodging properties in Texas with gross annual revenue over $13,000. This information is obtained from the State of Texas Comptroller's office and is based on state tax information. Source Strategies Incorporated augments this information with average annual daily rates (i.e., average price) obtained through surveys, financial reports, appraisers, and directories. Source Strategies also obtains information from Smith Travel Resource Incorporated, a private consulting firm that conducts monthly surveys on lodging properties' average daily rates, occupancy rates and operating expenditures. Average annual occupancy rates (i.e., quantity/capacity) are then calculated by dividing total revenue by average annual daily rates and capacity. Idle capacity is then just one minus the occupancy rate (which is equivalent to the number of unoccupied rooms divided by the number of rooms). We obtained this annual information for 1991 through 1997. In addition, Source Strategies provided information on whether a property is brand affiliated (compared to an independent) and the brand affiliation for those that are brand affiliated. These

data do not have the taxpayer information. This information we obtained directly from the State of Texas Comptroller's records.

Annual information on travel expenditures and retail wages for each of the 254 counties was obtained from the Texas Tourism Division. The travel expenditure data are based on information from fourteen travel-related businesses and calculated using a model developed by the U.S. Travel Data Center. In addition, the Tourism Division provided annual information on the tax rates of lodging properties at the city level.[9] We obtained annual county level information on population, per capita income, unemployment rate and average wage in the construction industry from the Census Bureau. Finally, brands that offer similar services/amenities are classified in the same sector. The sector (Full-Service, Limited-Service or Extended Stay) of each brand was obtained from lodging magazines and textbooks.[10]

Summary statistics of the data are provided in Table 1, Table 2 and Figure 1. Table 1 contains the means and average annual growth rates of the county level information and tax rates. Table 2 contains annual information on the number of properties, total number of rooms, percent idle capacity and Herfindahl Indexes. The Herfindahl indexes are calculated based on the number of rooms with county, county-sector, city, and city-sector as the market definitions.[11,12] When calculating the Herfindahl index, different properties with the same taxpayer information are considered one firm.[13] Perhaps the most

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[9] While providing information on the large majority of properties in Texas, the Tourism Division information on tax rates did not include all cities where lodging properties are located. We obtained the remaining property tax rates through a phone survey. These include both city and county taxes. The state tax rate on lodging properties remained constant at 6% throughout the 1990s.

[10] The Full Service sector consists of Fairmont, Westin, Four Seasons, Hyatt, Sheraton, Omni, Marriott, Renaissance, Loews, Stouffer, Bristol, Crowne Plaza, Hilton, Red Lion, Courtyard, Adam's Mark, Radisson, DoubleTree, Wyndham, Holiday, Ramada, Four Points, Medallion, Holiday Select, Clarion, Howard Johnson and Harvey. The Limited Service sector consists of Hampton, LaQuinta, Holiday Express, Fairfield, Country, Wingate, Homeplace, Drury, Days, Comfort, Best Western, Shoney's, Budgetel, Ramada Ltd, Quality, Sleep, Motel 6, Super 8, Travelodge, Red Roof, Rodeway, Econolodge, Park, Allstar, Homestead, Microtel, Travelers, Red Carpet, Exel and Knights. The Extended Stay sector consists of Residence, Homewood, DoubleTree Suites, Sheraton Suites, Hawthorn, Embassy, Summerfield, Sumner Suites, MainStay, AmeriSuites, HomeGate, Travel Suites, Lexington, Villager, Comfort Suites, StudioPlus and Extended Stay.

[11] Because independent properties do not have sector classifications, these properties are not included when calculating the Herfindahl indexes for the county-sector and city-sector market classifications.

[12] Similar figures are obtained when the Herfindahl indexes are calculated based on quantity.

[13] To illustrate how the Herfindahl indexes are calculated, suppose there exists four hotels in Anderson County all with different taxpayer information. If the hotels have 200, 150, 100 and 50 rooms, the county Herfindahl index for Anderson would be 3000 ($40^2+30^2+20^2+10^2$). If the 200 and 150 room properties had the same taxpayer, the county

interesting observation from Table 2 is the growth across years in the number properties and the total number of rooms has been accompanied by a decrease in idle capacity. As expected, the Herfindahl index increases when a market is more narrowly defined. In addition, the Herfindahl index does not vary significantly across years for any of the four market classifications.

While Table 2 does describe the change in the aggregate number of properties and rooms across years, it does not provide information on the amount of entry, exit and capacity changes in the lodging industry. Figure 1 depicts the change attributable to new properties, the change attributable to exits and the change attributable to property expansions/contractions as a percent of the total number of rooms for the different years.[14] In addition, Figure 1 differentiates between a new property that is owned by a new entrant and one owned by an incumbent (where an incumbent is defined as a taxpayer who owns at least one other property in the county). Given that our annual data consists of years 1991 through 1997, we cannot determine those properties that entered or changed capacity in 1991 nor those properties that exited in 1997. The figure indicates that the percent of total rooms accounted for by new properties is the primary explanation for the increase in total rooms across years. Interestingly, a new entrant rather than an incumbent owns the majority of these new properties. Figure 1 also demonstrates that the percent of total rooms accounted for by exiting properties range from 1.3 to 2.1 percent depending on the year. Note that while the percent for entering properties has increased somewhat steadily across years, the percent for exiting properties has been relatively constant across years. While not indicated in Figure 1, the majority

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Herfindahl index would be 5400 ($70^2+20^2+10^2$). Suppose all four properties again have different taxpayer information and the 200 and 150 room properties are in the limited-service sector while the 100 and 50 room properties are in the full-service sector. In this case, the county-sector Herfindahl index would be 5101 ($57.1^2+42.9^2$) for the limited-service sector and 5556 ($66.7^2+33.3^2$) for the full-service sector. The calculations of city and city-sector Herfindahl indexes are similar to those for the county.

[14] The percentages in 1997 are likely to be slightly understated. The property information provided by Source Strategy Incorporated are based on state taxpayer information and published in March of the following year. These annual publications do not include properties that have entered the previously year and are late in paying their taxes. Given that the subsequent year's publication does include these properties, those properties that were missing in years 1991 through 1996 were included in the dataset based on information contained in the subsequent year's publication. Because we do not have the 1998 data, this cannot be done for 1997. The regressions in Section IV are estimated with the 1997 information. However, the coefficient estimates do not change appreciably when the 1997 observations are not included.

of the new property entry and exit involve smaller properties.[15] As for existing properties changing their number of rooms, Figure 1 indicate that while these room changes involve a smaller percent of total rooms than property entry and exit, the percentage does range from .7 to 1.5 and appears to be increasing across years.

IV. EMPIRICAL RESULTS

To test the implications of the entry deterrence literature, we use two different empirical specifications. The first tests whether more concentrated markets have more or less idle capacity. The second specification tests whether firms with a larger market presence have more or less idle capacity in the market.

There are several issues that must be addressed in the two specifications. The first is what constitutes a market. Because lodging properties are vertically and horizontally differentiated, any market definition is problematic. We consider four market definitions based initially on geographic location and then on amenities/accommodations. These four are county, county-sector, city and city-sector. For the county (city) market definition, all properties located in the same county (city) are assumed to be in the same market. The county-sector (city-sector) market definition requires properties to be located in the same county (city) as well as sector for them to be considered in the same market.[16] While none of these is ideal, we are interested in whether our results are consistent across the four market definitions.

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[15] The average property size in our data is over 85 rooms while the average for those that enter is 46.1 rooms and for those than exit is 27.6 rooms. Our finding that smaller properties are more likely to exit is similar to Lieberman's (1990) finding that smaller chemical plants have higher rates of closure and differs from the case studies presented in Ghemawat and Nalebuff (1990). While Lieberman attributes his empirical findings to economies of scale, smaller lodging properties are more likely to exit because of capital specificity (i.e., it is easy to convert a bed and breakfast into a residential home than to convert a hotel into office space or an apartment building). Lieberman also finds that firms with larger market shares are more likely to reduce capacity. Neither Lieberman nor Ghemawat and Nalebuff provide empirical evidence pertaining to the relationship between idle capacity and market concentration nor between idle capacity and market share.

[16] For brand affiliated properties, the sector classification is based on amenities and accommodations. Therefore, a property is more likely (ceterus paribus) to be a closer substitute to other properties in the same sector. Because independents do not have sector classifications and vary widely in terms of amenities and accommodations, these properties are not included in the estimation when markets are defined based on county-sector and city-sector.

The second issue concerns how to measure market concentration and a firm's presence in a market. The results presented in this paper use Herfindahl index based on capacity (i.e., number of rooms) as the measure of market concentration. However, the empirical results do not change appreciably when the Herfindahl index is calculated based on quantity instead of capacity. We calculate a firm's market presence by dividing the firm's capacity in the market by the total capacity in the market. As with the Herfindahl index, the empirical results change little if market share of quantity instead of capacity is used as the measure of a firm's market presence.

The final issue is whether to use market level fixed effects in our estimation. We could include market fixed effects and thereby use within market, across year variation to identify the effect of market concentration on market idle capacity. The main problem with including market fixed effects is that there is little within market, across year variation in market concentration and idle capacity. In addition, the variation that does exist is primarily the result of entry, exit, capacity expansion and acquisitions. Because of the large expenditure on specialized capital and the durability of this capital, the decision to enter, exit, change capacity or acquire another property depends on firms' expectations of returns in the future from the investment. These expected returns are largely a function of market expectations. If we do not account for how these market expectations vary from 1991 to 1997, then using within market, across year variation to identify the relationship between market concentration and idle capacity is problematic. For these reasons, we do not include market fixed effects in the first specification. However, we are able to account for market level fixed effects in the specification testing whether firms with a larger market presence have more idle capacity. In fact, we are able to include market-year fixed effects which not only controls for market expectations and the within year demand variability of the market, but also allows the expectations and demand variability to vary across years. By including market-year fixed effects, we identify the effect of firm share of market capacity on firm idle capacity using within market-year variation across firms.

Table 3 provides information for the four different market definitions. The average number of properties in a market ranges from 12.5 when a market is defined as a county to 3.7 when a market is

defined as a city-sector. For each market definition, the average number of firms in a market is significantly less than the average number of properties. The reason for this is that a firm often owns multiple properties in a market.[17,18] Table 3 also indicates that the average number of rooms in a market for a firm almost doubles when a market is defined based on not only geographic location but also sector classification. The reason for this is because independent properties have, on average, much fewer rooms than brand affiliated properties and independent properties are not included when the market classification is county-sector or city-sector. Finally, the table indicates that those firms with higher (lower) than average share of market capacity have, on average, less (more) idle capacity than the market average. When markets are classified based on county, idle capacity is 3.6 percentage points less than the average in the market for firms with a greater than average share of market capacity and 2.1 percentage points greater for firms with less. These differences are relatively large, especially for county and city market classifications, considering the average percent idle capacity is approximately 42 percent (see Table 2). Because the second empirical specification uses within market-year variation for identification, these differences are of concern since they appear to contradict the entry deterrence theory predicting that firms with greater market presence have more incentive to invest in entry deterring capacity and thus have more idle capacity. However, these differences do not account for other factors that would influence idle capacity; such as brand affiliation and whether the firm recently opened a property in the market. In fact, the reason these differences change dramatically when markets are defined based on sector is because independent properties have, on average, fewer rooms and much greater idle capacity than the brand

[17] The firm owning multiple properties could be the owner of the brand trademark, a franchisee or an owner of multiple independent properties. In regards to brand-affiliated properties, firms often own multiple brand trademarks (i.e., Holiday Inn and Holiday Inn Express) and franchisees often own multiple properties affiliated with different brands. Furthermore, some firms own properties in different geographic areas, others own properties in the same geographic area but in different sectors, while still others own properties in the same geographic area and in different sectors. This is one reason we use four different market definitions. See Conlin and Rysman (2004) for a thorough analysis of the multi-unit ownership issue.

[18] Kalnins and Lafontaine (2002) document multi-unit ownership in the Texas restaurant industry. They find that the probability an existing franchisee owns a new location increases if the franchisee's existing location is in relatively close proximity. Unlike the restaurant industry a franchisee in the hotel industry often has properties affiliated with multiple franchisors.

affiliated properties.[19] Number of rooms and idle capacity also vary significantly across brands and on whether a property was opened within the last year.

First Specification

The first specification tests the relationship between market concentration and idle capacity. In this specification, the following model is estimated.

$$(\text{Percent Idle Capacity})_{m,t} = \varsigma_t + \lambda\ (\text{Herfindahl Index})_{m,t} + \eta \mathbf{X}_{m,t} + \varepsilon$$

The dependent variable is market m's percent idle capacity in year t. Market m's Herfindahl index (based on capacity) in year t is an independent variable measuring market concentration. We expect λ to be greater than zero based on the entry deterrence literature. The vector $\mathbf{X}_{m,t}$ includes the following variables: market m's county population, per capita income, average retail wage, travel expenditures, unemployment rate, average tax rate and average construction wage as well as the prior year's growth rates of these variables. These variables control for demand and cost factors, and the expectations of these factors, that are likely to influence rooms booked and capacity decisions. In all regressions we correct the standard errors for arbitrary heteroskedasticity and clustering within a market over time.

The results of this specification, when the data are pooled, are given in Table 4 for all market definitions (county, county-sector, city and city-sector).[20,21] In all cases, the estimates of λ are positive and, for three of the market definitions, statistically significant.[22] In terms of the marginal effect when county is the market definition, a 1000 point increase in the Herfindahl index results in an increase in market idle capacity of slightly less than half a percentage point. Many of the coefficient estimates associated with the demand and supply variables are also economically and statistically significant. Table

[19] The average number of rooms and the average idle capacity for an independent property is 48.8 and 52.4 percent, respectively. For a brand affiliated property, average number of rooms is 142.2 and average idle capacity is 37.9 percent.

[20] The results in Table 4 do not change appreciably when only between market variation is used to estimate the coefficients.

[21] For presentation purposes, the Herfindahl index, population, per capita income and travel expenditures are divided by 1,000.

[22] While the Herfindahl index is arguably endogenous, there are no obvious instrumental variables to resolve this problem. The reason we calculate the Herfindahl index based on capacity rather than quantity is due to this endogeneity issue.

4 indicates that markets with large lagged population and travel expenditure growths have less idle capacity.

One explanation for the positive Herfindahl index coefficients is that large firms have more incentive to invest in entry deterring capacity causing idle capacity to increase with an increase in market concentration. However, the positive coefficients could also be caused by firms with minimal capacity exiting those markets with high idle capacity (resulting in a larger Herfindahl index). Another explanation for the positive Herfindahl index coefficients is that there is less within year demand variability and higher expected demand growth in areas with greater market concentration. Or perhaps it is the case that markets with higher concentrations experience greater collusion than was foreseen at the time the firms selected capacities. We control for market factors that are likely to be correlated with demand variability, demand growth and collusion (such as market size) by including many market level demand and cost factors as independent variables. However, it may be the case that these independent variables do not adequately control for the across market variation in within year demand variability, expected demand growth and collusion. In our second specification, we are better able to account for this across market variability by including market-year fixed effects.[23]

Second Specification

We now consider whether firms with a large market presence invest more in entry deterring capacity. For the second specification, we estimate the following model which tests whether firms with larger shares of market capacity have greater idle capacity.

$$\begin{aligned}(\text{Percent Idle Capacity})_{i,m,t} = \phi_{m,t} + \phi_B(\text{Share of Capacity Affiliated with Brand B})_{i,m,t} + \lambda\ (\text{Share of Market Capacity})_{i,m,t} \\ + \eta\ (\text{Incumbent Opens Property})_{i,m,t} + \zeta\ (\text{New Entrant Opens Property})_{i,m,t} + \varepsilon\end{aligned}$$

We expect the percent idle capacity for firm i in market m in year t to be affected by not only firm i's incentive to invest in entry deterring capacity but also on market expectations, market demand variability,

[23] In another specification, we regress the percent change in the total number of rooms in a market from the prior year on the prior year's Herfindahl index, the prior year's idle capacity and the same market level demand and cost factors as in Table 4. We find that conditional on idle capacity and these market level demand and cost factors, the percent change in the total number of rooms is greater in more concentrated markets. While these results are

market level collusion, the brand affiliations of firm i's properties and whether firm i has recently opened a property in market m. To control for market expectations, market demand variability, market level collusion and brand affiliation, we include market-year and brand fixed effects.[24] Because firm i's idle capacity in market m in year t is likely to depend on whether firm i has recently opened a property and the effect of the opening on idle capacity is likely to depend on whether firm i has an existing property, we include indicator variables for whether an incumbent firm i has opened a property in market m in year t and whether a new entrant firm i has opened a property in market m in year t. In all regressions we correct the standard errors for arbitrary heteroskedasticity and clustering within a taxpayer across market-years.

Table 5 contains the results from this specification, when county, county-sector, city and city-sector are used as the market definition. The coefficient estimate associated with share of market capacity is positive and statistically significant for all four market definitions. These positive coefficients suggest that firms with larger market presence invest more in entry deterring capacity. The marginal effect of increasing firm i's county share of capacity by 10 percentage points is to increase firm i's idle capacity in the county by 1.15 percentage points. The positive coefficient estimates associated with a property opening by a new entrant indicate that properties opened by new entrants have more idle capacity. While this was expected for new entrants, it was also expected that the idle capacity of a firm with an existing property in the market would increase if it opened an additional property in the market. The results in Table 5 do not support the contention that an incumbent's idle capacity increases after opening a new property. The coefficient associated with the incumbent opening a new property varies in sign and is not statistically significant for any of the market definitions. Perhaps incumbents promote the opening of new properties more than new entrants.[25]

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consistent with the entry deterrence literature, the specification does use across market variation for identification (similar to the first specification).

[24] Because firm i may own several properties affiliated with different brands, we control for brand affiliation by including as independent variables the fraction of firm i's capacity in market m affiliated with each particular brand.

[25] In another specification concerning whether a firm's share of market capacity affects its decision to invest in entry deterring capacity, we test whether the probability that an incumbent firm opens a new property in the market depends on the incumbent's market share. After controlling for brand fixed effects, market-year fixed effects, and

The coefficient estimates in Table 5 are identified using within market-year variation while the estimates in Table 4 are identified using across market, within year variation. Similar to Table 4, the results in Table 5 are consistent with the entry deterrence literature. However, there are alternative explanations for the results in Table 5. As mentioned in the introduction, if expected demand growth, demand variability or an unforeseen level of collusion is correlated with a firm's market presence and idle capacity, then these explanations could explain the results in Table 5. We believe that investment in entry deterring capacity is the more likely explanation for these results.

V. CONCLUSION

Empirically testing whether firms' actions are affected by their incentive to deter entry is quite difficult. This is because there are many reasons, besides entry deterrence, why firms take these actions. (Possible actions include advertising, research and development, and capacity investment.) For example, it is difficult to determine if a firm's advertising expenditure is based on demand considerations or whether deterring entry is also important. This paper distinguishes among the different reasons for firms to have idle capacity by considering how market characteristics and market presence affect firms' incentives to use capacity to deter entry. If a firm's incentive to take entry deterring actions is influenced by market characteristics and market presence, then testing whether the level of the action is a function of the market characteristics and a firm's market presence allows one to empirically address whether the action is influenced by entry deterring considerations.

This paper finds that more concentrated markets have greater idle capacity. It also finds evidence that firms with larger market shares (whose incentive to deter entry is greater) have more idle capacity than firms with smaller market shares. These results are consistent with the entry deterrence literature and provide evidence that investment in capacity is affected by entry deterrent considerations.

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prior year performance of the firm (i.e.., average room price and occupancy rate), we find that increasing a firm's share of market capacity increases the probability that the firm opens a new property in the market. This result is not sensitive to market definition and provides some limited evidence that firms with a large market presence invest more in entry deterring capacity.

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TABLE 1
Descriptive Statistics By County

	Means	Mean Annual Growth (Percent)
Travel Expenditures (millions)	100.7	1.62
Annual Retail Wage (thousands)	14.62	0.49
Tax Rate	5.11*	1.54
Population (thousands)	82.11	1.28
Per Capita Income (thousands)	17.59	1.16
Unemployment Rate	6.64	1.40
Annual Construction Wage (thousands)	19.05	2.76

* Does not include the state tax rate on lodging properties which was six percent throughout the 1990s.

TABLE 2
Descriptive Statistics By Year

Variable	1991	1992	1993	1994	1995	1996	1997
Number of Properties	2,669	2,686	2,721	2,778	2,806	2,884	2,891
Number of Rooms	227,489	228,077	228,244	232,590	236,016	246,740	255,876
Percent Idle Capacity	44.7	43.4	41.6	39.9	40.0	40.3	40.2
County Herfindahl Index Based on Number of Rooms	1,235	1,223	1,213	1,181	1,144	1,077	1,033
County-Sector Herfindahl Index Based on Number of Rooms*	2,605	2,552	2,551	2,374	2,169	2,057	1,889
City Herfindahl Index Based on Number of Rooms	2,211	2,199	2,169	2,121	2,060	1,980	1,868
City-Sector Herfindahl Index Based on Number of Rooms*	3,481	3,457	3,451	3,264	2,977	2,867	2,664

Note: Independent properties are not included when calculating the County- and City-Sector Herfindahl Indexes.

TABLE 3
Descriptive Statistics by Market Definition

	County	County-Sector	City	City-Sector
Average Number of Properties in Market	12.5	5.5	6.0	3.7
Average Number of Firms in Market	11.1	4.5	5.5	3.2
Average Number of Rooms in Market for Firm	95.8	173.4	92.8	162.4
Average Idle Capacity for Firms in Market with Greater than Average Share of Market Capacity minus Average Idle Capacity for Firms in Market	-3.6%	-1.3%	-3.0%	-1.0%
Average Idle Capacity for Firms in Market with Less than Average Share of Market Capacity minus Average Idle Capacity for Firms in Market	2.1%	0.8%	1.9%	0.7%

Note: Independent properties are not included in the County- and City-Sector market classifications.

TABLE 4

Dependent Variable: Percent Idle Capacity in Market

Variables	County	County-Sector	City	City-Sector
Herfindahl Index	0.478**	0.159	0.345**	0.240*
	(0.167)	(0.154)	(0.129)	(0.129)
Population	-0.010*	-0.003	-0.003*	-0.0002
	(0.006)	(0.003)	(0.002)	(0.002)
Per Capita Income	-0.023	0.065	-0.094	0.068
	(0.123)	(0.136)	(0.123)	(0.136)
Retail Wage	0.306	-0.209	0.094	-0.137
	(0.228)	(0.366)	(0.219)	(0.262)
Travel Expenditures	0.002	0.0003	0.000	-0.001
	(0.002)	(0.001)	(0.001)	(0.001)
Unemployment Rate	0.023	-0.359**	0.018	-0.399**
	(0.134)	(0.151)	(0.110)	(0.133)
Tax Rate	-0.234	-0.282	-0.246	-0.222
	(0.217)	(0.428)	(0.173)	(0.311)
Construction Wage	-0.137	-0.368**	-0.152*	-0.399**
	(0.090)	(0.130)	(0.075)	(0.115)
Lagged Population Growth	-0.593**	-0.977**	-0.660**	-0.915**
	(0.161)	(0.293)	(0.162)	(0.254)
Lagged Per Capita Income Growth	-0.006	-0.034	-0.026	-0.058
	(0.032)	(0.040)	(0.041)	(0.045)
Lagged Retail Wage Growth	0.055*	0.091	0.065*	0.090
	(0.031)	(0.057)	(0.035)	(0.063)
Lagged Travel Exp. Growth	-0.163**	-0.157**	-0.166**	-0.157**
	(0.030)	(0.040)	(0.032)	(0.040)
Lagged Unempl. Rate Growth	-0.001	0.043**	0.007	0.039**
	(0.011)	(0.018)	(0.011)	(0.016)
Lagged Tax Rate Growth	0.002	0.004	0.004	0.007
	(0.005)	(0.008)	(0.006)	(0.008)
Lagged Construction Wage Growth	0.004	0.054**	0.009	0.066**
	(0.012)	(0.023)	(0.012)	(0.022)
Year Fixed Effects	YES	YES	YES	YES
R-Squared	0.26	0.19	0.17	0.17
Observations	1,556	1,369	3,220	2,041

Notes: Standard errors in parentheses, corrected for heteroskedasticity and clustering based on market. (*) represents statistically significant at ten percent level. (**) represents statistically significant at five percent level.

TABLE 5

Dependent Variable: Percent Idle Capacity

Market	County	County-Sector	City	City-Sector
Independent Variables				
Share of Market Capacity	0.115**	0.177**	0.106**	0.157**
	(0.027)	(0.035)	(0.022)	(0.030)
Opening of Incumbent Property	0.43	-0.23	1.13	0.85
	(1.16)	(0.92)	(1.40)	(1.26)
Opening of New Entrant Property	1.13*	4.42**	1.48**	4.94**
	(0.59)	(0.87)	(0.63)	(0.96)
Market-Year Fixed Effects	YES	YES	YES	YES
Brand Fixed Effects	YES	YES	YES	YES
R-Squared	0.39	0.56	0.49	0.64
Observations	14,884	5,493	15,361	5,858

Notes: Standard errors in parentheses, corrected for heteroskedasticity and clustering around taxpayer identification. (*) represents statistically significant at ten percent level. (**) represents statistically significant at five percent level.

Independent properties are dropped when market is defined by county-sector or by city-sector. See footnote 16.

FIGURE 1

Room Changes as a Percent of Total Number of Rooms